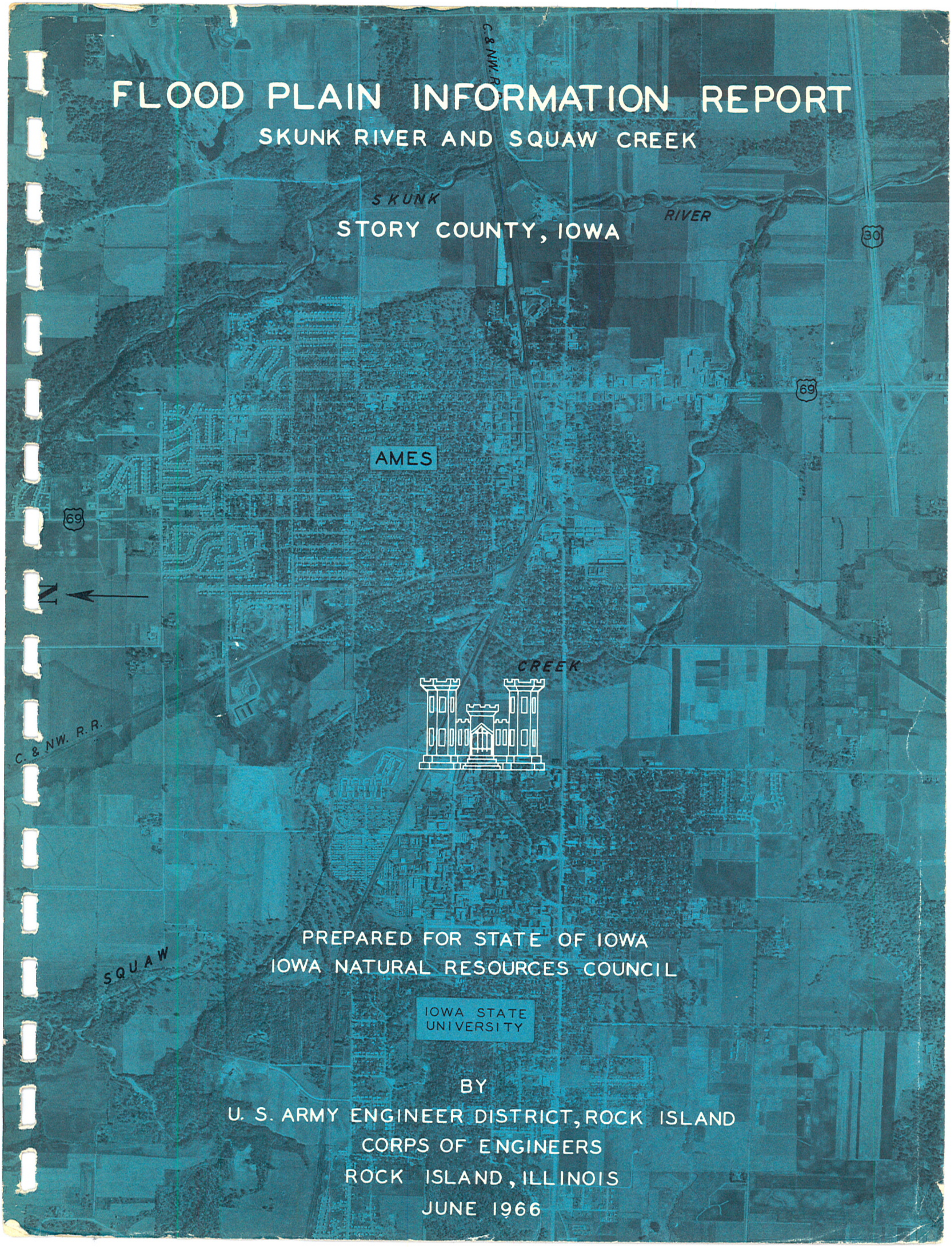
FLOOD PLAIN INFORMATION REPORT

SKUNK RIVER AND SQUAW CREEK

STORY COUNTY, IOWA



PREPARED FOR STATE OF IOWA
IOWA NATURAL RESOURCES COUNCIL

BY

U. S. ARMY ENGINEER DISTRICT, ROCK ISLAND
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

JUNE 1966

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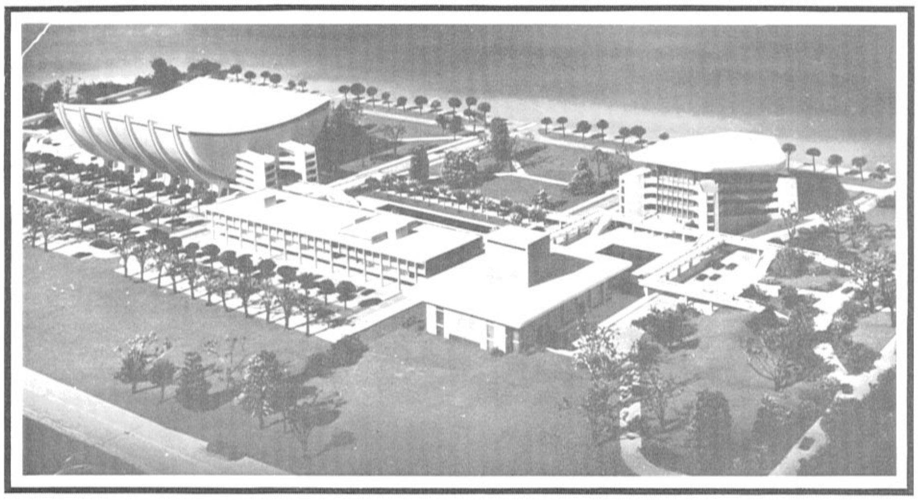
on
SKUNK RIVER AND SQUAW CREEK
STORY COUNTY, IOWA



Iowa State University Cultural Center, Ames, Iowa. Iowa State University planners have recognized the flood potential of Squaw Creek. As shown by the above photograph the center has been designed for flood proofing, with the main structures elevated above estimated flood stages.

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FLOOD PLAIN INFORMATION REPORT

on

SKUNK RIVER AND SQUAW CREEK

STORY COUNTY, IOWA

I - INTRODUCTION

The most notable floods in the Skunk River and Squaw Creek basins occurred during the years 1918, 1944, 1947, 1954, 1958, 1960, and 1965. To date the flood plains have not been extensively developed and consist mainly of agricultural land with several scattered commercial and public developments within the city of Ames and Iowa State University; consequently damages from these floods have been relatively light. However, the population of the city of Ames and the enrollment at Iowa State University is increasing at a rapid rate; and because of the resulting growth, it is certain that the development of more flood plain land will be attempted in the near future. If such developments were allowed to take place without sufficient regard for the potential flood hazards, the improvements would be subject to increasing flood damages.

On 3 September 1963, the Iowa Natural Resources Council submitted a formal request to the District Engineer, U. S. Army Engineer District, Rock Island, to prepare a flood plain information study for Skunk River and Squaw Creek in Story County, Iowa. The limits of the Skunk River and Squaw Creek study areas, shown on Plate 1, extend on Skunk River from the Interstate 35 Bridge approximately 3.3 miles downstream from the confluence with Squaw Creek, in Section 30, Township 83N, R23W, Story County, Iowa, to a gaging station 4.9 miles upstream from the confluence with Squaw Creek in Section 23, Township 84N, R24W, Story County, Iowa. The study also continues from the mouth of Squaw Creek to the southeast corner of Section 29, Township 84N, R24W, Story County, Iowa. The complete study area, approximately 568 square miles, is shown on the aerial mosaic, Plate 2.

The purpose of the study is to provide the State and local agencies with specific information on past and present flood hazards, as well as to provide a guide to the expected frequency of occurrence of future floods of varying magnitudes. With this information, the local governments can plan the most efficient use of the flood plain in view of the potential flood hazards.

This report is a condensation of the information contained in the technical appendix of the flood plain information study, and is prepared to acquaint the general public with the existing flood problems and the need for immediate action in regulating the development of areas subject to flooding.

It covers briefly the history of floods in the study area, a description of the flood problem, and general guidelines for the use of flood plain land and the reduction of future flood damages. The general guidelines provide information that can be useful in establishing zoning ordinances and other regulatory action which will permit conditional usage of flood plain land.

The technical appendix contains additional detailed information on past floods, flood plain information, methods of flood damage reduction, and the more technical aspects which will be especially useful to planners, contractors and engineers. You may obtain this additional flood plain information by making your request to:

Iowa Natural Resources Council
State Office Building
Des Moines, Iowa 50319

A limited number of copies for consultation will also be available at:

City of Ames Engineer
City Hall
Ames, Iowa

II - FLOOD HISTORY

The most severe floods of record on Skunk River and Squaw Creek occurred in June 1918, May 1944, June 1947, June 1954, August 1954, July 1958, March 1960, and June 1965. Total damages from past floods have been relatively light and there has been no record of loss of life. County records, newspaper accounts, and other sources of information about the most significant floods have been condensed and are presented in the following paragraphs.

Flood of June 1918

This was one of the earliest floods on record. Runoff from sustained heavy rains resulted in one of the largest recorded floods on Skunk River and Squaw Creek. The flood was produced by the combination of a series of heavy rainfalls totalling 14 inches within 20 consecutive days. The city of Ames was isolated from all surrounding communities for approximately one week. All roads into the city were closed because of a washed out bridge, or the highway was in such a condition that it was impassable. The Northwestern Railroad stopped all traffic in the vicinity because of weakened embankments under the constant action of the water. Railroad bridges were washed out by flood waters both North and South of the city of Ames, restricting all traffic between the city and Des Moines, Iowa. Gas service was interrupted for one week because of inundation of the gas plant, located within the Skunk River flood plain. It was estimated that the damage to bridges alone was $200,000.

Flood of May 1944

This flood again virtually cut off the city of Ames from all surrounding communities. The storm consisted of heavy winds and 8.21 inches of rain which fell during a 48-hour period. No trains were running on the Northwestern tracks in or out of the city because of weakened bridges and embankments. The underpass to the westbound tracks was completely filled with water and silt. All mail service into the city from the east, west, and south was restricted because of flood waters. Northwestern Bell Telephone Company announced that 1,500 phones were out of order causing exceptionally slow communication to nearby communities. Business houses in Ames suffered the heaviest losses from flood waters in their history. Almost every basement within the city was under inches of water because of inadequate drainage and sewer capacities. Total damage to the area surpassed all previous storm damages.

