82d Congress, 1st Session - - - - - House Document No. 153

LITTLE CALUMET RIVER AND TRIBUTARIES, INDIANA

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED DECEMBER 19, 1950, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION ON A PRELIMINARY EXAMINATION AND SURVEY OF LITTLE CALUMET RIVER AND TRIBUTARIES, INDIANA, AUTHORIZED BY THE FLOOD CONTROL ACT APPROVED ON AUGUST 18, 1941

JUNE 4, 1951.—Referred to the Committee on Public Works and ordered to be printed with one illustration

---

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1951

84650

CONTENTS

	Page
Letter of transmittal	v
Comments of the Bureau of the Budget	v
Comments of the State of Indiana	vii
Comments of the Governor of Illinois	vii
Report of the Chief of Engineers, United States Army	1
Report of the Board of Engineers for Rivers and Harbors	5
Report of the district engineer:	
Syllabus	6
Authority	6
Scope of survey	7
Prior reports:	
Reports of the Corps of Engineers	7
Reports by other agencies	7
Description:	
General	8
Watershed	8
Stream	9
Valley	9
Tributaries	10
Topography	11
General geology	12
Stream slopes	12
Cross-sectional dimensions and channel flow capacities	12
Maps	13
Economic development:	
General	13
Population	14
Land use and development	14
Transportation facilities	14
Water supply and stream pollution	15
Climatology:	
Temperature	15
Precipitation	15
Notable storms	15
Runoff and stream flow data	16
Floods of record	17
Standard project flood	18
Extent and character of flooded areas:	
Areas subject to overflow	18
Bridges	20
Flood damages:	
General	20
Direct damages, flood of April 5–6, 1947	20
Indirect damages, flood of April 5–6, 1947	21
Flood damages of March 19–20, 1948	21
Separation of flood damages	22
Average annual damages	22
Summary of average annual damages	23
Existing Corps of Engineers flood-control projects: Existing project	23
Improvements by other Federal and non-Federal agencies	23
Improvement desired	25
Flood problems and solutions considered:	
General	27
Local areas	28

Report of the district engineer—Continued Page
Flood-control plans:
Main stem of Little Calumet River 30
Calumet Union Drainage System 31
Calumet Slough 32
Other water uses 32
Estimates of first costs and annual charges 33
Estimates of average annual benefits:
General 36
Little Calumet River—Plan A 36
Calumet Union Drainage Ditch—Plan B 38
Calumet Slough—Plan C 38
Total average annual benefits 38
Comparison of benefits and costs 38
Proposed local cooperation 39
Allocation of costs 39
Coordination with other agencies:
Coordination with Federal agencies 39
Coordination with State agencies 40
Coordination with local communities 40
Discussion 40
Conclusion and recommendations:
Conclusion 41
Recommendations 42
Recommendations of the division engineer 42

LIST OF TABLES

Table
1. Stream slopes, Little Calumet River 12
2. Estimated direct flood damages of April 5–6, 1947 21
3. Average annual direct damage, urban 23
4. Average annual direct damage, agricultural 23
5. Plan A—Estimated first cost and annual charges, channel improvements on Little Calumet River, Calumet-Sag Channel to Hart Ditch 34
6. Plan B—Estimated first cost and annual charges, channel improvements, Calumet Union Drainage Ditch—mouth to One Hundred and Seventy-first Street 35
7. Plan C—Estimated first cost and annual charges, channel improvement of Calumet Slough 36
8. Summary of first costs and annual charges 36
9. Average area flooded annually along Little Calumet River, with improvements proposed under Plan A 37
10. Summary of average annual flood-control benefits 38
11. Comparison of benefits and costs 39
12. Allocation of first costs and cost of maintenance 39

LIST OF ILLUSTRATIONS MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Only pl. 1 printed)

Plate
1. General map.
2. Detail map mile 0.0 to mile 10.73.
3. Detail map mile 10.73 to mile 24.17.
4. Detail map mile 24.17 to mile 36.10.
5. Little Calumet River profile, mile 0.0 to mile 35.00.
6. Calumet Slough—Calumet Union drainage ditch profiles.
7. Subsurface exploration.
8. Analysis curves.

LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY,
Washington 25, D. C., May 23, 1951.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated December 19, 1950, from the Chief of Engineers, United States Army, together with accompanying papers and an illustration, on a preliminary examination and survey of Little Calumet River and tributaries, Indiana, for flood control, authorized by the Flood Control Act approved on August 18, 1941.

In accordance with section 1 of Public Law 534, Seventy-eighth Congress, the views of the State of Indiana and the Governor of the State of Illinois are set forth in the enclosed communications.

The Bureau of the Budget advises that, while there is no objection to the submission of the report to Congress, the project should be considered to be of low priority. It states also that any estimate of appropriation for the initiation of this project, if authorized by Congress, must be justified in accordance with the policy set forth in the President's letter to the Secretary of the Army dated July 21, 1950, concerning curtailment of civil public works. The complete views of the Bureau of the Budget are set forth in the enclosed communication.

Sincerely yours,

FRANK PACE, JR.,
Secretary of the Army.

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., May 2, 1951.

The honorable the SECRETARY OF THE ARMY

(Through the Budget Officer for the Department of the Army).

MY DEAR MR. SECRETARY: Receipt is acknowledged of your letter dated December 27, 1950, submitting the report of the Chief of Engineers on Little Calumet River and tributaries, Indiana, authorized by the Flood Control Act approved August 18, 1941.

The Chief of Engineers recommends improvement of the Calumet Union Drainage System by enlargement of the drainage ditch; modification and replacement of certain appurtenant structures; replacement of four highway bridges, three road culverts, and one farm bridge; and modification of five railroad bridges, all at an estimated total cost of $1,149,800, of which $434,300 represents the Federal first cost. The total annual carrying charges are estimated at $60,300 and the

average annual benefits at $99,900, resulting in a benefit-cost ratio of 1.66.

The estimate of benefits is based on eliminating the damages caused by the overflow of the Calumet Union Drainage Ditch in an area comprising the towns of Harvey, Hazel Crest, Markham, Dixmoor, and Posen, Ill., and containing about 2,300 residences and 215 commercial establishments. The damages in this area caused by the greatest flood of record on April 6, 1947, are estimated at $977,400. The second highest flood of record occurred in March 1948.

It is reported that during floods of the magnitude of that which occurred in April 1947, the affected area is inundated to depths ranging up to 2 feet but that an estimated 35 percent of the resulting damage is attributable to inadequate local storm drainage systems. The assumed basis for this percentage is the ratio of the total volume of stream overflow from the ditch to the excess volume of runoff due to the inadequate storm drainage system in the town of Harvey as estimated for both the April 1947 and March 1948 floods. Although other towns are also assumed to be flooded, the calculations indicate that the total volume of runoff in excess of the overflow capacity of the drainage ditch is assumed to flow into the Harvey area and augment the excess runoff of that community's storm drainage system. As the figures indicate that the percentages of damage vary appreciably with the size of the flood and the assumed conditions, it is possible that the major and more frequest damage could be caused by the inadequacy of the local drainage system, and that any additional damage resulting from overflow of the drainage ditch should not properly be evaluated on a proportionate basis. The flood of April 1947 is rated to have a frequency occurrence of only once in 50 years and was considerably greater than any previous flood of record.

On the basis of information contained in the report, it is apparent that the proposed improvement would provide only a partial solution to the flood problems in the area. No protection would be provided against possible overflow of the Little Calument River and certain of its tributaries. Furthermore, unless appropriate remedial measures are taken, the relatively high and fairly frequent damages due to inadequate local storm drainage systems would not be eliminated by the proposed improvement.

In view of the afore-mentioned considerations, I am authorized by the Director of the Bureau of the Budget to advise you that, while there would be no objection to the submission of the report to Congress, on the basis of the information contained in the report, authorization of the proposed improvements for flood protection in the Little Calumet River Basin should be considered to be of low priority. If authorized by Congress, any estimate of appropriation for the initiation of this project must be justified in accordance with the policy set forth in the President's letter dated July 21, 1950, which directed that all civil public works be considered with the objective, as far as practical, of deferring, curtailing, or slowing down projects which do not directly contribute to defense or to civilian requirements essential in the changed international situation, or any modification of this policy.

Sincerely yours,

WILLIAM F. MCCANDLESS,
Assistant Director, Estimates.

COMMENTS OF THE STATE OF INDIANA

STATE OF INDIANA,
FLOOD CONTROL AND WATER RESOURCES COMMISSION,
Indianapolis 2, Ind., November 3, 1950.

Col. W. E. POTTER,
Acting Assistant Chief of Engineers for Civil Works,
Corps of Engineers, Department of the Army,
Office of the Chief of Engineers, Washington, D. C.

DEAR COLONEL POTTER: In regard to your note of October 27, 1950, addressed to Mr. John C. Mellett as secretary of the Indiana Flood Control and Water Resources Commission, I am taking the liberty of replying since I have become the executive secretary of this commission. Mr. Mellett is still a member of the commission but has relinquished duties as secretary since he was filling in in this position temporarily. The matter of the Little Calumet River and tributaries has been discussed at various times by the commission staff but since the work you mention has very little to do with the Calumet in Indiana, we have no special comment for or against it. I hope this will help clear your record.

There are, however, a number of projects in Indiana for which we have a great deal of interest and for which we are working with the Corps of Engineers district offices in Louisville, Chicago, and Detroit. I hope to be able to talk further about them with you before the budget for fiscal 1951–52 is started on its way.

Most sincerely,

ROBERT W. KELLUM, *Executive Secretary.*

COMMENTS OF THE GOVERNOR OF THE STATE OF ILLINOIS

STATE OF ILLINOIS,
OFFICE OF THE GOVERNOR,
Springfield, August 24, 1950.

The CHIEF OF ENGINEERS, UNITED STATES ARMY,
Washington 25, D. C.

DEAR SIR: Under date of May 25, 1950, the Chief of Engineers, United States Army, forwarded by letter to this office a proposed report on a preliminary examination and survey of Little Calumet River and tributaries, Indiana.

The subject report has been reviewed by the division of waterways and the State water resources and flood control board has concurred in the conclusions and recommendations of the division.

After consideration of the report and the reviews of same as prepared by the aforementioned State agency, the State finds that the proposed plan is generally satisfactory to the State of Illinois, provided that any necessary changes be accomplished through conferences prior to the completion of the definite project plan.

Subject to the above provision, the State concurs in the recommendations of the Chief of Engineers, United States Army.

Very truly yours,

ADLAI E. STEVENSON, *Governor.*

LITTLE CALUMET RIVER AND TRIBUTARIES, INDIANA

REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., December 19, 1950.

Subject: Little Calumet River and Tributaries, Indiana.
To: The Secretary of the Army.

