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PREPARED BY THE
FLOOD PLAIN MANAGEMENT SERVICES UNIT
OF THE
U.S. ARMY ENGINEER DISTRICT, BUFFALO



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INTRODUCTION

In many areas of the country, the prospect of using protective works to alleviate possible flood damages effectively has reached the point of diminishing returns. The increase in flood damage potential, despite great expenditures on flood control, is greater than it ever was. Concerned by this very serious situation of rising flood damages throughout the nation, the President transmitted a report by the Task Force on Federal Flood Control Policy titled "A Unified National Program for Managing Flood Losses" to Congress in August 1966. As a result of the recommendations of this report, the Flood Plain Management Services Program was developed within the Corps of Engineers to provide local governments with a better understanding of flood problems and their effect on future growth and development. This program provides flood hazard information that may be used in land use planning for guiding community growth.

The increase in flood damages has been the result of rapid growth of flood damageable developments in the flood plain, which has been occurring at a rate greater than that of providing flood control works. Flood damages have affected man's environment significantly. They have threatened his life and health, his property, and his business or place of employment. An obvious solution to this problem is wiser use of flood plains. However, without adequate knowledge of the flood hazard and a will on the part of the users of the flood plains to plan with the hazard in mind, this wise use is impossible. Effective, sound land use in floodable areas through the use of regulatory powers has not been used extensively until recent years. It is now time to enact and enforce sound land use regulations in order to reduce future flood damages. Because man is strongly attracted to the use of flood plain areas, flood plain management practices are not likely to eliminate flood damages completely. However, man certainly can reduce these damages. Flood plain management must be given greater consideration by both planners and local governments.

The basis for the Corps of Engineers Flood Plain Management Services Program is Section 206, Public Law 86-645 (Flood Control Act of 1960), as amended.

1. Authority. The general authority for flood plain information studies by the Corps of Engineers is Section 206(a), Public Law 86-645 (Approved 14 July 1960) which reads:

"SEC. 206(a) That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by States and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard: Provided, that the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of a State or a responsible local governmental agency and upon approval by the Chief of Engineers."

2. Objectives. The major objectives of these studies and technical advice are:

a. To compile in a clear and useful form and to disseminate to State and local governmental agencies specific information on floods and potential flood hazards, including identification of areas subject to inundation by floods of various magnitudes and frequencies.

b. To encourage optimum and prudent use of the nation's river valleys by providing to State and local governmental agencies a factual basis for:

(1) Reducing future flood damages and hazards through carefully considered and well-planned state and local regulations and use of the flood plains.

(2) Developing land use plans, which may include consideration of justifiable flood protective works.

(3) Preserving adequate floodway and channel rights-of-way and channel clearances.

c. To publicize available information for the guidance of private citizens and interests on the use of flood plains and the possible hazards of using them.

d. To reduce future expenditures for Federal projects to protect developments which, in the absence of the information program, would have taken place, and reduce expenditures for alleviation of flood problems arising from improper flood plain development.

3. Relation of information studies to other measures. Flood plain information studies are a medium for public guidance which can be used either in conjunction with or in lieu of other means of reducing flood damages. They will provide a useful means of explaining the flood hazard and in securing effective understanding of, and cooperation with, flood warning services and evacuation measures where these are used. Information studies, in addition to use for official zoning and other regulatory action, will enable individuals and organizations to gauge the need for flood-proofing measures to reduce their losses in flood-prone areas, including areas where protective works cannot be justified. Flood plain information studies are intended to furnish data and advice and to encourage those affected to help themselves. Section 206 does not extend any Federal authority over zoning or other regulations of flood plain use, which come within the sovereignty and police power of the individual States and local governmental agencies. Neither does this legislation provide for the Corps of Engineers to undertake community planning for States or municipalities, storm sewer, drainage studies, or local mapping beyond the needs of proper presentation of flood hazards such as normally done by local public employees or by private planning or other consultants.

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DEVELOPMENT OF FLOOD PLAINS

Before we proceed any further, it should be emphasized that flood plain management does not advocate non-development of the flood plain. What is stressed is that development must not continue in flood plains without regard for possible future flooding. The past unwise development of our nation's flood plains has continued too long. Examples of this unwise development are shown in the following paragraphs.

WHY FLOOD PLAIN MANAGEMENT?

