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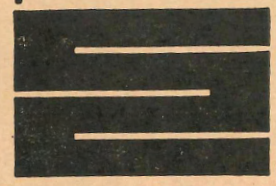
FLOOD DAMAGE SURVEY

FOR THE

TUG FORK VALLEY



STANLEY CONSULTANTS

FLOOD DAMAGE SURVEY

FOR THE

TUG FORK VALLEY

Contract No. DACW 69-77-C-0105
Huntington District
U.S. Army Corps of Engineers

By Stanley Consultants
Cleveland, Ohio
October, 1978

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PART I

SUMMARY AND CONCLUSIONS

The major objective of this study is the development of data on historic and potential flood damages for the Tug Fork River Basin of West Virginia, Virginia, and Kentucky. The area analyzed essentially includes both banks of the river from river mile 0.0 to river mile 138.1, respectively located at Fort Gay and Welch, West Virginia. Specifically analyzed in the study are damages that actually occurred during the flooding of April, 1977, and damages that would potentially occur from flooding under present day conditions from the 1977 level flood; the Standard Project Flood (SPF); and the 500-year, 100-year, 50-year, 20-year, and 5-year frequency floods. Table 1 summarizes the results of the analysis.

As noted in the table, total damages resulting from the April, 1977 flood are estimated to be in excess of $197 million, with commercial and industrial damages comprising almost 50 percent of that amount, residential capturing 21 percent and other properties comprising the remaining 29 percent of the total. Further breakdown of damages in the commercial/industrial sector shows that commercial properties suffered the majority of damages in this category. For example, during the 1977 as-occurred flood event, commercial damages represent almost 57 percent of the commercial/industrial damage total. Within the industrial subsector, the coal industry

TABLE 1

STUDY AREA DAMAGES BY FLOOD ($000's)

Flood	Total Damage	Percent Distribution		
		Residential	Commercial/Industrial	Other
1977 as-occurred	$197,261.1	21.3	49.3	29.4
1977 recurrence	197,766.3	25.3	45.8	28.9
SPF[1]	273,704.6	26.5	45.0	28.5
500-year[1]	200,029.6	26.7	45.8	27.5
100-year[1]	131,669.1	27.8	41.4	30.8
50-year[1]	100,148.0	29.0	40.1	30.9
20-year[1]	47,424.3	36.6	25.7	37.7
5-year[1]	17,534.6	45.8	18.4	35.8

[1]Based upon frequency analysis performed prior to the April 1977 flood

Source: Stanley Consultants, Huntington District, U.S. Army Corps of Engineers

sustained the bulk of the damages, primarily in physical damages and business/financial losses. Food and beverage processing facilities were also heavily affected in this subsector.

Estimates of damages that would occur under present day conditions range from a high of over $273 million for the SPF to a low of slightly over $17 million for the 5-year frequency flood. With the exception of damages under the lower frequency 5-year and 20-year frequency floods, commercial and industrial damages consistently constitute the greatest percentage of total damages. Deviation from this rule at the lower frequency levels is, of course, a result of the fact that relatively fewer commercial and industrial properties

are located in areas subject to more frequent flooding. The railroad, government, church, school, highway, and other miscellaneous damages included in the "other" category consistently constitute 27 percent to 38 percent of the total damages at each of the flood levels analyzed.

Development of damage estimates for properties in the Tug Fork Valley involved an initial survey of all properties in the Valley followed by detailed interviews and analysis. Basic structural, elevation, and value information was collected during the initial survey. Follow-up activities involved interviews with each affected commercial and industrial property owner, interviews with government officials and others, and on-site appraisals of properties. Residential damages were estimated using the extensive data developed during the initial field survey and residential depth-damage relationship tables provided by the Huntington District of the U.S. Army Corps of Engineers.

PART II

INTRODUCTION

GENERAL

The Tug Fork Valley Flood Protection Study was authorized under Section 90 of the 1974 Water Resources Development Act. Stanley Consultants was engaged to complete a flood damage report through a contract executed between Stanley Consultants and the Huntington District of the U.S. Army Corps of Engineers.

PURPOSE AND SCOPE

This flood damage analysis is part of a broadly-based effort by the U.S. Army Corps of Engineers to identify and develop measures capable of reducing flooding in the 1,555 square mile Tug Fork River Basin of West Virginia, Virginia, and Kentucky. The essential objective of the analysis described in this report is the development of data on historic and potential flood damages for the various areas in the Tug Fork Basin capable of being flooded.

The specific detailed objectives addressed by this study include:

1. Development of damages which actually occurred in the April, 1977 flood in the Tug Fork Basin.
2. Development of an estimate of flood damages that would result from the following flood stages based upon the development conditions existing at the time of the survey: the Standard Project Flood (SPF); the 500-year frequency flood; the 100-year frequency flood; the 50-year frequency flood; the

20-year frequency flood; the 5-year frequency flood; and the recurrence of the April, 1977 level of flooding.

3. Preparation of an analysis of structural value - furnishing value; structural value - personal belongings value; and actual depth-damage relationships for residential properties in the Tug Fork Basin through the execution of detailed interviews and analysis of residential properties affected by the April, 1977 flooding.

STUDY AREA

The study area for this report encompasses portions of eight counties in three states including: McDowell, Mingo, and Wayne Counties in West Virginia; Martin, Pike, and Lawrence Counties in Kentucky; and Buchanan and Tazewell Counties in Virginia. Among the more significant communities included in the study area are Williamson, Welch, Kermit, Matewan, and Crum, West Virginia. The specific area of investigation is the flood plain area along the main stem of the Tug Fork River and the area tributaries back to dead level backwater on the river. The downstream and upstream limits of the area are river miles 0.0 and 138.1 respectively located at Fort Gay, West Virginia, and Welch, West Virginia.

REACHES

For the purpose of this report the study area flood plain was divided into 38 reaches. Table 2 outlines these reaches along with their upstream and downstream limits.

TABLE 2

TUG FORK VALLEY FLOOD DAMAGE SURVEY
REACH DESCRIPTIONS

Reach	Name	State	Upstream Limit	Downstream Limit
110	Ft. Gay to Crum	WVa	RM 27.6	RM 0.0
120	Ft. Gay to Crum - Kentucky Bank of River	Ky	RM 27.6	RM 0.0
210	Crum through Kermit excluding Lick Branch	WVa	RM 35.4	RM 27.6
211	Lick Branch	WVa	From confluence with Tug Fork at RM 28.2 to dead level backwater.	
220	Crum through Kermit - Kentucky Bank of River	Ky	RM 35.4	RM 27.6
310	Kermit to Fairview excluding communities of Nolan, West Chattaroy, and Buffalo Creek	WVa	RM 54.1	RM 35.4
311	Nolan	WVa	RM 49.0	RM 48.6
312	Buffalo Creek	WVa	From confluence with Tug Fork at RM 52.7 to dead level backwater.	
313	West Chattaroy	WVa	RM 53.4	RM 52.8
314	Fairview	WVa	RM 55.3	RM 54.1
320	Kermit to Fairview - Kentucky Bank of River	Ky	RM 54.8	RM 35.4
411	West Williamson	WVa	RM 56.5	RM 55.5
410	Williamson Area outside floodwall excluding East and West Williamson and Fairview	WVa	RM 60.9	RM 56.5

TABLE 2 - (Continued)

Reach	Name	State	Upstream Limit	Downstream Limit
412	Williamson - Inside floodwall	WVa	RM 57.7	RM 57.1
413	East Williamson	WVa	RM 58.6	RM 58.0
420	Williamson Area - Kentucky Bank of River excluding South Williamson, Julius Branch, Turkey and Taylor Creeks, and Pond Creek	Ky	RM 58.1	RM 54.8
421	Julius Branch	Ky	From confluence with Tug Fork at RM 56.3 to dead level backwater.	
422	Turkey and Taylor Creeks	Ky	RM 55.2 Also includes area of confluence with Tug Fork back to dead level backwater.	RM 54.9
423	South Williamson	Ky	RM 57.3	RM 56.4
424	Pond Creek	Ky	From confluence with Tug Fork at RM 58.1 back to dead level backwater.	
510	Williamson Area to RM 69.9 excluding Big Bend Area	WVa	RM 69.9	RM 60.9
511	Big Bend Cutoff - West Virginia Bank	WVa	RM 69.5	RM 65.2
520	Williamson Area to Matewan - Kentucky Bank of River excluding Aflex, Goody, and Big Bend Cutoff Area	Ky	RM 69.9	RM 58.1
521	Goody	Ky	RM 58.4	RM 58.1
522	Aflex	Ky	RM 59.9	RM 59.5

TABLE 2 - (Continued)

Reach	Name	State	Upstream Limit	Downstream Limit
523	Big Bend Cutoff - Kentucky Bank	Ky	RM 69.6	RM 65.2
610	Matewan through Vulcan excluding Mate Creek	WVa	RM 80.0	RM 69.9
611	Matewan	WVa	RM 70.8	RM 70.5
612	Mate Creek	WVa	From confluence with Tug Fork at RM 70.8 back to dead level backwater.	
620	Matewan through Vulcan - Kentucky Bank of River excluding Blackberry Creek and Peter Creek	Ky	RM 80.0	RM 69.9
621	Blackberry Creek	Ky	From confluence with Tug Fork at RM 72.0 back to dead level backwater.	
622	Peter Creek	Ky	From confluence with Tug Fork at RM 77.7 back to dead level backwater.	
710	Vulcan to Iaeger - W. Va. portion	WVa (LB Only)	RM 108.9	RM 100.1
		WVa (RB Only)	RM 108.9	RM 80.0
720	Vulcan to Iaeger - Ky. portion	Ky	RM 94.6	RM 80.0
730	Vulcan to Iaeger - Va. portion	Va	RM 100.1	RM 94.6
810	Iaeger	WVa	RM 112.7	RM 108.9
910	Iaeger to Welch	WVa	RM 132.5	RM 112.7
010	Welch	WVa	RM 138.1	RM 132.5

Source: Stanley Consultants, Huntington District, U.S. Army Corps of Engineers

ELEVATIONS AT WHICH DATA WERE COLLECTED

Data were gathered and damage estimates were performed for the following eight flood stages: the April, 1977 flood; recurrence of the April, 1977 level of flooding; the Standard Project Flood; and the 500-year, 100-year, 50-year, 20-year, and 5-year frequency floods. Over time, as hydrologic conditions change, the elevations corresponding to these frequencies may be adjusted. For that reason, the current elevations corresponding to the above flood levels serve as a more precise indicator of the flood levels analyzed in this report.

Table 3 lists by reach the elevation of each flood event. The flood elevations correspond to the expected level of flooding for each event at the downstream limitation (expressed in river miles) of each reach. Reaches 211, 312, 421, 612, 621, and 622 are tributary reaches. The river miles stated as the boundaries for these tributary reaches are the points at which the tributaries meet with the Tug Fork River. Exhibit 1 is flood profile data, which were used in the study.

CHARACTERISTICS OF FLOODING

Damage Concepts

The stage-frequency relationships (flood profiles) used in the study were provided by the Corps of Engineers. The relationships used reflect conditions prevailing at the time of the study; however,

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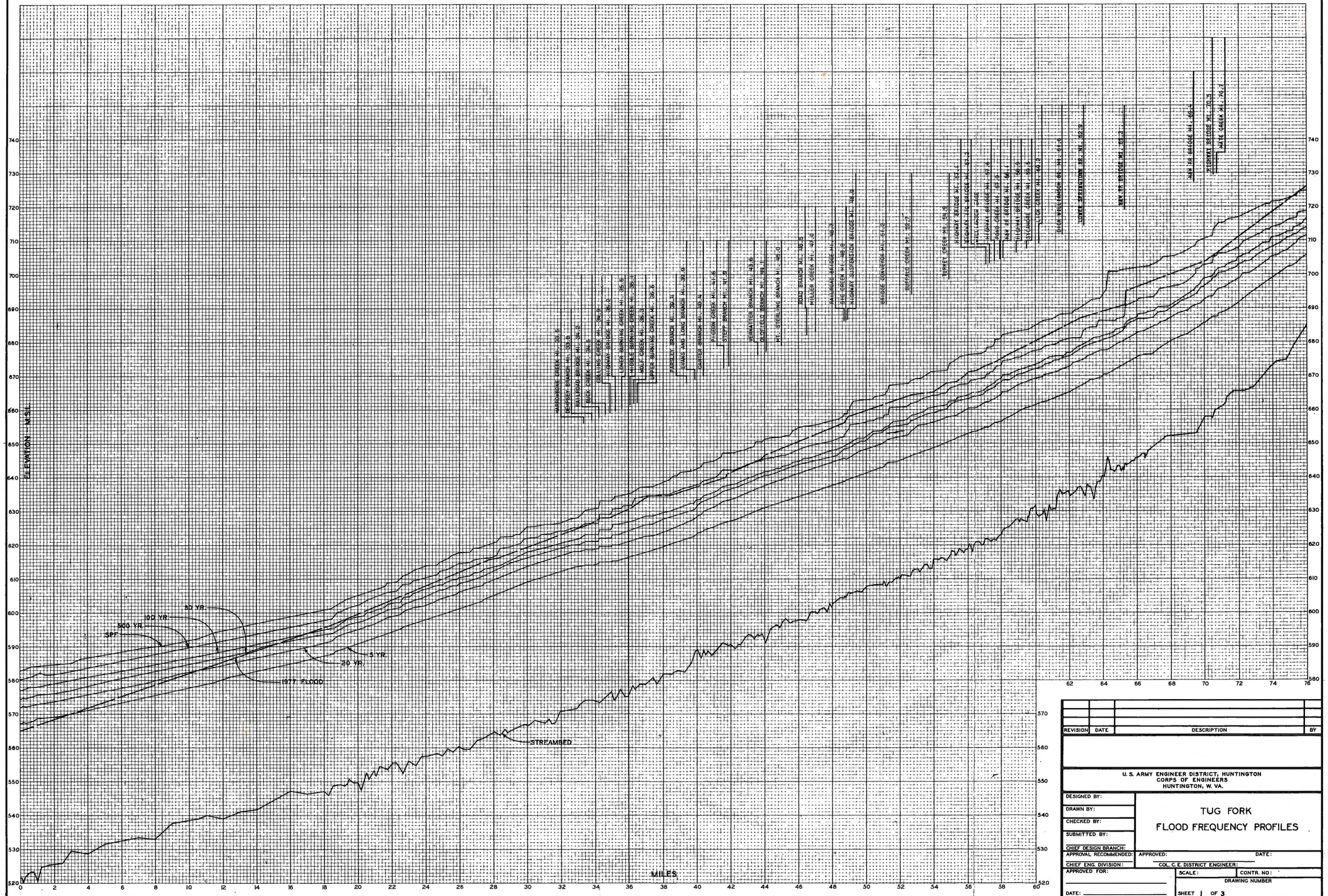

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CORPS OF ENGINEERS
HUNTINGTON, W. VA.

