CHAPTER 3

IDENTIFICATION OF PROBLEMS AND NEEDS

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This chapter identifies and investigates the problems and needs of the study area with regard to flood damage reduction, recreation, and environmental resources.

IDENTIFICATION OF FLOOD DAMAGE REDUCTION NEEDS

HISTORICAL FLOOD DATA

The Trinity River frequently exceeds its channel capacity and floods its banks. A number of major floods have been recorded in the study area prior to and since the turn of the century. The flood of record occurred in May 1908 and had an estimated peak discharge of 184,000 cubic feet per second at the Dallas gage. This flood caused the death of 11 persons and produced over $5 million in damage. Significant floods and the peak discharge recorded for each are listed in table 3-1.

Table 3-1
Significant Flood Events and
Peak Discharges Recorded at Dallas Gage

Time of Significant Flood Event	Dallas Gage Discharge (CFS)
May 1908	184,000
Apr 1922	69,600
Jun 1941	77,000
Apr 1942	111,000
Mar 1945	52,900
May 1949	82,500
May 1957	75,300
May 1966	42,100
May 1969	67,000
Nov 1981	37,400
May 1989	58,700
May 1990	82,300
Dec 1991	62,200

Continued urbanization throughout the watershed is a significant factor influencing both the current and future flood problems. Various Federal and non-Federal flood control projects have been constructed to alleviate the flooding problems. Federal projects which have significantly reduced the threat to life and property include the Fort Worth and Dallas Floodways and six reservoirs.

In 1989, Dallas recorded rainfall amounts of 9.6 inches in May and 8.8 inches in June. Several lives were lost along the Five Mile Creek tributary, and damages of over $1 million were incurred. The most destructive flood event in recent years, produced from the effects of Hurricane Norma, occurred in October 1989, causing at least $6 million in damages. Over 450 homes and businesses were damaged, and an additional 30 homes were completely destroyed. Dallas County was declared a disaster area by the President. Particular details of these storm events can also be found in National Weather Service Storm Data Reports. The December 1991 flood devastated residents in the Rochester Park neighborhood for the third consecutive year, and occurred in the midst of construction of a much needed levee in the neighborhood.

Channel capacities of the Trinity River within the study area are inadequate to confine events beyond the 2-year frequency. Increased urbanization in the upper watershed area and increased vegetation growth in the primary area of concern has intensified the flooding problem.

Flood prone areas within the 100-year floodplain of the watershed were identified by FEMA in March 1984. Dallas enrolled in the National Flood Insurance Program's Emergency Program since June 19, 1970 and the Regular Program since July 23, 1971, and currently holds 2,833 flood insurance policies valued at $146,577,700.

EXISTING CONDITIONS ANALYSES

General

In order to accurately assess the need for flood damage reduction measures, an analysis of annual damages under existing conditions was performed. Due to the complexity and length of this study, the existing conditions hydrology, hydraulic, and economics models used in the initial investigation phase (1991 - 1993) were modified to reflect more recent topographic data, and changes in design and economic parameters. The phases are referenced chronologically as "1991-1993", "1994-1996", and "1996-1997". The following sections discuss the basis for the existing conditions models for each phase of this study.

1991-1993

Hydrology. The hydrology model used during this initial phase of the study was developed from the Upper Trinity River Reconnaissance Study model and expected probability water surface elevations. The watershed area was divided into 110 subareas in order to be responsive to the timing of each major tributary's runoff contribution to the total flood hydrograph and also to obtain detailed flow information (flood hydrographs) at all major points of interest on the Clear, West, and Elm Forks, as well as the mainstem of the Trinity River. The United States Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) program "HEC-1" was used to model the hydrology of this watershed. A one-hour computation time interval was used. All reservoirs with flood control storage were assumed to be at conservation pool level at the start of frequency related storms/floods and at a level corresponding to one-third of the full flood control pool (except at Lewisville Lake which was started at 89 percent full) at the start of the USACE Standard Project Flood (SPF). All reservoirs without flood control storage were assumed to be at normal (conservation pool) level at the start of all storm/flood events. Lake Bridgeport, Eagle Mountain Lake, Lake Worth, and Lake Arlington were assumed to reside at a level corresponding to 2, 3, 2, and 3 feet, respectively, above normal (conservation pool) level at the start of the SPF event. Comparisons were made between the frequency versus discharge relationships determined based on the statistical analysis of historical data at the major streamflow gages and those based on results of the HEC-1 modeling. Adjustments were made to the rainfall losses for some subareas in order to produce a better correlation.

Hydraulics. The hydraulic analysis for this study included that portion of the Trinity River from Interstate Highway 20/635 upstream to the confluence of the West Fork and the Elm Fork of the Trinity at the upstream end of the existing Dallas Floodway. The river, within the study area, is a perennial stream characterized by a main channel with an average depth of about 30 feet, a top width of about 200 feet, and overbanks which are generally very wide and flat. The historically stable river channel has an average bottom slope of about 0.05 percent. Channel migration and bank stability problems were not revealed by an analysis of historical topographic data and aerial photographs taken periodically over the past 47 years. The overbank areas in the floodplain are generally covered with heavy vegetation. Examination of historical aerial photographs revealed that a gradual increase in the density of the vegetative cover on the floodplain areas has occurred and has led to an increase in the hydraulic roughness of the floodplain. The areas that have the greatest density of vegetation are covered with mature trees of sufficient height to extend above the water surface of the highest flood flows considered in this analysis; therefore, a consistent roughness value was assumed for all depths of flows.