Flood of June 1947

Heavy rains totalling 5 inches in a 20-hour period caused relatively high flows on both the Skunk River and Squaw Creek. Many families were evacuated from their homes because of high water. Flooding occurred on state-owned lands on both sides of Lincoln Way in the Squaw Creek area, causing damage to agricultural land and crops. The total damage from this flood was much less than that of the two previously recorded floods.

Flood of June 1954

Heavy rains caused Skunk River and Squaw Creek to go over their banks. Squaw Creek flooded over South Riverside Drive, south of the bridge closing the road to traffic. Water covered several acres of the Squaw Creek flood plain south of Lincoln Way between Ames and the University as shown on Photo No. 1, Exhibit 1. The collection of debris such as that shown on Photo No. 2, Exhibit 1, restricted flow at many locations and was an additional factor that increased the flood stages in some reaches. Squaw Creek flooded over Brookside Park as shown by Photos No. 3 and 4, Exhibit 2, causing light damage to the recreational facilities.

Flood of August 1954

Heavy rains establishing an all-time record of 6 inches in a

12-hour period fell within the Skunk River and Squaw Creek watersheds. Storm sewers were inadequate for the heavy flow of water and sanitary sewage backed into basements in many areas of the city. Several families were moved from their residence because of high water. The Grand Avenue underpass was closed because of stalled automobiles. The Iowa State University golf course was flooded as shown by Photo No. 5, Exhibit 3. The Squaw Creek flood plain between Ames and the University was again flooded, as was Brookside Park.

Flood of July 1958

Rains totalling 3.11 inches fell in the Skunk River and Squaw Creek watersheds. Residents south of Fourth Street were marooned when Squaw Creek flood waters overflowed South Maple Avenue. Water washed out part of the county road south of Riverside Drive Bridge over Squaw Creek thus stopping all traffic on the road. City work crews were called to remove debris and log jams at many bridges in an attempt to lower water surface levels. Brookside Park was flooded twice during the week.

Flood of March 1960

Water spread over lowlands on both sides of Lincoln Way at the Skunk River crossing and Squaw Creek Bridge. East and West Roads south of Ames, and South Riverside Drive leading to the airport as shown on Photo No. 6, Exhibit 3, were covered by flood waters. Skunk River and Squaw Creek were out of their banks along the entire study area. Sandbag levees were constructed south of Squaw Creek between the channel and Meadow Lane Trailer Court on U. S. Highway #69. Damage to agriculture was light because spring field operations had not begun. Ice jams occurred at almost all bridges.

Flood of June 1965

High water was caused by heavy rains within the watershed, supplemented by already saturated conditions. Damage was mostly restricted to agricultural land. Inadequate storm sewer capacity and interior drainage caused flooding of some commercial and residential developments. Total damage from this flood was considered small, however, it pointed out many locations where a serious flood potential exists.

III - FLOOD CONTROL IMPROVEMENTS

At the present time there are no existing flood control improvements for protection of the Skunk River and Squaw Creek flood plains in the study area. Direct flood control measures to alleviate possible future damages would include any one or a combination of the

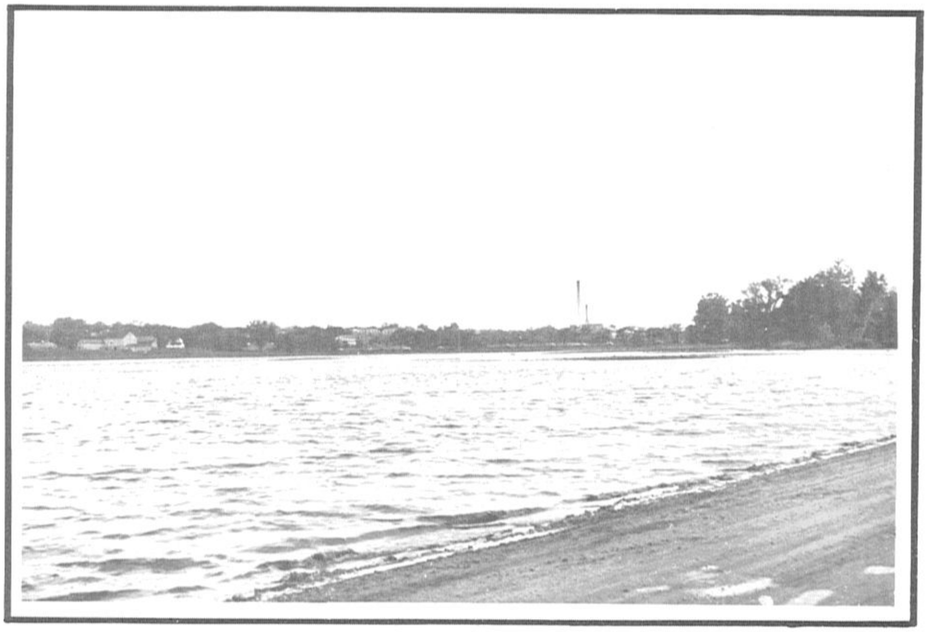


Photo 1 - Flooding of lowlands along Squaw Creek, during the June 1954 flood, between South Riverside Drive and Beech Avenue, South of Lincoln Way near mile 2.00q.

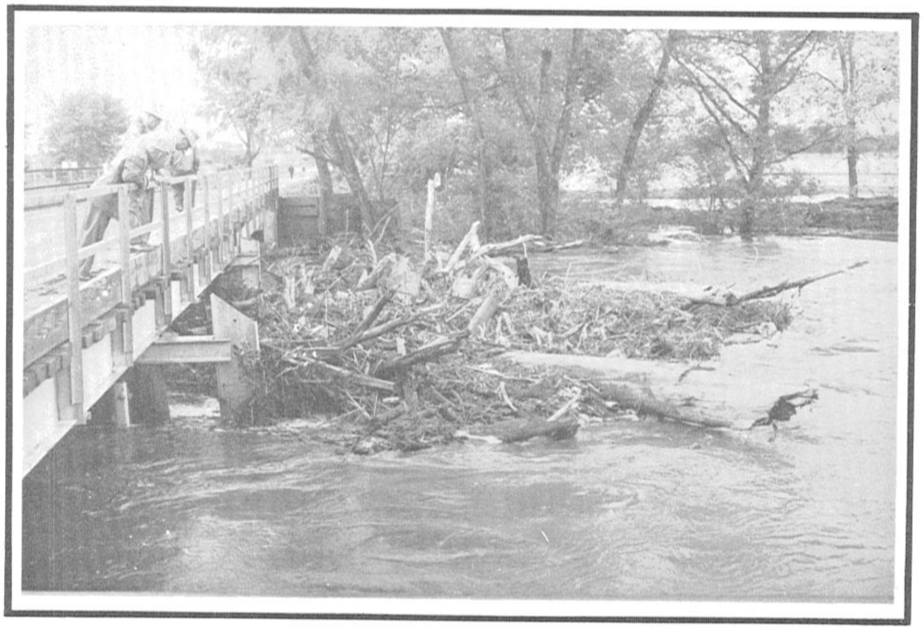


Photo 2 - Debris accumulation at South Riverside Drive bridge during the June 1954 Flood on Squaw Creek at Mile 1.91q.

Exhibit 1

Photo 3 - Flooding in Brookside Park above the 6th Street Bridge during the June 1954 Flood on Squaw Creek near mile 2.70q.

Photo 4 - Brookside Park entrance during the June 1954 Flood on Squaw Creek near mile 2.64q.

Exhibit 2

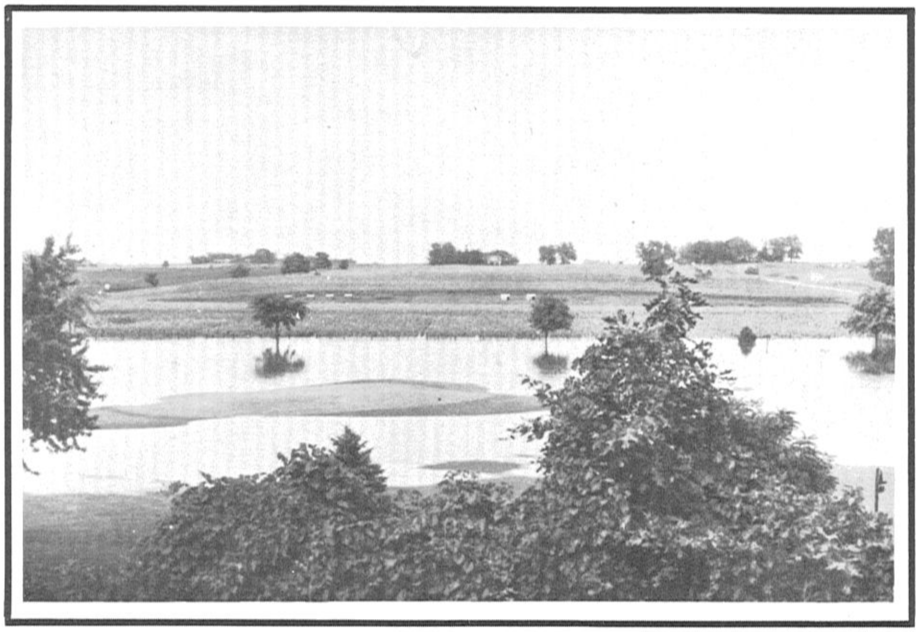


Photo 5 - Flooding in the Iowa State University Golf Course during the August 1954 Flood on Squaw Creek near mile 4.00q.

Photo 6 - Flooding along South Riverside Drive during the March 1960 Flood on Squaw Creek near mile 1.90q.

Exhibit 3

following: Improvement of the existing channel and overbank areas, bridge improvement, levee protection, and flood retention reservoirs. If adequate flood plain regulations are instituted and enforced now, these flood control measures may be kept at a minimum in the future. The 1965 Flood Control Act authorized the Ames multiple-purpose reservoir, located on Skunk River approximately five miles upstream of Ames, Iowa, with total storage capacity of 94,000 acre-feet of which 60,600 acre-feet are allocated to flood control operation. The general effect of Ames reservoir would be the reduction of flood stages and damages in the Skunk River valley within the study area. The final survey report on the Skunk River is currently underway and will consider a reservoir on Squaw Creek near Gilbert, approximately five miles upstream of Ames. Such a reservoir, if ultimately authorized and built, would further reduce flood stages in the study area.