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CHECKED BY:
SUBMITTED BY:
CHIEF DESIGN BRANCH:
APPROVAL RECOMMENDED:
CHIEF ENG. DIVISION:

TUG FORK
FLOOD FREQUENCY PROFILES

APPROVED:
DATE:
COL. C.E. DISTRICT ENGINEER:
APPROVED FOR:
DATE:
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DRAWING NUMBER
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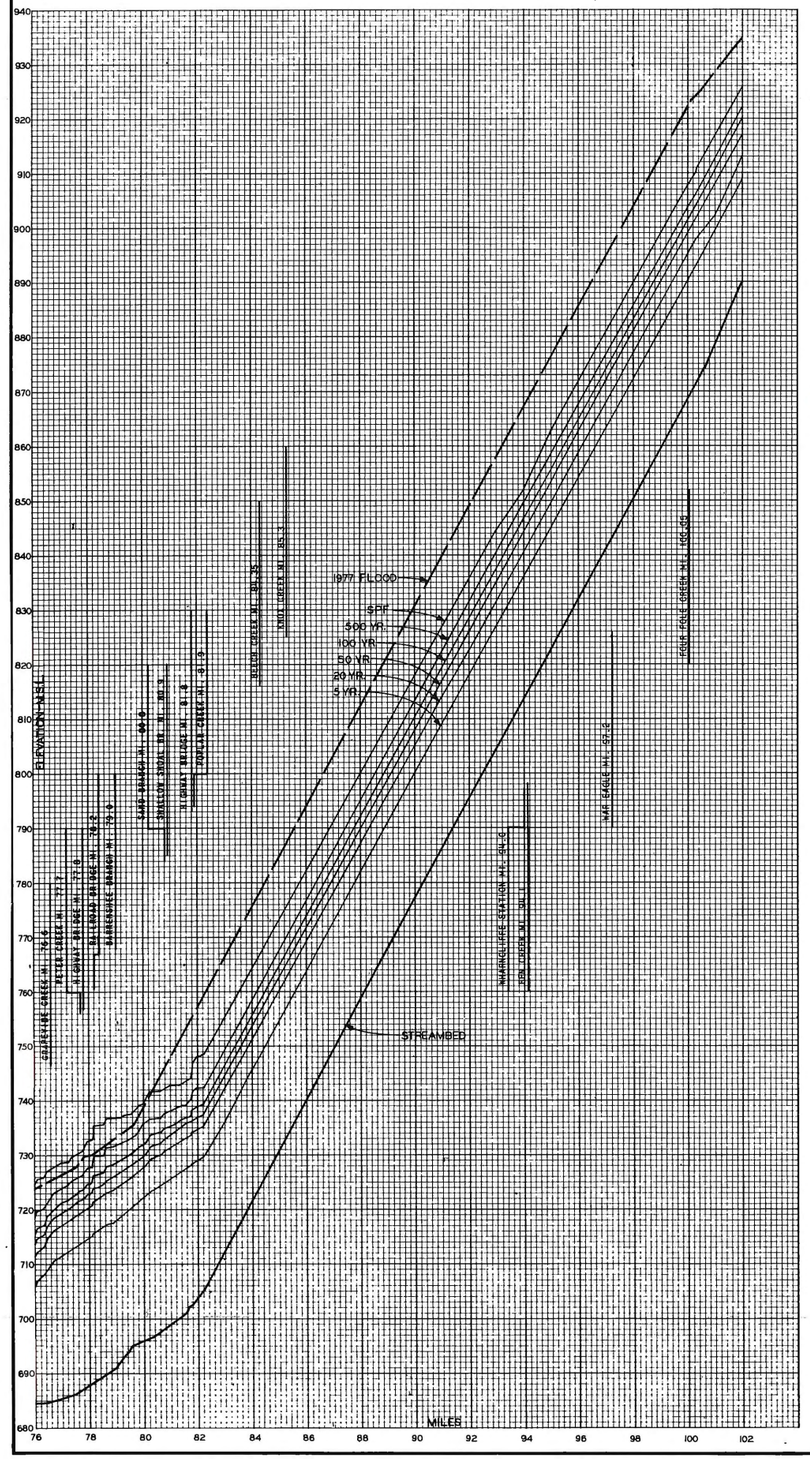

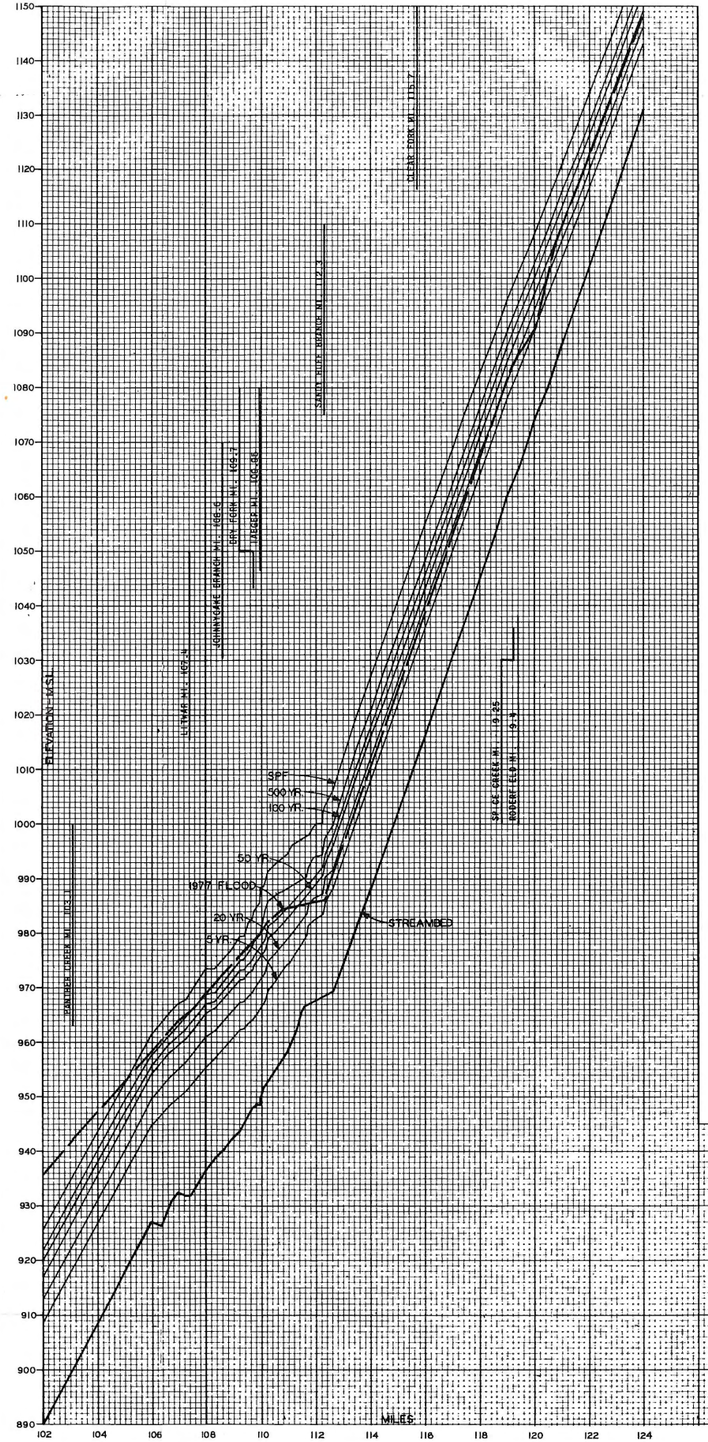

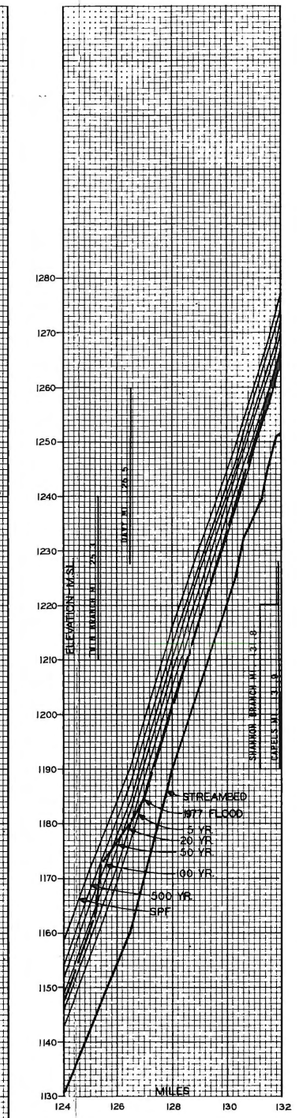

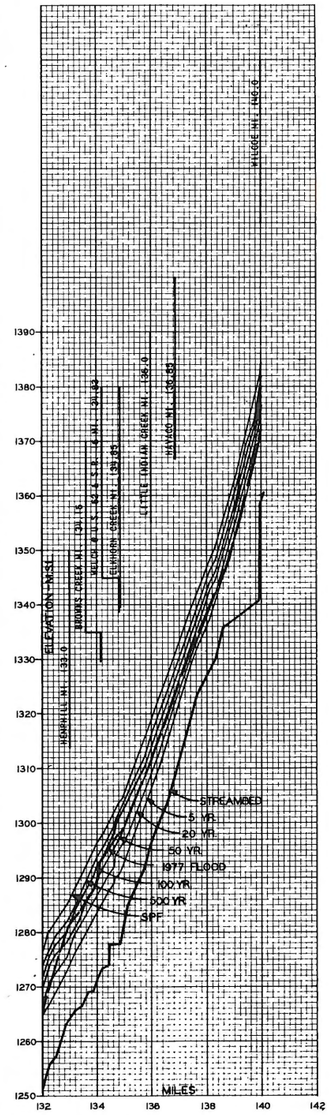

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TUG FORK
FLOOD FREQUENCY PROFILES

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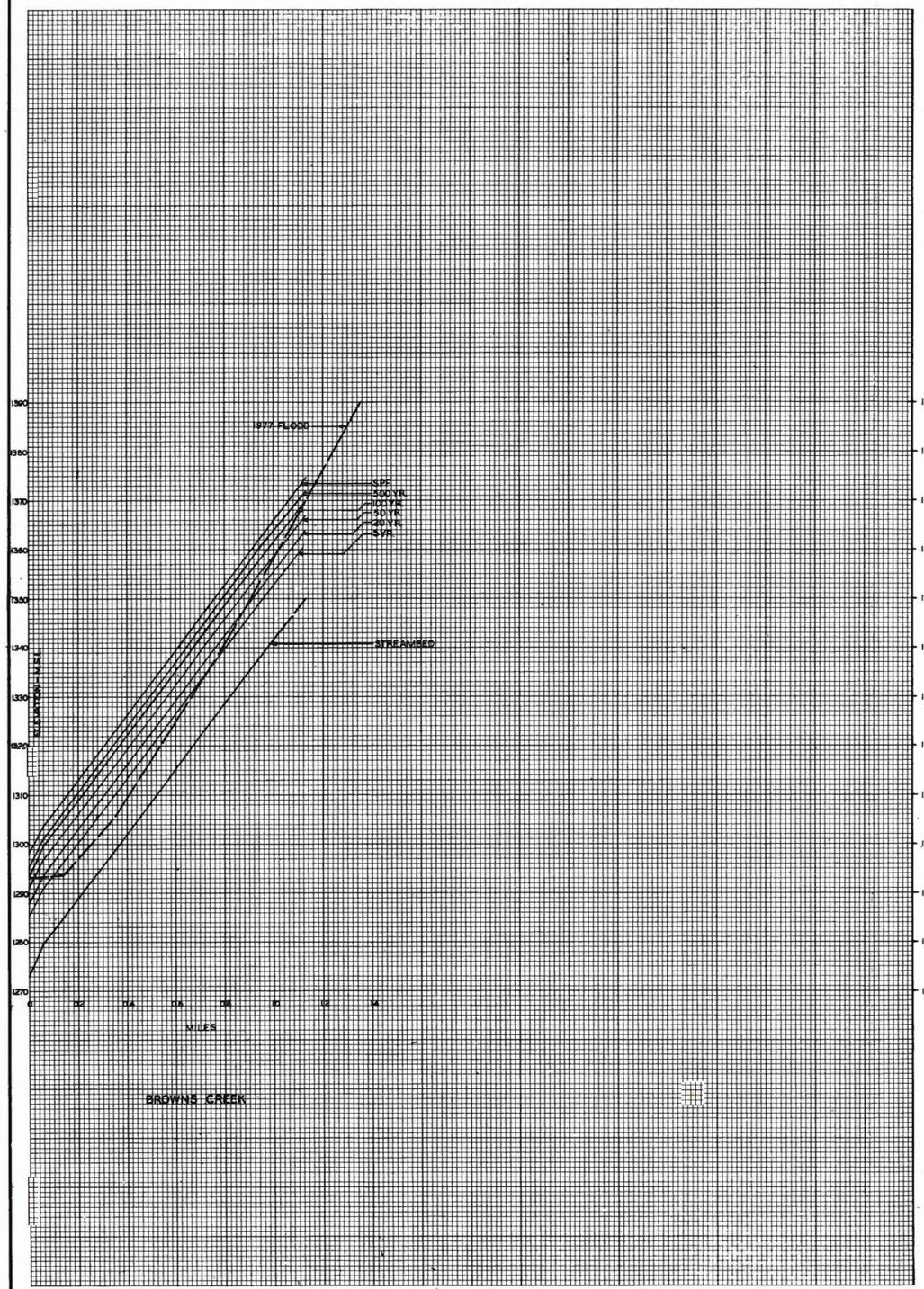
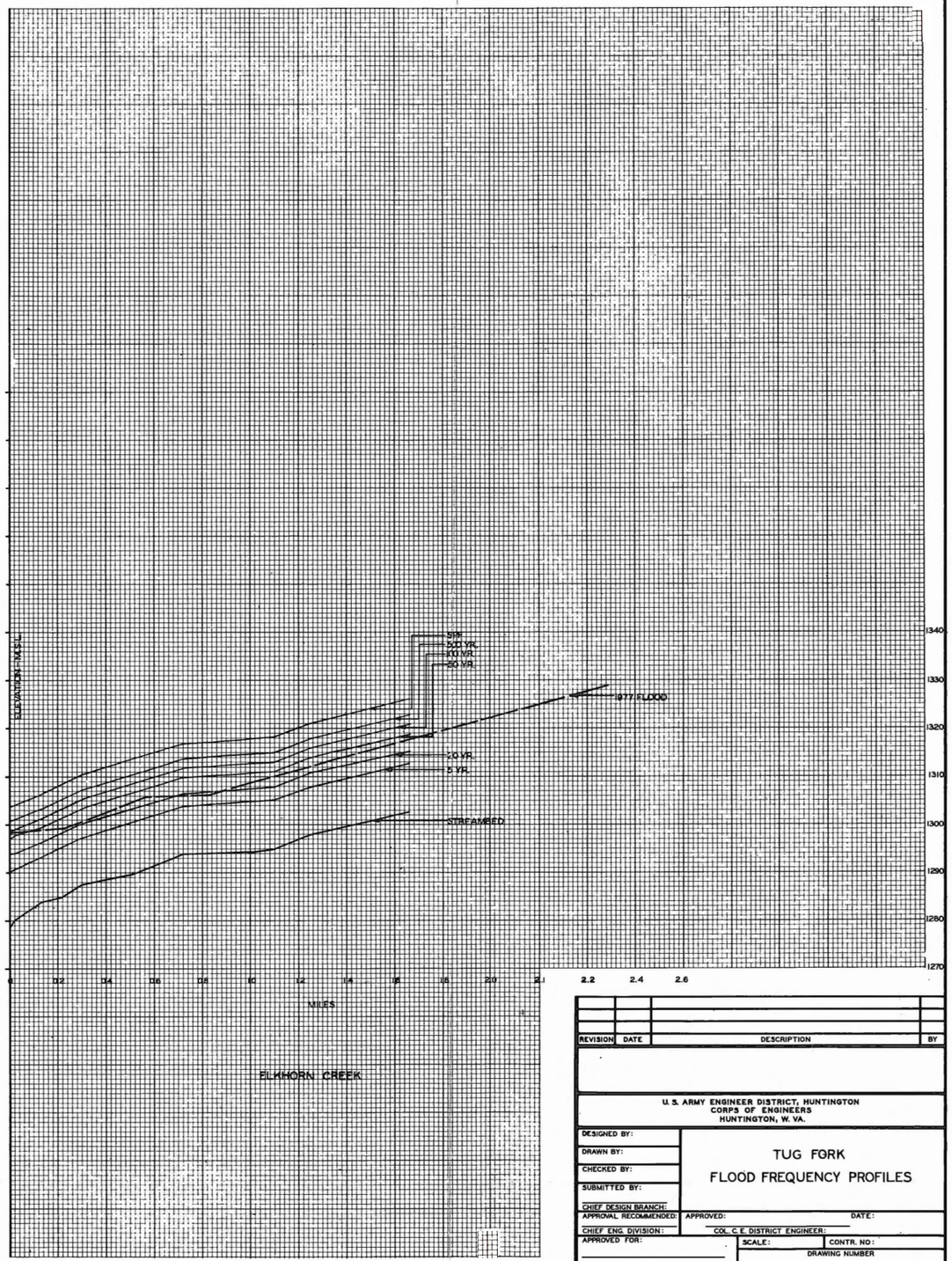


BROWNS CREEK



ELKHORN CREEK

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TUG FORK
FLOOD FREQUENCY PROFILES

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SHEET 3 OF 3

TABLE 3

TUG FORK VALLEY
FLOOD ELEVATIONS BY FLOOD AND REACH

Reach	Downstream Boundary River Mile	Flood Elevation at Downstream Boundary						
		1977[1]	SPF[1]	500[1]	100[1]	50[1]	20[1]	5[1]
110	0.0	565.0	583.0	580.2	577.0	574.5	572.0	567.4
120	0.0	565.0	583.0	580.2	577.0	574.5	572.0	567.4
210	27.6	615.1	620.1	617.1	613.2	611.4	608.9	604.4
211	28.2	616.0	620.9	618.1	614.3	612.6	610.2	605.7
220	27.6	615.1	620.1	617.1	613.2	611.4	608.9	604.4
310	35.4	629.1	634.2	630.5	625.9	623.1	619.9	615.3
311	48.6	655.8	657.9	651.9	649.0	648.2	645.4	638.7
312	52.7	664.0	668.5	661.9	658.1	656.8	653.5	646.5
313	52.8	664.1	668.8	662.0	658.2	657.0	653.7	646.7
314	54.1	665.8	671.2	664.2	660.4	659.2	655.9	648.8
320	35.4	629.1	634.2	630.5	625.9	623.1	619.9	615.3
410	56.5	671.5	676.4	668.7	665.0	663.8	660.7	653.4
411	55.5	668.8	675.5	667.6	663.7	662.5	659.2	651.8