1. I submit for transmission to Congress my report with accompanying papers on preliminary examination and survey of Little Calumet River and tributaries, Indiana, for flood control, authorized by the Flood Control Act approved August 18, 1941.

2. The Little Calumet River rises in the northwestern part of La Porte County, about 6 miles south of Michigan City, Ind., and flows generally westerly about 56 miles to its junction with the Calumet-Sag Channel at Calumet Park, Ill. The watershed contains 587 square miles, of which 205 are in Illinois and 382 in Indiana. Under normal flow conditions, the drainage from 340 square miles lying east of Hart Ditch, mile 16.22, has its outlet into Lake Michigan through an artificial channel, known as Burns waterway, at mile 35, while the remaining 247 square miles lying west, and inclusive, of Hart Ditch drains into the Calumet-Sag Channel. The upper 15 miles and the lower 16 miles of the stream valley are extremely narrow; while the middle portion, between Salt Creek and Hart Ditch, a distance of about 17 miles, ranges in width from 0.5 to 2 miles. The middle portion of the valley is extremely flat, and was originally a marsh. About half of it is now under cultivation and the remainder about equally divided between swampland, parks, and subdivisions. From the Illinois-Indiana State line to a point just west of Thorn Creek, the valley is extensively cultivated, principally as truck gardens while below Thorn Creek it is not in use. Major tributaries of the Little Calumet River are Salt Creek, Deep River, Hart Ditch, Thorn Creek, Calumet Union Drainage Ditch and Calumet Slough. The largest of these is Deep River which drains an area of about 152 square miles in the central part of the basin. The Calumet Union Drainage System comprises a number of small natural streams, drainage ditches, conduits, and pipe culverts which drain an area of 23 square miles in the vicinity of Harvey, Ill. The system discharges into the Little Calumet River through the Robey Street pipe at mile 2.06 and through the Calumet Union Drainage Ditch at mile 5.93. With the exception of sand bars, the river is relatively free of natural obstructions. Although numerous bridge piers obstruct the flow to some extent, the extremely flat gradient of the stream bed is the most serious impediment to channel flow. There are no existing Federal

84650—51——2

flood-control projects in the portion of the basin under consideration; however, a number of channel improvements have been made by local interests, beginning with the construction of Hart Ditch about 100 years ago, and by Federal relief agencies during the period 1933 through 1936. The major undertaking by local interests was the construction of Burns Ditch and Burns Waterway, completed in 1926 at a cost of about $1,035,000.

3. Population of the basin, based upon the 1940 census, is about 202,000, predominantly urban. Harvey, Ill., with a 1940 population of 17,878, is the largest community lying entirely within the basin, but the watershed also contains small areas of Gary and Hammond, Ind. The economic development of the watershed is closely interwoven with that of the somewhat larger area which has become a great industrial center known as the Calumet region, embracing all the territory along the Lake Michigan shore from South Chicago to Michigan City, with a southerly extension to the watershed divide. The most important industrial activities within the basin are at Harvey and Chicago Heights, Ill. They include the manufacture of drop forgings, iron castings, engines, cranes, and foundry and railroad equipment. The great industrial centers of South Chicago, Whiting, East Chicago, Hammond, and Gary are adjacent to the watershed. Along the southern and eastern margins of the basin, mixed farming and truck gardening predominate, with some dairying and stock raising. Transportation facilities are abundant.

4. The Little Calumet River is subject to floods as a result of heavy runoff on its tributaries, principally Hart Ditch and Thorn Creek. The flat, low-lying portions of the valley are flooded by snow melt in the spring and prolonged floods are caused by inadequate channel capacity which forces a large part of the water into temporary storage. The greatest flood of record on the river occurred as the result of intense rainfall over the basin on April 4 and 5, 1947. Other notable floods occurred in March 1908 and in March 1944. Along the main stream, principal flood damages occur in the reach between mile 6.26 and mile 28.49, where about 1,400 acres of agricultural land, 400 acres of marsh land, residential areas, and a subdivision are subject to overflow at maximum stages. Above and below this reach, channel capacities are generally sufficient to prevent appreciable flood damage. The greatest damages in the basin occur in Harvey and vicinity as a result of overflow from the Calumet Union Drainage Ditch and its extensions. Commercial and residential areas in Harvey south of the Grand Trunk Railway and west of the Illinois Central Railroad and principal portions of the residential suburbs of Hazel Crest, Markham, Dixmoor, and Posen are flooded to depths up to 2 feet. The Harvey industrial area east of the Illinois Central Railroad is only slightly flooded, due to protection afforded by the railroad embankment. About 2,300 residences and 215 commercial establishments are affected by the overflow. A number of highways and underpasses are frequently flooded. The other principal damage area is along Calumet Slough where a total of 100 residences and 20 commercial establishments in Oak Forest, Midlothian, and Robbins are affected by overflow of that tributary. A damage survey following the April 1947 flood indicated that direct damages from stream overflow and inadequate storm sewer systems totaled about $1,028,000 in the watershed, exclusive of nonrecurring damages in areas which

have since been protected by levees or by increased pumping capacity. In the area of the Calumet Union Drainage System, damages were estimated at $977,400. Indirect damages from the 1947 flood were estimated at $68,630, of which $56,740 were in the Calumet Union drainage system. Direct damages from the March 1948 flood were $143,600 for the watershed, including $139,200 in the Calumet Union Drainage System; indirect damages from the flood were negligible. Within the area of the Calumet Union drainage system it was determined that 65 percent of the damages were due to stream overflow and the remainder to inadequate storm sewer capacity. On this basis, average annual flood damages within the system area are estimated at $99,900. Average annual flood damages along the Little Calumet River are estimated at $20,800 and along Calumet Slough at $6,100.

5. Local interests generally desire flood control on the Little Calumet River and adequate drainage for the watershed. Interests in Illinois protest any improvements which would further decrease the normal dry-weather flow of the Little Calumet River to the west, and conservation interests in Indiana object to any improvement that would straighten the river and drain the marshes. The Gary Boat Club is interested in maintaining the normal flow from both branches of Burns Ditch through Burns Waterway, but desires that flood flows be diverted away from Burns Waterway. Officials of Harvey, Robbins, and Hazel Crest, Ill., request that consideration be given to drainage improvements which will afford relief to their respective communities.

6. The district engineer finds that, in general, flood problems in the Little Calumet River Basin arise both from stream overflow and from inadequate storm drainage systems. Damage due to the latter condition can be prevented only by major reconstruction of existing storm drains, the installation of sump pumps in individual basements, and extension of storm drains to those areas which now have none. The flood problem is complicated by the extreme flatness of much of the basin, the resulting sluggish character of most of the streams, and by the fact that the course of drainage has been repeatedly changed by man through construction of artificial channels. The unusual concentration of highway and railroad crossings, together with extensive urban and industrial developments, severely limit new construction for flood control. For these reasons and the lack of suitable reservoir sites on the tributaries no general over-all plan of flood control was found to be justified. Consideration of specific areas where local protection might be warranted led to the development of three plans, designated as A, B, and C. Plan A, for protection of the area east of Hart Ditch between Hammond and Gary, Ind., and Plan C for the region bordering on Calumet Slough, lack economic justification at the present time. Plan B provides for enlargement of the Calumet Union Drainage Ditch and some of its connections to carry the design flow, which ranges from 650 cubic feet per second at Hazel Crest to 2,000 cubic feet per second at the mouth and has an estimated frequency of occurrence of once in 50 years. In the reach between One Hundred and Seventy-first Street and One Hundred and Sixty-ninth Street in Hazel Crest, the plan contemplates enlargement of the channel to a bottom width of 20 feet and an average depth of 10 feet. Concrete culverts would

replace existing pipe culverts at six street crossings. To provide surcharge at the entrance of the existing conduit, at One Hundred and Sixty-ninth Street and Dixie Highway, thereby increasing the capacity of the conduit to 650 cubic feet per second, levees ranging from 2 to 3 feet in height would be constructed for a distance of about 600 feet upstream of the intake, and the concrete headwall at the intake would be raised about 2 feet. The existing conduit extending along Dixie Highway from One Hundred and Sixty-ninth Street to One Hundred and Sixty-first Street would not require enlargement. In the reach between the outlet of the conduit and the junction with the Robey Street pipe, a distance of 300 feet, the channel would be enlarged to a bottom width of 25 feet and a depth of 10 feet. A hand-operated drainage gate would be installed at the inlet to the Robey Street pipe to prevent flood flows from entering the pipe, and to provide capacity for storm drainage which enters the pipe below the inlet. A 3-foot concrete weir would be constructed in the channel just downstream of the Robey Street pipe to divert low flows, polluted by partially untreated sewage, into the pipe. Bridge modifications would not be required in this reach. Downstream from the Robey Street pipe, the Calumet Union Drainage Ditch would be enlarged to bottom widths ranging from 12.5 to 20 feet, with depths of 11 to 16 feet and variable side slopes. Low spots along the bank would be raised by levees having a height of 2 to 4 feet. Four highway bridges, three road culverts, one farm bridge, and one foot bridge would be replaced; five railroad bridges would be modified, and 3 miles of power lines relocated. The existing 60-inch conduit between Robey Street and Park Avenue would be removed. Hydraulic design of the channel provides for a freeboard of 2 feet. Concrete paving would be provided under all bridges. Excavated material would be deposited along the banks. No collateral benefits attributable to purposes other than flood control would accrue to the plan of improvement. The estimated first cost of plan B is $1,149,800, of which $434,300 would be Federal for channel improvements and railroad bridge modifications and $715,500 would be the cost to local interests for highway and foot bridge modifications, power line relocation, and rights-of-way. Annual carrying charges are estimated at $60,300, of which $17,100 would be Federal and $43,200, non-Federal. The average annual benefits are estimated at $99,900 from the elimination of flood damages. The benefit-cost ratio is 1.66. The district engineer therefore recommends that a flood-protection project be adopted to provide for improvement of the Calumet Union Drainage System, Illinois, in the Little Calumet River Basin, in general conformity with plan B of his report at an estimated cost to the United States of $434,300 for construction, subject to the condition that local agencies furnish assurances satisfactory to the Secretary of the Army that they will (*a*) Bear the cost of and be responsible for modification of all highway and foot bridges and relocation of all utilities; (*b*) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the channel improvements and deposition of the spoil; (*c*) hold and save the United States free from damages resulting from the construction works; (*d*) establish and enforce regulations satisfactory to the Secretary of the Army designed to prevent encroachments on the improved channel; and (*e*) main-

tain the project works, after completion, in accordance with regulations prescribed by the Secretary of the Army. The division engineer concurs.

