Brush Creek & Tributaries

Missouri & Kansas

A Feasibility Report on Flood Damage Reduction

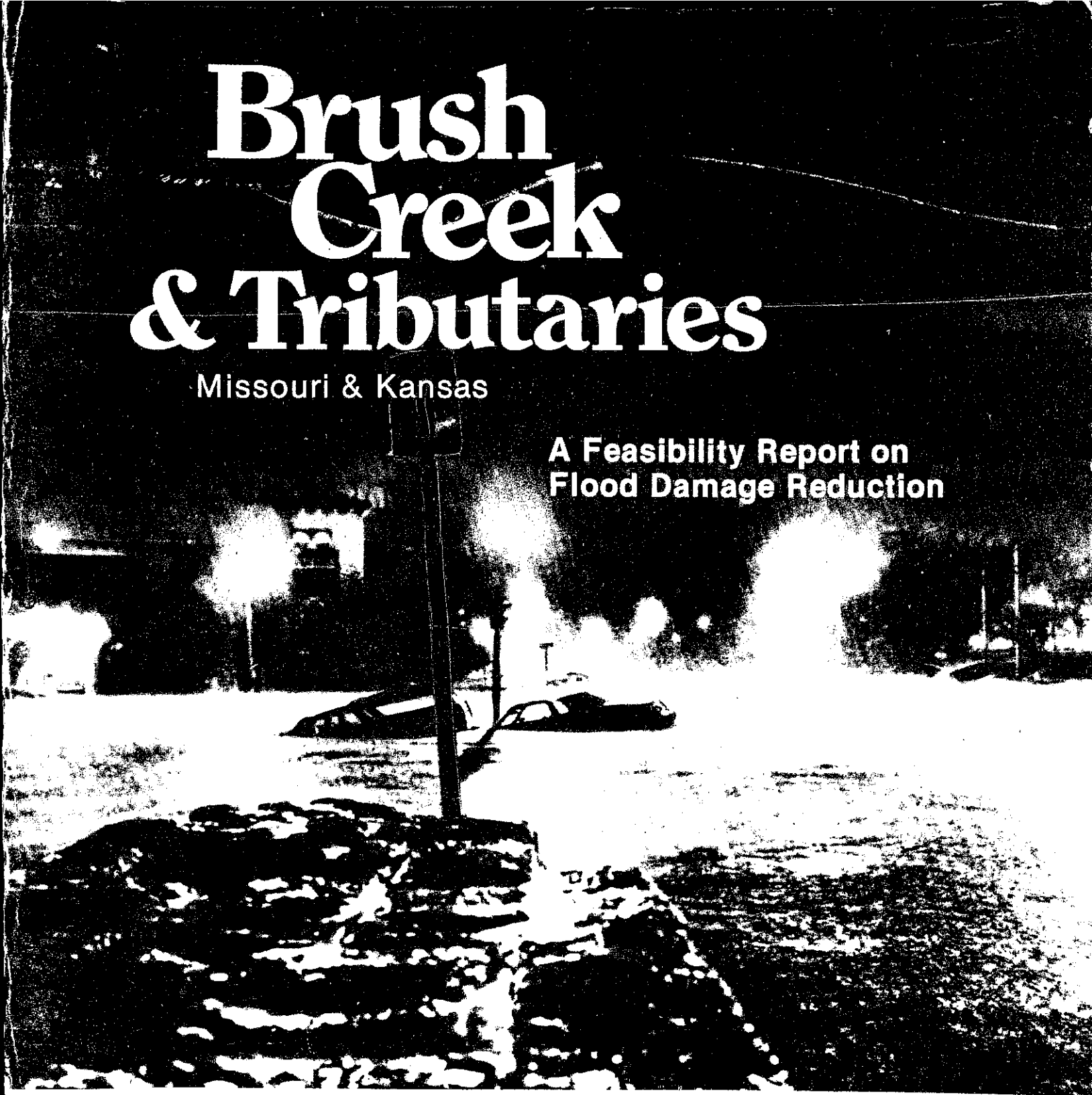

Photo by William H. Batson, Kansas City Star/Times

MAIN REPORT
&
Environmental Impact Statement

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

Kansas City District

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI

BRUSH CREEK AND TRIBUTARIES

MISSOURI AND KANSAS

MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT

MAIN REPORT

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A Feasibility Report

on

Flood Damage Reduction

INTRODUCTION

The Kansas City Metropolitan Region experienced localized heavy rainfall beginning on 12 September 1977 and by 13 September experienced flooding of catastrophic proportions. Total damage in the region was estimated at about $100 million and 25 lives were lost. Heaviest hit was the Brush Creek basin, especially that part which lies in Kansas City, Missouri. The Kansas City District, Corps of Engineers, was asked to study the flooding problem in the basin to see if solutions, either Federal or non-Federal, were possible that would lessen future flood damage and loss of life. This report documents the study which was begun shortly after the 1977 flood.

STUDY AUTHORITY

Authority for this study is provided by a resolution of the Committee on Public Works, United States Senate. The resolution was adopted on 9 March 1971, and requested the Corps of Engineers to provide "a plan for the comprehensive development of the water and related land resources of the metropolitan region of Kansas City, Missouri, and Kansas, with due consideration for other planning activities being pursued. . . . Such study to include appropriate consideration of flood plain management practices as an alternative or supplement to works of improvement."

Two reports have resulted from that study resolution. The main report was completd by the Kansas City District, Corps of Engineers, in October 1979, and covered all pertinent water resource issues except flooding in the Brush Creek basin. Brush Creek and tributary flood problems in Jackson County, Missouri, and Johnson County, Kansas, are covered in this report.

STUDY SCOPE

This report presents the results of the study of flooding and associated problems and needs in the Brush Creek basin. Plate 1 is a location and vicinity map of the study area. The basin includes a highly urbanized portion of Kansas City, Missouri, and all or part of nine cities in Johnson County, Kansas, and a small part of Kansas City, Kansas, in Wyandotte County.

Primary study emphasis was placed on reducing flood damages and hazard to life in the basin. Other related aspects of the study are park and recreation development and transportation. All reasonable alternative plans to solve those water resource problems were considered, including both structural and nonstructural means. Studies were made in the detail and depth needed to permit plan selection and determination of feasibility.

STUDY PARTICIPANTS AND COORDINATION

The Kansas City District, U.S. Army Corps of Engineers, had the principal responsibility for conducting and coordinating the Brush Creek study, consolidating information from other studies, formulating plans and preparing the report. During the course of the study formal and informal meetings and other contacts were held with appropriate Federal and State government agencies and with local officials and interested groups and individuals.

Two formal public meetings were held during the course of the study. Both were in Kansas City, Missouri, and the dates were 15 February 1979 and _____ 1980 (to be held). The first meeting was attended by 168 persons, of whom 25 spoke (_____ people attended the second meeting and _____ presented their views). Summaries of the meetings are provided in Appendix E, Public Views and Comments.

The following communities, agencies, and organizations participated in the study by providing information or by making their views known at times other than, or in addition to, the formal public meetings:

Local:	Mid-America Regional Council Kansas City, Missouri Kansas City, Kansas Fairway, Kansas Mission, Kansas Mission Hills, Kansas Prairie Village, Kansas Roeland Park, Kansas
State:	Kansas Water Resources Board Kansas Board of Agriculture, Div. of Water Resources Kansas Park and Resources Authority Missouri Department of Natural Resources Missouri Department of Conservation
Federal:	Heritage Conservation and Recreation Service Fish and Wildlife Service Environmental Protection Agency Federal Emergency Management Agency
Non-Governmental:	Bryantwood Homes Assn., Fairway, Kansas J. C. Nichols Company Plaza Merchants Assn., Kansas City, Missouri.

The latter three of the above listed Federal agencies were requested to becomes cooperating agencies in the scoping process associated with Environmental Impact Statement preparation.

PRIOR REPORTS AND STUDIES

Several reports and studies of varying scope and detail have been prepared with concern flooding problems within the Brush Creek basin. Several were prepared by the Corps of Engineers; others were prepared by various municipalities or private interests or by consultants for them.

CORPS OF ENGINEERS REPORTS

House Document No. 91-332. This report of 4 May 1970 recommended a plan for flood control in the Blue River basin of which Brush Creek is a part. The plan consisted of modification of the lowermost 12 miles of the Blue River channel and construction of four multiple-purpose lakes in the upper part of the basin.

The report included a preliminary analysis of Brush Creek but concluded that no flood reduction plans were feasible. The recommended plan was authorized by Congress on 31 December 1970. Initial construction funds were appropriated for the channel portion of the plan in October 1978. The three lakes in the Kansas portion of the basin are in an inactive status. The fourth lake, Mill Lake, is classified as deferred for restudy.

Flood Plain Information Reports. The Kansas City District, Corps of Engineers, published two flood plain information reports on the Blue River basin in 1970. One report issued in April covered the Blue River, Brush Creek, and Indian Creek within Kansas City, Missouri. The other report, published in May 1970, covered the Blue River and tributaries in Johnson County, Kansas. These reports pointed out the relatively severe flood hazard from an Intermediate Regional Flood or Standard Project Flood on the Brush Creek and Rock Creek tributaries of the Blue River.

NON-FEDERAL REPORTS

Kansas City, Missouri, Plan for Brush Creek and Town Fork. Shortly after the September 1977 flood, Kansas City, Missouri, identified several problem areas on Brush Creek and Town Fork based on information available at that time. A package of improvements at those locations was assembled and the plan was presented to Kansas City voters as part of a public improvements bond issue in August 1978. The bond issue received the support of a majority of voters but was defeated because it received less than the two-thirds majority required for passage.

Fairway, Kansas, Drainage Plan. A drainage report was prepared by a consultant for the City of Fairway, Kansas, in 1968. The report considered many drainage improvements, including straightening and enlarging of Rock Creek through that city. The report did not evaluate dollar benefits, but hinted that costs very likely exceeded benefits. The modified channel considered in that report would have had about a 10-year capacity at that time. No action was taken by the city toward implementation of the Rock Creek channel portion of the drainage plan.

Mission, Kansas, Storm Drainage Plan. A storm drainage plan was prepared in 1968 by a consultant for the City of Mission, Kansas, which considered a new conduit for Rock Creek around the Mission Shopping Center. The plan was submitted by the city to the Federal Department of Housing and Urban Development for a possible construction grant that same year but was not funded. No subsequent action has been taken to implement the plan.

Brush Creek Bikeway Plan. A recreation plan was developed by Kansas City, Missouri, in 1977, which proposed a bikeway in or adjacent to the Brush Creek channel extending from Main Street east to Woodland Avenue. The bikeway was constructed in 1979.

Prairie Village, Kansas, Drainage Plan. In 1976, the City of Prairie Village developed a plan consisting of a series of drainage modifications on Brush Creek and ten small tributaries within that city. Construction of the project was begun in 1977.

Other Reports. Two studies have been made on Brush Creek flooding in Kansas City by the consulting firm of Black and Veatch. The early study, dated 1945, was prepared for Kansas City and includes a remarkably accurate projection of fully-urbanized flood discharges for floods up to 50-year frequency. The second study, dated 1978, was prepared for the J. C. Nichols Company. It deals with flood problems in the vicinity of the Country Club Plaza, and particularly with the Wornall Road bridge. This study and report were prepared as a result of the September 1977 flood.

A third report has been prepared for the City of Kansas City, Missouri, by the consulting firm of Howard, Needles, Tammer and Bergendoff. It is principally concerned with the design of a new Wornall Road bridge over Brush Creek in the Plaza Shopping District vicinity.

THE REPORT AND STUDY PROCESS

The Brush Creek report consists of a main report, environmental impact statement, and the follwoing appendixes:

Appendix A - Problem Identification
Appendix B - Plan Formulation, Assessment, and Evaluation
Appendix C - Engineering Investigations
Appendix D - Economics
Appendix E - Public Views and Comments

- **Main Report and Environmental Impact Statement.** This report documents the planning process. It is written in a nontechnical manner, and in sufficient length and level of detail to support essential analyses and conclusions. The accompanying Environmental Impact Statement (EIS) is a part of the main report. To avoid duplication, the EIS references discussion in other sections of the report and appendixes in support of some analyses.
- **Appendix A, Problem Identification.** This appendix contains detailed and technical descriptions and data to support the first two sections of the main report. It contains supporting discussion on existing and future conditions, problems and needs, and planning objectives.
- **Appendix B, Plan Formulation, Assessment, and Evaluation.** This appendix displays in detail the step-by-step process of assembling and analyzing alterative plans. The information supplements that contained in the main report, providing more material relating to trade-off analyses, sensitivity studies, risk and uncertainty aspects, and system of accounts.
- **Appendix C, Engineering Investigations.** This appendix contains technical discussions of hydrology and hydraulics for both existing and modified conditions. It contains design and cost data on all the final plans, and the results of geologic studies pertinent to assessment of plans.
- **Appendix D, Economics.** This appendix contains details of the economic benefits and costs of alternative plans, and describes how the benefits were derived.
- **Appendix E, Public Views and Comments.** This appendix is written in two parts. The first part is a description of the public involvement program. The second part displays copies of pertinent correspondence sent or received during the latter stages of the study. It is anticipated that this part will be expanded considerably after the final public meeting.

The process adopted in this study involved four functional planning tasks, increasing in successive levels of detail as more information was obtained. The four tasks are: (1) problem identification, (2) formulation of alternative plans, (3) assessment of each plan's impacts, and (4) comparison, or evaluation of the plans in order to determine which best satisfies the needs and objectives. Public involvement is an important aspect of all four tasks, but is especially important in the evaluation and trade-off analysis.

PROBLEM IDENTIFICATION

This section presents basic background information pertaining to the Brush Creek basin. Additional information may be found in Appendixes A and D, Problem Identification and Economics.

NATIONAL OBJECTIVES

Two broad national objectives were set forth by the U. S. Water Resources Council and were formally adopted as applicable to all Federal water resources planning activities on 25 June 1973. These national objectives, as described in the Principles and Standards are summarized as follows:

National Economic Development (NED objective—to increase the nation's output of goods and services and improve national economic efficiency.

Environmental Quality (EQ) objective—to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of natural and cultural resources and ecological systems.

EXISTING CONDITION

The Brush Creek basin covers 29.4 square miles. Government jurisdiction within this area is divided among two states, three counties and 13 cities. The upper reaches of the basin are within Johnson and Wyandotte Counties in Kansas. The lower reaches are within Jackson County, Missouri. Kansas City, Missouri, has by far the greatest share of the municipal jurisdiction.

There are two major tributaries to Brush Creek - Town Fork and Rock Creek. Town Fork is a right bank tributary draining 5.4 square miles entirely within Kansas City, Missouri. Rock Creek is a left bank tributary with a drainage area of 4.6 square miles. The Rock Creek drainage is entirely within Johnson County.

The basin can be categorized as fully urbanized. The predominant land use is residential, followed by recreation, and public and quasi-public uses. Areas of commercial uses are relatively small, though quite important, and located generally in the flood plain in the middle portion of the basin. Industrial development is generally limited to the extreme lower reaches. Plate 2 shows basin land use.

The urbanization process in the basin and along the stream course is so complete that little remains of the natural environment. The terrestrial habitat prior to urbanization was probably made up of various forest types. Now, only an occasional remnant specimen of oak and other species associated with the earlier oak-hickory forest can be found. These are generally interspersed with ornamental species in parks. The aquatic habitat in all reaches of the stream has been altered to some degree. The most pronounced modification has occurred in the middle reaches where the stream channel has been straightened and lined with concrete.

CLIMATE AND NATURAL RESOURCES

The climate of the Kansas City region is classified as modified continental. It is somewhat atypical of most climate at its latitude because no physical features exist that obstruct the free flow of air currents. Moist currents from the Gulf, dry currents from the semi-arid southwest and cold polar continental currents are all free to affect the weather of the area. Because of this wide range of potential influences, the weather in the Kansas City region is subject to rapid change. Weather changes are most apparent in the early spring but decrease as the season progresses. The mean date of the last freezing temperature is April 7. Mean annual precipitation is 34 inches. About 11 inches of that amount occurs in the spring months.

The summer season is warm and moderately humid. July is the hottest month with a mean daily maximum temperature of 80 degrees F. The nights during the summer are mild with a mean minimum temperature of 70 degrees F. Precipitation during the summer season is normally near 15 inches which makes this the wettest season. Fall is a season characterized by mild days and cool nights. The first freezing temperature is in late October, but has occurred as early as September 30. Mean precipitation in the fall months is only half the summer precipitation, about 6 inches. Winters are rather dry and not severely cold. Mean precipitation is nearly five inches, and snowfall averages 14 inches. The coldest month is January with a mean maximum temperature of 36 degrees F. Mean minimum temperature during January is 19 degrees. F.

The geologic character of the Kansas City region is quite uniform and does not present unique or extraordinary features. The basement of the rock strata is composed of igneous and metamorphic rock. Though now buried to depths exceeding 2,000 feet, the rock was at or near the surface for a long time. With invasion of an ancient warmwater sea, the primary geologic action on landscape of the region changed from surface erosion to sediment deposition. This deposition provided the material for the construction of the earlies sedimentary rocks which were sandstones. Several distinct periods of advancing and receding seas deposited material which was transformed with time into limestone and shale. Each of these periods left a distinct system of rock layers. The Pennsylvanian system is the most important in the Kansas City region. Rock from this system forms familiar outcroppings in the area.

In more recent geologic times the area was encroached upon by advancing glaciers. The Nebraskan and the succeeding Kansan ice sheets covered portions of the region. The Kansan had the greatest southern expansion. Evidence indicates that it extended south of the Missouri River. Much of the topography and the streams and rivers we know today were formed by the moving ice.

After the withdrawal of the ice another event of particular interest occurred. This was the deposition of windblown silt called loess. The material was derived from an unknown source, transported by the Missouri River and wind-carried to nearby hills. Based on remains of fauna found in the loess, the climate at this time, nearly one million years ago, must have been similar to the present. The recent geologic activity has been the combined activity of erosion, transportation, and deposition of base material. These actions have resulted in alluvial deposits in the valleys of principal streams. Materials in the alluvial deposits are generally clay, sand, and gravel.

The most valuable mineral resources in the Kansas City region are those related to the construction industry, specifically limestone, sand, gravel, and shale. Of these, limestone is the most important. It is extracted for production of cement, concrete aggregate, roadstone, agricultural limestone, riprap, dimension limestone and other uses. Nearly 40 stone operations are active in the region. The greatest annual production is centered in Jackson and Johnson Counties. Sand and gravel production in the region is centered along the Kansas and Missouri Rivers. Recovery is from dredge operations on the rivers or from pits in their alluvial deposits.

Nine different coal beds rated as economically recoverable are found in the strata under the Kansas City region. However, coal is no longer commercially produced in the area. Coal is found in thin and variable seams and has a high sulfur content.

Oil and gas wells were drilled in the Kansas City region in the late 1860's. These were the first producing wells in Missouri. From the 1920's through the 1940's, production was intensely developed and considerable amounts of natural gas and lesser amounts of oil were produced. Many of these fields have now been abandoned. The use of secondary recovery methods has increased production of some fields in recent years.

The soils, inconjunction with the temperature climate, represent one of the major natural resources of the Kansas City region. Being generally well drained and productive, they support a valuable and diverse agricultural base. They also generally provide for construction and development activity without severe limitations.

HISTORY AND CULTURAL CHARACTER

In 1845 John C. McCoy, a leading trader along the Santa Fe Trail, established the town of Westport. This community, located in the north central portion of the Brush Creek basin, rapidly became the dominant town of the area. It served as the eastern terminus for the Santa Fe, Oregon and California trails and functioned as a major trade center. In the same general time frame (1839-1845) a Methodist Mission and Indian Manual Labor School was established in the upper part of the basin in what is now Roeland Park, Kansas. This school was established to provide religious and vocational training for Indian children. In 1855 it was the location of the first territorial legislature meeting in Kansas.

During the 1850's, the Missouri River port of Kansas (later to become Kansas City, Missouri) began to replace Westport as the major commercial center. The road connecting the two centers became a major focal point for expanding development. In 1864, the basin was the scene of a major Civil War battle. Identified as the Battle of Westport, the battle was fought for control of the Missouri River and as a general campaign against Fort Leavenworth. The present day Plaza vicinity was the site of the last two days of this battle.

The 1880's saw the initiation of the park and boulevard system in Kansas City, Missouri. This plan, developed initially by George Kessler, called for wide park-like streets to connect developed areas and parks. The boulevards so developed became popular locations in the early 1900's for homes and estates for the more well-to-do citizens of Kansas City. The Brush Creek basin was the scene of much of this development. Emphasis provided by the donation of Swope Park immediately southeast of the basin directly led to the construction of north-south parkways like Ward Parkway, The Paseo, Swope Parkway, Gillham Road, and the city's major east-west parkways of Volker Boulevard and Brush Creek Boulevard. Sixteen of Kansas City's 24 parkways cross the Brush Creek basin.

In the first quarter of the 1900's, developments in the Brush Creek basin made it one of the major areas of cultural activity in the Kansas City area. In this time frame, the Nelson Art Gallery was established, the Country Club Plaza commercial area was constructed and Rockhurst College began holding classes. Rather dense multi-family residences were constructed along the parkways and later along streets adjacent to the parkways. From 1925 to 1960, development in the basin continued. Much of this development occurred along the upper reaches of Brush Creek within the Kansas portion of the basin. Some of these developments resulted in the incorporation of communities which were basically without commercial activity and contained little employment base. These successful developments served as nuclei for other developments, and by 1960 the basin was completely urbanized.

Reflective of its rather rich history, the basin contains a number of sites and buildings which have been recognized by the Kansas and Missouri Historical Societies for their historic significance. It is estimated that 16 structures and sites within the basin have been so identifed. This includes the Shawnee Mission which is listed in the National Register of Historic Places. A number of other buildings have been identified by groups such as the Landmark Commission as being significant. No known archeological sites exist within the basin, perhaps because of the early urbanization of the basin and possible destruction of sites during this process.

SOCIAL AND ECONOMIC CHARACTER

In the same way Brush Creek physically cuts across a dense part of the metropolitan area, the Brush Creek basin cuts across a wide section of social and economic characteristics. In almost every demographic and economic category the basin contains both the extreme highs and lows within the urban area.

Value of residential structures is a case in point. Homes in the areas of the basin roughly bounded by Ward Parkway on the east, Mission Road on the west and Johnson Drive and 75th Street on the north and south respectively, have an average value of over $140,000 (adjusted from 1970 census data). This area is the largest area of high valued homes in the metro area. By contrast, the residential structures in the lower part of the basin, roughly parallel to Prospect, average $30,000 (adjusted from 1970 census) and are among the lowest value dwellings in the urban area.

Educational attainment has similar spatial characteristics. In the portion of the basin west of Main Street and south of Johnson Drive and Ward Parkway, the percentage of persons over 25 having attended college is quite high, ranging from 30 to 60 percent. The high figure (60%) is by far the highest percentage in the urban area. By contrast, the area of the basin generally east of Main Street and north of Brush Creek Boulevard and 47th Street has a high percentage of persons having attended grade school only (percentages ranged from 20% to 40%).

The employment of persons in the basin also varies between the western (upper) portion of the basin and the eastern (lower) portion. West of Main Street and south of Johnson Drive and Ward Parkway 35 percent to 45 percent of the employed persons are in occupations classed as professional or managerial. In the remainder of the basin a similar percentage (25% to 40%) are in blue collar or labor occupations.

Related to these occupational characteristics is the per capita income. The per capita income of the western portion of the basin is 3 to 6 times that of other portions of the basin. A portion of the basin south of Johnson Drive west of Ward Parkway, north of 67th and east of Mission Road has the highest per capita income in the region.

The age of residents in the basin also varies but in a somewhat different manner. The lowest percentage of children and youth and the greatest percentage of persons over 65 years is found in the central part of the basin, generally in the area between the state line and Prospect Avenue. The

percentage extremes in this part of the basin are among the most significant in the region. The percentage of persons 65 and over range from 15 percent to 20 percent of the population in the central part of the basin, while school age population was a regional low of 15 percent to 20 percent.

Density of population in the basin is rather uniform and quite high. Most areas contain from 3,000 to 9,000 persons per square mile. Only the extreme western portion of the basin has densities below 3,000 persons per square mile. The highest density is in the area between Ward Parkway and Main Street.

BIOLOGICAL CHARACTER

The dense urban development within the basin has substantially changed the terrestrial and aquatic character of the basin. Only in parks, particularly parks along the stream course, and on golf courses, are open undeveloped areas even available. The parks and golf courses are structured for active recreation, prohibiting any possibility of undisturbed habitat.

The stream courses themselves have also been similarly altered. Large segments have been channelized, or channeled through culverts. The stream channelization through the Plaza area is indicative of the scale of modification that has occurred. The stream in this reach is currently contained in a concrete lined channel, but was initially channelized in 1909. The existing concrete channel was constructed in the mid 1930's.

The only remnants of predevelopment habitat that remain in the basin are occasional specimens of the oak-hickory forest. The most impressive are individual sycamore and oaks (various species) located in Brush Creek Park and along Ward Parkway and Volker Boulevard.

PARKS AND OPEN SPACES

Park and recreation development is a major flood plain activity along Brush Creek. In Kansas City, Missouri, nine parks, parkways, or greenways are located partially or entirely within Brush Creek or Town Fork flood plains. A description of those areas is provided in Appendix A. In Johnson County, three private country clubs occupy a large portion of the Brush Creek and Rock Creek flood plains. Approximate locations and boundaries of the parks and country club areas are identified on Plate 2.

THE WITHOUT CONDITION

The "without" condition represents a projected future not influenced by Federal (Corps) action to reduce the flooding hazard within the basin. This condition must be established for the purpose of comparison with a range of alternative plans to determine if and what type of flood plain management action is desirable.

Hydrologic and hydraulic conditions are not expected to change significantly in the future in the absence of Federal action. All the communities within the basin are currently participating in the National Flood Insurance Program. Hence, any encroachment on the flood plain would be outside the designated floodway and would be floodproofed or elevated to the 100-year level. In addition, although several studies have been completed for two of the three study reaches, setting forth possible solutions to the flooding problems, none of the proposals have been implemented and at this time the likelihood of local comprehensive solutions seems remote. This is not to say that particular measures would not be accomplished, such as the replacement of a bridge across Brush Creek or a tributary with one having a larger opening.

From a flood damage standpoint, conditions have improved somewhat since the 1977 flood. The improvements have occurred predominantly in the Plaza Shopping district area on Brush Creek. Several businesses which suffered major damages to high value contents stored in basement levels no longer use those levels for storage. First floor use in some stores has also been changed to lessen flood damage potential. The future condition adopted for this study is that those businesses will continue the modified handling of high value contents. Additionally, a number of houses along Brush Creek were damaged beyond repair in the 1977 flood and have since been removed. A result of the change is post-flood conditions is that a recurrence of the 1977 flood would result in approximately $58.8 million damages in the future, compared to the $66.4 million damages which actually occurred. Estimates of future flood damage, with and without alternative plans, will be based on the lower value condition.

It is expected that there will continue to be flood damage on a fairly frequent basis in the Rock Creek reach, both in the commercially developed area in Mission, Kansas, and the residential area in Fairway, Kansas. It is difficult to assess the future of the Mission, Kansas, portion of the study reach; however, a number of businesses have chosen to relocate from that area because of the flooding problems. Continuation of the relocation would have adverse economic effects on the city. The residential area in Fairway, Kansas, has continued to be relatively stable to date despite the occurrence of several damaging floods since the mid-1960's.

No documentation of recurrent flood damage on Town Fork prior to the 1977 flood was found. However, public input has revealed that frequent flooding has occurred in several locations along Town Fork in residential areas immediately upstream of several bridges. Continued flooding could lead to decreased property values and declining neighborhoods.

PROBLEMS AND NEEDS

FLOODING

"Kansas City was hit yesterday and last night by the worst rainfall in its history . . . For the first time in memory Brush Creek swelled out of its banks to inundate the County Club Plaza, filling shops with several feet of water."

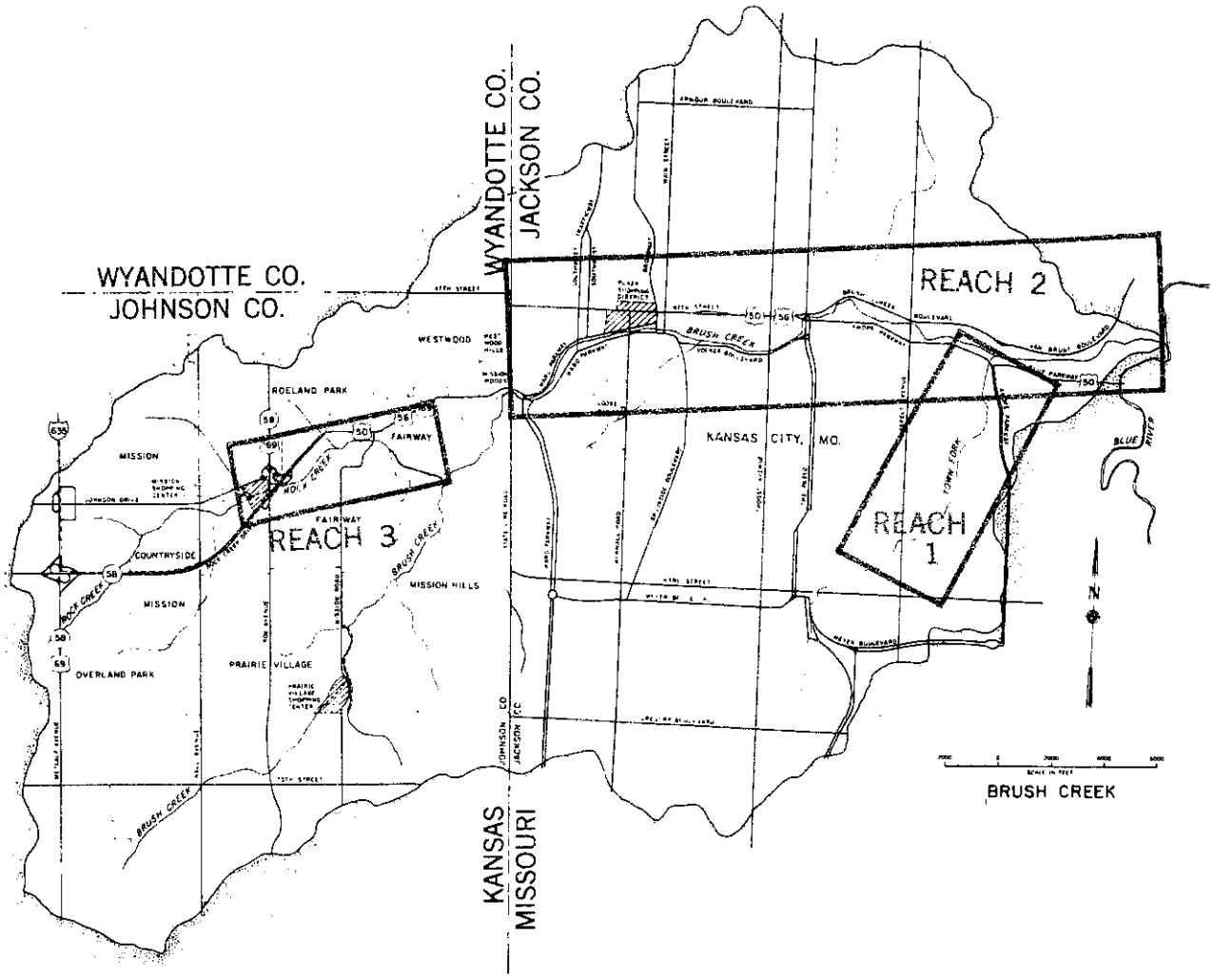
—Kansas City Times
September 13, 1977

This type of headline had not been seen prior to the 1977 flood, either for flooding in the Plaza area or for most other parts of the Brush Creek basin. Just as with many fully urbanized basins, minor tributary flooding had been experienced. However, an even minor damaging flood of a basin-wide scope had not been experienced. Instead, the first basin-wide flood experience was of catastrophic proportions. The 1977 flood had a recurrence interval of 200 to 500 years over Brush Creek in Kansas City, Missouri. The discharges would be slightly more frequent on upper Brush Creek and the tributaries, ranging from once in 50 years up to once in 200 years. Because of the extreme infrequency of the 1977 flood, the only major flood, it is difficult for the average person to realize the actual threat of flooding. Some would incorrectly rationalize that no major flood on Brush Creek will occur again for another 200 years, whereas a flood of equal or greater magnitude could occur very soon.

