# FLOODPLAIN RECONNAISSANCE STUDY
# NOVEMBER 1985 FLOOD
# POTOMAC RIVER BASIN

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MARCH 1986

FOR THE

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN

This publication has been prepared by a consultant for the Interstate Commission on the Potomac River Basin. Funds were provided by the United States Government, the U.S. Environmental Protection Agency, and the signatory bodies to the Interstate Commission on the Potomac River Basin: Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia. The opinions expressed are those of the author and should not be construed as representing the opinions or policies of the United States or any of its agencies, the several states, or the Commissioners of the Interstate Commission on the Potomac River Basin.

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## INTRODUCTION

On November, 3 and 4 1985, the western portion of the Potomac River basin experienced severe flooding that followed several days of continuous rainfall. At many locations the flood was the largest ever recorded. A total of 43 lives were lost, and the storm was the most expensive natural disaster in the United States during 1985 (Potomac Reporter, 1986). The primary objective of this reconnaissance study was to determine the spatial extent and physical characteristics of the geomorphic change produced by the flood. The emphasis of the study is on flood induced changes in fluvial morphology and stratigraphy.

During the second and third weeks of December, 1985 over 118 specific locations in the watershed were visited. Numerous other localities were surveyed from the roadside and a total of 1928 miles were logged. At each site observations and measurements were made of the geomorphic features produced by the flood. In addition to the geographic and physiographic location of the site, these observations included: the extent of vegetation damage; the character of stream channel and floodplain modification; estimates of volumes and areas of erosion and deposition; and the nature of the stratigraphic record left by the flood.

This report summarizes and interprets the field observations. Section 1 briefly discusses the available meteorologic and hydrologic data and compares the flood to historic storms in the region. The second section summarizes the type and extent of damage in the various tributaries of the Potomac River. The final section interprets the field observations with respect to the geomorphic effects of floods of different magnitudes. An Appendix includes a descripition of the road stops with location map and a photo log.

## METEOROLOGY AND HYDROLOGY

The November flooding followed 3 to 4 days of steady rainfall that orignated from a tropical storm commonly called Hurricane Juan. The total rainfall was large but not uncommon for the region (Table 1). Nevertheless, the total runoff was large and at several locations the discharges were the largest ever recorded.

The greatest recorded total storm rainfall ranged between 254 to 357 mm (10 to 14 in) and occurred in a triangular shaped region in West Virginia between the communities of Petersburg, Franklin and Parsons (U. S. Weather Service, Provisional Data, 1986). Outside of this area the total rainfall was between 76 to 152 mm (3 to 6 in). The headwaters of the North Branch of the Potomac typically received 102 to 127 mm (4 to 5 in). The Shenandoah drainage received approximately 152 mm (6 in) of total precipitation.

While the total rainfall from Hurricane Juan was large, it was not uncommon for the region (Table 1). In this area, the estimated 100 year-8 hour rainfall is 140 to 153 mm (5.5 to 6.0 in) (Yarnell, 1935). In central Virginia, Hershfield (1961) estimates that a rainfall of 178 mm (7 in) in 12 hours will recurr every 100 years. The greatest recorded rainfall in the area occurred in 1969 during Hurricane Camile. During this storm, 686 to 711 mm (27 to 28 in) of rain fell in an eight hour period.

Prior to November, 1985, the largest recorded storm in the Petersburg area occurred in 1949 (Table 1). Historic records indicate that a flood of similar magnitude occurred in 1877 (Grover, 1937). Although the total rainfall of the 1949 and 1985 storms was similar, the discharge of the 1985 storm was considerably greater (Table 1). This is apparently due to the different nature of the storms. The 1949 flood occurred in the summer after several days of intense but scattered thunderstorms (Stringfield and Smith, 1956). Apparently the sporadic distribution of these thunderstorms resulted in lower amounts of water entering the stream channel network at any given time. In contrast, the 1985 flooding occurred in the late fall after several days of continuous rainfall. Presumably, the combination of widespread rainfall on the barren fall landscape was conducive to runoff. Since a larger area was affected at the same time, and there was less vegetation to retard runoff, the downstream flooding was greater.

The discharges recorded during the flood were the greatest on record for many gaging stations (Table 2). Recurrence intervals in the South Branch of the Potomac were commonly greater than 500 years. The longest recurrence intervals occurred on the South Branch above Moorefield W. Va. The remainder of this drainage had intervals between 100-500 years. Maximum discharges in the rest of the basin had recurence intervals of less than 100 years.

TABLE 2

DISCHARGES FOR THE NOVEMBER, 1985 FLOOD
SOUTH BRANCH OF THE POTOMAC RIVER

| LOCATION | AREA | PREVIOUS FLOODS DATE | PREVIOUS FLOODS CFS | NOV. CFS | FLOOD R.I. |
|---|---|---|---|---|---|
| Franklin, W.VA. So. Branch | 132 | 1949 | 15,000 | 44,000 | >500 |
| Cabins, W.Va. No. Fk. So. Br. | 314 | 1949 | 50,000 | 90,000 | >500 |
| Petersburg, W.Va. So. Branch | 642 | 1949 | 62,000 | 130,000 | 100-500 |
| Moorefield, W.Va. So. Fk. So. Br. | 283 | 1949 | 39,000 | 110,000 | >500 |
| Springfield, W.Va. So. Br. Pot R. | 1471 | 1936 | 143,000 | 240,000 | 100-500 |

SOURCE; U. S. G. S., 1986

## DISTRIBUTION OF FLOOD MODIFICATION

Although the entire Potomac drainage was affected by the storm, the greatest modification occurred in the South Branch drainage. Specifically, the North Fork of the South Branch of the Potomac River. Flood damage along the mainstem of the Potomac was greatest between the confluence with the South Branch and the Williamsport/ Fort Frederick region. Damage along the North Fork of the Potomac River was located primarily in the headwaters and was generally comparable to a large spring runoff event. The Shenandoah drainage experienced widespread overbank flooding but channel modification was limited to specific physiographic settings. Throughout the basin local flooding occurred behind bridges and road embankments built across the floodplain. A summary of the observations made at specific locations is included in the Appendix. The numbers within the text refer to specific locations described in the Appendix.

The field observations at every site visited were synthesized to determine if the location had suffered permanent damage and/orreceived a distinguishable stratigraphic deposit of the flood. Permanent damage or modification was considered to have occurred where the flood altered the landscape to the extent that the previous land use or vegetation can not recover naturally in periods less than decades or centuries. For example, numerous agricultural fields were flooded and covered with a thin veneer of fine grained sediment. Although the current year's agricultural crop was destroyed, the agricultural potential of the field was not permanently altered. In contrast, several areas had their topsoil completely eroded or covered by a continous layer of boulders. In these cases the agricultural potential of the field was permanently lost and the previous vegetation cannot readily reestablish itself. In other areas, river channel widening permanently removed the adjacent floodplain without modifying the remaining field. These areas were considered to have suffered permanent damage when it was evident that the majority of the field had been eroded. Unfortunatly, little information is available concerning the amount of channel scour or widening that occurred. These effects cannot be easily identified without prior knowledge of the actual dimensions of the channel.