TABLE 3 - (Continued)

Reach	Downstream Boundary River Mile	Flood Elevation at Downstream Boundary						
		1977[1]	SPF[1]	500[1]	100[1]	50[1]	20[1]	5[1]
412	57.1	672.5	677.2	669.8	666.4	665.3	662.0	654.7
413	58.0	675.1	680.9	673.2	668.9	667.6	664.3	656.9
420	54.8	667.6	671.5	665.3	661.4	660.4	657.3	650.2
421	56.3	671.2	676.3	668.7	665.0	663.8	660.5	653.2
422	54.9	667.8	673.7	666.2	662.4	661.2	657.9	650.6
423	56.4	671.3	676.3	668.7	665.0	663.8	660.5	653.2
424	58.1	675.4	682.1	674.3	669.9	668.5	665.2	657.4
510	60.9	682.8	686.6	679.0	674.8	673.7	670.6	663.0
511	65.2	692.4	694.5	687.1	683.8	683.0	680.1	673.0
520	58.1	675.4	682.1	674.3	669.9	668.5	665.2	657.4
521	58.1	675.4	682.1	674.3	669.9	668.5	665.2	657.4
522	59.5	679.1	683.6	676.3	672.6	671.4	668.2	660.6
523	65.2	692.4	694.5	687.1	683.8	683.0	680.1	673.0
610	69.9	703.4	710.1	702.3	698.4	696.6	692.0	685.3

TABLE 3 - (Continued)

Reach	Downstream Boundary River Mile	Flood Elevation at Downstream Boundary						
		1977[1]	SPF[1]	500[1]	100[1]	50[1]	20[1]	5[1]
611	70.5	705.0	711.3	703.5	699.7	698.2	693.8	687.1
612	70.8	707.0	715.3	706.3	702.0	700.3	695.8	688.4
620	69.9	703.4	710.1	702.3	698.4	696.6	692.0	685.3
621	72.0	712.8	718.2	709.6	705.0	703.1	698.9	692.0
622	77.7	728.8	730.8	726.2	723.6	721.8	719.6	714.0
710	80.0 RB	739.6	739.5	734.7	731.9	729.9	727.8	722.2
	100.1 LB	923.0	908.6	904.6	902.0	900.0	896.0	891.3
720	80.0	739.6	739.5	734.7	731.9	729.9	727.8	722.2
730	94.6	872.8	858.5	854.9	852.3	850.2	846.3	841.4
810	108.9	974.5	976.7	973.1	971.3	969.6	965.4	960.4
910	112.7	985.9	1,007.6	1,001.3	999.0	997.5	994.1	989.5
010	132.5	1,274.5	1,282.1	1,279.5	1,277.8	1,276.0	1,272.6	1,270.0

[1]Based upon frequency analysis performed prior to the 1977 flood

Source: Huntington District, U.S. Army Corps of Engineers and Stanley Consultants

they are always subject to modification or refinement as hydrologic conditions in the drainage basin change. Other parameters which influence damage estimates, and which were jointly developed or considered by Stanley Consultants and representatives of the Huntington District Corps of Engineers include warning times, flood duration, flood water velocity, sediment load, and existing protection.

Based upon interviews performed during the detailed surveys, it was determined that very little effective warning time existed. Over 80 percent of the people interviewed during the residential survey stated they had no warning that their homes would be flooded, while 15 percent perceived between one and two hours of warning. Only 4 percent of the people interviewed had more than two hours of warning time. Correspondingly, this study assumes minimal content movement in attempts to minimize damages.

Flood duration assumptions reflect a relatively rapid rise and fall of water, with average durations for the larger floods in the range of 60 to 70 hours. Velocities of flood waters vary considerably within the study area. For example, main channel velocities (feet/second) for the Standard Project Flood at the following river miles and locations are as follows: River mile 18.0 (Webb) 17.0 ft./sec; 38.4 (Kermit) 16.3; 57.3 (Williamson) 14.2; 70.7 (Matewan) 10.8; 109.4 (Iaeger) 10.6; and 132.6 (Welch) 15.7 ft./sec. Similar variances of velocity are also applicable to lesser events. Although

variances in duration times and velocities existed throughout the study area, in all cases these factors combined to inflict considerable structural and content damage, both from actual water contact, and also from damage caused by floating debris. Sediment deposited by the flood waters was a clay-like material normally three to five inches in depth, although instances of greater and lesser deposits were observed.

Protection offered by existing flood walls was taken into account in computing damges in the Williamson, South Williamson, and West Williamson reaches. Levels of protection in place are:

Williamson (Reach 412) - Protection provided against the 5-year and 20-year frequency floods.

South Williamson (Reach 423) - Only that part of the reach in which the Appalachian Regional Hospital is located is protected. Protection provided against all levels of flooding except the SPF.

West Williamson (Reach 411) - Protection provided against the 5-year frequency flood.

Key Assumptions

Several assumptions are inherent in all damage estimates included in this report. Damages to destroyed structures and their contents were included in damage determination of the 1977 as-occurred flood event, but were deleted from future flood damage estimates. For future floods, damaged structures were assumed to be rehabilitated

to their pre-flood condition. For the 1977 flood, as-occurred damage estimates were based on the structure's pre-flood condition and value. Finally, no damages were assigned to HUD-provided mobile homes for the 1977 as-occurred flood, but potential damages were estimated for these units for the remainder of the flood events.

MATERIALS PROVIDED BY THE CONTRACTING OFFICER

The government provided substantial information and mapping critical to the conduct of the study. Included were:

1. Detailed aerial photographic maps for most of the study area at a scale of 1" = 200' with 5-foot contour intervals. Structures located in the flood plain were highlighted on the maps.
2. United States Geological Survey 7 1/2 minute quadrangle maps for the limited areas not covered by the 1" = 200' maps described above.
3. Working size profiles of the April, 1977 flood; the Standard Project Flood (SPF); and the 500-year, 100-year, 50-year, 20-year, and 5-year frequency floods for the study area. All of the profiles with the exception of that for the April, 1977 flood were also provided in computer card deck form.
4. County highway maps for each of the counties in the study area.
5. Location and description of known bench marks.

6. Newspaper clipping files reflecting local and regional news coverage of the April, 1977 flood.
7. Sample residential and industrial/commercial flood damage data collection forms.
8. Residential depth-damage-value relationships.
9. A letter of introduction for use in making contacts in the study area.
10. A sample statement for compliance with the Privacy Act of 1974 (ORH form PA-3, dated 1 June 1976).

INFORMATION PROVIDED BY AFFECTED INTERESTS

Substantial amounts of information and assistance were provided by a variety of interests in the study area. Of particular importance was the April, 1977 flood damage data provided by local and state government officials and business and industrial interests. This information primarily consisted of:

1. Damage information relating to highways, schools, and state and municipal facilities provided by State Highway, State Disaster Office, county school officials, and county and municipal officials in the study area.
2. Physical damage, business loss, and emergency cost damage estimates provided during interviews by local businessmen and industrial interests.
3. Emergency cost-related damage information provided by local officials and state police and National Guard officials.

4. Market value information on residential properties provided by real estate personnel in the area.
5. Railroad damage information provided by the Norfolk and Western Railroad through its main office in Roanoke, Virginia.
6. Utility damage data provided by the electric, telephone, and natural gas companies serving the area.
7. Business loss, flood insurance coverage, and other miscellaneous data provided respectively by the Small Business Administration; the Department of Housing and Urban Development; and the United States Department of Health, Education, and Welfare.

PART III

DAMAGE ESTIMATION PROCEDURES

GENERAL

This part of the report provides a general discussion of the methods used to collect data and then estimate flood damages for the various categories of improvements in the Tug Fork Valley flood plain. Damages were calculated for each of the 11 property categories including:

1. Residential.
2. Commercial/Industrial.
3. Utilities.
4. Highways.
5. Railroads.
6. Schools.
7. Churches.
8. Municipal.
9. Other Government.
10. Fraternal.
11. Miscellaneous.

Due to the limited number of industrial properties in the study area, industrial and commercial properties were combined into one category. This avoids potential disclosure of information on any individual industrial firm. Data collection and damage calculation

techniques varied considerably by category and are, therefore, detailed by category in subsequent sections.

Discussed in the categorically-organized sections which follow the description of initial field survey efforts, are methods used to determine flood damages for the April, 1977 flood as-occurred and for potential flooding under present day conditions for the 1977 flood level; the Standard Project Flood (SPF); and for the 500-year, 100-year, 50-year, 20-year, and 5-year frequency floods. A final section of Part III describes detailed residential analysis techniques used to evaluate the relevancy and accuracy of the depth-damage tables used to estimate damages to study area residential properties under "as-occurred," and "present day" conditions.

INITIAL FIELD SURVEY

General

An initial reconnaissance of all structures located within the SPF flood plain, was conducted by consultant personnel during June, 1977. Prior to the initial field survey, local real estate personnel were contacted to obtain data on property values in the Tug Fork Valley. Using data from recent sales and their knowledge of local values and conditions, they assisted in establishing values (excluding land) for properties typical of each class, type, condition, and geographic area.

The value estimates provided by the appraisers represent June, 1977 market values, based upon pre-flood structure condition. Their value estimates treated damaged structures as if they had been rehabilitated to their pre-flood condition. The data provided by the

appraisers were compiled into a "typical" notebook. Copies of this notebook were distributed to all field personnel to assist in assigning structural values during the field survey.

Residential Structures

During the field survey, data collected for each residential structure included property use (primary or secondary structure), elevation, type (configuration of the building), presence of a basement, exterior construction material, condition, age, value, and details on damage the structure sustained during the April flooding.

Age data for residential structures were obtained through assistance of local residents. As the initial field survey progressed, residents were asked the ages or age ranges of structures in the area being surveyed. The ages of the structures, as provided by the local residents, were used as guidelines by the field crews when estimating ages of the remaining structures in the area.

Each structure was also assigned a unique identification number designed to permit location of the structure at a later date. These identification numbers were placed both on the field survey form and on the working maps used in the field survey. The property identification system was designed so that each map was self-contained. The initial structure on each map was designated as "1" and the numbers assigned to the structures increased until all structures on the map were surveyed. Any given map contains structures in

one or more reaches. A property, therefore, is identified by using its map, reach, and structure numbers. When structures were not shown on the map, they were inserted by field personnel and numbered appropriately.

Commercial and Miscellaneous Structures

Structures with the following use characteristics were identified as either commercial or miscellaneous structures:

1. Commercial.
2. Industrial.
3. Schools.
4. Churches.
5. Government.
6. Fraternal (Moose, Elks, etc.).
7. Other (i.e. utilities, welfare organizations).

With certain exceptions, the data collected for these structures were identical to those obtained for residential buildings. Neither the age of the structure nor the structural condition was determined for these properties and structural values were omitted due to the fact that these values were to be determined during subsequent interviews. In addition to the data obtained for residential properties, the type of activity carried out within the structure was determined and entered on the form for future reference. For properties with commercial or industrial uses, the business activity was also identified relative to its Standard Industrial Classification category.

All commercial and miscellaneous properties were assigned a structure number as part of the general numbering system described earlier.

SURVEY INSTRUCTIONS AND FIELD FORMS

Included on the following pages are copies of instruction sheets provided to field personnel for use during the field survey. Also included are copies of the actual forms used by the survey teams. The instruction sheets explain in detail the methodology used during the survey, while the forms show how the data gathered were catalogued. It should be noted that first floor elevations of structures were determined through the use of hand levels. Several types of reference points were used for ground control purposes: USGS bench marks shown on the field maps, supplemental bench marks and elevations obtained from state and local agency sources, and contour line intersection points with streets. Contour information was used in those cases where other information was not available and in sparsely populated areas where bench marks were often found to be at a great distance from structures.

High water marks?

What kind of accuracy do we have using the hand level?

EXHIBIT 2

INSTRUCTIONS FOR RESIDENTIAL FIELD SURVEY FORM

The following items must be obtained for each residential primary and secondary structure within the study area.

REACH NUMBER - Fill in the reach number as shown on the maps.

MAP NUMBER - All maps used in the field have been numbered prior to the start of the field survey. Insert the proper map number for each entry.

RIVER MILE - River miles are noted by tenths of a mile on all maps. Insert the river mile closest to the structure.

STRUCTURE NUMBER - Assign each structure (including residential secondary structures) a different number. These numbers must also be inserted at the proper locations on the maps.

UNIT NUMBER - This is used to identify various units within a structure. For residential properties it is applicable to multifamily and apartment units. For example, assume structure 52 is a 4-unit apartment building. The following entries would be made for this building under structure number and unit number: 52 1, 52 2, 52 3, 52 4.

USE - Use the following code:

0 = primary residential structure

1 = secondary structure (detached garage, sheds, metal storage buildings, etc.)

ELEVATION - Contour maps and known bench marks identified on the field maps will be used to estimate first floor elevations. For apartment buildings, with units on the upper floors, the elevation estimate should reflect the first floor elevation plus the distance to the floor of the upper units. For example, if the elevations of the first floor units are 580', the elevation of the second floor units could be 589' (580' plus 9.0' to the floor of the second story floor).

CLASS -

1 = one story

2 = two or more stories

3 = split foyer

4 = mobile home

5 = mobile home - HUD housing

BASEMENT -

0 = no basement, or structure with a crawl space

1 = basement

EXTERIOR -

1 = wood, masonite

2 = brick

3 = aluminum

4 = other

EXHIBIT 2 - (Continued)

CONDITION - This will be based upon the criteria used in the 1960 Census of Housing.

1 = sound

2 = deteriorating

3 = dilapidated

AGE - Estimate in years the age of the structure.

DAMAGE - This will be used to identify those properties severely damaged by the flood and where it appears a detailed survey would not be feasible.

0 = survey feasible

1 = survey infeasible-uninhabited at time of survey, appears as if structure will be repaired

2 = property totally destroyed or removed due to flood

VALUE - Using the typical notebook provided, estimate structure value to the nearest one hundred dollars. When the structure contains more than one unit, prorate the structural value to the various units. VALUE ESTIMATES ARE TO BE MADE ON A "BEFORE THE FLOOD" CONDITION BASIS.

COMMENTS - List any comments which would be helpful in estimating damages. Additionally, for secondary structures it may be helpful to state the type of structure it is (garage, shed, etc.).

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APPRAISERS _____ Sheet.... ..

DATE _____ Dept. No. ..... Job No. .....

Computed by..... Date..... Reviewed by..... Date..... Punched by..... Subject.....

Checked by..... Date..... Approved by..... Date..... Verified by..... .....

RESIDENTIAL FLOOD DAMAGE SURVEY-TUG FORK VALLEY

REACH NO.	MAP NO.	RIVER MILE	STRUC NO.	UNIT NO.	USE	ELEV. FT.	CLASS	BASE	EXT.	COND.	AGE	DAMAGE	VALUE $1,000	COMMENTS

NOTE: RIGHT JUSTIFY ALL ENTRIES.

EXHIBIT 3

EXHIBIT 4

INSTRUCTIONS FOR COMMERCIAL AND MISCELLANEOUS

PROPERTIES FIELD SURVEY FORM

The following directions are applicable to structures having the following uses: commercial structures, churches, schools, municipal buildings, fraternal (Eagles, Elks, Moose, VFW, etc.), industrial, and other miscellaneous properties.

REACH NUMBER, MAP NUMBER, RIVER MILE, ELEVATION, STRUCTURE NUMBER, UNIT NUMBER, CLASS, BASEMENT, EXTERIOR -

See residential instructions.

USE - Used to identify the usage of the building and may be 1 through 7.

USE CLASS	CODE
Commercial	1
Church	2
School	3
Government (specify under comments type of use: an office, fire station, library, etc.)	4
Fraternal	5
Industrial	6
Other (specify use under comments)	7

EXHIBIT 4 - (Continued)

COMMERCIAL/INDUSTRIAL CLASS - This is used to identify the type of commercial or industrial activity carried on within a structure. This is applicable only to use 1 (commercial) and use 6 (industrial).