IV - EXISTING FLOOD PLAIN MANAGEMENT CONTROL

Although the city of Ames has prepared comprehensive plans and enacted zoning ordinances, it appears that there are no subdivision regulations, building codes, or zoning ordinances adopted with provisions which affect or regulate the use of land with respect to flood risk. The authority of local governing bodies to zone for protection from floods is included in the standard objectives listed in the state enabling statutes, Chapter 358A and Chapter 414 of the Iowa Code 1962, as amended. (See also Chapter 374, Laws of Sixty-First General Assembly of Iowa, 1965.)

State regulation of the flood plains of Iowa rivers and streams is provided primarily through administration of Chapter 455A of the Iowa Code by the Iowa Natural Resources Council. This statute assigns to the Resources Council the duty and authority to establish and enforce an appropriate comprehensive state-wide program for the control, utilization, and protection of the surface and ground-water resources of the state. Prior approval of the Resources Council is required for any structure, dam, obstruction, deposit, or excavation to be erected, made, used, or maintained in or on the floodway or flood plains of any river or stream. Similarly, works of any nature for flood control may not be constructed or installed unless and until the proposed works are approved by the Resources Council. Chapter 374, Laws of the Sixty-First General Assembly of Iowa, 1965, amended this statute to authorize the Resources Council to establish and enforce regulations for the orderly development and wise use of the flood plains of any river or stream within the state. The Resources Council is directed to determine the characteristics of floods which reasonably may be expected to occur and to establish encroachment limits, protection methods, and minimum protection levels appropriate to flooding characteristics of the stream and to reasonable use of the flood plains. Policies and procedures for administration of this Act presently are being formulated by the Resources Council. Other statutes affecting activities on the flood plain but less directly concerned with flood plain regulation are listed in the bibliography.

V - FLOOD PROBLEM

Since floods are random occurrences, there is no method for accurately predicting the time of occurrence or size of any flood event. However, an analysis of past floods can give an indication of the frequency of occurrence of a given stage or discharge.

In connection with flood damages and flood control planning, it is customary to estimate the frequency (or probability) with which specific flood stages or discharges may be equaled or exceeded rather than the frequency of an exact value of stage or discharge. When expressed correctly, frequency can be stated in two ways, that is, once in a specified number of years, or as a percent--the percentage being numerically equal to the estimated number of occurrences in 100 years. Another term, recurrence interval, is defined as the average interval of time in years over a long period which can be expected to elapse between floods equaling or exceeding the specified flood. Therefore, a flood having a frequency of once in 20 years can also be expressed as having a five percent frequency (five occurrences in 100 years) or as having a recurrence interval of 20 years. The longer the period of record, the more reliable the estimate of future flood frequencies. Therefore, as additional years of record are added to a frequency study, the frequencies of floods, as previously determined, may change.

As stated previously, floods of varying magnitude occurred on Skunk River and Squaw Creek in the years 1918, 1944, 1947, 1954, 1958, 1960, and 1965. High water marks recovered at certain locations for the floods of 1944, 1954, 1958, and 1960 have been plotted on the profiles shown on Plate 4. Because of the scarcity of high water information, profiles for the historic floods have not been plotted. The historic floods on Skunk River and Squaw Creek have produced damage in the developed reaches, however, there is no record of loss of life due to past floods.

In Tables 1 and 2, computed floods are shown which indicate discharge and corresponding elevation for flood estimates of various frequencies. Table 2 indicates the estimated frequency of elevations produced under free flow conditions only, that is, no ice or debris jams. Therefore, a given elevation will, in actuality, probably occur somewhat more frequently than is indicated in the table. The areas which would be inundated by such floods are shown on Plate 3.

GUIDE LINES FOR REDUCING FLOOD DAMAGES

a. General. Man has been building on and occupying the flood plains of Iowa rivers and streams since the advent of the pioneer settlers. The streams first provided transportation and water supply. Later, mill dams were built and early highways and railroads were constructed along the gentle valley grades. Today the continuing growth of Iowa's cities results in ever increasing encroachment on the flood plains.

Streams in flood may carry thousands of times more flow than during low flow periods. These vast quantities of water caused little damage until the works of man invaded the flood plain. Man has learned through bitter experience that floods periodically inundate portions of the flood plain, damaging or sweeping away roads, buildings and homes. In addition to these property damages, floods often pose a severe threat to human life and health. Over the years, reservoirs, channel improvements, levees and other flood protection works have been constructed to protect the works of man against the force of nature's floods. Unfortunately, the construction of these protection works is extremely expensive. In addition, encroachment on the flood plains has taken place faster than flood protection works have been constructed with the result that flood hazard areas and flood damages have been steadily increasing in Iowa and across the nation.

Historically, man has tried to reduce flood damages through the exercise of control over the river in time of flood. Many different types of control works can be constructed for this purpose. Dams and reservoirs can be constructed to store water for gradual release after the threat of flooding has passed. Channel improvements are used to remove constrictions and improve flow characteristics so that future flood stages are reduced. Watershed treatment involves the regulation of the rate of runoff to the main stem and tributaries. Levees, dikes, and flood walls can be constructed to confine the river to a definite course at stages which may be well above the adjacent flood plain. These methods are generally very costly and therefore are more often used in areas where development has already heavily encroached on the flood plain, or where future plans call for the extensive use of the flood plain. There should be a history of, or an existing potential for heavy flood damage to justify the cost of these measures.

The increase in flood hazards and flood damages, despite the expenditure of billions of dollars of tax funds for the construction of flood control works, has led to a new approach to the reduction of these hazards and damages, the exercise of control over the land lying adjacent to the river through the planned management and development of flood hazard areas. The flood plain plan, if fully integrated into the comprehensive land use and development plan of an area and enforced by means of appropriate zoning, subdivision and building regulations, can prevent the creation of new flood hazard areas. While flood plain areas probably never can be considered flood free, planning will allow selection of a flood risk commensurate with the type of development desired and allow a reasonable level of protection to be built into a project during initial construction.

Regulation of the flood plain can be carried out by a variety of means--encroachment lines, zoning ordinances, subdivision regulations, and modifications or additions to building codes. These methods will be described subsequently in some detail. However, it is not within the purpose of this report to recommend the specific technique to be used. Flood plain regulations are the responsibility of State and local governments, and these report data are provided to furnish a basis for appropriate regulatory action. It is hoped that the basic data in this report will be used in conjunction with comprehensive plans to develop a reasonable and desirable plan for use of the Skunk River and Squaw Creek flood plains.

Fortunately, the need for flood plain planning within the study area has been recognized by local interests before extensive flood plain development has taken place. This means that future damages in the study area can be reduced now, at little or no cost to the taxpayer, by the enactment and enforcement of flood plain regulations. The city of Ames Plan Commission and the Iowa State University Planners have done extensive research on the present and projected growth in the areas of land use, population, economy, recreation, and transportation and have published comprehensive planning reports. The flood data in this report, together with the planning program for future land use, will enable State and local interests to minimize flood damage risks.

Flood plain management may also include other methods which are helpful, particularly in special localized areas. These include park and open space developments, evacuation, urban redevelopment, flood proofing, tax reductions, and warning signs. Discussion of these methods is given in the Technical Appendix.

b. Encroachment lines. A designated floodway is the area of channel and those portions of the flood plains adjoining the channel which are reasonably required to carry and discharge the flood water or flood flow of a flood of a specific size without unduly raising upstream water surface elevations. Encroachment lines or limits are the lateral boundaries of this floodway. They are two definitely established lines, one on each side of the river, and between these lines no construction or filling such as that shown on Photos No. 7 and 8, Exhibit 4, and Photo No. 9, Exhibit 5, should be permitted which will cause an impedance to flow. Flood plain shaping and filling, as shown by Photo No. 10, Exhibit 5, is an example of improvement that may be advantageous to the existing flood plain if developed into a recreational park or area which has good flood flow characteristics. Many new developments have recognized the flood potential and are designed for flood proofing with the main structure elevations above estimated flood stages as shown by Photos No. 11 and 12, Exhibit 6. If possible, encroachment limits should be established before extensive development has taken place in order that costly clearance of existing structures may be avoided. Final choice of the magnitude of the flood, which will determine the size of the floodway, is a matter for State and local decision because in the final analysis, it is determined by consideration of local land use plans and comprehensive state-wide flood control plans.

The data contained in this report are being used by State and local interests to determine the size of the regulatory flood, and to establish floodway encroachment lines or limits and land use districts. For the present time, problems or situations regarding encroachment at specific points in the study area should be referred to the Iowa Natural Resources Council at Des Moines.

c. Zoning. Zoning is a legal tool used by cities, towns, and counties to control and direct the use and development of land and property within their jurisdiction. Division of a municipality or county into various zones should be the result of a comprehensive planning program for the entire area, with the purpose of guiding its growth. The planning program as such has no legal status. Zoning, as described above, is a legal tool that is used to implement and enforce the details of the planning program. Its objectives are the conservation of property value and the achievement of the most appropriate and beneficial use of available land. Flood plain zoning is not a special type of ordinance, but merely another set of provisions which can be incorporated into a comprehensive zoning ordinance so that flood damage can be minimized. Zoning regulations may be used in lieu of encroachment laws as well as a supplement to them. Thus, designated floodways may be zoned for the purpose of passing flood waters and for other limited uses that do not conflict with that primary purpose. The ordinance may also establish regulations for the flood plain areas outside the floodway. These include designating elevations above which certain types of development must be constructed. The enabling statutes which authorize municipalities and counties in Iowa to adopt zoning regulations are Chapters 414 and 358A, respectively, of the Iowa Code 1962 as amended. Amendments enacted in 1965 specifically added protection from floods as an authorized objective of zoning (Chapter 374, Laws at the Sixty-First General Assembly of Iowa, 1965).

d. Subdivision regulations. A subdivision can be defined in a broad sense as a tract or parcel of land divided into two or more lots or other units for the purpose of sale or building development. Sub-

Photo 7 - Looking South across Squaw Creek at filling on the flood plain, downstream from Stange Road bridge near mile 3.80q.

Photo 8 - Looking downstream at filling on the Squaw Creek flood plain downstream from South Maple Street near mile 1.60q.