7. The Board of Engineers for Rivers and Harbors, having afforded local interests an opportunity to present additional information, concurs generally with the reporting officers and recommends adoption of a flood-control project in general accordance with plan B of the district engineer, subject to certain conditions of local cooperation.

8. After due consideration of these reports, I concur in the views of the Board and accordingly recommend that a flood-control project be adopted for the Little Calumet River, Ill. and Ind., to provide for improvement of the Calumet Union drainage system, Illinois, generally in accordance with plan B of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $434,300 for construction, subject to the condition that responsible local interests furnish assurances satisfactory to the Secretary of the Army that they will: (*a*) Make all necessary modifications to highway and foot bridges, and relocate all utilities as required; (*b*) provide without cost to the United States all lands, easements, rights-of-way, and spoil-disposal areas necessary for construction of the project; (*c*) hold and save the United States free from damages due to the construction works; (*d*) establish and enforce regulations designed to prevent encroachments on the improved channel; and (*e*) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

LEWIS A. PICK,
Major General,
Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

[Second endorsement]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington 25, D. C., April 19, 1950.

Subject: Little Calumet River and Tributaries, Indiana.
To: The Chief of Engineers, United States Army.

1. Local interests were advised of the nature of the district and division engineers' reports and were afforded opportunity to furnish additional information to the Board. Careful consideration has been given to the communications received.

2. The Board, after due consideration of the reports of the district and division engineers, concurs generally in the views of the reporting officers. A comprehensive flood-control project for the Little Calumet River Basin cannot be justified by the prospective benefits. Of the plans developed by the district engineer for the protection of specific flood areas, only that for improvement of the Calumet Union Drainage System is economically feasible at this time.

3. The Board accordingly recommends that a flood-control project be adopted for the Little Calumet River, Ill. and Ind., to provide for improvement of the Calumet Union Drainage System, Illinois, generally in accordance with plan B of the district engineer, and with

such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $434,300 for construction, subject to the condition that responsible local interests furnish assurances satisfactory to the Secretary of the Army that they will: (*a*) Make all necessary modifications to highway and foot bridges, and relocate all utilities as required; (*b*) provide without cost to the United States all lands, easements, rights-of-way, and spoil-disposal areas necessary for construction of the project; (*c*) hold and save the United States free from damages due to the construction works; (*d*) establish and enforce regulations designed to prevent encroachments on the improved channel; and (*e*) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

For the Board:

J. S. BRAGDON,
Brigadier General,
Chairman.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The district engineer finds that the only feasible and economically justifiable plan of improvement for reducing flood losses in the Little Calumet River Basin at the present time is channel enlargement of the Calumet Union Drainage Ditch, a tributary of the Little Calumet River. He recommends channel improvements on the Calumet Union Drainage Ditch at an estimated first cost to the United States of $434,300 for construction, provided that local interests give assurances satisfactory to the Secretary of the Army that the requisite local cooperation, as described within the report, will be provided.

CORPS OF ENGINEERS, UNITED STATES ARMY,
OFFICE OF THE DISTRICT ENGINEER,
CHICAGO DISTRICT,
Chicago, Ill., August 15, 1949.

Subject: Report on Little Calumet River and tributaries, Illinois and Indiana, for flood control.

Through: The Division Engineer, Great Lakes Division, Corps of Engineers, Chicago, Ill.

To: The Chief of Engineers, United States Army, Washington 25, D. C.

AUTHORITY

1. This report is submitted in compliance with an item contained in section 4 of Public Law 228, Seventy-seventh Congress, first session, approved August 18, 1941 (Flood Control Act of 1941). A verbatim statement of the authorization is quoted as follows:

> The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas * * * which include the following-named localities, and the Secretary of Agriculture is authorized and directed to cause preliminary examinations and surveys for run-off and water-flow retardation and soil-erosion prevention on such drainage areas:
>
> * * * * * * *
>
> Little Calumet River and tributaries, Indiana.
>
> * * * * * * *

2. The Board of Engineers for Rivers and Harbors reviewed the preliminary examination report, dated January 15, 1943, and, on

November 8, 1943, recommended a survey to determine the advisability and cost of improvement and the local cooperation required, which was authorized by the Chief of Engineers on June 5, 1945.

SCOPE OF SURVEY

3. This report considers the flood problems of the Little Calumet River and its tributaries upstream from its junction with the Calumet-Sag Channel in Illinois. No flood problems of consequence have been found along the Little Calumet River lakeward of its junction with Calumet-Sag Channel.

4. In connection with this report, a field survey, including valley and channel cross sections, profiles, bridge data, and high water data, was made of the Little Calumet River from Calumet-Sag Channel to Salt Creek, of Hart Ditch from its mouth to Illinois State Highway 1, of the Calumet Union Drainage Ditch from its mouth to Hazel Crest, Ill., and of the Calumet Slough from its mouth to Oak Forest, Ill. Auger borings were obtained along the Calumet Union Drainage Ditch and Calumet Slough. The field survey was supplemented by data obtained from the Illinois Division of Waterways. Flood damage surveys were made in areas affected by floods on the Little Calumet River, Calumet Union Drainage Ditch, and Calumet Slough. The office studies undertaken for this report include hydrologic and hydraulic studies, channel design and bridge alterations, quantity and cost estimates, and estimates of average annual damages and benefits. Mileages on the Little Calumet River are referred to its junction with Calumet-Sag Channel; elevations are in feet above mean sea level datum (1929 adjustment).

5. Conferences were held with the United States Fish and Wildlife Service, the Soil Conservation Service, the United States Public Health Service, the Illinois Division of Waterways, the Indiana Flood Control and Water Resources Commission, the city of Harvey, Ill., and other communities. (See pars. 77 to 81.)

PRIOR REPORTS

6. *Reports of the Corps of Engineers.*—No reports for flood control on the Little Calumet River, other than the preliminary examination report, prepared under the afore-mentioned authority, have been submitted by the Corps of Engineers. The preliminary examination report, dated January 15, 1943, found that flood problems of importance existed in the area adjacent to the Little Calumet River, that detention reservoir sites were lacking, and that it appeared probable that a plan to reduce flood damage involving channel enlargement and levee construction would have economic justification and could be developed. A survey was recommended.

7. *Reports by other agencies.*—The following reports have been prepared by agencies other than the Corps of Engineers.

(*a*) Description of the engineering features of Burns Ditch by Mr. Ray D. Hammons, published in Engineering-News Record for March 12, 1925.

(*b*) Report on Little Calumet River conditions From the Head of Burns Ditch to the Head of the Sag Canal with Suggested Improvements, by Col. A. P. Melton, in December 1927.

(*c*) Report entitled "Little Calumet River-Burns Ditch Condensed History and Synopsis of Present Conditions," by Mr. L. E. Alswede (Illinois Division of Waterways), in February 1936.

(*d*) Preliminary Report of Little Calumet River, Lake County, Indiana, by the Soil Conservation Service, in November 1939.

(*e*) A report and plan for enlarging the Little Calumet River in the area bounded by Hammond, Munster, and Highland, Ind., by Mr. B. C. Wooley, in 1940.

(*f*) Report on enlarging the Little Calumet River from the head of Burns Ditch to the Illinois-Indiana State line, by Mr. Leo Besozzi (consulting engineer, Hammond, Ind.), in December 1940.

(*g*) A preliminary report entitled, "Floods Little Calumet River Basin September 1942 to May 1947" by the Indianapolis district of the United States Geological Survey, dated May 1947.

(*h*) A preliminary examination report for flood control, Little Calumet River Basin in Illinois, dated December 1948, by the Division of Waterways, State of Illinois.

DESCRIPTION

8. *General.*—The history of the Little Calumet River indicates that in prehistoric time during high-level lake stages, when the shore line was considerably farther inland than at present, the stream, following its present course, entered Lake Michigan at Riverdale, Ill. As the lake levels were lowered and the shore line receded, the constant wave action formed sand bars across the mouth of the stream, thereby steadily shifting the mouth southeastward a distance of some 14 miles to a point north of the former town of Miller, now a part of Gary, Ind. The upper (Little Calumet River) and lower (Grand Calumet River) parts of the stream then flowed in parallel but opposite directions, separated only by a narrow barrier consisting of alternating sand ridges and lagoons. Frequently the mouth of the stream, north of Miller, was nearly closed by sand drift. Subsequent to 1870, an artificial channel (Calumet River) dredged from Lake Michigan, just north of the State line, to the present mouth of Grand Calumet River, reversed the flow of the lower part (Grand Calumet River) of the stream, compelling it to flow westward like the upper part. Flow of both parts of the stream then entered Lake Michigan through the artificial channel (Calumet River) and the former mouth near Miller disappeared. The completion of the Calument-Sag Channel, in 1922, connecting the Little Calumet River at Riverdale with the Chicago Sanitary and Ship Canal at Sag Junction, changed the flow of that reach of the river between its junction with the Calumet-Sag Channel and the Grand Calumet River, so that it now has a gentle reverse flow (away from the lake), except during heavy rains, floods, or sudden fluctuations of the lake level. The completion of Burns Ditch and Burns Waterway, in 1926, provided a second outlet for the Little Calumet River into Lake Michigan at a point about 10 miles east of the center of Gary, Ind.

9. *Watershed.*—The watershed above the junction with the Calumet-Sag Channel contains 587 square miles, of which 205 square miles are in Illinois (Cook and Will Counties), and 382 square miles are in Indiana (La Porte, Porter, and Lake Counties). Under normal flow conditions the drainage from 340 square miles of the watershed lying

east of Hart Ditch has its outlet into Lake Michigan through Burns Waterway, whereas the remaining 247 square miles lying west, and inclusive, of Hart ditch drains into the Calumet-Sag Channel. The watershed area, roughly rectangular in shape, has a maximum length and width of 47 and 22 miles, respectively. The divide between the Grand Calumet River and the Little Calumet River consists of a sand ridge about a mile wide and about 30 feet above the level of Lake Michigan. The divide between the area drained by the Little Calumet River and the area drained by the Kankakee and Des Plaines Rivers is part of the Valparaiso morainic system.

10. *Stream.*—The Little Calumet River rises in the northwestern part of La Porte County, about 6 miles south of Michigan City, Ind. Prior to construction of Burns Ditch and Burns Waterway, the stream flowed westerly, approximately parallel to the south shore of Lake Michigan and only a few miles from it, through Porter and Lake Counties; thence northwesterly through Cook County to its junction with the Calumet-Sag Channel. The total length of the stream in this meandering course was about 65 miles. Its present length is about 56 miles.