The HEC-2 Water Surface Profiles computer program was used to hydraulically model and compute water surface profiles. The hydraulic model utilized topographic maps, provided by the city of Dallas, which were compiled from aerial photography flown in March 1977. These maps were updated to reflect the contours of two city landfills completed after 1977. Channel geometry was input from surveyed cross sections used in previous Trinity River hydraulic models. The White Rock Creek confluence with the Trinity River and the low-lying residential areas north of the Rochester Park Levee store significant volumes of flood water during major flood events, and separate HEC-2 models were created to more accurately represent these storage volumes in the computation of peak discharges for the various flood events.

Economics. Detailed economic investigations and analyses were conducted in connection with this study. The principal purpose of these economic analyses was to identify the extent of the flood problem and, on a comparable basis, evaluate solutions to reduce flood losses. These analyses were conducted following procedures and guidelines as set forth in the Water Resources Council's Principles and Guidelines (March 10, 1983).

As part of these activities, field surveys were conducted to identify the numbers and types of property, as well as the market value of the investment, affected by flooding. Damageable property and costs associated with flooding are divided among five damage categories, as shown in table 3-2.

A full range of water surface profiles based on existing stream conditions were provided by the hydrology and hydraulics models, as described above. These profiles were used to delineate the floodplain limits and determine the relationship of damageable properties to both elevation and frequency of flood occurrence.

Table 3-2
Major Damage Categories

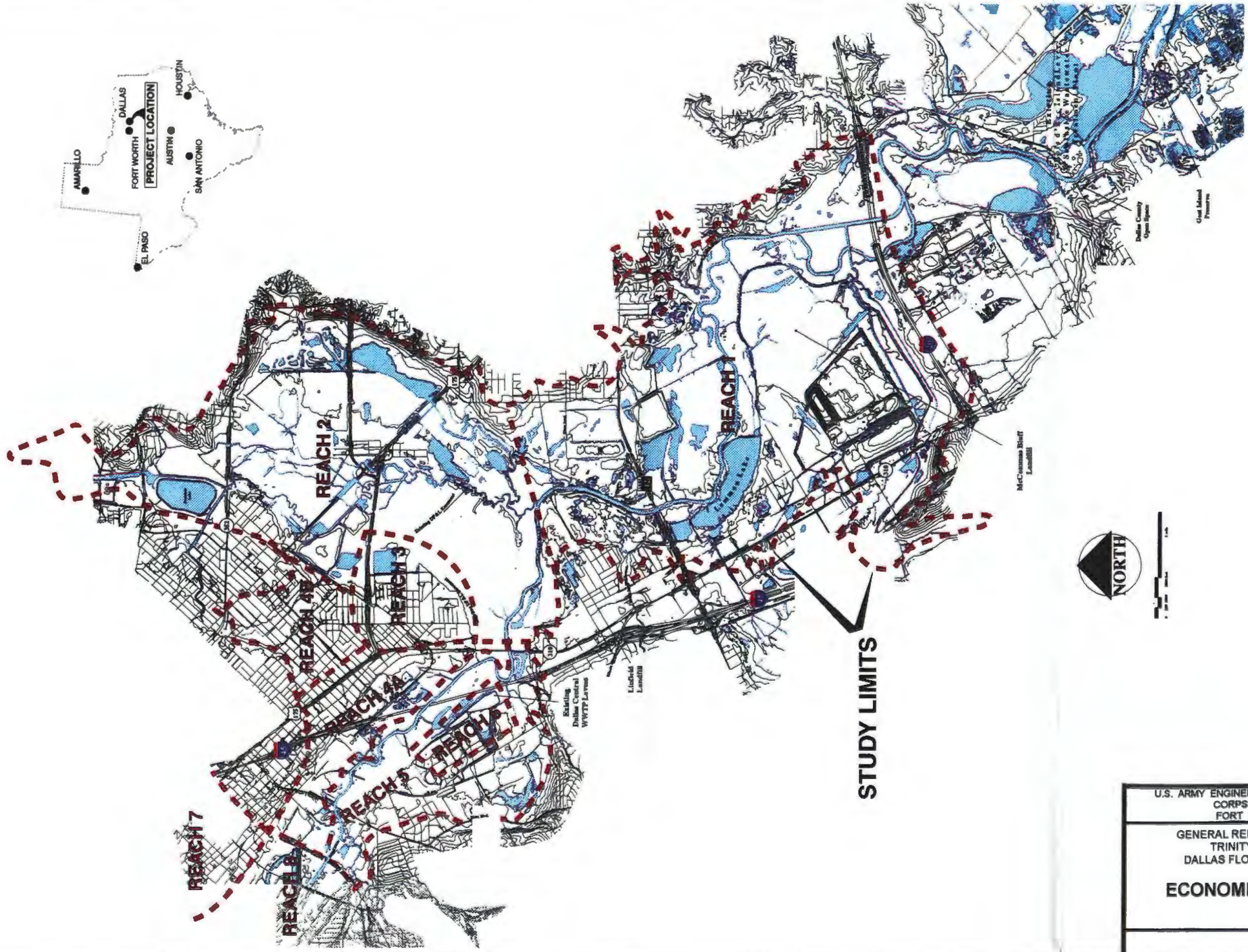
Damage Category	Activity Description
Residential	Single and multi-family dwellings
Commercial and Industrial	Retail and wholesale businesses
Public	Public and quasi-public buildings
Flood Insurance Administration	Costs to the public for flood insurance program administration
Other:	
Transportation	Streets, highways, and bridges
Communications and Utilities	Electrical, gas, telephone, sewerage, and water supply facilities and buildings
Public Health and Relief	Flood-fighting and related emergency management activities