Exhibit 4

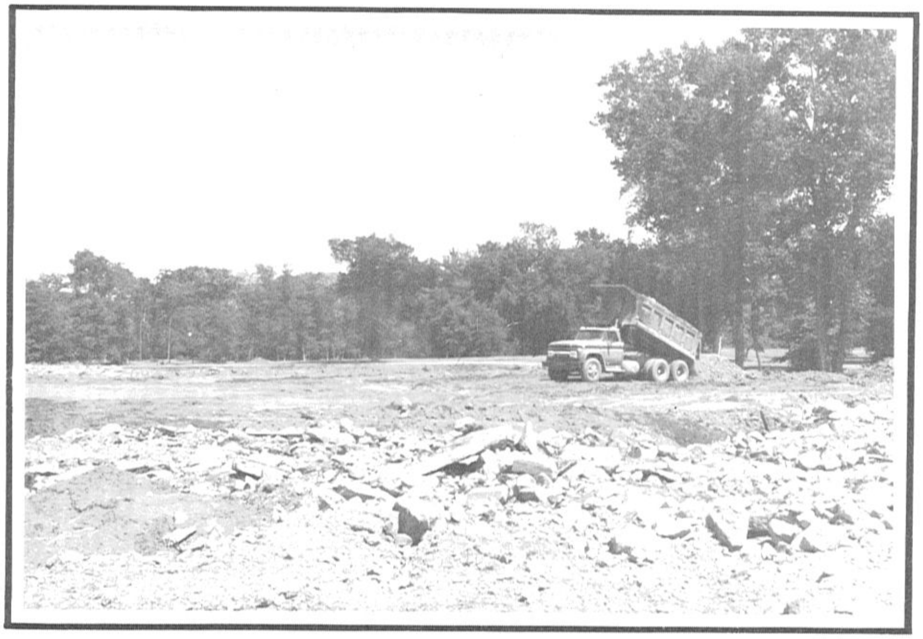


Photo 9 - Looking downstream at filling operations on the Squaw Creek flood plain downstream from South Maple Street near mile 1.60q.

Photo 10 - Looking east from Skunk River at filling and shaping on the left bank flood plain between Lincoln Way and the Chicago Northwestern Railroad near mile 1.00.

Exhibit 5

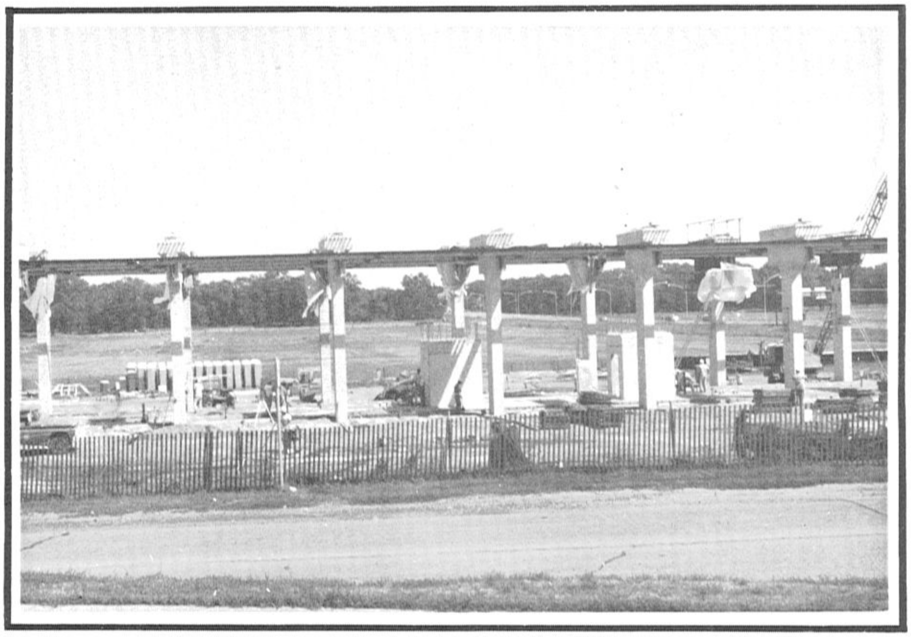


Photo 11 - Looking east toward Squaw Creek at construction of a university residential hall. Note: building is designed to withstand flood waters with a minimum amount of damage. It is located near mile 2.35q.

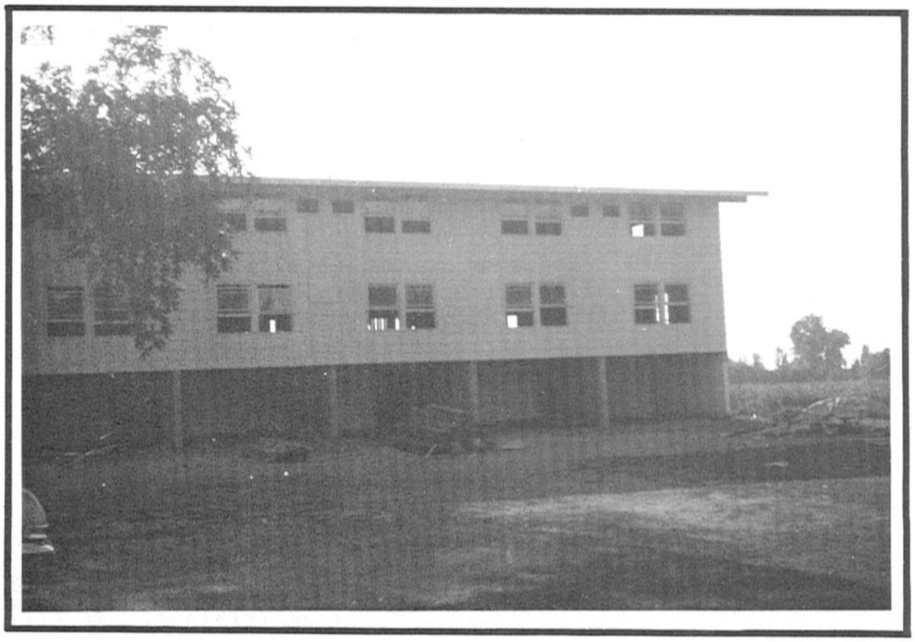


Photo 12 - Looking downstream at construction on the Squaw Creek flood plain. The building is designed to incur a minimum amount of damage when flooded. It is located near mile 1.00q.

Exhibit 6

division regulations are used by local governments to specify the manner in which land may be subdivided within the entire area under their jurisdiction. Regulations may state the required width of streets, requirements for curbs and gutters, size of lots, elevation of land, freedom from flooding, size of floodways and other points pertinent to the welfare of the community. It has been found that responsible subdividers favor such regulations because the regulations discourage land speculation and prevent unscrupulous competition from other subdividers who might develop flood hazard land with less than minimum desirable standards. Experience has also shown that various municipal costs are reduced during flood periods and that the annual maintenance required for streets and utilities is minimized. Subdivision regulations provide an efficient means of controlling development in areas which are presently undeveloped. By introducing such regulations early in these areas, planned flood plain development can take place without being hampered by nonconforming uses.

e. Building codes. The primary purpose of building codes is to set up minimum standards for controlling the design, construction and quality of materials used in buildings and structures within a given area, so that life, health, property, and public welfare are safeguarded. Since it may not be practical to prevent the location of any building in all areas subject to flooding, building codes can be used to minimize structural and consequential damages resulting from flood velocities and inundation. Some of the methods adaptable to building codes are:

(1) Prevent flotation of buildings from their foundations by specifying anchorage.

(2) Establish basement elevations and minimum first floor elevations consistent with potential flood occurrences.

(3) Prohibit basements in those areas subject to very shallow, infrequent flooding where filling and slab construction would prevent virtually all damage.

(4) Require reinforcement to withstand water pressure or high velocity flow and restrict the use of materials which deteriorate rapidly in the presence of water.

(5) Prohibit equipment that might be hazardous to life when submerged. This includes chemical storage, boilers or electrical equipment.

f. Flood plain regulations. Flood plain regulation involves the establishment of legal tools with which to control the extent and type of future development which will be allowed to take place within the flood plain. The regulations must be definite enough so that there is general public understanding of the problem and the choices of action which the regulations provide. Regulations must be specific enough so that criteria, such as minimum first floor elevations, type of construction or encroachment limits, are known for the area in question. There are basically two main objectives of regulation. The first is to assure and guarantee the retention of an adequate floodway for the river--floodway as previously being defined as the channel and those portions of the flood plains adjoining the channel, which are reasonably required to carry and discharge the flood water or flood flow of a flood of a specific size without unduly raising upstream water surface elevations. Its size is based on sound economic and hydraulic criteria. Development and use of the area lying on either side of the floodway, and which may become inundated by the regulatory flood, should be planned and controlled. The second objective of regulation is to encourage sound land use consistent with the flood hazard and the community land use needs.

The profiles shown on Plate 4, combined with the detailed information contained in the Technical Appendix, will provide a basis which will allow formulation of flood plain regulations. Such regulations will be consistent with both minimum State requirements and the overall comprehensive plan of local authorities.

CONCLUSION

The city of Ames and Iowa State University have active planning programs carried out through their various governing bodies. These planning agencies have made comprehensive studies of present growth trends, forecasts of future economic and population growth, and the resulting needs for housing, recreation facilities, schools, parks, and major streets. The following estimates are particularly relevant to the urgent need for flood plain regulation in the Skunk River and Squaw Creek basins. The city of Ames and Iowa State University have experienced a growing population throughout their entire history. With the projected increase in employment opportunities and anticipated rise in University enrollment, growth is expected to continue at a rapid rate. In a report prepared by the city of Ames Plan Commission in April 1965, entitled "Ames, A Report On The Comprehensive Plan", it is estimated that the population for the city of Ames will grow to approximately 75,000 by 1985. This represents an increase of almost 48,000 people over the 1960 population of 27,003. History has shown that such growth in urban areas encroaching on a flood plain will produce vast increase in future flood damages if allowed to occur without sound planning and flood plain management practices. In recognition of this need, the report on the comprehensive plan for Ames has provided for reservation of a sizeable portion of both Squaw Creek and Skunk River flood plains for recreation and other open space uses. However, plans for prospective developments on the flood plains by the University and anticipated development within the city could affect flood conditions and increase flood damages. Therefore, it is of paramount importance that these imminent projects be compatible with an overall plan for the development of the flood plains of Squaw Creek and the Skunk River consistent with the needs of man and nature.

