

The Use of Flood Maps in Northeastern Illinois

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•FLOOD MAPPING can be considered a multipurpose program from which a wide range of benefits can accrue to both public and private interests. The multipurpose aspects of a flood mapping program can be illustrated by examining the uses made of flood maps in Northeastern Illinois. In general, flood maps are used to establish the hydrologic basis for flood-plain regulations to guide the location of residential, commercial, and industrial structures. The 17 maps that have been prepared for Northeastern Illinois have been presented at public meetings and were discussed with officials from 97 municipalities having a total population of 1,100,000. Additionally, officials from the six counties of Northeastern Illinois (Cook, DuPage, Kane, Lake, McHenry, and Will) have been presented with maps and advised on their potential use. The purpose of the meetings with the municipal and county officials was to familiarize them with the flood-plain information, and to guide the use of the data when they are formulating land use plans.

The use of flood maps is not limited to guiding new development, however, for the maps can be used to preserve the natural recharge potential of the shallow aquifers, guide the purchase of open space, aid the location of sewage treatment plants and refuse disposal sites, and help in the selection of sites for storage reservoirs.

All levels of government (Federal, State, local, and special district) have had occasion to use the flood maps for Northeastern Illinois. These run the gamut from building and zoning, health, and highway departments to school boards and sanitary districts.

Additionally, private users ranging from the individual homeowner seeking a house "that doesn't flood" to the large land development corporation that is planning a 2,000 unit subdivision and wants to avoid the problems associated with marketing houses in a subdivision that has a reputation for flooding.

FLOOD MAPPING BENEFITS

Flood mapping has proved to be a significant tool that can aid in avoiding the uneconomic development of flood plains. This is of particular significance in rapidly expanding metropolitan areas. In Northeastern Illinois, for example, it is estimated that the population is increasing at a rate of 75,000 per year and this increase normally will require a yearly addition of 25,000 housing units (1).

It is conceivable that this growth and development can be accommodated without increasing flood damages or foreclosing other potential benefits because only 11 percent of Northeastern Illinois has been subject to inundation. Table 1 gives the percent of area that has been flooded in three drainage subbasins.

TABLE 1

Basin	Drainage Area	Percent of Area Inundated
Skokie River	11	18
Weller Creek	13	3
Salt Creek	10	14

The average for these three basins is 11 percent and this percentage appears to be representative of the entire area. Flood maps, if properly used, can produce the following benefits.

Reduced Demands for Flood Control Works

If the areal limits of the flood plains are not well defined, it is reasonable to assume that 11 percent of the new houses each year or 2,750 will be located on sites subject to inundation, and that ultimately public expenditures will be required to mitigate the flood losses associated with such sites.

Recent experience has shown that the cost of flood control for residential areas amounts to approximately \$3,400 per house (2). (The cost of a low levee to protect a 150 house subdivision is estimated at \$513,000.) This represents the cost of flood control prorated per house for a wholly residential area. Other flood control surveys show a higher prorated cost per house (\$7,000 per house on the Little Calumet River) for protection, but these areas contain vacant land where additional development can be located. In this study the cost of flood control per house is estimated to be \$3,400. For Northeastern Illinois, the annual cost of flood control could conceivably average \$9,350,000 per year (2,750 houses \times \$3,400). Of course, this amount would not be spent every year because expenditures for flood control generally take place shortly after major floods, and major floods are assumed to be randomly distributed in time.

If the flood maps are successful in steering new development away from flood-plain areas, an annual benefit of \$9,350,000 per year will accrue to Northeastern Illinois. This is an annual benefit because it is reasonable to assume that unless adequate definition of flood-plain areas is available, 11 percent of the new houses each year will be located on flood plains.

Availability of Ground Water

During normal and low water levels, the streams of Northeastern Illinois are effluent—the base flow of the stream is a discharge from the ground water reservoir to the surface. This process is reversed, however, during periods of high flow when the streams become influent—there is a discharge from the surface waters to the ground water reservoir. This recharge takes place because of the differential in head; the surface water levels rise very rapidly following runoff from precipitation, whereas the ground water levels rise slowly because of the slow infiltration through the overlying materials.