Possibly a lack of knowledge of the flood hazard also contributed to the high loss of life in the flood. Approximately 12 of the total of 25 lives lost in the Kansas City region during the 1977 flood occurred within the Brush Creek basin. Flash flooding is a characteristic of the basin and some persons did not have a respect for the rising water and high stream velocities. There was also a general lack of knowledge of the relationship between a high volume discharge and man-made obstructions which exist along the channel. These obstructions, which are bridges and tunnels or conduits, act as dams. The depth of flooding was significantly increased because of these obstructions. This led to increased damages to the residential, commercial and industrial structures in the flood plains.

A field survey of the Brush Creek flood plain was conducted in the spring of 1978. The area included in the survey generally covered the 500-year flood plain. The following is a discussion of the survey results for Town Fork, Brush Creek, and Rock Creek. Detail of analysis varied with the damage sustained and with potential damage in future floods. Brush Creek, from State Line Road to its confluence with the Blue River is presented in most detail. Town Fork from 63rd Street north to its confluence with Brush Creek, and Rock Creek from upstream of the Mission Shopping Center to its confluence with Brush Creek were given less emphasis. These study areas were chosen after preliminary examination of the 1977 flood losses. Figure 1 shows these study areas.

FIGURE 1
BRUSH CREEK BASIN STUDY REACHES



Town Fork is a right bank tributary of Brush Creek which flows a distance of approximately 1.3 miles in a northeast direction from the vicinity of 63rd and Paseo to the confluence with Brush Creek at Swope Parkway. The development in the flood plain is predominantly residential with a total of 140 single family residences. Retail commercial development is concentrated in the center of the area along Prospect Avenue and consists of 12 retail businesses. The losses which resulted from the flood of 12 and 13 September 1977 are shown below for Town Fork:

Residential losses	$406,000
Commercial losses	78,000
Public and other losses	179,000
Total	$663,000

The study area in Kansas City, Missouri, extends along Brush Creek a distance of 5.5 miles from the state line downstream to the confluence with the Blue River. The flood of 12-13 September 1977 resulted in $66,406,000 in losses in the study areas along Brush Creek. The losses for each of the 12 study reaches, as obtained in the comprehensive field survey, are provided in Table 1, following.

TABLE 1
SEPTEMBER 1977 FLOOD DAMAGE - BRUSH CREEK

Reach	Boundaries	Commercial Losses	Residential Losses	Public & Misc. Losses	Total
BC 1	Benton Bridge to mouth	$ 1,299,000	$ 3,000	$ 230,000	$ 1,532,000
BC 2	Prospect bridge downstream to Benton bridge	z8	2,000	258,000	260,000
BC 3	Woodland bridge downstream to Prospect bridge	55,000	48,000	50,000	153,000
BC 4	Paseo tunnel downstream to Woodland bridge	30,000	898,000	105,000	1,033,000
BC 5	Troost bridge downstream to Paseo tunnel	643,000	312,000	462,000	1,417,000
BC 6A	Rockhill birdge downstream to Troost bridge	370,000	424,000	—	794,000
BC 6	Railroad bridge downstream to Rockhill bridge	639,000	541,000	887,000	2,067,000
BC 7	J. C. Nichols Parkway bridge downstream to railraod bridge	—	—	135,000	135,000
BC 8	Wornall bridge downstream to J. C. Nichols Parkway bridge	30,382,000	—	2,133,000	32,515,000
BC 9	Belleveiw bridge downstream to Wornall bridge	24,046,000	272,000	1,522,000	25,840,000
BC 10	50th Street bridge downstream to Belleview bridge	—	179,000	80,000	259,000
BC 11	State line bridge downstream to 50th Street bridge	—	122,000	279,000	401,000
	TOTAL - All reaches	$57,464,000	$2,801,000	$6,141,000	$66,406,000

The actual damages incurred by businesses in the 1977 flood amounted to $48,281,000. Because of the reduced use of basements for storage space, the recurrence of a flood of similar magnitude would cause an estimated $41,004,000 in damages.

Potential residentail damages from a flood of the magnitude of the 1977 flood amounts to an estimated $2,474,000. Since 1977, approximately 34 single family residences have been demolished because of damages incurred in the 1977 flood.

The Rock Creek study area extends along Rock Creek in Johnson County, Kansas, from Lamar Avenue east to the confluence with Brush Creek. The flood of 12-13 September 1977, resulted in $1,151,000 in losses in the study area along Rock Creek. The losses for each of 13 study reaches, as obtained in a comprehensive field survey, are provided in Table 2 below.

TABLE 2
SEPTEMBER 1977 FLOOD DAMAGE - ROCK CREEK

Reach	Boundaries	Commercial Losses	Residential Losses	Public & Misc. Losses	Total
RC 1	Belinder upstream to Fairway city limit	$	$ 29,500	$	$ 29,500
RC 2	Fairway city limit upstream to Reinhardt	—	78,500	—	78,500
RC 3	Reinhardt upstream to near the intersection of 55th Street and Johnson Drive	—	37,000	—	37,000
RC 4	Intersection of 55th Street and Johnson Drive upstream to Mission city limit	—	95,200	—	95,200
RC 5	Mission city limit upstream to tunnel outlet near Roe Avenue	—	—	—	—
RC 6	Tunnel outlet upstream to tunnel entrance near Roeland Drive	525,300	—	8,700	534,000
RC 7	Roeland Drive upstream to cross-section I west of building located at 5101 Johnson Dr.	—	—	—	—
RC 8	West of building locted at 5101 Johnson Drive to cross-section K near city park located on Birch Street	38,350	—	1,400	39,750
RC 9	City park near Birch St. upstream to Nall Ave.	24,100	—	—	24,100
RC 10	Nall Avenue upstream to Outlook Drive	62,000	2,000	7,800	71,800
RC 11	Outlook Dr. upstream for approximately ½ block	181,600	—	—	181,600
RC 12	One-half block west of Outlook Drive to Woodson Road	58,700	—	500	59,250
RC 13	Woodson Road upstream to Lamar Avenue	—	—	—	—
	TOTAL - All reaches	$890,050	$242,200	$18,450	$1,150,700

Computed losses differ from actual losses since statistical methods are used to arrive at probable losses occurring on a yearly average or over a longer period such as once in 10, 25, 50, or 100 years. Again, detail of analysis varied somewhat with the magnitude of expected losses in each of the study areas. The following discussion is a summary of the analysis which is described in the Economic Appendix.

No detailed analysis was completed for the Town Fork study area. It was known that the 1977 flood on Town Fork approximated the 200-year event with total damages of $663,000. It was also apparent from the profiles and flooded area mapping that damage would not be significant for a flood of less than 25-year magnitude. Therefore, it was decided to proceed into plan formulation and then to test the plans with approximate economic analysis. Should a plan exhibit a benefit to cost ratio near 1 to 1 or greater, additional analysis would be undertaken.

Estimated average annual damages for Brush Creek and Rock Creek were derived through an integration process in which hydraulic and hydrologic relationships were integrated with stage/damage functions. The average annual damages were computed by reach for each flood zone and each damage category utilizing computer programs. Brush Creek average annual damages follow in Table 3. It should be noted that Reaches 8 and 9, or the Plaza Shopping District area, account for over 83 percent of the total of $1,675,000.

TABLE 3
BRUSH CREEK AVERAGE ANNUAL DAMAGES

Reach	1979 Values
BC 1	$ 77,500
BC 2	24,900
BC 3	11,400
BC 4	10,900
BC 5	53,200
BC 6A	22,100
BC 6	64,200
BC 7	6,500
BC 8	459,000
BC 9	936,300
BC 10	5,200
BC 11	3,800
TOTAL - All reaches	$1,675,000

Significant losses would generally begin to occur between a 10-year and 25-year flood, with a 25-year flood resulting in losses of $13,476,600. A 100-year flood would result in losses amounting to $33,837,400, with $29,415,600 (or 85% of the total) occurring in reach BC 8 and 9. The estimated flood losses for the various individual flood events are presented in Table 4, below.

TABLE 4
ESTIMATE OF TOTAL LOSSES FOR VARIOUS FLOOD EVENTS BRUSH CREEK
(Based on 2nd Quarter 1979 Prices)

Reach	10-Year	25-Year	100-Year	500-Year
BC 1	$ 195,500	$ 847,400	$ 1,125,300	$ 1,458,700
BC 2	46,800	7,311,500	367,200	416,400
BC 3	18,100	89,000	131,900	279,500
BC 4	—	53,100	182,700	1,041,500
BC 5	43,600	338,500	1,058,600	4,113,400
BC 6A	—	204,900	474,300	1,084,500
BC 6	195,500	520,100	764,200	1,042,000
BC 7	—	75,300	97,200	109,000
BC 8	—	1,976,700	13,964,700	23,575,900
BC 9	1,215,400	8,988,000	15,450,900	24,474,000
BC 10	—	43,800	154,100	239,700
BC 11	—	28,300	66,300	126,900
Total - All reaches	$1,714,900	$13,476,600	$33,837,400	$57,961,500

Average annual losses were computed for only the six lower reaches of Rock Creek. Field examination of the remainder of Rock Creek revealed that current development adjacent to the channel would make a solution prohibitively expense. Table 5 below provides the computed annual losses for the six reaches.

TABLE 5
ROCK CREEK AVERAGE ANNUAL DAMAGES

Reach	1979 Values
RC 1	$ 200
RC 2	10,800
RC 3	7,900
RC 4	58,400
RC 5	---
RC 6	146,600
Total - All reaches	$223,900

RECREATION

Recreation is a major concern in the study area, although not a problem of the same magnitude as flooding. The 1973 Recreation Master Plan prepared by Kansas City, Missouri states that several neighborhoods along Brush Creek have only minimal amounts of open space in comparison with accepted standards used for planning within the region. A noticeable need is the lack of continuity in the parkway along Brush Creek. In several locations there are breaks, such as bridges or areas of private development which separate parkway segments. Some measures for flood control could eliminate some of the barriers. On the other hand, without proper planning some measures could adversely affect the existing park and open space areas.

Although the tributary flood plains do not have as much park area as Brush Creek, Town Fork Greenway is an important park area on that tributary. Currently Fairway, Kansas has but one 2-acre playground, which is less than the recommended standards. The flood plain of Rock Creek within Mission, Kansas is fully developed and little potential exists for open space or parkland in conjunction with plans for flood damage reduction.

TRANSPORTATION

Transportation has also been identified as a concern in the discussion of flood problems. Not only do many of the bridge crossings obstruct flow, but a number of bridges along Brush Creek present other problems in terms of age, physical condition, and traffic flow. Several bridges were constructed in the early 1900's and may soon be due for replacement. In some cases replacement might be necessary not so much because of a lack of structural integrity, but because of a lack of traffic carrying capacity. The situation at Wornall Road and Brush Creek would be a prime example. Wornall Road has become an important north-south artery which intersects Brush Creek in the heart of the Plaza Shopping District. The bridges at Woodland Avenue, Prospect Avenue, Troost Avenue, Rockhill Road, and at several other north-south roads could be considered for replacement to improve traffic flow.

SOCIAL WELL BEING CONCERNS

A separate discussion of social well being concerns and their relationship to Brush Creek basin flooding is presented as a backdrop for plan formulation and assessment as plans. Possibly the most important subject is the atmosphere which has developed since the September 1977 flood. An increased level of awareness of the flooding problem now exists and, with it, probably a higher anxiety level. Where prior to the flood no great attention was paid to rains, more people are now watching and in severe storms the news media is usually there to report. This, of course, is in rememberance of the 1977 flood.

It can generally be assumed that an area with a threat of frequent flooding will not be as stable as an area with no threat. To this point, and in the absence of repeated lesser flood events, there appears to be no increase instability of commercial or residential areas. The cohesiveness of some affected communities increased after the flood as people pulled together to alleviate the disruption and inconvenience brought about by flooding.

Public health and safety is an important consideration in this study. The loss of life in the 1977 flood demonstrated the danger of flooding throughout the basin. Brush Creek can rise from low flow to flood stage in 30 to 60 minutes and the velocity of the water in some places is greater than 20 feet per second. Many of the roads crossing the channel are overtopped by a 100-year or greater flood, cutting off access and increasing the hazard. Warning devices would not be applicable because of the flashy nature of the basin. There is a need to continue public education about the dangers of flash flooding. Many of the lives lost in the 1977 flood were because of carelessness.

The esthetic values along Brush Creek are also a concern. This would apply mainly to the area from State Line Road to Cleveland Boulevard. Important features include the parkland, Volker Fountain, pleasantly designed bridges, and expansive grassy area from Oak Street to Locust, the stone walls in the channel, the trees and grassy channel banks. A change in the appearance of the channel or a loss in open space along the channel would be a significant effect on the esthetics of this area. The Brush Creek channel and adjacent lands have become, to many, an historical landmark.

PLANNING OBJECTIVES

Based on the flooding and related problems and needs identified in the Brush Creek basin, a number of planning objectives were set forth to aid in the preparation and evaluation of specific plans. They are:

a. Reduce the flood damage potential on Brush Creek in Kanss City, Missouri, on Town Fork in Kansas City from 63rd Street to its confluence with Brush Creek, and on Rock Creek in Johnson County from Roeland Drive to its confluence with Brush Creek.

b. Reduce the hazard to human life from flooding in the above study areas.

c. Increase recreational potential in the study areas in conjunction with flood hazard reduction.

d. Provide transportation improvements in the study areas in conjunction with flood hazard reduction.

e. Maintain the significant esthetic and cultural qualities within the Brush Creek study area.

THE PLAN FORMULATION PROCESS

Before actually preparing plans for the three established study areas, it was essential that two tasks be performed. First, planning criteria and assumptions must be established. These serve to establish the measures against which plans may be compared. Secondly, a logical sequence of planning steps must be established, which if followed, will lead to the most desirable plan or plans. Both the criteria and planning procedures utilized in this study are in accordance with guidelines contained in the Water Resources Council's Principles, Standards, and Procedures for Planning Water and Related Land Resources, and related Corps of Engineers guidance.

FORMULATION AND EVALUATION CRITERIA

A broad range of technical, environmental, and social criteria were applied in evaluating all possible alternatives. Technical criteria were adopted from appropriate Corps of Engineers guidance, and deal mainly with the engineering feasibility of each plan. Environmental and social criteria were derived from several sources, including Corps guidance, Water Resources Council requirements, the National Environmental Policy Act and other Federal laws, and appropriate Executive Orders such as EO 11988, Flood Plain Management. These criteria are presented in Appendix B.

ASSUMPTIONS

Several assumptions were important on the formulation and evaluation of plans. They are:

- No future development obstructive to flood flow will occur in the designated 100-year floodway of study streams.
- Development or redevelopment in the 100-year flood fringe area may occur. Such development may result in an increase of up to, but no more than, one foot in the 100-year flood profile. It is assumed that this development would not be subject to flood damage.
- Future development (outside the floodway) will occur according to the Concept I projections of population and employment adopted by MARC.
- Flood insurance will remain available in all communities where it is currently available in amounts at least as great as now permitted by law.
- Adoption and enforcement of land use regulations will remain a predominantly local responsibility.

KEY STEPS IN THE PLANNING PROCESS

Six key formulation steps were followed in the planning process. The criteria and procedures used are in accordance with the guidelines contained in the Water Resources Council's Principles, Standards, and Procedurs for Planning Water and Related Land Resources, and related Corps of Engineers Engineering Regulations. A summary of the plan formulation process follows, including a flow chart in Figure 2.

Step 1 was the identification of all possible regulatory and corrective measures for meeting the flood protection needs of the basin. This consisted of brief appraisal of individual general measures for resolving existing and potential flood problems. Five structural measures and five nonstructural measures were identified, including measures not traditionally used by the Corps of Engineers.

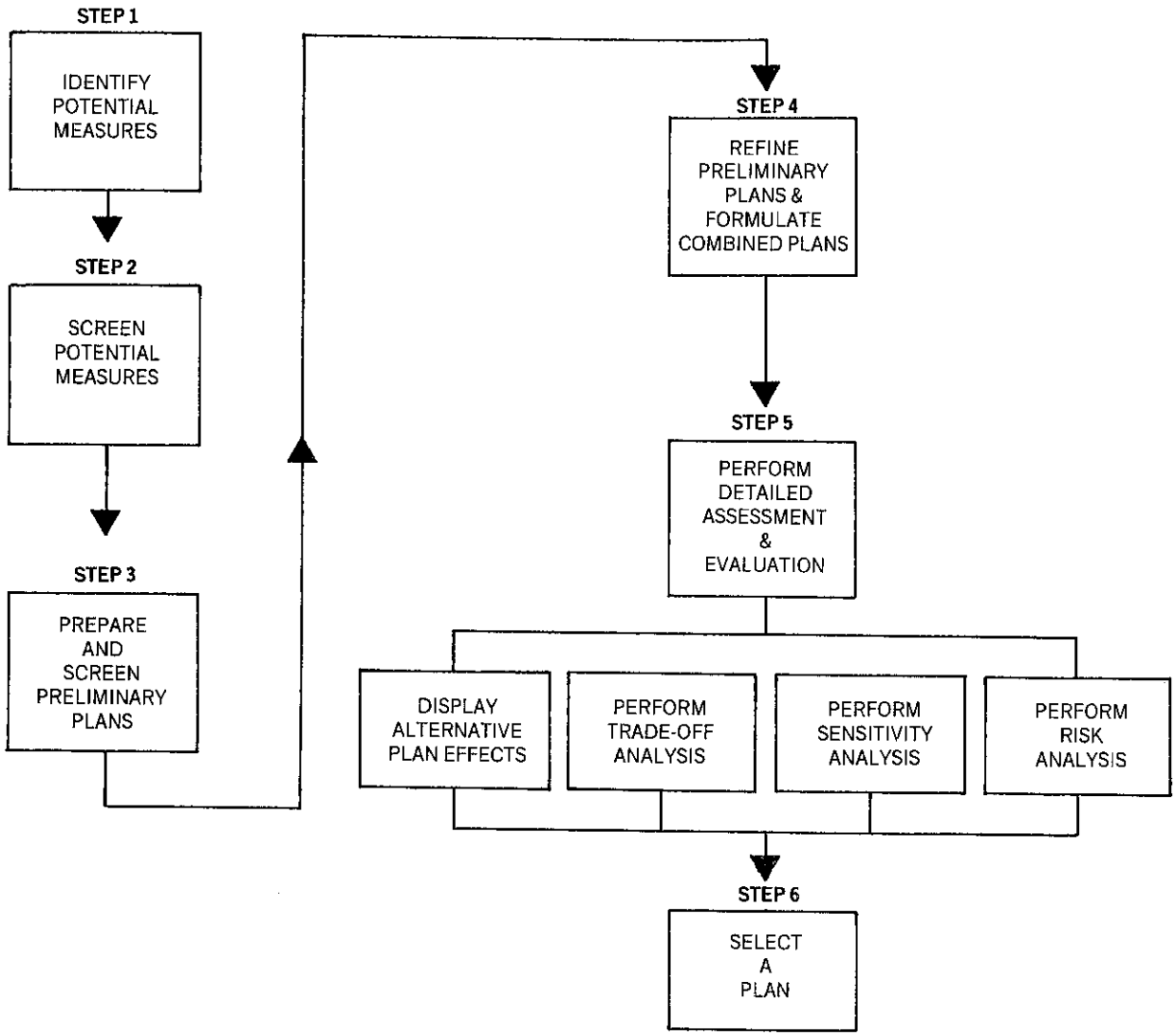
Step 2 consisted of screening of all measures appraised in Step 1, including actions that would not entail Corps participation, for each of the three study reaches in the basin. Plans of others were included in this phase and are noted in the discussion. This analysis involved preliminary study of specific individual measures, or in some cases combinations of measures. The measures were categorized as to ability to meet each of the planning objectives, potential resource requirements, and other important factors. Measures determined to be highly impracticable were eliminated at this step.

Step 3 consisted of assembling the measures which passed Step 2 into a group of preliminary plans, and screening those plans. Plans of others for various parts of the basin were included. The screening included intermediate level quantitative and economic analysis. The result of this step was determination of the type and scope of plans, in addition to the "no-action" alternative which would be subject to refinement in the subsequent step. Nine plans, both structural and non-structural, plus the "no-action" alternative were examined during this step. At this point, it was determined that no feasible plans could be developed for Reaches 1 and 3, Town Fork and Rock Creek. Two basic types of plans were found to warrant additional study in Reach 2, Brush Creek.

Step 4 consisted mainly of refinement of the two basic types of plans developed in Step 3. One of the two types included bridge and channel modifications along Brush Creek. Six variations were examined on this type of plan. The second type was an underground diversion from Brush Creek to the Kansas River. Five variations in size, alinement, and method of construction were examined on this plan. Additionally, there were a number of possible combinations of the two types of plans, of which three were examined. One of the three combination plans was developed specifically to provide Standard Project Flood (SPF) level of protection. The 14 variations on the two basic plans were assessed, with the result that four were carried on the Step 5 analysis.

Step 5 consisted of detailed analysis of the plans retained after Step 4 above. This analysis identified and measured the likely environmental and social impacts, and included a further economic evaluation of the alternative plans. Analysis was conducted in accordance with the Water Resources Council's Principles, Standards, and Procedurs for Planning Water and Related Lan Resources. Comparison of the final alternative plans under a system of four accounts permitted trade-offs to be

FIGURE 2
PLAN FORMULATION FLOW CHART



made between accounts of the beneficial and adverse impacts of each alternative plan. The four accounts are National Economic Development (NED), Environmental Quality (EQ), Social Well-Being (SWB), and Regional Development (RD). Risk and uncertainty aspects of each plan were evaluated primarily by means of sensitivity analysis. Displays were prepared which summarized the detailed assessment and evaluation.

Step 6 consisted of selecting a plan which best satisfied the planning objectives and conformed with the planning criteria specified—technical, economic, environmental, and social.

FORMULATION OF PRELIMINARY PLANS

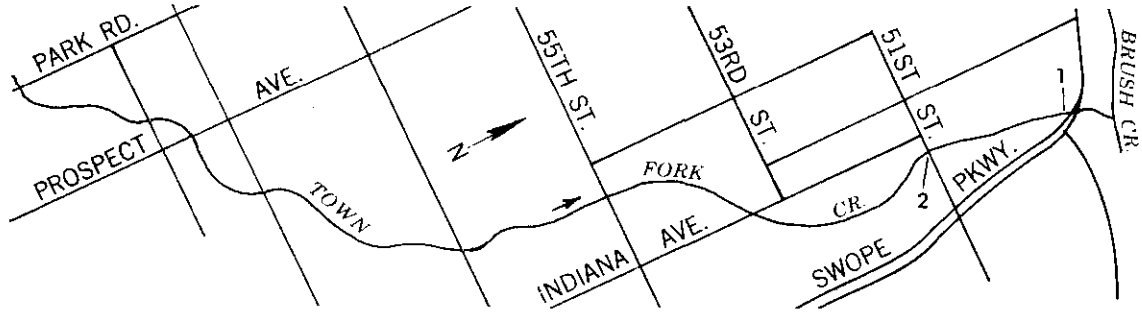
This section presents the results of planning Steps 1 through 4. For a more detailed discussion of the formulation of preliminary plans, see Appendix B.

TOWN FORK

A wide range of nonstructural and structural measures were initially considered for Town Fork. The screening of those measures yielded the following results:

- **Regulatory Actions.** Kansas City, Missouri is participating in the National Flood Insurance Program. As a condition of that participation, the City has adopted regulatory measures designed to minimize any worsening of the existing flood hazard. However, those measures cannot significantly reduce the existing flood hazard.
- **Floodproofing.** Very few structures in the Town Fork flood plain are subject to frequent flooding. Floodproofing of existing structures would cost far more than the benefits derived. This measure would not be feasible for any areas along Town Fork.
- **Permanent Evacuation.** This meausre was implemented to a degree when a number of structures were removed as part of the urban redevelopment plan and creation of the Town Fork Greenway. As with floodproofing, the very few structures subject to relatively frequent flooding would not warrant a permanent evacuation plan.
- **Temporary Evacuation.** There would be insufficient warning time, even with sophisticated warning devices, to provide for a significant reduction in hazad to property damage or hazard to life.
- **Channel Modification.** This measure has been implemented on a segment of lower Town Fork. It would not be feasible to further enlarge the channel in other areas because of the high cost relative to potential benefits.
- **Levee or Floodwall.** There are no suitable locations for levees or floodwalls on Town Fork which could protect a sizable amount of development.
- **Underground Diversion.** There are no suitable locations for an underground diversion measure on Town Fork.
- **Bridge or Tunnel Modifications.** The existing tunnel under Swope Parkway will carry less than a 10-year discharge. Floodwater which cannot pass through the tunnel overflows into the commercial area east of Swope Parkway. Close upstream the 51st Street bridge similarly backs up floodwaters. On upper Town Fork, the 55th Street, 59th Street, Prospect Avenue, and Park Avenue bridges all cause backup of floodwater in more severe flood events. Replacement of these structures was considered further in the planning process. However, in the Step 3 intermediate screening it was determined that the cost of any one or more of these measures would far exceed the benefits. The measures considered on lower Town Fork are shown on Figure 3.

FIGURE 3
LOCATION OF MEASURES CONSIDERED FOR TOWN FORK



DESCRIPTION OF MEASURES CONSIDERED:

1. Construct an additional tunnel beneath Swope Parkway which would empty into the Brush Creek channel.
2. Replace the reinforced concrete box bridge at 51st Street.

• **Detention Structure.** There are no suitable locations in the Town Fork basin to locate a major detention structure unless substantial relocation of existing development were included.

• **Acquisition for Park.** There is no sizable parcel of vacant private land in the flood plain which would be acquired. Additional park development would require relocation of existing structures, which was discussed previously.

• **No Action.** Although the "no action" alternative would have no effect on the Town Fork flood problem, it was considered as a basis for comparison.

BRUSH CREEK

The initial and intermediate screenings of measures on Brush Creek resulted in the following assessments:

• **Regulatory Actions.** As was the case with Town Fork, Kansas City's participation in the National Flood Insurance Program insures that regulatory measures will be continued.

• **Floodproofing.** Both commercial and residential structures were examined for possible floodproofing. This measure can be accomplished physically in two different ways. One way is to make the basement and first floor levels of a building watertight. The other way is to elevate the building in place by means of fill material or foundation treatment. Neither of these ways is appropriate for the structures along Brush Creek because of age and condition of the structures. Attempting to make basements of these buildings watertight would create the strong possibility of wall failure from external wall pressure during a flood. Similarly, attempting to raise the structures in place would run the risk of significant damage for a rather low potential benefit, and would cause access problems in most cases. A different type of floodproofing has already been accomplished privately. Several businesses in the Plaza Shopping District have relocated high value contents from basements to higher levels in their buildings, or have rearranged first floor merchandise and equipment to reduce the potential for flood loss.

• **Permanent Evacuation.** Most of the commercial structures in the Brush Creek flood plain are not subject to less than 25-year flood hazard. It is readily apparent that these structures could not be economically evacuated. There are two residential areas which are partially subject to 10-year flood hazard, and these areas were evaluated for evacuation. One area is along Virginia and Tracy Streets immediately north of Brush Creek; and the other area is along Harrison, Charlotte, Campbell, and Holmes Streets north of Brush Creek. Thirty structures would be affected in the first area, and 40 structures would be affected in the second. The areas would be converted to part of open space use. Approximate costs and benefits for the evacuation are shown in Table 6.

TABLE 6
RELOCATION PLAN BENEFITS AND COSTS

	Vicinity Paseo and 47th St.	Rockhill Rd. to Troost	Combination
First Cost	$965,000	$1,175,000	$2,140,000
Annual Cost	66,500	80,000	147,300
Annual Benefit	13,100	7,200	20,300
Benefit to Cost Ratio	0.20	0.09	0.14

The B/C ratio would be less than 0.2 with any of the options listed. These options would provide for evacuation of the 100-year flood plain. There are about 10 residences within the limits of the 10-year flood plain in each of the areas, respectively. Acquisitions and relocation costs per residence are estimated to total $31,500 based on preliminary real estate study. Assuming that most of the average annual damages within each area occur within the 10-year flood plain, estimated B/C ratios for evacuation of a more limited area would be less than 0.5 to 1.

At the February 1979 public meeting, both citizens and public officials were strongly opposed to any measures which would disrupt or destroy a neighborhood. The evacuation meaure would not be socially or politically acceptable for the two residential areas.

• **Temporary Evacuation.** Brush Creek floods do not afford sufficient warning time to provide for temporary evacuation of property. The September 1977 flood barely afforded some residents time for excape. Even sophisticated warning devices would not significantly increase warning time because of the very rapid rise of floodwaters.

• **Channel and Bridge Modification.** It was apparent from the 1977 flood that the bridges along Brush Creek cause a significant backup of floodwater in some locations. It would be the intent of these measures to reduce or eliminate that backup by modifying or replacing one or more bridges along Brush Creek and also by modifying the channel above and below the bridges.

Planning for the bridge and channel plan began with the knowledge that the close proximity of high-value development and major transportation routes to the existing channel presented a major obstacle in planning. An initial test of bridge effect was made of the maximum possible reduction in flood stages along Brush Creek by simply assuming the elimination of all bridges and bridge approaches. Under this assumption, hydraulic computer modeling showed that the most reaches the 100-year level of protection was about the maximum achievable.

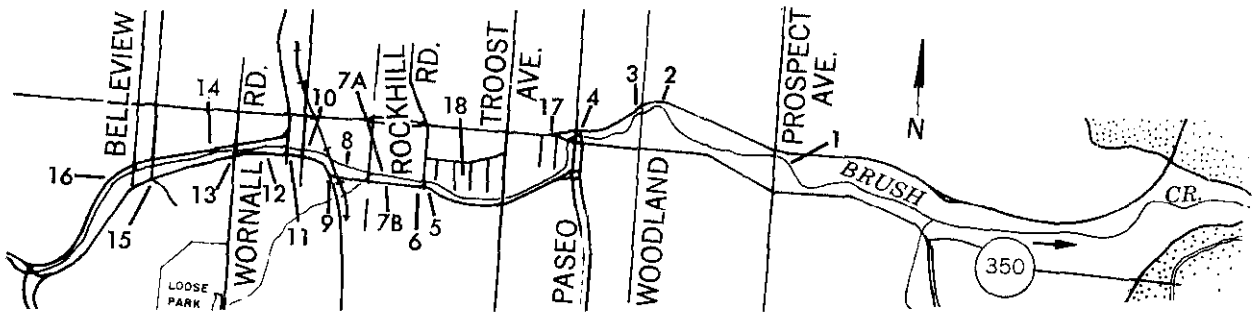
Therefore, this plan was formulated with the intent of providing 100-year discharge was utilized in the sizing of modifications. The downstream beginning point for planning was Prospect Avenue. That part of the reach below Prospect Avenue has a common flood plain with the Blue River, which even with improvements now underway, would have approximately 37-year level of protection. There would have been no reason to consider modifying the channel in the lower reach to accommodate a 100-year or greater event on Brush Creek when that level of flooding from Blue River backwater would occur more frequently. Blue River flood profiles for existing and modified conditions are provided in the Problem Identification Appendix. The usptream and point for planning was Belleview, above the Plaza Shopping District where most of the Brush Creek damages occur.

The locations of the measures proposed for this initial plan are located in Figure 4. Table 7 presents a listing of the individual plan components and their respective costs. There would be an approximate savings of $900,000 with utilization of any open channel option to a supplemental Oak to Locust conduit. The preliminary cost of the plan with the open channel was $17,157,000. Table 8 presents estimated average annual benefits of the initial bridge and channel plan. The benefit to cost ratio was approximately 1.1 to 1.

