SALT-GILA RIVER
INTERIM FLOOD CONTROL WORKS

environmental engineers, scientists,
planners, & management consultants

CDM

A PROPOSAL
FOR THE

SALT-GILA RIVER
INTERIM FLOOD CONTROL WORKS

Submitted to

Flood Control District of Maricopa County

Camp Dresser & McKee Inc.

September 1980

CDM

environmental engineers, scientists,
planners, & management consultants

CAMP DRESSER & McKEE INC.

710 South Broadway, Suite 201
Walnut Creek, California 94596
415 933-2900

September 9, 1980

Mr. Lionel C. Lewis
Flood Control District of
Maricopa County
3335 West Durango
Phoenix, AZ 85009

Dear Mr. Lewis:

In response to your request, we have prepared and are pleased to submit this proposal to perform an engineering study of interim flood control works for the Salt-Gila River from 91st Avenue to Gillespie Dam.

We will utilize the firm of Arthur Beard Engineers of Phoenix to provide local support. The Beard firm will serve as a subcontractor to CDM, which is the same arrangement we have for the Flood Control Element of the Central Arizona Water Control Study.

We believe you will find our team offers the following advantages:

- Qualified firms with extensive drainage and flood control experience in Arizona and other Western States,
- an up-to-date hydraulic analysis of the Salt-Gila River that was developed as part of our recently completed structural alternative study for the Central Arizona Water Control Study,
- competent engineers experienced in hydrology, hydraulics, and the use of computer models, and
- senior experienced personnel who have developed innovative solutions to real-life drainage and flood control problems.

It is CDM's intent to establish a permanent office in Maricopa County in the near future to better serve the Flood Control District and our current clients in Arizona.

We are very interested in this project, and appreciate the opportunity to submit this proposal. If you have any questions concerning our proposal, we will be pleased to answer them for you.

Respectfully submitted,

CAMP DRESSER & McKEE INC.

Roger G. Fry

Roger G. Fry
Associate

RGF:bw
Enclosures: 3 copies of proposal

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STUDY INTEREST COMMITTEE

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CITY OF AVONDALE

DARRELL JORDAN
SALT RIVER PROJECT

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SALT-GILA MASTER PLAN

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MIKE GOODMAN

DICK TODD

MIKE SULLIVAN

Rev. 05/06/91

SALT-GILA MASTER PLAN
EXECUTIVE COMMITTEE

FEBRUARY 26, 1991

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Doug Toy	ADWR

I. INTRODUCTION

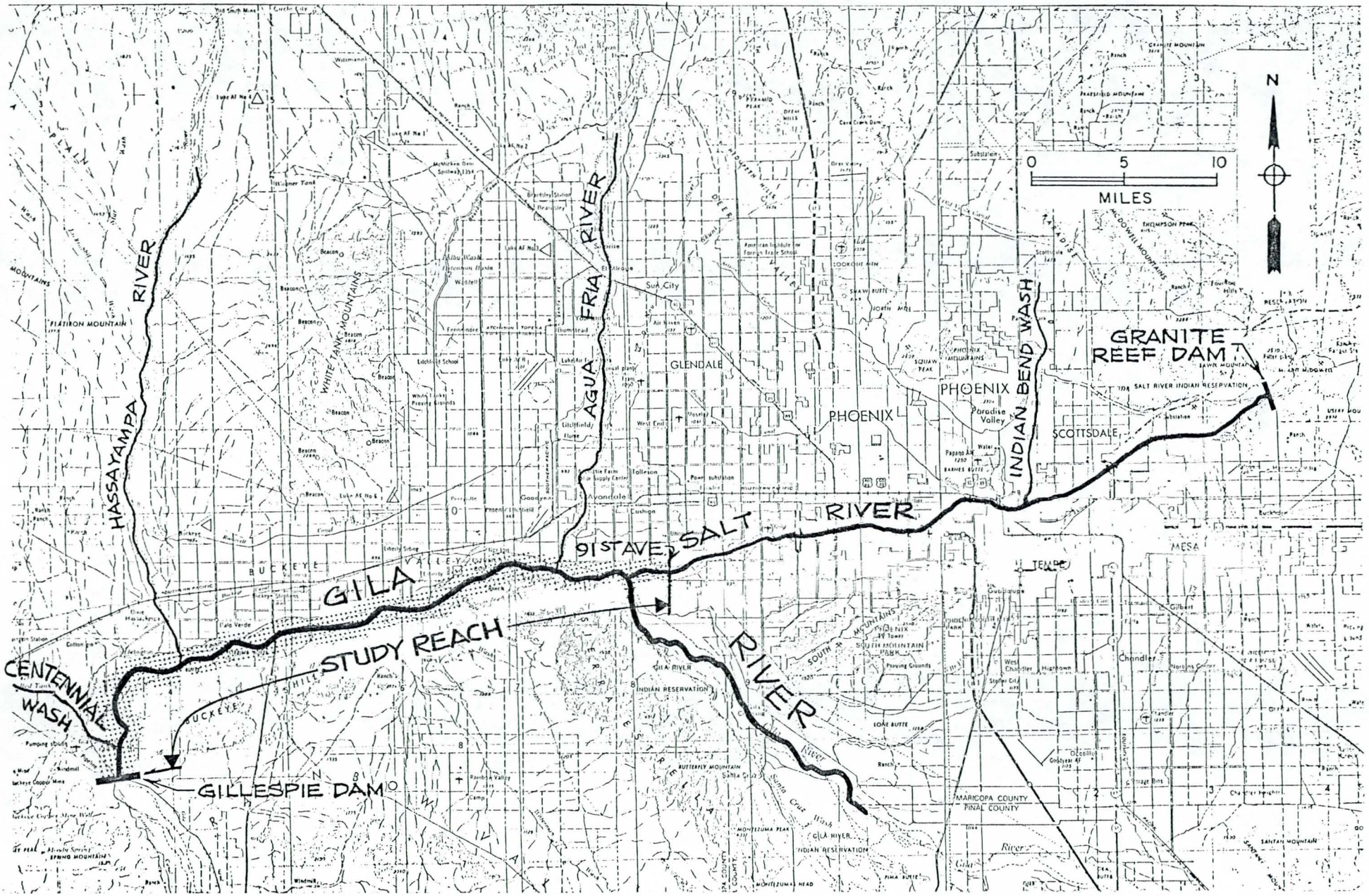
REQUEST FOR PROPOSAL

Camp Dresser & McKee (CDM) proposes to perform an engineering study of interim flood control works for the Salt-Gila River from 91st Avenue to Gillespie Dam (see Location Map). This proposal is being submitted in response to a request from the Flood Control District of Maricopa County.

PROBLEM STATEMENT

High volume floodwaters in the Salt and Gila Rivers during February-March, 1978, December 1978-January 1979 and again in February 1980 caused great risk to personal safety and health, physical damage and financial loss. It disrupted transportation and communication systems, adversely impacted the economy of the State and caused general inconvenience to its citizens. Studies are being conducted by several agencies to identify and recommend long term, full scope measures to minimize the effect of future high volume flows. The time period to complete the studies, gain acceptance, appropriate funds and put the project works in place will be measured in decades.

The Flood Control District of Maricopa County, realizing this long time period, wants to provide measures to give early relief from the potentially damaging floods which may occur in the interim.



LOCATION MAP

INTRODUCTION

This chapter presents our proposed approach for the engineering study of interim flood control works for the Salt-Gila River as described in the Scope of Work and as elaborated by Messrs. Karan and Lewis.

TASK DESCRIPTIONS

PHASE I

Task 1 - Perform Data Search

At the initial stages of the work, all available data and information relevant to the study will be assembled. Data will be acquired from the Flood Control District of Maricopa County, the Arizona Department of Water Resources, the U.S. Army Corps of Engineers, the Federal Insurance Administration, and other agencies and local interests which may have developed pertinent information. Data to be collected will include, but not limited to, maps, photographs, local drainage systems, flooding records, and flood damage reports.

Task 2 - Conduct Field Studies and Surveys

Field studies consisting of site inspections with representatives of the Flood Control District, property owners, irrigation districts, and other local groups will be conducted. Drainage, flooding, erosion, and other concerns and problems, as identified by the Flood Control District and these agencies and groups, will be obtained. Photographs and notes will be taken to document existing conditions.

At locations where topographic data and/or information on man-made facilities is lacking, a field crew will survey to the extent necessary to identify and record needed information. During the performance of subsequent tasks, additional field survey needs may be identified, and if so, surveying will be conducted at that time.

Task 3 - Review Basic Data

Data collected in Tasks 1 and 2 will be reviewed to determine their utility in the study. The data will be compiled by the following river reaches:

Reach 1 - 91st Avenue to 107th Avenue
Reach 2 - 107th Avenue to Sarival Avenue (163rd)
Reach 3 - Sarival Avenue (163rd) to State Route 85
Reach 4 - Vicinity of State Route 85
Reach 5 - Northwest Bank at Powers Butte
Reach 6 - Powers Butte to Gillespie Dam

Sub-watershed boundaries will be determined for all six reaches. The elements of local drainage systems (channels, pipes, ditches, and other features) will be drawn on maps and their sizes will be indicated.

Flood flows will be tabulated from available records for the Salt River, Gila River, Agua Fria River, Hassayampa River, Centennial Wash, and smaller tributaries. Recurrence intervals for the flood flows will be compiled, if they are available.

Task 4 - Perform Hydraulic Analyses of Existing Conditions

Hydraulic analyses will be performed for the Salt-Gila River utilizing the cross-sections used by CDM for the Central Arizona Water Control Study, with modifications thereto to represent the recently changed conditions identified in Tasks 2 and 3.

Water surface profiles will be calculated for flows of 50,000, 75,000 100,000, 200,000 and 300,000 cfs. The Corps of Engineers' HEC-2 computer program, which is currently up and running on CDM's computer facility, will be used to calculate the water surface profiles. Special attention will be given to water surface conditions caused by obstructions, such as the Highway 85 bridge. Utilizing the results of the HEC-2 simulations, areas of high flow velocity, overtopping of existing levees, restricted channels, abrupt bends, and other stress points will be located and evaluated. These will then be compared with the damage areas reported during the last three years, and any discrepancies between the two will be noted.

Water surface profiles will also be calculated for the Agua Fria River, Hassayampa River, and Centennial Wash for a distance of approximately one-half mile upstream of their junctions with the Gila River.

Lastly, the calculated water surface profiles will be compared to the Federal Flood Insurance water surface profiles and discrepancies, if any, will be evaluated.

Task 5 - Develop Interim Flood Control Measures

The flood control problem areas as identified in Task 2, and verified in Task 4, will be the bases for formulating two or more alternative interim flood control measures at each reach. Evaluation of topography, local drainage systems, type and severity of the damage, and other items will be made in the formulation of flood control measures to minimize losses at these problem areas. These measures could include, but not be limited to, channel improvements, levee improvements, clearing of vegetation, removal of sediment deposits, and bridge improvements.

Preliminary design and hydraulic analyses will be made for each of the two or more alternative interim measures to the extent necessary to insure that the hydraulic performance is acceptable.

CDM's recent experiences in Phoenix and Tucson, and in other areas in Arizona and California, have indicated that sediment production, transport and deposition must be studied together with hydraulic aspects in order to develop viable flood control measures. We propose, therefore, to perform a generalized study of sediment aspects of the Salt-Gila River and its tributaries.

The results of this task will be presented on maps and generalized drawings showing the proposed improvements and other features as appropriate.

PHASE II

Task 6 - Evaluate Interim Flood Control Measures

Each of the alternative interim flood control measures from Task 5 will be evaluated in terms of their reliability, effectiveness, environmental impact, potential for staged construction, public acceptance, and compatibility with: (1) other projects, (2) local and County plans, and (3) the Federal Flood Insurance program.

The end product of the task will be a ranking matrix for comparison of the various interim measures.