COMMERCIAL AND INDUSTRIAL CLASSIFICATION	CODE
Wholesale and Retail Trade	1
Services	2
Finance, Insurance, Real Estate	3
Transportation, Communication, Public Utilities	4
Agriculture, Forestry, Fisheries	5
Mining	6
Contract Construction	7
Manufacturing	--
Food and Kindred Products	8
Textile Mill Products	9
Apparel and Other Fabric Products	10
Lumber Products and Furniture	11
Paper and Allied Products	12
Printing and Publishing	13
Chemicals	14
Petroleum Refining	15
Primary Metals	16
Fabricated Metals	17
Machinery	18
Electrical Machinery	19

EXHIBIT 4 - (Continued)

COMMERCIAL AND INDUSTRIAL CLASSIFICATION	CODE
Motor Vehicles and Supplies	20
Transportation Equipment	21
Other Manufacturing	22

VALUE - Will be determined during the detailed survey, through owners, managers, etc.

DAMAGE - This will be used to identify those properties severely damaged by the flood.

1 = not yet open for business

2 = property totally destroyed or removed due to flood

NAME - When possible, list the name of the structure or business.

ADDRESS - Where possible, obtain the address of the structure.

COMMENTS - Make any comments useful in estimating damages. Also, use this area to further define the type of use (for example under government state the type of use, office, fire station, post office, etc.).

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APPRAISERS _____ _____ Sheet.... ...

DATE _____ Dept. No. ..... Job No. .....

Computed by..... Date..... Reviewed by..... Date..... Punched by..... Subject.....

Checked by..... Date..... Approved by..... Date..... Verified by..... .....

COMMERCIAL AND MISC. FLOOD DAMAGE SURVEY - TUG FORK VALLEY

REACH NO.	MAP NO.	RIVER MILE	ELEV. FT.	STRUC NO.	UNIT NO.	USE	COM. CLASS	CLASS	BASE	EX	DAMAGE	VALUE $1,000	NAME	ADDRESS	COMMENTS

NOTE: RIGHT JUSTIFY ALL ENTRIES.

EXHIBIT 5

RESIDENTIAL DAMAGE ESTIMATION

General

Data from the initial field reconnaissance were used as inputs during the residential damage estimation. Basic inputs needed were structure type and value, presence of a basement, river mile, and elevation of the structure. Each residential dwelling unit was considered separately. For example, a four-family apartment building was considered as four individual units with total structural value prorated to the individual units.

Damage Estimation

A total of thirty-four generalized depth-damage tables supplied by the Huntington District Corps of Engineers were used in estimating damage. The tables were based upon field data and analysis developed during a survey of potential flood damages to the Huntington-Ashland-Portsmouth Metro area performed during 1975-76. The data obtained from the H-A-P Metro Study underwent supplemental analysis in order to develop depth-damage relationships applicable to two assumptions regarding warning time. The first set of curves, which is representative of Ohio River mainstream flooding, assumes a relatively slow rise and fall of water. The second, which was selected for use in this study and represents tributary flooding, assumes a warning time of only a few hours which would be sufficient to remove only a few high value items which could be transported in an automobile.

Tables for the following house configurations (classes) were used in damage estimation: one story-no basement, one story-basement,

multistory-no basement, multistory-basement, split level, and mobile homes. Each class of house was further subdivided into tables representing various structural value ranges within the class. The tables are based upon relationships established during the Huntington area study.

Interior structure damage, exterior structure damage, and lot damage are expressed as percentages of structure value. Content value (furnishings and personal belongings) is also expressed as a percentage of structure value. In general, as structure value increases, the content value to structure value ratio decreases. The tables are designed however, to allow the use of different content-structure value relationships. Furnishings and personal belongings damages are expressed as percentages of content value.

Various water depths, and the corresponding damage relationships are expressed on the tables. For water depths not explicitly shown on the tables straight line interpolation between points was used. For structures which were destroyed by the flood or were subsequently razed, regardless of water depth, damages were set equal to the maximum amount shown on the depth-damage tables. Also, the damage estimates for future floods were slightly modified to reflect the probability of structure failure as reflected by the 1977 as-occurred flood event. Table 4 presents an example of the tables used for the study.

Secondary structure, or outbuilding damages were similarly estimated as a function of value and water depth, with a minimum damage amount established. Metal storage sheds, due to their

TABLE 4

SAMPLE RESIDENTIAL DEPTH-DAMAGE TABLE

Type: Multistory with Basement

Value Range: $6,000 thru $9,999

Depth of Water Over Main Floor Feet	Structural Damage			Contents Damage			
	Interior[1]	Exterior[1]	Total[1]	Furnishings[2]	Personal Belongings[2]	Total[2]	Lot Damage[1]
-8	0%	0%	0%	0%	0%	0%	0%
-7.5	2	0	2	2.5	.5	3	0
-7	3	0	3	4.5	1	5.5	0
-6	3.5	0	3.5	6	3	9	0
-5	4.5	0	4.5	6	4.5	10.5	0
-4	5	0	5	6	5	11	0
-3	5.5	0	5.5	6	5	11	0
-1	9	0	9	6	6	12	2
- .5	9.5	0	9.5	6	6	12	3.5
0	10.5	0	10.5	6	6	12	3.5
.5	23	1	24	12	6.5	18.5	3.5
1	31.5	1	32.5	16	6.5	22.5	3.5
2	34.5	3	37.5	26	10.5	36.5	3.5
3	39.5	4	43.5	26.5	14	40.5	3.5
4	42.5	4.5	47	29	16	45	3.5

TABLE 4 - (Continued)

Depth of Water Over Main Floor Feet	Structural Damage			Contents Damage			
	Interior[1]	Exterior[1]	Total[1]	Furnishings[2]	Personal Belongings[2]	Total[2]	Lot Damage[1]
5	45.5%	5%	50.5%	31%	17.5%	48.5%	3.5%
6	52	5	57	31	18.5	49.5	3.5
7	58	5	63	31	19.5	50.5	3.5
8	64.5	5	69.5	31	20	51	3.5
9	69.5	5.5	75	34	20.5	54.5	3.5
9.5	71.5	5.5	77	36.5	21	57.5	3.5
10	75.5	5.5	81	38	23.5	61.5	3.5
11	81	5.5	86.5	39.5	26.5	66	3.5
12	83	5.5	88.5	42.5	29	71.5	3.5
13	84.5	5.5	90	44	30.5	74.5	3.5
14	86	5.5	91.5	45.5	32	77.5	3.5
15	87	5.5	92.5	45.5	33	78.5	3.5
16	87.5	5.5	93	46	33.5	79.5	3.5
17	88.5	5.5	94	46	34.5	80.5	3.5
25	89	5.5	94.5	46	34.5	80.5	3.5

[1]Percent of structure value

[2]Percent of content value

Source: Huntington District Corps of Engineers

tendency to float away, were considered a total loss at a water depth of two feet.

Elevations for each of the floods were taken from the river profiles at the river mile appropriate for each structure. Computer application of the depth-damage tables resulted in an estimate of damage to each structure. Individual damages were then aggregated to obtain total residential damage by reach.

Use of the method discussed above to estimate damages to primary structures in future hypothetical floods presumes all such structures are capable of withstanding flood forces. The evidence from the April, 1977 flood suggests that a significant portion of the houses may actually be swept away by a flood. To the extent that structures collapse, damages estimated by use of the depth-damage tables are understated. An adjustment to correct for this understatement is therefore, necessary.

The two elements required to construct adjusted damages are estimates of structure damage (SDC), furnishings damage (FDC) and personal belongings damage (PBDC) for a structure which does collapse and a probability (PC) that the structure will collapse. The damage estimates are developed as follows:

SDC = value of primary structure

FDC = (FMAX) (content value)

PBDC = (PBMAX) (content value)

where FMAX and PBMAX are the highest damage factors taken from the relevant depth-damage tables referenced above.

The probability of collapse depends on the value of the structure (V), its age (A), the depth of flood water (D), the condition of the structure (COND) and the class of the structure (CLASS). An equation for estimating the probability that a given structure will collapse in a particular flood is developed using regression analysis of the April, 1977 flood data. For all primary structures other than mobile homes suffering damage in the April, 1977 flood, the PC was set equal to 1.0 if the structure collapsed or equal to 0.0 if it did not collapse. Dummy variables are defined as follows to capture the impact of condition and class on PC.

COND 2 = 1.0 if CONDITION equals deteriorating, 0.0 otherwise

COND 3 = 1.0 if CONDITION equals dilapidated, 0.0 otherwise

CLASS 2 = 1.0 if CLASS equals one story with basement, 0.0 otherwise

CLASS 3 = 1.0 if CLASS equals two story without basement, 0.0 otherwise

CLASS 4 = 1.0 if CLASS equals two story with basement, 0.0 otherwise

CLASS 5 = 1.0 if CLASS equals split level, 0.0 otherwise

The regression results for this equation are:

$$PC = .0003 - \underset{(0.50)}{.0011V} + \underset{(0.50)}{.0002A} + \underset{(21.29)}{.0149D} + \underset{(14.34)}{.1649\ COND\ 2} + \underset{(10.35)}{.2028\ COND\ 3}$$

$$- \underset{(1.00)}{.0148\ CLASS\ 2} - \underset{(7.23)}{.0911\ CLASS\ 3} - \underset{(1.77)}{.0301\ CLASS\ 4} + \underset{(0.56)}{.0548\ CLASS\ 5}$$

$R^2 = .20$
$n = 4157$

The figures in parentheses are the absolute values of t statistics which show all variables but A, CLASS 2, and CLASS 5 are significant at the 90 percent confidence level. All signs appear plausible and the dominant influence of water depth is evident. The goodness of fit, measured by R^2, is disappointing and probably suggests that velocity of flooding is an important factor which has not been captured in the model.

The probability equation is used in the following manner to obtain adjusted damages for primary structures in future floods. Using the appropriate data on the independent variables for each structure, the equation is applied to obtain an estimate of PC. If PC was estimated to exceed 1.0, it is set equal to 1.0. If it is estimated to be negative, it is set equal to 0.0. Revised structure damage (SDR), furnishings damage (FDR), and personal belongings damage (PBDR) and total damages (TDR) are then computed as:

$$SDR = (PC)\ (SDC) + (1-PC)\ (SDO)$$

$$FDR = (PC)\ (FDC) + (1-PC)\ (FDO)$$

$$PBDR = (PC)\ (PBDC) + (1-PC)\ (PBDO)$$

$$TDR = SDR + FDR + PBDR + L$$

where SDO, FDO, PBDO and L are the original damage estimates for primary structures, furnishings, personal belongings and lots.

No adjustment for collapses was made for mobile homes or secondary structures since the original methodology included provisions for these structures being destroyed.

COMMERCIAL AND INDUSTRIAL DAMAGE ESTIMATION

General

The commercial/industrial survey involved estimating damage to all businesses located within the study area. With the exception of the 100, 700, and 900 series of reaches this was accomplished through direct owner-manager interviews. When businesses were either closed, unoccupied, abandoned, or had been razed as a consequence of the April flooding, information was gathered through neighboring property owners, follow-up contact with the subject property owner in person or by telephone, or through estimates by the appraiser based upon his experience and the similarity of the property to other previously surveyed properties. For reaches in the 100, 700 and 900 series, contractor appraisals were used solely in making damage determination.

Commercial/Industrial Survey Form

Presented below is the form used in the detailed commercial/industrial survey. Structural data gathered during the initial survey were transferred to these forms, and later verified during the interviews. Structural values were obtained during the actual interviews.

The form is generally self-explanatory; however, certain damage concepts must be explained. As the form shows, damages were disaggregated into three major categories: physical, business and financial loss, and emergency costs. These overall damages were

further subdivided into various subcategories, as shown on the second page of Exhibit 6. For the purpose of this report, the term "loss of output, sales, etc." refers to sales loss less the cost of goods sold. The term "costs of goods sold" reflects operations involving merchandise as an income-producing factor. It expresses merchandise costs as a percentage of gross sales. This percentage, which varies by type of business, was determined using a series of cost-of-doing-business ratios which were developed by Dun & Bradstreet. The study covered 185 lines of businesses and used as a data base federal income tax returns filed by various types of businesses.

Column "A" reflects damages that actually occurred as a consequence of the April, 1977, flooding. The "B" column reflects damages that would result from a current day recurrence of the 1977 level of flooding. Differences in damage estimates to a specific business for the 1977 "A" and the 1977 "B" floods, which represent the same level of flooding, may occur for numerous reasons. These include, but are not limited to the following factors. Greater structure damage could occur if a building was reconstructed to a higher value when the flood damage was repaired. This usually consisted of the upgrading of the interior of a structure. Also, following the flood, business proprieters may decide to carry greater or lesser amounts of stock and equipment. Therefore, content damage for the 1977 "B" event could be greater or less than for the 1977 "A" event.

EXHIBIT 6

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Appraiser _____
Date _____

TUG FORK VALLEY FLOOD DAMAGE SURVEY
COMMERCIAL/INDUSTRIAL DAMAGES

General

Name of Business _____ Type of Business/ Commercial Class. _____

Address _____ Person Interviewed _____

Reach No. _____ Map. No. _____ River Mile _____

Structure/ Unit No.	Elev.	Class	Exterior Construction	Basement	Damageable Grounds	Fence	Other

Total Value of Structures $_____

Inventory: Raw Materials _____ Equipment _____ No. of

Product _____ Stock _____ Employees _____

Miscellaneous Questions

1. What percent of business and financial losses can be (were) avoided by transfer of business to another location?

2. How much warning time did the owner/operator have prior to the flood?

3. Was business or production interrupted during the flood?

   YES NO

   Were employees laid off? YES NO Number _____

   Average hourly rate _____ Time per employee _____

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FLOOD DAMAGE INFORMATION

Flood Depths	1977			SPF		500		100		50		20		5	
Flood Elevation															
Depth of Flood Above:															
Street Level															
Basement Floor															
First Floor															
Second Floor															
	A	B													
	$	%	$	%	$	%	$	%	$	%	$	%	$	%	$
Physical Damages															
Buildings															
Contents															
Furnishings															
Equipment															
Decoration															
Raw Materials															
Finished Goods															
Other															
Grounds and Fences															
Cleanup															
Total															
Business and Financial Losses															
Loss of Output, Sales, Etc.															
Wage Loss															
Other															
Total															
Emergency Costs															
Evacuation															
Disaster Relief															
Increased Op. Expenses															
Other															
Total															
TOTALS															

EXHIBIT 6 - (Continued)

Damages in all of the other columns also reflect damages assuming those flood levels occurred now. In some cases, the individual being interviewed was best able to visualize and express damages for the 1977 "B" through the 5-year flood events relative to the damages in the as-occurred column. For example, the SPF might be 110 percent, the 500-year 75 percent of column "A". Individual unit damages were later aggregated by reach and type of business.

A resurvey of selected commercial establishments was performed in early 1978. The purposes were to ascertain the accuracy of the initial survey process and to determine if owners/managers had discovered any additional damages since the initial surveys were performed. The correlation between the 1977 surveys and those which took place in 1978 was quite close. In the cases where substantial variations were noted, appropriate modifications to the damage estimates were made.

Coal mine damage estimation was, of necessity, handled somewhat differently due to the unique nature and size of the facilities damaged. For the nine mines suffering direct physical damages from flooding, the standard commercial/industrial survey form was executed. Information was obtained from both mine supervisory personnel at the mine sites and corporate and engineering personnel occasionally located in offices outside the study area. Owner personnel estimates for the 1977 flood as-occurred were used in all cases with only minor adjustments for reasonableness by contractor

personnel. Insights provided by owners regarding future flood damage potentials were supplemented by contacts with the West Virginia Department of Mines and the Kentucky Department of Mines and Minerals. Mine location and mine mouth elevations were confirmed through these sources along with production and employment level figures. Flood water entry through mine mouths was assumed to be a requisite for future damages to occur in view of the typical location of air shafts and other water entry points.

Production losses for both directly and indirectly affected mines were estimated using tonnage and typical market value per ton data obtained from the earlier referenced state agencies and factors such as commutation patterns, transportation problems, and related factors. Production losses identified through state production data were counted as attributable to Tug Fork flooding on the following basis:

Mingo, McDowell and Wayne Counties - 100% of losses counted as attributable to 77 Flood

Logan, Mercer and Wyoming Counties - 25% of total county losses counted as attributable to 77 Flood

Pike, Martin, and Lawrence Counties - Losses for selected mines were counted based upon mine locations

Production losses for levels of flooding other than the 1977 flood were estimated based upon the relationship between the amount of highway and railroad mileage inundated by the 1977 flood versus

the amount inundated by each of the other levels under examination. Losses were prorated by reach based upon the number of affected primary residential structures found in each reach.