TABLE 7
INITIAL BRIDGE AND CHANNEL PLAN COSTS

Measure	Cost	
Prospect Ave. Bridge	$ 1,327,000	
Woodland Ave. Bridge & Brush Creek Blvd. Raise	1,225,000	
Paseo & Swope Parkway Open Channel	1,950,000	
Rockhill Rd. Bridge	2,351,000	
Oak to Locust Conduit	4,419,000	— 4,419,000
Oak to Locust Open Channel (Option)		+ 3,694,000
Floodwall at Oak St.	192,000	— 192,000
Remove R.R. Bridge	52,000	
Main St. Bridge Modification	30,000	
J. C. Nichols Bridge Modification	22,000	
Wornall Rd. Bridge	1,110,000	
Ward Parkway Road Raise	283,000	
Roanoke Bridge Modification	832,000	
Belleview Bridge Modification	556,000	
Channel Modifications from R.R. Bridge to U.S. Wornall Rd.	3,725,000	
TOTAL		
Plan with Oak-Locust Conduit	$18,074,000	
Plan with Oak-Locust Open Channel		$17,157,000

FIGURE 4
LOCATION OF MEASURES CONSIDERED FOR BRUSH CREEK

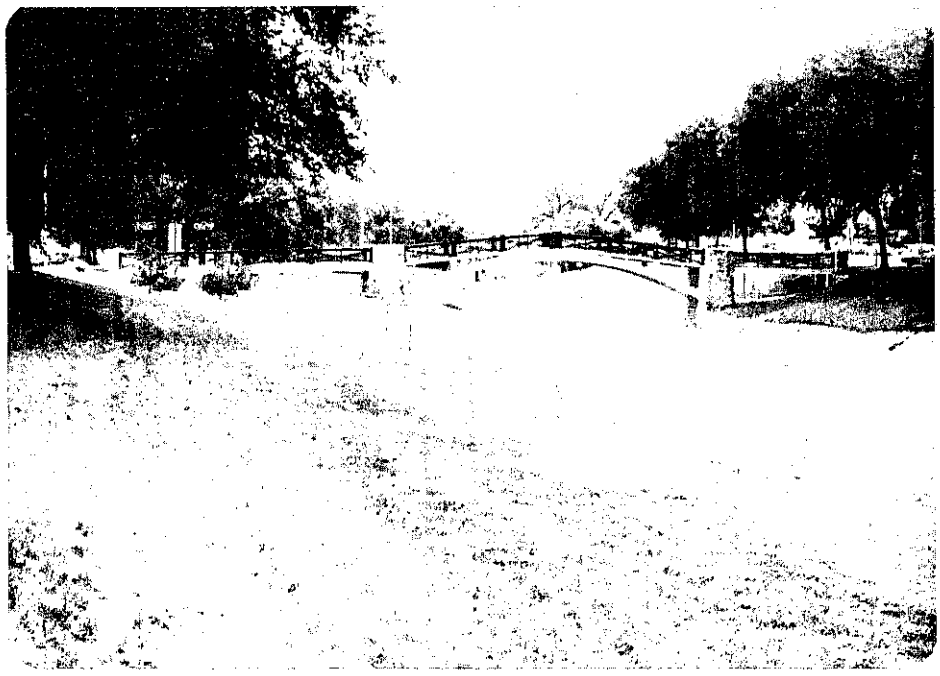


DESCRIPTION OF MEASURES CONSIDERED:

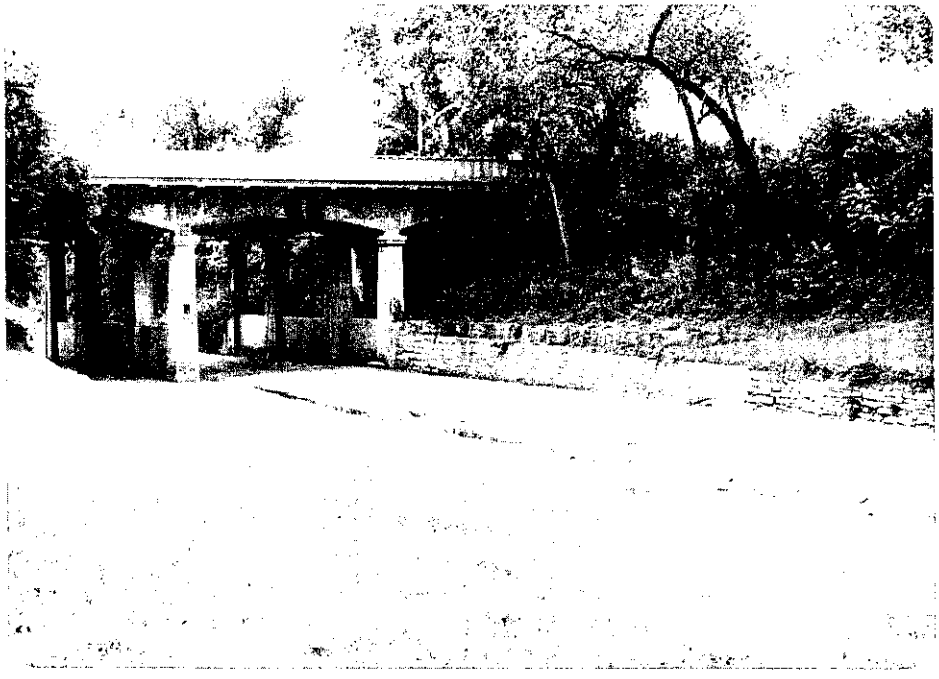
1. Replace the bridge at Prospect and modify the channel upstream and downstream of the bridge by widening.
2. Replace the bridge at Woodland and modify the channel upstream and downstream of bridge by widening.
3. Raise Brush Creek Blvd. approximately 2 feet beginning at its intersection with Woodland Ave. and continuing for approximately 600 feet west.
4. Supplement the existing tunnel passing under The Paseo with an open channel across The Paseo and Swope Parkway. Bridges would be built across the channel at its intersection with the streets.
5. Replace the bridge at Rockhill Road and modify channel upstream and downstream of bridge by widening.
6. Replace the pedestrian bridge immediate upstream at the bridge at Rockhill Road. A pedestrian walkway would be added to new bridge at Rockhill Road.
7. a. Double the capacity of the Oak to Locust tunnel which passes beneath Volker Park. Modify the channel upstream and downstream of the enlarged tunnel by widening.
   b. As an option to No. 7a, convert the tunnel to an open channel. This option should eliminate the need for Measure No. 8 below.
8. Construct a small floodwall along the north bank of Brush Creek immediately upstream of the Oak to Locust channel to protect structures within the area bounded by Main to Oak Streets and Brush Creek to 48th St.
9. Remove the Kansas City Public Service Railroad bridge without replacement.
10. Modify the bridge at Main St. to increase the channel width and modify the channel upstream and downstream of the bridge by widening.
11. Modify the bridge at J. C. Nichols Pkwy. to increase the channel width and modify the channel upstream and downstream of the bridge by widening.
12. Remove the pedestrian bridge between the J. C. Nichols Pkwy. and Wornall Rd. bridges. A pedestrian walkway would be added to the bridge at Wornall Road.
13. Replace the bridge at Wornall Rd. and modify channel upstream and downstream of the bridge by widening.
14. Raise Ward Parkway (north side) approximately 2 feet beginning at its intersection with Wornall Rd. and continuing for approximately 900 ft. west.
15. Modify the bridge at Roanoke to increase the channel width and modify the channel upstream and downstream of the bridge by widening.
16. Modify the bridge at Belleview to increase the channel width and modify the channel upstream and downstream of the bridge by widening.
17. Permanently evacuate all residences on Virginia and Tracy Streets which are located between Brush Creek and Highway 50. Convert the evacuated area to open space or park.
18. Permanently evacuate the majority of residences or other structures located between Rockhill Road and Troost Ave. and between Brush Creek and 48th Street. Excavate this area to provide an increased floodway and convert the land to open space or park.

TABLE 8
INITIAL BRIDGE AND CHANNEL PLAN BENEFITS

Reach	Average Annual Benefits
BC 1, 2, 3	$ 0
BC 4	5,400
BC 5	37,500
BC 6A	—10,700
BC 6	57,400
BC 7	5,400
BC 8	411,900
BC 9	775,500
BC 10	4,100
BC 11	0
TOTAL - All reaches	$1,286,800

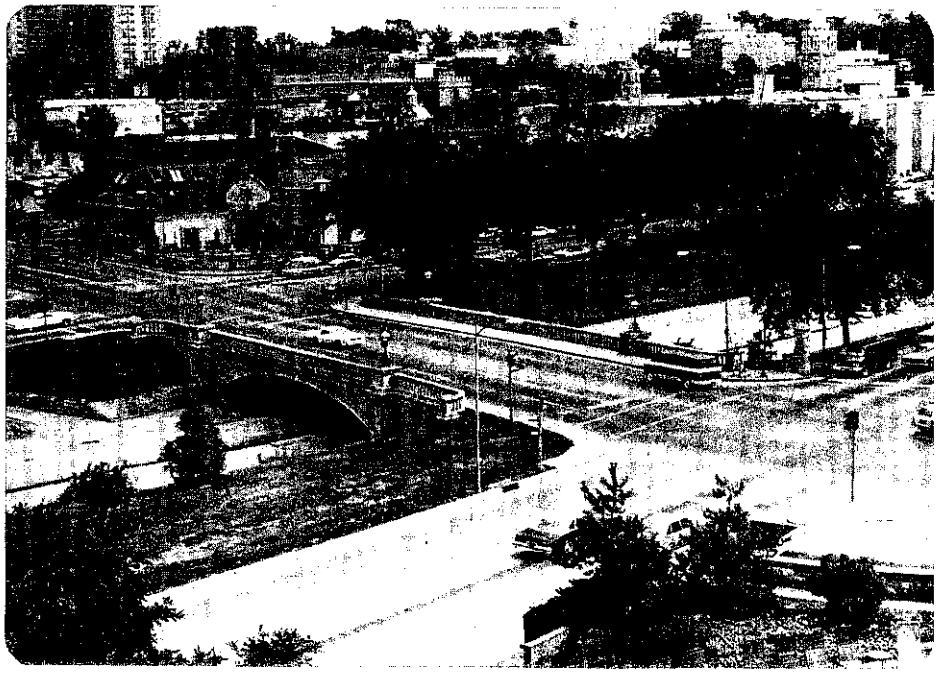


Brush Creek looking downstream at Plaza Pedestrian Bridge.



Brush Creek looing downstream at Main Street Bridge.

Brush Creek looking downstream at Ward Parkway Bridge

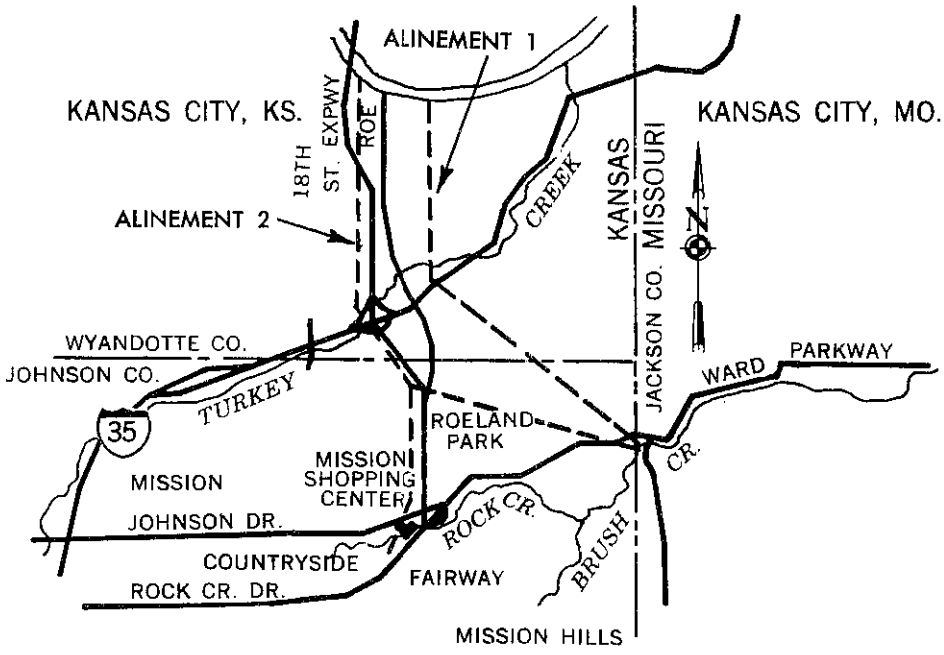


Panorama of portion of Plaza Shopping District
with Brush Creek and Wornall Road Bridge.

• **Levee or Floodwall.** In most of the high damage locations along Brush Creek there are physical constraints which preclude construction of levees or floodwalls, particularly in the Plaza area. Possible locations are along the left bank from Main Street to Oak Street and Rockhill Road to Troost Avenue. A levee or floodwall in these locations was considered as an element of the bridge and channel modification plan previously discussed.

• **Underground Diversion.** It would be possible, from an engineering and geologic standpoint, to divert floodwaters by means of an underground tunnel from Brush Creek to the Kansas River. Underground tunnels, inlets, and an outlet would be the main components. Because the alinement passed beneath Turkey Creek, consideration was also given to diverting flood flows from Turkey Creek as part of the plan. Figure 5 shows two possible tunnel alinements.

FIGURE 5
PRELIMINARY DIVERSION ALINEMENTS



Serious consideration was given to this alternative only in late Step 3 planning and much of the data could not be verified. The exact location of the Bethany Falls limestone layer, the rock quality, safety, and costs were all a matter of some conjecture. Consequently, it was decided to make an approximate and conservative analysis before making a decision on carrying this type of alternative into detailed, or Step 4, planning.

Both alternative alinements were evaluated and Table 9 below presents the estimated costs and benefits.

TABLE 9
INITIAL UNDERGROUND DIVERSION
PLAN COSTS AND BENEFITS

	Short Alinement	Long Alinement
First Cost	$19,000,000	$26,100,000
Annual Cost	1,310,000	1,800,000
Annual Benefit	1,730,000	2,241,000
Benefit to Cost Ratio	1.3	1.2

There was a high degree of uncertainty with the costs and benefits of the underground diversion plan at this point in the study. A realistic range of benefit to cost ratios for the plan would be from 0.6 to 1.5.

- **Detention Structure.** There is very little undeveloped land which could be used for detention storage. Consideration was given to the private golf course area immediately upstream from State Line Road. Detention could be provided by raising the elevation of State Line Road so that it acted as a dam, passing through only non-damaging flows during floods. This measure would require extensive evacuation or floodproofing of high-value homes. It would require raising not only State Line Road, but also crossroads, affecting access to several homes and commercial properties. It would also require alterations in the private recreation facilities on both sides of State Line Road to a major extent. For these reasons it was not considered to be a feasible alternative.
- **Acquisition for Park.** The principal opportunity for acquisition would be to link existing parklands into an unbroken corridor. This would require the evacuation of existing properties, which is discussed under "permanent evacuation."
- **No Action.** The "no action" alternative would not have any effect on the Brush Creek flood problem. It was considered as a basis for comparison of other alternatives.

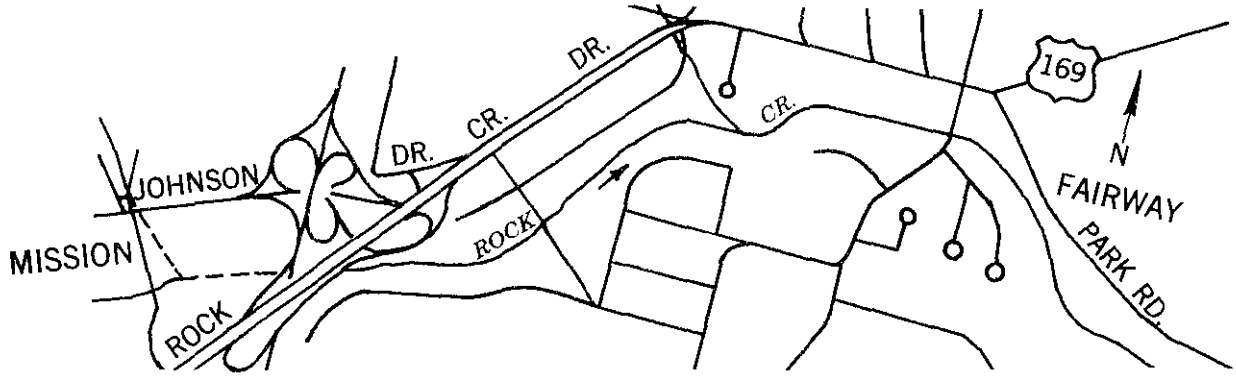
ROCK CREEK

A summary of the initial and intermediate screenings of measures on Rock Creek is as follows:

- **Regulatory Actions.** There are three communities subject to flood hazard from Rock Creek. They are Fairway, Mission, and Mission Hills, Kansas. All three communities are participating in the National Flood Insurance Program and all have adopted regulatory measures consistent with that program.
- **Floodproofing.** This measure would require permanent blockage of all openings in buildings to be floodproofed. For the commercial buildings, mainly in the Mission Shopping Center, this is not physically possible. For the residential structures, mainly in Fairway, it is not economical nor desired by the residents.
- **Permanent Evacuation.** It is readily apparent that the Mission Shopping Center could not be economically evacuated. A number of houses in Fairway were considered for evacuation but the measure was found not to be economically justified and was strongly opposed by local residents.
- **Temporary Evacuation.** There would be insufficient warning time, even with warning devices, to provide for a significant reduction in hazard to property or hazard to life.
- **Channel Modificatin.** Much of the Rock Creek channel has rock bottom, and deepening the channel is not practical. Widening of the channel would reduce the severity of frequent floods but would not appreciably reduce larger floods of 50-year or greater magnitude. The measure would not be economically feasible.
- **Levee or Floodwall.** There are no suitable locations for a levee or floodwall on Rock Creek.
- **Underground Diversion.** The existing damages on Rock Creek alone do not warrant consideration of an underground diversion. However, this measure could be considered as a part of a larger Brush Creek diversion plan.
- **Bridge or Tunnel Modification.** Flood profiles show that the only significant bridge obstructions downstream from the Mission Shopping Center are two ramps at 18th Street Expressway and U.S. 69 Highway. These bridges were considered for replacement in combination with a tunnel modification at the Mission Shopping Center. An existing tunnel carries Rock Creek flows under the shopping center, but it has a very limited capacity. Consideration was given to adding a supplemental conduit under the shopping center parking lot. Figure 6 illustrates the possible locations of the bridge and tunnel modifications.

The conduit and two ramp modifications are estimated to cost $4,095,000, or an annualized cost of $282,000. Because of the steepness of the stream, and based on examination of profiles, it was assumed that the conduit would not substantially benefit areas upstream from the shopping center. It was recognized that the plan would result in increased flooding in Fairway, but no estimate was made of a damage amount. The actual September 1977 flood damage to the shopping center was $534,000 and the flood discharge frequency was estimated at 50-year.

FIGURE 6
LOCATION OF MEASURES CONSIDERED FOR ROCK CREEK



DESCRIPTION OF MEASURES CONSIDERED
1. Supplement existing conduit under the Mission Shopping Center with an acditional conduit under the shopping center parking lot.
2. Enlarge the channel beneath 18th St. Expressway ramp and Hwy. 50 ramp by replacing existing reinforced concrete box bridges.

Data concerning average annual losses for the Mission Shopping Center are presented in the Problem Identification Appendix. The shopping center alone suffers an annualized damage of $125,000. Assuming full damage reduction, the benefit to cost ratio would be 0.44:1. This plan is clearly not economically justified.

- **Detention Structures.** There are no suitable locations in the Rock Creek basin for detention structures.
- **Acquisition for Park.** No undeveloped land is available. Park development would require permanent evacuation of existing properties, which is discussed under "permanent evacuation."
- **No Action.** The "no action" alternative was considered as a basis for comparison.

It is concluded that several plans for flood damage reduction do demonstrate possible economic feasibility. These plans deal with problems on Brush Creek (Reach 2) and Rock Creek (Reach 3). Additionally, one plan could reduce the flood hazard on Turkey Creek. No alternatives were found feasible for Town Fork (Reach 1).

The bridge and channel plan for the Brush Creek study reach would be given a detailed hydraulic analysis for refinement. Individual plan components would be examined to evaluate their contribution to damage reduction.

Much study would be required for the underground diversion plan. Core drilling to accurately locate and analyze the Bethany Falls limestone would have to be accomplished early in the Step 4 effort. In addition, information on costing and construction techniques would have to be developed. Hydaulic studies of tunnel operation would also have to be undertaken. Both alinements and other alternative alinements based on technical and economic constraints would be examined.

The "no action" alternative was also retained for comparative purposes. Its main assumption was that hydraulic conditions would remain similar to existing conditions and that no substantial local program of structural modifications would be pursued. Some non-structural means of reducing damage, such as shifting the location of valuable merchandise, would continue in effect.

INTERMEDIATE SCREENING

This step consists mainly of refinement of the two basic types of plans developed previously. Six variations are examined on the bridge and channel plan, five variations are examined on the underground diversion plan, and three combination are considered.

The refinement step is described in the following paragraphs, and is summarized in Tabel 10.

TABLE 10
SUMMARY - STEP 4 SCREENING

Plan	Description & Scope	*Conclusion	Rationale	B/C Ratio Min	B/C Ratio Max
BCP 1[1]	Limited bridge & channel plan - Wornall Road bridge replacement with necessary channel modification.	N	Incomplete and localized solutions; worsens flood hazard during severe flood events.	1.8 to 2.2	
BCP 2[1]	Limited bridge & channel plan - Plaza vicinity.	R	Effective in reducing depths of flooding in high damage Plaza vicinity without worsening downstream conditions.	2.7 to 3.3	
BCP 3[1]	Comprehensive bridge & channel plan - extends from upstream Wornall Road to downstream of the Paseo; minimal modification in Oak to Locust area.	N	Incomplete because of backwater effects into high damage Plaza vicinity.	Not computed	
BCP 4[1]	Same as BCP 3 above but with supplemental cut-and-cover conduit in Oak to Locust area.	N	Economically inefficient; cut-and-cover conduit cost much greater than an open channel section.	Not computed	
BCP 5[1]	Same as BCP 3 above but with an open channel in Oak to Locust area.	R	Least expensive comprehensive plan which produces good flood depth reduction in critical damage areas.	1.06 to 1.4	
BCP 6[1]	Same as BCP 5 above but with additional replacement of Rockhill Road bridge.	N	Economically inefficient; area impacted by bridge removal not a critical damage location.	Not computed	
UDP 1	Single tunnel from Brush Creek to the Kansas River.	R	Provides the only realistic alternative to alteration of the Brush Creek channel, even though plan is economically infeasible.	0.67 to 1.4	
UDP 2	Parallel tunnels from Brush Creek to the Kansas River meant to provide SPF protection.	N	Not the most realistic and economical plan provided SPF protection.	Less than 0.5	
UDP 3	Single tunnel from Brush Creek to Kansas River with parallel tunnel from Turkey Creek to Kansas.	N	Entire plan is economically infeasible; Turkey Creek to Kansas River segment not incrementally justified.	Less than 0.5	
UDP 4	Long alinement to benefit additional Johnson County communities.	N	Plan is economically infeasible and has increased risk of operational difficulties because of inlet locations.	Less than 0.6	
UDP 5[1]	Slight variation to UDP 4 above.	N	Plan is economically infeasible and has increased risk of operational difficulties because of loss of control over drainage area upstream of plaza.	Less than 0.6	
CP 1	Combination of Plans BCP 1 and UDP 1.	N	Economically infeasible; Plan BCP 1 is also not incrementally justified.	Less than 0.5	
CP 2	Combination of Plans BCP 1, UDP 1, and replacement of the pedestrian bridge.	N	Economically infeasible; pedestrian bridge is incrementally justified.	Less than 0.5	
CP 3	Combination of Plans BCP 2 and UDP 1 meant to provide SPF protection.	R	The most realistic alternative providing SPF protection; plan is economically infeasible but is retained due to Corps planning regulations.	0.46 to 0.76	

*R = Retained for detailed assessment and evaluation
N = Not retained
1 = See Table 11 for plan components.

In the refinement of the bridge and channel plan, variations should include plans of more limited scope dealing with the Plaza Shopping District because of the high damage potential there. Two limited bridge and channel plans dealing with the Plaza were devised. One would replace only the Wornall Road bridge, which is a critical one for flood flows. The other would modify or replace other bridges from the Kansas City Public Service bridge upstream to Wornall Road, and would include associated channel modifications.

Several variations should be examined on the more extensive type plan which initially extended from Prospect Avenue upstream to Wornall Road. Among the possible variations are the following:

- Replacement of Troost Avenue bridge (not included in initial plan).
- Deletion of one or more of Prospect Avenue, Woodland Avenue, Roanoke Street, Belleview Street, J. C. Nichols Road, and Main Street bridge modifications and replacements. These may not contribute greatly to flood hazard reduction in the initial plan.
- Deletion of the small floodwall in the vicinity of Oak Street.

• Deletion of the road raises in the vicinities of Woodland Avenue and Wornall Road, respectively.

• Replacement of the pedestrian bridge downstream from Wornall Road. In the initial plan the existing bridge was to be removed without replacement.

• Replacement of the Kansas City Public Service Railroal bridge, which also was to be removed and not replace in the initial plan.

Table 11 presents a complete listing of the components of the six plans considered, which are labelel BCP 1 through BCP 6. They are also separated into limited and comprehensive plans. Plans BCP 4, BCP 5, and BCP 6 vary only slightly from plan BCP 3. Two bridge and channel alternative plans were retained for further analysis. These are Plans BCP 2 and BCP 5 - the former being a limited approach concentrating on reduction of damage in the Plaza vicinity and the latter being a comprehensive plan meant to reduce the flood hazard in a greater portion of the Brush Creek study area.

TABLE 11
BRIDGE & CHANNEL PLANS CONSIDERED - STEP 4

Complete Range of Possible Structural Modifications	Limited Plans		Comprehensive Plans			
	BCP 1	BCP 2	BCP 3	BCP 4	BCP 5	BCP 6
Supplemental Channel at the Paseo			X	X	X	X
Troost Bridge Replacement			X	X	X	X
Channel Modification - Rockhill Road through Troost Bridge			X	X	X	X
Rockhill Road Bridge Replacement						X
Supplemental Oak to Locust Conduit				X		
Swale Over Oak to Locust Conduit Area			X	X		
Open Channel Oak to Locust					X	X
KCPS Railroad Bridge Replacement		X	X	X	X	X
Main Street Bridge Modification		X				
J. C. Nichols Bridge Modification		X	X	X	X	X
Replace Pedestrian Bridge		X		X	X	X
Wornall Road Bridge Replacement	X	X	X	X	X	X
Channel Modification from Downstream Railraod Bridge to Upstream Wornall Road		X	X	X	X	X

After analysis of the six bridge and channel plans, two were selected to be retained for detailted assessment. Plan BCP 2, one of the limited plans, would reduce the Plaza flood hazard significantly. It would have a benefit to cost ratio in the range of from 1.7 to 3.3. Plan BCP 5, a more comprehensive plan, would reduce the flood hazard from reach 5 through reach 10 (roughly, from the Paseo through the Plaza). Its benefits to cost ratio would range from 1.06 to 1.4.

In the refinement of the underground diversion plan, five variations were considered:

• **Plan UDP 1.** A single tunnel capable of diverting 5,200-5,400 cfs from Brush Creek in the vicinity of State Line Road and Ward Parkway.

• **Plan UDP 2.** Parallel tunnels capable of diverting a total of 10,500 cfs from Brush Creek. This would approximate an SFP, or 500 year, level of protection from State Line Road downstream to the vicinity of Rockhill Road where lower basin contributions to flow become substantial.

• **Plan UDP 3.** A single tunnel from Brush Creek diverting 5,200-5,400 cfs and an additional parallel tunnel section from Turkey Creek diverting a similar amount.

• **Plan UDP 4.** A long alinement meant to benefit the Kansas Communities of Mission and Fairway, in addition to Kansas City, Missouri. A total of 5,200-5,400 cfs would be diverted from the inlets on Rock Creek and Brush Creek.

• **Plan UDP 5.** This plan would divert floods from farther upstream on Brush Creek to provide protection for Mission Hills. Kansas.

Out of this group of five alternatives, only Plan UDP 1 was retained for detailed assessment and evaluation. As shown in Table 10, this plan would be more economical than any of the other four diversion plans. It would have a benefit to cost ratio of from 0.67 to 1.4.

With a good knowledge of the effects of various bridge and channel modifications and the effects of a single tunnel to divert about 5,200-5,400 cfs from Brush Creek during flood events, it was possible to prepare several combination plans. It was also possible to prepare a plan capable to providing a high

degree of protection against a Standard Project Flood (SPF) which approximates a 500-year flood on Brush Creek. The following combination plans were examined:

- CP 1 consisted of plans BCP 1 and UDP 1, or the tunnel plus the Wornall Road bridge modification.
- CP 2 consisted of plans BCP 1 and UDP 1 plus removal and replacement of the pedestrian bridge immediately downstream of the Wornall Road bridge. The existing pedestrian bridge increases depths of flooding in Reach 9 by as much as 1½ feet.
- CP 3 consisted of plans BCP 2 and UDP 1. This plan should provide an SPF level of protection to reaches 8 and 9, where the great majority of potential damages are located.

Plan CP 3 was retained for detailed assessment and evaluation. It did not appear to be economically feasible with a benefit to cost ratio of 0.46 to 0.76, but it was the best of the three combined plans. It satisfies the planning criteria that a plan capable of providing SPF level of protection be included in the final array of plans.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

This section reports on planning Step 5, assessment and evaluation. Assessment concerns determination of the impacts of each respective plan, and evaluation concerns comparisons between and among all the plans and the "no action" or "without" condition. Following is a discussion of each of the four plans.

PLAN BCP 5 - COMPREHENSIVE BRIDGE AND CHANNEL PLAN

GENERAL PLAN DESCRIPTION

This bridge and channel plan, BCP 5, is shown in plan view on Plate 3. It would increase the discharge capacity of the channel through the Plaza shopping district to approximately a 100-year level of protection. Levels of protection below the Plaza would be increased to varying levels depending on the location. The existing channel would be widened, new bridges would be constructed, cross-sectional areas under other existing bridges would be increased, an existing conduit would be excavated to an open cut section, and one supplemental channel reach would be constructed. The principal plan components are as follows:

- **Wornall Road Bridge.** The existing Wornall Road Bridge would be removed, the channel would be widened on both sides, and a new three-span reinforced concrete bridge would be constructed. The new bridge would be about 160 feet long with a 46-foot wide roadway and 8-foot wide sidewalks on each side.
- **Pedestrian Bridge Downstream from Wornall Road.** The existing pedestrian bridge now located 480 feet downstream from Wornall Road would be removed, the channel would be widened on both sides, and a new bridge would be constructed. The new bridge would be about 180 feet long with an eight-foot wide reinforced concrete deck slab.
- **Kansas City Public Service Railroad Bridge.** The existing bridge located 500 feet downstream from Main Street would be removed, the channel would be widened on both sides, and a new three-span steel girder bridge would be constructed. The new bridge would be approximately 260 feet long.
- **Oak Street Bridge.** The existing triple box reinforced concrete conduit under Oak Street would be removed in making the channel open cut from Oak to Locust. The channel would be widened in this area which would require construction of a new Oak Street bridge. The bridge would be a three-span reinforced concrete structure approximately 120 feet long with a 48-foot wide roadway and 8-foot wide sidewalks on each side.

• **Pedestrian Bridge at Open Channel.** The bridge would be similar to the new pedestrian bridge downstream from Wornall Road. It would replace existing sidewalks from Volker Fountain to Volker Boulevard.

• **Troost Avenue Bridge.** The existing Troost Avenue Bridge would be removed, the channel would be widened on both sides, and a new three-span bridge with a reinforced deck slab roadway would be constructed. The new bridge would be approximately 190 feet long with a 46-foot wide roadway and 8-foot wide sidewalks on each side.

• **Supplemental Channel at the Paseo.** A 20-foot wide U-wall supplemental channel would be constructed diagonally across Paseo Boulevard and Swope Parkway running from southwest to northeast. It would start 400 feet south of the intersection of Paseo Boulevard and Swope Parkway where Brush Creek makes a 90° bend from north to east under Paseo Boulevard. A reinforced concrete box conduit, 10 feet by 23 feet, would be constructed to bridge each of the two roadways over the supplemental channel.

• **Channel Retaining Walls.** Reinforced concrete cantilevered channel retaining walls would be constructed along each side of widened channel reaches. Stem heights of these walls would vary from 3.5 feet to 15 feet, with maximum heights typically at the bridges where abutments and walls meet. Total length of widened channel would be [illegible] feet, and the average height of new channel walls would be 7 feet.

Real Estate requirements are not extensive for this plan, principally because the City of Kansas City, Missouri already owns the land along and within the channel which would be impacted. In addition to City-owned lands, real estate requirements would include the removal of a building owned by Gates Barbecue, which is presently used in that firm's sauce-making operation. A temporary easement would be required on privately owned properties adjacent to the proposed new Kansas City Public Service Railroad bridge. A small area of Kansas City, Missouri parkland, also at the location of the supplemental channel, would be lost to the open cut. Additional lands for project construction would be required on the north side of Brush Creek between Rockhill Road and Troost Bridge. Widening of the channel necessitates this acquisition. About 25 acres of unspecified land would have to be acquired for disposal of waste materials from project construction.