Although the primary area of investigation is defined as that portion of the Trinity River between the confluence of Five Mile Creek near IH-20 downstream and the terminus of the existing Dallas Floodway Levees upstream, preliminary analysis revealed significant hydraulic correlations between the extension area and the leveed area upstream. Consequently, about eight miles of the existing Dallas Floodway was included in the study area. These primary and secondary study areas were further subdivided into reaches based on concentrations of damageable properties. The primary study area is defined as reaches 1 - 6, while the secondary study area includes reaches 7 and 8. These reaches are shown in figure 3-1 and defined as follows:

- **Reach 1 (Sleepy Hollow):** Extends from the confluence of White Rock Creek south eastward to the confluence of 5-Mile Creek. The reach is bounded by IH-20, the MKT Rail Road, and Linfield and Riverwood Roads. This reach includes the Sleepy Hollow Golf Course located near the river and Loop 12. The land use includes commercial, industrial, residential, and public facilities. The McCommas Bluff and Linfield landfill sites are located in this reach. The total investment value of this reach was estimated at $32 million.

- **Reach 2 (White Rock):** Includes a portion of the White Rock Creek Tributary from IH-30 upstream to its confluence with the Trinity River near Linfield Street. The reach is further bounded by Pemberton Road, IH-30, the Southern Pacific Railroad and the Rochester Park Levee. Land use includes single and multi-family residential, commercial and industrial properties. The total investment value of this reach was estimated at $7 million.

- **Reach 3 (Rochester Park):** This reach is located near the center of the study area and is predominately enclosed along its southern border by the Rochester Park Levee. The reach is further bounded by Hwy. 175 (Hawn Freeway), and Hwy. 310 (Central Expressway). The land use is predominately single and multi-family residential and a few commercial and public properties. The total investment value of this reach was estimated at $55 million.



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ECONOMIC REACH MAP

FIGURE 3-1

- **Reach 4A (Lamar):** This reach (initially combined with reach 4B) is located within the SPF floodplain limits along the east bank of the Trinity River. Beginning near the intersection of Lamar Street and Hwy. 175 and continuing northerly upstream to the AT & SF railroad. The reach is bounded on the east by Hwy. 310 (Central Expressway). The major land use categories include residential, commercial and industrial facilities. The total investment value of this reach was estimated at $45 million.

- **Reach 4B (Oakland Channel):** This reach (initially combined with reach 4A) is located parallel and to the east of Reach 4A. It is bounded by Hwy. 310 and Second Avenue. The Oakland Channel, which flows into White Rock Creek is located within this reach. The primary land use categories are single and multifamily residential and some commercial facilities. The total investment value of this reach was estimated at $217 million.

- **Reach 5 (Cadillac Heights):** Located on the West Bank of the Trinity River, the SPF limits of this reach extends from IH-45 to the AT&SF Railroad at the end of the existing Dallas Floodway. This area includes single-family residential, commercial, industrial and public properties. The total investment value of this reach was estimated at $27 million.

- **Reach 6 (Treatment Plant):** This reach is located downstream of Reach 5 and consists solely of the Central Wastewater Treatment Plant facility. This public facility represents the greatest single investment in the study area. The total investment value of this reach was estimated at $459 million.

- **Reach 7 (East Levee):** This reach, located upstream of the primary study area, encompasses the SPF flood plain limits protected by the East Levee of the existing Dallas Floodway System. The area includes the Central Business District and a mixture of all land use categories. Commercial facilities dominate the reach (69 percent) with almost 1982 structures. A total of 2,885 structures were identified with an estimated value of over $4.8 billion.

- **Reach 8 (West Levee):** This reach, located upstream of the primary study area, encompasses the SPF flood plain limits protected by the West Levee of the existing Dallas Floodway. The area includes all land use categories - residential, commercial and industrial, and public facilities. Residential structures account for over 90 percent of the land use in this reach with over 6,900 identified. A total of 7,700 structures were identified with an estimated value of over $934 million.

Estimates of expected annual damages under existing conditions were calculated through integration of frequency-damage data. Generally, this involved multiplication of the mean damages between each pair of flood events by the difference in exceedance probabilities for that pair of events, repeated over the entire range of flood events through the SPF, for each category of damageable property. Incidental damages (comprising transportation, communications and utilities facilities, and public health and relief operations) were estimated on the basis of the historical information submitted by the local sponsor documenting Federal Emergency Management Agency (FEMA) claims.

Initial estimates of existing flood damages and benefits presented herein reflect June 1993 prices and level of development. The prevailing Federal interest rate of 8.0 percent was applied to convert first costs and undiscounted future damages and benefits to average annual equivalent values. A 50-year period of analysis was used, extending from 1997 to 2047. The STDMA Flood Damage Program was used to determine single event and expected annual damages (EAD). The total equivalent annual flood losses in the study area were estimated at over $20.8 million, based on June 1993 prices, and the prevailing Federal interest rate of 8.0 percent. This information is detailed by reach in table 3-3.