Let's look at the past results without any type of flood plain management. Federal investment in flood protection and prevention has amounted to more than \$7 billion since the national flood control policy was adopted in 1936. The current rate for such expenditures is approximately \$500 million per year, and it is increasing. Despite this massive investment, estimated average annual losses from floods have doubled from \$0.5 billion in 1936 to \$1 billion today. This tremendous increase in average annual flood damages is not due to increased flooding since 1936, nor because the protective works are not adequate, but because people have been moving into the Nation's flood plains faster than the Federal Government can afford to build flood control projects.

There are several reasons why people build or buy a home in a flood plain:

1. They want to live near water.
2. Information on the flooding hazard was not available.
3. They didn't look into the possibility of flooding, so they didn't know.
4. When an area hasn't had a flood for several years, people begin to think "maybe it won't flood anymore."
5. They knew the area was a flood plain but decided to risk it.
6. The land is cheap.

Here are some examples of developments that were constructed in a flood plain despite the hazards.



Photo 1 - This development was constructed in an area that had floods recorded in 1900, 08, 22, 32, 42, and 49. The development was built in 1954 and flooded in 57, 59, 61 and three times in 62.



Photo 2 - The 1964 flood shown here was 12 feet lower than a flood that occurred in 1937.



Photo 3 - The area where this development was constructed has a history of flooding. Yet this development was constructed and, as shown, still has its share of flooding.



Photo 4 - There are some people who don't mind flooding.

These are only a few examples of the trend that has caused the average annual flood damages to double in the past three decades. To reverse this trend, flood plain management must be undertaken by every Local, County, and State Government where applicable.

The Federal Government has taken the initiative by establishing the Flood Plain Management Services program. Through this program, the Corps of Engineers will furnish information to a community on past and possible future floods. It is then the responsibility of the local government with the authority to regulate development in a flood plain to utilize the flood information and protect future residents from suffering flood damages.

The Corps of Engineers Flood Plain Management Services Program has four principal parts:

1. Flood Plain Information Reports - These present information on past and possible future floods. This information includes flooded area maps and water surface profiles. The objective of a flood plain information report is to provide data that will be used as a guide by the planners and local officials for effective and workable legislation for the control of land use within the flood plain. To obtain this objective, planners and local governments must have technical information on the largest known floods of the past and data on possible future floods, such as the Intermediate Regional Flood (100-year) and the Standard Project Flood.

2. Technical Services - Local, State, and other Federal agencies can be provided with flood levels and frequencies for a particular location, such as a site of a school, sewage plant, or subdivision. Under Executive Order 11296 all projects involving Federal funds receive a flood hazard evaluation under this portion of the program. This is to insure that no additional Federally supported projects will be subject to future flooding.

3. Guides and Pamphlets - Guides, pamphlets, and information sheets are continually being developed to explain the program and to assist local communities by providing sample flood plain regulations information on the flood proofing of buildings and other aspects of the program as they develop.

4. Comprehensive Flood Damage Prevention Planning - The program is set up to assist local governments in bringing about increased consideration of alternate measures of flood damage prevention. This is the ultimate objective of the program: to bring State and local officials into a planning action to a greater degree to insure increased consideration of other alternative measures as well as flood control.

WHAT IS GOOD FLOOD PLAIN MANAGEMENT?

Good flood plain management is using a stream's flood plain for man's purposes whenever the stream is not using it to carry flood water. The important point is that the stream has first priority over the flood plain even if only for short flood periods. A term we hear so often, "flood damage" is somewhat misleading. The term might better be described as "man's self-inflicted damages." The only flood plains having flood damages are those in which man has intruded. The point is that any development in a flood plain by man will suffer damages. How much damage man is willing to absorb must govern the amount and type of development he should place in a flood plain.

An ideal development of a flood plain is to utilize the flood plain for optimum development for man's purposes, while keeping the flood damage to the minimum.

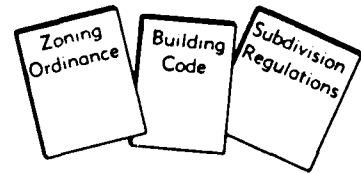
The first step in good flood plain management is to establish a floodway. This is a strip of land on either side of the stream which is needed for safe passage of a selected flood, preferably the Intermediate Regional flood (100-year). Within the floodway limits only those land uses which will not restrict the flow are permitted. Examples are open space recreational uses, parking lots, agriculture, and storage during non-flood seasons. The water surface elevations of the selected flood that is used to determine the floodway should be the minimum elevation of the lowest openings of buildings outside of the floodway in what can be called the floodway fringe area. Beyond the floodway fringe area development can become more sophisticated as the risk of flooding decreases. However, any development that cannot be allowed to sustain any flood damages should be above and beyond the limit of the Standard Project Flood.