IMPACT ASSESSMENT AND EVALUATION

Impact assessment and evaluation are two distinct functions. Impact assessment is an objective analysis conducted to identify and measure likely economic, social, and environmental changes which would occur through implementation of a particular plan. Evaluation has a broader scope involving judgment of the positive and negative aspects of identified impacts and comparison of all the plans. A more detailed discussion of impact assessment and evaluation may be found in Appendix B - Formulation, Assessment, and Evaluation.

Plan BCP 5 economic impacts are displayed by means of three tables. Table 12 displays the costs of the plan from the standpoint of project investment and also in terms of annualized costs.

TABLE 12
PLAN BCP 5 COSTS
(1979 Price Levels, 100 Year Period of Analysis, 7-1/8% Interest Rate)

Project Investment		Annualized Costs	
Construction	$ 7,160,000	Interest on Investment	$1,236,630
Construction Contingency	1,410,000	Amortization	1,270
Engineering and Design	880,000	Operation and Maintenance	10,000
Supervision and Administration	690,000		
Lands and Damages	770,000	Total Annualized Costs	$1,247,900
Relocations	4,190,000		
Interest during Construction	2,256,000		
Total Investment	$17,356,000		

Table 13 displays average annual flood damage losses under existing conditions, residual average annual losses with Plan BCP 5 in place, and the resultant annual benefits of the plan.

TABLE 13
BCP 5 AVERAGE ANNUAL LOSSES AND BENEFITS
(2nd Quarter 1979 Prices)

Reach	Existing Average Annual Losses	Residual Average Annual Losses	Average Annual Flood Control Benefits
BC 1	$ 77,500	$ 77,500	$ —
BC 2	24,900	24,900	—
BC 3	11,400	11,400	—
BC 4	10,900	2,600	8,300
BC 5	53,200	16,900	36,300
BC 6A	22,100	20,900	1,200
BC 6	64,200	2,200	62,000
BC 7	6,500	600	5,900
BC 8	459,000	32,000	427,000
BC 9	936,300	123,600	812,700
BC 10	5,200	1,200	4,000
BC 11	3,800	3,800	—
Total	$1,675,000	$317,600	$1,357,400

Existing average annual losses are reduced by 81 percent with this plan. Commercial and business losses account for about 67 percent of the residual average annual damages with this plan in effect. Residential losses comprise 12 percent and public and miscellaneous losses account for 21 percent. Reduction in physical flood losses accounts for 85 percent of the $1,357,400 average annual flood control benefits, while reduction in business losses accounts for the remaining 15 percent.

Table 14 displays residual primary damages with Plan BCP 5 in place for the 100 and 500-year events. Residual primary damages for the 100-year discharge are reduced by 82 percent; for the 500-year discharge they are reduced by 57 percent.

TABLE 14
PLAN BCP 5 PRIMARY DAMAGES WITH AND WITHOUT PLAN
(1979 Prices)

	100-Year		500-Year	
Reach	Existing	Modified	Existing	Modified
BC 1	$ 1,125,000	$1,125,000	$ 1,459,000	$ 1,459,000
BC 2	367,000	367,000	416,000	416,000
BC 3	132,000	132,000	280,000	280,000
BC 4	183,000	69,000	1,042,000	79,000
BC 5	1,059,000	420,000	4,113,000	1,361,000
BC 6A	474,000	360,000	1,085,000	991,000
BC 6	764,000	73,000	1,042,000	332,000
BC 7	97,000	22,000	109,000	70,000
BC 8	13,965,000	31,000	23,576,000	8,208,000
BC 9	15,451,000	3,549,000	24,474,000	11,852,000
BC 10	154,000	20,000	240,000	133,000
BC 11	66,000	66,000	127,000	127,000
Totals	$33,837,000	$6,234,000	$57,963,000	$25,308,000

Social impacts of significance concern potential changes in esthetics, disruption in neighborhoods and commercial areas due to construction, the disruption of transportation routes, the permanent and temporary land acquisitions necessary for plan implementation, and reduction in flood hazard due to decreased flood depths and number of affected structures. Changes in esthetics are closely tied to physical alterations which are discussed as environmental impacts. There are no significant institutional problems.

This plan, because of its comprehensive nature, would be disruptive to neighborhoods, commercial areas, and normal transportation movement throughout the construction period. At some point in the estimated three year construction period, Wornall Road, Oak Street, Troost Avenue, and The Paseo/Swope Parkway intersection would be closed. They would not all be closed at the same time. Also, Locust Street would be permanently closed at the new open channel. Pedestrian traffic in the

Plaza vicinity and across the major roads would also be disrupted. There are a number of major and many minor utility modifications which have the potential to disrupt service to customers. At this point it is difficult to assess the impact on the Plaza Shopping District during the Christmas season, but it should be possible to schedule construction so that there would be little or no impact at that time. Relocation would involve five residential structures and three sheds or garages due to channel widening between Troost Avenue and Rockhill Road, and one commercial structure at the Paseo/Swope Parkway intersection. The social impact of flood hazard is demonstrated by the following: during a 100-year flood event the plan would provide protection for 61 of the 89 commercial structures and 37 of the 128 residential structures affected by that event; during a 500-year event the plan would protect 73 of the 187 commercial and 45 of the 172 residential structures which would otherwise be affected. This is accomplished by reduction of flood depths and the better confinement of severe floods to the channel.

Environmental impacts of significance for the plan are due to the physical alterations required. There would be some impact associated with the replacement of the Wornall Road, Plaza pedestrian, Kansas City Public Service Railroad, and Troost Avenue bridges. Additionally, a bridge at Oak Street, two in the Paseo/Swope Parkway, and a pedestrian bridge in the Volker fountain vicinity would be added. A more significant impact would be the widening in the channel, which would begin just downstream of The Paseo and extend just upstream of Wornall Road with slightly over 9,000 feet of new channel sidewall being added. Green space would be lost due to channel widening, with the open grass mall at the Volker Fountain and the Robert G. Sweet Arboretum just upstream of Oak Street along Volker Boulevard most significantly affected. The grass mall would be changed to an open channel, the limits of which can be seen on Plate 3.

Evaluation at this planning stage, comparison of this plan to the without condition, indicates that there are both positive and negative effects. Reduction in depths of flooding not only reduces flood damage, but also reduces hazard to human life. These are positive impacts. The cost of the plan is a negative impact. The temporary disruption caused by construction is also a negative impact, although the older bridges would eventually have to be replaced because of struction deterioration in any event. In some cases traffic flow may be improved, quite likely at the Wornall Road bridge and The Paseo/Swope Parkway intersection. Loss of open space is a negative impact; however, there are several instances where recreational potential may be enhanced by providing better access to the channel. The present Oak to Locust and Paseo conduits do not allow a continuous bicycle pathway where as the addition of open channels would provide continuity. Esthetics is important in the Brush Creek reach and the sum total of changes means a major alteration in appearance. This alteration must be considered a negative impact, although that impact can be mitigated, as discussed in the next section.

MITIGATION REQUIREMENTS

The environmental quality objective is to preserve or enhance certain water and related resources and amenities that have ecological, cultural, esthetic or other values which makes them significant in terms of environmental quality. Project features should be designed so that the visual and human-cultural values associated with the project will be protected, preserved, maintained, or enhanced. This is being pursued on this bridge and channel plan through coordination with the Kansas City, Missouri Parks and Recreational Department and other local interests. It is likely that some of the components of the bridge and channel plan would have adverse esthethic impacts. However, through the use of various architectural treatments and landscaping, there may also be positive impacts which would serve to mitigate any adverse effects.

IMPLEMENTATION RESPONSIBILITIES

This and subsequent discussions of implementation responsibilities concerning the detailed plans present information on the diversion of responsibilities between Federal and non-Federal interests. On 6 June 1978, President Carter announced a series of water policy initiatives, one of which pertained to cost sharing. The proposed cost sharing which should be used for flood control plans presented herein is as follows:

a. The Federal share would be 75% of the construction costs;
b. The State share would be 5% of the construction cost; and

c. The local sponsor's share would be 20% of the construction cost, plus 100% of the required operation, maintenance, and replacement costs for the life of the project.

Current guidance provides that the 20% local contribution may include any combination of cash or in-kind contribution and can be made prior to initiation of construction or in 10 annual installments.

Table 15 presents a summary of the cost sharing responsibilities for the plan BCP 5. Based on the President's recommended cost sharing policy, implementation of Plan BCP 5 would require $13,017,000 in Federal funds, $868,000 in State (Missouri) funds, and $3,471,000 in local sponsor funds or in-kind services. Additionally, the local sponsor's estimated annual operation and maintenance cost would be $10,000.

TABLE 15
PLAN BCP 5 COST APPORTIONMENT
(Based on President's Recommended Cost Sharing Policy)
(1979 Prices)

Federal First Cost	$11,325,000
Interest During Construction	1,692,000
Total Federal First Cost	13,017,000
Non-Federal First Cost	3,775,000
Interest During Construction	564,000
Total Non-Federal First Cost	4,339,000
(State)	(868,000)
(Local)	(3,471,000)
Sponsor O&M	10,000

PLAN BCP 2 - LIMITED SCOPE BRIDGE AND CHANNEL PLAN

GENERAL PLAN DESCRIPTION

The limited bridge and channel plan, as shown in plan view on Plate 3, would increase the discharge capacity of the channel only through the Plaza Shopping District vicinity, providing somewhat less than a 100-year level of protection, but greater than 50-year. As can be seen from the plan view, this plan is a portion of Plan BCP 5. Therefore, no detailed discussion of plan components is presented, and the description provided for Plan BCP 5 should be referenced. The principal plan components are the Wornall Road bridge, pedestrian bridge downstream from Wornall Road, Kansas City Public Service Railroad bridge, and channel retaining walls along reaches BC 7 and BC 8. Real estate requirements for this plan consist only of a temporary construction easement adjacent to the proposed new Kansas City Public Service Railroad bridge.

ASSESSMENT AND EVALUATION

Plan BCP 2 economic impacts are displayed by means of three tables. Table 16 displays the costs of the plan from the standpoint of project investment and also in terms of annualized costs.

TABLE 16
PLAN BCP 2 COSTS
(1979 Price Levels, 100-Year Period of Analysis, 7-1/8% Interest Rate)

Project Investment		Annualized Costs	
Construction	$2,348,000	Interest on Investment	$416,500
Construction Contingency	462,000	Amortization	400
Engineering and Design	290,000	Operation and Maintenance	5,000
Supervision and Administration	230,000		
Lands and Damages	170,000	Total Annualized Costs	$421,900
Relocations	1,900,000		
Interest During Construction	446,000		
Total Investment	$5,846,000		

Table 17 displays average annual flood damage losses under existing conditions, residual average annual losses with Plan BCP 2 in place, and the resultant annual benefits of the plan.

TABLE 17
BCP 2 AVERAGE ANNUAL LOSSES AND BENEFITS
(2nd Quarter 1979 Prices)

Reach	Existing Average Annual Losses	Residual Average Annual Losses	Average Annual Flood Control BEnefits
BC 1	$ 77,500	$ 77,500	$ —
BC 2	24,900	24,900	—
BC 3	11,400	11,400	—
BC 4	10,900	10,900	—
BC 5	53,200	53,200	—
BC 6A	22,100	22,100	—
BC 6	64,200	64,200	—
BC 7	6,500	4,600	1,900
BC 8	459,000	72,700	386,300
BC 9	936,300	161,000	775,300
BC 10	5,200	800	4,400
BC 11	3,800	3,800	—
Total	$1,675,000	$507,100	$1,167,900

Existing average annual losses by 70 percent. Commercial and business losses account for about 60 percent of the residual average annual damages with this plan in effect. Residential losses comprise 14 percent and public and miscellaneous losses account for the remaining 26 percent. Reduction in physical flood losses accounts for 84 percent of the $1,167,900 average annual flood control benefits, while reduction in business losses accounts for the remaining 16 percent.

Table 18 displays residual primary damages with Plan BCP 2 in place fo the 100- and 500-year events. Residual primary damages for the 100-year discharge are reduced by 65 percent; for the 500-year discharge they are reduced by 43 percent.

TABLE 18
PLAN BCP 2 PRIMARY DAMAGES WITH AND WITHOUT PLAN
(1979 Prices)

	100-Year		500-Year	
Reach	Existing	Modified	Existing	Modified
BC 1	$ 1,125,000	$ 1,125,000	$ 1,459,000	$ 1,459,000
BC 2	367,000	367,000	416,000	416,000
BC 3	132,000	132,000	280,000	280,000
BC 4	183,000	183,000	1,042,000	1,042,000
BC 5	1,059,000	1,057,000	4,113,000	4,113,000
BC 6A	474,000	474,000	1,085,000	1,085,000
BC 6	764,000	764,000	1,042,000	1,042,000
BC 7	97,000	73,000	109,000	79,000
BC 8	13,965,000	1,973,000	23,576,000	10,227,000
BC 9	15,451,000	5,191,000	24,474,000	12,851,000
BC 10	154,000	14,000	240,000	73,000
BC 11	66,000	66,000	127,000	127,000
Totals	$33,837,000	$11,419,000	$57,963,000	$32,794,000

Social impacts of significance for this plan are similar to those of Plan BCP 5, except reduced in scope because of the reduced plan scope. Again, disruption of traffic would be a principal construction impact with the Wornall Road and Plaza pedestrian bridges being replaced; there would also be utilities relocations which could disrupt service to customers. Noise and dust would be evident through a portion of the construction period. Institutional concerns would result from the limited scope of the alternative, with a highly damageable upstream area receiving protection while lower portions of Brush Creek do not. The plan provides protection to 35 of the 89 commercial structures, but only two of 128 residential structures subject to 100-year flood damage. All 35 commercial structures are in the Plaza area. The plan also provides protection to 34 of 189 commercial structures and 11 of 172 residential structures subject to 500-year flood damage.

Environmental impacts are also not as extensive with BCP 2 as BCP 5 because the cultural and esthetic attributes of the area between Oak Street and Rockhill Road are not affected. Channel and bridge modifications do alter the appearance of the Plaza vicinity from just downstream of the Kansas City Public Service Railroad bridge to just upstream of the Wornall Road bridge. Over 4,000 linear feet of new channel wall would be added with the channel modification and a limited amount of adjacent green space would be lost. The existing bicycle pathway entrance into the channel at Main Street has been incorporated into the plan such that access would not be affected.

In evaluation of this plan, the principal positive impacts would be reduction of flood depths in the Plaza vicinity, flood damage reduction, and the benefit to public health and safety resulting from the increased protection. Replacement of the two bridges, especially the Wornall Road bridge, would have a positive impact for transportation improvements. At the same time, it would have a negative impact for changing the esthetic appearance of the bridge. Modification of the channel would also be a negative impact due to change in appearance and loss of open space. The Plaza is a unique commercial, and residential area eligible for nomination to the Federal Register of Historic Places and mitigative actions, discussed next, should be considered.

MITIGATION REQUIREMENTS

As with Plan BCP 5, there is a need to closely examine project design features to insure that adverse esthetic and cultural impacts due to the channel and bridge modifications are minimized. Again, this is being pursued through coordination with the Kansas City, Missouri Parks and Recreation Department. The use of various architectural treatments and landscaping techniques is being explored.

IMPLEMENTATION RESPONSIBILITIES

Table 19 presents a summary of the cost sharing responsibilities for Plan BCP 2. Based on the President's recommended cost sharing policy, implementation of Plan BCP 2 would require $4,384,000 in Federal funds, $292,000 in State (Missouri) funds, and $1,169,000 in local sponsor funds or in-kind services. Additionally, the local sponsor's estimated annual operation and maintenance cost would be $5,000.

TABLE 19
PLAN BCP 2 COST APPORTIONMENT
(Based on President's Recommended Cost Sharing Policy)
(1979 Prices)

Federal First Cost	$4,050,000
Interest During Construction	334,000
Total Federal First Cost	4,384,000
Non-Federal First Cost	1,350,000
Interest During Construction	111,000
Total Non-Federal First Cost	1,461,000
(State)	(292,000)
(Local)	(1,169,000)
Sponsor O&M	5,000

PLAN UDP 1 - UNDERGROUND DIVERSION (SINGLE TUNNEL)

GENERAL PLAN DESCRIPTION

This single tunnel diversion plan, as seen in plan view on Plate 4 is simple in description, but more complex in design and operation. An inlet would be located on Bruch Creek in the vicinity of State Line Road; a tunnel would extend northwest to an outlet at the Kansas River, a distance of about 20,100 feet. During high flow conditions on Brush Creek, flood water would be diverted, thereby decreasing the chance of flooding downstream on Brush Creek to its confluence at the Blue River. An approximate 100-year level of protection is afforded. The following is a description of the principal plan components:

Intake. The intake structure would be located in the Brush Creek flood plain between State Line Road and Ward Parkway. It would be a gated structure which encircles a 22-foot diameter concrete-lined vertical shaft. The gated structure is hexagonal in shape and is surrounded by a steel pipe trashrack. A 10' x 15' automatically-operated gate is located on each of the six sides. The gates are designed to automatically open fully when the water surface rises to elevation 847.5 and close as the water surface drops below elevation 847.5. This elevation corresponds to about a 6,000 cubic feet per second discharge in the Brush Creek channel—well below the discharge where damage begins to occur.

Turkey Creek Access. The Turkey Creek Access is provided for tunnel construction purposes. The access is an excavated area from which tunneling operations would begin and proceed in both the upstream and downstream directions. A ramp would exit from the excavation and would be used to remove material from the tunnel during construction. When tunneling operations are complete a conduit with a permanent access shaft to the tunnel for maintenance purposes would be constructed.

Tunnel. The tunnel would be 17 feet in diameter and 20,100 feet long. It would be constructed by the use of a mole (mechanical drilling machine). It would be confined to the Bethany Falls limestone. The tunnel capacity would be approimately 5,200 cfs.

Outlet Structure. The outlet for the tunnel diversion plan would be located on the right bank of the Kansas River in Kansas City, Kansas. The downstream portion of this plan consists of a section of tunnel (soft ground tunneling), a section of cut and cover conduit, and an outlet structure. The outlet structure does not incorporate an energy dissipator. The structure is designed such that the flow is directed on the surface of the Kansas River, and the energy is expected to dissipate by eddies and turbulance.

Most of the real estate requirement for this plan would be for easement along the tunnel alinement. The estimate was based upon a field survey of the proposed route of the tunnel. The survey indicated that there are approximately 135 residential units plus 13 other types of properties which include improvements, such as commercial, industrial, churches, railroads, highways, and schools. Several unimproved properties were also in the path of the alinement provided, one of which is the access area at Turkey Creek which would be purchased in fee. An additional 25 acres of unspecified land would be purchased for disposal of the rock from the tunnel.

ASSESSMENT AND EVALUATION

Plan UDP 1 economic impacts are displayed by means of three tables. Table 20 displays the costs of the plan from the standpoint of project investment and also in terms of annualized costs.

TABLE 20
PLAN UDP 1 COSTS
(1979 Price Levels, 100-year Period of Analysis, 7-1/8% Interest Rate)

Project Investment		Annualized Costs	
Construction	$17,061,000	Interest on Investment	$2,121,000
Construction Contingency	3,329,000	Amortization	2,200
Engineering and Design	1,930,000	Operation and Maintenance	11,000
Supervision and Administration	1,630,000		
Lands and Damages	1,950,000	Total Annualized Costs	$2,134,200
Relocations	0		
Interest During Construction	3,869,000		
Total Investment	$29,769,000		

Table 21 displays average annual flood damage losses under existing conditions, residual average annual losses with plan BCP 2 in place, and the resultant annual benefits of the plan.

TABLE 21
UDP 1 AVERAGE ANNUAL LOSSES AND BENEFITS
(2nd Quarter 1979 Prices)

Reach	Existing Average Annual Losses	Residual Average Annual Losses	Average Annual Flood Control Benefits
BC 1	$ 77,500	$ 49,400	$ 28,100
BC 2	24,900	9,200	15,700
BC 3	11,400	5,200	6,200
BC 4	10,900	1,700	9,200
BC 5	53,200	9,200	44,000
BC 6A	22,100	2,800	19,300
BC 6	64,200	24,300	39,900
BC 7	6,500	800	5,700
BC 8	459,000	30,700	428,300
BC 9	936,300	88,900	847,400
BC 10	5,200	500	4,700
BC 11	3,800	400	3,400
Total	$1,675,000	$223,100	$1,451,900

Existing average annual losses are reduced by nearly 87 percent with this plan. Approximately 69 percent of the remaining average annual losses are commercial and business losses, 10 percent are residential losses, and public and miscellaneous losses account for 21 percent. Of the $1,451,900 average annual flood control benefits provided by plan UDP 1, reduction in actual physical flood losses account for 85 percent, while the remaining 15 percent reflects reduction in business losses.

Table 22 displays residual primary damages with plan UDP 1 in place for the 100- and 500-year events. Residual primary damages for the 100-year flood are reduced by 89 percent; for the 500-year flood they are reduced by 55 percent.

TABLE 22
PLAN UDP 1 PRIMARY DAMAGES WITH AND WITHOUT PLAN
(1979 Prices)

	100-Year		500-Year	
Reach	Existing	Modified	Existing	Modified
BC 1	$ 1,125,000	$ 987,000	$ 1,459,000	$ 1,162,000
BC 2	367,000	315,000	416,000	370,000
BC 3	132,000	90,000	280,000	180,000
BC 4	183,000	52,000	1,042,000	85,000
BC 5	1,059,000	244,000	4,113,000	831,000
BC 6A	474,000	60,000	1,085,000	409,000
BC 6	764,000	451,000	1,042,000	825,000
BC 7	97,000	33,000	109,000	90,000
BC 8	13,965,000	8,000	23,576,000	9,593,000
BC 9	15,451,000	1,675,000	24,474,000	12,390,000
BC 10	154,000	0	240,000	100,000
BC 11	66,000	17,000	127,000	32,000
Totals	$33,837,000	$3,932,000	$57,963,000	$26,067,000

Social impacts of significance are fewer in number with this plan. Three will be discussed. First, this plan reduces flood depths and hazard in every reach. Sixty-six of the 89 commercial and 85 of the 128 residential structures are protected from the 100-year flood event. During the 500-year event 103 of the 189 commercial and 52 of the 172 residential structures would be protected. The second impact concerns the possible reaction of the communities and especially the residents immediately above, or in close proximity to the tunnel alinement. Recent occurrences of subsidence of old limestone mines due to poor mining practices has increased public concern. Finally, institutional impacts are especially significant. All of the benefits of the plan are derived in Kansas City, Missouri while the majority of the project lies in Johnson County, Kansas communities of Mission Woods, Westwood, Roeland Park and Kansas City, Kansas in Wyandotte County. Although cost apportionment would not be an issue with the responsibilities remaining with the State of Missouri and Kansas City, Missouri, it is possible that substantial political opposition could develop in Kansas.

Unlike the previous two plans, disruption of transportation and utility services are not considered significant with this plan. Disposal of materials from the bored tunnel at the Turkey Creek access would create additional traffic and some disruption. However, this location is already in light industrial usage and the impact would not be as great as with a residential area.

Environmental impacts of significance are minimal for a project of this size since the 20,100 feet of tunnel is beneath the ground surface. No significant water quality impact on the Kansas River or Brush Creek is anticipated. The inlet would not operate until stream flow reaches 6,000 cfs, or about a 5- to 8-year event. By that time it is probable that the initial flush of pollutants washed from the ground surface would have passed the inlet, continuing on to the Blue River. Disposal of material from the access and the tunnel would present the only major possible impact on fish and/or wildlife habitat, depending on the site selected.

Evaluation of the impacts leads to the conclusion that this plan has few adverse significant environmental impacts. And although its significant social impacts are fewer in number than the previous two plans because of less disruption, they are more pronounced. The flood protection and reduction in hazard to life in all reaches are strong positive impacts. At the same time the possible adverse public and political sentiment toward this type of plan could be equally strong within the Kansas communities. The cost is a negative impact. Careful selection of a disposal site and good construction management should lessen the adverse impacts of noise, dust, and traffic disruption during construction.

MITIGATION REQUIREMENTS

There are no identified mitigation requirements for this plan. The ground surface is not altered except at the inlet, outlet, and access point.

IMPLEMENTATION RESPONSIBILITIES

Table 23 presents a summary of the cost sharing responsibilities for Plan UDP 1. Based on the President's recommended cost sharing policy, implementation of Plan UDP 1 would require $22,327,000 in Federal funds, $1,488,000 in State (Missouri) funds, and $5,954,000 in local sponsor funds or in-kind services. Additionally, the local sponsor's estimated annual operation and maintenance cost would be $11,000.

TABLE 23
PLAN UDP 1 COST APPORTIONMENT
(Based on President's Recommended Cost Sharing Policy)
(1979 Prices)

Federal First Cost	$19,425,000
Interest During Construction	2,902,000
Total Federal First Cost	22,327,000
Non-Federal First Cost	6,475,000
Interest During Construction	967,000
Total Non-Federal First Cost	7,442,000
(State)	(1,488,000)
(Local)	(5,954,000)
Sponsor O&M	11,000

PLAN CP 3 - COMBINATION BRIDGE AND CHANNEL AND UNDERGROUND DIVERSION

GENERAL PLAN DESCRIPTION

This is the most extensive of the retained plans and is a combination of Plans UDP 1 and BCP 2. No specific plate has been prepared to the plan alone and Plates 3 and 4 should be referenced. This plan is capable of providing an SPF level of protection, and was formulated specifically for that purpose. For a discussion of the plan components, and real estate requirements, previous plan discussions should be referenced.

ASSESSMENT AND EVALUATION

Plan CP 3 economic impacts are displayed by means of three tables. Table 24 displays the costs of the plan from the standpoint of project investment and also in terms of annualized costs.

TABLE 24
PLAN CP 3 COSTS
(1979 Price Levels, 100-year Period of Analysis, 7-1/8% Interest Rate)

Project Investment		Annualized Costs	
Construction	$19,410,000	Interest on Investment	$2,559,900
Construction Contingency	3,790,000	Amortization	2,700
Engineering and Design	2,190,000	Operation and Maintenance	16,000
Supervision and Administration	1,850,000		
Lands and Damages	2,120,000	Total Annualized Costs	$2,576,600
Relocations	1,900,000		
Interest During Construction	4,669,000		
Total Investment	$35,929,000		

Table 25 displays average annual flood damage losses under existing conditions, residual average annual losses with Plan BCP 5 in place, and the resultant annual benefits of the plan.

TABLE 25
PLAN CP 3 AVERAGE ANNUAL LOSSES AND BENEFITS
(2nd Quarter 1979 Prices)

Reach	Existing Average Annual Losses	Residual Average Annual Losses	Average Annual Flood Control Benefits
BC 1	$ 77,500	$ 49,400	$ 28,100
BC 2	24,900	9,200	15,700
BC 3	11,400	5,200	6,200
BC 4	10,900	1,700	9,200
BC 5	53,200	9,200	44,0000
BC 6A	22,100	2,800	19,300
BC 6	64,200	24,300	39,900
BC 7	6,500	600	5,900
BC 8	459,000	300	458,700
BC 9	936,300	7,800	928,500
BC 10	5,200	500	4,700
BC 11	3,800	400	3,400
Total	$1,675,000	$111,400	$1,563,600

Existing average annual losses are reduced by 93 percent with this plan. Of the remaining average annual losses with this plan in effect, commercial and business losses account for 47 percent, residential losses account for 20 percent and public and miscellaneous losses comprise 33 percent. Reduction in physical flood losses accounts for 85 percent of the $1,563,600 total average annual flood control benefits, while reduction in business losses accounts for the remaining 15 percent.

Table 26 displays residual primary damages with Plan CP 3 in place for the 100- and 500-year events. Residual primary damages for the 100-year discharge are reduced by 94 percent; for the 500-year discharge they are reduced by 91 percent.

TABLE 26
PLAN CP 3 PRIMARY DAMAGES WITH AND WITHOUT PLAN
(1979 Prices)

	100-Year		500-Year	
Reach	Existing	Modified	Existing	Modified
BC 1	$ 1,125,000	$ 987,000	$ 1,459,000	$1,162,000
BC 2	367,000	315,000	416,000	370,000
BC 3	132,000	90,000	280,000	180,000
BC 4	183,000	52,000	1,042,000	85,000
BC 5	1,059,000	244,000	4,113,000	831,000
BC 6A	474,000	60,000	1,085,000	409,000
BC 6	764,000	451,000	1,042,000	825,000
BC 7	97,000	27,000	109,000	71,000
BC 8	13,965,000	0	23,576,000	47,000
BC 9	15,451,000	0	24,474,000	1,425,000
BC 10	154,000	0	240,000	100,000
BC 11	66,000	17,000	127,000	32,000
Totals	$33,837,000	$2,243,000	$57,963,000	$5,537,000

Social impacts of this plan are a combination of Plans BCP 2 and UDP 1 and previous discussions should be referenced. It is important to note that the level of flood protection afforded, and coincidentally the reduction in hazard to human life, is greatest with this plan. Even severe events are, for the most part, confined to the channel. This plan would provide protection for 82 of the 89 commercial and 85 of 128 residential structures during a 100-year flood event; during a 500-year event the combined plan would protect 150 of 189 commercial and 54 of 172 residential structures. The social impact of most concern with this plan, as it was with Plan UDP 1 is institutional acceptability. The majority of the project would be located in Kansas communities while the benefiting area would be Kansas City, Missouri.

Environmental impacts would also be a combination of Plans BCP 2 and UDP 1. Previous discussions should be referenced. The plan evaluation discussions for these two plans should also be referenced to determine the positive or negative nature of the impacts. When reviewing materials pertaining to reduction in flood depths, damage, and hazard to life, it should be kept in mind that Plan CP 3 was developed specifically to provide SPF protection against significant losses. This was in response to planning regulations. The overriding impact of this plan is cost. Annual costs would exceed annual benfits by a wide margin.

MITIGATION REQUIREMENTS

Mitigation would only become applicable for the bridge and channel portion of this plan. The discussion presented for Plans BCP 5 and BCP 2 should be examined. Coordination with the Kansas City, Missouri Parks Department is now occurring.

IMPLEMENTATION RESPONSIBILITIES

Table 27 presents a summary of the cost sharing responsibiliteis for Plan CP 3. Based on the President's recommended cost sharing policy, implementation of Plan CP 3 would require $26,947,000 in Federal funds, $1,796,000 in State (Missouri) funds, and $7,186,000 in local sponsor funds or in-kind services. Additionally, the local sponsor's estimated annual operation and maintenance cost would be $16,000.

TABLE 27
PLAN CP 3 COST APPORTIONMENT
(Based on President's Recommended Cost Sharing Policy)
(1979 Prices)

Federal First Cost	$23,445,000
Interest During Construction	3,502,000
Total Federal First Cost	26,947,000
Non-Federal First Cost	7,815,000
Interest During Construction	1,167,000
Total Non-Federal First Cost	8,982,000
(State)	(1,796,000)
(Local)	(7,186,000)
Sponsor O&M	16,000

COMPARISON OF DETAILED PLANS

At this point all of the four structural plans have been thoroughly assessed and evaluated. Both the positive and adverse impacts of each plan have been set forth and each plan has been compared to the "without" condition. Contributions to planning accounts objectives, have been determined and plan response to specific planning criteria has been set forth. Plan risk and uncertainty have also been established. Step 6, tentative selection of a plan, can now be accomplished as plans are compared to each other and to the "without condition. This selection is facilitated through the use of Table 28, Summary Comparison of Final Alternative Plans. The table presents all crucial and determinative factors relevant to plan selection.