Task 7 - Prepare Preliminary Improvement Plans

Utilizing the ranking matrix developed in Task 6, specific measures will be recommended for each of the six reaches. Following acceptance by the Flood Control District, the recommended measures will then be hydraulically analyzed in more detail than was done in Task 5. In addition, structural analyses will be performed. Preliminary improvement plans will then be prepared for each recommended measure.

Task 8 - Prepare Benefit/Cost Analysis

A capital cost estimate will be prepared for each interim measure. This estimate will include the cost of construction, land rights, engineering and administration, and contingencies.

The average annual costs to operate and maintain the works of improvement for each interim measure will also be estimated.

The average annual flood control benefits that will result from the interim measures will be estimated in accordance with the procedures of the Arizona Department of Water Resources. A benefit/cost analysis will then be prepared for each measure utilizing average annual construction, land rights, operation and maintenance costs.

Task 9 - Prepare Report

A technical report will be prepared that will describe the study objectives, flood control problems, basic data, hydraulic analysis of existing river conditions, and the broad considerations and analysis leading to the interim flood control measures formulated in Task 5.

The ranking matrix for the evaluation of the alternative flood control measures will be included in the report, as will the preliminary improvement plans for the recommended measures, the cost estimates, and benefit/cost analysis. Recommended construction, operation and maintenance features will be described for each interim measure.

Sixteen copies of the report will be prepared in draft form and submitted to the Flood Control District for review. Following District approval of the draft, the report will be finalized and the original typewritten materials, drawings and charts in reproducible form will be submitted to the District. One copy of supporting material, references, and HEC-2 computer output will be given to the District.

Task 10 - Coordination and Management

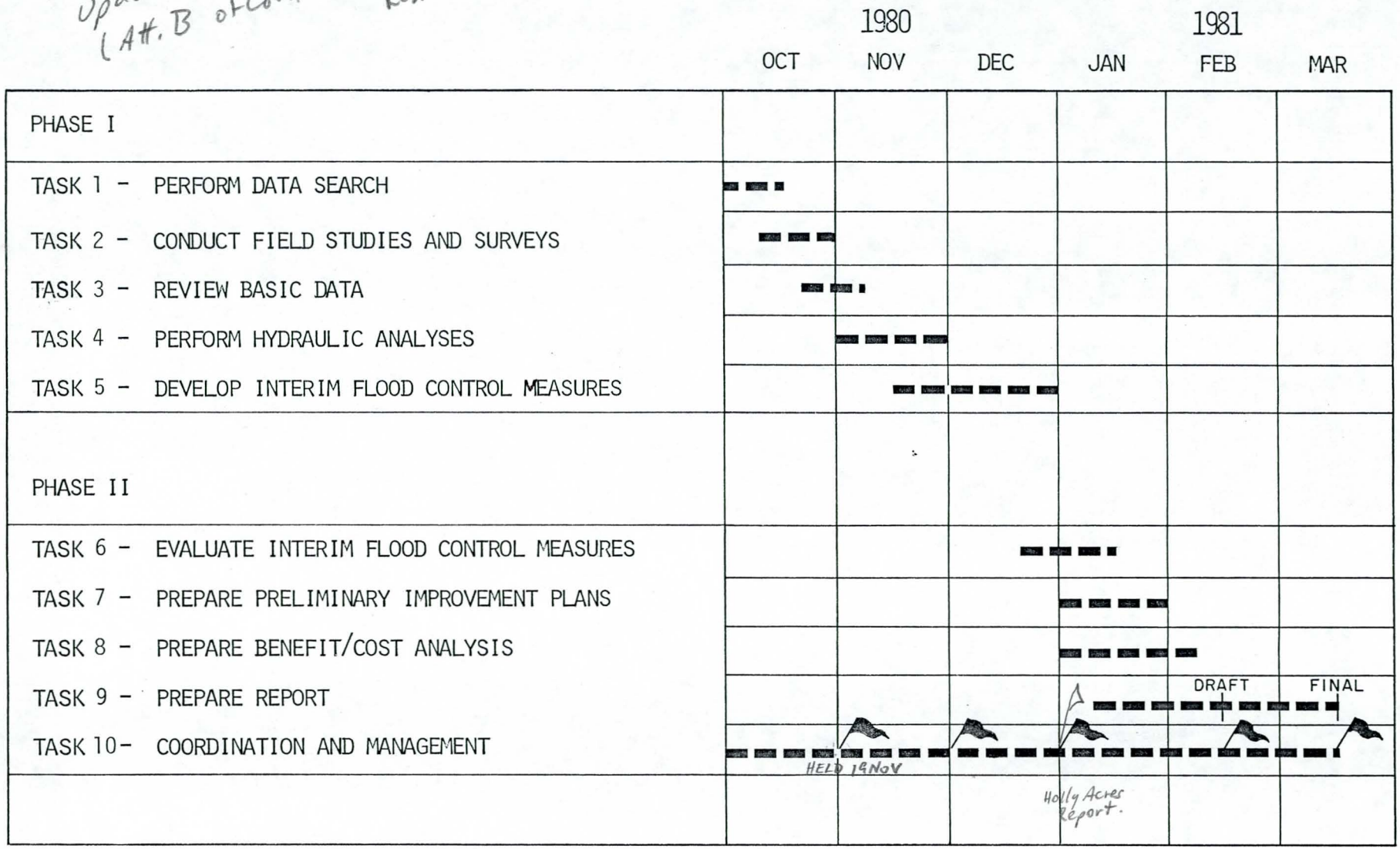
At the beginning of the study the Principal-in-Charge and the Project Manager will work closely with the Flood Control District in the development of a work program and time schedule. Management and coordination with the District will be provided throughout the study period.

CDM will participate in a milestone meeting once each month. At these milestone meetings CDM will report the activities of the past month, describe forthcoming activities, exchange information with, and receive guidance from, the District.

SCHEDULE

The following schedule presents the time in which CDM proposes to perform the tasks described above.

See updated Schedule (Att. B of Contract) KMP



MILESTONE MEETING WITH DISTRICT

SCHEDULE

III. STUDY ORGANIZATION

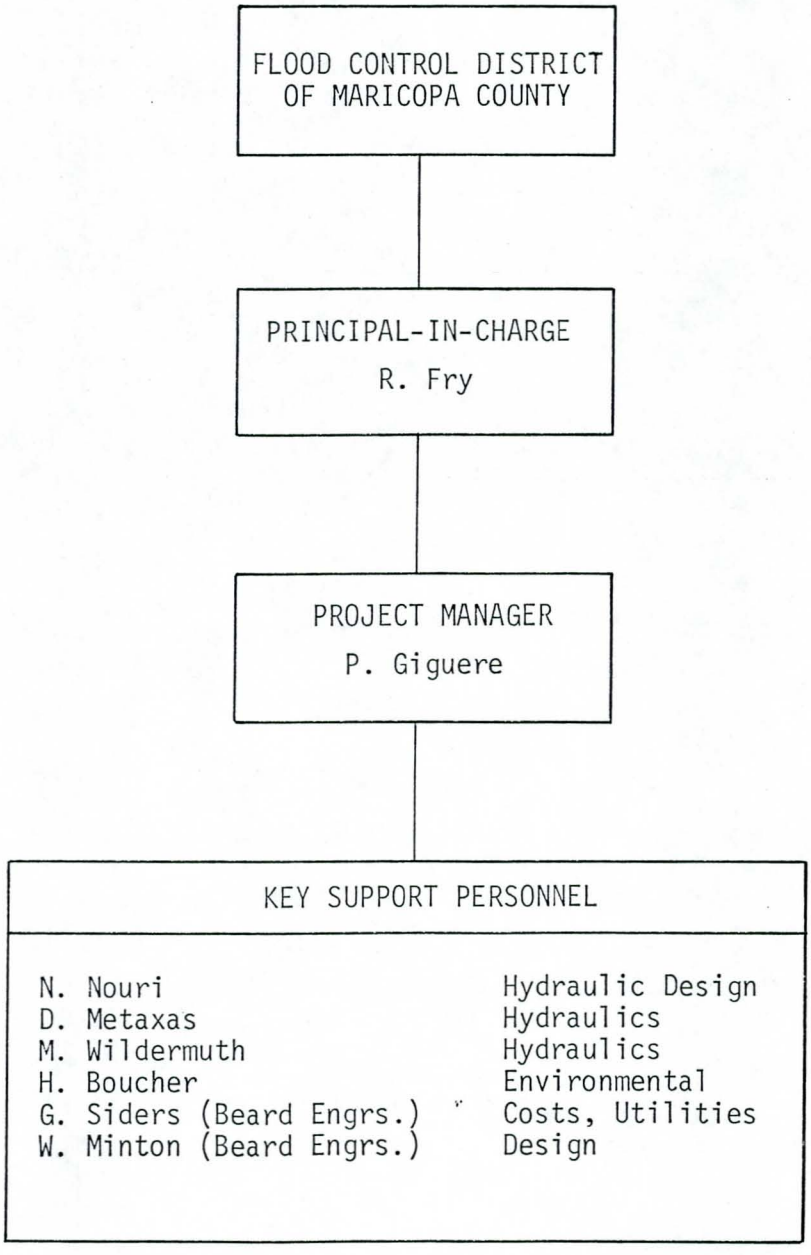
INTRODUCTION

We have assembled a well qualified and highly experienced team to perform the proposed study. This section presents a chart depicting the study organization and highlights of the qualifications of the study personnel. Detailed resumes of these personnel are contained in Section 6.

PRINCIPAL-IN-CHARGE

Mr. Roger Fry will serve as Principal-in-Charge for the study. He will assume responsibility for coordinating the study efforts between CDM and the District, will provide overall direction and guidance of the study, and will participate in the execution of tasks. Mr. Fry has 23 years of experience in the planning and design of drainage and flood control facilities, drainage and water quality master planning, and calibration and application of mathematical models to drainage projects. His experience is summarized below.

- Project Manager for 14 drainage and flood control projects which involved planning, analysis, plan evaluation, feasibility studies preliminary design, and public involvement programs.
- Project Manager for four projects in Arizona: Flood Control Element of the Central Arizona Water Control Study; Santa Cruz River in Tucson; San Pedro River near Redington; Agua Caliente Wash near Tucson.
- CDM Project Manager for the Corte Madera Creek project in Marin County, which received a 1978 Engineering Excellence Award from the Consulting Engineers Association of California.
- Project Manager or Project Engineer for the design of drainage and flood control facilities for more than 20 projects.



STUDY ORGANIZATION

PROJECT MANAGER - Paul R. Giguere

Mr. Paul Giguere will be the Project Manager for this study. Mr. Giguere is an Associate Engineer of CDM and is Project Engineer for the channelization phase of the Flood Control Element of the Central Arizona Water Control Study. He has worked with Mr. Fry on several flood control projects in California and Arizona. For this study Mr. Giguere would direct the day-to-day technical work of the support staff and would actively participate in performing each task.

- M.S. Degree with four years of engineering experience.
- Prepared Solano County Surface Runoff Management Plan.
- Participated in numerous flood control studies, including two projects in Southern Arizona.
- Expert in mathematical modeling of flood control hydraulics, sediment transport, and urban hydrology.

SUPPORT PERSONNEL

Mr. Fry and Mr. Giguere will be supported by other CDM and Beard staff members. Highlights of the qualifications and experience of these specialists are detailed below.

M. Hasan Nouri

- Senior Engineer for Camp Dresser & McKee Inc.
- Over ten years of water resources engineering experience.
- Specialized experience on several river mechanics and river engineering projects.
- Participated on the Flood Control Element of the Central Arizona Water Control Study.

Dennis J. Metaxas

- Staff Engineer for Camp Dresser & McKee Inc.
- Three years of experience in water resources engineering with hydraulic and hydrologic emphasis.
- Experience in applications of HEC-2 and other hydraulic and hydrology computer models.
- Participated in the planning and design of four drainage and flood control projects including the Central Arizona Water Control Study.