UTILITY DAMAGES

Utility damage estimates are based upon value, damageability, and historical damage information provided by Columbia Gas of West Virginia, General Telephone Company, Chesapeake and Potomac Telephone Company, Appalacian Power Company, and Kentucky Power Company. Primary sources of information included the regional manager of the Columbia Gas of West Virginia office in Williamson, the Director of Public Relations for the Chesapeake and Potomac Telephone Company in Charleston, and various personnel in the engineering and customer service offices of the Appalachian Power Company in Logan and Bluefield. Basic insights, facility information and flood damage data (April, 1977) provided by these companies were combined with location and elevation information developed during the initial field survey to produce damage and revenue losses on estimates for the levels of flooding examined in this study. Actual damage information provided by the companies was used for the April, 1977 flood. Facilities suffering significant damage included electric substations, gas regulator stations, telephone and electric cables, switches, office and storage facilities, and gas and electric meters, and telephone stations.

Damage to gas meters, electric meters, and telephone stations was estimated using average repair cost and typical location data developed through field investigations and discussions with gas, electric, and telephone company representatives. For residential properties such damages were separately estimated as a function of the total residential damage estimation computer program. Estimates assumed damage to approximately 1,187 gas meters, 3,599 electric meters, and 2,978 telephone stations. Assumed per unit average repair/replacement costs for the involved units were $75 for gas meters, $20 for electric meters, and $110 for telephone stations.

Revenue loss and cable and switching equipment losses were of necessity not available on a facility specific or reach specific basis. Consequently, the above losses that either did occur in the 1977 flood or might occur under other flood conditions were disaggregated to the evaluation reach level based upon the number of affected residential properties in each reach. Cable and equipment loss base numbers and revenue loss numbers were provided by the respective utility companies based upon their experience in the 1977 flood.

No attempt was made to value electric, gas, and telephone lines and equipment. Values were placed upon other structures such as buildings, electric substations, and gas regulator stations and were primarily provided by the owner companies.

HIGHWAY DAMAGES

Included in the highway classification are damages to all nonmunicipal roads in the study area. Major road types included:

1. State highways not on the federal aid system.
2. State highways on the federal aid system.
3. County and other local roads.

Municipal roads were tabulated separately based upon the mileage of roads in incorporated areas and in other areas of an urbanized nature. Damages to these "municipal" roads are included in the municipal damage category.

No attempt was made to place a value on highways and related structures. However, detailed historical flood damage data were developed for study area highways from the following sources:

1. Detailed interviews with the Chief Engineer for Development for the West Virginia Department of Highways. He made available detailed estimates of damages resulting from the April, 1977 flood and provided access to detailed maps and reports in the Maintenance Division of the Department of Highways.
2. Telephone contacts with both the Kentucky Department of Transportation and the Federal Highway Administration in Frankford, Kentucky, to obtain April, 1977 flood damage information on Kentucky highways.
3. Data on April, 1977 damages to county and other local roads available in Federal Disaster Assistance Administration

(FDAA) records in the FDAA field office in London, Kentucky, and the West Virginia State Disaster Coordinating Office in Charleston.

Information from the above sources was used along with contractor experience in highway design and construction to develop average per mile damages for all highways inundated by the flooding of April, 1977. Average damages per mile proved to be $18,330. This figure was based upon available information and not assumed to vary with depth of water. Actual damages were found to vary, depending upon road type and other variables, from less than $5,000 per mile of road inundated to over $65,000 per mile. Inability to define the complete range of reasons for this variability resulted in the use of the average damages per mile figure noted above as the most accurate means of calculating damages on a study area basis.

The average figure was used along with mileage data developed from working maps of the study area to compute as-occurred damage costs for the 1977 flood. Damages which would occur under present day conditions were estimated using the same average damage cost per mile with adjustments made in reaches where major bridge structures were destroyed by the 1977 flood and had not been replaced. In cases where repairs and replacement of structures were in progress, it was assumed for damage estimation purposes that the facilities were in place. Bridge damage estimates were based upon data provided by the same sources referenced for highways.

RAILROAD DAMAGES

Railroad damages resulting from the April, 1977 flood were developed with the aid of detailed physical damage, emergency cost, and revenue loss data provided by the Norfolk and Western Railroad through the Senior Vice President for Operations for the railroad in Roanoke. Physical damage losses consisted of damage to rail bed and tracks and signal facilities throughout the Norfolk and Western system in the Tug Fork Valley and substantial losses to buildings, building contents, rail yards, goods and cargo, rolling stock, and miscellaneous equipment located primarily in the Williamson yard of the company. Business losses primarily consisted of losses resulting from business being handled during the flooding by other transportation modes and major losses resulting from delayed and rerouted traffic. Emergency costs largely consisted of the expenses resulting from emergency movement of goods and equipment and the placement of protective measures.

In the case of the damages incurred during the April, 1977 flood, physical facility damages to major structures and other identifiable equipment items were assigned to the reaches in which the damages actually occurred. Damages to rail bed and track facilities and emergency and business loss costs were assigned to reaches in the study area on the basis of the railroad mileage damaged in each flood zone in each of the reaches.

Potential flood damages were computed using the April, 1977 flood data and contractor inspection of major railroad facilities

as a base. Through analysis of the April, 1977 data an ayerage per mile damage cost of $41,822 was developed for railbed and track damage. This figure was applied to the affected mileage at each depth of flooding in each reach to determine potential damages. The same damage per mile figure was used irrespective of water depth. Damages to other physical facilities were computed based upon the potential level of flooding at each facility and the relative value and damageability information available for the facility from the April, 1977 data. Similarly, business loss and emergency cost data available for April, 1977 were used as a base in prorating and estimating potential damages under other flood conditions.

SCHOOL DAMAGES

Value and damage estimates for schools were developed through an on-site appraisal of school buildings, complemented by value and historical content and structural damage data provided by the county school superintendents in McDowell and Mingo Counties and April, 1977 flood damage data for other schools provided by the regional offices of the United States Department of Health, Education, and Welfare located in Atlanta and Philadelphia. April, 1977 flood damage data for the Southern West Virginia Community College facilities located at Williamson was collected through an on-site appraisal and through contacts with the business office of the college located at Logan, West Virginia.

The primary data developed through the foregoing sources were used along with elevation and structural configuration data developed during the initial field survey to construct basic depth-damage relationships for each school facility. These relationships permitted the development of estimates of potential damage at levels of flooding other than that occurring in April, 1977.

Damages to school districts were found to be almost totally physical in nature. Due to the limited "effective" warning time available, little to nothing in the way of emergency costs were found to have been incurred in 1977 or are likely to be incurred during other flood events. State legislative enactments prevent the loss of pupil attendance-related revenues and employees do not lose wages while schools are not in operation.

MUNICIPAL DAMAGES

Municipal facilities in the study area vary widely in type and value. Facilities included in this category included town and city halls; police and fire stations; garage and maintenance installations; sewage and water treatment plants and systems; parking meters and parking areas; street systems; recreational facilities; and a substantial number of miscellaneous facilities either owned or operated by municipal entities.

Initial field survey efforts served to locate municipal structures and determine their elevation, structural type, and approximate

structural value. Contacts were then made with the Federal Disaster Assistance Administration (FDAA) field office in London, Kentucky and the West Virginia State Disaster Coordinating office in Charleston, West Virginia. Data collected from those offices included federal damage estimates and damage survey reports for every municipal facility damaged in the April, 1977 flood. This information served to provide a detailed description of the type and extent of the damage incurred by municipal facilities and provided, in many cases, the value of the damaged facilities. This information, which also included municipal road damage estimates and partial estimates of emergency costs incurred by municipal entities, served as the primary source for 1977 as-occurred damage estimates, and as the base for developing depth-damage relationships for estimating potential damage under other flood conditions.

Information available from the damage survey reports was augmented by a combination of contractor facility inspections and interviews with responsible municipal officials in key communities. Particularly detailed interviews and inspections took place in Williamson, Matewan, and Welch. The interviews provided additional major insight into emergency costs incurred by municipal entities, in addition to unique damage components and reconstruction plans significant to the estimation of damages for other flood events.

Using the FDAA and interview data as a base, depth-damage relationships for each structure were developed and damages for all structures were computed. Emergency cost information was estimated for levels of flooding other than the 1977 as-occurred flood through the application

of judgment factors based upon the relative levels of flooding and input provided by local officials. Revenue or other financial losses by municipalities were, in general, found to be minor or nonexistent. In the few cases where such losses could be documented or accurately projected, they were, for presentation purposes, included as a component of physical damages.

Municipal street damages were estimated using actual April, 1977 damage figures as a base for developing average per mile damage costs. The average cost developed and applied to all municipal streets was $46,569 per mile of street inundated irrespective of water depth. Average damage costs were then applied on a per mile basis to each community using mileage figures developed from working maps of the study area. In cases where unique road damage factors were present in communities, the average per mile damage figures were adjusted to reflect such unique factors.

OTHER GOVERNMENT DAMAGES

Facilities in the other government category include post offices; state and county highway offices and garages; libraries; county courthouses and offices; state liquor stores; armories; a hospital; miscellaneous state and federal office facilities; and a variety of other miscellaneous facilities of a unique nature. Also included in the category are emergency costs incurred by state police and national guard units as well as by a few other units of government.

Techniques used to appraise and estimate physical damages to other government facilities closely resembled those described earlier for municipal facilities. Damage survey report data for the April, 1977 flood provided a substantial data base for computing 1977 as-occurred damages and developing depth-damage relationships for computing potential damages for other flood events. In the case of facilities not covered in the survey reports, contacts were made with responsible officials to determine April, 1977 flood damage data. Most of the facilities not covered in the damage survey reports were United States Postal Service facilities located in most of the communities in the study area. For these facilities data were provided by regional Postal Service officials in Charleston, West Virginia, and by the postmaster at Williamson, West Virginia. For the few postal facilities affected in the Kentucky portion of the study area, contractor appraisals were made using the relative damage relationships established in West Virginia. In the case of all major structures, either an on-site contractor appraisal or a contact with a locally responsible individual was used to supplement the damage survey report information.

Through the use of the primary information described above and the elevation, structural type, and location data collected during the initial field survey, physical damage estimates were completed for all flood levels through the development of depth-damage relationships for each affected structure.

Emergency cost data were provided by the state police and National Guard officials in West Virginia and Kentucky. Additional state-incurred expenses were furnished by the Governor's Disaster Recovery Office in West Virginia and the Bureau of Natural Resources, Division of Water Resources in Kentucky. These data were used to supplement the partial emergency cost data available for the 1977 flood through the Federal Disaster Assistance Administration. FDAA costs included emergency housing measures undertaken by HUD and Corps of Engineers emergency expenditures. With few exceptions, the emergency cost data were not available on a reach specific basis. Consequently, the general estimates provided were disaggregated to the several reaches in the study area on the basis of the relative number of damaged residential properties in each reach. The April, 1977 emergency cost data were used as a base by the contractor for estimating the potential recurrence of such costs at lesser levels of flooding. Judgment factors employed included the relative levels of other potential floods and the number of properties and percent of total communities affected at levels other than that which occurred in April, 1977. An average emergency cost of approximately $4,800 per residence was estimated for all flood levels.

I don't think this is realistic for all floods

C ≈ 24,000,000
5000 structures

CHURCH DAMAGES

Basic value, location, structural type, and elevation data were obtained for the over one hundred churches in the study area through

a brief field inspection of each structure. With these data as a base, churches representative of the different types of churches found in the area were selected and inspected to develop detailed damageability information. Churches were split into four basic types: one story-no basement, multistory-no basement, one story with basement, multistory with basement. Four one story-no basement churches and three churches in each of the other categories were inspected. This inspection information served as the basis for depth-damage relationship tables which were developed and then applied to all of the area churches. Depth-damage information developed as a part of other studies was used as a check against and as input to the damage estimates developed for the study area.

FRATERNAL STRUCTURE DAMAGES

Location, value, structural type, and elevation data for all fraternal organization structures in the flood plain were obtained as part of the initial survey of all properties. Each Elks, Eagles, VFW, and other fraternal structure was then inspected to determine depth-damage relationships and establish the extent of damage that actually occurred during the flooding of April, 1977. Damage estimates were then made for each structure for each level of flooding.

MISCELLANEOUS DAMAGES

Included in the miscellaneous damage category are physical damages to a number of privately-owned or nonprofit charity and

welfare organization facilities, physical damages resulting from the complete or partial loss of automobiles parked on public streets and in driveways in study area communities, and emergency costs in the form of Red Cross and related relief program costs and relief-related expenses incurred at the Appalachian Regional Hospital in South Williamson, Kentucky.

In the case of the charity and welfare facilities, each facility was appraised and inspected on an individual basis during a follow-up visit conducted subsequent to the initial field survey. Automobile losses were estimated using April, 1977 flood automobile loss information provided by municipal and state police officials as a base. Estimates indicate that 784 automobiles were significantly damaged at an assumed average loss per car of $2,000. This level of loss per automobile was assumed to occur once water entered the engine and interior areas of an automobile. Undoubtedly, a number of automobiles suffered minor damages through less significant levels of inundation, but these were not generally reported and are, therefore, not included in the damage estimate.

Potential automobile losses for levels of flooding other than the 1977 flood were estimated on the basis of the relative number of miles of streets affected by the other levels of flooding.

Emergency cost expenditures during the 1977 flooding by the Red Cross and related agencies were obtained through direct contact with the involved entities and were disaggregated to the various

reaches based upon the number of damaged residential properties in each reach. The rather substantial April, 1977 emergency expenses incurred at the Appalachian Regional Hospital in South Williamson were based upon written records and supporting materials prepared by the hospital and were assigned to the South Williamson reach in which the hospital is located. These expenses primarily consisted of the provision of shelter, food, and medical care to refugees, disaster assistance workers, army troops, and state police personnel. With the April, 1977 flood data as a base, judgments based upon the relative number of properties affected were used to estimate the extent to which such emergency costs would recur at other levels of flooding.

Did all of the people they fed come from S. Williamson. Not a proper allocation!

DETAILED RESIDENTIAL ANALYSIS

General

To serve as a check on the relevancy of the generalized depth-damage tables to residential structures in the study area, detailed surveys were performed on a sample of 200 study area residences. These data were used to analyze the structural value-furnishings value relationships, structural value-personal belongings value relationships, and actual depth-damage relationships inherent in the depth-damage tables.

what else?

Sample Stratification

Simple random sampling would result in a sample distribution across residential classes which is similar to the population distribution. This can lead to excessively small numbers of samples in

some cells. Furthermore, simple random sampling fails to acknowledge that sampling should be more heavily concentrated in cells which display the greatest variability in damage. In this light, sample stratification by classes was deemed desirable.

Since damage was not known for the population, variability within classes was measured by variability of structural value. The sum of squares about the mean was used as the measure of variability. The percentage of the 200 samples drawn from each structure class was set equal to the class sum of squares divided by the total sum of squares. Results of the stratification analysis are displayed in Table 5.

Sample Selection

Using the categorical stratification described, sample properties were selected randomly from the total population of properties remaining in use after the 1977 flood until each cell was filled. Contacts were then made by field personnel at each of the properties constituting the sample. In cases where residential property owners were not at home, a follow-up contact was made at a later time. Where the follow-up contact also yielded negative results, field personnel used data and maps available from the initial field survey to substitute a nearby property of the same structural type and approximate value. The same substitution method was used in cases where the property owner refused to allow the survey.

TABLE 5

SAMPLE STRATIFICATION

Class		Value Sum of Squares	Percent of Total	Number in Sample	Aver. Structure Value ($000)	Standard Deviation ($000)
Stories	Basement					
One	No	222,249	39.4	79	$12.6	$ 8.7
One	Yes	58,391	10.4	21	17.0	9.1
Two	No	129,016	22.9	46	16.6	10.5
Two	Yes	96,278	17.1	34	22.3	11.0
Split Level	No - Combined with Two Story-No Basement				34.2	7.0
Split Level	Yes - Combined with Two Story-Basement				41.3	15.8
Mobile Home	No	57,868	10.3	20	5.4	2.1

Source: Stanley Consultants

Detailed Survey Forms and Methods

The survey form used for residential structures allowed the field teams to assemble a complete inventory of structural and content items found in each structure. These data were used to calculate potential structural and content damage to each unit. Details on content valuation and damage estimation procedures are presented in a later section. Pages 1 through 4 of the form presented below deal primarily with structural items, while pages 5 and 6 focus on the content items.

The form allows identification of structural components through circling or checking applicable items. When appropriate, the location or condition of individual items was noted. Location indicators are as follows: B = basement, 1 = first floor, 2 = second floor, 3 = third or higher floor. Condition indicators for structural items are: A = poor, B = fair, C = good, D = new. For structural items where the original quality of an item was a major determinant of its damageability, the quality (type) code is: 1 = fair, 2 = average, 3 = excellent. All outbuildings were also listed on page 2 of the form, along with their construction materials, dimensions, and condition.