In addition to the permanence of damage, sites were evaluated to determine if a distinguishable record of the flood would be left in the fluvial stratigraphy. Areas where the recent flood left sedimentary deposits that were distinct in grainsize and structure from the underlying sediment were condsidered potential stratigraphic horizons. For example, areas where the flood deposited thick boulders above fine grained soil, in a location that will not be readily destroyed by normal fluvial processes, were considered to have obtained a stratigraphic imprint of the flood. In contrast, areas where a thin lamina of fine sediment was deposited over several meters of fine grained soil were not considered to have obtained a permanently distinguishable record of the flood. Likewise, areas where the recent deposits, no matter how distinguishable, are likely to be extensively reworked by subsequent floods were not considered to have a permanent record of the flood. These areas included mid-channel islands and side channel bars.

# SOUTH BRANCH OF THE POTOMAC RIVER

## NORTH FORK OF THE SOUTH BRANCH:

The North Fork of the South Branch of the Potomac River recieved the greatest permanent damage and stratigraphic imprint of the flood. Damage to adjacent stream valleys thatreceived similar amounts of total rainfall was also severe but was mitigated by geologic controls and land use. The drainage pattern west of Petersburg has a trellis morphology that is controlled by the geology of the North-East trending anticlines and synclines of sandstones, shales, and limestones. The larger tributaries flow parallel to the axis of the the underlying structure except at water gaps where the streams transect the limbs of the folds. Generally, the valleys are underlain by less resistant beds of shale and limestone, whereas the steep valley walls are composed of quartizite, and sandstones .

Along the North Fork between Circleville and Petersburg, whole communites, bridges, and roads were destroyed and the entire valley bottom was modified to some degree. See Appendix 17-10 to 17-23. Because of the steep valley walls, almost all of the agricultural land along the North Fork is on the valley floor. Most of this bottom land, was severly eroded, stripped of topsoil and covered with gravel and boulder deposits. Two traverses across a floodplain (18-18) reveal that only 30 to 45% of the valley bottom was not disturbed (Table 3). The worst flooding occurred within the backwater influence of water gaps. These same physiographic locations suffered extensive damage in the 1949 flood (Springfield et al, 1956).

TABLE 3
FLOODPLAIN TRAVERSE, SITE 18-18

PERCENT TOTAL LINEAR DISTANCE

| | TRAVERSE 1 | TRAVERSE 2 |
|---|---|---|
| TOTAL LENGTH | 169 M | 144 M |
| BOULDER FIELDS | 43% | 24% |
| DRY CHUTES | 24% | 32% |
| UNDISTURBED | 33% | 44% |

Throughout this tributary, floodplains were extremely modified by both erosion and deposition. At many locations, especially river bends, the flood waters cut across the floodplain and flowed directly down the valley. In the process, new channels were eroded into the existing floodplain. At one location, (18-18), the river makes a right angle turn into a bedrock confined reach. Upstream of the confined channel, the floodwaters filled the entire valley and transformed the previously grassy floodplain into a chaotic boulder field.

Two large chutes were scoured into the floodplain surface at site 18-18. The largest channel was 330 m long, 25 to 40 m wide and 1 to 2 m deep. This channel is comparable in dimension to the permanent stream channel. The chute is subparallel to the normal channel, and extends upstream to a horse-shoe shaped headcut. The once grassy surface that surrounds the chute is now covered with a thick veneer of gravel and boulders. The largest continuous boulder field on this floodplain is 175 m by 160 m in area, and averages 0.5 m, thick but is locally over a meter deep. The superposition of boulders at the headcut of the channels suggest that the boulder veneer was deposited prior to the headward growth of the chute. Grooves and tool-marks in the floodplain surface indicate that the boulders were transported violently across the floodplain surface and not deposited passively.

Channels with similar morphology were formed during the 1936 flood in the Connecticut River valley (Jahns, 1947). However those channels were 455 m long, 120 m wide, and more than 6 m deep! During the 1955 flood in Connecticut, channels 1 m deep and 24 m wide, and 2 m deep, 5 m wide and 60 m long were scoured into the floodplain (Wolman and Eiler, 1958). Recent floods in central Texas have also produced analogous features, but only a quarter the size of the North Fork chutes (Baker, 1977).

In addition to scouring the floodplain, the development of this chute exposed the floodplain's stratigraphy and revealed a cap of alluvial soil overlaying gravel and boulder deposits. The sediments of these boulder deposits are comparable in grainsize and structure to the sediment deposited in the current flood. Along one section of exposed bank at 18-18, 63% of 126 linear meters of bank contained imbricated boulder deposits. The largest exposed gravel lens was 14 m long and 1 m thick. While these deposits were not as extensive as the deposits from the 1985 flood, they appear to be formed by similar processes. Similiar boulder fields and chutes are common flood features along The North Fork of the South Branch of the Potomac. Photos of this particular field are included in the Appendix.

SOUTH BRANCH AND THE SOUTH FORK OF THE SOUTH BRANCH OF THE POTOMAC R.

The stream valleys of the South Branch and the South Fork of the South Branch of the Potomac river received similar amounts of rainfall as the North Fork. Nevertheless, the overall modification of the fluvial landscape was considerably less. This is apparently due to both geologic controls and better land use planning. In general, the geomorphic modification along the South Branch was limited to a zone 100 m wide along the channel. The greatest modification occurred at stream bends and upstream of constricted reaches. Bank erosion, gravel splays, and destruction of vegetation was common throughout the stream valley. However the newly formed channels and the large gravel veneers that were common in the North Fork floodplain were generally absent in the valleys of the South Branch and South Fork.

The different response of these stream valleys may be explained in terms of differences in their drainage networks. Although the general physiography of the North Fork and South Branch are similar, the trellis drainage network is less well developed in the southern valleys. From the headwaters of the North Fork and the South Branch to their major water gaps, the tributaries have 1.0 and 0.63 channels entering per kilometer, respectively. Moreover, the total number of first and second order channels (at a scale of 1:25,000) are 0.63/km and 0.46/km respectively. These differences are apparently due to lower amounts of impervious shales and a wider synclinal fold in the South Branch drainage. The North Fork the drainage traverses steeply dipping, almost vertical strata of quartizite that offers little opportunuity for surface detention or groundwater storage. The overall effect is that the North Fork has a greater drainage density. Consequently, even though the two valleys received similar amounts of total rainfall, the North Fork had faster runoff and greater effective discharges. In addition, the steeper gradient of the North Fork probably increased stream velocities and exacerbated floodplain alteration.