Probably the most important influence on future developments on the Squaw Creek flood plain is the proposed Elwood Drive. This primary thoroughfare will parallel the west side of Squaw Creek in a north-south direction extending from the present Elwood Drive to its crossing over Squaw Creek about one-quarter mile downstream from Stange Road.

Prospective developments by the University are limited to the Squaw Creek flood plain west of the proposed Elwood Drive on both sides of Lincoln Way. Elwood Drive will be designed to act as a levee to protect the proposed developments west of the drive from flood stages equivalent to the elevation of Lincoln Way. One of these developments to be located between the Chicago and North-western Railroad southward to Lincoln Way has been designated as a dormitory and parking area when the University population exceeds 30,000. Currently, a development of six dormitories is planned for completion by 1978. The dormitories will be interconnected by a series of elevated walkways to provide access in the event flood stages interrupt normal access routes. The area south of Lincoln Way between Beech Avenue and west of the proposed Elwood Drive has been designated for use as the Iowa State Cultural Center. As described in the Technical Appendix, the center was designed such that only parking and flood-proofed utility facilities will be constructed at elevations below estimated flood stages. Again, elevated walkways will provide access in the event flood stages interrupt normal access routes. Downstream from the Center, long range plans by the University include a football stadium on the flood plain of Squaw Creek.

In view of the anticipated growth of the city and greater demands for use of land within the flood plains of the two streams, the city of Ames in its report on the comprehensive plan for Ames has designated most of the flood plain areas as public recreation and nature reserves. In areas of the flood plain occupied by existing commercial and industrial development (for example, Squaw Creek flood plain near South Duff Street) the city recognizes the need to allow similar developments consistent with the flood hazard. <u>However, the existence of buildings that were constructed without regard to the flood hazard do not justify additional construction on the same basis.</u>

In order that the flood plains will continue to be an asset to this community, each prospective development should be constructed compatible to a uniform development plan for the flood plains of Squaw Creek and Skunk River within this study area. Therefore, it is vital that action be taken now to provide for a comprehensive plan of development for the two flood plains together with appropriate flood plain regulations in accordance with the land use needs of the community and the flood hazard.

GLOSSARY OF SELECTED TERMS

A. HYDROLOGIC TERMS

1. Channel. A natural or artificial watercourse of perceptible extent with definite bed and banks to confine and conduct continuously or periodically flowing water. Channel flow thus is that water which is flowing within the limits of the defined channel.

2. Flood. A temporary rise in stream flow or stage that results in significant adverse effects in the areas adjacent to the stream.

3. Flood stage. A term commonly used by the U. S. Weather Bureau and others to designate that stage, on a particular river gage, at which overflow of the natural banks of the stream results in significant damage in any portion of the reach for which the gage is representative index.

4. Flood frequency. A means of expressing the probability of flood occurrences as determined from a statistical analysis or representative stream flow records. It is customary to estimate the frequency with which specific flood stages or discharges may be equaled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedence frequency" but in practice the term "frequency" is used. The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years. Also see: Recurrence interval.

5. Flood record. Records of flood events for which there is reasonable reliable data useful in technical analysis. The highest recorded stage or discharge is often referred to as "maximum flood of record" as differentiated from "historic high water marks" which may not be well defined.

6. Flood plain. The relatively flat lowlands adjoining a watercourse or other body of water subject to overflow therefrom during flood periods.

7. Flood profile. The longitudinal profile traced by the crest of a flood event expressed in elevation.

8. Historical flood. A known flood which occurred before systematic record-keeping was begun for the stream or area under consideration.

9. Floodway. The channel of the stream or body of water and that portion of the flood plain that is inundated by a flood and used to carry the flow of the flood.

10. Recurrence interval. The average interval of time, based on a statistical analysis of actual or representative stream flow records, which can be expected to elapse between floods equal to or greater than a specified stage or discharge. Recurrence interval is generally expressed in years. Also see: Flood frequency.

11. Standard project flood. A hypothetical flood, estimated by the Corps of Engineers, representing the critical flood runoff volume and peak discharge that may be expected from the most severe combination of meteorological and hydrologic conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combinations.

12. Channel bottom. The elevation of the deepest part of a stream channel at a particular section. Such elevations, when determined for many sections along the length of a stream, provide a profile of the bottom from mouth to source.

B. REGULATORY TERMS

1. Building code. A collection of regulations adopted by a local governing body setting forth standards for the construction of buildings and other structures for the purpose of protecting the health, safety, and general welfare of the public.

2. Designated floodway. The channel of a stream and that portion of the adjoining flood plain designated by a regulatory agency (Iowa Natural Resources Council) to provide for reasonable passage of flood flows.

3. Encroachment lines. Lateral limits or lines along streams or other bodies of water, within which no structure or fill may be added. Their purposes are to preserve the flood carrying capacity of the stream or other body of water and its flood plain, and to assure attainment of the basic objective of improvement plans that may be considered or proposed. Their location, if along a stream, should be such that the floodway between them including the channel, will handle a designated flood flow or condition. These lines are set by regulatory agencies and may be changed by them.

4. Flood plain regulations. A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within flood plain limits. The term encompasses zoning ordinance, subdivision regulation, building and housing codes, encroachment laws, and open area regulations.

5. Flood proofing. A combination of structural provisions, changes, or adjustments to properties subject to flooding primarily for the reduction or elimination of flood damages.

6. Subdivision regulations. Regulations and standards established by a local public authority, generally the local planning agency, with authority from a State enabling law, for the subdivision of land in order to secure coordinated land development, including adequate building sites and land for vital community services and facilities such as streets, utilities, schools and parks.

7. Zoning ordinance. An ordinance adopted by a local governing body, with authority from a State zoning enabling law, which under the police power divides an entire local governmental area into districts and, within each district, regulates the use of land, the height, bulk, and use of buildings or other structures, and the density of population.

C. OTHER TERMS

Urban redevelopment. The overall program of public and private action, growing out of the National Housing Act of 1954 as amended, designed to prevent the spread of blight, to rehabilitate and conserve urban areas that can be economically restored, and to clear and redevelop areas that cannot be saved.

TABLE 1

DISCHARGES FOR FLOODS OF VARIOUS RECURRENCE INTERVALS

		Discharge of Computed Floods		
Mile	Drainage Area Square Miles	50-year Flood	100-year Flood	Standard Project Flood
Skunk River				
-3.33	568.0	19,000	23,500	35,000
0.00	329.0	14,500	18,000	26,500
4.91	315.0	14,000	17,500	26,000
Squaw Creek				
0.00q	227.0	12,000	15,000	22,000
1.66q	208.5	11,500	14,500	21,000
4.10q	192.6	11,000	13,500	20,500

TABLE 2

FLOOD PROFILE INFORMATION

Skunk River Mile	Location	Elevation of Flood Profile - Feet: 50-year Flood	100-year Flood	Standard Project Flood
Interstate 35	Downstream	43.2	44.5	47.1
-3.33	Upstream	46.2	47.4	49.7
-3.03		46.4	47.6	49.9
County Road	Downstream	46.6	47.7	50.0
-2.85	Upstream	46.6	47.7	50.1
-2.48		47.0	48.0	50.4
-2.21		47.5	48.4	50.6
-1.95		48.0	48.8	50.7
-1.68		48.8	49.4	51.1
-1.42		49.8	50.3	51.6
-1.15		50.7	51.1	52.2
-0.88		52.0	52.4	53.3
-0.61		53.9	54.3	55.1
Highway #30	Downstream	55.9	56.5	57.6
-0.34	Upstream	56.7	57.7	59.9
South 16th Street	Downstream	57.2	58.1	60.5
-0.17	Upstream	57.2	58.2	60.5
0.00		57.3	58.2	60.6
0.26		57.8	58.5	60.7
0.53		59.1	59.5	61.0
Lincoln Way	Downstream	60.8	61.2	62.1
0.83	Upstream	62.6	63.8	65.0
0.98		63.2	64.2	65.3

TABLE 2 (Cont'd)

FLOOD PROFILE INFORMATION

Mile	Location	Elevation of Flood Profile - Feet 50-year Flood	100-year Flood	Standard Project Flood
C&NW RR	Downstream	64.6	65.4	66.7
1.20	Upstream	64.6	65.4	66.8
1.40		65.8	66.9	68.9
1.58		66.3	67.2	69.2
North 13th Street	Downstream	67.3	68.0	69.7
1.77	Upstream	68.6	70.0	71.0
1.88		69.0	70.2	71.3
2.00		69.3	70.4	71.5
2.15		69.8	70.8	72.0
2.39		70.6	71.5	72.7
2.59		71.3	72.0	73.3
2.79		72.0	72.7	74.0
2.98		73.3	74.1	75.4
3.18		74.3	75.0	76.3
3.38		75.2	75.8	77.0
3.56		76.2	76.7	77.8
3.76		77.0	77.5	78.6
3.95		77.7	78.3	79.5
4.15		79.0	79.8	81.1
Riverside Road	Downstream	82.8	83.4	84.6
4.56	Upstream	83.2	84.1	85.0
4.72		83.9	84.8	85.7
4.91		85.3	86.0	87.4

TABLE 2 (Cont'd)