A detailed analysis of a shallow aquifer in Northeastern Illinois concluded that 33 percent or 100,000 gallons per day per square mile of the potential yield was from stream flow (3). The figure for the entire region would not be that high but conceivably could be 10 percent of the potential yield from the shallow aquifer—based on analysis of location of shallow aquifer in relation to pumpage cones and drainage ways. This would amount to 50,700,000 gallons per day (10 percent of 507,000,000 gallons per day estimated for all of Northeastern Illinois).

The natural recharge associated with floods can be preserved only if flood plains are kept free of development, for when development takes place it is generally followed by programs of engineering works (channel deepening, reservoirs, levees) designed to reduce flood damages by keeping the water away from the development. This in turn reduces the natural recharge associated with flooding.

Flooding gives rise to an estimated annual water supply benefit of \$3,700,000. This figure is computed on the basis that the ground water has a value of \$0.22 per thousand gallons (the price of Lake Michigan water at the Chicago corporate limits the most considered alternative) less the \$0.02 per thousand gallons estimated cost for development (4). Unless adequate definition of flood plains is available and properly used, development of the flood plains will trigger flood control programs that will eliminate the recharge associated with flooding.

PURCHASE OF OPEN SPACE

Standards for public recreational open space recommend 17-25 acres per 1,000 population in 1960, and 29-35 acres per 1,000 population by 1980 (5). If these standards

are to be met in the next 20 yr, an average of 1,950 acres of open space will be required each year to keep up with population growth (75,000 per year population increase \times 26 acres per 1,000—the average of the recommended standard).

The value of flood-plain land should be less than land not subject to inundation. This reduction in value reflects the losses that will be suffered from flooding. However, when flood plains are not well defined, this reduction in value is not always perceived. In a recent condemnation suit, a park board realized a substantial reduction in price for a parcel of land that was shown to be a flood plain by the introduction of a flood map in the court case (6). In a similar case, a highway department paid the regular land price for a parcel of flood plain when it was not shown that the land was subject to floods.

A reasonable difference in price between flood-plain land and flood-free land is \$1,000 per acre. At this rate the use of flood maps to guide open space purchases will result in an annual benefit of \$1,950,000.

Water Pollution Abatement

By locating sewage treatment plants above flood heights, it is possible to avoid shut-down and bypassing when the receiving streams flood. Flood-free refuse disposal sites are safeguards against refuse saturation by flood water that in turn would mobilize the contaminants. Also, they avoid the channel encroachments and subsequent raised flood stages associated with refuse disposal sites on flood plains.

ECONOMIC FEASIBILITY OF FLOOD MAPPING

All of the benefits discussed above will not automatically evolve from a flood mapping program and therefore cannot be wholly attributed to it. Flood mapping is an effective and dramatic means of communicating the flood situation to property managers. Thus, it is reasonable to ascribe ten percent of the benefits to the data (the flood maps) and reserve the remaining 90 percent of the benefits for the administration and effectuation of flood damage reduction programs.

The average annual benefits of the flood mapping program are ten percent of the following: reduced demand for flood control—\$9,350,000; availability of ground water—\$3,700,000; purchase of open space—\$1,950,000; or \$1,500,000 per year.

The cost of preparing 53 flood maps for Northeastern Illinois is \$375,000. Assuming that the flood maps will need to be redone every ten years because of new developments, changed channel conditions, and unusual hydrologic events, the average annual cost would be \$37,500.

When the benefits and costs are compared for flood mapping, the benefits exceed the costs by a 40 to 1 ratio (\$1,500,000 : \$37,500). The average annual benefits also exceed the average annual cost by \$1,462,500 (\$1,500,000 - \$37,500).

The economic feasibility of flood mapping in Northeastern Illinois demonstrates the justification for the program. The flow of benefits generated by the program greatly exceeds the costs and is far superior to some recent actions that encouraged new development on flood plains so that the increased flood damages would make a flood control project economically feasible.

REFERENCES

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