Pages 3 and 4 were used to list each individual room, its use (i.e.: bedroom, living room), location by floor, number and type of doors and windows, its dimensions, ceiling heights, and the wall and ceiling construction materials. The present condition of each component was determined, and when appropriate, the original quality of the item was noted.

Content valuation started with the compilation of a furniture "typical" notebook containing pictures, values, and brief descriptions of furniture items. The furniture items contained in the typical notebook are similar to those contained in the furniture typical notebook used in the Huntington-Ashland-Portsmouth Metro study. Values assigned to the items reflect 1977 price levels in Tug Fork Valley. The survey form lists furniture typically found in a household, along with a means to indicate an item's location by floor, original quality (type) and present condition. The "type" code is as follows: 1 = fair, 2 = average, 3 = excellent. Condition indicators are: 1 = poor, 2 = fair, 3 = good, 4 = new. A matrix of values was established to allow value estimation of each item based upon its present condition and original quality. Owner estimates were used to determine value when they were volunteered.

Another section of the survey form was a series of questions designed to determine the effect of the April flooding on the valley residents. The last two questions were of particular interest as they sought to establish at what point residents perceived a danger of flooding, and to what extent damages were lowered through movement of items away from the flood zone.

Also presented below is the three page form used in evaluating personal belongings. Residents were asked which of the items were located on the premises, and the approximate age of each item. When possible, owner estimates were used to determine value. When necessary, field personel estimated values based upon the average new value of an item, less depreciation.

Sample Results

Analysis of the data obtained during the detailed residential survey showed excellent correlation between the actual damage experienced in the Tug Fork Valley and the damage relationships expressed in the depth-damage tables. No adjustments to the tables were necessitated by the findings.

Also, the answers to the warning time and content movement questions were incorporated into the assumptions inherent in damage estimation.

Perhaps this page needs some more specifics as to comparability -

EXHIBIT 7

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2127
HUNTINGTON, WEST VIRGINIA 25721

STANLEY CONSULTANTS
SUITE 404, 6659 PEARL ROAD
CLEVELAND, OHIO 44130

RESIDENTIAL STRUCTURE/CONTENT SURVEY - POTENTIAL FLOOD DAMAGE

SCI HOUSE NO._____ STORIES_____ APPRAISER_____ DATE_____

REACH_____ MAP #_____ OUTSIDE DIMENSIONS

STRUCTURAL VALUE_____ Length____ft. Width____ft. Height____ft. to eves

BASEMENT

Unfinished Ceiling Ht._____ft.

None _____
Full _____
Partial _____%
Crawl Space _____
Sump Pump _____

BASEMENT FLOOR

Concrete _____
Dirt _____
Other_____

HEATING SYSTEM — **Floor**

Forced Air _____ B
Gravity _____ 1
Steam/Hot Water____ 2
Electric _____ 3
Wall/Space _____ Gas
Other_____

EXTERIOR WALLS

Wood _____
Masonry/Stone _____
Metal/Alum _____
Other_____

AIR CONDITIONING

Central_____ Location_____

Window #		Cond.
Floor B	_____	A B C D
	1_____	A B C D
	2_____	A B C D
	3_____	A B C D

ELECTRICAL SYSTEM

Fuse/Breaker Location B 1 2 3

WATER HEATER

Gas Electric
Floor B 1 2 3

WATER SOFTENER

Yes_____ No_____
Floor B 1 2 3

KITCHEN CABINETS (built-in)

	Lower	Upper
Type	1 2 3 4	1 2 3 4
Cond.	A B C D	A B C D
	Linear ft._____	Linear ft._____

EXHIBIT 7 - (Continued)

House # _____
Reach _____
Map # _____

GARAGE

Attached _____ 1 Car _____
Detached _____ 2 Car _____
Built-in _____ Cond. A B C D
Carport _____ Const: W Ma M
Shed _____ _____ft x _____ ft.

OUTBUILDINGS

	Cond.
Metal _____ft. x _____ft.	A B C D
_____	A B C D

WATER SYSTEM

Public _____ Private _____

SEWER SYSTEM

Public _____ Private _____

FENCING

Linear Feet _____
Picket _____
Wood _____
Chain _____
Other _____

MISCELLANEOUS

GENERAL QUESTIONS:

1. Occupant's place of work_____. Occupation_____
2. Number of lost days of work _____. Reason: Required at home. Access Proble
   Place of work out of business.
3. Number of days spent on cleanup. At home_____ At work _____
4. Number of days out of house due to flooding_____.
5. Place of residence while displaced.
6. Number of hours of effective warning that house would be flooded _____.
7. To what extent were items in the house moved out of the house or to a higher floor? What items were moved?

EXHIBIT 7 - (Continued)

House #_____
Reach_____
Map #_____

ROOM						
DIMENSIONS	X	X	X	X	X	X
LOCATION	B 1 2 3	B 1 2 3	B 1 2 3	B 1 2 3	B 1 2 3	B 1 2 3
FLOOR (Type C)	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Carpet	C A	C A	C A	C A	C A	C A
Wood	W B	W B	W B	W B	W B	W B
Tile	T C	T	T	T	T	T
Other	D					
WALLS	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Plaster	Pl A	Pl A	Pl A	Pl A	Pl A	Pl A
Drywall	D B	D B	D B	D B	D B	D B
Panel	Pn C	Pn C	Pn C	Pn C	Pn C	Pn
Other	D					
CEILING	A	A	A	A	A	A
Plaster	Pl B	Pl B	Pl B	Pl B	Pl B	Pl B
Drywall	D C	D C	D C	D C	D C	D C
Acoustical	A D	A D	A D	A D	A D	A D
Other						
WINDOWS (#)						
Regular	____	____	____	____	____	____
Picture	____	____	____	____	____	____
DOORS						
Int.-Solid	IS___	IS___	IS___	IS___	IS___	IS___
Int.-Hollow	IH___	IH___	IH___	IH___	IH___	IH___
Ext.-Solid	ES___	ES___	ES___	ES___	ES___	ES___
Ext.-Hollow	EH___	EH___	EH___	EH___	EH___	EH___
Other						

EXHIBIT 7 - (Continued)

House #_____
Reach_____
Map #_____

MISCELLANEOUS

CEILING HEIGHT: Finished Basement _____ft. 1_____ft. 2_____ft. 3_____ft.

EXHIBIT 7 - (Continued)

		Location	Type	Cond.	Value
	LIVING, FAMILY, DEN				
1	Sofa	B 1 2 3	1 2 3	1234	
2		B 1 2 3	1 2 3	1234	
3		B 1 2 3	1 2 3	1234	
4	Sofa Bed	B 1 2 3	1 2 3	1234	
5		B 1 2 3	1 2 3	1234	
6	Stuffed Chairs	B 1 2 3	1 2 3	1234	
7		B 1 2 3	1 2 3	1234	
8		B 1 2 3	1 2 3	1234	
9		B 1 2 3	1 2 3	1234	
10		B 1 2 3	1 2 3	1234	
11	Recliner	B 1 2 3	1 2 3	1234	
12		B 1 2 3	1 2 3	1234	
13	Swivel Rocker	B 1 2 3	1 2 3	1234	
14		B 1 2 3	1 2 3	1234	
15	Chairs Misc.	B 1 2 3	1 2 3	1234	
16		B 1 2 3	1 2 3	1234	
17		B 1 2 3	1 2 3	1234	
18		B 1 2 3	1 2 3	1234	
19	Desk	B 1 2 3	1 2 3	1234	
20		B 1 2 3	1 2 3	1234	
21	End Table/ Nitestand	B 1 2 3	1 2 3	1234	
22		B 1 2 3	1 2 3	1234	
23		B 1 2 3	1 2 3	1234	
24		B 1 2 3	1 2 3	1234	
25		B 1 2 3	1 2 3	1234	
26	Coffee Table	B 1 2 3	1 2 3	1234	
27		B 1 2 3	1 2 3	1234	
28	Stereo	B 1 2 3	P C S D	1234	
29		B 1 2 3	P C S D	1234	
30	Television	B 1 2 3	P C S D	1234	
31		B 1 2 3	P C S D	1234	
32		B 1 2 3	P C S D	1234	
	KITCHEN, DINING ROOM				
	Kitchen Table	B 1 2 3	1 2 3	1234	

		Location	Type	Cond.	Va
34	Kitchen Chairs #_____	B 1 2 3	1 2 3	1234	
35	Dining Table	B 1 2 3	1 2 3	1234	
36	Dining Chairs #_____	B 1 2 3	1 2 3	1234	
37	China Closet	B 1 2 3	1 2 3	1234	
	CURTAINS & DRAPES				
38	Type &	B	1 2 3	1234	
39	Condition	1	1 2 3	1234	
40		2	1 2 3	1234	
41		3	1 2 3	1234	
	BEDROOMS				
	BEDS				
42	S B F L	B 1 2 3	1 2 3	1234	
43	S B F L	B 1 2 3	1 2 3	1234	
44	S B F L	B 1 2 3	1 2 3	1234	
45	S B F L	B 1 2 3	1 2 3	1234	
46	S B F L	B 1 2 3	1 2 3	1234	
47	S B F L	B 1 2 3	1 2 3	1234	
48	S B F L	B 1 2 3	1 2 3	1234	
49	S B F L	B 1 2 3	1 2 3	1234	
50	Dresser	B 1 2 3	1 2 3	1234	
51		B 1 2 3	1 2 3	1234	
52		B 1 2 3	1 2 3	1234	
53		B 1 2 3	1 2 3	1234	
54	Chests (upright)	B 1 2 3	1 2 3	1234	
55		B 1 2 3	1 2 3	1234	
56		B 1 2 3	1 2 3	1234	
57		B 1 2 3	1 2 3	1234	

EXHIBIT 7 - (Continued)

House #_____
Reach_____
Map #_____

		Location	Type	Cond.	Value
	APPLIANCES				
58	Refriger-	B 1 2 3	S M L	1234	
59	ator	B 1 2 3	S M L	1234	
60	Range (Free-standing)	B 1 2 3	S D	1234	
61	*Range (Built-in)	B 1 2 3	S D	1234	
62	Microwave Oven	B 1 2 3	S D	1234	
63	Dishwasher (Portable)	B 1 2 3	S D	1234	
64	*Dishwasher (Built-in)	B 1 2 3	S D	1234	
65	Washer (Automatic)	B 1 2 3	S D	1234	
66	Washer (Wringer)	B 1 2 3		1234	
67	Dryer	B 1 2 3	S D	1234	
68	Freezer	B 1 2 3	S M L	1234	
	Lamp, Type & Condi-tion				
69	Floor	B	1 2 3	1234	
70		1	1 2 3	1234	
71		2	1 2 3	1234	
72		3	1 2 3	1234	
73	Table	B	1 2 3	1234	
74		1	1 2 3	1234	
75		2	1 2 3	1234	
76		3	1 2 3	1234	
	Rug, Type & Condi-tion				
77		B	1 2 3	1234	
78		1	1 2 3	1234	
79		2	1 2 3	1234	
80		3	1 2 3	1234	

		Location	Type	Cond.	Val
81	_____	B 1 2 3	1 2 3	1234	
82	_____	B 1 2 3	1 2 3	1234	
83	_____	B 1 2 3	1 2 3	1234	
84	_____	B 1 2 3	1 2 3	1234	
85	_____	B 1 2 3	1 2 3	1234	
86	_____	B 1 2 3	1 2 3	1234	
87	_____	B 1 2 3	1 2 3	1234	
88	_____	B 1 2 3	1 2 3	1234	
89	_____	B 1 2 3	1 2 3	1234	
90	_____	B 1 2 3	1 2 3	1234	
91	_____	B 1 2 3	1 2 3	1234	
92	_____	B 1 2 3	1 2 3	1234	
93	_____	B 1 2 3	1 2 3	1234	
94	_____	B 1 2 3	1 2 3	1234	
95	_____	B 1 2 3	1 2 3	1234	
96	_____	B 1 2 3	1 2 3	1234	
97	_____	B 1 2 3	1 2 3	1234	
98	_____	B 1 2 3	1 2 3	1234	
99	_____	B 1 2 3	1 2 3	1234	
100	_____	B 1 2 3	1 2 3	1234	
101	_____	B 1 2 3	1 2 3	1234	
102	_____	B 1 2 3	1 2 3	1234	
103	_____	B 1 2 3	1 2 3	1234	
104	_____	B 1 2 3	1 2 3	1234	
105	_____	B 1 2 3	1 2 3	1234	
106	_____	B 1 2 3	1 2 3	1234	
107	_____	B 1 2 3	1 2 3	1234	
108	_____	B 1 2 3	1 2 3	1234	
109	_____	B 1 2 3	1 2 3	1234	
110	_____	B 1 2 3	1 2 3	1234	

*Structural Item

EXHIBIT 8

PERSONAL BELONGINGS SURVEY

SCI HOUSE NO._____ DATE_____

REACH_____ SCI REPRESENTATIVE_____

NUMBER OF CHILDREN (Age 0-16)_____ NUMBER OF ADULTS_____

	Quantity	Age	Value
Blender		1 2 3 4 5 6 7 8 9 10	
Table mixer		1 2 3 4 5 6 7 8 9 10	
Portable mixer		1 2 3 4 5 6 7 8 9 10	
Toaster		1 2 3 4 5 6 7 8 9 10 15	
Table top oven-broiler		1 2 3 4 5 6 7 8 9 10	
Electric can opener		1 2 3 4 5 6 7 8 9 10	
Coffee percolator		1 2 3 4 5 6 7 8 9 10	
Electric fry pan		1 2 3 4 5 6 7 8 9 10	
Crock pot		1 2 3 4 5 6 7 8 9 10	
Waffle iron		1 2 3 4 5 6 7 8 9 10 15	
Steam iron		1 2 3 4 5 6 7 8 9 10	
Vacuum		1 2 3 4 5 6 7 8 9 10	
Portable electric heater		1 2 3 4 5 6 7 8 9 10	
Electric fan		1 2 3 4 5 6 7 8 9 10	
Dehumidifier		1 2 3 4 5 6 7 8 9 10	
Humidifier		1 2 3 4 5 6 7 8 9 10	
Movie projector		1 2 3 4 5 6 7 8 9 10 15 20	
Slide projector		1 2 3 4 5 6 7 8 9 10 15 20	
Movie camera		1 2 3 4 5 6 7 8 9 10 15 20	
35 mm camera		1 2 3 4 5 6 7 8 9 10 15 20	
Sewing machine		1 2 3 4 5 6 7 8 9 10 15 20	
Hair dryer		1 2 3 4 5 6 7 8 9 10	
Small tape recorder		1 2 3 4 5 6 7 8 9 10	
Small radio		1 2 3 4 5 6 7 8 9 10	
Electric razor		1 2 3 4 5 6 7 8 9 10	

EXHIBIT 8 - (Continued)

Personal Belongings
Page 2 of 3
House # _____
Reach _____
Map # _____

	Quantity	Age	Value
Table saw		1 2 3 4 5 6 7 8 9 10	
Circular saw		1 2 3 4 5 6 7 8 9 10	
Electric drill		1 2 3 4 5 6 7 8 9 10	
Electric sander		1 2 3 4 5 6 7 8 9 10	
Jigsaw		1 2 3 4 5 6 7 8 9 10	
Sabre saw		1 2 3 4 5 6 7 8 9 10	
Lawnmower			
Push		1 2 3 4 5 6 7 8 9 10	
Riding		1 2 3 4 5 6 7 8 9 10	
Small tractor		1 2 3 4 5 6 7 8 9 10	
Miscellaneous		1 2 3 4 5 6 7 8 9 10	
		1 2 3 4 5 6 7 8 9 10	
		1 2 3 4 5 6 7 8 9 10	

Hand tools	$_____	
Garden and Yard tools	$_____	
Adult bicycle	$_____	1 2 3 4 5 6 7 8 9 10
Children's bicycle	$_____	1 2 3 4 5 6 7 8 9 10
Camping equipment	$_____	1 2 3 4 5 6 7 8 9 10
Fishing equipment	$_____	1 2 3 4 5 6 7 8 9 10
Golf equipment	$_____	1 2 3 4 5 6 7 8 9 10
Tennis equipment	$_____	1 2 3 4 5 6 7 8 9 10
Hunting equipment	$_____	1 2 3 4 5 6 7 8 9 10
Toys and games	$_____	1 2 3 4 5 6 7 8 9 10
Miscellaneous		1 2 3 4 5 6 7 8 9 10
		1 2 3 4 5 6 7 8 9 10
Clothing		
Children's	$_____	

House #_____
Reach_____
Map #_____

EXHIBIT 8 - (Continued)

Clothing (continued)	
Men's	$_____
Women's	$_____
Jewelry	$_____
Blankets	$_____
Linens, towels, and bedding	$_____
Pots, pans, and cooking utensils	$_____
China and crystal	$_____
Everyday dishes	$_____
Silverware	$_____
Everyday silver	$_____
Food	$_____
Special insured items	
Miscellaneous	
Luggage	$_____
Medication and cosmetics	$_____
Books	$_____
Typewriter	$_____

PART IV

THE 1977 FLOOD AND ITS IMPACT

GENERAL

The April flooding in the Tug Fork Valley resulted from periods of extremely heavy rainfall over the Tug Fork and Levisa Fork Watersheds. The rains began the night of 3 April and continued until early morning 5 April. Official rainfall measurements in the valley ranged from 1.3 to 8.7 inches, with all official measuring stations on the ridge separating the Tug Fork and Levisa Fork basins reporting amounts in excess of five inches. Unofficial measurements of six to ten inches were common. Near Bradshaw, West Virginia, about fifteen miles south of Iaeger, an unofficial measurement of over fifteen inches was reported.