Mark J. Wildermuth

- Associate Engineer for Camp Dresser & McKee Inc.
- Four years of drainage and flood control experience including participation in the Central Arizona Water Control Study.
- Participated in flood insurance studies in three States.

Henry R. Boucher

- Environmental Planner for Camp Dresser & McKee Inc.
- Ten years of experience in city and environmental planning and assessment.
- Prepared several environmental impact reports and general plan studies that involved public participation.
- In charge of the environmental element of the Alhambra Creek Local Protection Project.

Gary E. Siders

- Chief Engineer of Phoenix Office of Arthur Beard Engineers, Inc.
- Ten years of civil engineering experience.
- Participated in the Flood Control Element of the Central Arizona Water Control in data collection, utilities and cost estimating.
- Project Manager for the design of a 48-inch water line across the Salt River in the City of Phoenix.

William D. Minton

- Project Manager of Arthur Beard Engineers, Inc.
- Thirteen years of civil engineering experience.
- Considerable experience in the planning and design of water and storm drainage facilities, including the Central Arizona Water Control Study.

IV. BUDGET

CDM can perform the work set forth in the Scope of Work for $70,000 to $85,000. If the higher amount were available, more extensive work could be performed, such as more detailed field studies and surveys, and analyzing the interim flood control measures in greater detail.

The above budget range reflects the savings in cost that we can offer because of our current work on the Salt-Gila River flood control element of the Central Arizona Water Control Study that we are performing for the Corps of Engineers.

It is our belief that the determination of budget and fees for professional services should be made after final selection is made of the most qualified consultant for the proposed study. Therefore, please consider the proposed budget range to be a guideline from which CDM and the District can mutually agree upon appropriate levels of effort by task that will be responsive to the needs of Maricopa County and within available funding levels.

V. QUALIFICATIONS & EXPERIENCE

CAMP DRESSER & McKEE INC.

Camp Dresser & McKee Inc. (CDM) is the largest engineering consulting organization in the United States specializing exclusively in environmental engineering and related services. Its corporate offices are in Boston, Massachusetts, and it has regional offices throughout the United States and in several foreign countries.

CDM has a multi-disciplinary staff of more than 1,400 employees and has been engaged in more than 1,000 flood control, water resources, and wastewater projects during the last ten years. These projects have involved planning, design and supervision of construction and operation of a wide array of facilities ranging from flood control channels to wastewater treatment plants. CDM offers complete environmental services through its regional offices. On the West Coast, CDM maintains offices in Pasadena, Newport Beach and Walnut Creek, California. These offices presently have 80 employees and provide full engineering services. They have been very active in drainage and flood control planning and management and in the design of flood control, wastewater and water supply facilities.

The Water Resources Division (WRD) of CDM has extensive experience and a worldwide reputation in drainage and flood control studies. What has grown into the Water Resources Division of CDM began in 1959 as Water Resources Engineers (WRE). Over the years WRE has specialized in water resources planning and management, flood control and drainage, water quality studies, analysis and design of water supply, storage and distribution systems and economic evaluation of engineering alternatives. In 1975, WRE was acquired by Camp Dresser & McKee Inc. In 1976, CDM acquired the firm of Harvey O. Banks, Consulting Engineer, Inc., and merged it with WRE to form the nucleus of CDM's Water Resources Division. Mr. Banks' firm specialized in water resources planning, water rights, and institutional requirements

related to water resource development. Mr. Banks became President of CDM's Water Resources Division.

Professional services to the Flood Control District for this study would be provided through CDM's offices in California.

CAPABILITIES IN STORMWATER MANAGEMENT,
DRAINAGE AND FLOOD CONTROL

Camp Dresser & McKee offers the technical skill and experience gained from hundreds of projects undertaken in metropolitan and rural areas to meet all aspects of stormwater management, drainage and flood control. Well-planned and effectively operated stormwater management, drainage and flood control programs prevent loss of life, damage to property and inconvenience to the public. Effectively implemented programs, whether they call for structural or nonstructural approaches to stormwater management, drainage or flood control, also protect the quality of valuable ground and surface water supplies, while preserving the aesthetically valuable natural resources of a community.

CDM studies result in recommendations for both nonstructural and structural measures for stormwater management, drainage and flood control. Nonstructural approaches include on-site retention of runoff and regulating land use by zoning areas such as flood plains. These approaches prove economically attractive, as well as environmentally and aesthetically desirable.

When structural measures are required to remedy critical stormwater management, drainage or flood control problems, CDM prepares preliminary and final plans, and provides services during construction for cost-effective systems.

Over the years CDM has completed many small, medium and large-sized drainage and flood control projects for clients in the Western States.

PROJECT DESCRIPTIONS

The following project descriptions are representative of drainage and flood control projects performed by CDM in which all or portions of the projects are related to the Flood Control District's proposed interim flood control works for the Salt-Gila River. We would like to emphasize that the proposed study personnel have direct experience on almost all of the projects described.

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Urban Runoff and Basin Drainage Study, Cedar-Green Rivers

LOCATION: Seattle Metropolitan Area, Washington

CLIENT: U.S. Corps of Engineers, Seattle District

DESCRIPTION:

Camp Dresser & McKee in a joint venture with a Seattle consulting firm, conducted an urban runoff and drainage study for the 1,160 square mile Seattle metropolitan area. The population of the study area was over one million. The project report is a planning document presenting studies accomplished under authority of the Comprehensive Water and Related Land Resource Study of Puget Sound and Adjacent Waters (PS&AW) Washington. The study results provide a basis for local government action leading to development of detailed drainage plans for the Cedar and Green River sub-basins.

The study identified the major existing and potential future urban drainage problem areas and described alternatives available for solving these problems. The drainage systems recommended provided the major trunk drainage systems which would be developed by public agencies using public funds. The cost of smaller collection systems serving individual properties and private developments were not included as these facilities would be the responsibility of the property owners.

The Urban Runoff and Basin Drainage Study considered alternative methods of planning for urban stormwater runoff. These alternative methods included not only physical features, such as conduits and channels, but development regulations such as runoff control, zoning and land use restrictions, which are based upon the premise that the nearer we approach nature's way of draining the land, the less will be the adverse impact upon natural streams and wetlands and upon man.

The project and Water Resources Engineers received an Engineering Excellence Award from the Consulting Engineers Association of Washington.

Category: Master Planning

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Drainage Plan for Drainage Area 29

LOCATION: San Francisco Bay Area, California

CLIENT: Contra Costa County Flood Control and Water Conservation District

DESCRIPTION:

Camp Dresser & McKee worked on a flood control and drainage plan for a portion of eastern Contra Costa County designated as Drainage Area 29. The area consists of a wide distribution of sinks and depressions located in highly permeable alluvium with no natural streams or channels. In the undeveloped areas, storm water collects in depressions where it infiltrates into the groundwater basin or evaporates. With accelerating residential growth, however, the size of impervious areas is increasing rapidly causing an increase in the rate and volume of runoff. Many sink areas have been eliminated and ponding is becoming a problem in some of the remaining sinks.

CDM was retained to develop a drainage plan for the area and to design the facilities. Several conceptual alternatives were considered. These included retention of sink areas which would serve as infiltration and recharge basins and provide recreational opportunities, interconnection of deep ponds as a drainage channel pipe system, and channels and ditches. The alternatives were evaluated for technical, institutional and financial, environmental, economic, and social acceptability. The best overall alternative selected was a combination of a pipeline system and detention basins.

Category: Master Planning

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Alhambra Creek Local Protection Project

LOCATION: Contra Costa County, California

CLIENT: U.S. Army Corps of Engineers
San Francisco District

DESCRIPTION:

CDM, in association with another firm, reviewed and re-evaluated the findings of an earlier Corps report on Alhambra Creek and examined new alternatives for solving its flooding problem. As part of the study, investigations were performed of various means of integrating new flood control solutions with ways to revitalize the downtown, tap the creek's potential as a resource for water and creekside recreational activities, and enhance the creek's aesthetic quality.

This Stage II project emphasized the development of a broad range of management measures and two levels of alternatives--preliminary and intermediate plans--to respond to public concerns, planning constraints, and planning objectives. Six preliminary plans were developed and assessed comparatively and in relation to a "No Action" situation. The impacts of these plans were evaluated. From this assessment and evaluation, three intermediate plans evolved for further development, assessment, and comparison to a "No Action" Plan. Intermediate plans were designed for four levels of flood protection: standard project flood and the 100-year, 50-year, and 25-year events.

Category: Master Planning

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Central Arizona Water Control Study

LOCATION: Maricopa County, Arizona

CLIENT: U.S. Army Corps of Engineers
Los Angeles District

DESCRIPTION:

The Colorado River Basin Project Act authorized construction of the Central Arizona Project (CAP) to bring Colorado River water to central Arizona. One of the authorized features is Orme Dam and Reservoir, proposed to be constructed at the confluence of the Salt and Verde Rivers. Orme Dam is intended to provide regulatory storage for CAP water and flood control on the Salt River through the metropolitan area of Phoenix.

Because of environmental and social considerations of Orme Dam and Reservoir, several alternatives to the Orme Dam plan were identified by the Bureau of Reclamation and the Corps of Engineers. CDM has been retained by the Corps of Engineers to study structural flood control alternatives for this project. CDM's activities involve the hydraulic design and preliminary cost estimates for the following eight elements to provide the needed flood protection.

New Dams

- New Bartlett Dam
- Cliff Site Dam
- New Horseshoe Dam

Flood Outlets

- Existing Bartlett Dam
- Existing Horseshoe Dam

Channelization

- Earth Bottom Channels
- Greenbelt Floodways
- Levee Systems

Category: Hydraulic Analysis and Design

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Cove Country Club Development

LOCATION: Coachella Valley, California

CLIENT: Jones-Tillson and Associates

DESCRIPTION:

This project involved the preliminary design and hydraulic analysis of flood control and hydraulic analysis of flood control facilities for Deep Canyon Creek as it flows through the 700-acre Cove County Club.

Deep Canyon Creek has a 100-year peak flow of 20,000 cfs. Because of dual use requirements, a grass lined wide channel with mild side slopes was designed. Several drop structures were utilized to maintain substantial flow upstream of each drop, and a low flow channel was utilized. In addition, in order to accommodate the erosive energy of Deep Canyon Creek as it enters the property via a 60 foot drop over a natural ledge, a plunge pool was designed.

Category: Hydraulic Analysis and Design

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Corte Madera Creek Project

LOCATION: Marin County, California

CLIENT: U.S. Army Corps of Engineers
San Francisco District

DESCRIPTION:

Some years ago the need was generally recognized for flood control works along a suburban section of Corte Madera Creek in Marin County, north of San Francisco. The Corte Madera Creek Project was authorized by the U.S. Congress in 1962. The project was to extend about five miles up the creek from San Francisco Bay. Construction of a concrete channel began downstream in 1967. The final 3,000 feet were to be constructed in 1972. But the Town of Ross in 1974, reacting to concerns of property owners along the creek over the destruction of the natural environmental setting, successfully stopped the project through litigation. At the request of U.S. Congressman John Burton, the Corps and a Citizens Advisory Committee jointly selected a consulting team to plan 100-year flood protection while maintaining the local environmental character of the stream.

As a member of the consulting team, Water Resources Engineers provided the necessary hydrologic and hydraulic analyses of the alternative stream channel configurations. The alternatives evaluated had to comply with the following stipulated objectives:

- Protect the visual quality and character of the creek
- Preserve as many trees as possible along the creek
- Preserve the creek's ecological system
- Provide public park space separate from private property

First generated quantities of runoff at various points along the stream with its computerized runoff model. Flow profiles were then calculated using HEC-2 for a variety of cross-sections of natural earth channels, grassed floodways, stone retaining walls, natural stream meanders, and related nonartificial features.

A landscape and channel improvement plan was found and recommended. The project showed that protection from damages by a significant flooding event can be provided with channel improvements that blend with surrounding natural environmental features. Congressman Burton wrote a letter of commendation to the team for its innovative planning that satisfied all public concerns and ameliorated a potentially serious flooding problem at the same time.