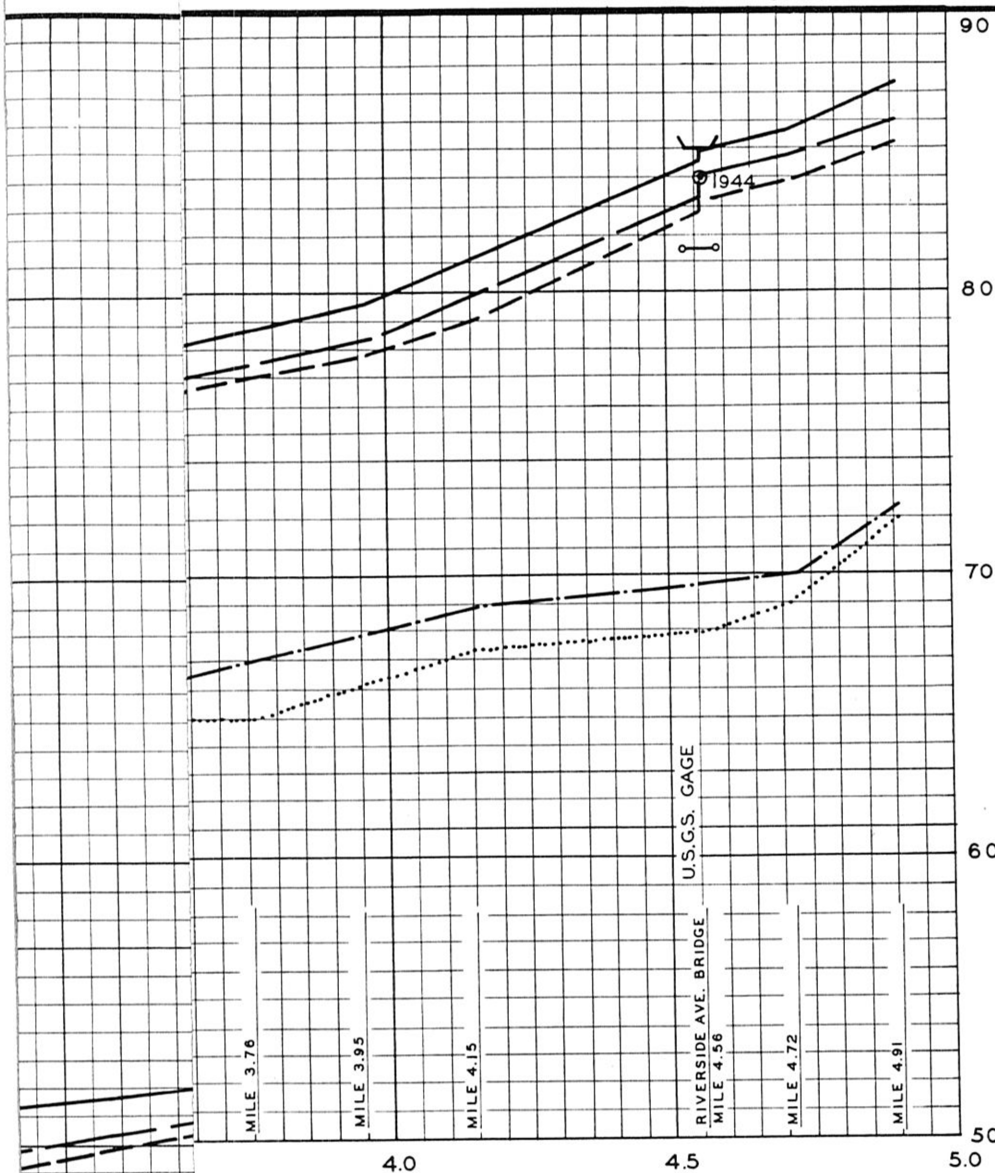
FLOOD PROFILE INFORMATION

Squaw Creek		Elevation of Flood Profile - Feet		
Mile	Location	50-year Flood	100-year Flood	Standard Project Flood
0.00q		57.3	58.2	60.6
0.45q		59.1	59.7	61.2
0.62q		59.7	60.2	61.5
Duff Avenue	Downstream	61.0	61.6	63.0
0.81q	Upstream	61.7	62.8	64.6
1.02q		63.1	63.8	65.4
1.21q		63.5	64.1	65.6
C&NW RR	Downstream	64.7	65.1	66.3
1.43q	Upstream	66.8	67.8	68.9
1.66q		67.2	68.1	69.2
Riverside Avenue	Downstream	67.7	68.4	69.5
1.91q	Upstream	68.6	69.2	70.2
1.98q		68.7	69.3	70.3
2.07q		69.0	69.6	70.6
Lincoln Way	Downstream	69.7	70.2	71.2
2.26q	Upstream	70.5	71.4	73.3
2.44q		71.0	71.7	73.5
C&NW RR Spur Line	Downstream	71.5	72.2	73.8
2.57q	Upstream	71.5	72.2	74.8
C&NW RR	Downstream	72.1	73.0	75.3
2.59q	Upstream	72.1	73.0	75.3
North 6th Street	Downstream	72.7	73.6	75.9
2.63q	Upstream	72.9	73.8	76.0
2.74q		73.7	74.6	76.7

TABLE 2 (Cont'd)

FLOOD PROFILE INFORMATION

Mile	Location	Elevation of Flood Profile - Feet 50-year Flood	100-year Flood	Standard Project Flood
2.87q		74.1	74.9	76.9
3.07q		74.6	75.3	77.2
North 13th Street	Downstream	75.2	75.9	77.7
3.24q	Upstream	76.1	77.0	79.4
3.41q		76.3	77.2	79.5
3.64q		77.0	77.9	80.1
Stange Road	Downstream	77.9	78.7	80.8
3.84q	Upstream	78.7	79.8	82.4
4.10q		79.6	80.5	82.8
4.34q		80.9	81.6	83.5
4.65q		82.5	83.0	84.5
4.88q		83.0	83.6	85.2
5.12q		83.5	84.1	85.7
5.33q		84.1	84.7	86.2



LEGEND

STANDARD PROJECT FLOOD
100 YEAR FREQUENCY
50 YEAR FREQUENCY
LOW WATER PROFILE
CHANNEL BOTTOM
BRIDGE - LOW STEEL ELEVATION
MINIMUM ROADWAY ELEVATION
HIGH WATER MARK