Table 3-3
Expected Average Annual Damages
(June 1993 prices and level of development, 8.0% interest, 50-year period of analysis)

Reach	Annual Damages			Description
	Direct	Incidental	Total	
1	$311,800	$32,427	$344,200	Below White Rock
2	$53,300	$5,543	$58,800	White Rock
3	$166,300	$17,295	$183,600	Rochester Park
4	$1,741,100	$181,074	$1,922,200	Lamar/Oakland Area
5	$1,086,900	$113,038	$1,199,900	Cadillac Heights
6	$1,930,800	$200,803	$2,131,600	Treatment Plant
Subtotal	$5,290,200	$550,181	$5,840,300	Study Area
7	$11,800,000	$1,227,200	$13,027,200	East Levee
8	$1,7968,000	$186,867	$1,983,700	West Levee
Subtotal	$13,596,800	$1,414,067	$15,010,900	Upstream Levees
Total	$18,887,000	$1,964,248	$20,851,200	

1994-1996

Hydrology and Hydraulics. The hydrology and hydraulic models were updated to incorporate the results of the Upper Trinity River Feasibility Study, which utilized more recent topographic maps developed from aerial photography flown in February 1991, estimated to have an accuracy of plus or minus 0.5 feet. Therefore, models for this study are a subset of the models used for the Upper Trinity Feasibility Study, thereby maintaining consistency between the two studies. A calibration of these models was accomplished by the methods described in Appendix A, to closely match the May 1990 Flood.

Baseline conditions were assumed to represent estimated watershed development for the year 2000, based on land use data obtained from the North Central Texas Council of Governments (NCTCOG), and "percent urbanization" and "percent imperviousness" for each subarea as derived from the Geographic Information System (GIS).

The development of the baseline model was based on the requirements of the Upper Trinity River Feasibility Study that certain projects which influence the hydraulic and hydrologic conditions within the floodplain would be incorporated into the HEC-2 model to form a basis for future hydraulic studies within the Trinity River corridor. The following projects are future permitted projects and/or projects constructed, or under construction, since the 1991 aerial photography and mapping was completed. All landfills have been represented as completed.

- Southside Sewage Treatment Plan Levee modification
- McCommas Bluff Landfill and Swale
- Rochester Park Levee
- Central Wastewater Treatment Plant Levee modification
- DART OC-2 Rail Line Bridge
- Dixie Metals Company Landfill
- Dallas Floodway channel and levee modifications (AT&SF Railroad bridge to Houston Street bridge)
- Various small permitted fill areas

A complete description of the hydrologic and hydraulic analysis for this baseline condition and corresponding water surface profiles are presented in Appendix A.

Economics. The expected annual damages for this baseline condition were revised based on the modifications to the hydrology and hydraulics models, as described above, and on supplemental data gathered from surveys and the Dallas County Appraisal District for the Upper Trinity Feasibility Study. In addition, a risk-based analysis was incorporated, in accordance with recent USACE guidelines. The NexGen Hydrologic Engineering Center-Flood Damage Assessment (HEC-FDA) program integrates hydrologic engineering and economic analysis through application of the Monte Carlo simulation, calculates stage-damage-uncertainty information at damage reach index locations, and computes equivalent annual damages. The revised expected annual damages for baseline conditions, based on October 1995 prices and a prevailing Federal interest rate of 7.63 percent, are shown in table 3-4.

Traditional expression of the frequency of flood events has been in terms of the recurrence interval in years, such as, the "100-Year Flood". The more appropriate expression of the probability of a particular flood magnitude is in terms of "percent chance exceedance", especially as it relates to a risk-based analysis. Therefore, the "100-Year Flood", which is defined as "the magnitude of flooding which has a 1 percent probability of being equaled or exceeded in any given year" would be expressed as the "1 percent chance flood". For comparison purposes, the nine flood events computed for this study, traditionally referred to as the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, 500-year, and the Standard Project Flood (SPF), would be referred to, in probabilistic terms, as the 99 percent, 50 percent, 20 percent, 10 percent, 4 percent, 2 percent, 1 percent, 0.2 percent chance flood, and the SPF, respectively. Although the analyses contained herein were performed as risk-based analyses, results of these investigations are expressed in traditional terms for the benefit of the reader.

Table 3-4
Revised Expected Average Annual Damages
(October 1995 prices and level of development, 7.63% interest, 50-year period of analysis)

Reach	Annual Damages			Description
	Direct	Incidental	Total	
1	$338,200	$35,173	$373,400	Below White Rock
2	$58,400	$6,074	$64,500	White Rock
3	$168,000	$17,472	$185,500	Rochester Park
4	$1,853,800	$192,795	$2,046,600	Lamar/Oakland Area
5	$986,000	$102,544	$1,088,500	Cadillac Heights
6	$1,254,200	$130,437	$1,384,600	Treatment Plant
Subtotal	$4,658,600	$484,494	$5,143,100	Study Area
7	$12,131,000	$1,261,624	$13,392,600	East Levee
8	$1,102,400	$114,650	$1,217,000	West Levee
Subtotal	$13,233,400	$1,376,274	$14,609,600	Upstream Levees
Total	$17,892,000	$1,860,768	$19,752,700	

1996-1997

Hydrology and Hydraulics. The major change instigating the need for a revised hydraulic model during this phase of the study was the passage of the Water Resources Development Act (WRDA) of 1996, in October 1996. Section 351, contained therein, provided that the city of Dallas would be granted credit for the portions of two previously constructed non-Federal levees deemed compatible with the Federal plan. These levees included the Rochester Park Levee and the modifications to the Central Wastewater Treatment Plant (CWWTP) Levee, and were constructed by the city of Dallas in response to the floods of 1989-1991. Section 351 states the following:

> *(a) IN GENERAL -- The project for flood control, Dallas Floodway Extension, Dallas, Texas, authorized by section 301 of the River and Harbor Act of 1965 (79 Stat. 1091), is modified to provide that flood protection works constructed by the non-Federal interests along the Trinity River in Dallas, Texas, for Rochester Park and the Central Wastewater Treatment Plant shall be included as a part of the project and the cost of such works shall be credited against the non-Federal share of project costs.*
>
> *(b) DETERMINATION OF AMOUNT. -- The amount to be credited under subsection (a) shall be determined by the Secretary. In determining such amount, the Secretary may permit credit only for that portion of the work performed by the non-Federal interests that is compatible with the project referred to in subsection (a), including any modification thereof, and that is required for construction of such project.*
>
> *(c) CASH CONTRIBUTION.-- Nothing in this section shall be construed to limit the applicability of the requirement contained in section 103(a)(1)(A) of the Water Resources Development Act of 1986 (33 U.S.C. 2213(a)(1)(A)) to the project referred to in subsection (a).*

In order to accurately assess the economic benefits associated with these levees, it was necessary to revise the existing conditions hydraulics model to reflect the characteristics of the study area prior to 1991 when the construction of these levees was initiated. Water surface profiles derived from this revised model are presented in Appendix A.

Economics. Table 3-5 displays the numbers and estimated total values of properties (structures and contents) located within the study area after applying the revised hydraulic model. A total of 2,550 structures were identified within the SPF limits. As shown, the total flood plain investment within the SPF limits of the primary study area is valued at over $841.0 million based on January 1997 prices.

Expected annual damages were tabulated for the final phase, utilizing the HEC-FDA program, based on the aforementioned revisions, and on the current prevailing Federal interest rate of 7.375 percent. Incidental damages, comprised of transportation, communications and utilities facilities, and public health and relief operations, were added to the results to obtain the total expected annual damages.

Table 3-6 shows the total expected annual damages for the SPF floodplain under these revised existing conditions. The primary study area could expect damages totaling over $6.5 million and the secondary study area over $13.1 million. The combined expected annual damage exceeds $19.6 million.

Table 3-5
Total Floodplain Investments by Reach
Under Existing Conditions
(January 1997 Prices and Level of Development)
(1,000's $)

Reach	Single-Family Residential		Multi-Family Residential		Commercial/ Industrial		Public		Total Structure Investment		Vehicles	Rail	Total Investment
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*Value*	*Value*	*Value*
Primary Study Area													
1	73	1,768.3	0	0.0	26	22,876.1	3	2,558.8	102	27,203.2	192.9	4,443.8	31,839.9
2	68	4,339.9	3	476.1	19	1,707.7	0	0.0	90	6,523.7	430.9	0.0	6,954.6
3	247	6,463.4	112	9,234.0	8	199.0	4	36,651.5	371	52,547.9	2,021.0	0.0	54,568.9
4A	107	2,715.3	6	382.0	68	34,194.2	0	0.0	181	37,291.5	345.3	7,063.1	44,699.9
4B	1,432	34,189.1	0	0.0	61	5,102.8	4	177,768.0	1497	217,059.9	0.0	0.0	217,059.9
5	228	6,630.1	0	0.0	66	18,006.2	0	0.0	294	24,636.3	742.8	1,623.0	27,002.1
6	0	0.0	0	0.0	0	0.0	15	458,878.6	15	458,878.6	0.0	0.0	458,878.6
	Area Total												
	2,155	$56,106.1	121	$10,092.1	248	$82,086.0	26	$675,856.9	2,550	$824,141.1	$3,732.9	$13,129.9	$841,003.9
%	84.5%	6.7%	4.7%	1.2%	9.7%	9.8%	1.0%	80.4%	100.0%		0.4%	1.6%	100.0%
Secondary Study Area													
7	869	75,871.6	3	1,691.3	1,982	4,553,940.5	31	$220,968.8	2,885	$4,852,472.2	$5,058.1	N/A	$4,857,530.3
8	6,493	$297,262.5	474	$110,933.0	642	$440,403.4	94	$58,497.6	7,703	$907,096.5	$27,221.7	N/A	$934,318.2
	Area Total												
	7,362	$373,134.1	477	$112,624.3	2,624	$4,994,343.9	125	$279,466.4	10,588	$5,759,568.7	$32,279.8	$0.0	$5,791,848.5
%	69.5%	6.4%	4.5%	1.9%	24.8%	86.2%	1.2%	4.8%	100.0%		0.6%	0.0%	100.0%
Total Investment													
	9,517	$429,240.2	598	$122,716.4	2,872	$5,076,429.9	151	$955,323.3	13,138	$6,583,709.8	$36,012.7	$13,129.9	$6,632,852.4

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Table 3-6
Expected Annual Damages
Under Existing Conditions (Pre-1991)
(January 1997 prices and level of development, 7.375% interest, 50-year period of analysis)