In addition to lower discharges in the South Fork and South Branch, the land use adjacent to the floodplain also helped mitigate flood damage. In the these valleys, the broader, gently rolling hillsides are ideally suited for agriculture and pasture. The principal land use consists of medium scale farms with the majority of buildings on grassy knolls that overlook the valley and floodplain. In contrast the steep walls of the North Fork are unsuitable for agriculture and the useable land is restricted to the valley bottoms. Consequently the North Fork valley had a greater number of structures and communities on, or adjacent to the floodplain.

THE SOUTH BRANCH OF THE POTOMAC R., PETERSBURG GAP DOWNSTREAM TO MC NEILL, W. VA.

Downstream of Petersburg Gap the South Branch opens into a a wide valley. At the head of the expansion, the bridge at Rt 220 was destroyed, a large field of cobbles was deposited and a channel was incised into the floodplain. Below this area, to the vicinity of Mc Neill, the greatest geomorphic change occurred at river bends and constrictions. Gravel splays were deposited within 50-100 meters of the channel and fine sand began to be a common site on fields. Straight reaches were widened and reworked, but did not inherit any stratigraphic deposits of the flood. Near Mc Neill W. VA., the South Branch enters a relatively straight reach that was inaccessable by car. Assuming this reach was affected like other constricted reaches in the area, geomorphic change was restricted to the channel and adjacent floodplain.

Upstream from Romney W. VA., (19-1,2), the river returns to a wide, alluvial valley. Thoughout this area, point-bars and the active floodplain surface was extensively reworked. Gravel and sandy splay deposits occurred on the floodplain surface of some river bends. These lobe-like deposits were not associated with extensive floodplain scour and appeared to be deposited passively. These deposits are similar in morphology but larger in area than the overbank gravels that have been described in recent floods in southern Illinois (Ritter, 1975), and in the Mid-Atlantic Piedmont following Hurricane Agnes (Moss and Kochel, 1978; Costa, 1974).

Strips of cobbles, sand and silt were also common along this section of channel. All of the surficial sediment on the mid-channel islands and side channel bars was completly reworked and the vegetation flattened. At Rocks W. Va., near Romney, 30 m of bank erosion was reported by local residents.

Below Romney W. VA., near Blues Beach (19-4), to the confluence with the Potomac, the South Branch flows through a narrow valley with tight meanders. The surrounding drainage received between 140 and 153 mm (5 to 6 in) of storm rainfall. Throughout this reach there was extensive distruction of riparian vegetation and overbank deposits of sand and gravel. However the large cobble and gravel splay deposits that characterized the flood deposits above Romney were absent. Deposits of silt and mud 20 to 50 cm thick were common as well as some ribbon-like gravel deposits that paralleled the channel. Tributary channels were reworked and probably enlarged, but little geomorphic modification or stratigraphic imprint of the flood was apparent. In the Cacapon drainages, overbank flooding and reworking of the active channel and floodplain were common. However, no evidence of permanent change was observed.

## THE POTOMAC RIVER, BELOW THE CONFLUENCE OF THE SOUTH BRANCH.

At the confluence of the South Branch to the Potomac, there was extensive flood damage. This was apparently due to a combination of backwater effects produced at the confluence and the constricted nature of the upstream channel. Throughout this reach, the channel banks were widened what appeared to be several meters. Along the bank every tree for hundreds of meters was uprooted or broken. The trees had diameters up to 70 cm, and were approximately 50 to 60 years old.

Below the confluence with the South Branch, the majority of flood effects to the mainstem occurred above the Williamsport area. Generally, the geomorphic changes were restricted to the active channel and consisted of reworking of the substrate, islands and bars. Floodplain modification consisted of the destruction of vegetation and overbank deposition of silt and clay. In many areas rows of trees adjacent to the channel were flattened. No gravel deposition was observed outside the active channel. With the exception of tree scars, no permanent stratigraphic record was left on the floodplain. Nevertheless overbank sedimentation was considerably. In places, 75 to 150 m of the floodplain was covered with several centimeters of fine sediment. Pockets of silt 7-10 cm thick were common.

Water damage to buildings throughout this reach was common. Hancock Md. experienced the worst flooding in 50 years and the C&O canal was breeched at several locations. Many agricultural fields were covered with silt and the current years crop destroyed. However, most of this damage was caused by water and silt, not by a rearrangement of the landscape.

Below the Fort Frederick / Williamsport area the effects of the flood were localized. Low lying areas adjacent to the channel were inundated and silt deposition was common. In most areas only an occassional tree was uprooted. The most extensive modification occurred at the confluences of tributaries. At the confluence of the Shenandoah and the Potomac River, backwater flooding caused channel widening, vegetation distruction and extensive mud and water damage to Harpers Ferry National Park. The confluence of the Monocacy also had significant deposition of fine grained sediment (Miller, et al, 1986).

## NORTH BRANCH OF THE POTOMAC RIVER

This area did not recieve the same amount of rainfall, nor was the geomorphic modification as great as in the South Branch drainage. The majority of the drainage received 127 to 153 mm (5 to 6 in) total rainfall (U. S. Weather Service, 1986). The combination of lower overall rainfall and the modifying influence of the reservoirs resulted in less overall damage.

In most reaches of the river, only 5 to 10% of the floodplain showed signs of flooding. Deposition of sand and silt was commonly limited to a 5 m strip adjacent to the channel. Deposits of leaf and plant debris were common 10's of meters away from the channel. No gravel deposits or floodplain incision was observed. At only two sites, Bayard W. Va. and Abrams Creek, were extensive sand deposits observed. However, throughout the main tributary, mid-channel islands and point-bars were covered with a fresh layer of sediment, which usually consisted of well sorted sand. New Creek and Patterson Creek did have an occassional cobble deposit, but most of the floodplain had only patches of erosion or deposition. In general, little permanent geomorphic change or stratigraphic record was left by the flood.

## SHENANDOAH RIVER

During the field reconnaissance both the North and South Forks of the Shenandoah river were visted. The drainage received 125 to 153 mm (5 to 7 in) of total rainfall and had localized areas of extensive damage. Both the North and South Forks experience similar modification. In both tributaries the channel and floodplain modification was limited by the stream channel pattern and morphology.