11. Since the completion of Burns Ditch and Burns Waterway in 1926, the flow of that part of the stream lying east of Burns Waterway is diverted through an eastern arm (Salt Creek arm) of Burns Ditch to Burns waterway and thence into Lake Michigan. At about mile 23 the flow of the Little Calumet River has been reversed in an easterly direction through the Gary arm and main arm of Burns Ditch to Burns Waterway and into Lake Michigan. Direction of flow in the stream between Hart Ditch (mile 16.22) and the head of the Gary arm (mile 23) is dependent upon stages at the mouth of Hart Ditch. During flood periods, runoff from Hart Ditch is divided, a considerable portion flowing eastward across the summit to remain in temporary storage while the remainder flows downstream (westward). When stages recede some of the water in temporary storage recrosses the summit to flow downstream (westward) while the remainder flows eastward through Burns Ditch and Burns Waterway into Lake Michigan. West of Hart Ditch, the flow of the stream follows the same course as that prior to diversion through Burns Waterway. The stream above Calumet-Sag Channel is not navigable, except by rowboats. Numerous sand bars fill the channel. Other obstructions are chiefly piers, trestle, pipelines, and culverts.

12. *Valley.*—The Little Calumet River Valley from its headwaters to Salt Creek, about 15 miles in length, is extremely narrow averaging about 800 feet in width. In the portion of this reach above Chesterton, Ind., crop and pasture lands predominate with a few swampy areas. Between Chesterton and Salt Creek practically the entire valley is swampy. The valley from Salt Creek to Hart Ditch, about 17 miles in length, is narrow, ranging in width from one-half to 2 miles. The area is extremely flat and was originally a marsh. At present, about half of this area is under cultivation and the remainder is about equally divided between swampland, parks, and subdivisions. From Hart Ditch to the confluence with the Calumet-Sag Channel, a distance of about 16 miles, the valley is extremely narrow, in some places being not over 500 feet in width. From Hart Ditch to the Illinois-Indiana State line a portion of the area has been developed into parks and subdivisions, and from the State line to a point just

west of Thorn Creek the area is extensively cultivated (principally truck gardening). The remainder of the area, between Thorn Creek and the Calumet-Sag Channel, is not in use.

13. *Tributaries.*—The major tributaries of the Little Calumet River are Salt Creek, Deep River, Hart Ditch, Thorn Creek, Calumet Union Drainage Ditch, and Calumet Slough.

(*a*) Salt Creek, with its origin near Valparaiso, Ind., flows northwesterly to the Little Calumet River (mile 36.28), has a length of approximately 23.7 miles, and a fall of about 159 feet, or approximately 6.7 feet per mile. The watershed has an area of about 76 square miles and consists mainly of rolling agricultural land.

(*b*) Deep River, the largest tributary of the Little Calumet River has its source near Crown Point, Ind. It follows a meandering course, generally east and north to the Little Calumet River (mile 28.03). This stream has a length of 33.0 miles and a fall of 103 feet, or an average of approximately 3.1 feet per mile. The watershed has an area of about 152 square miles, and consists principally of rolling agricultural land. There are two dams on the stream, one at Hobart, Ind. (Hobart Dam), forming Lake George, and the other near the mouth (Earlwood Dam). Both pools created by the dams are used for recreation.

(*c*) Plum Creek formerly drained into North Creek, a tributary to Thorn Creek. However, the flow was very sluggish, and a diversion ditch (Hart Ditch) was constructed through a sand ridge in a northeasterly direction from Dyer, Ind., to the Little Calumet River, which increased the slope and velocity of the creek, thereby draining the adjacent marshy area. The present watercourse, comprising Plum Creek and Hart Ditch, is designated as Hart Ditch. This watercourse rises about 5 miles south of Crete, Ill., and flows in a northeasterly direction into Indiana where it joins the Little Calumet River at mile 16.22. The watercourse follows a rather straight alinement, and is about 24.6 miles in length. The fall is about 164 feet, or an average of approximately 6.7 feet per mile. The watershed has an area of 68 square miles, of which about 30 square miles consist of rolling land, and the remainder of flat land, almost all of which is farmed. A concrete dam, near the mouth, forms a pond used to supply water to an adjacent golf course.

(*d*) Thorn Creek rises near Crete, Ill., and flows northerly through Cook County emptying into the Little Calumet River at mile 8.70. The stream follows a meandering course and is about 16.8 miles in length. The fall is about 192 feet, or an average of 11.4 feet per mile. It has a drainage area of 107 square miles.

(*e*) The Calumet Union Drainage System comprises:

(1) A number of small, unnamed, natural streams and drainage ditches which drain the high ground southwest of Hazel Crest, Ill., and an area west of Harvey, Ill.

(2) A two-cell, 10 by 6 foot conduit extending from One Hundred and Sixty-ninth Street, Hazel Crest to near One Hundred and Sixty-first Street, Harvey. This conduit takes the flow from the small streams southwest of Hazel Crest.

(3) A short ditch which carries the flow from the two-cell conduit, and also the flow from a ditch system entering from the west, to One Hundred and Sixty-first and Robey Streets, where

the flow divides, into the conduits and open ditch described in subparagraphs (4) and (5) below.

(4) A 72-to 90-inch concrete pipe paralleling Robey Street and extending northward to the Little Calumet River, at mile 2.06.

(5) A 60-inch concrete pipe and an open overflow ditch adjacent thereto extending from Robey Street eastward along One Hundred and Sixty-first Street to a point just west of the Illinois Central Railroad, where the pipe and ditch merge into a single open ditch which continues easterly to an outlet into the Little Calumet River at mile 5.93.

The watershed comprises 23 square miles. The fall from near Flossmoor to the Little Calumet River is 110 feet over a distance of 7.3 miles, or an average of 15.1 feet per mile.

(*f*) Calumet Slough rises near Tinley Park, Ill., and flows in a northeasterly direction through Tinley Park, Oak Forest, Midlothian, and Robbins, Ill., to the Little Calumet River near mile 1.37. It has a length of 12.3 miles and a fall of 127 feet, or an average of 10.3 feet per mile. The drainage area totals 19 square miles.

14. *Topography.*—Elevations within the Little Calumet River watershed range from about 580 feet, at the junction of the Little Calumet River and the Calumet-Sag Channel, to about 870 feet, near Valparaiso, Ind. The maximum elevation attained in the northern divide is about 630 feet between the Little Calumet and Grand Calumet Rivers, and about 680 feet east of Burns Waterway. Along the southern divide elevations range from about 700 to 870 feet. Topographically the watershed may be classified in the following categories: terminal moraine ridges, ground moraines, and old lake plains.

(*a*) *Terminal moraine ridges.*—The Valparaiso moraine, which traverses the basin, is subparallel to the Lake Michigan shore line. The crest of this ridge is extremely irregular, and is part of the divide which separates the Little Calumet River basin from the Kankakee River basin. The moraine, being moderately to strongly rolling, has adequate drainage. Cultivated crops predominate, pasture and hay crops are subordinate, and only small areas remain in timber, principally on the steeper slopes near Valparaiso. The Tinley moraine is distinct from the Valparaiso moraine and lies between that moraine and the old lake plains. The southeastern portion of the Tinley moraine, in the vicinity of Flossmoor, is not well differentiated. Near South Chicago Heights and Steger, Ill., the moraine is again a definite upland. Farther east, however, the moraine loses its identity.

(*b*) *Ground moraines.*—The greater part of the area between the two terminal moraines is included within the area of ground moraines. This area includes extensive flat or very gently undulatory areas. This belt of flat lowland was once a string of shallow lakes. Swamp growths prevail in the depressions, while the better-drained areas are divided between cultivated crops and hay or pasture lands, with very little upland timber.

(*c*) *Old lake plains.*—The most marked and extensive land form east and north of the Tinley moraine is the area formerly covered by old Lake Chicago. This plain is characterized by undulating or practically flat terrain broken into broad shallow steps along the lines of old beach ridges. Natural drainage is extremely sluggish, and artificial drainage has been only moderately successful. The area

is predominantly urban in character. Woodlands are limited to forest preserves.

15. *General geology.*—The Wisconsin glacier, the latest invasion of ice, gave the region of the Little Calumet River watershed practically all of its present physiographic features. The area lies in what is known in a physiographic classification of the United States as the Central Lowland. Subdivision of this province places the watershed within the Lake Plain and the Valparaiso Upland.

16. Bedrock of the region is of the Niagaran formation, which consists of limestone and dolomite. Depths within the Lake Plain range from 0 to 130 feet below the surface in the vicinity of Chicago, and to 240 feet in northern Indiana. In the Valparaiso Upland, bedrock has been encountered at depths ranging from 30 to 295 feet.

17. Glacial drift comprises the greater bulk of the surface material over the area, and is ordinarily composed of a matrix of clay in which stones of various sizes and kinds are imbedded. Loess, though poorly developed in the region and ranging in thickness from a few inches to several feet, is the basis of most of the soils. Five main soil groups have been differentiated, based chiefly on their physical character, and are as follows: (1) fine soils, including loams and clays; (2) sandy soils; (3) dune sands; (4) bottomland soils, mainly alluvial; and (5) peat and muck.

18. *Stream slopes.*—From the junction of the Calumet-Sag Channel to its source, the rise of the Little Calumet River is about 100 feet. However, since construction of the Burns Ditch and Burns Waterway the average slopes have changed. Table 1 gives the average low water slope in the several reaches.

TABLE 1.—*Stream slopes, Little Calumet River*

Reach	Distance (miles)	Rise (feet) [1]	Average slope (feet per mile)
Calumet-Sag Channel to Thorn Creek	8.70	2.7	0.3 (westward flow).
Thorn Creek to State line	4.25	1.9	.4 (westward flow).
State line to Hart Ditch	3.27	3.1	.9 (westward flow).
Hart Ditch to mile 16.67 (summit)	.45	4.2	9.3 (westward flow).
Mile 16.67 to Kennedy Ave	.61	2.4	3.9 (eastward flow).
Kennedy Ave. to Broadway	8.02	.9	.1 (eastward flow).
Broadway to Pennsylvania R. R	1.24	1.6	1.3 (eastward flow).
Pennsylvania R. R. to Deep River	1.49	4.6	3.1 (eastward flow).
Deep River to Burns Waterway	6.97	2.1	.3 (eastward flow).
Burns Waterway to source	21	100	4.8 (westward flow).

[1] Rise is for average low water during 1946–47 period.