The Standard Project Flood is considered by the Corps of Engineers to be the upper limit of possible flooding from a stream. Figure 1 shows a simple illustration of proper flood plain development.

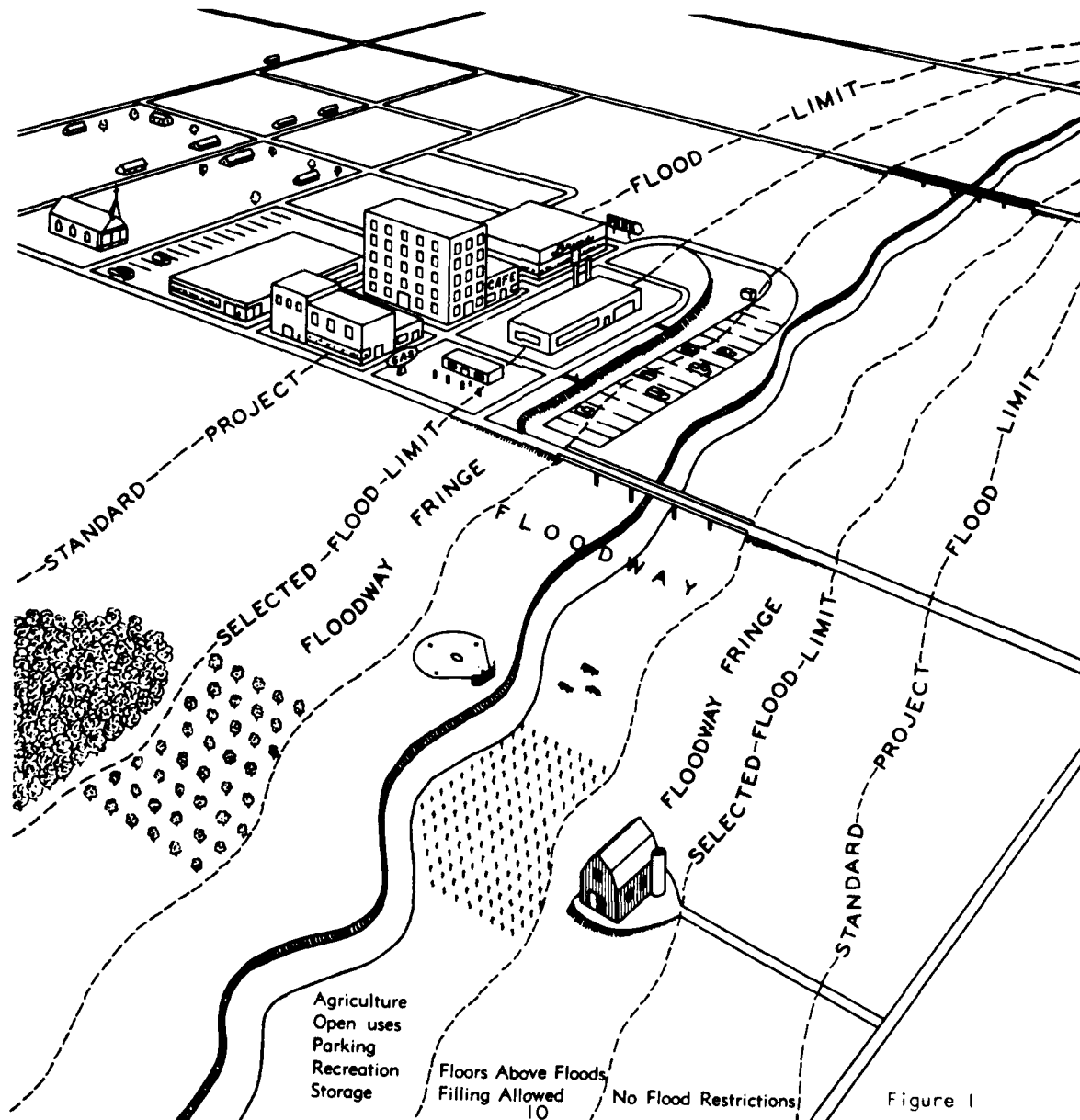
It is often argued that the area recommended for the floodway limit is too valuable and is needed for the growth and increase in tax base of the community. However, every community needs recreational areas, and the floodway can fulfill this need. Floodway recreational areas are a great value to a community because they draw people to live in the community. The loss in tax base to the community is offset by the public services the community need not provide the area. Also, there will be no need for any emergency public expenditures during future floods.