Stream channels in most of Shennandoah drainage are entrenched, elongated meanders. The morphology of these channels is controlled by erosion resistant bedrock. Throughout this area erosion only occurred at the stream bends. In these areas the point-bars were extensively reworked. In some reaches, (16-6), large blankets of sand were deposited. Trees adjacent to the channel were uprooted, and water damage to nearby fields was extensive.

# INTREPRETATION

The November, 1985 flood was a high magnitude event of low frequency and limited spatial extent. In the area of the largest total rainfall, the recurrence intervals of stream discharge were greater than 500 years. In some areas they probably exceeded 1000 years. Downstream of the storm center, recurrence intervals were between 100 and 500 years. Field observations made throughout the region indicate that the type of fluvial geomorphic modification left by these high magnitude events can be catagorized by the recurrence interval of discharge (Table 4). This discussion applies only to large tributaries in the western Potomac river basin and ergodic reasoning is inherent in the analysis. Furthermore, these generalizations apply to channel reaches several kilometers in length, rather than to modifications at a particular location.

In general, these high magnitude, low frequency events disrupt the landscape. Channels are enlarged, riparian vegetation is altered, and floodplains experience both erosion and deposition. At any particular location, the type of geomorphic modification and stratigraphic record left by the flood depends on local physiography. For any size flood, areas with local backwater effects exhibit the largest modification. River bends, tributary junctions, and areas upstream of channel constrictions are particularly sensitive to change. Relatively straight, bedrock controlled reaches without floodplains show little evidence of flooding. Nevertheless, similar reaches of river experience similar modification from floods of similar size.

In areas where the recurrence interval of discharge was greater than 500 years, the floodplain along the entire length of the channel was modified to some degree. Only within bedrock constrictions where there was no previous floodplain was morphlogic change difficult to discern.

The most characteristic feature left by these large events were channels incised into the floodplain. Along the North Fork of the South Branch of the Potomac, these channels were 100's of meters in length, 10's of meters in width, subparallel to the permanent channel, and comparable in dimension. Large boulder veneer deposits on the floodplain surface and adjacent to the incised channels were also characteristic. These deposits are 1000's $m^2$ in area, 1 to 2 m thick, and contain boulders up to 82 cm in diameter. These boulder sheets can extend 100's of meters from the channel and are generally located in areas that will not readily be eroded by normal channel processes. Stratigraphically, these boulder deposits may be difficult to distinguish from channel lag deposits left by the normal lateral migration of stream channels.

These flood features were widespread along the channel and in areas that are not likely to be reworked. Therefore, they should leave a regionally correlatable stratigraphic horizon of the flood. However, the combination of channel incision and boulder deposition produced by the flood creates a very irregular geomorphic surface. Therefore, the stratigraphic time lines of the deposits will be complex and discontinous when the incised channels are subsequently filled with sediment.

The geomorphic features left by floods with recurrence intervals of 100 to 500 years covered less area at any location, and are generally only located at river bends and local backwater areas. Along the entire length of the channel the damage was spotty and similar in spatial extent to that described in the Connecticut River flood of 1955 (Wolman et al, 1958). The principal difference in the impact of 100 to 500 year floods and those greater than 500 years, is the absence of large incised channels. Although, floodplains and point bars were locally eroded, the large chutes were never observed. Furthermore, boulder deposits were smaller in area and generally occurred within 10's m of the channel. Gravel splay deposits were well formed and several " text book " examples of hydraulically sorted sediment were observed. Generally, the sedimentary deposits had better definition and structure than the chaotic deposits left by floods of greater recurrence intervals. The geomorphic surface and stratigraphic time lines of these deposits are more uniform and distinct than those of larger floods. However, the spotty distribution of these deposits would make regional stratigraphic correlation difficult.

Little permanent damage or record was observed for areas where the recurrence interval was less than 100 years. Geomorphic work was concentrated in reworking of the active channel. Overbank deposition was limited to several centimeters of sand and silt. Floodplain erosion was also limited to several centimeters and was most common around plant roots.

TABLE 4

MORPHOLOGIC CHARACTERISTICS OF LARGE FLOODS IN THE WESTERN POTOMAC RIVER BASIN

| RECURRENCE INTERVAL | LOCATION OF MODIFICATION | MORPHOLOGIC CHARACTERISTICS | STRATIGRAPHIC CHARACTERISTICS |
|---|---|---|---|
| > 500 | Entire reach of channel; 100's m from channel | Chutes 100's m long, 10's m wide; floodplain boulder fields | Irregular geomorphic surface, complex time lines; regional correlation possible |
| 100-500 | River bends, constrictions; within 100 m of channel | No large chutes; boulder deposited passively and within 10's m of channel | Well defined surface and time lines; regional correlation difficult |
| < 100 | Low lying areas | Reworking of active channel; minor morphologic change; overbank sedimentation of fine grained sediment. | Difficult to distinguish or preserve |

## CONCLUSIONS

The November 1985 flood in the Potomac River Basin was a high magnitude, low frequency event of limited aerial extent. This report provides a record of the fluvial geomorphic impacts of the flood in various parts of the basin.

The most significant loss of property and life occurred in the South Branch of the Potomac River. Damage in this area is comparable to any recorded flood in the region. The greatest effects occurred in a area of approximately 1750 $km^2$, where 254 to 357 mm (10 to 14 in) of rain fell on relatively impervious rocks. Downstream from the storm center the amount of modification was related to the local physiography of the channel. Flood effects were particularly noticeable at river bends, tributary junctions, and areas associated with channel constrictions.

Field observations suggest that certain geomorphic features may be related to floods of definable recurrence intervals. These observations are tentative and only apply to streams with physiography similar to the South Branch of the Potomac. Future work is needed to confirm and refine these observations. Nevertheless, the observations will provide a useful guide when comparing future floods in the region.

## ACKNOWLEDGEMENTS

This report was funded by the Interstate Commission on the Potomac River Basin. Mr. Douglas J. Parkinson provided excellent assistance in the field and office. I am also indebted to Dr. Andrew Miller for his assistance in the field and his encourgement throughout the project. Dr. M. G. Wolman read an early draft of the report and provided useful comments throughout the project.

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# APPENDIX

## DESCRIPTION OF FIELD SITES

The following descriptions are summaries of the field observations made at specific locations. All of the measuerments are approximations and averages. Horizontal distances were measured by pacing. Flood water heights are averages of debris heights measured with a stadia rod. The thickness of sediment was measured with rulers at several locations.

### 12/10/85 CUMBERLAND

10-1 BRADDOCK RUN IN LA VALE, MD.: A small tributary that drains a suburban area. No permanent modification, evidence of fresh cobble movement. Minor localized flooding in area.