19. *Cross-sectional dimensions and channel-flow capacities.*—The channel of the Little Calumet River from Calumet-Sag Channel to Southeastern Avenue (mile 16.58), at bankfull stages ranges from 60 to 180 feet in width and from 4 to 22 feet in depth. In this reach the channel has been dredged to a minimum bottom width of 50 feet; however, some silting and shoaling has occurred since completion of dredging operations (see par. 54). From Southeastern Avenue to the head of the Gary arm of Burns Ditch (mile 23) the stream remains in its natural state, with an average channel width of 150 feet and depth of 3 feet at bankfull stage. Dimensions at bankfull stages in Burns Ditch average 75 feet in width and 13 feet in depth, and in Burns Waterway average 150 feet in width and 30 feet in depth. The Little Calumet River is relatively free of natural obstructions

although some rock has been found in the bed along the lower reaches of the stream. Although numerous bridge piers obstruct the flow to some extent, the extreme flat gradient of the stream bed is the most serious impediment to channel flow. The flow capacity of the channel at bankfull stage is as follows: at Calumet-Sag Channel, 1,700 cubic feet per second; at Thorn Creek, 1,300 cubic feet per second; at Hart Ditch, 500 cubic feet per second; at Gary Small Farms (mile 23), 200 cubic feet per second; at Deep River, 2,300 cubic feet per second; and in Burns Waterway, 3,000 cubic feet per second.

20. Channel dimensions of Calumet Union drainage ditch from its mouth to the Illinois Central Railroad (mile 2.09) range, at bankfull stage, from 25 to 47 feet in width and from 5 to 11 feet in depth. Upstream from the Illinois Central Railroad to mile 4.08, this stream is part of the system of drainage ditches, conduits, and pipes heretofore described in subparagraph 13e. Through Hazel Crest, from mile 4.08 to mile 4.56, the average width of the channel is 31 feet and the average depth is about 7 feet. The flow capacity of the channel, at bankfull stage, is estimated at 500 cubic feet per second in Hazel Crest, 600 cubic feet per second at the Robey Street pipe, and 1,000 cubic feet per second at the mouth.

21. The Calumet Slough channel, from its mouth to mile 6.82 in Oak Forest, ranges from 28 to 60 feet in width and from 3 to 6 feet in depth, at bankfull stages. The flow capacity of the channel ranges from 150 cubic feet per second to 600 cubic feet per second in the above reach.

22. *Maps.*—Only the northern and western portions of the watershed are covered by Geological Survey quadrange sheets. These include the Calumet Lake, Blue Island, Harvey, Calumet City, Tinley Park, Frankfort, Steger, and Dyer 7½-minute quadrangles, and the Tolleston, Porter, and Crete 15-minute quadrangles. In addition, the unpublished Peotone quadrangle (15-minute sheet) has been made available. Soil maps have been published for Will County in Illinois and Lake, Porter, and La Porte Counties in Indiana. A general map of the Little Calumet River Basin is included in this report as plate 1; other maps and drawings accompanying the report are as follows:

Plate 2 [1]—Detail map mile 0.0 to 10.73.
Plate 3 [1]—Detail map mile 10.73 to mile 24.17.
Plate 4 [1]—Detail map mile 24.17 to mile 36.10.
Plate 5 [1]—Little Calumet River profile mile 0.0 to mile 35.00.
Plate 6 [1]—Calumet Slough-Calumet Union drainage ditch profiles.
Plate 7 [1]—Subsurface exploration.
Plate 8 [1]—Analysis curves.

ECONOMIC DEVELOPMENT

23. *General.*—The economic development of the Little Calumet River watershed is closely interwoven with that of the somewhat larger area, which has become a great industrial center known as the Calumet region, embracing all the territory along the Lake Michigan shore from South Chicago to Michigan City, with a southerly extension to the watershed divide. Among the early industries which located in the region were a chemical company, a packing company, and an oil company. In 1888, the Standard Oil Co. purchased a

[1] Not printed.

a large tract of land on the present site of Whiting, Ind., and that year is regarded as the beginning of the industrialization of the Calumet region. The first steel plant was established in 1901 at Indiana Harbor, now East Chicago, Ind. In 1905, the United States Steel Corp. announced that a new plant was to be located on the south shore of Lake Michigan (later designated as Gary, Ind.) and this became the largest single steel plant in the world and the nucleus of a new industrial center.

24. *Population.*—The total population within the watershed, based upon the 1940 census, is about 202,000, predominantly urban. Harvey, Ill. (17,878), is the largest community lying entirely within the watershed. Small areas of the southern parts of Gary and Hammond, Ind., are within the watershed. Table 1A of the appendix [1] lists the 1940 population of all pertinent places. Town records reveal that the present population, in at least several of the communities, is practically double that of 1940.

25. *Land use and development.*—Mineral resources are rather limited in value and extent. Sand obtained from the ridges for use in building construction, quarrying of rock, and production of brick from local clay constitutes the present development. The most important industrial activities within the actual watershed boundaries are at Harvey and Chicago Heights, both in Illinois. These activities, principally of the "machine shop" variety, include the manufacture of drop forgings, iron castings, engines, cranes, foundry equipment, railroad equipment, and many others. Adjacent to the watershed are the great industrial centers at South Chicago, Whiting, East Chicago, Hammond, and Gary. The areas within the Chicago metropolitan district, with the exception of those used for industrial purposes, have been developed principally for residential use, interspersed with truck farms, forest preserves, and golf courses. Along the southern and eastern margins of the basin, mixed farming and truck gardens predominate with some dairy and stock raising.

26. *Transportation facilities.*—Due to convergence of routes on Chicago, transportation facilities are abundant. Through railroads crossing the basin include the New York Central; Chesapeake & Ohio; Wabash; Baltimore & Ohio; Pennsylvania; New York, Chicago & St. Louis (Nickel Plate); Grand Trunk; Erie; Chicago, Indianapolis & Louisville (Monon); Chicago & Eastern Illinois; Chicago, Milwaukee, St. Paul & Pacific; Illinois Central; and Chicago, Rock Island & Pacific. In addition, the basin is served by the following belt and terminal railroads: Elgin, Joilet & Eastern; Baltimore & Ohio Chicago Terminal; and Indiana Harbor Belt—and by the Chicago South Shore and South Bend interurban electric. A network of Federal and State highways covers the area. The most important of these include Lincoln Highway (U S 30), Ridge Road (U S 6), Dunes Highway (U S 12), U S 20, Florida-Canadian (U S 41), and Governors Highway (U S 54). The proposed Tri-State Parkway and Calumet Parkway, presently under construction, will traverse the basin upon completion. There are several municipal and commercial airports, fairly well distributed throughout the basin. A number of pipelines traverse the basin, all terminating in the petroleum refineries at East Chicago and Whiting, Ind. There are no navigation improvements on

[1] Not printed.

the part of the Little Calumet River or its tributaries considered within the scope of this report. A boat harbor for small recreational craft is maintained at the mouth of Burns Waterway by local interests.

27. *Water supply and stream pollution.*—Water obtained from Lake Michigan is used by a majority of the large communities. Gary and Hammond have direct intakes from the lake and supply several communities in Indiana and Illinois; other Illinois communities purchase water from Chicago. Water supply for other areas in the basin is obtained from wells. The Little Calumet River is badly polluted by sewage, especially in the Illinois section. Gary and Hammond have modern, efficient sewage-treatment works which discharge the effluents into the Grand Calumet River. Harvey and several smaller communities have interceptors connected to the sewage-treatment works of the Sanitary District of Chicago, the effluent of which is discharged into the Calumet-Sag Channel. Other communities, including Lansing and Hazel Crest, Ill., have either inefficient sewage-treatment plants or no plants and accordingly discharge raw or partially treated sewage in the Little Calumet River or its tributaries. These conditions are detrimental to public health at all times, and especially harmful following floods, when deposits of sewage are left in streets, yards, and basements.

CLIMATOLOGY

28. *Temperature.*—The average annual mean temperature over the watershed, based on records at four stations, is about 50° F. January, the coldest month, has a mean temperature of 25° F., and July, the warmest month, has a mean temperature of 73° F. The highest recorded temperature is 109° F. and the lowest minus 23° F. There is a normal growing season of about 174 days. The average date of the last killing frost in the spring is April 27, and that of the first in the autumn is October 18. Mean monthly and annual temperatures for stations within the watershed are listed in table 2A of the appendix.[1]

29. *Precipitation.*—The average annual precipitation over the watershed, based on records at seven stations, is about 34 inches. The annual rainfall has ranged from a minimum of about 18 inches to a maximum of about 51 inches. The average monthly and annual precipitation for stations within the watershed are listed in table 3A of the appendix.[1]

30. The annual snowfall over the basin has averaged about 30 inches, and has ranged from a minimum of 12 inches to a maximum of 54 inches.

31. *Notable storms.*—The storm of March 4–5, 1908, resulted in the second greatest flood of record on the Little Calumet River. Precipitation for stations of record adjacent to the watershed was not relatively heavy, the average being about 1 inch; however, the ground was frozen and covered with snow. Although the large volume of runoff was undoubtedly due to frozen ground conditions and snow melt, it is likely that rainfall exceeding 1 inch occurred over the center of the basin.

32. Heavy precipitation occurred on March 12–16, 1944, in connection with a low-pressure trough which extended from the lower

[1] Not printed.

Lakes region to Oklahoma. Precipitation over the Little Calumet River Basin ranged from 2.5 inches at Chicago Heights to 3.9 inches at Valparaiso. This storm produced the third greatest flood of record on the Little Calumet River.

33. On April 4–5, 1947, a storm with centers at Lockport and Wheaton, Ill., and La Porte, Ind., produced rainfall totaling about 6 inches in 42 hours, the greater portion of which fell in about 11 hours. The storm area extended across northeastern Missouri, southeastern Iowa, central and northern Illinois, northern Indiana, and southern Michigan. The most intense rainfall occurred over the lower Des Plaines River Basin, and practically over the entire Little Calumet River Basin. This storm resulted in the greatest flood of record on the Little Calumet River. An isohyetal map and mass precipitation curves of this storm, over the Little Calumet River Basin, are shown on plate 1A of the appendix.[1]

34. An intense storm of short duration occurred on March 19, 1948. This storm centered in the vicinity of Chicago. The maximum recorded rainfall at the Mayfair pumping station in Chicago was 5.3 inches during a period of 14 hours. Rainfall over the Little Calumet River Basin averaged less than 2 inches in the eastern portion, including Salt Creek and Deep River, and averaged over 2 inches in the western portion, including Hart Ditch, Thorn Creek, Calumet Union Drainage Ditch, and Calumet Slough.

35. Excessive precipitation was recorded over the Little Calumet River Basin during the period May 9–12, 1948. Recorded rainfall totaled 5.28 inches at La Porte, Ind., 4.60 inches at Valparaiso, Ind., and 4.40 inches at Chicago Heights, Ill. Runoff, resulting from this rainstorm, exceeded previous maximum records on Salt Creek, Deep River, and Burns ditch.

36. Other storms having intense precipitation are listed in the following tabulation, with amount of greatest point rainfall and the station:

December 17–21, 1895, Valparaiso, Ind., 5.90 inches; June 16–19, 1897, Hammond, Ind., 13.55 inches; September 27–October 2, 1927, Hobart, Ind., 6.32 inches.