Some short-sighted communities have allowed unwise development in flood plains believing that sooner or later the Federal Government will build a flood control project to end the flooding. This is disastrous thinking! No flood control project provides 100 percent protection. Even if the projects did provide full protection, they are not constructed before development, but after, and then only if sufficient

Flood plain regulations



TO ENCOURAGE WISE USE AND AVOID FLOOD DAMAGE



damages are sustained to justify the project. Who will locate in the flood plain and sustain sufficient damages to justify a flood control project? Probably not those who allowed the development to occur.

Photos 5 and 6 illustrate why the type of development allowed in a flood plain is so important. Photo 5 shows that Community A used its flood plain for a strip park. The damages shown consist of removing the debris and general clean up. Photo 6 shows that Community B allowed residential development in the flood plain.

A quick look at both pictures indicates that each show severe flood damages. However, in Photo 5, damages consist of debris cleanup and repairing of picnic shelters and tables. This cost is provided by the entire community through local taxes. In Photo 6, the cost of replacing household furniture and appliances is at the expense of each individual homeowner. However, local taxes are also involved in rescue work, additional police and fire protection during the flood, utility repairs, and in refuse pickup after the flood.

SAMPLE FLOOD PLAIN REGULATIONS

Sample flood plain regulations that have been adopted by communities throughout the country are available at all Corps of Engineer District Offices and will be furnished on request. (See Plate I for Corps of Engineer Office addresses).

RESPONSIBILITY OF STATE, COUNTY AND LOCAL GOVERNMENTS

Floods are acts of Nature; flood damage results from the acts of man. If man did not occupy the flood plains, he would not receive flood damages. Therefore, those who choose to locate in flood prone areas should be responsible for the results of their actions. However, the typical citizen is not easily persuaded to protect himself from flood hazards unless there is a clear and present danger. Therefore, to protect its citizens from possible future flood damages each local community government must regulate the development of their flood plains. The authority and responsibility, in Ohio, for controlling the



Photo 5 - Community A.



Photo 6 - Community B.

amount and type of development through flood plain regulations lies solely in the hands of the local communities. When this responsibility is overlooked, the local community is sanctioning flood damages to the people who will locate in the flood plain. The mere supply of information from the Corps as to what elevation the water has reached in the past and what elevation it may reach in the future is useless unless those in decision-making positions use the information to avoid the flood threat. The local community has a responsibility to discourage flood plain development that would victimize unsuspecting citizens and impose a future burden on Federal taxpayers. Federal funds to construct flood protection projects benefit only those who locate in the flood plain at the expense of those who do not. If people did not move into flood prone areas the Corps of Engineers would not have to build flood control works to protect them.

The State of Ohio has established within the Department of Natural Resources a Flood Plain and Land Use Planning Section. This Section has established "Minimum Criteria for the Regulation of Ohio Flood Plains," which is expected to be incorporated into the proposed State flood plain legislation.

Information on Ohio's role in Flood Plain Management can be obtained from:

Mr. Terry Wakeman
Ohio Department of Natural Resources
Flood Plain and Land Use Planning Section
Room 809
65 South Front Street
Columbus, Ohio 43215

Telephone (614) 469-7803

WHAT INFORMATION IS AVAILABLE?

The Corps of Engineers has collected data on flood-prone areas since the Flood Control Act of 1936. This data is available and

will be furnished to anyone on request. This information includes high water marks of past floods, identification of past flood areas, and past flood profiles.

In areas where the Corps has made studies of possible flood protection projects, there may be information on possible future floods such as the 50-year flood, the Intermediate Regional Flood (100-year), and the Standard Project Flood.