TABLE 28
SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS

	WITHOUT CONDITION	PLAN BCP 5	PLAN BCP 2	PLAN UDP 1	PLAN CP 3
A. PLAN (Condition Description)	Same as Existing Condition. Hydraulic conditions and flood damage potential remain unchanged.	Comprehensive Bridge and Channel Plan with following major components: 1. Supplemental open channel at The Paseo/Swope Parkway intersection. 2. Replace Troost Ave. bridge. 3. Widen channel Rockhill Rd. to downstream Troost Ave. 4. Open channel to replace Oak to Locust conduit with new Oak St. bridge & pedestrian bridge at Volker Fountain. 5. Replace KCPS railroad bridge. 6. Replace Plaza pedestrian bridge. 7. Replace Wornall Rd. bridge. 8. Widen channel from upstream Wornall Rd. to downstream KCPS railroad bridge.	Limited Scope Bridge and Channel Plan. Major components same as items "5-8" of Plan BCP 5: 1. Replace KCPS railroad bridge. 2. Replace Plaza pedestrian bridge. 3. Replace Wornall Road bridge. 4. Widen channel from upstream Wornall Rd. to downstream KCPS railroad bridge.	Underground Diversion Plan with following major components: 1. Tunnel inlet between State Line Road and Ward Parkway on Brush Creek. 2. Outlet at Kansas Rivers - vicinity of Roe Blvd. 3. Tunnel connecting inlet and outlet. 4. Access to tunnel at Turkey Creek.	Combination Diversion and Bridge and Channel Plan. Major components area all of the components of Plans BCP 2 and UDP 1.
B. IMPACT ASSESSMENT[1]					
NED					
Annual Flood Damage Reduction	None. Nonstructural measures undertaken after 1977 flood would continue in effect.	$ 1,357,400	$1,167,900	$ 1,451,900	$ 1,563,600
Project First Cost	0	$15,100,000	$5,400,000	$25,900,000	$31,260,000
Operation and Maintenance	0	$ 10,000	$ 5,000	$ 11,000	$ 16,000
Total Annual Cost	0	$ 1,247,900	$ 421,900	$ 2,134,200	$ 2,578,600
EQ					
Terrestrial Flora and Fauna	None	Six acres of grass and tree covered area along Brush Creek converted to concrete. 25 acres at remote site required for disposal of excavated material.	2½ acres of grass and tree covered area in Plaza vicinity converted to concrete. 10 acres at remote site required for disposal of excavated material.	No significant effect in Brush Creek area. 25 acres at remote site required for disposal of excavated material.	2½ acres of grass and tree covered area in Plaza vicinity converted to concrete 25 acres at remote site required for disposal of excavated material.
Aquatic Flora and Fauna, Wetland	None	No significant impact	No significant impact	No significant impact.	No significant impact.
SWB					
Leisure Opportunities					
Hiking and Biking	No change.	Corridor made more continuous.	No significant change.	No change	No significant change
Playgrounds	No change.	Plaza playground reduced.	Plaza playground reduced.	No change	Plaza playground reduced
Reduction in Flood Depths	No change.	Reaches 5 - 10	Reaches 7 - 10	All Reaches	All Reaches
Structures Protected (100-Year Event)					
Commercial	0 of 89	61 of 89	35 of 89	66 of 89	82 of 89
Residential	0 of 128	33 of 128	7 of 128	85 of 128	85 of 128
Structures Protected (500-Year Event)					
Commercial	0 of 189	73 of 189	34 of 189	103 of 189	150 of 189
Residential	0 of 172	45 of 172	15 of 172	52 of 172	54 of 172
Relocations					
Structures	0	Five (5) residential; one (1) commercial; Three (3) sheds.	None	None	None
Utilities	0	Throughout plan limits.	Throughout plan limits.	None	Throughout Channel Modification Portion
Bridge Replacements	0	Wornall Road Bridge	Wornall Road Bridge	None	Wornall Road Bridge
Roads Closed (Permanent)	0	Locust	None	None	None
Roads Closed (Temporarily)	0	Wornall Rd.; Oak St.; Troost Ave.) The Paseo; Swope Parkway	Wornall Rd.	None	Wornall Roao
Esthetics					
Channel Length Altered	0	Approx. 6,200 Ft.	Approx. 2,400 Ft.	Approx. 150 Ft.	Approx. 2,400 Ft.
Greenspace Lost	0	6 acres	2.5 acres	None	2.5 acres
RD	None	Same as NED	Same as NED	Same as NED	Same as NED
C. PLAN EVALUATION					
1. Contributions to Planning Objectives*					
a. Reduce flood damage potential on Brush Creek from State Line to its confluence with the Blue River					
Beneficial	Continue utilization of floor space to maintain reduced damage potential.	Approx. 100-year protectin against significant damage in reaches 5-10.	Approx. 80-90-year protection against significant damage in reaches 8 and 9 (Plaza).	Approx. 100-140-year protection against signification damage in all reaches except No. 1	Approx. SPF level of protection gainst significant damage.
Adverse	Negligible reduction in damage potential from Sept. 1977 condition.	One Ft. increase in flood depth in reach 6A for floods in 10-year discharge range.	Plan geographic scope limited to Plaza and does not reduce downstream damage.	None	None

TABLE 28
SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS (Cont.)

	WITHOUT CONDITION	PLAN BCP 5	PLAN BCP 2	PLAN UDP 1	PLAN CP 3
b. Reduce hazard to human life on Brush Creek from State Line to its confluence with the Blue River.					
Beneficial	None	Depth of flooding reduced in reach 5 - 10.	Depths of flooding reduced in reaches 8-9.	Reduced depths of flooding in all reaches	Significantly reduced depths of flood in all reaches and confines severe floods to channel.
Adverse	Hazard not reduced.	None	Plan scope is limited to Plaza area.	None	None
c. Maintain the Significant Esthetic and Cultural qualities along Brush Creek					
Beneficial	No alterations would be made.	None	No modifications downstream of Plaza.	Eliminates the need for modifications.	No modifications downstream of Plaza.
Adverse	None	1. Alters the esthetics of Wornall Road bridge; Volker Fountain area; and much of channel from the Paseo to Wornall Road. 2. Reduced green space by approx. 6 acres.	1. Alters esthetics of Wornall Road bridge and channel in Plaza area. 2. Reduces green space by approx. 2.5 acres.	The fenced inlet alters the appearance of State Line to Ward Parkway area.	1. Alters esthetics of Wornall Road bridge and channel in Plaza area. 2. Reduces green space by approx. 2.5 acres. 3. The fenced inlet would alter the appearance of State Line to Wark Parkway area.
d. Increase Recreational Potential in Conjunction with Flood Hazard Reduction					
Beneficial	None	1. Potential wage of Kansas City, Missouri bikeway increased. 2. Parkland less vulnerable to flooding. 3. Parkland made more continuous by acquisition of two (2) non-park areas.	None	1. Parkland less vulnerable to flood damage. 2. Recreational development possibilities enhanced.	1. Parkland less vulnerable to flood damage. 2. Recreational development possibilities enhanced.
Adverse	Constraints exist on future development due to flooding.	About 5 acres of park green space converted to concrete.	About 2.5 acres of green space converted to concrete.	None	About 2.5 acres of green space converted to concrete.
e. Provide Transportation Improvements in Conjunction with Flood Hazard Reduction					
Beneficial	None	1. Wornall Rd. bridge widened 2. KCPS R.R. bridge improved for future use. 3. Provides for advanced replacement of several major bridges.	1. Wornall Rd. bridge widened. 2. KCPS R.R. bridge improved for future use. 3. Provides for advanced replacement of Wornall Rd. bridge.	None	1. Wornall Rd. bridge widened. 2. KCPS R.R. bridge improved for future use. 3. Provides for advanced replacement of Wornall Rd. bridge.
Adverse	None	Traffic disruption during construction.	Traffic disruption during construction.	Traffic disruption during construction.	Traffic disruption during construction.
2. Net (with vs. without) beneficial and adverse affects					
NED (Objective/Account)					
Beneficial		$109,500	$746,000	$682,300	$1,015,000
Adverse		None See "B" above.	None See "B" above.	None See "B" above.	None See "B" above.
EQ (Account)					
Beneficial		Same as C.1.d. above Same as C.1.e. above. Decrease in flood hazard. Reduced hazard to life-reach 5-10.	None Same as C.1.e. above. Decrease in flood hazard. Reduced hazard to life-reach 7-10.	None None Decrease in flood hazard Reduced hazard to life-all reaches.	None Same as C.1.e. above. Decrease in flood hazard. Reduced hazard to life-all reaches.
Adverse		Same as C.1.d. above. Same as C.1.e. above. Possible conflict in attitude due to visual impact on Plaza, Volker Fountain areas. Same as C.1.c. above.	Same as C.1.d. above. Same as C.1.e. above. Possible conflict in attitude due to visual impact on Plaza area. Same as C.1.c. above.	None Same as C.1.e. above. Probable adverse reaction from some residents along tunnel route. None	Same as C.1.d. above. Same as C.1.3. above. Combination of BCP 2 and UDP 1. Same as C.1.c. above.
SWB (Objective/Account)					
Beneficial		Same as NED.	Same as NED.	Same as NED.	Same as NED
Leisure Opportunities					
Transportation					
Community Cohesion					
Health and Safety					
Adverse					
Leisure Opportunities					
Transportation					
Community cohesion					
Esthetics					
RD (Account)					

TABLE 28
SUMMARY COMPARISON OF FINAL ALTERNATIVE PLANS (Cont.)

	WITHOUT CONDITION	PLAN BCP 5	PLAN BCP 2	PLAN UDP 1	PLAN CP 3
3. Plan Response to Associated Evaluation Criteria					
Acceptability (Acceptance by concerned publics)		High	Moderate	Low	Low
Completeness (All necessary investments or other actions to insure full plan attainment are incorporated)		High	High	High	High
Effectiveness (Technical performance of the plan and contributions of plan to planning objectives and system of accounts)		High	Moderate to High	High	High
Efficiency (Ability of plan to achieve planning objectives and contributions to NED and EQ outputs in a least cost way)		Moderate	High	Low	Low
Certainty (Likelihood of attainment of planning objectives and contributions to NED and EQ accounts)		High	High	High	High
Geographic Scope (Relevancy of scope of plan to scope of defined problems)		High	Moderate	Complete	Complete
NED Benefit to Cost Ratio (1979 price levels, 100-year period of analyses; 7-1/8% interest rate)		1.09:1	2.77:1	0.67:1	0.61:1
Reversibility (Capability of restoring the partially or fully implimented plan to approximate the "without condition")		Low	Low	High	Low
Stability (Capability of a plan to accommodate a broad range of different future conditions)		High	High	High	High
*4. Rankings of Plan Contributions in Relation to:					
NED (Objectives/Accounts)		2	1	3	4
EQ (Objectives/Accounts)		4	2	1	3
SWB (Objectives/Accounts)		3	4	2	1
RD (Objectives/Accounts)		2	1	3	4
D. IMPLEMENTATION RESPONSIBILITY					
First Cost					
Federal		$13,017,000	$4,384,000	$22,327,000	$26,947,000
State		$ 868,000	$ 292,000	$ 1,488,000	$ 1,796,000
Local		$ 3,417,000	$1,169,000	$ 5,954,000	$ 7,186,000
Operation and Maintenance Cost					
Local		$ 10,000	$ 5,900	$ 11,000	$ 16,000

*No. 1 indicates greatest contribution.

TRADE-OFF ANALYSIS

The comparison takes the form of a trade-off analysis in which comparative plan contributions are examined. Clearly setting forth what is gained or foregone by choosing a given alternative over other alternatives is a necessary step in arriving at a tentative plan selection. The analysis involves both quantitative or qualitative information. It is partly objective and partly subjective in nature.

Monetary Trade-offs. Of principal importance is the evaluation of the net contribution to the NED account. Both plans BCP 2 and BCP 5 have net economic benefits; plans UDP 1 and CP 3 do not. Under the December 1979 revisions to the Water Resource Council's Principals and Standards, plans UDP 1 and CP 3 may still be considered if combined beneficial NED and EQ effects outweigh combined adverse NED and EQ effects. Neither plan exhibits significant environmental enhancement.

Plans UDP 1 and CP 3 are eliminated from the remainder of the trade-off analyses. Net benefits of plans BCP 2 and BCP 5 are $746,000 and $109,500 respectively, while the respective benefit to cost ratios are 2.77 to 1 and 1.09 to 1. Plan BCP 5, the comprehensive plan, is sensitive to interest rate increases, with a benefit to cost ratio of 1.01 to 1 resulting at a rate of 7-5/8%. The present rate of 7-1/8%. Plan BCP 2, the limited plan, has no such sensitivity. Therefore, to gain the comprehensive nature of plan BCP 5, not only are net benefits foregone, but a very marginal economic justification results.

Geographic Scope and Level of Protection. These are two additional trade offs which follow directly from the above. Problems of flood damage and hazard to life have been documented for the entire Brush Creek reach from State Line to Brush Creek's confluence with the Blue River. It is important that a plan reduce damages over as large an area as possible. Plan BCP 5 covers most of the flood plain from downstream of The Paseo to upstream of Wornall Road, whereas plan BCP 2 covers only the Plaza area. In order to gain the comprehensive nature of plan BCP 5, net benefits are foregone. Plan BCP 2's limited geographic scope is a trade-off to gain net benefits.

A highly desirable goal is to attain a 100-year level of protection against significant damages with a plan. Also, as much of the study reach as possible should be protected not only for the purpose of flood damage reduction, but also for reduction of hazard to human life through confinement of severe floods to within banks. The high velocities and rapid depth increases for Brush Creek flooding increase this goal's importance. Plan BCP 5 does provide this level of protection to most critical areas along Brush Creek, whereas plan BCP 2 provides an approximate 80-90 year level of protection to only the Plaza area. Increased level of protection is sacrificed in plan BCP 2 for increased economic efficiency.

Cultural and Esthetic Effects. Another important trade-off pertains to impacts on the cultural and esthetic attributes of the Brush Creek channel, bridges, and adjacent parkland. A specific planning objective sets forth the goal of maintaining and preserving these attributes. However, alteration of the channel can have an adverse impact visually and culturally in some areas along Brush Creek.

The two most important portions of the channel impacted by one or both plans are the Plaza and the Volker Fountain area roughly described as from Oak Street to just downstream of Rockhill Road. Plan BCP 5 significantly impacts upon both areas, while BCP 2 significantly compacts only on the Plaza area. The Volker Fountain area is affected in BCP 5 by the conversion of the Oak to Locust tunnel to an open channel section. The Sweet Arboretum is also affected by this conversion. Mitigation of proposed alterations in both plans is being pursued with the Kansas City, Missouri Parks and Recreation Department and measures considered would include architectural treatments and landscaping.

Environmental Trade-offs. Because of the highly urbanized nature of the Brush Creek channel, there is very little effect on natural environment. The amount of grass and tree covered area converted to concrete channel is the most significant effect. For plan BCP 2 the loss of green space is 2.5 acres, and for BCP 5 it is 6 acres. These losses are a negative aspect of the enlarged channel necessary to carry higher flood flows.

Public and Political Acceptability. The comprehensive plan benefits not only the highly damagable Plaza area, but also commercial and residential areas downstream. Such a plan would have a higher degree of public acceptability than a limited plan. To gain this increased acceptability net benefits are foregone.

Summary and Compromise Plan. These are considered to be the important trade-offs between the limited plan (BCP 2) and the comprehensive plan (BCP 5). In reviewing the trade-offs, a compromise plan can be developed. It would be less comprehensive than Plan BCP 5 but yet have a more adequate geographic scope than plan BCP 2. This compromise plan should accomplish several things. It should:

1. Exhibit greater net benefits and be less sensitive to interest rates and cost escalation;
2. Provide as great a geographic scope as possible and include critical damage and hazard areas; and,
3. It should minimize adverse cultural and esthetic impacts.

A tentative compromise plan, called BCP 7, can be formulated and evaluated on the basis of existing data. It would lack only one component of the comprehensive plan, which is the open channel from Oak Street to Rockhill Road. The existing conduit would not be modified. The results are presented in a multi-sectioned display in Table 29. The first section lists the major plan

TABLE 29
BRIDGE AND CHANNEL PLAN COMPARISON

Components	BCP 2	BCP 5	BCP 7
Supplemental Channel at Paseo		X	X
Troost Bridge Replacement		X	X
Channel Mod, Rockhill to Troost		X	X
Open Channel, Oak to Locust		X	
KCPS Railroad Bridge Replacement	X	X	X
Main Street Bridge Mod	X	X	X
J. C. Nichols Bridge Mod	X	X	X
Pedestrian Bridge Replacement	X	X	X
Wornall Round Bridge Replacement	X	X	X
Costs			
First Cost (in thousands)	$5,400	$15,100	$11,879
Interest During Construction	445	2,256	1,775
Total Investment	$5,845	$17,356	$13,654
Annual Costs			
Interest and Amortization	$416,900	$1,237,900	$974,000
Operation and Maintenance	5,000	10,000	8,000
Total Annual Cost	$421,900	$1,247,900	$982,000

Flood Depth Reductions

	BCP 2			BCP 5			BCP 7		
Reach	10	100	500	10	100	500	10	100	500
5				−1.3	−4.1	−3.8	−1.3	−4.1	−3.8
6A				+1.1	−2.2	−0.8	+1.1	−2.2	−0.8
6				−7.2	−3.7	−3.5		−0.9	−0.9
7	+0.3	−4.1	−5.0	−3.2	−6.5	−6.8		−5.2	−6.2
8	−0.3	−5.1	−4.2	−2.9	−6.6	−5.1	−0.6	−5.8	−5.0
9	−3.5	−3.4	−3.0	−4.3	−3.8	−3.4	−3.5	−3.4	−3.2
10	−0.9	−2.2	−1.3	−1.1	−2.1	−1.3	−1.1	−2.2	−1.5

Benefit Analysis

		Benefits		
Reach	Damages	BCP 2	BCP 5	BCP 7 (est)
4	$ 10.9	$	$ 8.3	$ 8.3
5	53.2		36.3	36.3
6A	22.1		1.2	1.2
6	64.2		62.0	5
7	6.5	1.9	5.9	4
8	459.0	386.3	427.0	395
9	936.3	775.3	812.7	778
10	5.2	4.4	4.0	4.4
Totals	$1,557.4	$1,167.9	$1,357.4	$1,232
Benefit/Cost Ration		2.77	1.09	1.25
Net Benefits		$746,000	$109,500	$250,000

components and the second section presents plan costs. Elimination of the open channel from BCP 5 reduces investment by about $3.7 million. The third section displays comparative flood depth reductions. The benefit analysis section indicates that damage reduction with the compromise plan would be between that of plans BCP 2 and BCP 5. The benefit to cost ratio is estimated at 1.25 to 1 with net benefits of $250,000.

From the standpoint of social well-being and environmental quality, the compromise plan would have nearly all the beneficial effects of the comprehensive BCP 5 plan, but no more adverse effects than the limited plan BCP 2. A brief comparison is shown below.

- Geographic scope and level of protection. Compromise plan is nearly as good as BCP 5 and considerably bettern than BCP 2 in terms of the area benefited and in reducing hazard to human life.
- Cultural and esthetic effects. Compromise plan is nearly equal to BCP 2 and much better than BCP 5 because of Volker Fountain and Sweet Arboretum considerations.
- Environmental effects. Compromise plan is about half-way between BCP 2 and BCP 5. The conversion of the Oak to Locust tunnel to open channel would change 1.8 acres of grass and tree covered area to concrete.
- Public and political acceptability. Compromise plan would likely be superior to either BCP 2 or BCP 5.

RATIONALE FOR DESIGNATION OF NED PLAN

An NED plan addressed the planning objectives in a way which maximizes net economic benefits. The selection of the NED plan can be made through examination of the Summary Comparison, Table 28, which displays the NED account.

Plans UDP 1 and CP 3 cannot be considered because of their lack of economic justification. They have no net benefits. Although benefits and costs for each component of Plan BCP 2, the limited scope bridge and channel plan have not been computed, each is a necessary component to maximize protection of the Plaza area, where potential losses are greatest. Its net benefits are $746,000, while its total benefits are $1,167,000. Plan BCP 5, the more comprehensive bridge and channel plan was formulated to protect a greater percentage of the Brush Creek reach, without concentrating on only protecting high damage areas. This represented a more balanced and complete approach, recognizing that the flood problem extended to lower value areas downstream of the Plaza. Its net benefits and total benefits are $109,500 and $1,357,400, respectively. Clearly, plan BCP 2 must be designated as the NED Plan.

RATIONALE FOR DESIGNATION OF THE EQ PLAN (or Least Environmentally Damaging Plan)

Recognizing that environmental quality has both natural and man-made manifestations, an EQ Plan addresses the planning objectives in the way which emphasizes esthic, ecological, and cultural contributions. Beneficial EQ contributions are made by preserving, maintaining, restoring or enhancing the significant cultural and natural environmental attributes of the study area. In the case of Brush Creek from State Line Road to its confluence with the Blue River, natural atributes are not greatly significant because of man-made alterations which have occurred over time. It is the cultural and esthetic attributes which are of principal concern and this is reflected with utilization of a specific planning objective against which the plans were compared.

The plan which best maintains, preserves, restores, or enhances the cultural and esthetic attributes of the Brush Creek channel would be the best candidate for designation. This eliminates Plans BCP 2, BCP 5, and CP 3, which are the limited and comprehensive bridge and channel plans and the combination plan, respectively. Alteration of some length of channel is an important part of each plan. This leaves Plan UDP 1 for consideration.

Plan UDP 1 consists of an inlet between State Line Road and Ward Parkway on Brush Creek, an access at Turkey Creek, and an outlet at the Kansas River. In comparison to other locations on Brush Creek, the inlet location between State Line Road and Ward Parkway is not culturally or esthetically significant. At that location the channel is deep, erodable, and unimproved in comparison to the paved channel downstream. The large volume of automobile traffic on adjacent roadways

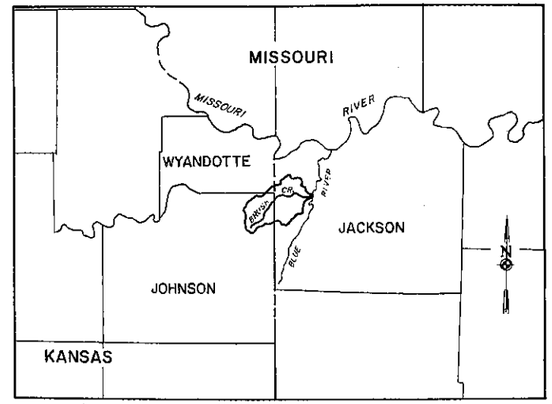
limits access to the area. At no location through the Plaza, through the Volker Fountain area, or downstream would the channel be altered. In essence, by utilizing an underground diversion the Brush Creek channel would be maintained and preserved. It would not be enhanced except that the flood threat would be drastically lessened, opening the door for increased public utilization and appreciation of the park-lined floodplain. There are no significant environmental attributes at the Turkey Creek or Kansas River locations. The tunnel is located underground with no identifiable adverse environmental impacts except during construction. Good construction management would minimize these impacts. Therefore, using the two criteria of "preservation" and "maintenance", plan UDP 1 is designated the EQ plan.

RATIONALE FOR DESIGNATION OF A TENTATIVELY SELECTED PLAN

The two plans in the final array eligible for consideration are plans BCP 2 and BCP 5. Plan BCP 2, the designated NED plan, significantly reduces flood damage and hazard in the Plaza area, but it does not provide a 100-year level of protection against significant damage. Its net social well being impacts are positive because of its capability of reducing flood hazard and hazard to human life. Its cultural and esthetic impacts on the Plaza are only moderately adverse. Its geographic scope is limited and is probably perceived to be lacking by the general public and especially residents of areas downstream of the Plaza.

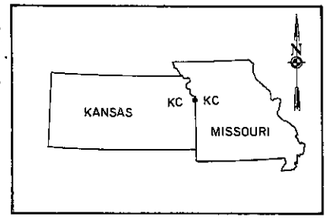
On the other hand, plan BCP 5 has adequate coverage of the critical problem areas on Brush Creek but does so at the expense of economic efficiency and some of the cultural and esthetic attributes along Brush Creek, specifically in the Volker Fountain area.

The compromise plan offered in the previous trade-off analysis is the tentatively selected plan. It is recognized that the plan will require a certain amount of additional evaluation, and must be included in the final array of plans in the final report. Subsequent planning efforts will involve refinement of beneficial and adverse effects of this plan and mitigation requirements. It would then be incorporated in the final array.



LOCATION

10 0 10 20
SCALE IN MILES



NOT TO SCALE

WYANDOTTE CO. KANSAS
JACKSON CO. MISSOURI
WYANDOTTE CO.
JOHNSON CO.
47TH STREET
ARMOUR BOULEVARD
MAIN STREET
SOUTHWEST TRAFFICWAY
SOUTHWEST BOULEVARD
BROADWAY
PLAZA SHOPPING DISTRICT
47TH STREET
350
56
BRUSH CREEK BOULEVARD
SWOPE PARKWAY
VAN BRUNT BOULEVARD
BLUE PARKWAY
350
WESTWOOD
WEST-WOOD HILLS
MISSION WOODS
ROELAND PARK
58
169
56
50
FAIRWAY
WARC PARKWAY
WARD PARKWAY
VOLKER BOULEVARD
LOOSE PARK
KANSAS CITY, MO.
PROSPECT AVENUE
SWOPE PARKWAY
BLUE RIVER
TOWN FORK
635
MISSION
MISSION SHOPPING CENTER
JOHNSON DRIVE
ROCK CREEK
ROCK CREEK DRIVE
STATE LINE ROAD
WARD PARKWAY
WORNALL ROAD
BROOKSIDE BOULEVARD
TROOST AVENUE
THE PASEO
FAIRWAY
BRUSH CREEK
MISSION ROAD
MISSION HILLS
COUNTRYSIDE
58
ROCK CREEK
MISSION
ROE AVENUE
63RD STREET
MEYER BOULEVARD
MEYER BOULEVARD
58
69
OVERLAND PARK
PRAIRIE VILLAGE
PRAIRIE VILLAGE SHOPPING CENTER
METCALF AVENUE
NALL AVENUE
JOHNSON CO.
JACKSON CO.
GREGORY BOULEVARD
75TH STREET
BRUSH CREEK
KANSAS
MISSOURI
N
2000 0 2000 4000 6000
SCALE IN FEET

BRUSH CREEK AND TRIBUTARIES
MISSOURI AND KANSAS

STUDY AREA

In 1 sheet | Sheet No. 1 | Scale: as shown

CORPS OF ENGINEERS U. S. ARMY
KANSAS CITY DISTRICT

PLATE NO. 1

LEGEND

- HIGH DENSITY RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- PUBLIC-QUASI PUBLIC
- PARKS
- OPEN SPACE
- RECREATION
- SCHOOLS
- CHURCHS

NOTE:

OPEN AREAS ARE LOW TO MEDIUM DENSITY RESIDENTIAL.

N

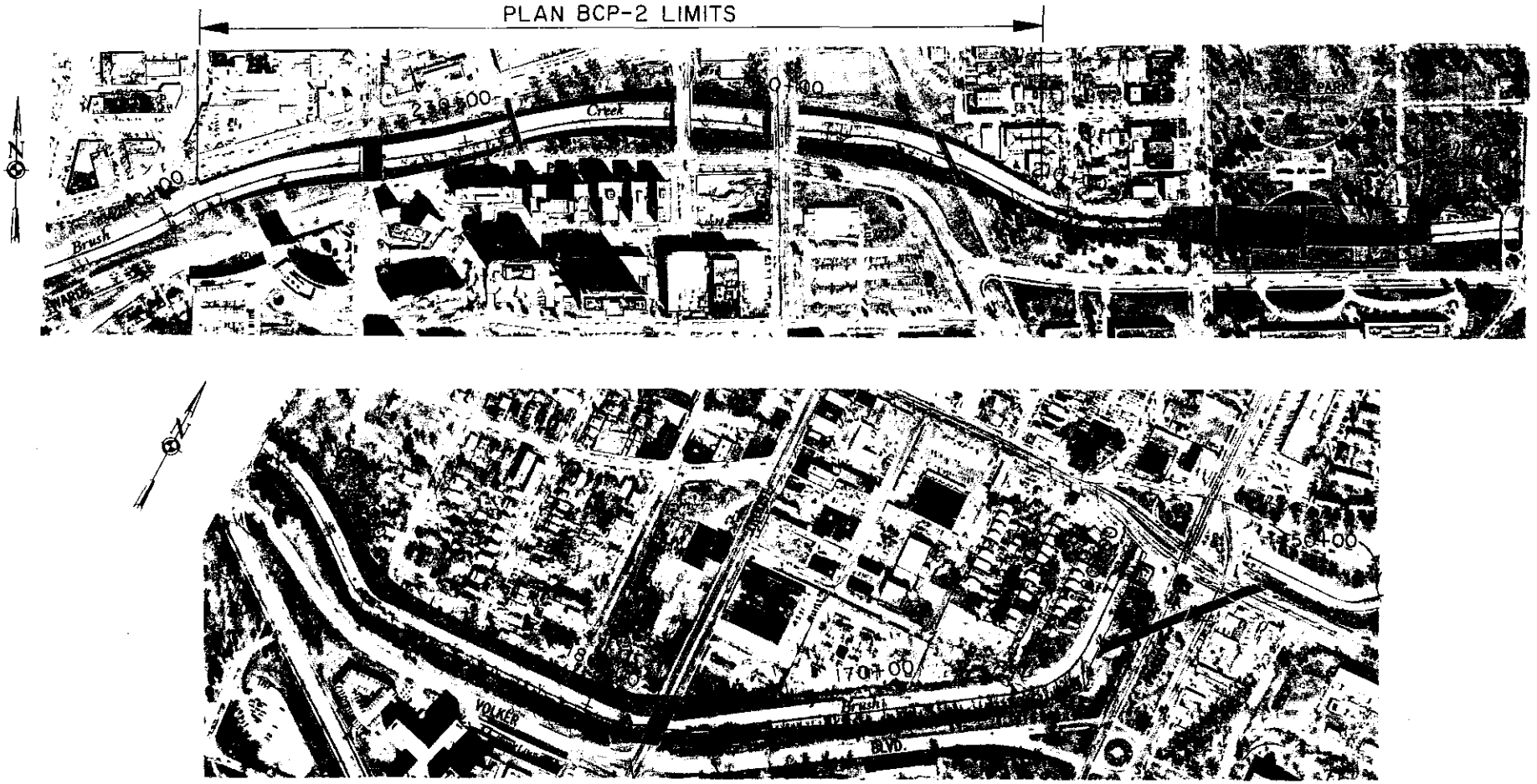
0 .5 1 2

MILES

VHS

BASIN LAND USE

PLATE 2



400 0 400 800

SCALE IN FEET

LEGEND

BRIDGE REPLACEMENTS_____

CHANNEL MODIFICATIONS_____

BRUSH CREEK AND TRIBUTARIES

MISSOURI AND KANSAS

PLAN VIEW

BRIDGE AND CHANNEL

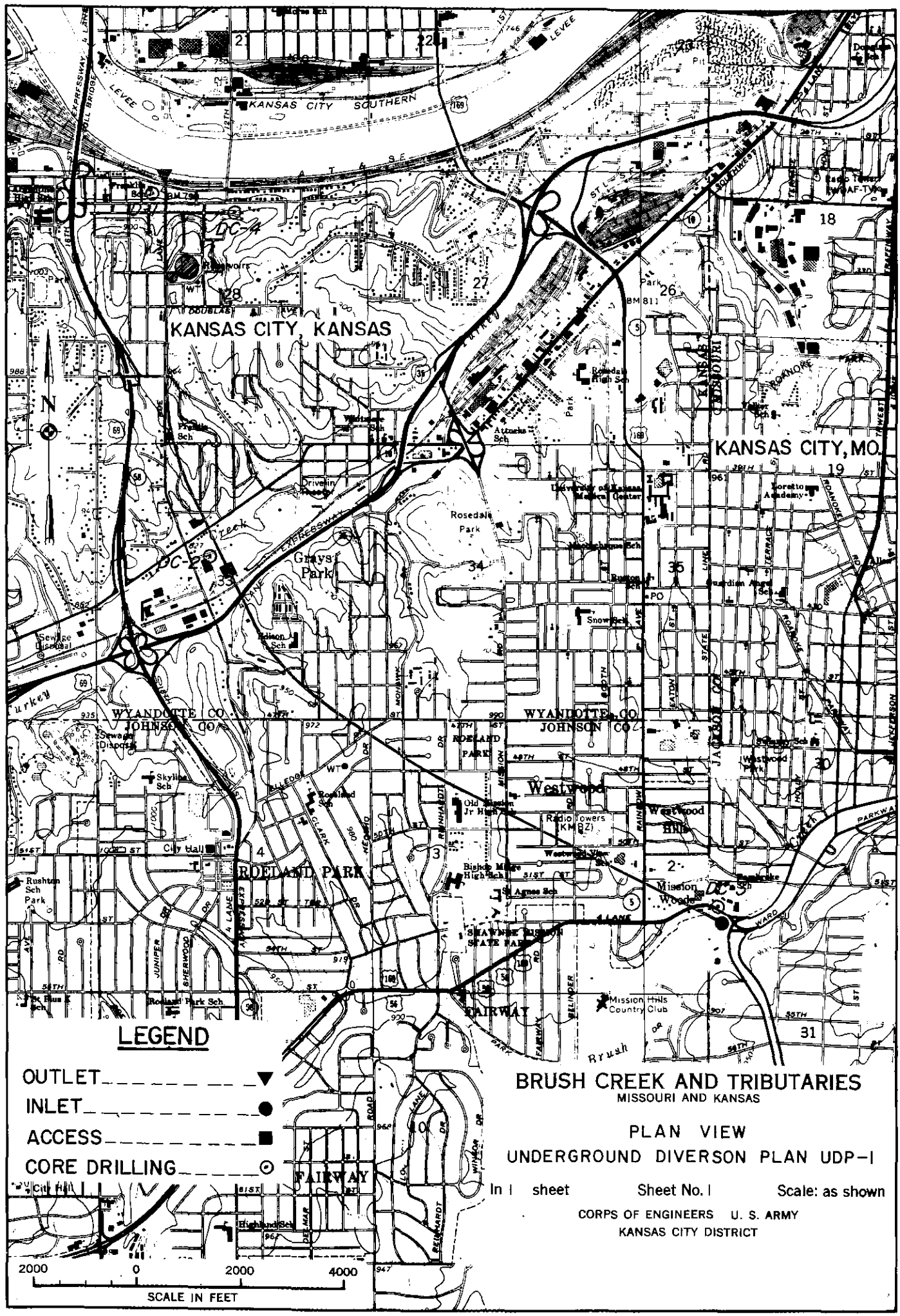
PLANS BCP-2 AND BCP-5

In 1 sheet Sheet No. 1 Scale: as shown

CORPS OF ENGINEERS U. S. ARMY

KANSAS CITY DISTRICT

PLATE NO. 3



LEGEND

OUTLET ▼

INLET ●

ACCESS ■

CORE DRILLING ⊙

BRUSH CREEK AND TRIBUTARIES

MISSOURI AND KANSAS

PLAN VIEW

UNDERGROUND DIVERSON PLAN UDP-I

In 1 sheet Sheet No. 1 Scale: as shown

CORPS OF ENGINEERS U. S. ARMY

KANSAS CITY DISTRICT

PLATE NO. 4

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

Proposed Flood Protection Plan for Brush Creek, Missouri and Kansas

The responsible lead agency is the Kansas City District, Corps of Engineers. The responsible cooperating agencies are the US Fish and Wildlife Service, Environmental Protection Agency, and Federal Emergency Management Agency.