RUNOFF AND STREAM-FLOW DATA

37. Sixteen stream-gaging stations have been established on the Little Calumet River and its tributaries, 13 by the Geological Survey, 1 by the Sanitary District of Chicago, and 2 by the Corps of Engineers. Pertinent data are listed in table 4A of the appendix.[1]

38. The maximum discharge recorded on the Little Calumet River at the North Harvey gage prior to diversion through Burns waterway was 5,840 cubic feet per second on March 6, 1908, and subsequent to diversion was 4,304 cubic feet per second on March 16, 1944. The maximum discharge of record and date of occurrence at other locations are as follows:

[1] Not printed.

Location	Cubic feet per second	Date
Little Calumet River at Porter, Ind	2,440	June 28, 1945
Burns Ditch at Gary, Ind	2,670	May 11, 1948
Salt Creek near McCool, Ind	2,520	Do.
Deep River at Hobart, Ind	2,900	Do.
Hart Ditch at Munster, Ind	2,450	Apr. 6, 1947
Thorn Creek at Thornton, Ill	[1] 6,500	Do.
Calumet Union Drainage Ditch at Hazel Crest, Ill	[1] 650	Apr. 5, 1947
Calumet Slough at Blue Island, Ill	[1] 1,000	Do.
Little Calumet River at Calumet-Sag Channel	[1] 6,800	Apr. 6, 1947

[1] Discharge computed by slope-area method.

39. The minimum discharge recorded on the Little Calumet River at the North Harvey gage, prior to diversion through Burns Waterway, was 37 cubic feet per second, and subsequent to diversion was 2 cubic feet per second. Other recorded low flows are as follows:

	Cubic feet per second
Little Calumet River at Porter, Ind	18
Burns Ditch at Gary, Ind	1.8
Salt Creek near McCool, Ind	20
Deep River at Hobert, Ind	5.8
Hart Ditch at Munster, Ind	1.2

FLOODS OF RECORD

40. The Little Calumet River is subject to floods as a result of heavy runoff on its tributaries, principally Hart ditch and Thorn Creek. Snow melt over the basin in the spring causes the streams to rise, and the flat low-lying portions of the Little Calumet River Valley are flooded several days or, in some instances, even weeks. Prolonged flood duration is also caused by inadequate channel capacity which forces a large part of the water into temporary storage. Since establishment of the stream-gaging station on the Little Calumet River at North Harvey in 1907, there have been 51 instances during which the discharge has exceeded 1,700 cubic feet per second (bankfull stage); of these, 33 occurred in February, March, or April, the majority associated with spring break-ups. Available discharge data on these floods are given in table 5A of the appendix.[1] The flood of April 5–6, 1947, was estimated to have a frequency equal to 1 percent chance of occurrence in 1 year, based on Gumbel's method of estimating flood frequencies described in paragraph 5 of the appendix.[1] Based upon the above flood-frequency data and estimated discharges (see par. 6a of the appendix [1]), a synthetic frequency-discharge relationship shown on plate 8 was developed for the Little Calumet River at mile 8.10 (drainage area of 189 square miles), which was considered the control station for estimating stage-damage values.

41. In the absence of discharge data for Calumet Union Drainage Ditch and Calumet Slough, the probable discharges corresponding to different frequencies shown on plate 8 have been computed by the relationship of estimated maximum discharges on these tributaries to the computed maximum discharge on the Little Calumet River during the flood of April 5–6, 1947, and by graphs showing the relation between rainfall intensity and frequency. The results of this study

[1] Not printed.

indicate that the flood of April 5–6, 1947, has a frequency equal to 2 percent chance of occurrence in 1 year on these streams.

STANDARD PROJECT FLOOD

42. Flood flows causing damages along the main stem of the Little Calumet River are due principally to discharges from Hart Ditch and Thorn Creek. From available stream-gaging records for Hart Ditch it was possible to derive unit hydrographs and estimate a standard project flood for Hart Ditch. Absence of stream-gaging records for Thorn Creek did not permit similar derivation and estimate for Thorn Creek. However, it was considered that the estimate of the standard project flood for Hart Ditch was applicable to Thorn Creek on a basis of direct proportion to their respective drainage areas. Inasmuch as flood problems along Calumet Union Drainage Ditch and Calumet Slough concern needed improvements to local storm drainage systems as well as remedial measures to inadequate stream channels, and flood damages resulting from Deep River and Salt Creek flows were insignificant, standard project flood estimates were not considered applicable thereto and, accordingly, no estimates were made.

43. *Standard project flood.*—In accordance with the procedure outlined in paragraph 7 of the appendix,[1] the peak value of the provisional standard project flood for Hart Ditch was estimated at 12,700 cubic feet per second. Based upon direct proportion of the drainage areas, the provisional standard project flood for the Thorn Creek Basin is estimated at 20,000 cubic feet per second. The provisional standard project flood estimate for Hart Ditch is so greatly in excess of the maximum flow of record on that stream (2,450 cubic feet per second), and so far beyond the discharge for which economically justifiable plans might be developed, that the design flows for the plans of improvement developed hereinafter have been limited to the maximum flows of record for each of the streams considered, and are as follows:

	Cubic feet per second
Little Calumet River (at elevation of Apr. 5–6, 1947, high water and including 1,700 cubic feet per second from Hart Ditch flowing east under natural conditions):	
At Hart Ditch	2,500
At junction with Calumet-Sag Channel	8,500
Calument Union Drainage Ditch:	
At Hazel Crest	650
At 161st St	[1] 1,600
At mouth	[1] 2,000
Calumet Slough: At mouth	1,000

[1] Discharge based on direct ratio of drainage areas.

EXTENT AND CHARACTER OF FLOODED AREAS

44. *Areas subject to overflow.*—The principal areas subject to overflow along the Little Calumet River and its tributaries are outlined on plates 2, 3, and 4. The flooded areas are described in more detail in the subparagraphs which follow.

(*a*) *Main stem of Little Calumet River.*—The areas inundated along the main stem are indicated on plates 2,[1] 3,[1] and 4 [1] of the drawings. In the reach from the Calumet-Sag Channel to Chicago Road (mile

[1]Not printed.

6.26) in South Holland, Ill., the valley is narrow and not utilized, and although the banks are subject to overflow the damage due to floods is negligible. In the reach between Chicago Road and the Illinois-Indiana State line (mile 12.95), the area subject to overflow is extensively cultivated, primarily in truck crops. It is estimated that about 214 acres of cultivated land in the above reach are flooded at the maximum river stage of record; in addition, Burnham and Torrence Avenues are also frequently flooded. Between the Illinois-Indiana State line (mile 12.95) and the Pennsylvania Railroad (mile 26.54), agricultural land estimated to comprise 1,200 acres, a small section of residential area of Hammond in the vicinity of Kennedy Avenue, the Gary Small Farms subdivision, south of Gary, and Southeastern Avenue are subject to overflow by the Little Calumet River at the maximum stage of record. The Gary Small Farms subdivision is sparsely settled and, although well suited for truck farming, if drained, is now practically a marsh. As shown on the maps, levees, including some recently constructed, and spoil banks protect residential areas in Hammond against direct overflow of the river, although their freeboard in some places for the maximum flood of record is very limited. Likewise, Wicker Memorial Park and an adjoining area to the east, as well as Gleason Park in the southern part of Gary, are similarly protected by levees. Increased pumping capacity, completed in 1949, at storm-sewer outfalls to the Little Calumet River in Hammond is expected to alleviate the flood damages previously experienced in residential areas due to blocked drainage at times of high river stages. An area of about 400 acres between the Pennsylvania Railroad (mile 26.54) and the New York Central Railroad (mile 28.49) is subject to flooding by backwater from Deep River, but this area is marshy and of little value for agriculture. East of the New York Central Railroad channel capacities are generally sufficient to prevent appreciable flood damage.

(*b*) *Thorn Creek.*—In the lower 4 miles between the mouth and Thornton, Ill., an area of about 245 acres devoted to agricultural purposes is affected by combined overflow from Thorn Creek and backwater of the Little Calumet River. Above Thornton, the creek flows through several urban areas and forest preserves, causing negligible flood damages thereto. Deer Creek, a tributary of Thorn Creek, overflows small agricultural areas, the small community of East Chicago Heights, and the Lincoln Highway (U S 30).

(*c*) *Calumet Union Drainage System.*—Overflow from the Calumet Union Drainage Ditch and its extensions floods the areas indicated on plate 2[1] of the drawings to depths ranging up to 2 feet. These areas, in general, comprise the commercial and residential portions of Harvey south of the Grand Trunk Railway and west of the Illinois Central Railroad, and the principal portions of the residential suburbs of Hazel Crest, Markham, Dixmoor, and Posen. The Harvey industrial area east of the Illinois Central Railroad is only slightly flooded, due to the overflow being partially blocked by the railroad embankment. About 2,300 residences of moderate value and 215 commercial establishments are affected by the overflow. A number of highways and underpasses are frequently flooded.

(*d*) *Calumet Slough.*—Overflow from Calumet Slough inundates the area shown on plate 2 of the drawings. In general, the major

[1] Not printed.

portion of the village of Robbins is affected, together with a substantial section of Midlothian and a small area in Oak Forest. It is estimated that a total of 100 residences and 20 commercial establishments are affected, of which those in Oak Forest and Midlothian are of moderate average value and those in Robbins of low average value. Several highways and underpasses are frequently inundated.

(e) *Other tributaries.*—It was found that no areas of consequence are flooded along Hart Ditch, Deep River, and other tributaries to the east.

45. *Bridges.*—Tables 7A to 9A of the appendix [1] list the bridges and detailed data on the Little Calumet River, Calumet Union Drainage Ditch, and Calumet Slough within the area subject to floods. On the Little Calumet River 4 highway bridges, 2 foot bridges, and 1 sewer line have elevations of low structure ranging up to 2.3 feet below high water of record. On the Calumet Union Drainage Ditch 3 highway bridges, 7 culverts, 1 farm bridge, 1 foot bridge, and the concrete conduit have elevations of low structure ranging up to 4.5 feet below high water. On the Calumet Slough 4 railroad, 11 highway or street, 1 farm, and 7 foot bridges, and 5 culverts, have elevations of low structure ranging up to 5.4 feet below high water.

FLOOD DAMAGES

46. *General.*—Subsequent to the major storm and flood of April 5–6, 1947, a damage survey was made for the Little Calumet River and its tributaries. Canvass was made of all industries and commercial establishments. Residential damage was obtained by distribution of damage forms and by canvass. Only 20 percent of the occupants of affected residences returned completed forms. To obtain an estimate of the remainder, canvass of typical areas was made in order to determine average damage for the several residential districts. Agricultural damages were negligible, inasmuch as the planting season had not started. A damage survey was also made following the storm and flood of March 19–20, 1948.