During many of the Corps studies, bench marks have been established. A bench mark is an established elevation located on a relatively immovable object such as a bridge abutment. The bench mark descriptions are available. The value of these bench marks is that they will provide a reference mark on the same datum as the Corps water surface profiles. The bench marks can be used to run levels from and to areas of proposed development to check the structure's possibility of being flooded in the future.

WHAT LOCAL ACTION CAN BE TAKEN BEFORE A FLOOD PLAIN REPORT IS AVAILABLE?

There are many communities that wish to enact flood plain regulations. However, because of State priorities, they will not receive a flood plain information report for several years. There is no need for a community to wait for a report. Interim regulations can be based on the largest past flood. The flood plain could be estimated by the zoning board, or the Soil Conservation Service may be able to determine its size from soil deposits.

For a specific development, such as a school, sewage treatment plant, building complex, or subdivision, the Corps can furnish a flooded area map and the 100-year water surface profile for that specific site. When a flood plain information report is made available, the flood plain regulations could then be adjusted to reflect the latest information.

HOW TO APPLY FOR A FLOOD PLAIN INFORMATION REPORT

To apply for a flood plain information report, the requesting agency must first determine that there is a need for such data and must be sincere in its desire to use the report to control flood plain development. Communities requesting a flood plain report only because the cost is mainly Federal defer these data from other communities and waste tax dollars.

A request for a flood plain information report can be made by the State, the County, local community officials, or any type of planning board that has jurisdiction over the proposed study area. The best group to request the study would be the one having the power to adopt and enforce flood plain regulations.

The application, in letter form, should contain:

1. The authority, law, charter, or resolution which clearly establishes the requesting agency as having jurisdiction in flood plain regulation and planning.
2. The requesting agency will request or sponsor flood plain regulations based on the data to be provided. The requesting agency should have the authority to cooperate with the Ohio Department of Natural Resources and the Corps of Engineers to disseminate and explain the information compiled and provided in the forthcoming flood plain information report.
3. Specific local objectives which prompt the application for the flood plain information study under Section 206.
4. A description of the geographic area to be studied.
5. The nature of present flood plain use and any contemplated community or other plans and trends for flood plain development.
6. Assurances of local cooperation. The letter of application should give assurances that:
 - (1) Available information and data will be furnished for the study.

(2) The applicant will publicize the information report in the community and area concerned and make copies available for use or inspection by responsible interested parties and individuals.

(3) Zoning and other regulatory, development, and planning agencies, and public information media will be provided with the flood plain information for their guidance and appropriate action.

(4) Survey markers, monuments, etc., established in any Federal surveys in the area will be preserved and safeguarded.

7. A map which shows the general location of the proposed study area.

"All applications should be sent to the Flood Plain and Land Use Planning Section, Ohio Department of Natural Resources, Ohio Departments Building, 65 South Front Street, Columbus, Ohio 43215. Assistance on preparing the application may also be obtained from the Flood Plain and Land Use Planning Section. The Ohio Department of Natural Resources will assign a priority for each study and send the application to the appropriate District Office of the Corps of Engineers. Plate 1 shows the Corps of Engineers District boundaries in Ohio and the addresses of each District."

WHAT ABOUT THOSE ALREADY IN THE FLOOD PLAIN?