The project and WRE were awarded an Engineering Excellence Award in 1978 by the Consulting Engineers Association of California.

Category: Hydraulic Analysis and Design

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Santa Cruz River

LOCATION: Tucson, Arizona

CLIENT: El Paso Natural Gas Company

DESCRIPTION:

In this project, CDM conducted a study of river mechanics and generation, transport and deposition of sediment in the Santa Cruz River through the southwest portion of the City of Tucson. The purpose of the study was to formulate plans to protect three buried pipelines that cross the river. Activities included data collection, a soil testing program, hydraulic and sediment analyses, and an assessment of the structural integrity of existing transverse wells.

A computer model, HEC-6, was set up to represent the river reach including the pipeline crossings. A modeling strategy was devised and carried out to assess the sediment transport rates and resulting bed scour and deposition. Analyses were made with the river flow confined in the existing cutoff and a second series of analyses were made with the river flow in it's original channel. Continuation and cessation of sand and gravel extraction operations at a downstream location were studied, and analysis of the alignment and lateral movement of the river channel was made.

Category: Erosion and Sedimentation

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: San Pedro River

LOCATION: Near Redington, Arizona

CLIENT: El Paso Natural Gas Company

DESCRIPTION:

A flood in October 1977 resulted in the failure of one of the supports of the 30-inch gas pipeline bridge over the San Pedro River in Southern Arizona. Excavation of the pier that failed revealed debris as much as ten feet below the ground level after the flood. In view of this failure and the potential damage that could occur to the pipeline during future floods, the gas company undertook a study to investigate the problem and implement a solution. CDM was engaged to perform the hydrologic and hydraulic analyses and to study scour conditions at and near the pipeline bridge.

CDM calculated water surface profiles for the October 1977 flood and the extreme event flood of September 1926 under various assumptions concerning the pressure of the pipeline and highway bridge. These calculated profiles were compared to recorded high water marks.

A general scour analysis was performed to estimate the possible depths of overall river bed scour near the pipeline crossing due to the October 1977 and September 1926 floods. In addition, an analysis was made to estimate possible depths of scour at the pipeline bridge piers due to local effects.

CDM made specific recommendations for repairing the damage, and controlling the river so that future flows would not damage the bridge or its abutments.

Category: Erosion and Sedimentation

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: San Lorenzo River Reconnaissance Study

LOCATION: Santa Cruz County, California

CLIENT: U.S. Army Corps of Engineers
San Francisco District

DESCRIPTION:

Historically, the San Lorenzo River has frequently flooded and caused substantial damage to the City of Santa Cruz. Following a large flood in December 1955, the Corps of Engineers made channel improvements and built levees from the river mouth to about 2-1/2 miles upstream thereof. Also included in the project were improvements in Branciforte Creek and interior drainage control.

After completion of construction, the project was transferred to the City of Santa Cruz for operations and maintenance. Subsequently, the channel began to silt. Dredging to project depth was not performed by the City as agreed before construction but, instead, the City has relied on the natural flushing action of the river to remove the accumulation of silt deposits from the channel.

The City could not adequately maintain the channel without a large expenditure of funds and the silt has accumulated to such an extent that the disastrous flood of December 1955 could be repeated. The City was concerned about the costs of removing sediments and the potential flood hazard of leaving the sediments in the channel. CDM, in association with another firm, performed sediment generation, transport and deposition analyses at the reconnaissance level to determine the cause of sediment-build-up at and near the mouth of the San Lorenzo River.

Category: Erosion and Sedimentation

FIRM: Camp Dresser & McKee Inc.

PROJECT NAME: Flood Insurance Study for Nine Communities in Southwest Texas

LOCATION: Hidalgo County, Texas

CLIENT: U.S. Department of Housing and Urban Development
Flood Insurance Administration

DESCRIPTION:

In 1978, Camp Dresser & McKee completed a flood insurance study for a number of cities in the Lower Rio Grande Valley. The study involved the estimation of flood flows, the mapping of floodwater extent for various frequencies of flooding events, and the routing of floodwater through a series of natural depressions and ponds created by man-made obstructions.

This study was unique in that there are only two identifiable natural drainageways in the entire county in addition to the river. Floods in the region, therefore, are manifested through local but extensive ponding in this very poorly drained area. Complications arise from virtually any man-made works, since any building or disturbance of the very flat topography immediately changes the local drainage pattern, often obstructing whatever drainage pathway exists. Buildings of all sorts, roadways, elevated irrigation canals, and railroad embankments all exacerbate the already severe drainage problems. Consequently, future plans for further land development are crucial determinants of the predicted floodable areas.

Soil Conservation Service, rainfall-runoff prediction techniques and a flood routing model were used to make projections of flood hydrographs and to route water through the ponds or the impoundments. The project was extended to include the remainder of the county (unincorporated areas) and a tenth community.

Category: Flood Insurance

PROJECT NAME: Facility Design

LOCATION: Various

CLIENT: Various

DESCRIPTION:

The following projects represent a few of the many flood control and storm drainage facilities designed by CDM:

Pipe and Conduit Systems

- Storm drainage pipe system for the 40-acre Seven Flags mobile home development in Sonoma County, California.
- Storm drainage pipe system for the 680-lot Southampton Company residential development in Benicia, California.

Channels and Control Structures

- Multipurpose, two mile long grasslined channel for San Diego Creek in Orange County, California, for the Irvine Company.
- A 4,000 foot channel with a capacity of 3,500 cfs in Colma Creek in South San Francisco for San Mateo County.

Dams and Spillways

- In Hayfork, California, for Trinity County, a spillway for the 60 foot high earth-fill Ewing Dam.
- A spillway to pass a flow of 32,000 cfs at the 74 foot high Anthony House Dam in Nevada County, California.

Detention Basins and Lakes

- Two runoff detention ponds and outlet works at the Hunter Ranch residential development in Vallejo, California.
- Inlet, outlet, and lateral drainage facilities for Refugio Valley Lake, a recreational lake in Hercules, California.

MATHEMATICAL MODELS DEVELOPED AND/OR UTILIZED BY CAMP DRESSER & McKEE INC.

HYDROLOGY AND HYDRAULICS

Data Fill-In and Stochastic Data Generation

Double-Mass Analysis

Rainfall-runoff (Rural)

Rainfall-Runoff (Urban)

Stormwater/Flood Routing

Reservoir Operations

Tidal Hydrodynamics

Backwater (HEC-2)

Groundwater

Water Distribution System Analysis

WATER RESOURCES DEVELOPMENT

Reservoir and Basin Yield

River Basin Simulation-Optimization

Data Management System

FACILITY PLANNING

Drainage/Flood Control

Water Supply

Wastewater

Stormwater Storage-Treatment-Overflow

WATER QUALITY

Streams
- Steady State
- Dynamic
- Ecological (Dynamic)
- Temperature

Estuaries
- Steady State
- Dynamic
- Ecological (Dynamic)
- Temperature

Reservoirs
- Dynamic
- Ecological (Dynamic)
- Temperature

Groundwater Basins
- Dynamic

Thermal Plume

ECONOMICS

Water Development Evaluation
Non-monetary Expression of Benefits Method

Water Development Evaluation
Benefits Foregone-Subjective Decision Method

Cost Determination Procedure (Water Quality)

SCOUR & DEPOSITION IN RIVERS

HEC-6

REFERENCES

The following references may be contacted for the purposes of assessing CDM's performance on past or current projects.

Mr. Joe Taylor
Deputy Chief Engineer
Contra Costa County Flood Control
& Water Conservation District
Martinez, CA
(415) 372-4470

Mr. Romaine Repair
Chief, Special Studies
U.S. Army Corps of Engineers
San Francisco District
(415) 556-0942

Mr. Charles Murphy
Flood Control Engineer
County of Marin
San Rafael, CA
(415) 479-1100

Mr. Joe Dixon
Phoenix Urban Study Office
U.S. Army Corps of Engineers
Los Angeles District
(602) 261-6781

STANDARD FORM (SF) 254
Architect-Engineer and Related Services Questionnaire

1. Firm Name / Business Address:
Arthur Beard Engineers, Inc.
4710 N. 16 St., Suite 112
Phoenix, Arizona 85016

232 E. Sixth St.
Tucson, Arizona 85702

1a. Submittal is for ☐ Parent Company ☒ Branch Office - Arizona

2. Year Present Firm Established: 1972

3. Date Prepared: January 1. 1979

4. Type of Ownership: Corporation

4a. Minority Owned ☐ yes ☒ no

5. Name of Parent Company, if any:
Arthur Beard Engineers, Inc.
6900 Wisconsin, Avenue, Suite 707
Chevy Chase, Maryland 20015

5a. Former Firm Name(s), if any, and Year(s) Established:
Arthur H. Beard, Jr., Consulting Engineer - 1958

6. Names of not more than Two Principals to Contact: Title / Telephone

1) Arthur H. Beard, Jr., P.E., President (602) 266-8469
2) Robert S. Howell, P.E., Vice President (602) 624-1793

7. Present Offices: City / State / Telephone / No. Personnel Each Office

1. Chevy Chase, Maryland	(301)	657-3660	26
2. Phoenix, Arizona	(602)	266-8469	6
3. Tucson, Arizona	(602)	624-1793	3
4. Charlottesville, Virginia	(804)	295-9800	1

7a. Total Personnel 36
Arizona 9

8. Personnel by Discipline: Arizona

2 Administrative	___ Electrical Engineers	___ Oceanographers
___ Architects	___ Estimators	___ Planners: Urban/Regional
___ Chemical Engineers	___ Geologists	2 Sanitary Engineers
3 Civil Engineers	___ Hydrologists	___ Soils Engineers
___ Construction Inspectors	___ Interior Designers	___ Specification Writers
2 Draftsmen	___ Landscape Architects	___ Structural Engineers
___ Ecologists	___ Mechanical Engineers	___ Surveyors
___ Economists	___ Mining Engineers	___ Transportation Engineers

9. Summary of Professional Services Fees Received: (insert index number)

Last 5 Years (most recent year first)

	19 77	19 76	19 75	19 74	19 73
Direct Federal contract work, including overseas	2	1	1	1	1
All other domestic work	2	1	1	1	1
All other foreign work*					

*Firms interested in foreign work, but without such experience, check here: ☐.