Abstract: The Brush Creek Basin, which can be catagorized as fully developed, covers approximately 29.4 square miles within the Kansas City Metropolitan Region. On 12-13 September 1977, the basin experienced over 12 inches of rain within a 48 hour period which resulted in a flood of catastrophic proportions. Twelve lives were lost and over $66 million of flood damages occurred within the basin. The Kansas City District has investigated various solutions for this problem. Over 20 alternatives were initially considered and four were selected for detailed study. Plan BCP2, consisting of limited bridge and channel modifications, would only provide flood protection to the Plaza area. Plan BCP5, consisting of more extensive bridge and channel modifications, would provide flood protection to additional areas located downstream of the Plaza. Plan UDP1, consisting of an underground diversion tunnel from Brush Creek at State Line to the Kansas River, would intercept peak Brush Creek flood flows and divert them to the Kansas River. Plan CP3 is a combination of Plan BCP2 and UDP1 and would provide SPF protection.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY JUNE 1980

If you would like further information on this environmental impact statement, please contact:
Mr. Dick Taylor
Kansas City District, Corps of Engineers
Room 700
601 East 12th Street
Kansas City, Missouri 64106
Commercial Telephone: (816) 374-3672
FTS Telephone: 758-3672

TABLE 1

LIST OF PREPARERS

Name	Expertise	Experience	Professional Discipline
William L. Smith	Urban Planning	10 years experience in EIS studies for Van Doren-Hazard-Stallings (VHS)	Planner & Engineer
John W. White	Hydraulics-hydrology	7 years experience in planning - design for VHS	Engineer
Dr. Larry J. Schmits	Archeology	8 years experience in archeological research and field work.	Archeologist
Dr. C. Michael Cowan	Biology	15 years experience in field of expertise, 10 years experience with EIS preparation	Biologist
Jane F. Flynn	History	5 years experience in field of expertise. 7 years experience in social science and community studies.	Historian

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

PROPOSED FLOOD PROTECTION
FOR
BRUSH CREEK, MISSOURI AND KANSAS

TABLE OF CONTENTS

TABLES

SUMMARY

This chapter is provided to identify the major factors and issues which were considered during the planning process. It also provides a brief discussion of the influence that these factors and issues have had on planning decisions. The identification of the environmental requirements which would have to be met by each alternative are also briefly discussed.

MAJOR CONCLUSIONS AND FINDINGS

Three distinct plan designations are required in the planning process. These are (1) the "tentatively selected plan", (2) the plan which best provides for national economic development (NED) by addressing planning objectives which maximum net economic benefits, and (3) the plan which meets planning objectives with the greatest enhancement of environmental quality (EQ).

Tentatively Selected Plan

See Page 41 of the Main Report for a discussion of the "Tentatively Selected Plan."

National Economic Development (NED) Plan

See Page 40 of the Main Report for a discussion of the "NED Plan".

Environmental Quality (EQ) Plan

See Page 40 of the Main Report for a discussion of the "EQ Plan".

AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

No areas of controversy which have been the subject of major disagreement among public interests have occurred to this point in the study. The only unresolved issue is the relationship between the Parks and Recreation Departments planning and the alternative plans in the final stage 3 array. This issue is unresolved because of the timing of the two planning efforts and not because of controversy. It should be noted that a conceptual development plan for the Brush Creek channel prepared for the Parks and Recreation Department was available during the course of plan formulation. This plan was quite general in nature and represented only potential "concepts" concerning design details which could be addressed in final design.

RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

Table identifies the relationships between each of the plans in the stage 3 final array and the environmental laws, executive orders and policies of Federal, State and local agencies. Coordination with the Fish and Wildlife Service indicates that there are no threatened or endangered species in the basin. A box elder, located near Brush Creek east of the State line, was identified by the Fish and Wildlife Service as a Missouri State Champion tree. This tree would not be affected.

NEED FOR AND OBJECTIVES OF ACTION

Study Authority

This study was authorized by a resolution of the Committee on Public Works, United States Senate on 9 March 1971, which requested the Corps of Engineers to provide "a plan for the comprehensive development of the water and related land resources of the metropolitan region of Kansas City, Missouri and Kansas, with due consideration for other planning activities being pursued . . . . such study to include appropriate consideration of flood plain management practices as an alternative or supplement to works of improvement."

Public Concerns

Public concern for this study is based on the need to reduce potential flood damage in the Brush Creek basin. This concern was related to a severe flood that occurred in September 1977. The total economic loss in this flood was $66,406,000 and 12 persons lost their lives. An additional concern in the study, which represents both a problem and an opportunity is the unique activities and visual characteristics of the Country Club Plaza Plaza and Nelson Art Gallery vicinity.

TABLE 1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

	Plan BCP 2	Plan BCP 5	Plan UDP 1	Plan CP 3
FEDERAL POLICIES				
Fish and Wildlife Coordination Act	← All plans in full compliance →			
National Historic Preservation Act of 1966	← All plans in partial compliance →			
National Environmental Policy Act	← All plans in full compliance →			
Federal Water Pollution Control Act Amend. of 1972	← All plans in full compliance →			
Endangered Species Act of 1973	← All plans in full compliance →			
Flood Plain Management (E.O. 11988)	← N/A basin fully developed →			
Protection of Wetlands (E.O. 11990)	← All plans in partial compliance →			
STATE AND LOCAL POLICIES				
City of Kansas City, Missouri Noise Ordinance	← All plans in full compliance →			
City of Kansas City, Kansas Noise Ordinance	← All plans in full compliance →			
City of Kansas City, Missouri Air Quality Ordinance	← All plans in full compliance →			
City of Kansas City, Kansas Air Quality Ordinance	← All plans in full compliance →			
LAND USE PLANS				
Land Use Zoning, Kansas City, Missouri	← All plans in full compliance →			
REQUIRED FEDERAL ENTITLEMENTS				
Section 404 Permit	← All plans in partial compliance →			

PLANNING OBJECTIVES

The following planning objectives were set forth to aid in the preparation and evaluation of specific plans.

a. Reduce the flood damage potential on Brush Creek in Kansas City, Missouri, on Town Fork in Kansas City from 63rd Street to its confluence with Brush Creek, and on Rock Creek in Johnson County from Roeland Drive to its confluence with Brush Creek.

b. Reduce the hazard to human life from flooding in the above study areas.

c. Increase recreational potential in the study areas in conjunction with flood hazard reduction.

d. Provide transportation improvements in the study areas in conjunction with flood hazard reduction.

e. Maintain the significant esthetic and cultural qualities within the Brush Creek study area.

ALTERNATIVES

A substantial number of alternatives were explored and analyzed during the initial stages of the plan formation. These plans included nonstructural measures as well as structural measures and resulted in identification of alternative plans throughout the Brush Creek Basin including the Rock Creek and Town Fork reaches. It should be noted that during early stages of plan formulation, a major effort was made to identify the planning being undertaken by others in the basin. These plans by others were included in the array of alternatives developed for the basin as either separate alternatives or as an element in a more comprehensive alternative.

The following discussion provides a cursory understanding of the possible solutions considered in the planning process. It also indicates the results of the evaluation of the possible solutions and whether the solution was considered in detailed planning. (Reference pages Technical Support Appendixes.)

PLANS ELIMINATED FROM FURTHER STUDY

Solution 1 Flood Proofing (Nonstructural Solution Throughout the Basin)

In the Plaza area of the Brush Creek Basin selected commercial structures were examined and found to be physically unsuitable for flood proofing because of age and condition. Flood proofing in the form of relocating high value contents from basements of businesses to other locations has already been accomplished privately. Residences were examined and many were found to be physically unsuitable for flood proofing.

Some residences in both the Town Fork and Rock Creek reaches could benefit from flood proofing. The value of this flood proofing would depend on the frequency and severity of the flooding and residential value and would require an analysis on a structure by structure basis. Flood proofing of the commercial structures in the Rock Creek Basin was found not to be practical.

Results of these analyses indicated that flood proofing could be included in nonstructural alternative plans for local implementation. However, they were not considered further in the plan formulation process.

Solution 2. Permanent Evacuation (Nonstructural Solution Throughout the Basin)

Most commercial structures in the Brush Creek reaches of the basin are not subject to floods less than 25 year frequency and, therefore, should not be considered for evacuation. Two residential areas on the left bank of Brush Creek, one on Virginia and Tracy Streets and the second on Harrison, Charlotte, Campbell and Holmes Streets, may be partially subject to 10 year flood hazards and were analyzed in detail. However, the cost and social disruption of such relocation caused this alternative solution to be eliminated from further consideration. It should also be noted that both areas have characteristics and legacies which could qualify them for historic designation by the City of Kansas City, Missouri.

In both the Town Fork and Rock Creek reaches the number of houses and cumulative or individual structural damages were not found to be significant enough to warrant an evacuation plan. This alternative solution was, therefore, not considered further.

Solution 3. Temporary Evacuation (Nonstructural Solution Throughout the Basin)

This alternate solution was considered as an alternative to permanent evacuation. It was determined that insufficient warning time exists, even with sophisticated warning devices, to significantly reduce hazard to life and potential for property damage. It was eliminated from further consideration for this reason.

Solution 4. Flood Insurance (Nonstructural Solution Throughout The Basin)

Kansas City, Missouri and Fairway, Mission Hills and Mission, Kansas are participating in the National Flood Insurance Program (NFIP). Flood insurance spreads the risk and reduces the relative magnitude of individual losses, but does not reduce the actual damages incurred. It was eliminated from further consideration.

Solution 5. Regulatory Actions (Nonstructural Solution Throughout The Basin)

Communities participating in the NFIP have regulatory measures to minimize increases in the existing flood hazard resulting from new development. This alternative solution was not considered further.

Solution 6. Detention Structures (Structural Solution Throughout the Basin)

Use of detention structures was evaluated throughout the Brush Creek basin including the Town Fork and Rock Creek reaches. In the Town Fork and Rock Creek reaches no suitable locations exist which would accommodate major detention structures without relocation of existing development. On the main branch of Brush Creek, immediately upstream of State Line Road, some detention storage is available in a private golf course. Extensive evacuation of high value homes, road relocations and disruption of the golf course would be required to provide the storage necessary to substantially alter a 100-year flood. This lack of acceptable detention sites eliminated this solution from further study.

Solution 7. Levee or Floodwall (Structural Solution Throughout the Basin)

The use of levee or floodwall construction was evaluated for feasibility and effectiveness. In the critical area of the Plaza it was found that the existing bridges and other significant physical constraints precluded construction of these measures. Two sections of Brush Creek lend themselves to this solution. These areas are downstream from the Plaza, the left bank between Main and Oak and the right bank downstream from Cleveland. However, this solution would have to be made in conjunction with bridge and channel changes to be effective. It was analyzed as a part of the bridge and channel solution and was found to have only little significance. Application of this solution in these two areas was eliminated from further consideration.

Use of levee or floodwall construction on Town Fork and Rock Creek was also investigated. These solutions were eliminated because no suitable sites were found.

Solution 8. Channel Enlargement (Structural Solution Town Fork and Rock Creek Reaches)

In both reaches there exist constraints to channel enlargement. In Town Fork the channel has been enlarged to practical limits by the City of Kansas City, Missouri. An exception would be channel widening in the immediate vicinity of bridges if bridge openings were modified as part of local programs.

Much the same situation exists along the Rock Creek channel. The bottom of this channel is rock and widening would be possible to reduce severity of frequent (5–year to 10–year) floods, but could not contain larger floods. These measures could be implemented locally. However, this solution was eliminated in both reaches because of the lack of economic feasibility.

Solution 9. Bridge Modification (Structural Solution Throughout the Basin)

Five bridges on Town Fork were analyzed for replacement. The structures investigated are located on 51st Street, 55th Street, 59th Street, Prospect Avenue and Park Avenue. All but one of these bridges pass the flow from a 10-year flood. It was determined that increasing the capacity of these bridges would significantly increase flooding downstream. The exception to this was the 51st Street bridge where a tunnel under Swope Parkway could be used in conjunction with the bridge replacement. However, all these alternatives were found to be economically infeasible and caused this set of alternative solutions to be eliminated from further consideration.

Each of the bridges on Brush Creek was found to increase flood depths and twelve of the bridges appeared to significantly increase flood damages. The twelve bridges are Prospect, Woodland, Paseo, Troost, Rockhill, the Rockhill pedestrian bridge, KCPS RR bridge, Main, J.C. Nichols, the Plaza Pedestrian Bridge, Wornall, Roanoke, and Belleview. Analysis of each of these structures indicated that five structures were the most critical; Paseo, Troost, the KCPS RR bridge, the Plaza Pedestrian Bridge and Wornall bridge. All other structures, while affecting flood depths, were not found to reduce flood damage appreciably and were eliminated from further investigation.

Only one set of bridges in the Rock Creek reach was found to significantly obstruct flow. These bridges located on the ramps at 18th Street Expressway and U.S. 50 contribute to the flooding of Mission Shopping Center. Economic analysis of the bridges indicated that replacement was not feasible.

Solution 10. Underground Diversion (Structural Solution on Town Fork and Rock Creek and Other Areas)

A diversion tunnel to avoid damages on Rock Creek was explored both as an exclusive alternative and as part of a larger tunnel plan for Brush Creek. In both instances the existing damages on Rock Creek did not warrant further consideration of the tunnel. A diversion tunnel on the Town Fork was found not to offer a suitable solution.

Several variations of a plan to divert flood flow from the Brush Creek reach were also analyzed and discarded. Among the discarded plans was the alternative to provide a large diversion through two parallel tunnels. This plan would have diverted approximately 10,500 cfs from Brush Creek.

A modification considered to this two tunnel alternative which was the use of one diversion tunnel from Brush Creek and a second parallel tunnel from Turkey Creek. The Turkey Creek tunnel would divert flood flows from the Turkey Creek Basin. This plan was discarded because only 5,200 to 5,400 cfs could be diverted from Turkey Creek. This volume would not significantly affect the potential downstream damages.

An alignment of the tunnel was explored which would benefit the Kansas communities of Mission and Fairway. Two inlets would have been provided with this alternative, one located on Rock Creek and the other on Brush Creek. This alternative along with a variation which would have placed the Kansas inlet near Mission Hills, were eliminated because they were not economically feasible.

Solution 11. Tunnels (Structural Solution in the Town Fork and Rock Creek Reaches)

The use of new or enlarged tunnels was considered in both the Town Fork and Rock Creek study reaches. In Town Fork the tunnel considered extended from 51st Street to Brush Creek under Swope Parkway. This tunnel would augment the existing tunnel which will carry less than a 10-year discharge. Analysis of costs and potential economic benefits indicated that the tunnel was not economically feasible.

The existing tunnel under Mission Shopping Center has less than a 5 year capacity. To augment this capacity a new adjacent tunnel was considered under the Center's parking lot. However, economic analysis indicated that the additional tunnel was not feasible and it was eliminated from further study.

WITHOUT CONDITION - THE NO ACTION ALTERNATIVE

The future conditions associated with hydrologic and hydraulic characteristics are not expected to change significantly in the future in the absence of Federal actions. The basin is fully developed and it is unlikely that any redevelopment will create significantly different runoff amounts or patterns. It is also unlikely that any future development will contribute to the increased potential for economic losses, because all communities are participating in the National Flood Insurance Program (NFIP). Regulations associated with the NFIP require all new development that encroaches into the 100 year flood plain will be floodproofed or elevated above the 100 year level.

Plans By Others

Independent study of flooding problems, dating from before 1970, have been conducted in several reaches of the basin. However, most of the recommendations in these studies have not been implemented. Several reasons exist for this lack of implementation. The major reason is that individual problem solutions often increase flooding problems elsewhere. What is needed is a comprehensive coordinated plan. It appears that the possibility for such a coordinated action independent of federal action is remote.

Several plans and studies which have been made or are underway deserve special attention. One is the 1973 Recreation Master Plan prepared by Kansas City, Missouri. This plan states that several neighborhoods along Brush Creek have only minimal amounts of open space in comparison with accepted standards. A lack of continuity was also noted in the parkway along Brush Creek resulting from the restrictions caused by bridges, culverts and tunnels. Augmenting this 1973 study is preliminary design of the Brush Creek Development Plan that is currently being prepared by a consultant to the Kansas City, Missouri Parks and Recreation Department. This plan is a conceptual design of the entire section of recreational development of Brush Creek from the State Line eastward to the Blue River.

Another improvement being considered by Kansas City, Missouri is the redesign of the Wornall Road Bridge. This bridge was a major problem point in the 1977 flood. Its redesign and reconstruction was of high interest to local businessmen and the City. This project has progressed to the point of preliminary design.

Both of these plans are contingent on a more comprehensive plan. The recreation plan would improve recreational opportunities and continuity of the parkway. However, the hydraulic analyses made in association with the plan were based on a number of assumptions which are not accurate unless other improvements are made. One such assumption was that bridges would have no impact on the flood flow. Analysis of the 1977 flood indicated, of course, that bridges were a key hydraulic feature contributing to the level of flood damage.

Replacement of the Wornall bridge presents a similar situation. The channel constraints and geometric constraints on the bridge design mean that the new bridge alone will not reduce damage during floods approaching a frequency of 100 years. In fact, hydraulic models of the bridge opening shown in the preliminary plans indicated that the new bridge may increase the flood stage during such a flood.

Other Factors Related to the "Future Without Condition"

Transportation has also been identified as a concern in the discussion of flood problems. Not only do many of the bridge crossings obstruct flow, but a number of bridges present transportation problems because of physical condition and their lack of traffic capacity. The City of Kansas City, Missouri estimates the economic life of a bridge at 30 years and a practical useful life of 50 years. Several bridges which were constructed in the early 1900's may, therefore, be due for replacement.

Community functions within the basin have been relatively stable over the last few decades. The commercial activity on the Plaza has made the area amajor commercial center of the region. It has registered continuous growth in both volume of sales and diversity of economic base. During the 1977 flood several businesses suffered major damages to high value contents. This plus the lives lost in the Plaza area as a result of the flood has raised concern about the continued vitality of the area.

Several houses along the left bank of Brush Creek between Rockhill Road and the Paseo were also damaged during the 1977 flood. Some were, in fact, damaged beyond repair. These residential areas are presently stressed by pressures for redevelopment and other factors which affect their continued vitality. The added threat of the flood hazard represented by Brush Creek additionally affects this areas vitality.

The flood damage in the Rock Creek reach has been documented from the mid 1960's. However, the effects of the continued threat of flooding is uncertain. While the area has continued to grow and there are no signs of instability in the residential areas, there have been a number of businesses which have chosen to relocate. It is possible that continued flooding could lead to decreased property values and adverse economic effects.

No flood damage in the Town Fork reach was documented prior to the 1977 flood. However, public input had revealed that flooding has been rather frequent immediately upstream from some bridges. As in the Rock Creek subbasin, continued flooding could decrease property values, affect the vitality of the area and contribute to the decline of the neighborhoods in the subbasin.

Future conditions without federal actions would appear to be a continuation of the trends that have emerged over the past decade. These are, a lack of comprehensive efforts to address the flooding problems and an increasing potential that the vitality of both the residential and commercial areas in the flood hazard areas will be adversely affected. This decrease in vitality will probably be most rapid in the residential areas within Kansas City, Missouri and the commercial areas of the Rock Creek basin. However, other residential and commercial areas will also be affected in the long run.

The two specific plans being considered by other agencies within the City of Kansas City, Missouri, the Brush Creek Concept Development Plan and the Wornall bridge demonstrate the need for a comprehensive approach. As identified in the discussion above, neither of the plans can be effective by themselves and their objectives can not be completely attained unless a more comprehensive set of actions are taken to address large flood flows (100 year frequency or larger).

PLANS CONSIDERED IN DETAIL

Four plans are contained in the array of alternatives given detailed study. Two of these plans are based on bridge and channel modifications. The other two are a diversion tunnel to the Kansas River and a combined plan of diversion and bridge and channel modification. All the plans are designed to protect the Brush Creek Reach of the Basin. No solutions were found to be economically feasible in the Town Fork or Rock Creek Reaches.

Limited Bridge and Channel Plan (This Plan is Designated as Plan BCP 2)

Plan Discussion

This plan includes the widening of the channel particularly at bridge openings, and replacement of three bridges. The length of channel to be affected extends from about 600 feet upstream of the Wornall bridge to immediately downstream of the KCPS RR bridge. Because of the net benefits it would provide it was identified as the NED Plan.

The critical element in this plan from a flood protection perspective is the replacement of the Wornall bridge, the Plaza Pedestrian Bridge and the KCPS RR bridge. All three of these structures severely affect flood flows through the Plaza area. Their ability to create a highly damaging backwater effect was readily visible during the 1977 flood. It should be noted that the improvement of one of these bridges without improving the downstream bridges could increase flooding conditions rather than reducing them. This results from a flow increased by the larger upstream channel being impeded by a downstream constriction. Therefore, reduction of damages in the Plaza area is contingent on all three bridge restrictions being altered to allow greater flows. This would be accomplished through bridge replacement.

Complimenting these bridge improvements are channel modifications which would widen the channel slightly and change the typical section to a rectangular shape. (Reference page .) The vertical sections would be protected by walls ranging in height from 15 feet at the bridges to 4.5 feet between the bridges. The channelized opening (i.e., from wall to wall) would also vary. The greatest width would be at the bridge opening and the narrowest point would be midway between the bridges.

It is also important that this plan not contribute to increased flooding conditions downstream. Analyses indicate that this plan meets this requirement. This can be mainly attributed to the existing Oak and Locust conduit which is an obstruction to downstream flows. This restriction also tends to increase depths of flooding in the Plaza area because of its backwater effect.

This plan would provide protection from a 100 year flood event for 35 of the 89 commercial structures and two of the 128 residential structures in the Brush Creek Reach. It is important to note, however, that all 35 of the commercial structures protected by this plan are in the Plaza area where structures have extremely high values. The percent of damage in dollars avoided through this plan are much greater than the percentage of structures would indicate. (Reference page 30 Economic Appendix.)

A 500 year flood event with this plan in place would affect 155 of 189 commercial structures and 161 of the 172 residential structures. Once again, however, the 34 commercial structures and the 11 residential structures protected are high value structures in the Plaza area and the economic benefits gained through this protection are not commensurate with the percentage of total structures protected.

Mitigation Requirements

Mitigation of this plan will require consideration of special esthetic and recreational treatment of the plan to make the design compatible with the Plaza area. This need results from the fact that the Plaza is a unique commercial and recreational area eligible for nomination to the National Register of Historic Places. The mitigation would be of the standards and purpose suggested by the concept plan developed for the Kansas City, Missouri Parks and Recreation Department. Measures can not, however, duplicate the Park and Recreation Department's plan because of the placement of the pedestrian and bicycle access points and the horizontal obstructions they suggest would significantly reduce the level of protection.

Specific steps which could be applied are: (1) the use of form liners to provide form and texture to concrete walls, (2) railing design that is similar to that found in the Plaza area, (3) overall design detailing which compliments the Plaza, (4) access points for pedestrian and bicycles at points between the bridges, (5) structuring pedestrian area of these access points which are similar to those in the Plaza, and (6) grading and landscaping of the unsurfaced areas to integrate the channel with the surrounding environment.

Comprehensive Bridge and Channel Plan (This Plan is Designated as Plan BCP 5)

Plan Discussion

This plan includes the elements discussed above for Plan BCP 2 as well as modifications from the KCPS RR bridge downstream to The Paseo. The additional modifications in replacement of the Troost bridge, an open channel between Oak and Rockhill, a new open channel at the Paseo to augment the existing tunnel, and changes in the channel cross section similar to those identified in Plan BCP 2.

During a 100 year flood event this plan would provide protection for 61 of the 89 commercial and 33 of the 128 residential structures in the Brush Creek reach. The plan has a similar level of benefits during a 500 year event. This plan would protect 73 of the 187 commercial and 45 of the 172 residential structures which would be affected by a 500 year flood. (Reference page 32 Economic Appendix.)

This plan would require the acquisition of five residential structures and 2 sheds or garages in the residential area between Rockhill and Troost. It would also require the acquisition of one commercial structure at the southeast corner of The Paseo and 47th Street.

Two features of the Brush Creek Parkway which would be affected by this plan are the open grass mall between the Nelson Gallery and Midwest Research Institute and the Robert L. Sweet Memorial Arboretum.

The grass mall area which extends between Oak and Rockhill Road provides a significant open space and the site of the Volker fountain. It was intended, when initially designed, to provide a panaromic view of the Gallery from Volker Boulevard. Under this plan an open channel would be cut through this area. The channel cut and the accompaning backslope could encroach on the fountain but would not result in its relocation.

The Sweet Arboretum is located just upstream of Oak Street along Volker Boulevard. This memorial to the founder of the Robert L. Sweet Lumber Company contains 38 different species of trees. It was dedicated in May of 1961 and 150 individual trees were planted. Widening of the channel as it approaches Oak Street will cause the loss of some of the ground within the arboretum and the removal of some of the trees.

Two roadways would be permanently altered by this plan. Locust between Rockhill and Oak would be terminated in the vicinity of the open cut and would no longer be a through facility. In addition, the northbound approach of The Paseo south of 47th Street would be realigned westward. The Paseo is basically a four (4) lane, divided facility south of 47th tapering to a four (4) lane undivided roadway north of 47th. (Reference Plate C-15 Technical Support Appendices.) Realignment of the northbound approach westward would place this taper south of the intersection. It would also restrict access to the businesses that are now served by the northbound lanes.

Mitigation Requirements

Mitigation of potential consequences associated with this plan are the same as discussed in the limited bridge and channel plan for the common segment of the channel that the two plans share. Downstream from the KCPS RR bridge, Plan BCP 5 would appear to require mitigation for its effects on both the Sweet Arboretum and the Frank A. Theis Memorial mall south of the Nelson Gallery.

It is anticipated that the mitigation for the Arboretum would include the relocation of some of the individual trees which could be successfully moved and planting of trees to offset the loss of specimens which could not be moved. At the present time, the number and type of trees affected by the channel increase are not known.

The impact of open channel on the grass mall between Oak and Rockhill will require mitigation to maintain the visual quality of the site and restore the Volker Fountain if it is affected by the open channel. It is anticipated that this mitigation would take a form similar to that described for the Plaza area. Measures would include texturing and shaping of the channel walls, landscaping of the area and possibly the planning of a special use area associated with the mall.

It should be noted that this open cut solves one of the greatest inhibitions to the planned use of the Brush Creek parkway as a continuous linear park. This inhibitor being the tunnel between Rockhill and Locust. The open cut would remove this inhibition allowing a continuous parkway from The Paseo through the Plaza and into Kansas. The open channel proposed at The Paseo would remove the second major obstacle to access along the channel. Implementation of this element of the plan would allow for creation of an attractive pedestrian parkway extending from State Line Road to the confluence of Brush Creek with the Blue River. This corridor could be connected with two north-south parkways; Ward Parkway on the west and Swope Parkway on the east, to serve as the key link in a parkway network which would provide pedestrian and bicycle to much of the central part of the City.

Underground Diversion Tunnel (Designated as Plan UPD 1)

Plan Discussion

The underground diversion tunnel plan calls for a tunnel of circular section to be "drilled" from the Brush Channel near the State Line northwestward to the Kansas River. The tunnel would be located in Bethany Falls limestone and be approximately 17 feet in diameter and 20,100 feet long.

Three access points would be provided. One would be at the intake located near Ward Parkway and the State Line. The outlet would be located in Kansas City, Kansas near Roe Boulevard and the Kansas River. The third access point would be located near the intersection of Roe Boulevard and I-35. This point would be the access point for removal of debris and the long term maintenance of the tunnel. (Reference Plate C-18 Technical Support Appendix.)

It is anticipated that the tunnel inlet would be designed to allow flow into the tunnel when the flow in Brush Creek reached 6,000 cfs. This corresponds to a 5–8 year flood event. Diversion would also cease at 6,000 cfs. With these conditions the tunnel would operate one to two hours per 5 year period and approximately 40 hours over a 100 year period. It is anticipated that this infrequent use will not require that the tunnel be fully lined even though the velocities of water in the tunnel may reach 25 to 28 feet per second.

Implementation of the tunnel plan would result in protection from the 100 year flood event for 66 of the 89 commercial and 85 of the 128 residential structures in the Brush Creek reach. During the 500 year flood event, the tunnel would protect 103 of the 189 commercial and 52 of the 172 residential structures. (Reference page 34 Economic Support Appendix.)

Prospects for implementation of this plan are somewhat complicated in that the areas benefited by the tunnel are all in Kansas City, Missouri, while the project is located in Kansas City, Kansas and other Kansas communities. The potential institutional problems which will have to be addressed include identification of local sponsor, local and state contributions, maintenance agreements and the possibility of problems for decision makers in Kansas. These possible problems are associated with the potential for public opposition to the project. This citation of potential opposition is not based on hard evidence or attitudinal surveys. Rather it is based on the fact that several areas of Kansas City, Kansas have been affected by subsidence of old limestone mines. These events have established a concern among some for any operation that can be associated with mining of limestone. This legacy of past faulty practices coupled with the fact that communities in Kansas will not directly benefit from the tunnel may make it difficult for those in Kansas to support the project.

It should be noted that the tunnel diversion would be quite beneficial to some of the planning components outlined in the Brush Creek Concept Plans prepared by the Kansas City , Missouri Parks and Recreation Department. The major benefit would be that some of the planning details suggested in the concept, such as the ponds in channel and the channel level walkways and some of the channel details could be maintained with reduced damage from flooding.

Combined Plans - Underground Diversion and Bridge and Channel Modification (Designated as Plan CP 3)

Plan Discussion

This plan is a combination of the limited bridge and channel modification (BCP 2) and the diversion plan (UDP 1). The discussion which has been provided for each of these plans separately also applies when they are combined. The exception, of course, is the level of protection provided when the two plans are combined.

The combined plan would provide protection for 82 of the 89 commercial and 85 of 128 residential structures during a 100 year flood event. During a 500 year flood event the combined plan would protect 150 of 189 commercial and 54 of 172 residential structures. (Reference page 36 Economic Appendix.)

Mitigation Requirements

The mitigation in the Plaza area which was discussed under the limited bridge and channel plan would also be required under this plan. The only alteration would be that greater flexibility would exist in treatments which could be applied to the channel. The diversion of large flood flows would make the channel capacity somewhat less critical and allow; walkways elevated above the channel floor, some alterations to the channel wall which could not be otherwise allowed because of increased side friction, and landscaping in some areas which could not be otherwise treated.