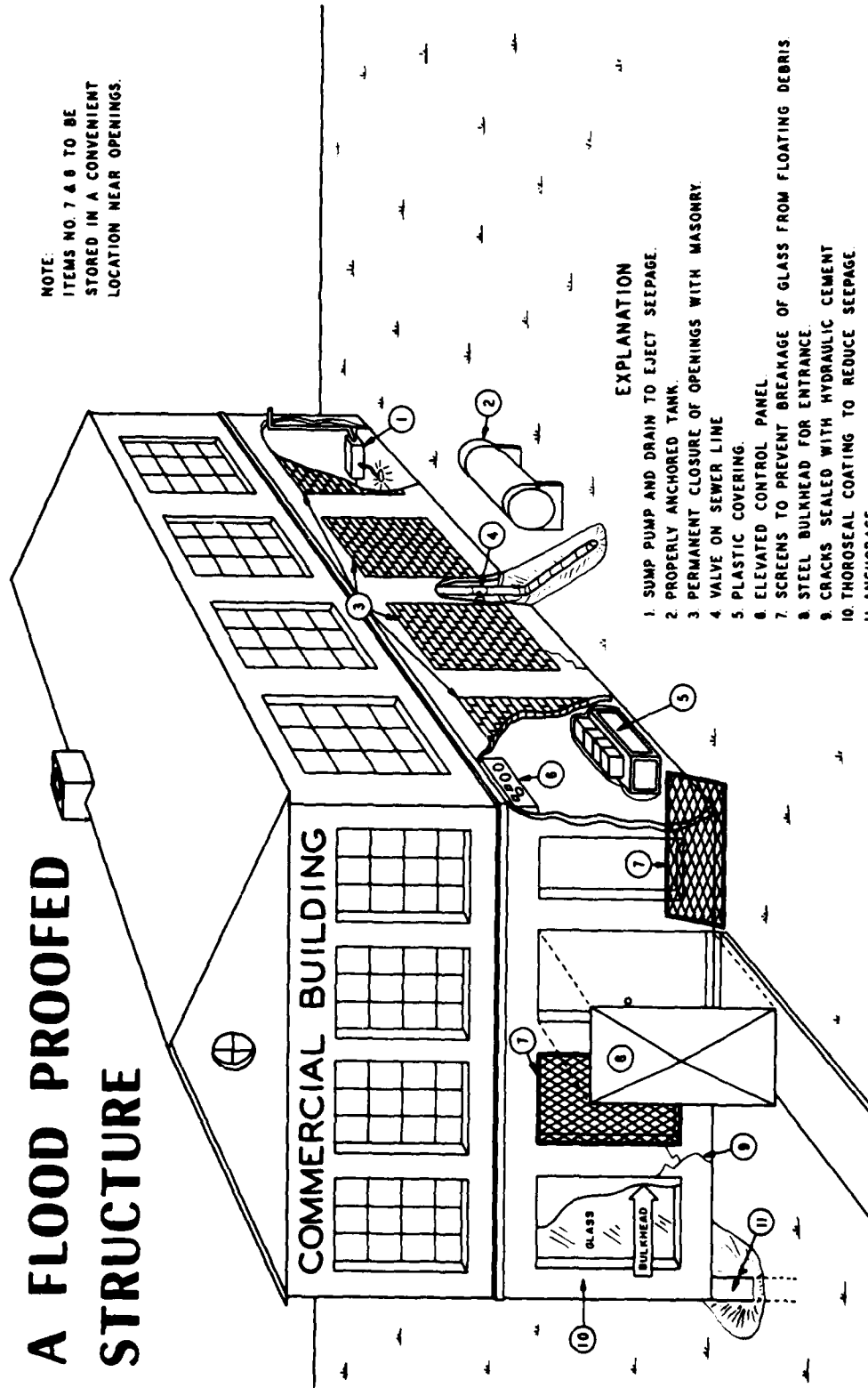
Limiting the amount and type of future development in a flood plain won't help those already living there. However, flood plain information furnished by the Corps will indicate what elevations future floods may reach. With this information the structures within flood-prone areas can be altered to reduce possible future flood damages.

Those already residing in the flood plain and subject to flood damage may be particularly interested in the methods of flood proofing the affected structures in order to reduce the possible damage. A recommended reference is "Introduction to Flood Proofing," by John R. Shaeffer. ⁽¹⁾ Some of the possible flood-proofing measures

(1) This booklet is available from Corps of Engineers District Offices.

A FLOOD PROOFED STRUCTURE

NOTE:
ITEMS NO. 7 & 8 TO BE
STORED IN A CONVENIENT
LOCATION NEAR OPENINGS.



EXPLANATION

1. SUMP PUMP AND DRAIN TO EJECT SEEPAGE.
2. PROPERLY ANCHORED TANK.
3. PERMANENT CLOSURE OF OPENINGS WITH MASONRY.
4. VALVE ON SEWER LINE.
5. PLASTIC COVERING.
6. ELEVATED CONTROL PANEL.
7. SCREENS TO PREVENT BREACKAGE OF GLASS FROM FLOATING DEBRIS.
8. STEEL BULKHEAD FOR ENTRANCE.
9. CRACKS SEALED WITH HYDRAULIC CEMENT.
10. THOROSEAL COATING TO REDUCE SEEPAGE.
11. ANCHORAGE.