NOTE:
ELEVATIONS BASED ON CITY OF AMES
DATUM 0.00 = M.S.L. DATUM 823.55

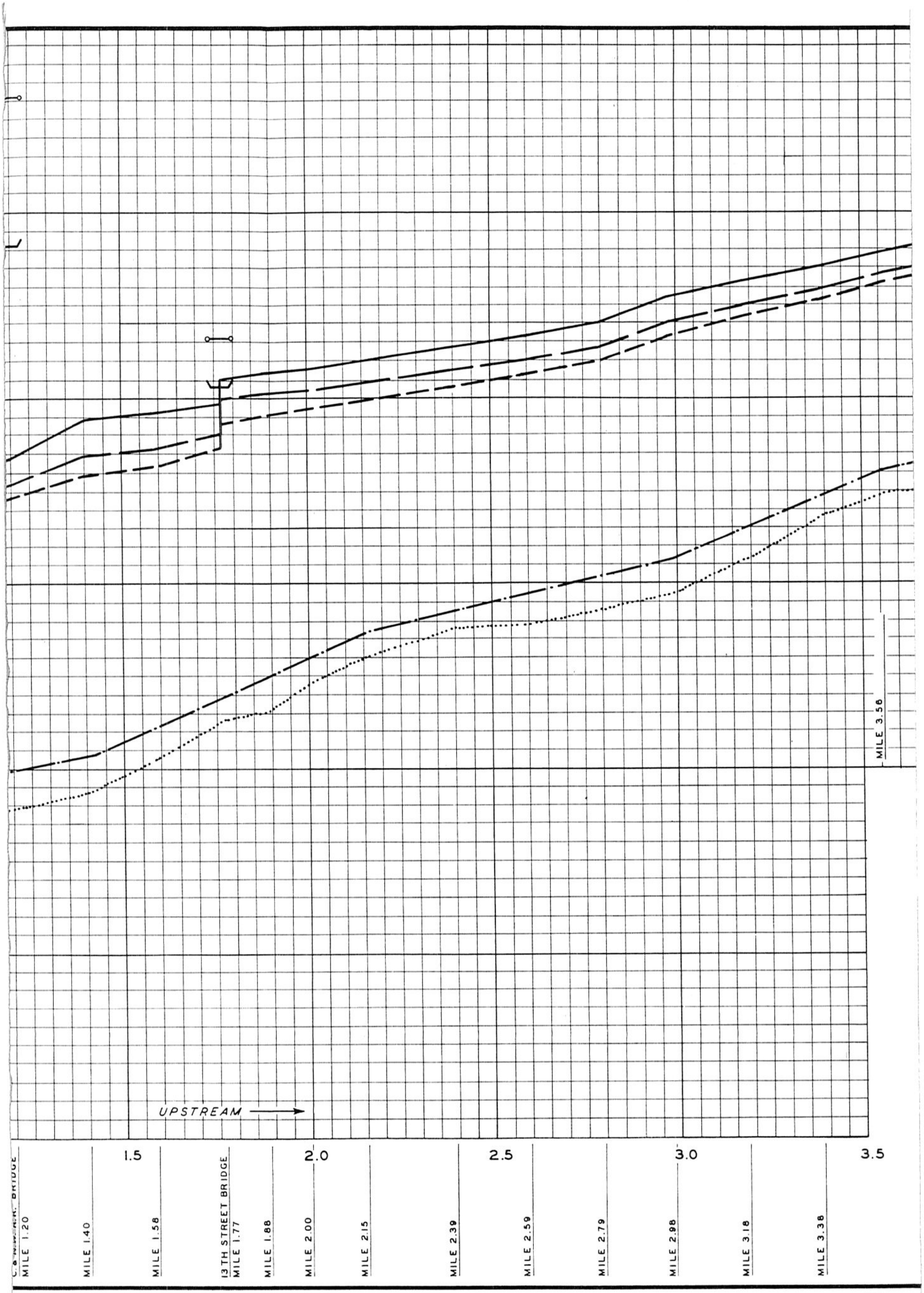
FLOOD PLAIN INFORMATION REPORT
STORY COUNTY, IOWA

PROFILES

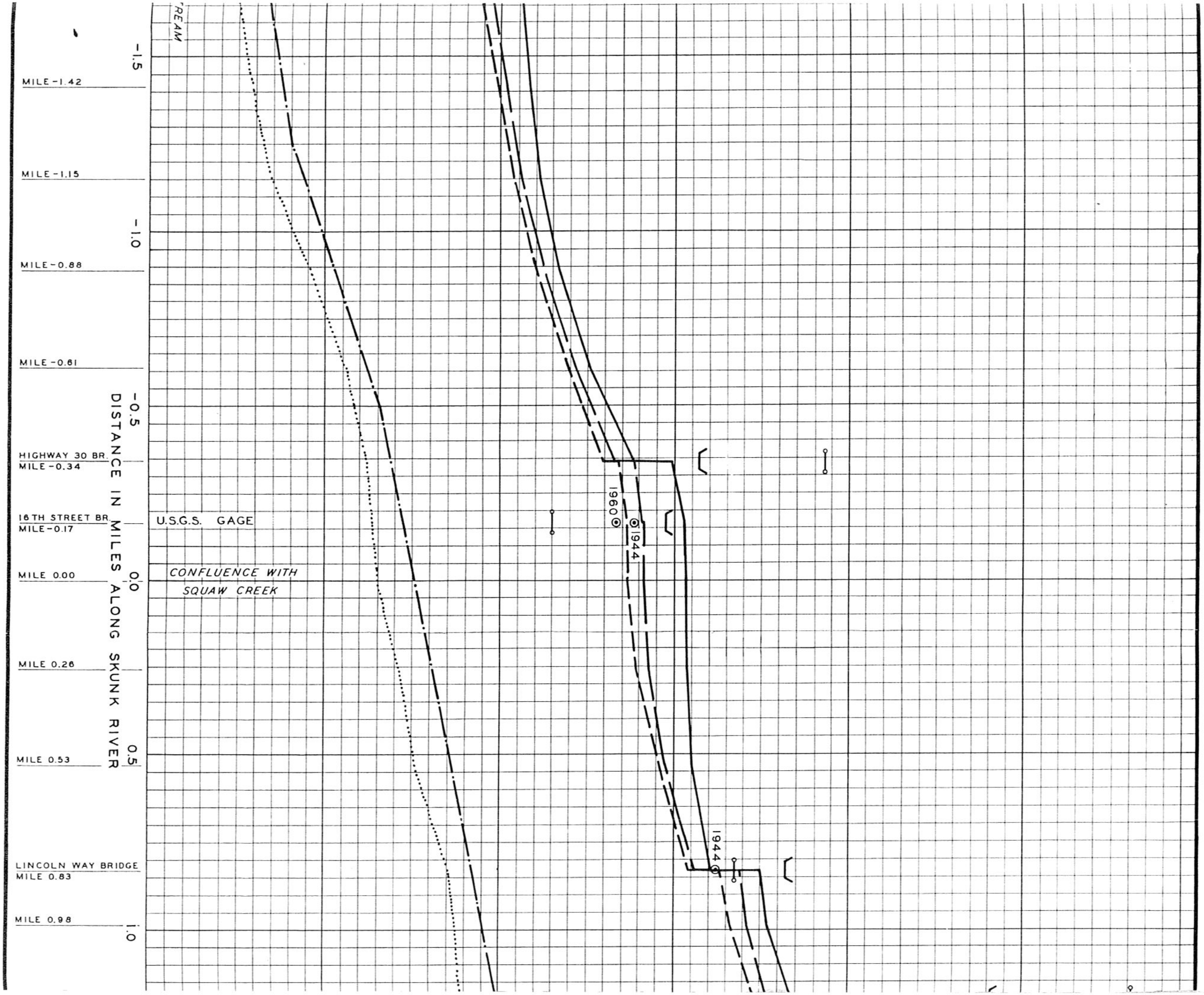
SKUNK RIVER
MILE -3.33 TO MILE 4.91

SQUAW CREEK
MOUTH TO MILE 5.33 q

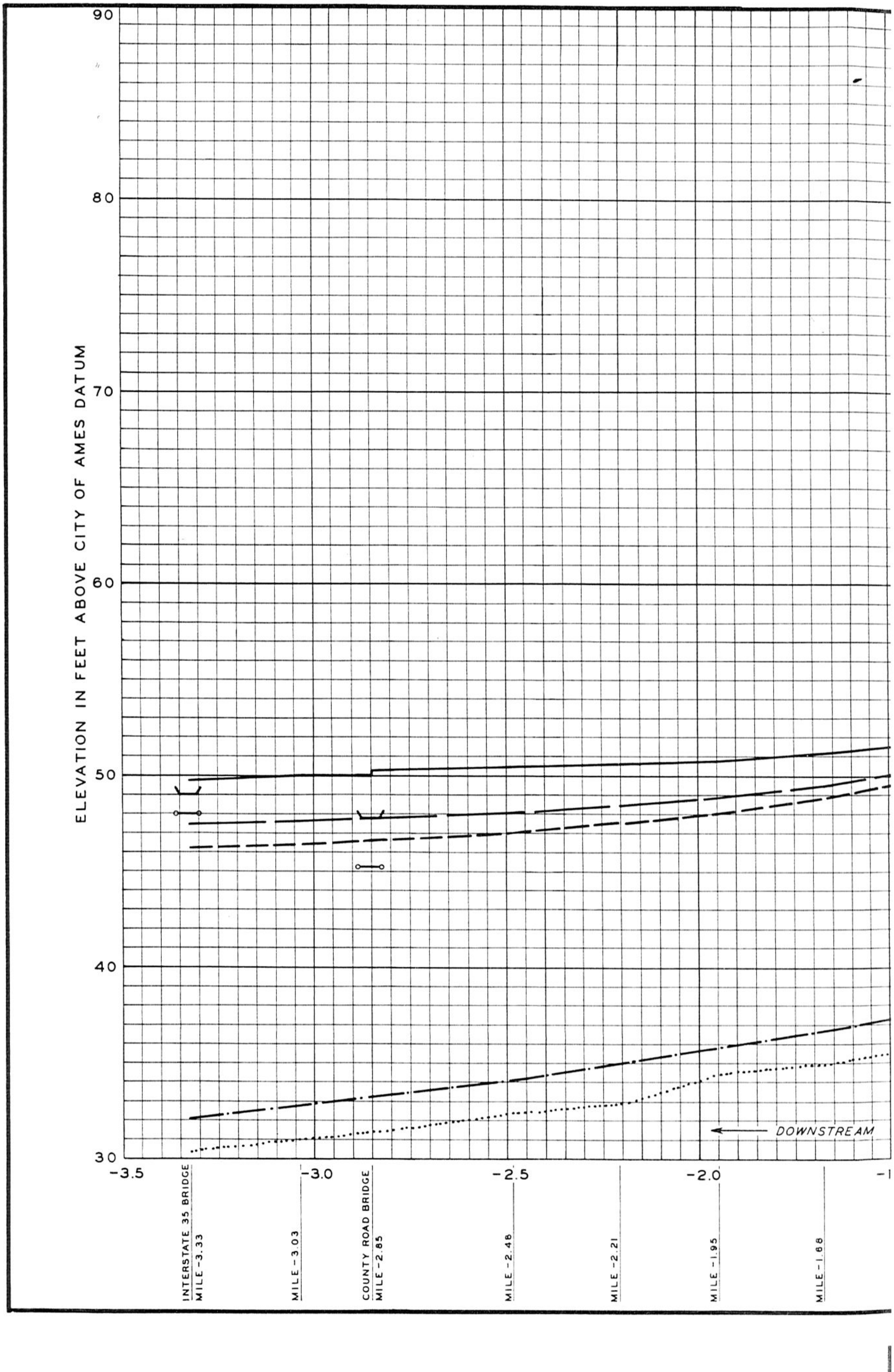
U. S. ARMY ENGINEER DISTRICT
ROCK ISLAND, ILLINOIS
NOVEMBER 1965



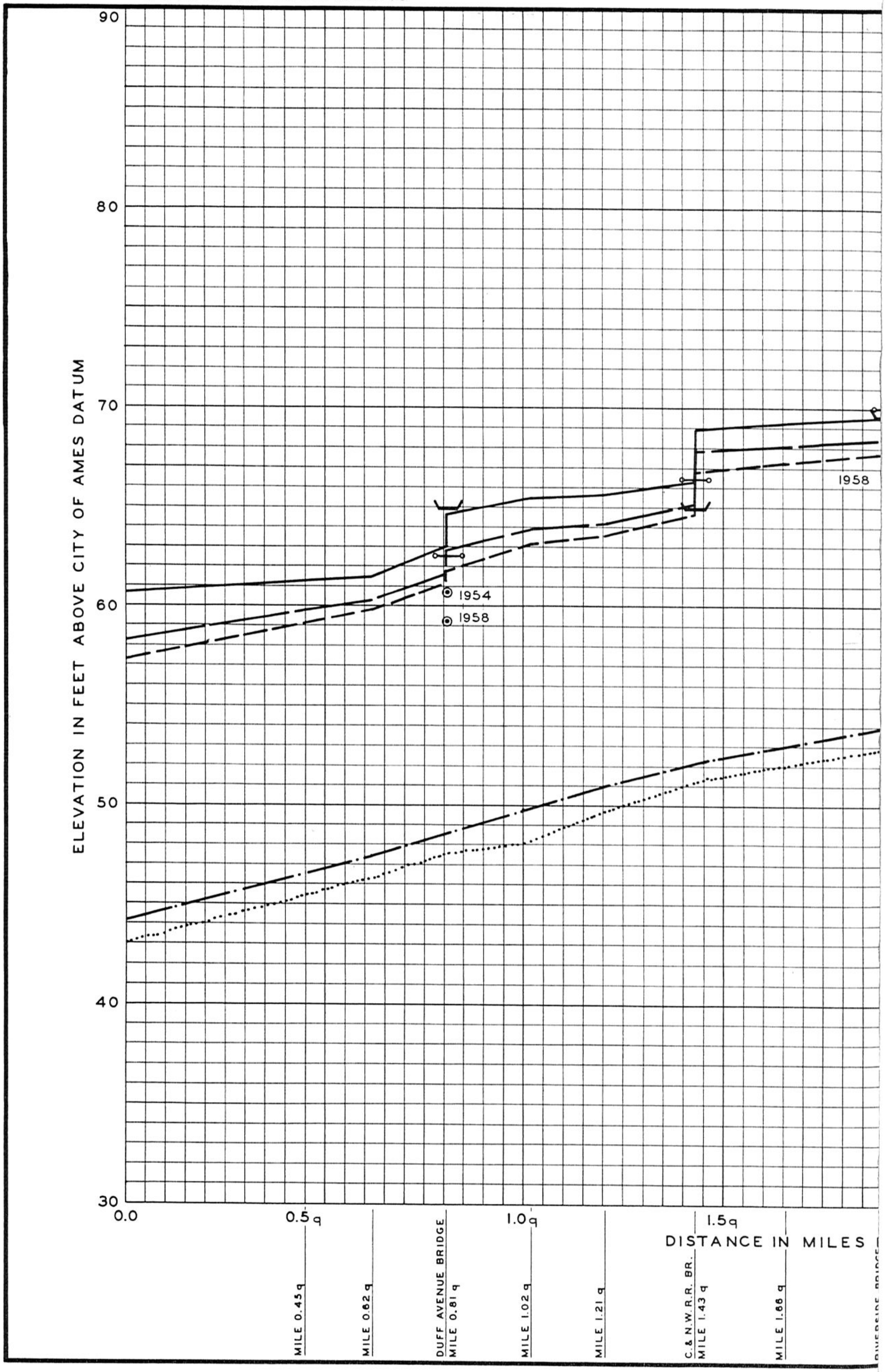
UPSTREAM
1.5
2.0
2.5
3.0
3.5
MILE 1.20
MILE 1.40
MILE 1.58
13TH STREET BRIDGE
MILE 1.77
MILE 1.88
MILE 2.00
MILE 2.15
MILE 2.39
MILE 2.59
MILE 2.79
MILE 2.98
MILE 3.18
MILE 3.38
MILE 3.56