Tabular Comparison of Plans

The following table (2) provides a comparison discussion of the alternative plans. This comparison identifies general consequence of the detailed plans on the area's significant resources, and economic characteristics, such as total costs, net benefits and benefit-cost ratio.

TABLE - 2 (EIS)

COMPARATIVE IMPACTS OF ALTERNATIVES

(Tentatively Selected Plan – Comprehensive Bridge and Channel Plan (BCP 5)

BASE CONDITION AND ALTERNATIVES	COUNTRY CLUB PLAZA AREA (District eligible for National Register of Historic Places) (Roanoke to K.C.P.S. RR Bridge)			BRUSH CREEK CORRIDOR FROM K.C.P.S. RR BRIDGE TO ROCKHILL ROAD (Contains Nelson Art Gallery and Mall a site eligible for National Register of Historic Places)		BRUSH CREEK CORRIDOR FROM ROCKHILL ROAD TO THE PASEO			AREA ALONG ALIGNMENT OF DIVERSION TUNNEL	PLAN ECONOMICS
	AESTHETICS	RECREATION	TRANSPORTATION	AESTHETICS	RECREATION	TRANSPORTATION	ACQUISITION-RELOCATION	RECREATION	SOCIO-PSYCHOLOGICAL	
BASE CONDITIONS	The aesthetics of Brush Creek channel are not unique. There are some areas with modest landscaping, and low rock walls can be found in several locations providing a focal point and visual relief from the concrete channel. Large trees and the form and shading they provide are the most exceptional natural features in the channel. The bridges and the fixtures on the bridges (such as the light standards on Wornall Road) are important visual elements.	Within the channel there are two access points and one small rather typical playground. The channel itself does provide an area for bicycling and walking.	Streets parallel both banks of the channel. Each street is a part of the major arterial system of the City and they carry substantial traffic volumes. Pedestrian access is provided by a pedestrian bridge over the channel and walkways on the Wornall Road Bridge. In addition to the pedestrian bridge and Wornall Road, there are two other street bridges and one RR bridge.	Two unique areas exist in this section of the Creek. One is the Sweet Arboretum which provides a collection of mature trees not native to the area. The second unique area is the mall and Volker fountain immediately south of the Nelson Art Gallery. The area also contains a variety of open space and areas of mature trees.	Recreation facilities include two access points into the channel. Walkways through the mall and by Volker fountain.	Troost and Paseo are two major north-south arterials which cross Brush Creek.	Not Applicable	There are no access points into the channel and no recreation facilities related to the channel.	Not Applicable	Average annual flood damage base condition Entire area: $1,675,000 Country Club Plaza area: $1,501,800 Nelson Art Gallery area: $64,200 Troost to The Paseo: $75,300 The Paseo to the Blue Rivers $14,700
NO ACTION CONTINUE EXISTING SITUATIONS & CONDITIONS NOTE: THE FUTURE WITHOUT CONDITION IS BASED ON EXISTING PLANS BY THE CITY AND OTHER AGENCIES RELATIVE TO THE FEATURES BEING ANALYZED.	It is assumed that the without condition is reflected by the 1978 Brush Creek Development Concept Plan. This plan would provide visual improvement throughout the channel. Treatments would include plantings and landscaping. Development of texture through landscaping timber and some rock walled areas. The plan would also provide a change of material through water impounded in the channel.	The plan[1] would provide six access points along with setting areas, pedestrian and bicycle paths. The plan is strongly focused toward the pedestrian with a key premise being to tie the Plaza area with the channel recreation. It should be noted that the pedestrian orientation of the channel development and the transportation plan may be in conflict.	It is assumed that the future transportation condition in the basin is reflected by the Brush Creek Transportation Plan[2]. This plan deals with street transportation and calls for the streets parallel to the channel to be one way pairs with Ward Parkway connected directly with Volker Blvd. Based on the K.C. Mo. Parks and Recreation Department plan, a bicycle path is also been designed making use of the channel. It is also anticipated that two bridges, Main and Wornall, would be replaced.	A treatment similar to that identified in the Plaza would be provided in this section. The plan[1] shows impounded water as a means of softening the visual effects of the concrete channel. Through the mall the plans show an open cut with special landscaping treatments near the Volker fountain.	The plan shows six access points with a major access point in the vicinity of the Volker fountain. It also shows access to the Sweet Arboretum. The open channel is used to facilitate access - pedestrian and bicycle - along the creek.	The transportation plan shows an improvement of the 47th Street and Paseo intersection. The modification would result in 47th being realigned to flow directly into Volker Blvd. The Troost Avenue bridge would also be replaced	The realignment of 47th Street would eliminate 6 commercial structures on the southeast corner of the 47th and Paseo intersection.	The park plan indicates the use of an open channel in the area of the 47th Street-Paseo intersection. This open channel would facilitate pedestrian and bicycle access and remove the last obstacle to use of the channel along its entire length. Along the channel from Rockhill to the Paseo the accent is on pedestrian activity and the landscaping is basically the same as other areas discussed.	Not Applicable	Same damages as Base Conditions. Notes: Improvements that have been noted for transportation and recreation have not been analyzed in detail but they appear to provide flood protection only for the frequent flood events (25-30 years) and may, depending on final design, increase damages associated with 100 and 500 year events.
BCP 2 LIMITED BRIDGE & CHANNEL PLAN	Comments: This plan would decrease the amount of land in the channel which is grass covered. It would cause the removal of a number of trees, landscaped areas and rock walls. Visual interest in the channel would also be reduced because of lack of diversity in material, texture and shape. Impact: Negative Notes: 1. Texturing of walls during construction and use of other detailing found on walls in the Plaza would greatly reduce the impact. 2. A relationship exists between this plan and the concept plans through the Plaza because the concept plans were based on the assumption that improvements to bridges had been made.	Comments This plan does not provide access to the channel floor. It would cause the removal of the existing playground. It would not tie the Plaza with the channel. Impact: Negative Notes: 1. The potential exists to provide channel access and pedestrian areas within the basic framework of the plan. 2. The potential also exists to tie the channel to the Plaza.	Comments: The plan deals with the base condition and anticipated plans in an appropriate manner. There would be short term disruptions of traffic flow because of detours, hauling and other construction related activity. Impact: Short term during construction slightly negative. Long term - positive. Notes: 1. The use of the channel as a pedestrian and bicycle corridor would not be affected if access points are provided.	No Direct Effect	No Direct Effect	No Direct Effect	No Direct Effect	No Direct Effect	No Direct Effect	Average annual flood damage with this plan Entire area: $307,100 Country Club Plaza area: $238,300 Nelson Art Gallery area: $64,200 Troost to The Paseo: $75,300 The Paseo to the Blue Rivers: $124,700 B/C ratio 2.77
BCP 5 COMPLETE BRIDGE & CHANNEL PLAN	Same as BCP 2	Same as BCP 2	Same as BCP 2	Comments: The plan as formulated would decrease the visual quality of the area by distracting view of Volker fountain, removal of trees, removal of part of Sweet Arboretum and the disruption of mall and view of the Nelson Art Gallery from Volker Blvd. Impact: Negative Notes: 1. Texturing and other wall treatments which could be applied on the Plaza could also be applied in this area. 2. Grading, planting of trees and other landscaping would allow this to approach the concept plan(1)	Comments: The plan does not allow for access to the channel. It does not allow access to the Volker Fountain or the Sweet Arboretum. Impact: Negative Notes: 1. Provision of access to the channel would reduce impacts. 2. Grading and landscaping of the open cut through the mall would allow for uses such as a natural amphitheatre.	Comments: The plan is in line with the changes anticipated in the Brush Creek Transportation Plan[2]. The open cut through The Paseo would also be in keeping with the Parks and Recreation Department plan to provide a bicycle corridor through the area. Impact: Short term during construction - slightly negative. Long term - positive.	Comments: The plan would require acquisition of 5 houses, 2 sheds or garages and 1 business structure. Impact: Negative	Comments: The plan is basically in keeping with the concept plan[1] particularly in the Paseo area. No access to the channel is provided in the plan. Impacts: Slightly negative Notes: 1. providing access to the channel would reduce the impact. 2. Aesthetic treatments would increase quality.	No Direct Effect	Average annual flood damage with this plan Entire area: $317,600 Country Club Plaza area: $156,200 Nelson Art Gallery area: $2,200 Troost to The Paseo: $37,600 The Paseo to the Blue Rivers: $116,400 B/C ratio 1.09
UDP 1 TUNNEL PLAN	No Direct Effect	Impact: Not known - assumed to be positive. Note: The hydraulic analyses made as part of the Brush Creek Development Concept Plan contained the assumption that the bridges over the channel would not have an impact on flood flow. This plan would divert flood flow and tend to make this assumption valid. However, hydraulic analyses have not been made with the Development Concept Plan and the tunnel considered simultaneously.	No Direct Effect	No Direct Effect	Impact: Not known - assumed to be positive. Note: Same as the comment under Country Club Plaza Area discussion.	No Direct Effect	Not Applicable	Impact: Not known - assumed to be positive. Note: Same as the comment under Country Club Plaza Area discussion.	Comments: At question here is the potential affects of the tunneling operations on the attitudes, opinions and fear of the residences in the tunnel corridor. Impact: Not known - assumed to be highly negative. Note: The impact designation is based on the publics fears of underground quarries in the same general area	Average annual flood damage with this plan Entire area: $233,100 Country Club Plaza area: $178,400 Nelson Art Gallery area: $24,300 Troost to The Paseo: $13,700 The Paseo to the Blue Rivers: $61,800 B/C ratio .58
CP 3 COMBINATION BRIDGE & CHANNEL PLUS TUNNEL	Same as BCP 2	Same as BCP 2	Same as BCP 2	No Direct Effect	Same as UPD 1	No Direct Effect	No Direct Effect	Same as UPD 1	Same as UPD 1	Average annual flood damage with this plan Entire area: $111,400 Country Club Plaza area: $8,700 Nelson Art Gallery area: $24,300 Troost to The Paseo: $12,900 The Paseo to the Blue River: $64,500 B/C ratio .61

1. Brush Creek Development Concept Plan; Parks and Recreation Department, Kansas City, Missouri (in progress).
2. Brush Creek Transportation Plan, Engineering Department, Kansas City, Missouri, 1968.

AFFECTED ENVIRONMENT

ENVIRONMENTAL CONDITIONS

The Brush Creek Basin covers approximately 29.4 square miles. (Reference Plate 1.) Government jurisdiction within this area is divided among two states, three counties and 13 cities. The upper reaches of the basin are within Johnson and Wyandotte Counties in Kansas. The lower reaches are within Jackson County, Missouri. Kansas City, Missouri has by far the greatest share of the municipal jurisdiction.

The basin can be categorized as fully developed. In fact, most parts can be classed as intensely urbanized. The predominate use is residential. This is followed by recreation, and public and quasi-public uses. Areas of commercial uses are relatively small, though quite important, and located generally in the middle portion of the basin. Industrial development is generally limited to the extreme lower reaches. (Reference Plate 2.)

Four of the metro region's sixteen facilities of higher learning are located in the basin along with 30 other major public facilities. Key facilities are the Country Club Plaza District, the nearby Nelson Art Gallery and the educational complex which includes Rockhurst College and the University of Missouri, Kansas City. All of these facilities are cultural centers of the Metropolitan area and are deeply integrated with the identity of the entire urban area.

Socio-economic characteristics of the basin vary dramatically from the upper reaches to the lower. The upper portion of the basin contains areas whose residents have the highest per capita incomes in the metropolitan region. The lower portion of the basin houses residents with very low incomes. Other demographic characteristics tend to follow this same trend. The value of housing and the amount of education are both, for instance, higher in the upper basin than in the lower basin.

The urbanization process in the basin and along the stream course is so complete that little remains of the natural environment. The terrestrial habitat prior to urbanization was probably made up of various forest types. Now, only an occasional remnant specimen of oak and other species associated with the earlier oak-hickory forest can be found. These are generally interspersed with ornamental species in parks. The aquatic habitat in all reaches of the stream have been similarly disturbed. The entire length of Rock and Brush Creek have been altered to some degree. The most pronounced modification has occurred in the middle reaches where much of the stream channel has been straightened and lined with concrete. However, this is where the Sweet Arboretum, one of the most unique features in the channel is located.

SIGNIFICANT RESOURCES OVERVIEW

The major elements of the basin's environment which will be affected by the plans are all integrated into a complex set of social and urban features. These individual social and urban features include: historic, recreational, transportation, culture, residences, commercial and esthetics. Their importance, however, is not in their individual value but in their integrated form.

History of the basin began very early, coinciding with the initial developments in the Kansas City area. The basin's history, in fact, intertwines with the early history of the nations westward movement. As early as 1821, when the Santa Fe Trail trade began, wagon caravans followed Mill Creek and Brush Creek Valleys from Westport through the area. It was not until approximately 1821 that records show actual settling.

Joseph Smith led a group of approximately 1,500 Mormons from the east and established a colony along brush Creek. The colony reached from the state line eastward along the creek for a mile or more. They bought several thousand acres but remained for less than two years. Time has obscured the particular reasons for their choice of the area. The fact that the Santa Fe Trail crossed the creek, at what is now Wornall Road, possibly was a contributing factor.

In 1845 John C. McCoy, a leading trader along the Santa Fe Trail, established the town of Westport. This community located in the north central portion of the Brush Creek basin rapidly became the dominate town in what was to become the Kansas City Metropolitan Area. It served as the eastern terminus for Santa Fe, Oregon and California trails and functioned as a major trade center.

In the same general time frame (1839-1845) a methodist mission and Indian Manual Labor School was established in the upper part of the basin in what is now Shawnee, Kansas. This school was established to provide religious and vocational training, for Indian children. It later (1855) was the location of the first territorial legislature meeting in Kansas.

Also in the 1850's the Missouri River port of Kansas (later to become Kansas City, Missouri) began to replace Westport as the major commercial center. The road connecting the two centers became a major focal point for expanding development.

In 1864 the basin was the scene of a major Civil War battle. Identified as the Battle of Westport, the battle was fought for control of the Missouri River and as a general campaign against Fort Leavenworth. The first day of this three day battle was fought inconclusively in the extreme lower reaches of the basin. The second day found Confederate troops on the ridge above Brush Creek threatening Westport only one mile straight north. Union forces and Major Generals S. R. Curtis, and A. S. Pleasanton finally succeeded in driving Confederate troops under Major General Sterling Price from the area on the third day of the battle. (The present day Plaza vicinity was the site of the last two days of this battle.)

The late 1880's saw the initiation of the historic park and boulevard system in Kansas City, Missouri. This plan, developed initially by George Kessler called for wide park like streets to connect developed areas and parks. Emphasis for the parkway system was provided by the donation of Swope Park immediately east of the Brush Creek basin. This directly lead to the construction of north-south parkways like The Paseo, Swope Parkway and Gillham Road.

In the late 1890's and early 1900's development of the Brush Creek basin began in earnest. It was sparked by the arrival of William Rockhill Nelson and Jesse Clyde Nichols. Nelson, in 1886, chose a 30 acre tract of land overlooking the Brush Creek valley as the site for his home. At that time the site was two miles beyond the southern limits of the City. His home, called Oakhall, was completed in 1887. It was demolished in 1930 for the construction of the William Rockhill Nelson Gallery of Art and the Atkins Museum of Fine Art.

In 1904 Nelson initiated the first major residential development in what is termed the Rockhill district. This development completed in 1910 is known as the "Nelson Houses". Although 24 houses were razed for the construction of a park to the south of the gallery, those remaining were listed in the National Register of Historic Places in 1975.

J.C. Nichols' activities in the basin began in earnest in 1907 when he purchased a 10 acre tract of land in the vicinity of 51st Street and Grand. Nichols' plans were not diminished by the sight of the marshy conditions of the creek. In 1909 he had the section of Brush Creek between Wornall Road and 51st Street straightened. He was able, through this project, to reclaim thirty acres of previously useless land. The project cost $30,000 and was referred to as a miniature Panama Canal.

Nichols continued buying land to the south of the creek, eventually owning over four thousand acres. It was from this acreage that the Country Club District was created. Some of the city's finest homes are located within the district's boundaries.

At about the same time the residential area was being developed, Nichols was in the process of acquiring land for a shopping center. The property he acquired was north of the creek and adjacent to the Country Club District. Construction of the first Country Club Plaza retail unit began in 1922.

In 1929 Major Albert Beach appointed a committee of 100 to draft a plan for the City. Included in their recommendations was the development of the Brush Creek Parkway from the state line to the Blue River. This project was to consist of channel improvements, roadways and the beautification of the banks. A total of $1,000,000 was voted for this project in a 1931 special bond election.

The paving of the creek began on November 5, 1935, and was completed at an estimated cost of $1,395,000. The paving was from 51st Street east to Cleveland. Approximately 1,600 men were employed to prepare the bed and to lay the outer strips and center trough in concrete. The city signed a contract for the concrete with the Ready-Mixed Concrete Company, owned by Thomas J. Pendergast, political boss of the City.

The roadway construction established the Brush Creek basin as the focal point of the parkway system. The construction of Brush Creek Boulevard and Volker Boulevard augmented the earlier north-south parkways. Though the development of parkways is till practiced in Kansas City, Missouri, the Brush Creek basin area is still the focus of activity. Sixteen of the City's 24 parkways cross the basin.

A part of the plan was the recommendation for funds to construct "a pretentious approach to the gallery." This was to be located on the south side or formal entrance of the building. The approach was to culminate in a "mirror lake" on land to the south of Brush Creek Boulevard. If this were to be built, according to the superintendent of parks, William H. Dunn, it would require that a concrete box channel be built to allow the creek to run underground. A triple box tunnel was constructed in 1936 to carry the flow of the creek 680 feet to the east of Oak Street at 49th Street. However, further plans for the lake never materialized.

In May of 1943, J. C. Nichols initiated a meeting to consider how it might be possible to pool the research efforts of the six-state midwest area that would produce more effective research results. The outcome of the meeting was the formation of the Midwest Research Institute (MRI).

An eight-acre tract was obtained, due south of the Nelson Gallery. The location of this site and the surrounding use which included the Gallery, Kansas City Art Institute, Conservatory of Music, the University of Kansas City sparked the initiation of the Cultural Center concept. This concept made the siting and the design of the MRI building very critical. Whatever was built had to harmonize with the Nelson Gallery, as well as other buildings in the area. It was decided that the Midwest Research Institute building would be situated so "it would center on the axis of the art gallery." The completion of the building in 1954 also resulted in the completion of the Cultural Center Mall with the terminals being the Nelson Gallery on the north and the Midwest Research Institute building on the south.

To compliment the Cultural Center concept plans were formulated for a fountain to be placed in the south part of the Mall. This mall was dedicated to Frank A. Theis, who was a long-time member and former president of the Board of Park Commissioners.

The fountain was to be in memory of William Volker. The land for the mall came into city ownership as the result of a 1947 bond improvement plan when $250,000 was authorized to purchase the land directly south of the gallery. However, the land was not purchased until 1956. Carl Milles, noted Swedish sculptor, was commissioned to design the fountain. He chose as the central figure, St. Martin of Tours. This he felt was consistent with William Volker's image of that of the Good Samaritan for his many philanthropic deeds.

A fund was set up to allow the general public to contribute as a way of showing their appreciation to Volker. Over $125,000 was received. Combined with $160,000 the City Council recommended be included in a 1955-56 bond improvement program, sufficient funds were obtained and the fountain was built.

In the late 1930's the character of the Country Club Plaza commercial area began a slight but basic change. This commercial area, with its spanish motif, was well designed and developed from the beginning. However, its enduring unique character was mandated with the placement of fountains, statues and other design details as critical visual points within the development. This change in character was associated with Cultural Center Concept and provides a truly unique compatibility and transition from a cultural and institutional area to a commercial area.

SIGNIFICANT RESOURCES

The above background on the affected environment identifies and sets in perspective some of the more critical specific features which would be most significantly affected by the alternative plans. These specific features are identified in Table 2 . The table also provides a comparison of impacts and the significant features which are associated with the alternative plans.

Country Club Plaza Area - Base Condition

The key area affected by all the plans is the Country Club Plaza Shopping area. This area was subject to the greatest economic damage during the September 1977 flood and has the highest average annual damage of any reach on Brush Creek. From an economic perspective, therefore, all of the plans had to provide a high degree of protection through the Plaza. Each of the four alternatives which suggest flood management measures would decrease the level of damage on the Plaza. The no action alternative would, of course, cause the area to remain subject to a high level of economic loss from flooding. It is anticipated that, while the no action alternative would not directly affect the visual quality, recreational potential and other features, it may have an adverse indirect affect in that some of the commercial establishments may desire to relocate.

The main features of the Country Club Plaza which would be affected by the alternative plans are the historic and cultural features which are represented by the esthetics of the area and the harmonious blend of commercial, recreational, residential and transportation uses. As noted previously, these combined features are significant enough to make the area eligible for nomination to the National Register of Historic Places.

A key concern in this area is that the alternative measures provide for visual continuity between the Plaza Shopping area on the left bank of the creek and the Plaza apartments and other residences on the right bank of the creek. It is also a concern that the esthetic quality provided by the measures with existing and planned recreation development.

It is also a concern that the alternative measures will not inhibit existing and planned transportation facilities. The transportation facilities include auto, bicycle and pedestrian corridors. The potential conflict points which exist are: (1) the bridges which carry auto and pedestrian traffic over the channel, and (2) pedestrian and bicycle traffic in the channel.

Recreational opportunities is also a concern. The Brush Creek corridor has historically been used as a recreational area and continuing recreation planning suggests that use will be expanded. A concern is that the physical development of the alternative measures will inhibit recreational opportunities.

Country Club Plaza Area - No Action

A key element of the Country Club Plaza area has historically been the sound level of comprehensive planning that has gone into the development of the area. It is important that the alternative measures provide for a continuation of this planning and future development. At this time there is no integrated plan for improvement on the Plaza. However, plans do exist for two separate elements of the uses found in the Plaza area. One is for vehicular traffic and the other is for recreational activity and pedestrian and bicycle access. The two plans, developed in different time frames, do not necessarily compliment each other.

The traffic circulation plan developed in 1968 by the Kansas City, Missouri Engineering Department calls for the use of the roadway on the left and right banks of the creek as one way pairs. These two facilities would tie directly into Volker Boulevard on the east and Ward Parkway on the west. In addition, this plan would connect Brookside Drive directly with J.C. Nichols Parkway.

The recreation plan calls for use of the channel and the channel sideslopes as a pedestrian and bicycle corridor, and as the focus for certain recreation activities. The plans objective is to connect the Plaza area with other points of interest along the stream channel such as the Sweet Arboretum and Volker fountain.

It should be pointed out that the traffic plan and the recreation plan appear to be in some conflict. First, the use of the streets which parallel the channel as one-way pairs would tend to create increases in the auto-pedestrian conflict between the shopping area and the channel. It may be that one plan effectively negates the other.

A second apparent conflict is the use of the channel as a pedestrian corridor to nearby interest points including the Sweet Arboretum. The traffic plan shows a connection of Brookside Drive with J.C. Nichols would cross the western end of the Arboretum and would tend to significantly reduce the level of pedestrian access to the channel.

Nelson Art Gallary - Base Condition

A second critical area affected by one of the alternative measures is in the vicinity of the Theis Memorial Mall and Volker fountain. The mall is part of the Nelson Art Gallery, a structure which is eligible for the National Register of the Historic Places. This area is an important part of the visual environment of the basin and the City.

The effect that the open channel through the mall will have on the visual quality of the "entrance" to the Gallery and the Volker fountain esthetics as it relates to the potential for recreational development is a point of concern.

Nelson Art Gallery Area - No Action

In determining the effects of the alternative measures in this area, it should be noted that the original plan for the mall called for a reflecting pool in this area of the mall and that the most recent planning shows an open cut channel with impounded water and point of channel access and egress for pedestrian and bicycle traffic.

Troost to The Paseo Area - Base Condition

A third area affected directly by one of the alternative measures is the area between Rockhill Road and The Paseo. This area contains two residential areas of interest on the left bank of the creek and a cut stone retaining wall on the right bank.

The residential area east of Rockhill Road includes a district bounded by 48th Street, Brush Creek, Holmes and Troost Avenue. It is known as the Brush Creek Trolley Barn Neighborhood. This area was developed in the early 1900's primarily as the result of the Metropolitan Street Railway Company. The Railway Company built a complex of buildings including a trolley barn, office space, ticket and recreational facilities for the employees, and some living quarters.

The residential stock is for the most part singularly unimportant, but collectively the houses contributed to the fabric of a neighborhood that developed as the result of a commercial enterprise. Small in size and venacular in design, the houses were in many instances occupied by employees of the Railway Company.

Outright demolition and demolition by neglect have measureably reduced the number of houses. However, the greatest loss came as the result of the September 13, 1977 flood. Prior to this extensive loss of structures, it was considered by the Landmarks Commission as an area with National Register possibilities. The significance was based on history and the architecture of both the remaining commercial buildings and the houses.

Located between Troost and The Paseo, on Tracy and Virginia Streets is a complex of residences built in 1917. With the exception of two houses, all were built and owned by the R. L. Rinker Realty Company. The significance of this complex is that the houses were designed by Nelle E. Peters, one of Kansas City's early women architects.

Mrs. Peters, considered a major local architect, was responsible for the designing of a large number of apartments, commercial structures and residences. This almost completely intact concentration of houses, designed by a woman architect in a time when women architects lacked recognition, makes them of special significance. Unfortunately, several of the houses were demolished as the result of the 1977 flood.

A key concern associated with measures in this part of the creek is that the effect on the residential areas are minimized. Both in terms of minimized effects from construction and minimum effects resulting from flooding.

The area within or near the Brush Creek channel which would be affected by the alternative measures is at the intersection of The Paseo and 47th Street. The factors of greatest concern in this area are the effects on (1) businesses on the southeast corner of the intersection, and (2) location and alignment of roadways, and the compatibility of the measure with available planned activity.

Troost to The Paseo Area - No Action

Planning by the City of Kansas City, Missouri suggests a realignment of The Paseo to eliminate the existing median and the realignment of 47th Street to tie directly to Volker Boulevard. This improvement would cause the removal of all businesses southeast of the 47th Street Paseo intersection.

Current recreation planning indicates the use of an open channel through this intersection which would facilitate the use of the channel itself as a pedestrian and bicycle corridor.

Diversion Tunnel - Base Conditions of Area

The major elements which would be affected by the alignment of the diversion tunnel are socio-pschological in nature. As has been noted, the general area through which the tunnel would be located has experienced subsidence of some underground limestone quarries. These quarries were old and not well designed. Nonetheless, their failure created a certain degree of anxiety and fear of similar activity. This attitude would have to be addressed if the tunnel measure were implemented.

Other Resources

A number of other factors which are potentially significant and are common to all alternative measures are the haul routes for debris and the noise and other disruptions associated with trucks and other construction activities, the storage of equipment and material in visually sensitive areas, air and water quality and disposal of material. These factors are discussed in the environmental assessment appendix.

ENVIRONMENTAL EFFECTS

The following discussion of environmental consequences is divided into specific geographical areas. The significant resources being discussed are identified by the subsection heading under each location. Reference is made to Table which briefly outlines the points covered in this discussion.

EFFECTS IN THE PLAZA AREA

The visual character of the Country Club Plaza district is one of the major attributes of this unique area. This visual character is typified typlified by the blend of architectural styles, fountain and well coordinated design details. It is this visual character along with the historic significance of the area, the unique functions of various urban uses and the amount and quality of urban planning which went in the development which make the Plaza and the residential district south of the Plaza eligible for the National Register of Historic Places.

Dividing the Plaza Commercial area and the residential area to the south is the channel of Brush Creek. This channel was altered as part of the original development. However, its design and planning were not developed to the same level of quality as the surrounding areas. Functionally, the channel and the bridges over the channel will not handle flood flows approaching 100 year frequency. In terms of multiple integrated uses the present channel is not equal to the surrounding area. Some activity and access to the channel is allowed; but the activities are limited to isolated points and access along the channel is not defined.

The channel and the bridges over the channel do not have the same quality as the adjacent areas. There are some isolated areas of landscaping and natural tree growth. In addition, there are some areas having limestone rock walls. However, in total the channel's physical appearance is not well coordinated and does not interact well with the Plaza and the residential area to the south.

Aesthetic Effects (Plaza Area)

The existing visual quality of the channel and the bridges over the channel do not approach the visual quality of the surrounding area particularly the Plaza area to the north. The existing channel does provide some differences in material in form of concrete, grass and a few rock walls. Visual texture within the existing channel is only provided in the rocked areas. Contrasts of details and specific visual sites are generally not impressive. Those which are most pleasing generally rely on the backdrop provided by the Plaza or the apartments to the south. Two exceptions are the light standards on Wornall Road bridge and the rock faces on the channel approaches to the Main Street bridge.

No Action

The "future without condition" is assumed to include the Brush Creek Concept Development Plan prepared by the Kansas City, Missouri Parks and Recreation Department. This plan appears to be designed to provide a better integration of uses though it would also change the visual appearance of the channel. The key visual changes would include additional material resulting from the storage of water in the channel, the use of landscaping timbers all combined with the existing rock walls and the concrete channel. The details and specific visual sites of interest would be increased though it is difficult to determine whether these areas would have the same quality and style as the Plaza.

In general, the concept plan would tend to improve the visual quality of the channel. The degree of improvement, however, is difficult to assess without a detailed design. It should be noted, however, that the plan presents two potential problems. First, it is not clear that the flood hazard on the Plaza would not be reduced significantly by the plan. The design of the pools, the shape and size of the channel combined with the preliminary design of the Wornall bridge suggest that the potential flood hazards may not be reduced significantly. It should be noted, however, that this possibility has not been subjected to detailed hydraulic modeling. The second potential problem is that the planned pools, depending on design, may create difficult and costly maintenance problems. This will occur if the pools are cut into the channel. Pools so created will act as a sediment trap which will be difficult to clean and result in decrease visual value.

Alternate Plans

Three of the four planned measures will affect the visual environment on the Plaza. In fact, since Plans BCP 2, BCP 5 and the CP 3 suggest the same improvements through the Plaza area they will tend to have the same consequences. These consequences in regard to the visual quality through the Plaza result from the decrease in grassed areas, loss of some trees, a wider, steeper channel and loss of some of the rock walls. The exact magnitude of these consequences can not be

determined until a final design is established. However, the preliminary design indicates that all three alternatives would result in negative impacts on the visual environment because of the loss of material diversity, landscaped areas, loss of trees and grassed areas and specific visually important sites.

The fourth alternative is the tunnel diversion (UDP 1). This plan would have no direct effect on the aesthetics of the Plaza. However, by reducing the flood flow it would tend to make the Brush Creek Development Concept Plan more viable. This would allow development of a project which would tend to increase the visual quality of the channel.

Recreational Effects (Plaza Area)

The existing level of recreation associated with the channel is not highly significant. The paved area does allow pedestrian and bicycle travel but the channel has not been specifically designed or altered to accommodate this travel. It should be noted that a bicycle pathway which uses segments of the channel is under construction and will be operational within a year.

Structural recreation is available within the channel only at a small playground between the pedestrian bridge and the bridge carrying J.C. Nichols Parkway. There are tennis courts on the left bank of the channel between J.C. Nichols Parkway and Main Street. However, these facilities are outside the channel.

No Action

The "future without condition" based upon the Brush Creek Development Concept Plan would increase the opportunity for pedestrian access and pedestrian involvement within the channel. This increased pedestrian involvement is reflected in the structured walkway, pools, landscaping and other details planned within the channel.

Alternative Plans

The three alternative plans which affect the Plaza would eliminate the channel access now available and prohibit some of the items identified in the concept plan. Elimination of these features, both existing and planned represent a negative impact. It should be noted, however, that the assessment of the impact is contingent upon the final design because the three plans offer other potential for recreational development. In the final design provisions for recreation development could be established.

The tunnel plan (UDP 1) would divert flood flow from the Plaza area. The plan would, therefore, have no direct affect on the existing or planned recreational activity. Indirectly the plan would tend to improve the opportunity to establish the park development identified in the concept plan because of the elimination of a major part of the flood hazard.

Transportation Effects (Plaza Area)

No Action

The "future without condition" is premised on the Brush Creek Transportation Plan. This plan describes the use of the parallel roadways on the left and right banks of the channel as one way pairs. This would tend to restrict the pedestrian activity in the channel and prohibit the objective of integrating the Plaza with the channel.