Ranges of Professional Services Fees

INDEX
1. Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500,000 to $1 million
5. $1 million to $2 million
6. $2 million to $5 million
7. $5 million to $10 million
8. $10 million or greater

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Experience Profile Code Numbers
for use with questions 10 and 11

001 Acoustics; Noise Abatement
002 Aerial Photogrammetry
003 Agricultural Development; Grain Storage; Farm Mechanization
004 Air Pollution Control
005 Airports; Navaids; Airport Lighting; Aircraft Fueling
006 Airports; Terminals & Hangars; Freight Handling
007 Arctic Facilities
008 Auditoriums & Theatres
009 Automation; Controls; Instrumentation
010 Barracks; Dormitories
011 Bridges
012 Cemeteries *(Planning & Relocation)*
013 Chemical Processing & Storage
014 Churches; Chapels
015 Codes; Standards; Ordinances
016 Cold Storage; Refrigeration; Fast Freeze
017 Commercial Buildings *(low rise)*; Shopping Centers
018 Communications Systems; TV; Microwave
019 Computer Facilities; Computer Service
020 Conservation and Resource Management
021 Construction Management
022 Corrosion Control; Cathodic Protection; Electrolysis
023 Cost Estimating
024 Dams *(Concrete; Arch)*
025 Dams *(Earth; Rock)*; Dikes; Levees
026 Desalinization *(Process & Facilities)*
027 Dining Halls; Clubs; Restaurants
028 Ecological & Archeological Investigations
029 Educational Facilities; Classrooms
030 Electronics
031 Elevators; Escalators; People-Movers
032 Energy Conservation; New Energy Sources
033 Environmental Impact Studies, Assessments or Statements
034 Fallout Shelters; Blast-Resistant Design
035 Field Houses; Gyms; Stadiums
036 Fire Protection
037 Fisheries; Fish Ladders
038 Forestry & Forest Products
039 Garages; Vehicle Maintenance Facilities; Parking Decks
040 Gas Systems *(Propane; Natural, Etc.)*
041 Graphic Design
042 Harbors; Jetties; Piers; Ship Terminal Facilities
043 Heating; Ventilating; Air Conditioning
044 Health Systems Planning
045 Highrise; Air-Rights-Type Buildings
046 Highways; Streets; Airfield Paving; Parking Lots
047 Historical Preservation
048 Hospitals & Medical Facilities
049 Hotels; Motels
050 Housing *(Residential, Multi-Family; Apartments; Condominiums)*
051 Hydraulics & Pneumatics
052 Industrial Buildings; Manufacturing Plants
053 Industrial Processes; Quality Control
054 Industrial Waste Treatment
055 Interior Design; Space Planning
056 Irrigation; Drainage
057 Judicial and Courtroom Facilities
058 Laboratories; Medical Research Facilities
059 Landscape Architecture
060 Libraries; Museums; Galleries
061 Lighting *(Interiors; Display; Theatre, Etc.)*
062 Lighting *(Exteriors; Streets; Memorials; Athletic Fields, Etc.)*
063 Materials Handling Systems; Conveyors; Sorters
064 Metallurgy
065 Microclimatology; Tropical Engineering
066 Military Design Standards
067 Mining & Mineralogy
068 Missile Facilities *(Silos; Fuels; Transport)*
069 Modular Systems Design; Pre-Fabricated Structures or Components
070 Naval Architecture; Off-Shore Platforms
071 Nuclear Facilities; Nuclear Shielding
072 Office Buildings; Industrial Parks
073 Oceanographic Engineering
074 Ordnance; Munitions; Special Weapons
075 Petroleum Exploration; Refining
076 Petroleum and Fuel *(Storage and Distribution)*
077 Pipelines *(Cross-Country—Liquid & Gas)*
078 Planning *(Community, Regional, Areawide and State)*
079 Planning *(Site, Installation, and Project)*
080 Plumbing & Piping Design
081 Pneumatic Structures; Air-Support Buildings
082 Postal Facilities
083 Power Generation, Transmission, Distribution
084 Prisons & Correctional Facilities
085 Product, Machine & Equipment Design
086 Radar; Sonar; Radio & Radar Telescopes
087 Railroad; Rapid Transit
088 Recreation Facilities *(Parks, Marinas, Etc.)*
089 Rehabilitation *(Buildings; Structures; Facilities)*
090 Resource Recovery; Recycling
091 Radio Frequency Systems & Shieldings
092 Rivers; Canals; Waterways; Flood Control
093 Safety Engineering; Accident Studies; OSHA Studies
094 Security Systems; Intruder & Smoke Detection
095 Seismic Designs & Studies
096 Sewage Collection, Treatment and Disposal
097 Soils & Geologic Studies; Foundations
098 Solar Energy Utilization
099 Solid Wastes; Incineration; Land Fill
100 Special Environments; Clean Rooms, Etc.
101 Structural Design; Special Structures
102 Surveying; Platting; Mapping; Flood Plain Studies
103 Swimming Pools
104 Storm Water Handling & Facilities
105 Telephone Systems *(Rural; Mobile; Intercom, Etc.)*
106 Testing & Inspection Services
107 Traffic & Transportation Engineering
108 Towers *(Self-Supporting & Guyed Systems)*
109 Tunnels & Subways
110 Urban Renewal; Community Development
111 Utilities *(Gas & Steam)*
112 Value Analysis; Life-Cycle Costing
113 Warehouses & Depots
114 Water Resources; Hydrology; Ground Water
115 Water Supply, Treatment and Distribution
116 Wind Tunnels; Research/Testing Facilities Design
117 Zoning; Land Use Studies
201 _____
202 _____
203 _____
204 _____
205 _____

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Prescribed By GSA Fed. Proc. Reg. (41 CFR) 1-16.803

10. Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 021			11) 115			21)		
2) 033			12)			22)		
3) 054			13)			23)		
4) 078			14)			24)		
5) 079			15)			25)		
6) 096			16)			26)		
7) 104			17)			27)		
8) 106			18)			28)		
9) 112			19)			29)		
10) 114			20)			30)		

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
033	P	1 Environmental Impact Statement 201 Facilities Plan for Western Phoenix Metropolitan Area	City of Phoenix, Water and Sewers Dept, 215 E. McDowell Rd Phoenix, Arizona 85004	$390 (Fee)	1978
115 033	P	2 15 MG Domestic Water Storage Reservoir (Earth Imbankment Type) Hedgepeth Hills, Phoenix, Arizona	City Engineer City of Phoenix 251 W. Washington St, Phoenix, AZ	$2,950	1978
	JV	3 South Rillito Interceptor Tucson, Arizona	Department of Water & Sewers City of Tucson P.O. Box 5547, Tucson, AZ 85703	$2,700	1978
	P	4 Tanque Verde Interceptor Tucson, Arizona	Department of Water & Sewers City of Tucson P.O. Box 5547, Tucson, AZ 85703	$1,500	1978
078 114	P	5 Maricopa County 208 Water Supply/ Demand Study	Maricopa Association of Govt's Transportation & Planning Offices 1801 W. Jefferson St., Phx, AZ 85007	$10 (Fee)	1977
079 104	P	6 Northwest Phoenix Storm Drainage Study, City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$148 (Fee)	1977
112	P	7 Value Engineering 40-hr. Workshop Phoenix, Arizona	Individual Associated with Consulting Firms, Local, State & Federal Gov't Agencies	N/A	1977

033 079 096		0.25 MGD Wastewater Reclamation Facilities. Federal Correctional Insitution Lompoc, California	Bureau of Prisons U.S. Department of Justice Washington, D.C. 20537	$600	1976
021 033 079 096	P	9 0.1 MGD Wastewater Treatment Facilities Patagonia, Arizona	Town of Patagonia P.O. Box 515 Patagonia, Arizona 85625	$220	1976
078		10 201 Facility Plan Oracle Sanitary District Oracle, Arizona	Oracle Sanitary District P.O. Box 215 Oracle, Arizona 85623	$10 (fee)	1976
104	P	11 39" Stormwater Sewer City of Phoenix	City Engineer City of Phoenix 251 Washington St., Phx, AZ 85003	$302	1976
115	P	12 Booster Pumping Station & Reverse Osmosis System for Water for Human Injection	Carter-Glogow Laboratories 5160 W. Bethany Home Rd Glendale, Arizona 85301	$25	1976
115	P	13 42" Water Transmission Main City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$835	1976
115	P	14 24" Water Transmission Main City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$557	1975
096	JV	15 Southwest Interceptor Sewer City of Tucson	Department of Water & Sewers City of Tucson P.O. Box 5547, Tucson, AZ 85703	$1,700	1975
115	P	16 Water System Additions Why, Arizona	Why Utilities Company P.O. Box 7128 Why, Arizona 85321	$30	1975
054	C	17 Industrial Waste Treatment Reduction of Hexevalent Chrome & Acid Neutralization	Hexcel Products P.O. Box 66 Casa Grande, Arizona 85222	N/A	1975
096	C	18 Review of Plans & Specifications Ina Road Water Pollution Control Facilities	Department of Sanitation Pima County, Pima County Governmental Cntr Tucson, Arizona 85701	N/A	1974
115	P	19 Moon Mountain Water Booster Pumping Station & Force Main City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$171	1974

115	P	20 Fire Protection & Distribution System Extensions City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$92	1974
115	P	21 24" Water Transmission Main City of Phoenix	City Engineer City of Phoenix 251 W. Washington St., Phx, AZ 85003	$873	1974
115	P	22 12" Water Main Extension City of Phoenix	City Engineer City of PHoenix 251 W. Washington St., Phx, AZ 85003	$153	1974
096	JV	23 Pantano Sewage Pumping Station and Force Main City of Tucson	Department of Water ¢ Sewers City of Tucson P.O. Box 5547, Tucson, AZ 85703	$120	1973
		24 Coulter Street Relief Sewer City of Phoenix	City Engineer City of PHoenix 251 W. Washington St., Phx, AZ 85003	$617	1973
		25			
		26			
		27			
		28			
		29			
		30			

12. The foregoing is a statement of facts

Signature: _____ Typed Name and Title: Arthur H. Beard, Jr. President

Date:

HENRY R. BOUCHER

Environmental Planner
Environmental Planning Division
Camp Dresser & McKee Inc.

QUALIFICATIONS SUMMARY

As an environmental planner, Mr. Boucher's areas of specialization are city and environmental planning; environmental impact assessment; land development; site analyses and planning; land use and growth management; and socioeconomics.

EXPERIENCE

With Camp Dresser & McKee Inc. (CDM), Mr. Boucher has been involved in the preparation of several Environmental Impact Assessments in California and Arizona, including the Environmental Assessments for the 201 Wastewater Facilities Plans for the Metropolitan Phoenix area. He also had a major role in preparing a comprehensive sludge residuals marketing study for the Phoenix 201 Facilities Plan.

Prior to joining CDM, Mr. Boucher's responsibilities were in the city planning field with the City of Martinez, California, focusing on the areas of land use planning and development, environmental impact assessment, open space and conservation planning, site planning and design, and zoning administration. He was responsible for the preparation of several Environmental Impact Reports and General Plan studies and has had experience with the various aspects of public participation in the city and environmental planning process.

EDUCATION	Sc.B. - Materials Engineering, Brown University, 1970 M. S. - Environmental Engineering, Stanford University, 1972
CERTIFICATION	American Institute of Certified Planners
PROFESSIONAL SOCIETIES	American Planning Association

PROFESSIONAL HISTORY

1979 to date	Project Planner with Camp Dresser & McKee Inc. (CDM). As a member of CDM's Environmental Planning Division, Mr. Boucher is responsible for providing environmental planning services to clients principally in the areas of environmental impact assessment, city planning, recreational facilities planning and socioeconomic studies.
1973 to 1978	As Associate Planner for the City of Martinez, California, Mr. Boucher assisted the Planning Department Director in all aspects of Department work including advisory role to the Planning Commission and City Council, General Plan development and implementation and land development review. Mr. Boucher served as acting Planning Director for the Department from January to November 1978, in which capacity he was responsible for planning, organizing and directing the current and advance planning activities of the Department. Mr. Boucher's key accomplishments included directing a General Plan study and adoption for a major area of the City of Martinez, preparation of several Environmental Impact Reports and obtaining major Federal and State grants for park development projects.
June to September 1970	In the Research Division of the British Steel Corporation, 1970, Mr. Boucher conducted an independent research study consisting of a comprehensive literature search on American and British tool steels.
June to September 1969	In the Research Department of Texas Instruments Mr. Boucher conducted a research study of developing alternative production heat treatment procedures.

ROGER G. FRY

Principal Engineer
Water Resources Division
Camp Dresser & McKee Inc.

QUALIFICATION SUMMARY

Mr. Fry has over 23 years of experience in the areas of hydrology and water resources, and in the planning and design of physical facilities for water supply, drainage and flood control. Mr. Fry has been directly responsible in the capacity of Project Manager for: (1) approximately 30 planning projects in California, Arizona, Washington and Alaska in which the engineering fees totaled in excess of $1.8 million, and (2) more than 25 design projects representing a total construction value of approximately $7 million. Mr. Fry has performed short-term foreign assignments as consultant and/or staff engineer on several water, irrigation and drainage projects. In addition, he has served as an expert witness in many court cases in California.