Reach	Annual Damages			Description
	Direct	Incidental	Total	
1	$294,200	$54,271	$348,900	Below White Rock
2	$50,800	$9,449	$60,200	White Rock
3	$431,500	$80,259	$511,800	Rochester Park
4A	$1,350,000	$251,100	$1,601,100	Lamar Area
4B	$741,100	$137,845	$878,900	Oakland Area
5	$1,085,700	$201,940	$1,287,600	Cadillac Heights
6	$1,696,300	$162,845	$1,859,100	Treatment Plant
Subtotal	$5,649,600	$898,159	$6,547,600	Study Area
7	$10,054,700	$1,870,174	$11,924,900	East Levee
8	$998,500	$185,721	$1,184,200	West Levee
Subtotal	$11,053,200	$2,055,895	$13,109,100	Upstream Levees
Total	$16,702,800	$2,954,054	$19,656,700	

IDENTIFICATION OF RECREATIONAL NEEDS

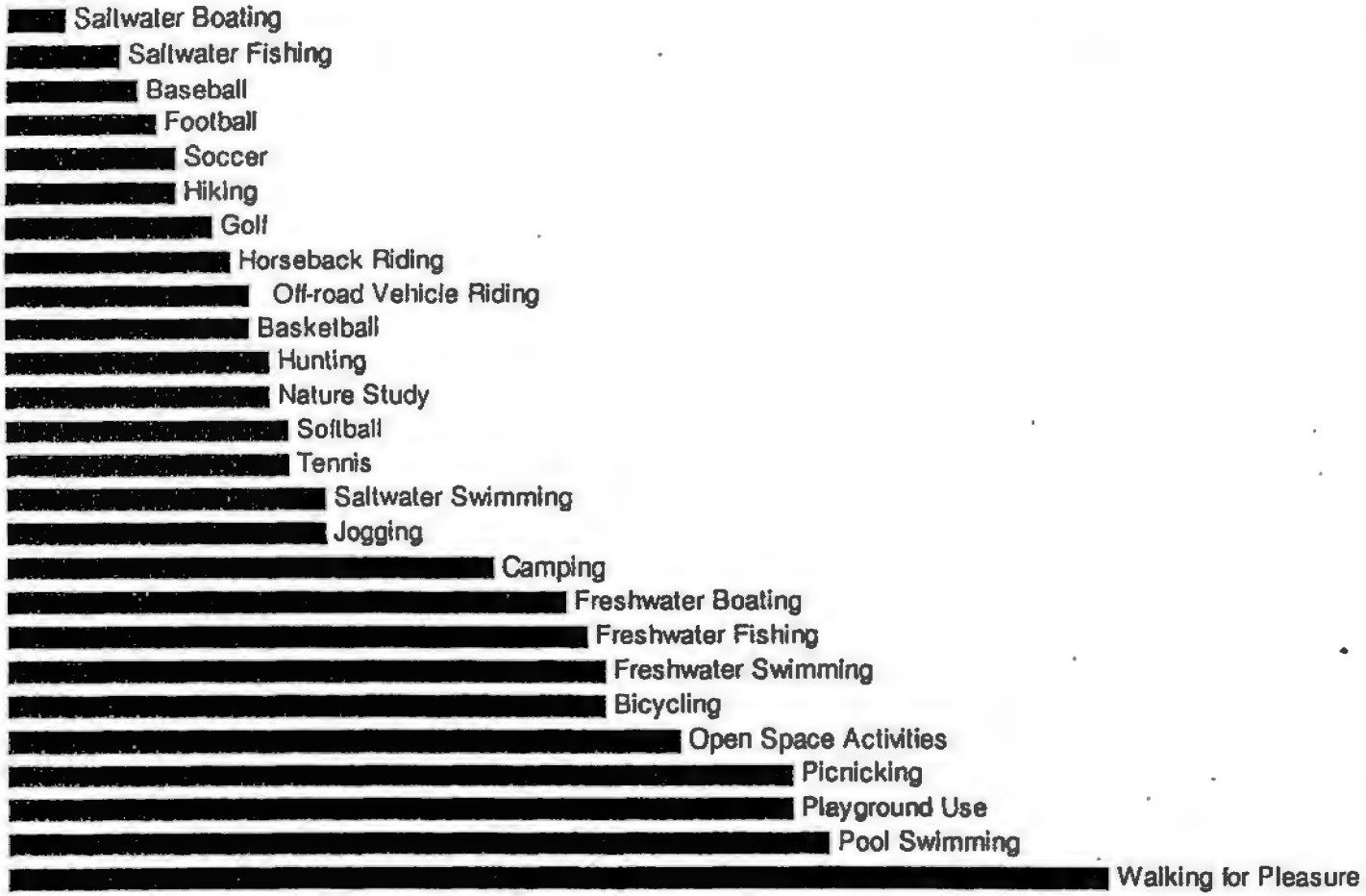
Open space and outdoor recreational facilities which currently exist within the study area are discussed in a preceding section of this report. While there are substantial amounts of open space and recreational facilities available to the residents of the area, projections show that the demand for these facilities is continuing to increase. Table 3-7 and figure 3-2 show the most popular outdoor recreational activities which were expected to occur in Region 4 in years 1995, and 2000, as projected in the 1990 Texas Outdoor Recreation Plan (TORP). Participation will increase for each projection year. Fresh water fishing, swimming, and picnicking will attract the most participation in the region for resource based activities. Participation in urban oriented activities projected for 1995 were over eight times as high as the participation in resource based activities in the region. This ratio is one of the highest in Texas. Texans from outside Region 4 will have little impact on the region's resources.