Flood Depths

This rapid rainfall, which occurred within a thirty-hour period, resulted in rapid run-offs and record discharges for many areas in the Tug Fork Valley. The flood water crested at Williamson, for example, at 52.3 feet, while the flood stage is 27.0 feet. Parts of Williamson are protected by a flood wall to a height of 44 feet. The previously highest reported water depth at Williamson was 44.5 feet (12 March 1963). At Kermit, where the flood stage is 38.0 feet, the flood waters crested at 54.5 feet. The highest reported historic flooding for this area recorded over 100 years ago, was 47.6 feet.

Flood water depths, however, varied substantially within the study area. The following table compares the magnitude of the 1977 flood relative to the other flood events considered in this report. The frequency data for the other flood events are based upon analyses performed prior to the occurrence of the 1977 flood.

TABLE 6

APRIL 1977 FLOOD DEPTHS

Approximate River Mile	Approximate Magnitude of 1977 Flood Relative to Other Flood Events
0.0- 2.5	less than 5 year
2.5- 10.5	between 5 and 20 year
10.5- 15.0	between 20 and 50 year
15.0- 17.0	between 50 and 100 year
17.0- 42.0	between 100 and 500 year
42.0- 80.0	between 500 and SPF
80.0-105.0	greater than SPF
105.0-110.0	between 500-SPF
110.0-111.0	between 100-500 year
111.0-111.3	between 50-100 year
111.3-111.8	between 20-50 year
111.8-120.2	between 5-20 year
120.2-126.5	between 20-50 year
126.5-128.8	between 5-20 year
128.8-130.5	less than 5 year
Welch Area	less than 5 year to less than 500 year

Source: Flood Profiles, Stanley Consultants

Warning Times

As noted earlier, the detailed residential survey showed that very little effective warning time about the potential magnitude of the flooding was perceived by the majority of valley residents. Very few people expected the water to crest at the depth it ultimately did. Consequently, little movement of contents to elevations above the flood waters occurred. In some cases, furniture was moved to higher points in the house, but because of the depth of the flood water, it was still ruined. While fleeing from the flood, most residents did attempt to save some personal belongings however. Generally the items they took with them were high value and easily transportable (i.e.: stereo, television, jewelry, antiques), or items with sentimental value (pictures, family bibles, etc.).

Evacuation of Residents

Exact figures on the number of people forced to evacuate their homes because of the flooding are not available. Within the study area, however, an estimated 15,000 residents had varying depths of water in their homes. The displaced residents sought shelter wherever possible. Emergency shelter was provided in armories, schools, churches and the Williamson Fieldhouse. Newspaper reports state that almost 200 evacuation centers were established in the Tug Valley. Often families stayed with friends and relatives whose homes were not damaged by the flood. Finally, many people

simply took refuge on hillsides above the floodwaters. The length of time during which people were out of their homes ranged from several hours for those located on the fringe areas of the flooding, to several months for those whose homes were severely damaged, to an indefinite period for those people whose homes were destroyed.

As a consequence of the displacement of residents and due to damage to schools' physical plants, normal operation of schools in the area was not possible following the flood. Schools were closed for varying lengths of time. In general, the minimum closure time was about one week, however, many schools in Mingo County were closed up to one and one-half months.

Structures Destroyed

An estimated 4,731 residential primary units were affected by the April flooding in the study area. This includes over 600 residential structures which were destroyed. Although buildings were destroyed in almost all reaches, the majority of the structures destroyed or heavily damaged were in the Matewan, Williamson, Buffalo Creek and Kermit to Fairview areas.

Loss of Life

Within the study area there were no reported deaths as a result of the flood. Had the water been much deeper, particularly in the Williamson area, it is quite possible many people who sought refuge on the second floors of buildings could have been trapped, resulting in a substantial loss of life.

Flood Insurance

The high repair costs for damages inflicted in the study area by the flood were transferred from the valley residents to some extent by the presence of flood insurance. Table 7 presents the number of flood insurance policies in effect at the time of the April flooding. The number of policies that were in force for the study area is somewhat overstated to the extent that the county totals represent the number of policies for the entire county, not just the portion of the county in the study area.

Details on the claims made under the insurance policies are available only on a statewide basis. In West Virginia 1,176 claims were processed in the amount of $7,500,000. In the fifteen counties in Kentucky affected by flooding, 1,361 claims, representing $25,546,000 were filed.

Transportation Problems

Prior to and following the flood, severe transportation problems were prevalent in the flooded area. All major access roads to the area were cut off by the flood waters. Among the roads closed were federal highways 119, 52 and 23. Most state and local roads were also closed for varying lengths of time. Segments of many of the major highways were closed for as long as four days after the onset of flooding, with access maintained to major communities through extensive detours. Normal service was reestablished in most areas within five to ten days but a few remote areas suffered relative

TABLE 7

FLOOD INSURANCE POLICIES IN FORCE, APRIL 1977

County[1] or Municipality	Number of Policies	Coverage ($000's)
Mingo County	401	10,669
Kermit	24	852
Williamson	465	16,469
Matewan	95	3,005
McDowell County	461	9,186
Iaeger	32	1,361
Welch	129	3,842
Wayne County	180	4,340
Martin County	0	0
Lawrence County	0	0
Pike County	0	0
Buchanan County[2]	0	0
Tazewell County[2]	0	0
Totals	1,787	49,724

[1]Unincorporated portion of the county

[2]Portion of the county within the report study area

Source: FIA

isolation for many weeks after the flood due to bridge losses and washouts. Only one main bridge, which connected Matewan and Buskirk, was washed away by the flood, but many smaller bridges serving clusters of homes were washed away or severely damaged. Highway officials estimate that during the days following the flood as many as 550 men were working on road repair with over 20,000 man-hours expended in road system reopening and related cleanup.

Emergency transportation equipment was supplied by various government agencies and included boats, helicopters, airplanes, trucks, heavy equipment and other motorized equipment.

Railroad operations were severely hampered due to the flood. In anticipation of the flood, railroad personnel did whatever was possible to minimize the effects of the floodwaters. This included moving rolling stock to higher elevations and stringing hopper cars across bridges to add additional weight and strength.

As early as mid-morning 4 April, dispatchers had received more than two dozen reports indicating that main line tracks had washed out, were blocked by slides, or were inundated by floodwaters. At about 9:00 p.m. that night, signals and communication systems between Iaeger and Williamson were reported out of order. The water crested at Williamson early Tuesday morning, flooding the 7,000-car capacity yard and all related shop and support facilities.

Salvage and repair operations were performed on a priority basis, with initial repairs taking place between Williamson and Kermit. Shortly after Thursday noon, a westbound main line was put back into operation, although trains were forced to operate at reduced speeds. Approximately 15 days after the flood, all main line service had been restored. Permanent restoration of all branch lines took about two months.

Damages to railroad equipment and facilities were largely concentrated in the Williamson area. Damages to the roadbed and track facilities were, however, spread out along the entire length of the

flooded area. Additionally, railroad personnel have estimated that loss of business consisted of 12,500 carloads of coal that were not mined in the tri-state area during the period following the flood.

Communication Problems

Communication also was a major problem in the period following the flood. Telephone company facilities and equipment were inundated by the flood waters, as were telephones in private homes and businesses. Approximately 17,000 telephone units were reported out of service at the height of the flooding. Initial reports of the severity of the flood were relayed through mobile radio operators. The C&P Telephone Company immediately started repair procedures utilizing crews from West Virginia, Virginia, Maryland, and Washington, D.C. About 25 days after the flood, telephone service was reported near normal. During the period following the flood, as stated elsewhere in this report, emergency communication equipment was provided by various state, federal, and local agencies. The C&P Telephone Company had as many as 350 personnel in the field at one time, and estimates indicate that in excess of 30,000 man-hours were expended in the restoration of communications to near normal.

Utility Problems

Damages to essential natural gas and electric utilities were also widespread in the study area. Although basic electric service was restored in most areas within one week, normal service and equipment were not back in place for almost a month in at least some

parts of the study area. The same basic service restoration pattern held true for natural gas service as well.

Although natural gas service is limited in the study area to only a few reaches, losses included over 2,000 meters, an office building, two regulator stations, and a variety of miscellaneous damages to vehicles and transmission equipment. Twenty-four gas company employees worked essentially full-time for slightly over one month restoring service, repairing equipment, and cleaning and restoring service lines.

Just the basic restoration of electric service in the study area involved the expenditure of over 15,000 man-hours of effort. Additional effort continued to be expended far beyond the period immediately following the flood in a continuing effort to repair damages to six substations, transmission lines, and other key facilities owned and maintained by Appalachian Power Company and Kentucky Power Company.

Impact on Area Economy

Throughout the study area, approximately 650 businesses were directly affected by the April flooding. Total direct and indirect damages to commercial establishments was close to $55,000,000. Loss of sales or output (actual sales loss and wage loss less cost of goods sold) was estimated at almost $11,000,000. The remainder of damage to commercial establishments consisted of structure and content damage, cleanup costs, and emergency costs. During the field survey, it was determined that approximately 75 businesses would not reopen following the flood.

Business losses resulting from the temporary closing of coal mines due to flooding totaled an estimated $30,516,564. This includes losses in production and sales from a number of mines affected by the inability of miners to get to work due to transportation and other related problems. Estimates indicate that a peak total of over 500 miners were out of work for periods of two weeks to eight months. Two of the nine mines in the study area that suffered direct physical damages from floodwaters have never reopened. The long-term secondary losses from these coal mine-related losses are, of necessity, quite substantial.

What costs are included for these

FLOOD DAMAGE SUMMARY

Table 8 outlines by property category, study area damages caused by the April flooding. Commercial/industrial and residential properties account for over 70 percent of total damages. The only other category accounting for more than 10 percent of the total is other government roads (12.6%). The balance of the damages are spread throughout the remaining eight categories.

Further breakdown of damages within each major classification is presented in the appendix of this report. Detailed tables showing the types of damages (physical, cleanup, emergency, business/financial, loss, wage loss and lot damage) by type of property and by reach are included. To obtain a more detailed perspective of damages, the reader should refer to these tables.

TABLE 8

1977 - AS-OCCURRED FLOOD DAMAGE BY CATEGORY ($000's)

Category	Unit	Number	Value	Damage	Percent of Total
Residential	Structures	5,429	$ 64,389.3	$ 42,104.2	21.3
Commercial/Industrial	Structures	672	46,005.4	97,219.7	49.3
Utilities	Structures	19	1,861.5	5,125.2	2.6
Highways	Miles	143.9	NA	4,549.8	2.3
Railroads	Miles	64.2	NA	10,097.1	5.1
Schools	Structures	38	11,239.0	3,636.3	1.8
Churches	Structures	79	3,673.5	1,063.1	0.5
Municipal	Structures/Miles	20/37.5	4,846.0	6,323.8	13.2
Other Government	Structures	41	1,473.2	24,917.9	12.6
Fraternal	Structures	6	680.0	118.8	0.1
Miscellaneous	Structures	1	50.0	2,105.0	1.2
Total		6,305	$134,217.0	$197,261.1	100.0

Source: Stanley Consultants

Should add footnote explaining why the damages in several of the categories exceed the value. (Part of accounting of values)

DAMAGE RELIEF EFFORTS

General

Following the April flooding, massive relief efforts were undertaken to provide assistance to disaster victims. Public, private, religious and charitable organizations responded to the residents' needs. Because of the overwhelming response, and the multitude of organizations involved, any discussion of disaster aid will certainly omit key organizations. Failure to mention any organization does not, by any means, imply a lack of assistance from that group. The following discussion briefly describes some of the organizations involved and their major areas of activity. For the purpose of the discussion the organizations are broken into governmental and nongovernmental categories.

FEDERAL GOVERNMENT ASSISTANCE

General

Major arms of the federal government involved in assisting the flood victims included: Federal Disaster Assistance Administration (FDAA), the Department of Housing and Urban Development (HUD), the U.S. Army Corps of Engineers, and the Small Business Administration (SBA). Although numerous other federal agencies were involved, these four agencies performed the bulk of the day-to-day contact with the flood victims.

Federal Disaster Assistance Administration

Immediately following the flood, FDAA, which provides assistance to federally declared "disaster areas," established several

Should add brief stat explaining that many of the reported appeals are already counted in other damage categories

disaster assistance centers in the valley. The centers gathered data on the various relief programs available through federal, state and volunteer organizations. This central listing of programs available allowed flood victims to apply for several types of aid at one location.

FDAA also made initial appraisals identifying the types of relief most urgently needed in the flooded area and assisted governmental entities in obtaining this aid. They handled federal assistance to state, local, and county governments for the following categories: debris clearance; protective measures; damage to water control facilities, road systems, public buildings and equipment, and public utilities; and miscellaneous governmental damages. FDAA was also responsible for providing assistance to qualified nonprofit facilities. FDAA expenditures for this assistance is estimated at slightly in excess of $13,270,000.

FDAA also participated in a grant program to the flood victims. The grants awarded to families and individuals were in amounts up to $5,000 and could be used to restore or replace the individual's home or personal belongings. Under this program, through FDAA, the federal government provided 75 percent of the grant monies disbursed, and the states involved provided the remaining 25 percent. The federal portion of the grants provided has been estimated at $5,063,800.

Housing and Urban Development

Following the flood, HUD began providing emergency shelter to the flood victims. The pressing need for emergency housing

was initially met through the use of camping trailers. Group sites were established where numerous families could be housed, and water and sewer facilities were constructed to serve the camps. In all cases where space and topography permitted, the camps were located out of the flood plain. When possible, the campers were located at the sites of homes which were under repair.

Another method used to house flood victims was through the use of mobile homes. Eligible residents were able to obtain furnished mobile homes rent free for a period of up to one year. After a year, if desired, residents may purchase the mobile homes from HUD for a nominal fee. In many cases HUD was able to obtain sites on which to locate the mobile homes. The residents were also able to choose a housing site, providing it met HUD's requirements.

As part of the initial field survey, HUD-provided mobile homes were identified. Table 9 presents by reach the location of HUD mobile homes in the study area. Mobile homes located outside of the study area are not included in the count, nor are mobile homes which were moved in after the field survey was completed.

It is estimated that during the recovery effort, HUD assistance to the residents of the Tug Fork Valley was in excess of nineteen million dollars.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers greatly aided the valley in the recovery effort. Among the myriad of duties performed by the

TABLE 9

HUD MOBILE HOMES IN STUDY AREA

Reach	Number	Reach	Number
210	20	510	9
220	1	511	22
310	179	520	46
311	11	521	4
312	37	522	11
313	9	610	39
314	6	611	8
320	174	612	21
410	1	620	33
411	7	621	50
412	1	622	14
413	1	710	5
420	17	720	14
421	1	810	7
422	4	910	6
423	17	10	5
424	43	Total	823

Source: Stanley Consultants field survey June, July, 1977.

Corps, three efforts were perhaps the most visible to the residents: search and rescue missions, development of mobile home sites and debris removal.

An immediate concern of the Corps' was to identify sites where temporary housing could be located. Once located, these sites were developed to allow the placement of HUD-provided mobile homes. Site development included, but was not limited to

site grading, provision of potable water supplies, and provision of sewage treatment facilities.

Debris removal was a substantial task due to the tremendous amount of material deposited by the flood. Debris removal alone required expenditures of almost 3.4 million dollars. Overall, the U.S. Army Corps of Engineers expended approximately 8.7 million dollars for recovery efforts in the Tug Fork Valley.

Small Business Administration

The SBA assisted flood victims through the issuance of disaster loans. The purpose of a SBA disaster loan is to restore the victim's home or business to pre-flood condition. In addition to real property, items covered include furniture and certain personal property in a residence, and inventory, furniture, fixtures, machinery, and equipment in a business structure. An important consideration is that all SBA disaster loans to restore or replace real or personal property which is, or will be, located within a special flood hazard area must be covered by federal flood insurance before any loan funds can be disbursed.