EXPERIENCE

Mr. Fry has served as Project Manager for more than 30 projects, including the following: (1) Urban runoff and basin drainage study for Metropolitan Seattle, Washington. This was a two-year study covering 1,100 square miles, two river basins, two counties, and 26 municipalities. (This study received a 1976 Engineering Excellence Award from the Consulting Engineers Council of Washington.) (2) Drainage management master plan, including an environmental impact assessment for Bellevue, Washington, a community of 60,000 people. (3) Hydrology and hydraulic design phase of Corte Madera Creek Project, Town of Ross, California. (This study received a 1978 Engineering Excellence Award from the Consulting Engineers Association of California.) (4) Surface runoff management plans (Section 208, PL 92-500) for Burnt Bridge Creek, Washington, and for Southern Solano County, California. (5) Water supply and distribution master plan, City of Benicia, California. (6) Preliminary design of drainage and flood control facilities for a 20-square-mile area along the Chena River in Fairbanks, Alaska.

In addition, Mr. Fry served as Project Engineer for all or portions of the following: (1) Countywide disaster repair program following the December 1964 floods in Northern California. (2) Hydrologic analyses and hydraulic design of the spillway for a 90-foot high rock-fill dam, Northern California. (3) Hydrologic studies and design of drainage facilities for many land development and highway projects. (4) Three basinwide soil and water conservation projects in Northern California. (5) Utilities element of a City Master Planning Program, San Francisco Bay Area, California. (6) Countywide investigation of agricultural, municipal and industrial water supplies and requirements,

EXPERIENCE - Continued

Northern California. (7) Basinwide surface and groundwater quality study, involving both agricultural and urban lands, Southern California. (This study received a 1970 Engineering Excellence Award from both the Consulting Engineering Association of California and the Consulting Engineers Council of the United States.) (8) Numerous engineering design projects, in which the total construction cost is some $4 million: water systems, drainage systems, fallout shelters, highways, bridges, subdivisions, and buildings.

EDUCATION	B.S. - Civil Engineering, University of California, 1956
	M.S. - Civil Engineering, University of California, 1958
REGISTRATION	Registered Professional Engineer: California, Nevada, Arizona, Washington, Michigan, Nebraska
PROFESSIONAL SOCIETIES	Consulting Engineers Association of California American Society of Civil Engineers American Public Works Association American Water Works Association

PAUL R. GIGUERE

Associate Engineer
Water Resources Division
Camp Dresser & McKee Inc.

QUALIFICATIONS SUMMARY

Mr. Giguere has over three years of professional experience in the field of water resources engineering. As an Associate Engineer with Camp Dresser & McKee, he has been involved in numerous water resources development and management projects, many involving the development and use of computer simulation models. Most of these projects have related to drainage and stormwater management, wastewater collection systems, erosion and sedimentation, water quality and water supply.

EXPERIENCE

Mr. Giguere has recently served as the project manager on such projects as the development of several interactive computer programs for wastewater flow simulation, and sewer system analysis and design for the Clark County Sanitation District in Las Vegas, Nevada, and the preparation of a reconnaissance report on siltation problems in the San Lorenzo River in California for the Corps of Engineers. Some of the other major projects on which Mr. Giguere has served as a project engineer include: the modification and application of storm runoff and stream quality computer models for the Southeast Michigan Council of Governments; use of the EPA "SWMM" and the Corps of Engineers "STORM" computer programs to develop and test automatic control strategies for reducing overflows from San Francisco's combined sewer system; the modeling of riverbed scour and sediment deposition utilizing the HEC-6 program; and the development of several preliminary master drainage plans for urbanizing areas in California.

EDUCATION	Massachusetts Institute of Technology - B.S. in Civil Engineering (Environmental Concentration), 1975 Stanford University - M.S. in Civil Engineering (Water Resources Planning Concentration), 1976
REGISTRATION	Professional Engineer: California
HONORS	Tau Beta Pi, MIT Chi Epsilon, MIT

PROFESSIONAL HISTORY

June 1976 to Date — Camp Dresser & McKee Inc., Associate Engineer

Since joining CDM, Mr. Giguere has been involved in a wide range of projects, including: (1) development of several interactive computer programs for wastewater flow simulation and sewer system analysis and design for the Clark County Sanitation District near Las Vegas, Nevada; (2) modification and application of storm runoff and stream quality models for use by the Southeast Michigan Council of Governments in their 208 Planning Study; (3) use of the EPA Storm Water Management Model to develop automatic control strategies for San Francisco's combined sewer system; (4) formulation of a Surface Runoff Management Plan for Solano County, California; (5) preparation of a reconnaissance report on siltation problems in the San Lorenzo River in California for the Corps of Engineers; (6) assessment of a buried pipeline crossing using the Corps of Engineers' HEC-6 model for scour and deposition in a riverbed; (7) development of several preliminary master drainage plans and erosion control plans for urbanizing areas in California; (8) preliminary design of a flood control channel and drop structures on a tributary of the Whitewater River near Palm Springs, California; (9) analysis of the water quality changes in a series of ponds near Madison, Wisconsin as a result of an industrial discharge; (10) participation in several phases of preconstruction monitoring and analysis for the Rodeo, California, sewage outfall; (11) analysis of several water distribution systems and water supply alternatives using advanced computer simulation techniques; (12) applications of the Corps' HEC-2 model for computing water surface profiles. Mr. Giguere is also responsible for CDM's Walnut Creek computer facilities and operations.

1974-1975 — Mr. Giguere worked as an Engineering Assistant for Carroll E. Taylor Associates, Auburn, Maine, during the summers of 1974 and 1975. The work primarily involved the development, modification and application of computer programs for structural design and analysis.

DENNIS J. METAXAS

Staff Engineer
Camp Dresser & McKee Inc.

QUALIFICATIONS SUMMARY

Mr. Metaxas' experience involves hydraulic and hydrologic analysis of water resource planning and management projects.

EXPERIENCE

Mr. Metaxas has worked on two flood control studies: one that involves tidal flooding on the San Francisco Bay shoreline and another that involves the flooding problems of Alhambra Creek in Contra Costa County. The latter study required developing various alternative plans (structural and non-structural) that would reduce flooding while minimizing the disruptive effects of any structural modifications. In addition, he assisted in the analysis of tidal hydraulics, engineering design and cost estimating phases of the Hayward Marsh Rehabilitation Project. He has also worked on numerous drainage system designs for private developers and also has experience in the hydraulic analysis of channel systems.

Prior to joining CDM he was with the Hydrologic Engineering Center, Army Corps of Engineers. While there he was involved in a water supply study for the City of Albuquerque, New Mexico, which addressed the extent of the water supply in the area, an evaluation of past usage, estimated future use, and a plan for resource management. He also worked extensively on computer programs for the Spatial Analysis Management Techniques developed by the Hydrologic Engineering Center, including training and instruction in its use. He has also worked on various modifications of the HEC-1 computer model and assisted users in its application.

In addition, Mr. Metaxas worked part-time at the Hydrologic Engineering Center while completing his University studies, assisting professional engineers in writing and improving programs for computer applications used in hydrologic investigations.

EDUCATION: Napa College - A.A., Engineering, 1974
University of California, Davis - B.S., Civil Engineering, 1977

TECHNICAL SOCIETIES: American Society of Civil Engineers

REGISTRATION: Engineer-in-Training, California

M. HASAN NOURI

Senior Engineer
Water Resources Division
Camp Dresser & McKee Inc.

QUALIFICATIONS SUMMARY

Mr. Nouri has more than 10 years of professional experience in the fields of civil, environmental and water resources engineering. As Senior Engineer for Camp Dresser & McKee Inc., Mr. Nouri is responsible for directing and managing projects in water resources engineering.

EXPERIENCE

Mr. Nouri's experience in the field of river mechanics and river engineering is extensive. Representative projects which he has completed are: design and services during construction for San Diego Creek in Irvine, California; flood analysis and mechanics of Santa Ana River at Riverside Narrows, California; and Mobile Riverbed Study of River Waal, in Zaltbommel, The Netherlands.

Prior to joining CDM, Mr. Nouri served as Project Manager and Project Engineer for Dames and Moore and Wilbur Smith and Associates. While with these firms, he managed the following projects: (1) Reduction of Flood Stages Along Burnt Fork Creek in Atlanta, Georgia; (2) Hydrologic Assessment of Site Selection for Nuclear Electric Generation Facilities in South Carolina; (3) Diversion of North Potato Creek in Copperhill, Tennessee; and (4) Design of Flood Retarding Structures in North Carolina.

EDUCATION

University of Kabul - B.S. in Civil Engineering, 1965
Georgia Institute of Technology - B.S. in Civil Engineering, 1968
Delft Technological University, Holland - Diploma (Equivalent to M.S.) in Hydraulic Engineering, 1970

REGISTRATION

Licensed Professional Engineer: California, South Carolina and Ontario, Canada

PROFESSIONAL HISTORY

1975 to Date — Senior Engineer, Camp Dresser & McKee Inc.

Project Manager for the design and construction of San Diego Creek Realignment for The Irvine Company's Woodbridge Village Development in Irvine, California. The project is a billion dollar development and the San Diego Creek Realignment has a construction cost in excess of $7 million. He also served as Project Manager on erosion and deposition processes in and above Conrock Gravel Pit in San Juan Creek, Orange County, California. He was project manager for the hydrologic and hydraulic analysis of Anaverde Creek at Antelope Valley Freeway for the California Department of Transportation. Mr. Nouri was Project Engineer involved in the analysis of sediment transportaion and design of temporary facilities for the diversion of San Diego Creek Channel during construction, and as Project Engineer was responsible for the preparation of groundwater contour maps for areas in San Bernardino and Riverside Counties. He was consultant on flood analysis and mechanics of the Santa Ana River at Riverside Narrows, California. The results of this study were used to design a 5,000-foot flood control levee with an estimated construction cost of $2.3 million.

1974 to 1975 — Water Resources Engineer, Dames and Moore, Atlanta, Georgia

Project Manager, surface water quality management for AMAX Coal Company's strip mining operation in Catlin, Illinois. Project Engineer for reduction of flood stages along Burnt Fork Creek in DeKalb County Georgia. Engineer, hydrologic assessment for site selection of nuclear electric generation facilities for South Carolina Electric and Gas Company and diversion of North Potato Creek for Cities Service Company's Copperhill operations in Tennessee.

1970 to 1974 — Water Resources Engineer, Traffic Engineer, Wilbur Smith and Associates, Atlanta, Georgia; Miami, Florida, and Columbia, South Carolina.

Engineer, Atlanta Area and Miami Area TOPICS Studies.

1967 to 1969 — Instructor - Engineering Faculty, University of Kabul, Afghanistan - Lectured in drainage design, fluid mechanics laboratory and open channel hydraulics.

PROFESSIONAL SOCIETIES

American Society of Civil Engineers
American Public Works Association

RESEARCH

Participated in reserach and model studies of the following: (1) "Water Hammer Resulting from Sudden Closure of a Downstream Valve, "Georgia Institute of Technology, Atlanta, Georgia, (2) "Excessive Turbine Vibrations," Kajaki Dam, Afghanistan, and (3) "Mobile River Bed Study of River Waal," Zaltbommel, Netherlands.

MARK J. WILDERMUTH

Associate Engineer
CDM-Water Resources Division

QUALIFICATIONS SUMMARY

Mr. Wildermuth has participated in a broad range of hydrologic and water resources studies. He has been involved in flood control planning and design, flood insurance and flood plain management studies, real time flood forecasting and hydropower scheduling, hydrologic simulation model development and parameter estimation.

EXPERIENCE

Mr. Wildermuth has been primarily involved in surface water hydrologic and hydraulic analysis. These projects include nuclear power plant siting studies in Iran; water supply studies for coal gasification in the Ohio River Basin and for domestic purposes in Catalina Island, California; flood insurance studies in Texas, Louisiana and Florida; hydraulic analysis and design of storm drains and a spillway; development of numerous computer codes including a sophisticated semi self-calibrating conceptual watershed model and a complete basin model for use in surface water simulation studies.