### 12/11/85 NORTH BRANCH OF POTOMAC R. FROM CUMBERLAND MD. TO HEADWATERS NEAR DOBBINS, W. VA.

11-1, THE NARROWS, WILLS CREEK, MD.: 75 m upstream from gaging station. Protected channel banks. Fresh point-bar gravel, 5 to 10% of floodplain had pockets of sand deposited. No permanent modification or stratigraphic imprint.

11-2, NORTH BR. POTOMAC R. IN CUMBERLAND NEAR WILLS CR. CONFLUENCE: Protected channel, no modification to channels or structures.

11-3, N. BR. POTOMAC R.: Downstream from Cumberland, suburban drainage, protected channel, no modification. Pockets of silt deposited adjacent to floodplain.

11-4, N. BR. POTOMAC R. AT CUMBERLAND FAIRGROUNDS: Partially rip-rapped channel, silt deposited in 1 cm x 5 m strip adjacent to less than 10% of channel.

11-5, TRIBUTARY, NEAR CRESAPTOWN MD.: Small 1 m wide stream with no evidence of recent deposition or channel modification. Cornfields show no evidence of storm damage.

11-6, N. BR. POTOMAC R. AT PINTO, MD.: Natural channel, adjacent floodplain was flooded, impact was more erosional than depositional. Sediment eroded around roots of grass and moss. Local deposition 1 cm thick.

11-7, US 220, NORTHWEST OF FORT HILL, MD.: No evidence of mass movements. Small streams experienced bank erosion but were not significantly modified.

11-8, N. BR. POTOMAC R. NEAR DAWSON: Straight natural channel. Thin discontinous deposition of fine silt and peloids, 1 cm thick, 5 to 10 m wide. Leaf and stick debris, flattened vegetation. Banks adjacent to channel were reworked, no permanent modification.

11-9, N. BR. POTOMAC R. AT KEYSER: Protected channel. Mid-channel island recieved a fresh veneer of sediment.

11-10, LIMESTONE RUN, SOUTH OF KEYSER W. VA.: Natural channel, no evidence of change on floodplain or adjacent hillslopes. Fresh gravel cap on downstrem end of point-bars. Geomorphic work limited to active channel. Erosion of dirt roads along hillside supplies sediment to lower Limestone Valley.

11-11, NEW CREEK ALONG ALLEGHENY FRONT SOUTH OF KEYSER W. VA.: Natural channel, fresh bedload movement on side-channel bars, silt pockets adjacent to channel.

11-12, N. BR. POTOMAC R., KITZMILLER BRIDGE: Wide, protected channel. Well sorted boulder bar without vegetation, recent cobble and boulder movement and sediment sorting.

11-13, N. BR. POTOMAC R., KITZMILLER GAGING STATION: Natural channel, high flow channel was activated and reworked. Vegetation on flood channel island was partially destroyed.

11-14, NETHKIN HILL OVERLOOK: No evidence of recent hillslope activity. Erosion of mid-channel islands and railroad embankment.

11-15, ROUTE US 50 AT W. VA. 42: Overlook, no evidence of hillslope activity.

11-16, ABRAM CREEK AT US 50, W. VA.: Straight natural channel with alternate bars. Downstream of bridge had erosion of floodplain peat and vegetation and boulder deposit. Upstream floodplain had deposition of medium sand by sandwaves, sand accumulation of 100 m x 15 m x .15 m, fine grained sediment absent.

11-17, DIFFICULT CREEK AT US 50: Natural cobble channel, fresh sand layer on mid-channel island, distrupted vegetation, small slump along dirt road.

11-18, N. BR. POTOMAC R. AT STEYER RUN: Meandering natural channel with 2 cm x 20 m of well sorted sand deposited along both banks. Steyer Run has bedrock controlled channel, no evidence of modification, recent gravel deposit at channel confluence.

Along the N. BR. Potomac between Steyer Run and Gorman, the narrow reaches show no evidence of modification. Point-bars in wide reaches were covered with fresh fresh sand deposits.

11-19, N. BR. POTOMAC AT BAYARD, W. VA.: Below confluence with Buffalo Creek; Partial channel protection. Continous well sorted sand deposits, 40 cm x 140 m x 60 m on right floodplain.

11-20, SAND RUN: Natural channel, no evidence of deposition. Approximately 5% of banks had fresh undercutting.

11-21, N. BR. POTOMAC NEAR DOBBIN, W. VA.: High gradient boulder channel only minor, local overbank flooding or modification.

DECEMBER, 12, 1985

NEW CREEK TO KEYSER, PATTERSON CREEK, MAIN STEM OF THE POTOMAC R. FROM CUMBERLAND MD. TO THE CONFLUENCE WITH THE SOUTH BRANCH AT OLDTOWN.

12-1, NEW CREEK IN CLAYSVILLE, W. VA.: Natural channel, flattened trees, occasional cobbles deposited on floodplain. This area may have had more extensive deposition which has since been bulldozed.

12-2, NEW CREEK AT PINE SWAMP RD, INTERSECTION OF RTS 220 AND 50: Straight, cobble bedded natural channel. Point-bars and side channel bars were reworked and capped with imbricated gravel, Max. diameter 0.5 m.

12-3 KNOBLY RD. ALONG KNOBLY MT.: Small, 1 m wide headwater streams show no evidence of recent flooding. No visible hillslope activity. Ochre Run had some fresh bank erosion.

12-4 N. BR. POTOMAC R., BRIDGE NEAR PINTO MD.: Partially protected channel, no evidence of overbank flooding. Fresh organic debris within channel.

12-5, 6, 7 TURNERS RUN: Three stops along tributary. No evidence of modification outside channel. Downstream point-bars have fresh gravel deposits along margins.

12-8, PATTERSON CREEK, W. VA.: Bermed channel with check-dam. Silt and leaf debri deposited in backwater areas of floodplain. Otherwise no evidence of change to floodplain or channel.

12-9, PATTERSON CREEK AT PLUM RUN: Natural pebble and gravel channel with overbank flooding up to road, patches of erosion and deposition, plant debri. Erosion of side channel bar in Patterson Creek removed 19 m x 4 m x 1 cm of topsoil and exposed roots.

12-10, N. BR., POTOMAC R. AT PATTERSON CREEK: Natural channel, adjacent cornfield flooded, silt on stalks. Sediment deposited in strip 1.5 cm x 6 m along channel. At confluence 5 cm x 15 m x 5 m of silt was deposited.

12-11, N, BR. POTOMAC R., DAN'S RUN/BROAD HOLLOW RUN: Mid-channel islands were reworked and eroded, plant debris deposits. No floodplain modification.

12-12, N. BR. POTOMAC R. AT GREENS SPRINGS AND OLDTOWN: Straight channel, adjacent to bank 1 cm x 25 m strip of leaves and silt. Sediment had already begun to be reworked and delivered from bank to channel. Adjacent cornfields covered with silt, 275 m x 75 m x 1 cm. Stream cut across floodplain, water level 5-6 m above floodplain.