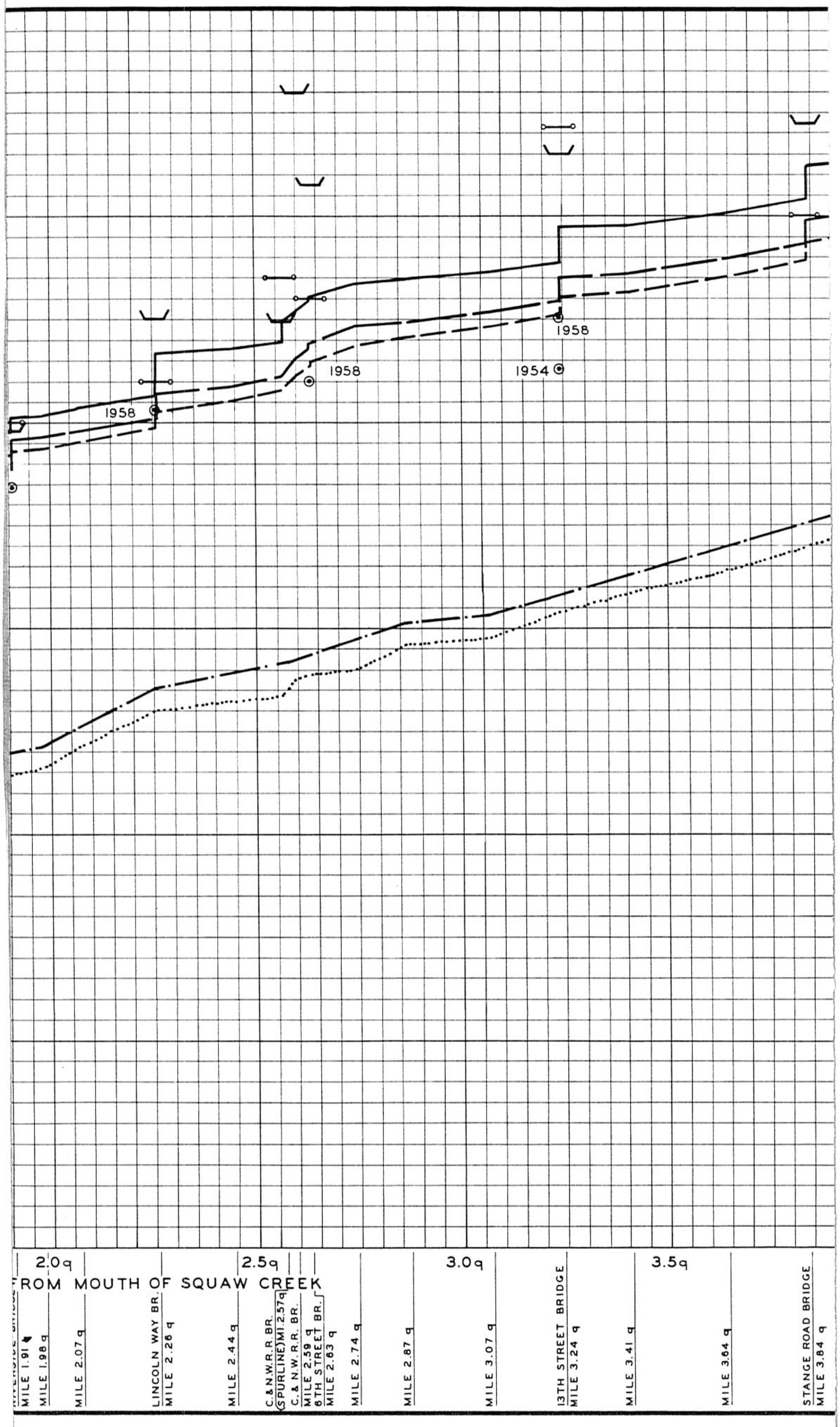


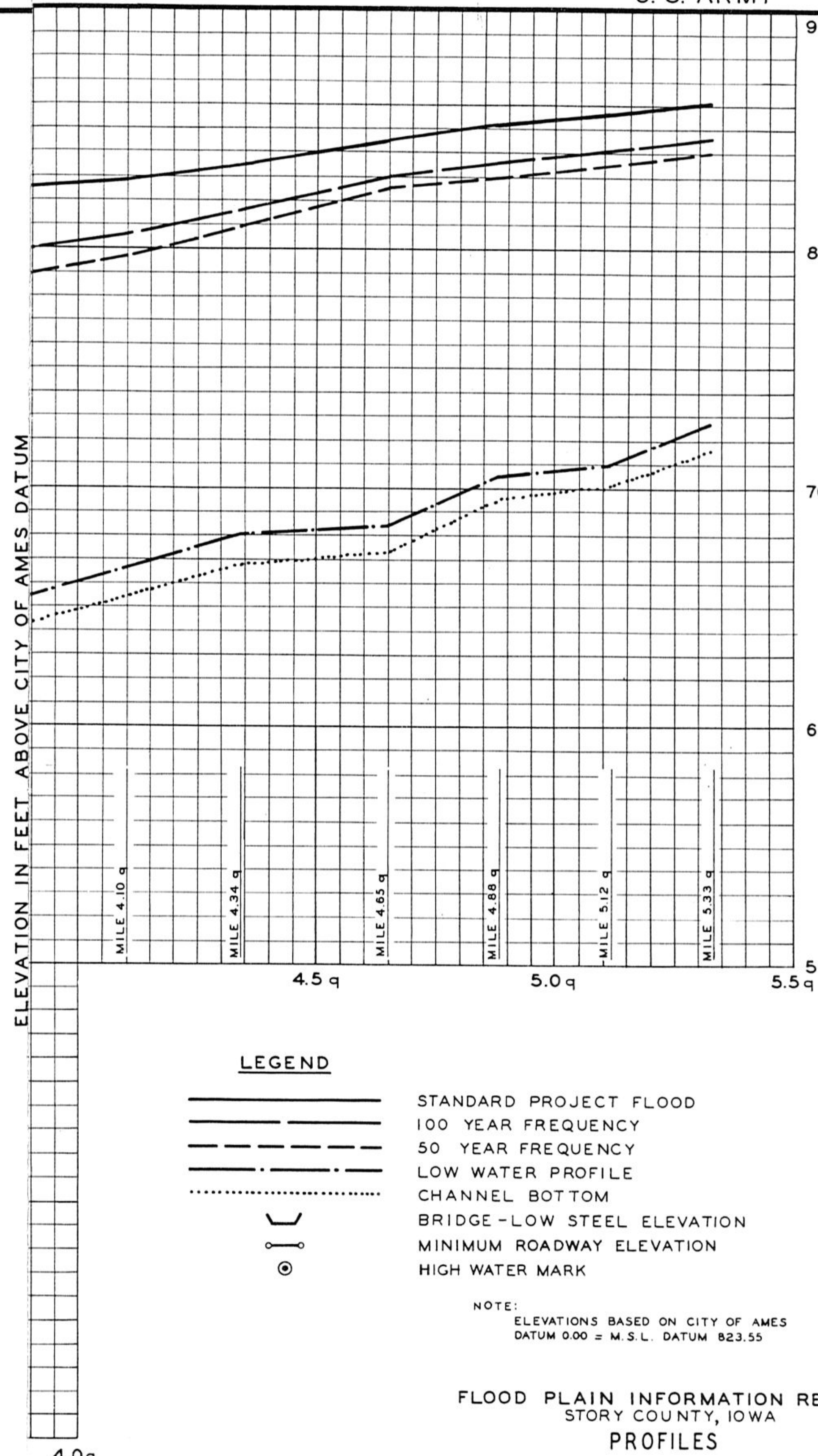
REAM
-1.5
MILE -1.42
MILE -1.15
-1.0
MILE -0.88
MILE -0.61
-0.5
HIGHWAY 30 BR.
MILE -0.34
16TH STREET BR.
MILE -0.17
U.S.G.S. GAGE
1960
1944
MILE 0.00
0.0
CONFLUENCE WITH
SQUAW CREEK
MILE 0.26
DISTANCE IN MILES ALONG SKUNK RIVER
0.5
MILE 0.53
1944
LINCOLN WAY BRIDGE
MILE 0.83
MILE 0.98
1.0


ELEVATION IN FEET ABOVE CITY OF AMES DATUM
90
80
70
60
50
40
30
-3.5
-3.0
-2.5
-2.0
DOWNSTREAM
INTERSTATE 35 BRIDGE
MILE -3.33
MILE -3.03
COUNTY ROAD BRIDGE
MILE -2.85
MILE -2.48
MILE -2.21
MILE -1.95
MILE -1.68

CORPS OF ENGINEERS




1958
1958
1958
1954
2.0q
2.5q
3.0q
3.5q
ROM MOUTH OF SQUAW CREEK
MILE 1.91
MILE 1.98 q
MILE 2.07 q
LINCOLN WAY BR.
MILE 2.28 q
MILE 2.44 q
C.&N.W.R.R. BR.
(SPURLINE) MI. 2.57 q
C.& N.W. R.R. BR.
MILE 2.59 q
6TH STREET BR.
MILE 2.63 q
MILE 2.74 q
MILE 2.87 q
MILE 3.07 q
13TH STREET BRIDGE
MILE 3.24 q
MILE 3.41 q
MILE 3.64 q
STANGE ROAD BRIDGE
MILE 3.84 q



NOTE:
ELEVATIONS BASED ON CITY OF AMES
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FLOOD PLAIN INFORMATION REPORT
STORY COUNTY, IOWA

PROFILES

SKUNK RIVER
MILE - 3.33 TO MILE 4.91

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