are listed in subsequent paragraphs. The first three methods are particularly applicable to residences or businesses which normally suffer only basement flooding. In the underdeveloped areas, some of the methods may be incorporated into building codes, zoning ordinances, or subdivision regulations in order that structures permitted in the restrictive zones can be better protected for floods greater than the selected reference flood. Figure 8 illustrates some of these flood proofing methods.

a. Seepage Control - This method involves the use of asphalt or quick set hydraulic compounds to seal walls which are subjected to water pressure. This approach is often complemented with sump pits and pumping. When this method is used foundation walls must be reinforced to withstand water pressure.

b. Prevention of Sewer Backup - In many areas not subject to direct overflow considerable damage occurs from backup of sanitary or combined sewers overloaded by high storm-water runoff or flooded manholes. Various types of automatic and manually operated valves and checks can be installed on house sewers as well as on lateral and trunk sewers to prevent flooding from sewer backup. In the absence of these measures a section of pipe screwed in place over basement drains is a cheap, effective means of coping with this problem. It allows water to rise up in the pipe but prevents overflow up to the limit of the length of pipe. It is recommended that, wherever possible, the storm and sanitary sewers be separate systems to prevent backup through a combined system into residences from overloaded storm sewers.

c. Permanent Closure - In a relatively watertight structure, unnecessary openings may be permanently sealed. If the passage of light is desirable, glass brick or other translucent material having adequate structural strength should be considered.

d. Protected Openings - Sandbagging of doorways and other necessary openings in structures has been used as a temporary emergency protection for many years. Removable bulkheads or flood

gates are often a more efficient means of accomplishing the same purpose. These devices can be bolted against a frame containing a neoprene gasket to provide a watertight seal.

e. Protective Coverings - The rapid development of new types of plastics with various specific properties should be considered to seal and protect machines and mechanical equipment from silt and rust damage.

f. Fire Protection - The possibility of fire from electrical short circuiting is a potential hazard during flooding. Power shut-off on a large scale is generally not practical because it usually would affect areas outside the flooded zone. In homes fuses should be protected to reduce the possibility of fire when power is not disrupted.

g. Elevation - The regulation of the minimum elevation above which future structures must be built has been discussed previously in connection with zoning and subdivision regulations. However, for existing structures in flood risk areas, provisions can be made for raising machinery, furniture or other valuable equipment above flood level. Some property owners have protected household furnishings during past floods by carrying them to higher floors. Heating plants can be permanently suspended from the cellar ceiling. It is possible to raise the first floor of a structure several feet in order to stay above normal flood levels. The basement would still be subject to damage, however, unless it could be protected by other flood proofing methods.

h. Watertight Covers - Storage tanks with contents damageable by flood waters should be protected by watertight caps. Watertight covers should also be installed on manholes in the flooded areas. This can prevent basement damage from overcharged sewers or pumping stations by the relatively frequent floods although property in the flooded area would still be subject to damage from greater floods.

i. Structural Design - Sometimes specific features can be incorporated into the design or orientation of a structure so

that potential damages are minimized. Concrete pilings have sometimes been beautifully integrated into the architectural design of a structure, while simultaneously raising the structure several feet above the flood plain.

J. Utilities Service - Considerable financial loss can occur when power failures cause disruption of refrigeration or heat. Disruption of gas service has a similar effect. Rerouting of utilities to provide separate service for flood affected areas can only be done by the utility companies. However, combining a general knowledge of the flood problem with foresight and good planning may simplify and expedite rerouting procedures when flooding does occur. In specific cases bottled gas has been used to supply heat, and gasoline driven generators have been utilized to supply minimum essential power.

FLOOD INSURANCE

The National Flood Insurance Program was established by the Housing and Urban Development Act of 1968 and is under the control of the Federal Insurance Administration in HUD. The program provides for subsidized flood insurance in return for action by State and/or local governments to adopt and enforce land use controls to guide future development in flood-prone areas to avoid or reduce possible future flood damage.

Information on the National Flood Insurance Program can be obtained from:

Federal Insurance Administrator
Department of Housing and Urban Development
451 Seventh Street S.W.
Washington, DC 20410

CONCLUSION

The Corps of Engineers Flood Plain Management Services Program has been established to assist local communities in planning sound

use of their flood plains. As the title indicates, the program provides service and the Corps is anxious to assist in all ways. If you have questions, feel free to call the Chief of Flood Plain Management Services at the Corps of Engineers District Office covering your area. If flood plain management is to work, all governmental agencies must work together with the public to make sound, effective decisions.