EDUCATION	B.S., Engineering, University of California M.S., Engineering, University of California
HONORS	Magna Cum Laude Departmental Scholar Hughes Fellowship
PROFESSIONAL SOCIETIES	American Society of Civil Engineers American Waterworks Association

PROFESSIONAL HISTORY

1980 — Associate Engineer, CDM-Water Resources Division

Since joining CDM, Mr. Wildermuth has been involved in a hydraulic study for flood control and reservoir design on the Salt River.

1976-1980 — Staff Engineer, Tetra Tech Inc.

Surface water hydrologic analysis and dam siting study to develop water supplies for coal gasification in the Ohio River Basin.

Hydrologic Engineering for the design of a nuclear power plant in Iran. Project responsibilities included determination of probable maximum precipitation (PMP); subsequent application of rainfall runoff model HEC-1 to determine probable maximum flood (PMF), application of HEC-2 to determine backwater profile for PMF, and use of a specially developed one-dimensional unsteady model to propagate dam failure hydrographs in irregular channels. Determination of a dam failure hydrograph. Scour, deposition and channel stability study. Prepared hydrologic design specifications using the American Nuclear Standard for cooling water intake, onsite runoff control structures and protection structures from externally caused floods.

Project Coordinator for Federal Insurance Administration Flood Insurance Studies for Pinellas and Pasco Counties in Florida and Galveston, Chambers, Jefferson and Orange Counties in Texas. Responsibilities included data collection and analysis, contacting concerned public agencies, supervision of hydrologic and hydraulic analysis, project scheduling and report preparation.

Mr. Wildermuth has applied numerous available models such as HEC-1, TR-20 in this work. He has developed and collaborated in the development of three specialized watershed models.

Collaborator in a water management analysis for Middle Ranch Reservoir on Santa Catalina Island. This analysis included a low flow frequency duration analysis, hydrologic modeling and the development of rationing schemes based on economic criteria.

Miscellaneous Experience: Literature search and review for rock fill dam design, conceptual diffuser design.

PROFESSIONAL HISTORY - Continued

1975-1977 — Student Civil Engineer, Los Angeles County Flood Control District

Design hydrology and hydraulics for storm drain systems. Application of Los Angeles County Flood Control modified rational hydrology computer package to estimate flood flows and conduit sizes.

Collaborated in PMF spillway adequacy study for Laguna Regulation Basin. This study included development of runoff model parameters and the conceptual development of a serial reservoir flood routing computer model.

Development of a semi self-calibrating conceptual watershed model. This conceptual model is currently extensively used by the Hydraulics and Hydrology section for spillway studies and will be used for developing watershed models to be used in a comprehensive flood forecasting system (resulted from Master of Science thesis).

1975-1976 — Research Assistant, Systems Engineering Department, University of California, Los Angeles

Conducted basic research in the field of reservoir operation for the maximization of hydro-electric power benefits and firm water benefits on a monthly, daily and hourly basis for the Central Valley Project, California. *

Collaborated on study to assess the use of remote sensing for reservoir inflows utilizing Sacramento Model and the Corps of Engineers #SSARR Model.

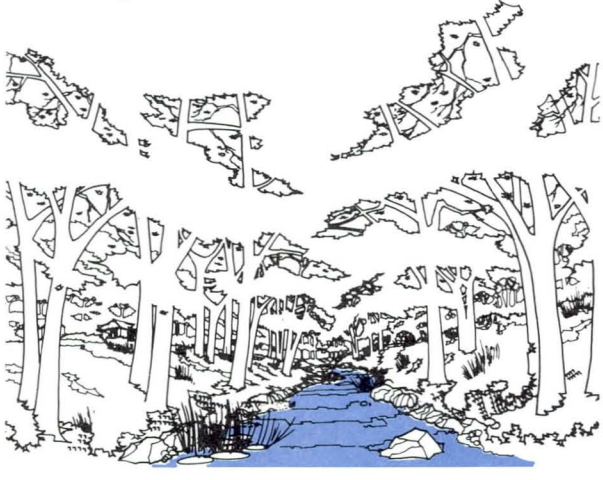
PUBLICATIONS — Mr. Wildermuth has authored and co-authored numerous project reports. Additionally, he has published two papers dealing with the practical estimation of parameters for hydrologic simulation models and on an innovative procedure for flood frequency estimation for ungaged basins.

WATER RESOURCES ENGINEERS RECEIVES AWARD FOR ENGINEERING EXCELLENCE

Corte Madera Creek Project for U.S. Army Corps of Engineers San Francisco District

The Corte Madera Creek Flood Control Project in Marin County, California, just north of San Francisco, was authorized by the U.S. Congress in 1962. The project was to extend about 5 miles upstream from San Francisco Bay. Construction of a concrete channel began downstream in 1967. The final 3,000 feet were to be constructed in 1972. But the Town of Ross, reacting to concerns of property owners along the creek over the destruction of the natural environmental setting, successfully stopped the project through litigation. At the request of U.S. Congressman John Burton, the Corps and a Citizens Advisory Committee jointly selected a consulting team to plan 100-year flood protection while maintaining the local environmental character of the stream.

Existing Creek



As a member of the consulting team including the planning firm of Royston, Hanamoto, Beck & Abey, Water Resources Engineers (WRE) provided the necessary hydrologic and hydraulic analyses of the alternative stream channel configurations. The alternatives evaluated had to comply with the following stipulated objectives:

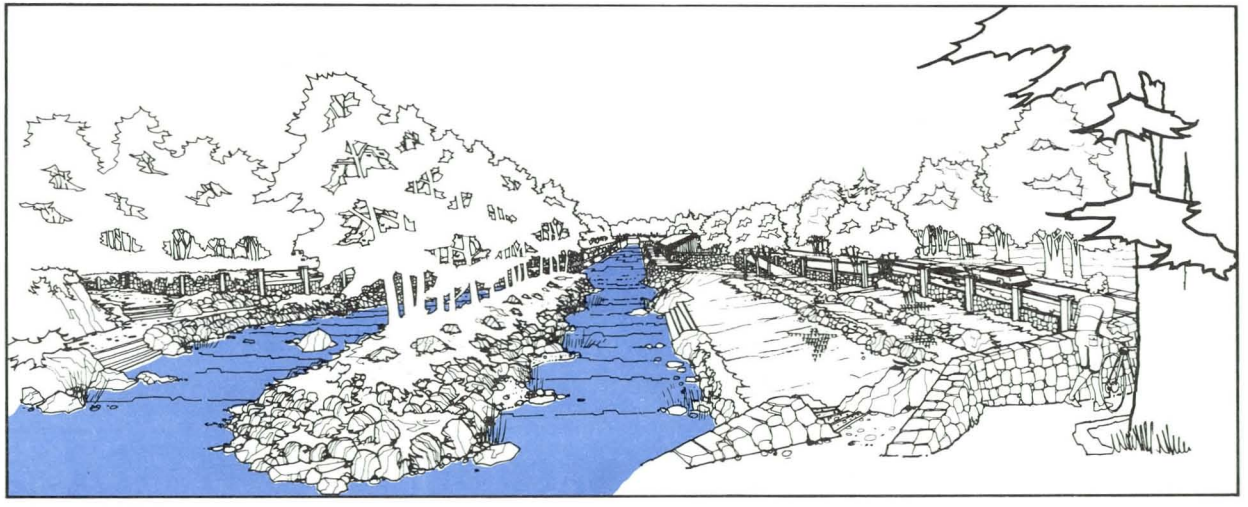
- protect the visual quality and character of the creek
- preserve as many trees as possible along the creek
- preserve the creek's ecological system
- provide public park space separate from private property

WRE estimated amounts of runoff at various points along the stream with its computerized runoff model. Then the water surface profiles were calculated for a variety of cross-sections including natural channels, grassed floodways, stone retaining walls, natural stream meanders, and related nonartificial features. All results were reported to the Corps and to the public.

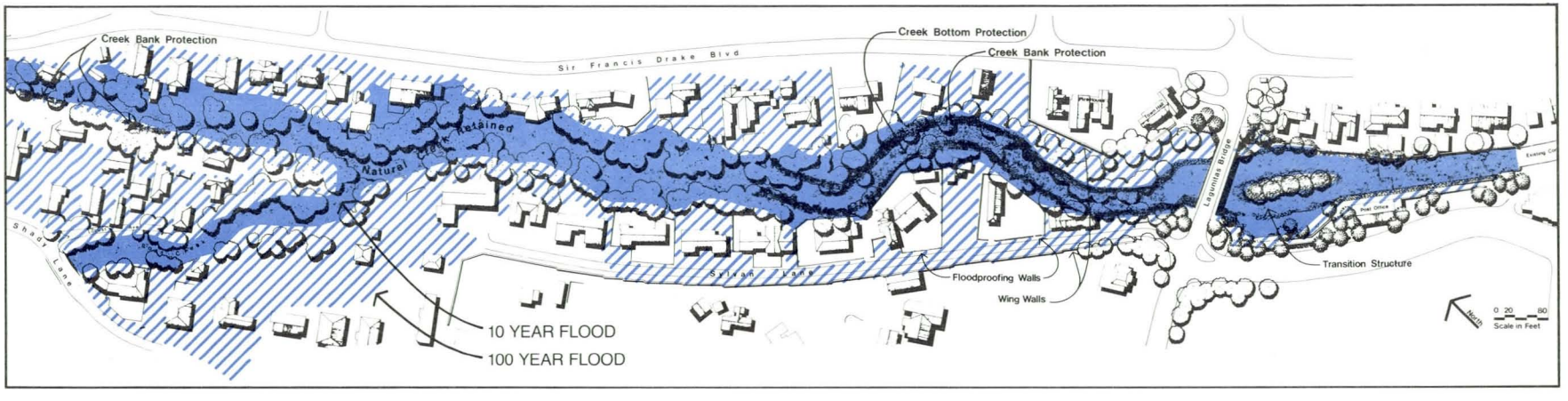
A landscape and channel improvement plan capable of meeting all the stated objectives was found and recommended. The project showed that damages that would result from a flooding event can be prevented with channel improvements that blend with surrounding natural environmental features. Following completion of the work, Congressman Burton wrote a letter of commendation to the team for its innovative planning that satisfied all public concerns and ameliorated a potentially serious flooding problem.

For this project, WRE was awarded an Engineering Excellence Award in 1978 by the Consulting Engineers Association of California.

Transition Structure



The Recommended Landscape and Channel Improvement Plan



CECW AWARD

WATER RESOURCES ENGINEERS WINS HONORABLE MENTION

Abstracted from the Daily Journal of Commerce, Seattle, Thursday, Feb. 5, 1976

Cedar - Green Rivers Drainage Study for U.S. Army Corps of Engineers Seattle District

Five awards were given on January 30, 1976, by the Consulting Engineers Council of Washington to projects entered by engineering firms in the state to compete in the Council's Engineering Excellence Awards Contest.

An Honorable Mention Award was earned by Water Resources Engineers, Inc. of Walnut Creek, California, in association with Yoder-Trotter-Orlob & Associates, also of Walnut Creek, and Kramer, Chin & Mayo, Inc. of Seattle. The award honored the joint venture's project for the Seattle District of the Corps of Engineers, entitled "RIBCO Urban Runoff and Basin Drainage Study, Cedar-Green River Basins."