12-13, CONFLUENCE OF NORTH AND SOUTH BRANCHS OF POTOMAC R.: Major damage to buildings and floodplain. House knocked off foundation and ground level filled with mud. Every tree along a 150-200 meter reach of river was uprooted and transported. Trees were 50+ years old and had diameters up to 60 cm wide. Channel was widened, cobbles and boulders deposited on adjacent floodplain.

12-14, S. BR. POTOMAC R., UPSTREAM FROM 12-13: Complete distruction of riparian vegetation. Erosion of top-soil, boulders 1 m x 1 m x 1 m were moved several meters. Tree 70 cm diam. was uprooted but not moved.

DECEMBER 13, 1985

MAINSTEM OF POTOMAC R., CONFLUENCE WITH SOUTH BRANCH TO FORT FREDERICK STATE PARK MD.

13-1, POTOMAC R., S. BR. CONFLUENCE: Upstream of confluence there were no uprooted trees, deposition of silt and sand, 2 cm thick. Downstream, trees up to 50 cm in diameter, and approximately 50 years old were uprooted. Gravel and boulders deposited on floodplain but erosion dominated. Fresh erosion along 1-3 m high banks.

13-2, TOWN CREEK: Tributary, evidence of flooding, 2 cm thick fresh silt in backwater areas above and below bridge. No large floodplain trees were uprooted, fresh sand and gravel gravel deposits on islands and bars.

13-3, C&O CANAL NORTH OF PAW PAW: Overbank flooding onto adjacent field, 5 cm thick deposits of fine sediment adjacent to channel. Approximately 50% of trees adjacent to channel were uprooted. Small log-cabin in park was knocked off foundation and transport 10's of meters toward river where it was deposited intacted.

13-4, POTOMAC RIVER NORTH SIDE OF PAW-PAW: Bridge was under construction during flood. Temporary bridge was damaged and closed. Steep channel banks, patches of erosion 3 m x 10 m, trees adjacent to channel were flattened. South side of river (site 19-8) suffered extensive water damage.

13-5, GERLOCK HOLLOW: Small 1 m wide stream, no modification to vegetation, freshly eroded banks.

Town Creek between Old Town and Flintstone: channel was viewed from road at several locations. Reworked point-bars and local overbank flooding.

13-6, SIDELING CREEK AT US 50: Natural channel, no evidence of permanent modification to floodplain or vegetation. Reworked point bars.

13-7, POTOMAC R. NEAR WOODMONT: Natural channel, flooded over C&O Canal. Some old trees were uprooted, fine sand deposits in strip 2-3 cm x 45 m adjacent to channel, upper terrace has 2-5 cm silt deposition, plant debri.

13-8, POTOMAC RIVER, 1 KM UPSTREAM OF HANCOCK BRIDGE: Overbank flooding covered 250 m of floodplain with 3 to 4 cm of silt and fine sand, locally 5 to 10 cm thick, a few trees adjacent to channel were uprooted.

13-9, POTOMAC AT C&O LOCK 52 NEAR TONOLOWAY CREEK: Steep channel, trees down on outside of bend, willows remain. Vegetation present on steep bank, 5 cm thick deposits trapped by vegetation. Water was 3 m above roadway.

13-10, POTOMAC RIVER AT ERNSTVILLE: Straight, natural channels with wide floodplain. Cornfield that is 6 to 10 m above channel was completely covered with 7-9 cm of silt, locally 15 cm. Minor permanent damage to floodplain or vegetation.

13-11, POTOMAC AT BIG POOL, FT. FREDERICK STATE PARK: Trees up to 20 cm. diameter, adjacent to channel were flattened Sand, silt and organic debris trapped by vegetation.

DECEMBER, 16, 1985

MAINSTEM OF POTOMAC BETWEEN HARPERS FERRY AND POINT OF ROCKS. NORTH AND SOUTH FORKS OF THE SHENENDOAH.

16-1, SHENENDOAH BELOW FRONT ROYAL AT I-66: Natural channel with discontinous sand deposits, 5 m wide, 0-15 cm thick, average 3-4 cm adjacent to channel. Large trees adjacent to river were flattened or uprooted. Overbank flooding to 8 m above floodplain.

16-2, N. BR. SHENANDOAH AT RT. 340 / 522: No evidence of permanent modification to channel or floodplain.

16-3, S. FK. SHENANDOAH AT FRONT ROYAL GAGE: Wide, shallow reach fresh movement on cobble bars, minor bank erosion and tree destruction. Less than 1 cm thick deposits of silt in fields.

16-4, S. FK. SHENANDOAH NEAR RIVERDALE: Straight natural reach, sand and silt deposited adjacent to channel 1-7 cm x 15 m strip of fresh bar deposits, some uprooted trees. No net change in bar morphology, significant reworking of deposits.

16-5, S. FK. SHENANDOAH AT GOOD FALLS: Entrenched meanders, all the trees down along inside of bend and at point-bar, silt deposited on bar, straight reaches unaffected.

16-6, S. FK. SHENANDOAH, 1 KM. DOWNSTREAM FROM BIXLER BRIDGE: At point-bar sandwaves deposited blanket of sand 500 m long, 50 m wide. Similiar deposits on the next two downstream bars.

16-7, S. FK. SHENANDOAH, 1 KM. NORTH OF US 221: Chute eroded into point-bar, 15 m wide, 1-2 m deep, uprooted trees that were 50 cm in diameter, gravel and sand deposits on bar.

16-8, S.FK. SHENANDOAH AT NEWPORT LANDING: Point-bar at narrow meander bend has fresh gravel deposits. Half of trees were uprooted. Sand deposits up to 20 cm thick upstream of bend.

16-A, POTOMAC R. AT RT 340 BRIDGE NEAR SANDY HOOK, MD: Straight channel with bedrock islands. Vegetation and floodplain were not modified, 15 m sand strip along bank.

16-B, SHENANDOAH R. AT HARPERS FERRY NATIONAL PARK: Natural, bedrock constrained channel, overbank flooding, reworked floodchannels, 5 m sand strip, some uprooted trees, no permanent channel modification.

16-C, POTOMAC R. AT US 287, BRUNSWICK, MD: Straight, wide channel, no permanent modification or significant deposition.

16-D, POTOMAC R. AT POINT OF ROCKS, MD: Straight, partially protected channel. Overbank flooding deposited 5 cm silt veneer to railroad, structural and water damage to buildings. Reworked mid-channel islands.