Table 3-8 shows regional facility needs for 13 of the 18 commonly used facilities/resources by 1995. Increases of more than 100 percent over existing supply are needed for five facilities (hiking, horseback, and multi-use trails, playgrounds, and freshwater swimming areas). Table 3-9 ranks the outdoor recreation needs within the region. Multi-use trails are the highest need followed by freshwater swimming, playgrounds, and hiking trails. Public recreation providers in the region have repeatedly expressed a need for more parks and passive open space. In recent years, park land and open space have become increasingly scarce as available sites have been reduced. Rapid development has replaced many natural areas with buildings and pavement. Needed lands shown in table 3-8 represent only the acres required to develop recreational facilities. Most park providers have identified undeveloped land as their highest priority need (park sites, open space, and greenbelt acquisition). The next greatest need expressed is for upgrading and renovating existing facilities.

Table 3-7
Projected Urban Outdoor Recreation Participation for Region 4

Activity/Facility Use	Project Participation (in 1000's Annual User Occasions)		
	1990	1995	2000
Baseball	4,852	4,882	5,183
Basketball	5,662	6,020	6,379
Bicycling	41,405	44,140	46,880
Bicycling on Trails	2,551	2,719	2,888
Football	2,673	2,870	3,068
Golf	5,268	5,781	6,295
Horseback Riding	3,054	3,255	3,456
Horseback Riding on Trails	784	835	887
Jogging/Running	19,073	20,055	21,039
Jogging/Running on Trails	5,875	6,177	6,480
Off-road Vehicle (ORV) Riding	5,374	5,723	6,074
ORV Riding on Trails	1,053	1,121	1,190
Open Space Activities	13,358	14,076	14,794
Playground Use	19,374	20,435	21,497
Soccer	5,748	6,073	6,398
Softball	6,607	6,911	7,217
Swimming, Pool	24,685	26,216	27,749
Tennis	5,732	6,132	6,533
Walking (Pleasure/Exercise)	57,876	63,100	68,330
Walking on Trails	13,549	14,772	15,996

Source: 1986 Participation Survey, Parks Division, TPWD, 1987.



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GENERAL REEVALUATION REPORT
TRINITY RIVER, TEXAS
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MOST POPULAR OUTDOOR RECREATION ACTIVITIES

FIGURE 3-2

Table 3-8
Additional Urban Outdoor Recreation Facilities/Resources Needed in Region 4

Facility/Resource	1986 Facility Supply	Facilities Needed Above 1986 Supply		
		1990	1995	2000
Baseball Fields	310	24	46	68
Basketball Goals	469	214	258	301
Boat Ramp Lanes	423	*	*	*
Campsites	5,393	*	*	*
Fishing Structures, (yd.)	8,167	316	967	1,619
Golf Holes	666	*	28	89
Hiking Trail Miles	23	63	69	76
Horseback Riding Trail Miles	31	81	89	96
Lake Acres (BFS Suitable)	165,749	*	*	*
Off-Road Vehicle Riding Acres	2,899	*	*	*
Picnic Tables	8,947	*	*	*
Playground Acres, Equipped	915	930	1,031	1,133
Soccer/Football Fields	564	103	118	134
Softball Fields	478	*	16	37
Swimming, Freshwater (1000 yd^2)	390	1,029	1,100	1,170
Swimming, Pool (1000 yd^2)	90	67	77	87
Tennis Courts	877	621	726	830
Trail Miles, Multi-Use (Walk,Bike,Jog)	118	263	292	322
Developed Land, Acres		4,572	5,457	6,709

** Indicates no needs exist based on a regional analysis of supply and participation; however, needs may exist locally within the region due to inadequate distribution of existing facilities.*

Source: Parks Division, TPWD, 1988

Table 3-9
Ranking of Outdoor Recreation Facility/Resource Needs in Region 4 through 1995

Need by Rank	Facility/Resource
1	Trail Miles, Multi-Use (Walk, Bike, Jog)
2	Swimming, Freshwater (1000 yd^2)
3	Playground Area, Equipped
4	Hiking Trail Miles
5	Horseback Riding Trail Miles
6	Soccer/Football Fields
7	Swimming, Pool (1000 yd^2)
8	Tennis Courts
9	Basketball Goals
10	Baseball Fields
11	Golf Holes
12	Fishing Structures, Freshwater (yd.)
13	Softball Fields
14	Boat Ramp Lanes, Freshwater
15	Campsites
16	Picnic Tables
17	Off-Road Vehicle Riding Acres
18	Lake Acres (BFS Suitable)

Source: Parks Division, TPWD, 1988.

The City of Dallas and the Dallas County Open Space Board have specific plans to acquire additional lands to meet future public recreational demands. Proposed acquisitions are often dependent on the availability of public funds and are influenced by private development pressures and development permit approvals. Both the City and the County have bond funded open space acquisition programs. The recent slump in the Texas economy has temporarily suppressed rising land costs, making the present a very good time to pursue needed acquisitions.

As would be expected, river and creek segments which have had trees and shrubs removed, have been channelized, lined with levees, or heavily developed are less desirable and the least utilized by area canoeists, bicyclists, hikers, and bird watchers. Many of these channelized and leveed river segments offer recreation potential but will need to be enhanced with river access points, trails, play areas, sports fields, tree and shrub plantings and wildlife habitat improvements in order to attract recreational users to the floodway.