GLOSSARY OF TERMS

Discharge. The quantity of flow in a stream at any given time, usually measured in cubic feet per second (cfs).

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40% to 60% of the Probable Maximum Floods for the same basins. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Flood Plain. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has been or may be covered by flood water.

Backup. Water flow through a pipe in a reverse direction.

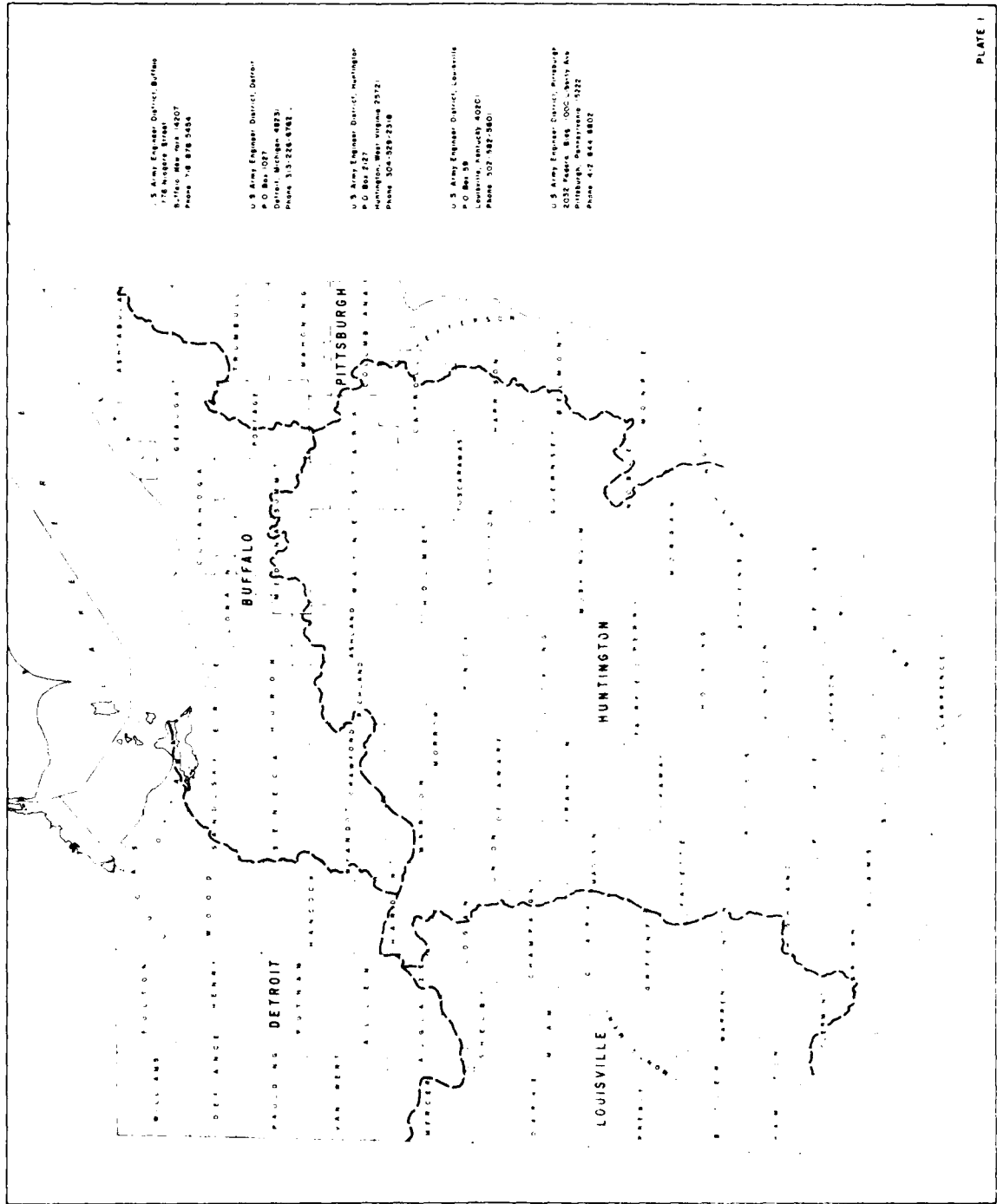


PLATE 1