An SBA disaster loan may not exceed the actual tangible loss suffered by the disaster victim (after deducting any recovery from insurance, the Red Cross, a state grant, permanent minirepairs, or other sources) plus eligible refinancing, expense for code compliance, or eligible relocation expenses. The following administrative limitations have been set on the amount for an individual loan.

Home Loans: A disaster home loan is limited to a maximum of $50,000 to restore a residence, $10,000 to restore residential contents, or $55,000 for both purposes, plus $50,000 for eligible refinancing. The costs of code compliance and eligible relocation are included within these dollar limits.

Business Loans: A disaster business loan is limited to a maximum of $500,000 for real and personal property losses. Refinancing, code compliance, relocation expenses, and all other eligible loan purposes are included in this dollar limitation.

The administrator of the SBA may approve a loan in excess of the above amounts if he determines it is necessary to avoid undue hardship to the individual.

The following table outlines SBA activity in the Tug Fork Valley as a result of the April flooding. The amounts are overstated to the extent that the West Virginia portion of the total includes the ten West Virginia counties declared disaster areas. Although exact figures are not available, the SBA spokesman stated the great majority of the West Virginia loans were made in McDowell and Mingo Counties.

STATE GOVERNMENT RELIEF EFFORTS

Almost every arm of state government became involved in disaster relief. As in the discussion of federal government assistance, only those agencies most directly involved with the public are mentioned.

TABLE 10

SBA ACTIVITY

TUG FORK VALLEY[1]

	Home	Business	Total
Interviews	6,609	649	7,258
Applications Processed	1,862	246	2,108
Applications Declined	275	7	282
Loans Approved	1,746	229	1,975
Amount of Loans Approved ($000's)	22,393	22,700	45,093
Applications Pending	--	--	135[2]

[1]As of September, 1977

[2]SBA estimate

Source: Small Business Administration

The list below outlines the state agencies most directly involved in disaster relief, along with their primary functions in the relief efforts. The first name is the agency as it is known in West Virginia, the second as it is known in Kentucky. When only one name is listed, the agency bears similar titles in both states.

State Office of Emergency Service/Disaster and Emergency Services - coordination of the other agencies providing disaster relief; provision of emergency engineering equipment.

Governor's Office - requesting that the counties be declared "disaster areas"; disseminate information to the news media; make emergency purchases; provide manpower at various relief centers.

National Guard (Adjutant General's Office)/Department of Military Affairs - evacuation and search and rescue missions (air, land and water); security; transportation; communication; provide potable drinking water; debris

removal; provide equipment and vehicles; rodent and disease control.

Department of Public Safety (State Police) - ground search and rescue; emergency communication; security.

Health Department and Department of Agriculture - check for, and destroy contaminated foodstuffs; disease and rodent control; test water supplies for purity; debris removal; inspect and condemn structures when necessary (the latter task also performed by the State Fire Marshall).

Department of Transportation - debris removal; road and bridge repair; demolition of condemned structures; provide communication and other equipment.

Department of Welfare - provide food, shelter, clothing and medical supplies; provide food stamps and commodities; administer FDAA grant program.

Department of Revenue - provide damage appraisals of residences and businesses; provide tax information assistance to individuals.

Department of Employment Security - provide manpower at information centers; provide information on job availability and unemployment benefits.

Department of Economic and Community Development/ Governor's Economic Development Commission - provide manpower at disaster assistance offices; provide telephone service and staffing at various locations.

Department of Natural Resources - search and rescue missions; communication and other equipment; debris removal along waterways; restore and reseed stream banks.

A summary of flood-related state expenditures received from the state of West Virginia totaled more than $13 million including individual assistance and family grant expenditures. Table 11 disaggregates these expenditures by type.

TABLE 11

STATE OF WEST VIRGINIA

EXPENDITURES AND OBLIGATIONS

Individual Assistance	$ 28,500.00
Individual and Family Grants[1]	1,509,779.34
Housing[1]	10,016,974.92
Winter Fuel	83,300.00
National Guard	648,740.47
Mass Care and Emergency Response	398,275.41
Administrative Costs	471,255.87
Ineligible Costs[1]	485,360.91
Total	$13,642,186.92

[1]Not included in other government emergency costs as have already been included in other damage categories

Source: State of West Virginia, Governor's Disaster Recovery Office

It should be noted that several of the categories listed above include expenses which have been allocated to other damage categories and thus have not been considered as other governmental emergency costs. Additionally, at least a portion of the above amounts were spent outside the study area.

The types of assistance provided by the state of Kentucky closely paralleled those described for West Virginia. Table 12 summarizes major expenditure categories by state government in Kentucky.

TABLE 12

STATE OF KENTUCKY

FLOOD-RELATED EXPENDITURES

Category	
Food Stamps and Unemployment Benefits	$6,682,267
Human Resource Department	
Administrative Costs	595,969
Individual and Family Grants	776,000
Emergency Food Costs	170,679
National Guard, State Police	390,000
Total	$4,614,915

Source: Commonwealth of Kentucky, Department of Natural Resources and Environmental Protection and Stanley Consultants

While the above expenditure summary by no means captures all state of Kentucky expenditures, it does provide some perspective on the level of state effort. The individual and family grants, state police, and National Guard costs identified above do reflect a best estimate of expenditures actually incurred in the study area as opposed to the state as a whole. The other two categories represent state totals.

The state of Virginia expended only limited resources in the study area due to the limited land area and almost nonexistent Virginia population found in the small portion of the study area found in Virginia. Like their counterparts in West Virginia and Kentucky, state agencies in Virginia did respond to the flooding, and their activities essentially mirrored those of their sister states in terms of type and magnitude.

OTHER RELIEF EFFORTS

The list of other agencies providing assistance in the period following the flood is almost endless. The Red Cross and Salvation Army perhaps were the most visible overall. However, the importance of other groups' aid cannot be overlooked. Local governments, churches, fraternal organizations, businesses, private citizens, and others all provided assistance. This aid included rescue operations; provision of emergency shelter, food, clothing and medical supplies; debris removal; and numerous other items.

PART V

FLOOD DAMAGE SUMMARY

GENERAL

This section summarizes potential damages which would accompany the 1977 recurrence through the five-year flood events.

CATEGORICAL DAMAGE BY FLOOD

Table 13 presents for each flood and category the number and value of structures damaged along with the estimated damage. Table 14 shows for each flood the percent distribution of damage by category. Detailed tables showing damages in all categories on a by reach basis are presented in the appendix of this report.

The damage and value estimates may include structures physically located above the specified flood levels. This occurs because basement flooding and lot damage occur before flood waters reach the first floor elevation.

Recurrence of 1977 Flood Level

Recurrence of the April 1977 level of flooding would currently result in a slightly higher overall total damage amount. Residential damages would be higher, due to damages which would be sustained by HUD-provided mobile homes. Commercial damages are estimated to be 6.8 percent less because some businesses did not reopen after the April 1977 flood. This may be understated as the decision as

to whether a business would reopen was made during the initial survey in June, 1977, and therefore, does not reflect new business activity in the area which has occurred since that time.

Standard Project Flood

This level of flooding, would cause the greatest amount of damage of all the flood events considered. The percent distribution of damage by category closely parallels that of the 1977 recurrence flood.

500-Year Flood

Although significantly more structures would be affected by this flood than were damaged in the 1977 flood, damages would not increase proportionately. This can be explained by the fact that more structures would be damaged in the extreme upstream and downstream areas of the study area. However, the area around and including Williamson would have lower flood depths and correspondingly suffer less damage.

100- and 50-Year Floods

Damages drop substantially for these two floods, however, the distribution of damages by category is still quite similar to the other flood events discussed.

20- and 5-Year Floods

Residential damages for these flood events increasingly represent a larger portion of the total, reaching over 45 percent for the five-year flood. Damage estimations also, as stated earlier, reflect the protection afforded by the flood wall at Williamson.

TABLE 13

DAMAGE BY CATEGORY AND FLOOD ($000's)

Category	Unit	1977 Recurrence Number	1977 Recurrence Value	1977 Recurrence Damage
Residential	Structures	5,579	63,192.7	50,086.9
Commercial/ Industrial	Structures	600	41,708.4	90,608.4
Utilities	Structures	19	1,861.5	5,136.9
Highways	Miles	143.9	NA	4,549.8
Railroads	Miles	64.2	NA	10,097.1
Schools	Structures	37	11,089.0	3,561.2
Churches	Structures	77	3,555.5	980.5
Municipal	Structures/ Miles	20/37.5	4,846.0	5,569.4
Other Government	Structures	41	1,473.2	786.3
	Emergency Costs	NA	NA	24,166.0
Fraternal	Structures	6	680.0	118.8
Miscellaneous	Structures	1	50.0	2,105.0
Total	Structures	6,380	128,456.3	197,766.3

Category	Unit	SPF Number	SPF Value	SPF Damage
Residential	Structures	6,837	76,191.0	72,419.4
Commercial/ Industrial	Structures	719	47,028.9	123,274.0
Utilities	Structures	21	1,901.5	6,869.4
Highways	Miles	205.6	NA	6,028.6
Railroads	Miles	116.8	NA	14,795.2
Schools	Structures	43	11,908.0	4,358.7
Churches	Structures	96	4,505.9	1,738.6
Municipal	Structures/ Miles	26/46.9	5,703.0	7,211.1
Other Government	Structures	49	1,550.7	1,194.9
	Emergency Costs	NA	NA	29,800.8
Fraternal	Structures	8	752.0	223.4
Miscellaneous	Structures	10	6,200.0	5,790.5
Total	Structures	7,809	155,741.0	273,704.6

Are these emergency costs only for those facilities described on p. 56?

TABLE 13 - (Continued)

Category	Unit	500 Year Number	500 Year Value	500 Year Damage
Residential	Structures	6,011	68,518.3	53,458.9
Commercial/ Industrial	Structures	626	39,549.1	91,642.6
Utilities	Structures	17	1,541.5	4,239.8
Highways	Miles	145.5	NA	4,144.8
Railroads	Miles	52.8	NA	7,944.8
Schools	Structures	40	11,589.0	3,605.1
Churches	Structures	86	4,215.9	962.2
Municipal	Structures/ Miles	24/38.8	5,686.0	5,315.9
Other Government	Structures	44	1,527.0	891.7
	Emergency Costs	NA	NA	25,455.4
Fraternal	Structures	8	752.0	120.8
Miscellaneous	Structures	5	180.0	2,247.6
Total	Structures	6,861	133,558.8	200,029.6

		100 Year Number	100 Year Value	100 Year Damage
Residential	Structures	4,980	57,059.9	36,658.7
Commercial/ Industrial	Structures	500	39,549.1	54,461.8
Utilities	Structures	17	1,541.5	3,048.7
Highways	Miles	71.2	NA	2,391.3
Railroads	Miles	19.1	NA	4,010.4
Schools	Structures	38	10,714.0	2,583.0
Churches	Structures	64	2,862.9	575.3
Municipal	Structures/ Miles	23/31.2	5,616.0	3,946.7
Other Government	Structures	36	1,415.5	430.9
	Emergency Costs	NA	NA	21,650.6
Fraternal	Structures	7	692.0	82.3
Miscellaneous	Structures	4	150.0	1,829.4
Total	Structures	5,669	119,600.9	131,669.1

TABLE 13 - (Continued)

Category	Unit	50 Year Number	50 Year Value	50 Year Damage
Residential	Structures	4,246	50,153.5	29,080.7
Commercial/ Industrial	Structures	434	30,217.4	40,163.8
Utilities	Structures	15	1,376.5	1,751.8
Highways	Miles	54.6	NA	1,000.6
Railroads	Miles	13.1	NA	2,701.5
Schools	Structures	28	9,319.0	2,016.3
Churches	Structures	55	2,427.5	455.8
Municipal	Structures/ Miles	18/25.7	4,051.0	2,877.2
Other Government	Structures	26	1,077.0	276.4
	Emergency Costs	NA	NA	18,353.4
Fraternal	Structures	5	610.0	61.6
Miscellaneous	Structures	2	80.0	1,409.3
Total	Structures	4,829	99,311.9	100,148.0

		20 Year Number	20 Year Value	20 Year Damage
Residential	Structures	2,719	32,499.6	17,334.3
Commercial/ Industrial	Structures	169	8,339.5	12,201.5
Utilities	Structures	10	1,091.5	974.0
Highways	Miles	30.3	NA	556.0
Railroads	Miles	4.8	NA	1,625.7
Schools	Structures	14	4,756.0	834.4
Churches	Structures	38	1,627.5	271.5
Municipal	Structures/ Miles	7/13.5	863.0	1,012.4
Other Government	Structures	18	576.0	109.3
	Emergency Costs	NA	NA	11,856.4
Fraternal	Structures	1	60.0	13.3
Miscellaneous	Structures	0	0	635.5
Total	Structures	2,976	49,813.1	47,424.3

TABLE 13 - (Continued)

Category	Unit	5 Year Number	5 Year Value	5 Year Damage
Residential	Structures	956	12,018.9	8,027.1
Commercial/ Industrial	Structures	62	2,744.0	3,227.4
Utilities	Structures	7	848.0	323.0
Highways	Miles	11.6	NA	212.6
Railroads	Miles	0.6	NA	47.9
Schools	Structures	8	3,897.0	389.8
Churches	Structures	18	802.5	86.2
Municipal	Structures/ Miles	4/5.6	238.0	363.3
Other Government	Structures	2	20.0	5.0
	Emergency Costs	NA	NA	4,567.1
Fraternal	Structures	0	0	0
Miscellaneous	Structures	0	0	285.2
Total	Structures	1,057	20,568.4	17,534.6

Source: Stanley Consultants

TABLE 14

PERCENT DISTRIBUTION OF DAMAGE BY CATEGORY

Category	Flood Event Recurrence 1977	SPF	500	100	50	20	5
Residential	25.3%	26.5%	26.7%	27.8%	29.0%	36.6%	45.8%
Commercial/Industrial	45.8	45.0	45.8	41.4	40.1	25.7	18.4
Utilities	2.6	2.5	2.1	2.3	1.7	2.1	1.8
Highways	2.3	2.2	2.1	1.8	1.0	1.2	1.2
Railroads	5.1	5.4	4.0	3.0	2.7	3.4	0.3
Schools	1.8	1.6	1.8	2.0	2.0	1.8	2.2
Churches	0.5	0.6	0.5	0.4	0.5	0.6	0.5
Municipal	2.8	2.6	2.7	3.0	2.9	2.1	2.1
Other Government	12.6	11.3	13.2	16.8	18.6	25.2	26.1
Fraternal	0.1	0.1	0.1	0.1	0.1	*	0.0
Miscellaneous	1.1	2.2	1.0	1.4	1.4	1.3	1.6

*Less than 0.1

Source: Stanley Consultants

APPENDIX

GENERAL

This appendix consists of detailed damage tables by category and reach for each flood event as identified in the main text. The methods used to estimate these damages have been described in the main text and are, therefore, not included here. Also included in this appendix and described later are summary listing tables and a zero-damage point table.

Residential Damage Tables

Residential damage tables are presented in the form of computer print-outs. These tables present by reach and flood event the value and number of structures affected (primary and secondary). Damages are shown separately for structure, lot, and contents. Following the individual reach tables, damages are aggregated for all reaches for each flood event.

Commercial Damages

Commercial damages are also reported by reach and flood event. Damage classifications for this category include: structure; contents; cleanup; loss of sales or output; wage loss; and emergency costs. Within each reach, damages are also broken out by type of business. An explanation on the procedure used to allocate businesses to the proper category "type" is included in the main text.

Other Damage Categories

Tables are also included for the following categories: municipal; other government; railroads; highways; utilities; fraternal organizations; churches; schools; and miscellaneous damages. These tables again show damages by reach and by flood, and break total damage into physical, emergency, and business and financial loss where such damage classifications are appropriate.

Summary Listing Tables

These tables categorize by reach, various information about primary residential structures, initially classifying the structures relative to their ages. Further breakdown by the ages classify structures by their class, presence of a basement, exterior construction and condition. This breakdown is reported on an incremental flood frequency basis, rather than a cumulative basis.

Zero Damage Points

The final appendix table lists by reach and category the zero damage points. These points are presented in two ways. The first is the actual elevation, the second relates this elevation to the five-year flood elevation at the river mile where the zero-damage point occurs. This number represents the feet above or below the five-year flood which is represented by the actual elevation. Residential zero-damage points are included on the computer print-outs. For the categories municipal and other government, the zero-damage point was set at the elevation of the five-year flood at the downstream limit of the reach because cleanup costs would be incurred.