47. *Direct damages, flood of April 5–6, 1947.*—As a result of the damage survey following the April 1947 flood, it was ascertained that the direct damages resulting from direct overflow of the streams and from the inadequate storm-sewer systems totaled approximately $1,027,800 over the Little Calumet River watershed exclusive of damages in portions of Hammond which have since been protected against flooding by levees and by increased pumping capacity now under construction at storm-sewer outfalls. A summary of these damages is given in table 2.

[1] Not printed.

TABLE 2.—*Estimated direct flood damages of Apr. 5–6, 1947*

Stream	Residential	Commercial	Manufacturing	Public buildings	Public services	Subtotal	Total
Little Calumet River							$16,100
Hammond	$12,100	0	0	0	0	$12,100	
Gary Small Farms	3,000	0	0	0	0	3,000	
Highways					$1,000	1,000	
Thorn Creek (Deer Creek)							7,400
East Chicago Heights	1,400	0	0	0	0	1,400	
Highways					6,000	6,000	
Calumet Union Drainage System [1]							977,400
Phoenix	13,000	$6,400	0	$1,000	0	20,400	
Harvey	685,000	167,300	$22,000	24,600	14,700	913,600	
Markham	11,500	200	0	0	0	11,700	
Posen	2,500	500	0	0	0	3,000	
Dixmoor	1,800	100	0	0	0	1,900	
Hazel Crest	20,500	1,900	0	0	2,400	24,800	
Highways					2,000	2,000	
Calumet Slough							26,900
Robbins	3,000	0	0	0	0	3,000	
Midlothian	9,200	3,200	0	0	0	12,400	
Oak Forest	2,700	6,800	0	0	0	9,500	
Highways					2,000	2,000	
Total (watershed)	765,700	186,400	22,000	25,600	28,100		1,027,800

[1] Includes damages due to inadequate sewer systems.

48. *Indirect damages, flood of April 5–6, 1947.*—The estimated indirect damages caused by the flood of April 5–6, 1947, are as follows:

(*a*) *Little Calumet River.*—The cost of pumping blocked drainage in Wicker Memorial Park in Highland, Ind., Woodmar Country Club in Hammond, and Gleason Park in Gary, totaled $3,500. Cost of traffic diversion due to inundated highways is estimated at $1,600. The total indirect damages on Little Calumet River are therefore estimated to be $5,100.

(*b*) *Calumet Union Drainage System.*—Red Cross expenditures for food, clothing, and shelter totaled $760 in Harvey, Hazel Crest, Markham, and Phoenix. Cost of replacement of equipment worn out in pumping water out of sewers in Hazel Crest totaled $780. Loss of earnings, including salaries and wages, to residents within Harvey, Hazel Crest, Phoenix, Markham, and Dixmoor totaled $22,200; loss of profits, not later realized, to commercial establishments in those communities totaled $29,600. Traffic diversion due to flooded highways and viaducts is estimated to have cost $3,400. The total indirect damages are thus estimated at $56,740.

(*c*) *Calumet Slough.*—Red Cross expenditures for food, clothing, and shelter totaled $690 in Robbins. Loss of earnings, including salaries and wages, to residents of Robbins, Midlothian, and Oak Forest, totaled $1,300; loss of profits, not later realized, to commercial establishments in those communities totaled $2,900. Cost of traffic diversion due to flooded highways and viaducts is estimated at $900. The total estimated indirect damages are hence $5,790.

(*d*) *Thorn Creek.*—The estimated cost of diverting traffic due to flooded highways is $1,000.

49. *Flood damages of March 19–20, 1948.*—A summary of the direct damages experienced as a result of the flood of March 19–20, 1948, follows; indirect damages caused by this flood were negligible.

Little Calumet River:		
Residential	$400	
Agricultural	200	
Total		$600
Calumet Union Drainage Ditch:		
Residential:		
Harvey	$134,500	
Hazel Crest	3,700	
Markham	200	
Public services: Hazel Crest	800	
Total		139,200
Calumet Slough:		
Residential:		
Oak Forest	$1,300	
Robbins	1,100	
Commercial	1,300	
Public services	100	
Total		3,800
Total		143,600

50. *Separation of flood damages.*—A method of estimating the portion of the total direct flood damages within the drainage area of the Calumet Union drainage system which are caused by bank overflow as opposed to those caused by inadequate storm sewers was developed, as explained in paragraphs 9 to 11 of the appendix,[1] on the basis of the volumes of impounded water due to each of these sources. On the afore-mentioned basis, the estimated average direct damages caused by overbank flow during the floods of April 1947 and March 1948 were 65 percent of the total direct damage. Hence, for the flood of April 5–6, 1947, the direct damage due to stream overflow was 65 percent of the $977,400 shown in table 2, or $635,300, and for the flood of March 19–20, 1948, the direct damage due to stream overflow was 65 percent of the $139,200 shown in the preceding paragraph, or $90,500. Hereinafter, in the development of average annual direct damages and average annual direct damages prevented on the Calumet Union Drainage System, only the damage due to stream overflow is considered.

51. *Average annual damages.*—(*a*) The average annual direct damage for various reaches was found by means of curves (see pl. 8[1] of the drawings) plotted to show (1) the frequency of occurrence of various discharges and consequently of the corresponding river stages; (2) damage as a function of stage; and, from these, (3) damage as a function of the frequency of occurrence. The derivation of flood frequencies is explained in paragraph 5 of the appendix.[1] The curves include seasonal curves based on variations in seasonal floods and in crop damage which is dependent on plant growth. Unit values of crop damage per acre due to floods which may occur during the periods April–May, June–July, and August–October, were based on data furnished by the Cook County Farm Bureau. Floods occurring during the November–March period were considered to cause negligible damage inasmuch as the crop season in the areas under consideration is practically limited to the April–October period. The analysis curves used to obtain the average annual area flooded were based on the peak discharge for each of the several periods during the year.

[1] Not printed.

The average annual direct damages here derived are those which would be caused by floods having an expected frequency of up to 1 percent chance of occurrence in 1 year on the Little Calumet River and 2 percent on the Calumet Union Drainage System and Calumet Slough.

TABLE 3.—*Average annual direct damage (urban)*

Stream	Average annual direct damage
Little Calumet River (including the backwater area along Thorn Creek)	$2,000
Calumet Union Drainage System	94,400
Calumet Slough	5,000

TABLE 4.—*Average annual direct damage (agricultural)*

Period	Average area flooded annually	Damage per acre	Average annua direct damage
Little Calumet River (including the backwater area along Thorn Creek):	*Acres*		
April-May	170	$5.50	$900
June-July	68	157.40	10,700
August-October	44	151.00	6,600
Total			18,200

(*b*) From the damage survey following the April 1947 flood a ratio between indirect and direct damages was determined. Applying this ratio to the average annual direct damages derived in the preceding subparagraph, the average annual indirect damages were found to be: (1) Little Calumet River, $600; (2) Calumet Union Drainage System, $5,500; and (3) Calumet Slough, $1,100.

52. *Summary of average annual damages.*—The total average annual damages are (*a*) $20,800 along the Little Calumet River, (*b*) $99,900 along the Calumet Union Drainage System, and (*c*) $6,100 along the Calumet Slough.

EXISTING CORPS OF ENGINEERS FLOOD-CONTROL PROJECTS

53. *Existing project.*—There are no existing Corps of Engineers flood-control or navigation projects in the portion of the Little Calumet River Basin under consideration.

IMPROVEMENTS BY OTHER FEDERAL AND NON-FEDERAL AGENCIES

54. The following is a summary of the improvements made by other Federal and non-Federal agencies on the Little Calumet River and its tributaries.

(*a*) About 1850, Aaron Hart, owner of swampland in the vicinity of Dyer, Ind., dug a ditch from a swamp, ineffectively drained by Plum Creek, northward through a sand ridge to a junction with the Little Calumet River. The shortening of the discharge route increased the gradient from less than 2½ feet per mile to nearly 20 feet per mile. Eventually, the ditch was deepened by erosion and lengthened completely across the swamp until it reached the upper portion of

Plum Creek, and thereupon became the uninterrupted course of the present creek known as Hart Ditch.

(*b*) Following a severe flood throughout Harvey in 1904, the Calumet Union Drainage District No. 1, in order to provide adequate drainage outlets for the watercourses which flowed through the city, constructed two open ditches which discharged into the Little Calumet River. One ditch, the Robey Street Branch, extended in a general northward direction from the vicinity of One Hundred and Sixty-first Street and the Dixie Highway to the Little Calumet River. The other ditch (the Calumet Union Drainage Ditch), extended easterly along One Hundred and Sixty-first Street to about Halsted Street, and thence in a northeasterly direction to the Little Calumet River. Subsequently, a concrete pipe ranging from 72 to 90 inches in diameter was laid in the bed of the Robey Street Branch and the channel was filled with earth. A 60-inch concrete pipe was laid along the north edge of the bed of the Calumet Union Drainage Ditch from its junction with the Robey Street Branch to Park Avenue. However, this latter section of the ditch was not completely backfilled.

(*c*) After many years of litigation, the construction of Burns Ditch and Burns Waterway was completed in 1926. It provided an outlet (Burns Waterway) about 1 mile long into Lake Michigan at a point about 10 miles east of the center of Gary, an arm extending west (Burns Ditch) about 7 miles from Burns Waterway to Deep River, following approximately the course of the Little Calumet River, and an arm extending east (Salt Creek arm) about 1 mile from Burns Waterway to Salt Creek, also following approximately the course of the Little Calumet River. By provision of the above-described work the flow of the Little Calumet River from and including Deep River eastward was diverted directly into Lake Michigan. The total cost of this undertaking to landowners, corporations, and municipalities was $1,035,134. The economic value of the improvement has been estimated by local authorities at $10,000,000. Part of the court proceedings involved an agreement with the Public Service Company of Northern Illinois, whereby the construction of Burns Ditch would be permitted, and the injunction obtained by this company against the project would be dismissed, provided that a low-flow diversion from Deep River westwardly via the Little Calumet River be maintained, such diversion to be the quantity passing through two 30-inch title drains. The city of Gary agreed to maintain, renew, and alter the dam, tile drain, diversion ditch, and embankment of Burns Ditch to prevent at all times any water in the Little Calumet River from flowing into Burns Ditch from the west, and to insure that the low-water flow of Deep River would enter the Little Calumet River and flow west into Illinois. The controlling works needed to fulfill the terms of the agreement were constructed; however, these were subsequently dynamited by parties unknown and to date have not been replaced.