It should be noted that the city anticipates that the useful life of a bridge is 50 years. The Wornall Road bridge was constructed in 1910. It has had some modification since but the basic structure is 70 years old. This age means that replacement of Wornall bridge is likely to occur within a reasonable time frame.

Alternative Plans

The three alternatives which provide for like improvements through the Plaza are compatible with the existing and long term improvements anticipated for the roadways along the Brush Creek channel. The Wornall Road bridge which is to be replaced in these plans is 70 years old and would have to be replaced in the forseeable future. (Note: The City presently is preparing the final design of a replacement facility.)

The tunnel alternative would not directly affect transportation on the Plaza. Its only indirect effect would be to reduce potential flood damage to bridges.

Economic Effects (Plaza Area)

No Action

It is not clear what effect the "future without condition" reflected by the Brush Creek Development Concept and the replacement of Wornall Road bridge would have on the level of damage associated with 100 year floods. It is initially anticipated that unless other improvements are made the future without condition would not change the effects of a severe flood. However, this total system has not been subjected to a complete hydraulic modeling.

The indirect effect of the "future without condition" is that the Plaza area would remain susceptible to floods under 100 year frequency. This continued threat of flood damage could have an affect on the vitality of the commercial area. After the 1977 flood a number of businesses threatened to move to a new location. Should another significant flood occur without significant channel change, a business migration may begin which would reduce the quality of the Plaza.

The two bridge and channel plans (BCP 2 and BCP 5) have the same beneficial effect on the flooding hazard on the Plaza. Each would eliminate the damage of a 100 year flood on the Plaza. They would also have the indirect benefit of reducing the possibility of business migration from the Plaza.

The diversion plan would also benefit the Plaza area by eliminating the potential damage on the 100 year flood. It would provide the indirect benefit of continued business vitality on the Plaza.

The combined bridge and channel plan and the diversion tunnel would provide maximum protection for the Plaza. This plan would eliminate damage from floods approaching 500 year frequency. Obviously, it would provide the indirect benefit of eliminating business migration sparked by flood hazards.

EFFECTS IN THE NELSON ART GALLERY AREA AND THE TROOST TO THE PASEO AREA

This area contains a significant open mall with a memorial fountain which together form the visual "entrance" to the Nelson Art Gallery. It also has the Sweet Memorial Arboretum and two left bank residential areas. The Nelson Art Gallery with its associated uses is particularly important because of the structure and the grass mall to the south and is eligible for nomination for the National Register of Historic Places.

Presently, the visual character of the channel is quite similar to that on the Plaza. The bottom is concrete lined. There are stone walls with grassed backslopes. Only two points of particular interest are found along the open channel; the Sweet Arboretum and the rock wall along the right bank between Rockhill and Troost.

The "future without condition" is based on the Park and Recreation Department's Brush Creek Concept development plan and Engineering Department's 1968 Brush Creek Transportation facilities over or parallel to the channel will develop in the future. A part of this planning calls for use of the channel throughout this segment as a pedestrian and bicycle corridor. This continuous use becomes possible because the conduit at the Paseo and Swope Parkway is replaced or augmented by an open channel and the conduit between Oak and Rockhill Road is replaced by an open channel. This corridor is to be integrated with surface interest points and by numerous surface access points. Pedestrian interest is to be maintained by landscaping, pooled water and other design details.

Improvement of the visual quality of the channel parallel recreation as a major objective of the plan. The planned change reflects improved definition of space by providing walkways, pools, landscaping and other points of interest. A key change is the open channel in front of the Volker fountain. The treatment in this area would include access to the fountain area, a water pool and other landscaping.

The transportation component of the "without condition" indicates major changes at both ends of the section. Upstream this plan indicates the extension of Brookside Boulevard northward across the channel to intersect with J.C. Nichols Parkway. This new extension would cross the channel in the vicinity of the present KCPS RR bridge. Parallel to this facility the Mid-American Regional Council (MARC) has proposed a planned transit facility.

On the downstream end of the section the transportation plan has proposed the realignment of Swope Parkway southward to connect directly with Volker Blvd. This change would result in realignment of The Paseo, Brush Creek Blvd. as well as Swope parkway.

Recreation Effects (Nelson Gallery to The Paseo)

No Action

The "future without condition" will provide a continuous recreation corridor from the Blue River to the Plaza. Basic activities would include pedestrian ways and bicycle paths with some developed sites for visual interest. No structured activities are identified along the corridor.

Alternative Plans

The limited bridge and channel plan (BCP 2) would have no direct effect in this area. Indirectly the limited bridge and channel plan would affect the future without condition by providing a discontinuity in the recreation along the channel.

The comprehensive bridge and channel plan (BCP 5) would increase the channel cross section, result in an open channel through the Nelson Gallery mall and an open channel through The Paseo and Swope Parkway intersection. These measures are in general accord with the concept plan. However, the plan does not specifically provide for the recreational activities identified in concept plan.

The diversion tunnel plan (UDP 1 and CP 3) would have little or no impact on the existing or planned recreation.

Aesthetic Effects (Nelson Gallery to The Paseo)

No Action

The "future without condition" would tend to improve the visual quality of the channel by improving the material composition, and the identification of space. The type and form of the changes would be similar to those on the Plaza. It should also be noted that the pool would have the same general problems discussed previously.

A significant point which should be discussed is the open channel between the Volker fountain and Volker Blvd. This area is the southern end of the impressive mall that focuses on the Nelson Art Gallery. An open channel in this area could, without proper care, be detrimental to this important view. The concept plan shows the use of rock walls, some concrete and landscaping timbers. This material would, in most circumstances, provide an interesting area. However, the Gallery presents such a formal view it is possible that the two styles may not blend.

Alternative Plans

The limited bridge channel plan (BCP 2) would have no direct or indirect effects on this segment of the channel.

The comprehensive bridge and channel plan (BCP 5) would have an adverse impact on the esthetic quality of the channel. Throughout this segment, the impact would result from a loss of trees, grassed areas and some of the rock walls. Two particular problem areas are the Sweet Arboretum which would be reduced in size by one third and the open cut in front of the Volker fountain.

The impact on the Sweet Aboretum is not known precisely at this time. However, as noted, it would appear that about one third of the Arboretum's area and about one third of the arboretums species would be affected.

An open channel in front of the Volker fountain, without accompanying esthetic treatments, would be detrimental to the visual quality of the mall and the view of the Gallery. The visual detriment would result from the lack of continuity in view and the conflict between the classic fountain and the concrete channel.

The diversion tunnel plans (UDP 1 and CP 3) would not directly affect the aesthetic quality of the channel. However, indirectly either plan would benefit the concept plan by providing diversion of flood flows. This diversion would make the implementation of the concept more feasible from a flood protection standpoint.

Transportation Effects (Nelson Gallery to The Paseo)

No Action

The discussion of the "future without condition" noted several changes in the roadway intersections. In addition, there are several bridges which are over 50 years old. Among these are the bridges over Troost Avenue and Rockhill Road. Neither of these bridges is presently scheduled for replacement. However, the Troost Avenue bridge has been closed twice within the last five years for improvements.

Alternative Plans

Limited bridge and channel plan (BCP 2) would have no direct or indirect impact.

The comprehensive bridge and channel plan is quite compatible with existing and planned improvements to the transportation network. The KCPS RR bridge would be replaced on the existing location. This would benefit the planned transit system. The open channel and realignment of the Paseo is compatible with the planned improvements in that area. It should be noted that the realignment of The Paseo would constrain access to a number (5) of businesses in the southeast quadrant of the Swope Parkway and Paseo intersection. With this plan access could be provided by the existing northbound lanes of The Paseo.

The replacement of the Troost Avenue bridge would benefit by providing a replacement for a structure which is 18 yeard older than the age (50) that the City considers to be the limit on useable life of structures.

The diversion plans (UDP 1 and CP 3) would not directly affect transportation in this segment. There would by an indirect benefit to transportation by diverting flood flows and reducing the possibility of future flood damage.

Relocation Effects (Nelson Gallery to The Paseo)

No Action

The "future without condition" reflected in the Brush Creek Transportation Plan would cause the relocation of 5 businesses in the southeast corner of the Swope Parkway and The Paseo. This relocation would result from the realignment of Swope Parkway south to align with Volker Boulevard.

Alternative Plans

The limited bridge and channel plan (BCP 2) would not affect relocation either directly or indirectly.

The comprehensive bridge and channel plan (BCP 5) would cause the acquisition and relocation of 5 residential buildings and 2 sheds and garages in the residential areas between Troost and Rockhill Road. It would also require acquisition of one business (a car wash) at the southeast corner of The Paseo and Swope Parkway. It should be noted that two of the residences which would be acquired were damaged in the 1977 flood and are not occupied.

The diversion plans (UDP 4 and CP 3) would have no direct or indirect affects.

Economic Effects (Nelson Gallery to The Paseo)

No Action

The "future without condition" would provide some reduction in flood hazards. However, this level of protection will not approach that needed for protection from a 100 year event. This low reduction of flood hazards results from the effect on flood stages associated with bridges.

Alternative Plans

The limited bridge and channel plan (BCP 2) would have no direct or indirect effect in this area.

The comprehensive bridge and channel plan (BCP 5) would provide protection from a 100 year flood. This would benefit the residential areas on the left bank between Rockhill Road and The Paseo. The diversion plans (UDP 1 and CP 3) would also provide protection from 100 year floods and benefit the same areas.

EFFECTS ALONG THE TUNNEL CORRIDOR

The planned location of the diversion tunnel is through an area of mixed uses. These uses include: residential, commercial, industrial, recreation and institutional facilities. There are no historic structures or sites along the corridor. The future without condition will not be significantly different than the existing.

Socio-Psychological Effects (along Tunnel Corridor)

South central Wyandotte County and northwestern Johnson County has been the location of the failure of several underground limestone quarries. This same general area is where the tunnel in Plans UDP 1 or CP 3 is to be located. These failure, which resulted from poor mining practices, created much public concern and fear that similar areas unknown to authorities existed and could fail.

The continued existence of this legacy from the poor mining practices of the past could have a significant effect on how the tunnel is perceived. If it is equated by the public as being similar to the mines that failed, there would be a considerable amount of apprehension and fear of the facility.

At this time information on the attitudes or potential reaction to the tunnel does not exist. Discussions of the tunnel have been presented at public meetings and discussions have taken place with decision makers in the communities involved. However, it is difficult to draw the potential reaction of people from these meetings. Experience has shown that public reaction is much greater when specific properties to be affected by a project are defined and the owners of the properties become aware of the project. To date, there have not been meetings specifically for the purpose of discussing the tunnel with residents of the area through which the tunnel would pass.

It should be anticipated, in the absence of hard data to the contrary, that the attitudes and reactions of persons along the tunnel corridor would be negative and emotional. This reaction could be compounded by the fact that none of the area through which the tunnel passes would benefit from the facility.

PUBLIC INVOLVEMENT

PUBLIC INVOLVEMENT PROGRAM

The public involvement program is presented in Appendix E to the main report. The methods used to involve and inform the public included; news releases, meeting notices and public meetings. The program also included; meetings with community organizations, City and County staff members and elected officials of the communities involved. In addition, two project fact sheets describing various alternatives under investigation were mailed to the approximately 1,400 persons on the projects mailing list. Comments on the alternatives were invited from those receiving the sheets. A scoping meeting with representatives of the Federal-State team was held to identify significant issues. See Table E-2 for the list of members composing this team.

The U.S. Fish and Wildlife Service, the Environmental Protection Agency, and Federal Emergency Management Agency were formally requested to be cooperating agencies and to identify and provide information concerning resources under their jurisdiction by law that might be adversely affected by the various alternatives under investigation. The draft main report and draft environmental impact statement has been provided to those agencies, groups, and individuals listed in the paragraph below titled "Statement Recipients".

REQUIRED COORDINATION

A draft of the Brush Creek Development Concept Plan, which is being prepared for the Kansas City, Missouri Parks and Recreation Department, will be available for internal review in mid-April 1980. The concepts identified in this document will be evaluated by the Corps and staff representatives of Kansas City, Missouri to determine the merits and feasibility of their inclusion in the Corps of Engineers project design. Extensive coordination among the Corps, various departments of the city government, and interested members of the public will be required.

STATEMENT RECIPIENTS

US Department of Agriculture
- Forest Service
- Soil Conservation Service

US Department of Commerce
- National Marine Fisheries Service

US Department of Health, Education and Welfare

US Department of Housing and Urban Development
- Regional Administrator, Region VII
- Kansas City, Kansas, Area Office
- St. Louis, Missouri, Area Office
- Federal Emergency Management Agency

US Department of the Interior
- Special Assistant to the Secretary
- Fish and Wildlife Service
- Heritage, Conservation and Recreation Service
- Bureau of Mines
- National Park Service
- Southwest Power Administration
- Geological Survey

US Department of Transportation
- Federal Aviation Administration
- Federal Highway Administration
- US Coast Guard

US Environmental Protection Agency

US Department of Energy

Advisory Council on Historic Preservation

Kansas State Historic Preservation Officer

Missouri State Historic Preservation Officer

Kansas Water Resources Board (for all Kansas State agencies)

Division of State Planning and Analysis (for all Missouri State agencies)

Jackson County, Missouri, Legislature

Johnson County, Kansas, Board of Commissioners

Wyandotte County, Kansas, Board of Commissioners

Mayors of
- Countryside, Kansas
- Fairway, Kansas
- Kansas City, Kansas
- Kansas City, Missouri
- Mission, Kansas
- Mission Hills, Kansas
- Mission Woods, Kansas
- Overland Park, Kansas
- Roeland Park, Kansas
- Westwood, Kansas

Missouri River Basin Commission

Mo-Ark Flood Control and Conservation Commission

National Audubon Society

Kansas Chapter, American Fisheries Society

Missouri Chapter, American Fisheries Society

Kansas Chapter, The Wildlife Society

Missouri Chapter, The Wildlife Society

Missouri Chapter, The Nature Conservancy

Missouri Chapter, Society of American Foresters

Conservation Federation of Missouri

Missouri Association of Soil and Water Conservation Districts

Audubon Society of Missouri

Coalition for the Environment

Kansas Chapter, Friends of the Earth

Missouri Chapter, Friends of the Earth

Sierra Club, Kansas City Group

Sierra Club, Kansas Group

Sierra Club, Columbia, Missouri

Burroughs-Audubon Society of Kansas City

Citizens Environmental Council, Kansas City

Area News Media (newspapers, radio, and T.V.)

Black Economic Union

Brush Creek Trolley Association

Chamber of Commerce

Historic Kansas City Foundation, Inc.

J.C. Nichols Co.

League of Women Voters

Pembroke-Country Day School

Plaza Merchants Association

Concerned individuals

Preliminary Section 404(b) Evaluation Report for the Tentatively Selected Plan for Brush Creek, Missouri and Kansas

Brush Creek, in the project area, is an intermittent, urbanized stream which has a concrete lined channel bottom. The fill material placed in the stream bottom would be concrete. The old concrete would be removed and the channel width enlarged prior to the placement of the new concrete lining. This construction activities would take place in the vicinity of the affected bridges. Disposal sites for the excavated material would not be located in any waters of the United States or adjacent wetlands. A preliminary checklist for the preparation of a 404(b) Evaluation Report is attached. A 404(b) Evaluation Report will be prepared and included as an appendix to the Draft Environmental Impact Statement.

PRELIMINARY 404(b) EVALUATION REPORT

	Yes	Potential Effects	No
I. Physical Effects			
A. Potential destruction of wetlands			X
B. Impact on water column			X
C. Covering of benthic communities			X
II. Chemical-Biological Interactive Effects			
A. Adverse effect of chemical constituents on water column			X
B. Adverse effect of chemical constituents on benthos			X
III. Applicable Water Quality Standards			
A. Will activity be in conformance with applicable standards?	X		
IV. Selection of Disposal Sites			
A. Impacts of fill material on chemical, physical, and biological integrity of aquatic ecosystem			X
B. Have the needs for the proposed activity been considered?	X		
C. Have alternatives been considered?	X		
D. Impacts on water uses at the proposed disposal site			X
E. Have mitigation measures to minimize harmful effects been considered?	X		
V. Contamination of Fill Material			
A. Contamination of fill material if from a land source			X
VI. Mixing Zone			
A. Have mixing zone determinations been established for each disposal site?	X		
VII. Impacts to Navigation			
A. Impairment to maintenance of navigation			X
B. Economic impact on navigation and anchorage			X
VIII. Public Participation and Coordination			
A. Will a public interest review be conducted?	X		

APPENDIX
LETTERS OF COORDINATION

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO:

FA/SE/COE--Brush Ck. Flood Control Study
Kansas City, MO (6-3-80-I-221)

MAR 12 1980

Colonel Walter C. Bell
District Engineer
U.S. Army Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106

Dear Colonel Bell:

This responds to your letter of February 20, 1980, concerning the alternatives for flood protection to the urban development located in the flood plain of Brush Creek in Kansas City, Missouri.

In accordance with Section 7(c) of the Endangered Species Act Amendments, I have reviewed your information and determined that no proposed or listed endangered or threatened species are in the p ·ct area.

Thank you for your interest and cooperation in conserving endangered species.

Sincerely yours,

DON W. MINNICH
Regional Director

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

United States Department of the Interior
FISH AND WILDLIFE SERVICE
2701 Rockcreek Parkway, Suite 106
North Kansas City, Missouri 64116

KANSAS CITY AREA OFFICE
816/374-6166

ECOLOGICAL SERVICES
816/374-5951

February 29, 1980

Colonel Walter C. Bell
District Engineer
Kansas City District, Corps of Engineers
601 E. 12th St.
Kansas City, Missouri 64106

Dear Colonel Bell:

We have reviewed the alternative described in the Public Information Fact Sheet, January, 1980 for the Brush Creek and Tributaries Flood Control Study. Since the study area is highly urbanized, project effects on fish and wildlife habitat will be minimal both in the basin and receiving waters. In a previous letter dated June 25, 1979, we stated that recreational benefits may be derived from creating a put-and-take urban fishery in conjunction with a holding basin. Apparently this will not be possible with present project plans.

As a note of interest, "Flora of Missouri" by Julian A. Steyermark, lists a champion boxelder found near Brush Creek east of the state line. Efforts should be made to preserve this tree, should it still exist.

Thank you for the opportunity to review the latest alternatives.

Sincerely yours,

James M. Lutey

for Tom A. Saunders
Area Manager

cc: RD, Denver, CO (ENV/LWRDP)
Missouri Department of Conservation
Jefferson City, MO

MRKED-SR 20 February 1980

Mr. Don W. Minnich
Regional Director
US Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, CO 80225

Dear Mr. Minnich:

In accordance with Section 7(c) of the Endangered Species Act Amendments of 1978, I am requesting the identification of any listed or proposed endangered species that may be found in the immediate vicinity of Brush Creek in Kansas City, Missouri, and along the Kansas River near the 18th Street Expressway Bridge in Kansas City, Kansas (Location map, Incl 1).

The Kansas City District, Corps of Engineers is studying several structural alternatives which would provide flood protection for the urban development located in the floodplain of Brush Creek in Kansas City, Missouri. A "Public Information Fact Sheet" dated January 1980 for the Brush Creek Flood Control Study, which describes some of the various structural and non-structural plans that have been investigated, is provided as Inclosure 1. Of the alternatives discussed, only Plan 1 (Bridge and Channel Modification) and Plan 2 (Brush Creek Underground Diversion) in Study Reach 2 appear to be engineeringly and economically feasible as well as environmentally acceptable. These alternatives and their various combinations will be retained for more detailed study.

I have reason to believe that no endangered species presently exist in the urbanized area affected by the Brush Creek flood protection alternatives described above. However, in accordance with Section 7(c) of the Endangered Species Act Amendments, you are requested to furnish this office your findings.

If you require further information on this matter, please feel free to contact Mr. Bob Ruf of my staff at (816) 374-2648 or FTS 758-2648.

Sincerely,

2 Incl
As stated

WALTER C. TELL
Colonel, Corps of Engineers
District Engineer

Copy Furnished:
Mr. Larry Vischer, US Fish & Wildlife Service, Kansas City Area Office

MRKED-ER

27 December 1979

Dr. Kathleen Q Camin
Regional Administrator
Environmental Protection Agency
Revion VII
324 East 11th Street
Kansas City, Missouri 64106

Dear Dr. Camin:

The Kansas City District, US Army Corps of Engineers is preparing a Draft Environmental Impact Statement (DEIS) and a Draft Feasibility Report (DFR) for a flood protection project in the Brush Creek Basin, Kansas and Missouri. The implementation of recommendations contained in the Final Feasibility Report may result in impacts to air and water quality for which your agency has jurisdiction by law.

In accordance with regulations promulgated by the President's Council on Environmental Quality in 40 CFR 1501.6, you are requested to be a cooperating agency in the preparation and review of this statement and report. A meeting of the Federal-State Kansas City Urban Study team will be held on 15 January 1980 at 9:00 A.M. in Room 730 of the Federal Office Building, 601 East 12th Street, Kansas City, Missouri. This meeting is being held to inform team members of the progress of the Brush Creek flood protection study and obtain input and guidance from the various agencies involved. Your agency's participation in this meeting is requested.

The DEIS and DFR are scheduled for release in May 1980 with a public meeting scheduled to be held in June 1980. Comments received from members of the public and public agencies will then be incorporated into the reports for submittal to our higher authority in August 1980.

MRKED-ER 27 December 1970
Dr. Kathleen Q. Cannin

If you have any questions regarding this matter, please contact Mr. Bob Ruf of my staff at (816) 374-2648.

Sincerely,

WALTER C. HILL
Colonel, Corps of Engineers
District Engineer

CF:
ED-BP
ED-X
Dist. Read. File

2

MRKED-PR

21 December 1979

Mr. Tom Saunders
Area Manager
US Fish and Wildlife Service
Suite 106, Rockcreek Office Building
2701 Rockcreek Parkway
North Kansas City, Missouri 64116

Dear Mr. Saunders:

The Kansas City District, US Army Corps of Engineers is preparing a Draft Environmental Impact Statement (DEIS) and a Draft Feasibility Report (DFR) for a flood protection project in the Brush Creek Basin, Kansas and Missouri. The implementation of recommendations contained in the Final Feasibility Report may result in impacts to the fish and wildlife resources of the area for which your agency has jurisdiction by law.

In accordance with regulations promulgated by the President's Council on Environmental Quality in 40 CFR 1501.6, you are requested to be a cooperating agency in the preparation and review of this statement and report. A meeting of the Federal-State Kansas City Urban Study team will be held on 15 January 1980 at 9:00 A.M. in Room 730 of the Federal Office Building, 601 East 12th Street, Kansas City, Missouri. This meeting is being held to inform team members of the progress of the Brush Creek flood protection study and obtain input and guidance from the various agencies involved. Your agency's participation in this meeting is requested.

The DEIS and DFR are scheduled for release in May 1980 with a public meeting scheduled to be held in June 1980. Comments received from members of the public and public agencies will then be incorporated into the reports for submittal to our higher authority in August 1980.

MRKED-SR
Mr. Tom Saunders

21 December 1979

If you have any questions regarding this matter, please contact Mr. Bob Ruf of my staff at (816) 374-2648.

Sincerely,

WALTER C. BELL
Colonel, Corps of Engineers
District Engineer

Copy furnished

Regional Director
US Fish and Wildlife Service
PO Box 25486
Denver Federal Center
Denver, Colorado 80255

ED-BP
ED-X
Dist. Read. File

MRKED-ER

19 December 1979

Mr. Bennie E. Stephenson
Regional Director
Federal Insurance Administration
Federal Emergency Management Agency
Room 210
911 Walnut
Kansas City, Missouri 64106

Dear Mr. Stephenson:

The Kansas City District, US Army Corps of Engineers is preparing a Draft Environmental Impact Statement (DEIS) and a Draft Feasibility Report (DFR) for a flood protection pro[illegible] in the Brush Creek Basin, Kansas and Missouri. The implementation of recommendations contained in the Final Feasibility Report may result in impacts to the area's Flood Insurance Program for which your agency has jurisdiction by law.

In accordance with regulations promulgated by the President's Council on Environmental Quality in 40 CFR 1501.6, you are requested to be a cooperating agency in the preparation and review of this statement and report. A meeting of the Federal-State Kansas City Urban Study team will be held on 15 January 1980 at 9:00 A.M. in Room 730 of the Federal Office Building, 601 East 12th Street, Kansas City, Missouri. This meeting is being held to inform team members of the progress of the Brush Creek flood protection study and obtain input and guidance from the various agencies involved. Your agency's participation in this meeting is requested.

The DEIS and DFR are scheduled for release in May 1980 with a public meeting scheduled to be held in June 1980. Comments received from members of the public and public agencies will then be incorporated into the reports for submittal to our higher authority in August 1980.

MRKED-BR
Mr. Dennie E. Stephenson

27 December 1979

If you have any questions regarding this matter, please contact Mr. Bob Ruf of my staff at (816) 374-2648.

Sincerely,

WALTER C. BELL
Colonel, Corps of Engineers
District Engineer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
2701 Rockcreek Parkway, Suite 106
North Kansas City, Missouri 64106

KANSAS CITY AREA OFFICE
816/374-6166

ECOLOGICAL SERVICES
816/374-5951

June 25, 1979

Colonel Walter C. Bell
Kansas City District
Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106

Dear Colonel Bell:

This responds to our receipt of your excellent publication, "Stage II Documentation, Brush Creek and tributaries, Missouri and Kansas," and cover letter dated May 11, 1979. Although you did not solicit a formal review, we would like to say that the report is well-written and adequately describes the Brush Creek Area.

Since the basin is fully developed and most parts are classified as highly urbanized, we will not offer any comments concerning fish and wildlife resources present. It would appear, however, that some recreational benefits may be derived from the implementation of flood-control measures such as creating a put-and-take urban fishery in conjunction with a holding basin if constructed. We offer technical advice if this aspect is explored.

Thank you for the opportunity to review this report.

Sincerely yours,

Tom A. Saunders
Area Manager

cc: RD, Denver, Colorado (ENV/LWRDP)
Missouri Dept. of Conservation
Jefferson City, Missouri

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America

APPENDIX E
PUBLIC VIEWS AND COMMENTS

TABLE OF CONTENTS

TABLES

PUBLIC INVOLVEMENT PROGRAM

The development and implementation of a program for public participation is an important task in this study. Such a program was developed early on which would enable interested people to learn about study activities and to express their views concerning the study.

PURPOSE AND OBJECTIVES

It was the intent of this program to make known to all segments of the public those issues concerning the study, and to do so in a timely manner. The program would enable receipt from the public of views and concerns relevant to the issues.

Because the Brush Creek study was an expansion of the Kansas City Urban Study, many of the public involvement activities are simply a follow-on to those activities which had already been initiated. Activities which had proved successful in the earlier study could provide an efficient means of involving the public in decisions concerning Brush Creek.

DESCRIPTION OF ACTIVITIES

Table E-1 is a chronological record of events in the public involvement program. It reflects the major contacts but does not include many personal contacts with public officials and interested citizens made by members of the Corps staff.

TABLE E-1
RECORD OF EVENTS

12 Oct 77	Request from Kansas City, Mo. and Chamber of Commerce of Greater Kansas City for study.
26 Oct 77	Request from MARC for study.
5 Dec 77	Request from Johnson County Commissioners for study.
30 Dec 77	Meeting with Senator Danforth and Kansas City, Mo. officials.
17 Mar 78	Notice of expansion of the Kansas City Urban Study to include Brush Creek.
18 Jul 78	News release on September 1977 flood damages.
20 Sep 78	Meeting with Kansas City, Mo. officials.
16 Jan 79	Notices of public meeting mailed.
6 Feb 79	News release on public meeting.
15 Feb 79	Public meeting and Fact Sheet No. 1.
25 Feb 79	Presentation to Bryantwood Homes Assoc.
11 Jun 79	Meeting with Kansas City, Mo. officials
11 Jul 79	Federal-State Team meeting
24 Jul 79	Meeting with Kansas City, Ks. officials.
31 Jul 79	Meeting with Johnson County community and county officials
10 Dec 79	Meeting with Kansas City, Mo. officials.
27 Dec 79	Fact Sheet No. 2 mailed.
15 Jan 80	Federal-State Team meeting (scoping meeting).
7 Feb 80	Presentation to Kansas City, Ks. Commissioners.
29 Feb 80	Presentation to Kansas City, Mo. Mayor Berkeley and City Council.
5 Mar 80	Presentation to Rosedale community group.
5 Mar 80	Meeting with Kansas City, Mo. officials.

MAILING LIST

One of the first tasks to be undertaken was the compilation of a mailing list. Initially, the list was formed by using that portion of the Kansas City Urban Study mailing list for Jackson County, Missouri, and Johnson County, Kansas, plus those who had requested that they be included on the list previously. Major additions were made to the list to include those who attended the February 1979 public meeting and those who attended other meetings. At this time there are approximately 1,400 persons on the mailing list.

MEETINGS

Both public meetings and less formal meetings with smaller groups are a part of the public involvement program. The first public meeting on the Brush Creek study was held in February 1979. It was attended by 168 persons, of which 19 persons spoke. The meeting focused on flood problems within the basin, and conceptual plans to solve those problems. A second public meeting is planned for June 1980.

A series of meetings has been held with smaller groups, either to discuss a particular element of the study or as general briefings. These meetings have mostly been with city and county staff members and elected officials.

FEDERAL-STATE TEAM

A Federal-State Urban Study Team was formed in 1975 to effect better coordination among representatives of the Federal agencies and the States of Missouri and Kansas. When the Urban Study was expanded to include Brush Creek, it was decided to continue the team as a part of the public involvement program. The team first met on Brush Creek in July 1979 and has since then met in January 1980. Meetings usually last for several hours and include a full discussion of issues and concerns relating to the flood problem and how best to deal with it. Table E-2 shows the composition of the Federal-State Team.

TABLE E-2
COMPOSITION OF THE FEDERAL-STATE TEAM

Entity	Agency
Missouri	Office of Administration
	Department of Conservation
	Department of Highways
	Department of Natural Resources
	University of Missouri Extension Service
Kansas	Forestry, Fish and Game Commission
	Geological Survey
	Department of Health and Environment
	Park and Resources Authority
	Division of Planning and Research
	Department of Transportation
	Water Resources Board
	Division of Water Resources
	Kansas State University Extension Service
Regional	Mid-America Regional Council
Federal	Heritage Conservation and Recreation Service
	Environmental Protection Agency
	Federal Emergency Management Agency
	Fish and Wildlife Service

COMMUNITY PRESENTATIONS

In addition to public meetings and other meetings, an effort was made to disseminate information on the Brush Creek study through presentations to community organizations. Emphasis was given to neighborhood organizations and homes associations.

PUBLICATIONS

In addition to those materials mentioned previously, such as news releases and meeting notices, two fact sheets were published. The first fact sheet was mailed to the entire mailing list shortly before the first public meeting. The second fact sheet updated study results as of December 1979, and included a self-addressed comment form so that opinions could be registered on the alternative plans. Sixty-one comment forms were returned with comments after the fact sheet was mailed.

The draft report and draft environmental impact statement will be the next publication to be publicly distributed. In May 1980, the public draft will be mailed out to Federal and State agencies, local governments, environmental organizations, and public libraries. This distribution will be made 15 to 30 days prior to the final public meeting.

LIBRARIES AS DEPOSITORIES

Many libraries in the Kansas City region has agreed to act as depositories for Urban Study materials. Most of these libraries will also be provided copies of the draft and final Brush Creek reports. Table E-3 lists the libraries which serve as depositories.

TABLE E-3
DEPOSITORY LIBRARIES

UMKC Linda Hall Library
Mid Continent Library
- North Independence Branch
- Gladstone Branch
- Excelsior Springs Branch
- Grandview Branch
- Platte Woods Branch

Antioch Library
Olathe Public Library
Kansas City, Kansas Library
- Main Library
- Wyandotte Plaza Branch

Kansas City, Missouri Library
- Main Library
- Plaza Library

Junior College District of Metropolitan Kansas City
- Maple Woods Library
- Longview Library
- Penn Valley Library
- Pioneer Library

Johnson County Community College
Kansas City, Kansas Community College
University of Missouri at Rolla
University of Missouri at Columbia
Kansas State University Library
University of Kansas Watson Library

FULFILLMENT OF PROGRAM OBJECTIVES

This section will be added to the final report.

COMMENTS ON THE DRAFT REPORT AND DRAFT ENVIRONMENTAL IMPACT STATEMENT

This section will be added to the final report.