16-E, POTOMAC RIVER AT WHITES FERRY MD: Wide valley floor, cut stream banks and terraces. Silt strip, 3 cm x 100 m, eroded mid-channel island, no permanent modification.

16-F, SHENANDOAH AT RT 7, NEAR CASLTEMANS FERRY: Straight natural channel with wide floodplain. Overbank flooding but no permanent modification, patches of erosion and deposition.

16-G, N. FK. SHENANDOAH AT RT 55, GAGING STATION: Straight, terraced channel. Overbank flooding, organic debri, discontious silt deposits.

16-H, N. FK. SHENANDOAH NEAR WOODSTOCK: Entrenched meanders, overbank flooding, no permanent modification, some uprooted trees with 30 cm diam., gravel movement.

DECEMBER, 17, 1985

US 33 ACROSS SHENANDOAH MT., TO THE NORTH FORK OF THE SOUTH BRANCH, FROM CIRCLEVILLE TO PETERSBURG W. VA.

17-1, ROUTE 33 WEST OF HARRISONBURG RIVEN ROCK RUN: High gradient boulder and cobble channel, fresh boulder movement in high flow channel, boulder deposition on floodplain. Trees intact on floodplain but uprooted along channel. Road covered with cobbles and sand.

17-2, SHENANDOAH MT. OVERLOOK: No evidence of major slope failure.

17-3, S. FK. S. BR. POTOMAC AT BRANDYWINE: Natural alluvial channel overbank flooding, active channel was reworked, cobble deposits in cornfield.

17-4, S. BR. POTOMAC AT US 33: Flooded over and around bridge, gravel and sand, 0-1 m thick deposits on floodplain, 20-40 cm diameter trees along channel were upright.

17-5, S. FK. S. BR. POTOMAC SOUTH END OF FRANKLIN: Boulder and cobble bars completly reworked. Splay deposits and sand-dunes on floodplain, 15 cm x 90 m gravel strip along channel.

17-6, FRIENDS RUN, WEST OF FRANKLINE ON US 33: Narrow, 2 m wide cobble channel, overbank flooding, reworking, bulldozed channel.

17-7, SCENIC OVERLOOK, GERMANY VALLEY: Shallow slides on valley walls.

17-8,9, GERMANY VALLEY: Six fresh slump scars, 200-300 $m^2$

along 150 meters of hillslope, only one lobe reached stream channel, no evidence of older scars.

17-10,11, NORTH FORK SOUTH BRANCH POTOMAC R., UPSTREAM EDGE OF CIRCLEVILLE: Floodplain reformed by bulldozers. Flooding apparently eroded entirely new channel at north end of bridge.

17-12, N. FK. S. BR. POTOMAC: Trees uprooted along channel.

17-13, N. FK. S. BR. POTOMAC AT JUDY GAP: Bridge intacted but overtopped, ends scoured and road washed out. 30 cm x 50 cm boulders were moved, some trees adjacent to channel remain intacted and a large metal shed was crushed.

17-14, N. FK. S. BR. POTOMAC AT RIVERTON: Narrow valley, near outside of low amplitude bend, overbank flooding, battered and destroyed houses, cobbles veneer on floodplain, channel widening left trees in present channel.

17-15, N. FK. S. BR. POTOMAC BELOW CONFLUENCE WITH MILL CREEK: New channel was eroded into floodplain and then abandoned, cobble veneer on floodplain.

17-16, N. FK. S. BR. POTOMAC 4 KMS. SOUTH OF SENECA ROCKS: Floodplain view, entire valley floor was flooded and modified, new channels were eroded into floodplain and abandoned, gravel veneers throughout floodplain.

17-17, N. FK. S. BR. POTOMAC R.: 0.7 KM SOUTH OF SENECA ROCKS: Entire floodplain was modified, sand deposits greater than 10 cm thick, boulder 30 cm x 40 cm diam. were deposited on floodplain.

17-18, N. FK. S. BR. POTOMAC R.: 0.6 KM SOUTH OF SENECA ROCKS; Outcrop constricted channel, new, abandoned channel incised into floodplain. Turkeys carcasses found in gravel deposits and are belived to have orignated from flooded turkey farm near Judy Gap.

17-19, N. FK. S. BR. POTOMAC R.: Overlook, entire valley was modified, topsoil eroded, gravel splay deposits, channels incised and abandoned in floodplain pastures. Same as (18-18).

17-20, N. FK. S. BR. POTOMAC R. AT RED RIDGE: Overlook of river bend in gorge, point-bar vegetation and topsoil eroded and replaced by sand and gravel deposits. See photos in appendix.

17-21, N. FK. S. BR. POTOMAC UPSTREAM OF NORTH GAP: Buildings on floodplain destroyed, bridge washed out, fresh boulders from adjacent hillslopes.

17-22, S. BR. POTOMAC R. AT US-220 IN PETERSBURG W. VA.: Petersburg south of RT 28 suffered extensive structural damage. Above RT-28 had extensive water damage.

17-23 N. FR. S. BR. POTOMAC R. AT PETERSBURG GAP: Entire trailer park was destroyed. River traversed floodplain, destroyed trailer park and left a gravel veneer. Trees adjacent to floodplain were intact.

DECEMBER, 18, 1985

MILL CREEK, SOUTH FORK OF SOUTH BRANCH OF THE POTOMAC RIVER FROM PETERSBURG TO FRANKLIN. SOUTH OF PETERSBURG TO DURGON W. VA.

18-1, EPHEMERAL TRIBUTARY TO MILL CREEK: Small, 1 m wide stream draining grassy slopes, flood filled 20 m wide valley floor, bank erosion, gravel deposition on floodplain.

18-2, MILL CREEK AT RT. 220, 1 KM. NORTH OF PANSY W. VA.: Natural channel, overbank flooding caused minor bank erosion and floodplain deposition. Maximum observed transported size was 15 cm x 20 cm, buried vegetation.

18-3, SOUTH BRANCH POTOMAC R. AND RT. 220 AT ENTRANCE TO GORGE: Straight channel with wide floodplains, little overall modification or permanent damage, trees intact along bank, local gravel deposits. Within gorge there is little overall area for storage. The occasional floodplain is covered with fresh sediment, uprooted trees.

18-4, SOUTH BRANCH POTOMAC NEAR KENTUCKY RUN : Recent boulder levee deposit along channel, average size 30 cm x 35 cm, trees adjacent to channel are upright, trailer park destroyed as stream traversed floodplain.

18-5, S. BR. POTOMAC R. AT HANOVER FACTORY ABOVE FRANKLIN W. VA.: Straight, natural channel flowing along mountain, field flooded, gravel levee deposit along bank, trees remain. Patches of sand in fields, only minor gravel deposits. Moderate damage to agricultural fields adjacent to stream.