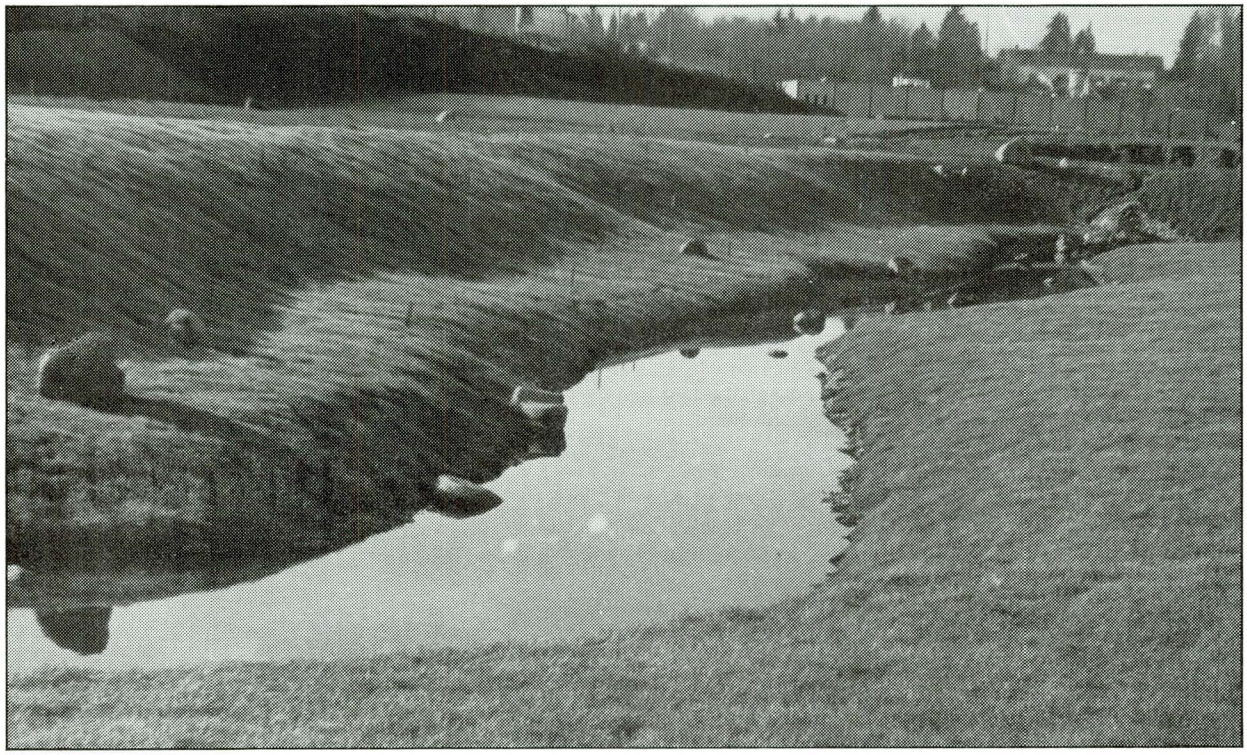
The purpose of the Urban Runoff and Basin Drainage Study was to develop a plan for the 27 watersheds within the 1,160 square mile Cedar and Green River Basins to combat the problems of flooding and erosion, and to assess the impact of storm runoff on water quality and quantity. The study developed a regional approach to financing and managing of urban drainage within the watersheds. In addition, a computer model was developed to evaluate storm drainage systems based on existing and proposed land uses by calculating the quality and quantity of stormwater runoff.

Judges in the state contest were Dean Ryland Hill, College of Engineering, University of Washington; Dean William Ilgen, School of Engineering, Gonzaga University, Spokane; Dr. Gary Zimmerman, Dean of the School of Engineering, Seattle University; and Gerald Williams, president of the Washington State Council of Architects, AIA.

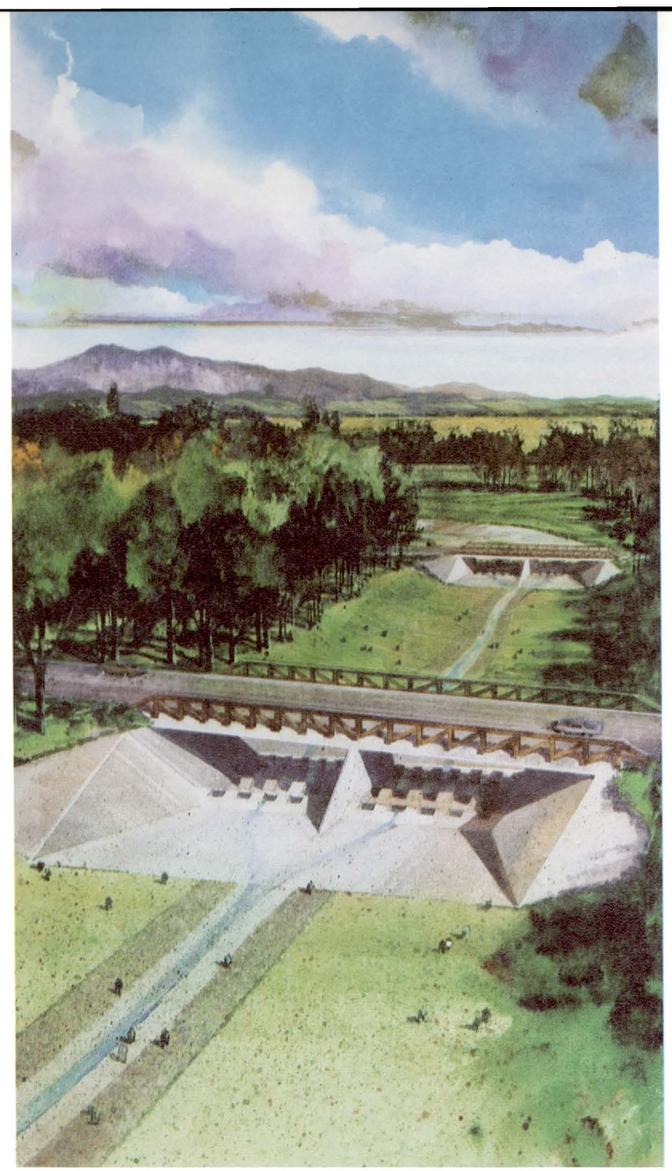
The award winning entries were on display at the Seattle-First National Bank Building, February 3 through 13, and at the University of Washington engineering library from February 16 to 27.

The five winning displays will be entered in the National Consulting Engineering Excellence Awards Contest to compete with other winning projects by ACEC member firms on projects constructed any place in the world.

The Eastern Portion of the Study Area. Lake Washington is in foreground.



The primary objective of the Study was to develop ways to manage urban drainage that will protect and enhance the natural environment. As a result of the recommendations presented in the Study, this man-made channel was designed and constructed to simulate the natural channel conditions of the small stream it replaced.



San Diego Creek rechannelization permits billion-dollar development of Woodbridge Village

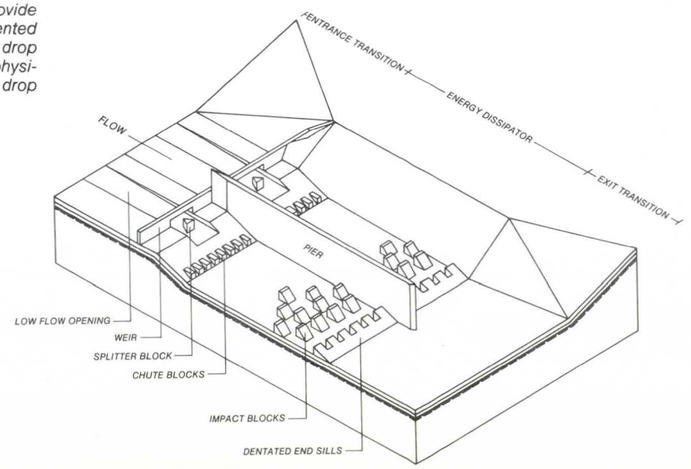
Camp Dresser & McKee's Pasadena office designs innovative channel to meet flood control/recreation goals

In 1975, all that stood in the way of development of the Village of Woodbridge, a residential community planned for Irvine, California, was a flood-prone stretch of San Diego Creek. Currently, construction on the billion-dollar development is about 25 percent complete. And further construction is set to begin, largely as a result of innovative plans to rechannel the creek prepared by Camp Dresser & McKee (CDM), Pasadena. The $7-million creek realignment will be completed late in 1978.

The community's developers, The Irvine Company, Newport Beach, California, retained CDM to conduct studies and design a flood control channel which would provide optimum flood protection, while complementing the developer's award-winning, environmentally non-disruptive design concept for the village. The village will ultimately encompass a 2.5-sq-mile (6.5 sq km) area, which San Diego Creek will traverse. A broad style and price range of housing will be provided: single-family detached units, apartments, townhouses and condominiums. Carefully sited recreational and commercial areas will round out the development.

CDM engineers have designed an environmentally compatible, grasslined channel that will not only provide the required flood protection 19,000-cubic-feet-per-second capacity generated by a 100-year flood (532 cu m/sec), but also serve as a recreation area during dry weather. Existing trees and shrubbery will be preserved. To avoid the extensive construction which often characterizes more traditional approaches, the plans called for slightly rechanneling the creek's path to the south. (The previous creek path will also be preserved.) The realigned and enlarged channel section will be provided with a series of flood control structures, which will reduce the flow velocity and control the creek's depth, and thus prevent erosion of the proposed grasslined channel.

Above: The $7-million creek rechannelization will provide optimum flood protection as well as a recreation-oriented greenbelt for Woodbridge Village. Right: Design of drop structures was based on results of mathematical and physical hydraulic model studies. Components of a typical drop structure are shown.



Flood control structures integral

Based on results of previous mathematical modelling efforts and physical hydraulic model studies, performed under the direction of The Irvine Company, it was determined that six control structures would be required to allow:

Dissipation of excess kinetic energy

To maintain a channel bottom slope of 0.0005, through the natural terrain which has a slope of 0.004, it was necessary to drop the channel invert at various locations. The resulting kinetic energy of the flow generated by each drop had to be dissipated before releasing the flow into the grasslined channel. Facilities which produce a hydraulic jump and consist of the chute blocks, impact blocks, and dentated end sills in the basin were designed to dissipate excess kinetic energy.

Maintenance of normal depth in the upstream reach

Inlet components consisting of a weir and an adverse bottom slope were required to maintain normal depth of flow in the upstream reach and thus prevent erosion.

Maintenance of traffic flow across the channel

To meet the above objectives there was a need to concentrate potential flood flows from the parabolic channel section into a more manageable geometric form such as a rectangular or trapezoidal section used in modelling studies. From cost design studies performed by CDM, it was concluded that the trapezoidal section would be most cost effective. Such cross-sections will have a width significantly less than the width of the grasslined channel, thus reducing the span of bridges required to cross it. In addition to the economic consideration, this design solution of combining the bridge structure with the drop structure maximizes the grassed area in the channel complex. Because five of the six control structures form roadbridge abutments, their visual impact will be minimized.

Construction proceeds on the flood control project, which is scheduled for completion late this year.

The multipurpose grasslined channel

Plans for the two-mile-long (3.2 km), 232-foot-wide (71 m) by 21-foot-deep (6.4 m) channel incorporate provisions for grasslined landscaping, vegetative screening at each drop structure, a rock bottom and a concrete low-flow channel, and replacement of all trees removed during construction. Landscape features were designed by the Reynolds Environmental Group, Newport Beach, California.

Hybrid Bermuda grass has been selected as the basic vegetation medium because of its resistance to stress and vigorous characteristics. Bermuda grass, estimated to have a shear resistance of 0.55 pounds per square foot (.26 kilopascal), resists average velocities up to 8 feet (2.4 m) per second. An irrigation system designed by the landscape architect will ensure an attractive appearance, grass growth, and provide maximum erosion resistance.

The channel bottom will be subject to shear stresses. A riprapped channel bottom will provide additional erosion protection at a minimal maintenance cost. Filter cloth is used to prevent washing out of fine soil particles through the gravel and riprap, and to provide the channel bottom with adequate bearing capacity for efficient operation of large-scale maintenance vehicles.

Interim facilities, consisting of a riprapped channel, a gabion (stone-filled wire basket) network, and training levees, will connect the creek with the grasslined channel. This permits future upstream extension of the channel in accordance with the city of Irvine's development plan.

Project slated for November completion

When construction of the flood control facilities is complete in November 1978, they will provide not only superior flood protection, but will also significantly add to Woodbridge Village's open space and recreational resources — walkways for the pedestrian and trails for the bicyclist and equestrian.