Without exception, the recreational master plans and sector plans of the cities and counties with jurisdiction along the Trinity River call for utilization of the flood plain for open space, linear parks, access areas, active and passive use areas, interpretive areas, natural areas, "urban wilderness" areas, and a system of linked hiking, biking and equestrian trails. A regional goal is to tie public lands and open space within the Trinity Corridor and its tributaries from Lewisville Lake, Lewisville, Coppell, Carrollton, Irving, White Rock Lake, Dallas, Grand Prairie, Mountain Creek Lake, Joe Pool Lake, Arlington, Fort Worth, Lake Worth, Benbrook Lake and other publicly owned areas. The cities have expressed interest in exploring Federal cost sharing options for acquiring riparian forests, open fields and wetlands which border the Trinity River and its tributaries, and have encouraged the Corps to consider the full potential for cost sharing in the acquisition of natural areas and open space, and in the construction of recreational facilities in conjunction with structural and nonstructural flood protection alternatives.

Working toward a system of parks, recreational areas, and linear trails along the Trinity is an integral portion of the North Central Texas Council of Government's ***Common Vision*** work program. NCTCOG has identified the Trinity River Corridor as a "unique regional resource." The value of this resource is increased because of its location within the heart of a growing Metroplex. The 100-mile long corridor encompasses the SPF flood plain of the West Fork above Eagle Mountain Lake and the Clear Fork from Benbrook to the Elm Fork, and along the Elm Fork from Lewisville Lake through the mainstem of the river, with its major tributaries, downstream to south Dallas.

While there are obviously conflicts between desires to reclaim the flood plain or preserve it, there is room within the 70,000 acres of the Corridor for both of these desires to be met. "The Trinity River Corridor is valuable to all 4 million residents of the Region and the millions to come." (NCTCOG, 1989)

The North Central Texas Council of Governments (NCTCOG) is pursuing a Trinity Greenbelt of major parks linked by a regional trail system. According to NCTCOG, "Tens of thousands of acres of open space are being preserved within the river corridor with outstanding potential for active and passive recreation. Using the Trinity River Information Network, local park departments and recreational professionals will prepare a realistic Trinity Greenbelt strategy of major parks linked by a regional trails system." It is the intent of NCTCOG to implement a "world class" Trinity Greenbelt strategy.

Local bicycle, equestrian, and conservation groups have shown a keen interest in the development of trails as part of a recreation plan for the study area, and have offered many recommendations for consideration. These recommendations are presented in appendix I.

IDENTIFICATION OF ENVIRONMENTAL NEEDS

The Dallas-Fort Worth Metroplex has experienced extensive urban development, and expansion continues into surrounding counties. The need to provide protection against ravaging floods in these areas has escalated along with the new development, as continually increasing areas of impervious surfaces associated with rooftops, parking lots, and highways yields greater volumes of storm water runoff. In addition, local drainage programs tend to increase the speed of runoff, thereby necessitating on-going improvement of flood control features. Within the Metroplex, the Corps of Engineers has constructed Benbrook, Joe Pool, Grapevine, Lewisville, and Ray Roberts Lakes, all of which are multi-purpose projects providing flood damage reduction benefits to the area. In addition, the Corps has constructed the Fort Worth and Dallas Floodways, which are composed of levees and channels, that provide needed protection for the downtown business districts of the respective cities.

With the exception of Joe Pool Lake and Lake Ray Roberts, these projects were constructed prior to the enactment of legislation requiring environmental review. Joe Pool Lake and Lake Ray Roberts were authorized prior to Corps authorities to mitigate environmental losses. Review of available information indicates that, while providing needed flood damage reduction and water supply for the Metroplex, these projects also forever altered the landscape. The most significant losses that occurred were to the bottomland hardwood areas that existed as riparian forested stringers along the main stem river and

tributaries. In addition, many small emergent wetland areas along the streams were either inundated and lost or were removed through the grading and leveling process of channel construction in the leveed reaches. Reduction of flooding brought about by these large projects has also increased secondary development throughout the region. Prior to the mid-1970's, there were no regulatory processes to protect or require mitigation for any of these wetland losses.

In 1985, the Corps of Engineers began a study to address the impacts of unrelated development projects along the Trinity River and it tributaries in Dallas, Denton, and Tarrant Counties. The *Final Regional Environmental Impact Statement* completed in 1987 indicated that within the 73,000-acre study area, only 570 acres of herbaceous wetlands were identifiable within the 100-year floodplain, and only 745 acres within the Standard Project Flood zone. Even without a definitive historic record of emergent wetlands losses within the area prior to the major Corps construction activities, it is clear that significant losses have occurred. These losses to wetlands adjacent to the riparian woodlands in the form of scars, seeps and cutoffs have also impacted many species of migratory shore birds, wading birds, reptiles, and amphibians. From a resource protection standpoint, it could be easily argued that priorities should be established for efforts to maintain and improve the integrity of bottomland hardwood forests because of their ecological significance, their visibility and appeal to observers, and the length of time required to re-establish a mature forest. Emergent wetlands also have ecological significance and can be established comparatively quicker than forests; therefore, annualized benefits can be quite high. Furthermore, emergent wetlands can be established in conjunction with other project features without inducing flood damages or compromising flood reduction benefits.

In summary, natural habitat in the area has given way to increased urbanization, making the remaining natural habitat more important. Accordingly, future actions should focus on protecting and enhancing the remaining natural environment of the area. Any fish, wildlife and environmental mitigation plan to be proposed for impacts that would accrue to bottomland hardwood forests will be based upon recognition of the importance of offsetting unavoidable losses to this significant habitat.