18-6, S. BR. POTOMAC R. AT CAVE W.VA.: Steep gradient, natural stream channel with alternate point-bars covered with 1 m x 1 m x 1 m size boulders. Cobble splay deposits on inside of bends, but overall minor overbank deposition.

18-7, BR. POTOMAC R. AT MOYER RUN, W.VA.: Tributary cuts old alluvial fan deposit, poorly rounded boulders in channel, channel widening 1-2 m.

18-8, S. BR. POTOMAC R. BETWEEN CAVE AND FRANKLIN: 5-10 small landslides along road-cut, 3-4 m long, 0.5 m deep.

18-9, S. BR POTOMAC R., RT-22, 5 KM UPSTREAM OF FRANKLIN: Above and below channel constriction there was significant channel and floodplain modification. Within constriction only minor modification, except adjacent to channel. Downstream the stream incised a 10 m wide, 1-2 m deep channel. Upstream cobble and boulder splay deposits on floodplain.

18-10, S. FK. BR. POTOMAC R., 1.7 KM. DOWNSTREAM OF OAK FLAT: Freshly cut 10 m wide 0.5 m deep cobble channel, almost all trees were left standing, cobbles and gravel deposited on wooded point-bar.

18-11, S. FK. S. BR. AT FT. SEYBERT BRIDGE: Wide flat valley floor with cornfields, overbank flooding left pockets of gravel, channel widened adjacent to bridge .

Untill Fisher Run, the small 1-2 m tributaries had no evidence of flooding. However, Fisher Run, Rough Run and the upper reach of Kettle Run had reworked cobble substrates, widened channels, and plant debris on floodplain. Kettle Run had small patches of overbank gravel, but effects on all of the tributaries were limited to active channel and point bar.

18-12 S. FK. S. BR. POTOMAC R. AT COUNTY LINE ON RT-22: Stream leaves constriction and enters wide valley. Only patches of overbank gravels, above and below bridge bank was eroded 1-2 m. Complete reworking of active channel but minor modification of vegetation or floodplain.

18-13, S. FK. S. BR. POTOMAC R. SOUTH OF MOOREFIELD: Above bridge the stream eroded into 10 m high bank, downstream trees were uprooted, houses and trailers destroyed at river bend. Reworked gravel bars in channel and occasional patches of freshly deposited gravel in fields.

18-14, S. FK. S. BR. POTOMAC R. AT MOOREFIELD FILTRATION PLANT: No evidence of permanant damage to floodplain or channel, overbank deposition of fines, 50 m x 5-10 cm deep, buried vegetation, stream channel gabion destroyed.

18-15, S. BR. POTOMAC R. DOWNSTREAM OF MOOREFIELD: Overbank flooding covered cornfield with 15-20 cm thick deposits of silt. Gravel only deposited adjacent to stream, uprooted trees are rare.

18-16, S. BR. POTOMAC R. NEAR DURGON: Natural channel, floodplain modification was restricted to 10-20 m strip adjacent to channel, silt and sand deposited on fields.

18-17, S. BR POTOMAC R. AT RT-220 BRIDGE: Bridge washed out, channel leaves constriction and enters wide floodplain reach where it deposited splay gravels and silt across the floodplain. Trees were not significantly modified.

18-18, N. FK. S. BR. POTOMAC R. BELOW SKIDMORE MTN: Abandonded channels incised into floodplain, large boulder fields. Described in text. Same as (17-19). Photos in Appendix

DECEMBER, 19, 1985

LOWER S. BR. POTOMAC R., FROM ROMNEY W. Va. TO SPRINGFIELD W. Va., CAPON RIVER TO POTOMAC CONFLUENCE, MAINSTEM OF POTOMAC TO SHEPERSTOWN MD.

Mill Creek along Rt-220 between Moorefield and Romney: Overbank flooding flattened brushes and adjacent vegetation, no overbank deposits or channel modification, local bank erosion and scour.

19-1, S. BR. POTOMAC R., RT-50 NEAR CONFLUENCE WITH MILL CREEK: River leaves constriction, freshly deposited gravel on point-bars, a 5 m strip of sand was deposited adjacent to channel, and a 15-20 m band of silt farther inland. Vegetation along bank was destroyed or flattened.

19-2, UPSTREAM FROM 19-1: Meandering channel in wide flat valley of grass and cornfields. Overbank flooding into valley flat, gravel deposited adjacent to channel. In straight reaches flood effects were confined to channel. At river bends the point-bars were reworked and gravel ribbons deposited on floodplain.

19-3, S. BR. POTOMAC R. NEAR RIDGEDALE: Channel constriction, several buildings detroyed, trees uprooted adjacent to channel but valley flat was not modified. Silt deposited in backwater areas. Old abandoned flood channel was reactivated.

19-4 S. BR. POTOMAC R. AT RT-28, BLUES BEACH: Constricted channel, houses destroyed, trees uprooted, gravel splay deposits at river bends. Silt 20-50 cm thick was deposited in backwater areas was already being reworked by rills.

19-5, S. BR. POTOMAC R. GAGING STATION, 4 KM EAST OF SPRINGFIELD: Stream enters constricted reaches, trees uprooted along banks, houses destroyed and road washed out, 2 cm thick silt deposits in backwater areas.

19-6, LITTLE CACAPON R., AT FRENCHBURG W. VA.: Natural channel 3-5 m wide, no visible flood modification to vegetation or channel.

19-7, CACAPON R. AT CACAPON BRIDGE: Natural, tree-lined channel, freshly deposited logs and organic debris on point bar. No permanent modification.

19-8, POTOMAC RIVER AT PAW PAW: Extensive flood and water damage to town. Buildings and trailers destroyed.

19-9, GREAT CACAPON RIVER AT LARGENT W. VA.: Minor damage, no modification, fresh sand deposited on point-bar.

19-10 POTOMAC RIVER AT GREAT CACAPON W. VA.: Flooded over railroad tracks. Freshly deposited, well sorted, medium sand 0-20 cm thick, 5 cm average, strip 35 m wide. Fresh gravel deposits within 5 m of the bank.

19-11, POTOMAC RIVER AT LITTLE GEORGETOWN W. VA.: Overbank flooding 1-3 cm thick silt deposits adjacent to channel, water damage to buildings and trailers. No channel modification.

19-12, POTOMAC RIVER AT FALLING WATERS W. VA.: Only evidence of flood was silt deposits 3-7 cm thick, 40 m wide band along channel.

19-13, POTOMAC RIVER AT SHEPHERSTOWN W. VA. GAGING STATION: Flood water level at base of old bridge abutments. Point bars and islands were reworked, silt drapes along banks otherwise no visible modification.