(*d*) During the winter of 1933–34 a CWA project, sponsored by the city of Gary, deepened and straightened the Little Calumet River from the junction of Burns Ditch and Deep River to a point approximately 5 miles westward thereof, and changed the gradient within this reach from its natural westward slope to an eastward slope.

(*e*) In 1935, WPA projects sponsored by the city of Hammond provided for cleaning and side-sloping the Little Calumet River at its

junction with Hart Ditch, constructing a deflector wall so that a greater flood flow from Hart Ditch would be carried westward into Illinois, and deepening and widening a 1,000-foot section of the Little Calumet River.

(*f*) In 1936, a WPA project sponsored by the Division of Waterways, State of Illinois, removed rock ledges, boulders, and other stream obstructions at the Roll Avenue Bridge (mile 1.14) in Blue Island.

(*g*) In October 1936, the Division of Waterways, State of Illinois, sponsored a WPA program whereby the channel of the Little Calumet River was cleaned, deepened, and widened, from the Illinois-Indiana State line to a point 4,700 feet westward. In 1938, the spoil banks were graded in the above reach.

(*h*) In 1941, the Division of Waterways extended the improvement of the Little Calumet River, started in 1936, to Thorn Creek.

(*i*) In the late fall of 1941, the Gary Park Commission rebuilt the levees along the Little Calumet River in Gleason Park that had washed out during the flood of June 1941.

(*j*) In 1943, the Little Calumet River Drainage Association (formed in 1939), comprised of representatives of practically all the communities in northern Lake County of Indiana, expended about $50,000 in enlarging the Little Calumet River from Southeastern Avenue (mile 16.58) to the Illinois-Indiana State line, a distance of about 3.6 miles, and in constructing a relief-outlet channel along a curved alinement for Hart Ditch.

(*k*) In 1946, Gary and other adjacent communities expended a sum of about $75,000 for maintenance dredging of Burns ditch and Burns Waterway.

(*l*) In 1947, the Division of Waterways completed the improvement of the Little Calumet River by dredging from Thorn Creek to Calumet-Sag Channel.

(*m*) In 1948, the Hammond Sanitary District initiated a program at an estimated cost of $330,168 to modernize and augment the pumping facilities at seven storm-sewer outfalls to the Little Calumet River, and to construct a levee system along the right bank of the Little Calumet River between Hohman Avenue and One Hundred and Seventy-second Street. This work is expected to be completed during the summer of 1949.

IMPROVEMENT DESIRED

55. A public hearing held at Hammond on November 12, 1941, was attended by 46 persons (in addition to representatives of the Corps of Engineers), of whom 11 represented Federal and State agencies, 25 represented local public and civic agencies, and 10 represented railroad interests. A copy of the record of public hearing was submitted with the preliminary examination report.

56. A summary of the statements made by the several organizations follows:

(*a*) The Little Calumet River Drainage Association requested Federal aid in extending channel improvements in the Little Calumet River as proposed by that organization to the extent that the entire reach from Southeastern Avenue (mile 16.58) to the Calumet-Sag Channel be enlarged to adequate proportions.

(*b*) The city of Gary desired that the Little Calumet River marsh be adequately drained from Deep River westward to the Calumet-Sag Channel.

(*c*) The Chicago Regional Planning Association desired that the Little Calumet River be widened and deepened from the State line to Deep River, that erosion-prevention methods be applied throughout the drainage basin to retard and prevent rapid soil erosion, and that a reexamination be made of the hydraulics of the Little Calumet River to determine whether the original plan of construction of Burns Ditch was sound, and whether the control structures (referred to in par. 54c) should be replaced.

(*d*) The Calumet District Clean Streams Committee recommended that proper drainage of the watershed be provided, that the normal flow of Deep River be maintained in the Little Calumet River for sanitation purposes, but that any improvement follow the present course of the channel rather than artificial cut-offs.

(*e*) The Department of Public Works and Buildings, State of Illinois, vigorously protested any further drainage improvements in the interest of flood control, water-flow retardation, and soil-erosion prevention that would further decrease the normal dry-weather flow of the Little Calumet River. However, no objection would be made to such water-control structures that would divert flood flows directly into Lake Michigan, provided an adequate normal flow westerly to the State of Illinois were maintained in accordance with its legal right as affirmed by court decision.

(*f*) The Lake County (Ind.) Conservation Council seriously objected to any improvement that would straighten the ditch (Little Calumet River) and drain the marshes.

(*g*) The Gary Boat Club was interested in maintaining the normal flow from both the east and west branches of Burns ditch through the Burns Waterway, but desired that flood flows be diverted away from Burns Waterway.

(*h*) Statement was made by an individual that the farmers of the territory were definitely interested in securing aid to prevent overflow on their lands.

57. The following correspondence, copies of which are included in the appendix,[1] was received subsequent to the hearing:

(*a*) A letter, dated November 14, 1941, from the State Natural History Survey Division (Illinois) stating that the channel of the Little Calumet should not be straightened unless it was absolutely necessary for the well-being of the people, that some provision should be made to maintain as great a flow of water through the Little Calumet River in dry weather as possible, and that the extension of pollution in streams and lakes of the Calumet region be prevented.

(*b*) A letter, dated November 27, 1941, from the Department of Conservation, State of Illinois, stating that the department was in accord with any project that provided for the betterment of wildlife and recreation, and definitely opposed all projects detrimental to wildlife.

58. Subsequent to the severe flood of April 1947, the following correspondence was received, copies of which are included in the appendix: [1]

(*a*) A letter, dated May 8, 1947, from Mr. Arthur E. Turngren, mayor, Harvey, Ill., requesting that consideration be given to diversion of the waters draining into the Calumet Union Drainage Ditch by

[1] Not printed.

construction of a ditch along Kedzie Avenue from One Hundred and Eighty-third Street to the Calumet-Sag Channel.

(*b*) A letter, dated May 15, 1947, from Mr. Hollis L. Reeves, president, village of Robbins, Ill., concurring in the above request.

(*c*) A letter, dated May 24, 1947, from Mr. Walter Holt, president, village of Hazel Crest, Ill., requesting that adequate drainage be provided along Park Avenue, which parallels the Illinois Central Railroad, and also concurring in the request made by the mayor of Harvey.

FLOOD PROBLEMS AND SOLUTIONS CONSIDERED

59. *General.*—The extent and character of the flooded areas within the watershed of the Little Calumet River have been discussed in paragraph 44, and the average annual damages resulting therefrom developed in paragraphs 46–52, inclusive. In general, the flood problems in the Little Calumet River Basin arise both from stream overflow and from inadequate storm drainage systems. The damage due to the latter condition can be corrected only by major reconstruction of existing storm drains, the installation of sump pumps in individual basements, and extension of the storm drains to those areas which now have none. The flood problem is complicated by the extreme flatness of much of the basin and the resulting sluggish character of most of the streams, and by the fact that the course of drainage has been repeatedly changed by man as in the case of the artificial construction of Burns ditch, Hart ditch, and the Calument-Sag Channel. Also, the city of Gary reversed the natural westward slope of the Little Calumet River from the junction of Burns ditch and Deep River to a point several miles westward thereof. Further, the unusual concentration of highway and railroad crossings, together with extensive urban and industrial developments, severely limit new construction for flood control. The general methods which were considered with a view to developing an over-all basin plan for the control of floods are discussed in the following subparagraphs. As indicated in these subparagraphs, it was found impracticable to develop an over-all basin plan, having economic justification, which would afford a high degree of protection to all areas.

(*a*) *Enlargement of channels or levees or a combination thereof.*—Any practicable plan to carry flood flows within stream banks would require that discharge from Hart ditch be diverted totally either to the east or to the west. A plan diverting Hart ditch flows to the east would require improvement of channels from Hart ditch to Burns waterway and also extensive improvement to channels west of Hart Ditch to carry flood flows from Thorn Creek. A plan diverting Hart Ditch flows to the west would require no channel improvement east of Hart Ditch, while extensive improvements to the west would need to take care of Thorn Creek flows and the increased flows from Hart Ditch. For these reasons, it was found that the most economical plan would be based upon the diversion of Hart Ditch flood flows to the west. However, numerous bridge alterations, in addition to extensive channel enlargement and levee construction, render such a project so costly that it cannot be justified economically.

(*b*) *Detention of flood waters.*—Tributary reservoirs, particularly on Hart Ditch and Thorn Creek would be an excellent method of basin protection since, were these streams controlled, only minor channel

improvements or levees would be necessary elsewhere. Aside from considerations of cost, the lack of suitable reservoir sites eliminates this method.

(*c*) *Diversion of Little Calumet River flows.*—A channel between the Little Calumet River east of Hart Ditch and the Grand Calumet River near the Indiana Harbor Canal could carry flood flows from Hart Ditch, but would be prohibitive in cost because of residential and industrial developments in the area through which it would pass. Likewise, a cut-off channel extending from the Little Calumet River near the mouth of Thorn Creek northward to the Little Calumet River near its junction with the Grand Calumet River, would, because of its relatively steep slope, be effective in carrying flood flows both from Thorn Creek and from Hart Ditch. However, the large amount of excavation and the numerous bridge alterations involved result in costs far in excess of any benefits which may reasonably be foreseen.

60. *Local areas.*—Accordingly, since no general over-all plan to keep streams within banks was found to be justified, consideration was next given to the specific areas where local protection might be warranted, as described in detail in the following subparagraphs.

(*a*) *Main stem of Little Calumet River.*—(1) Flooding along the main stem of the Little Calumet River from its junction with the Calumet-Sag Channel to the Indiana State line could be greatly reduced by diverting Hart Ditch flood flows eastward. This would necessitate improvement of the channel eastward of Hart Ditch to accommodate the increased flow. However, the relatively small benefits which would accrue to this reach fall far short of justifying the large costs involved, and accordingly no further consideration is herein given such a plan.

(2) The extensive area east of Hart Ditch could be effectively protected by means of a dam across the Little Calumet River just east of Hart Ditch which would force Hart Ditch flood flows to travel westward. The Little Calumet River channel would be enlarged westward of Hart Ditch sufficiently to enable it to pass the added Hart ditch flows with no more overbank flow than occurs under present conditions. This plan is presented in detail hereinafter in paragraph 61 as plan A.

(*b*) *Thorn Creek.*—Near the mouth, flooding results principally from Little Calumet River backwater and partly from inadequate channel capacity. Such flooding as occurs upstream is due to the small channels. There are no suitable reservoir sites on Thorn Creek and studies indicate that the cost of channel improvements or levees would be far in excess of their benefits. Consequently, no detailed consideration is given hereinafter to possible improvements for Thorn Creek.

(*c*) *Calumet Union Drainage System.*—A serious flood problem exists in the Calumet Union Drainage System basin (see pl. 2[1]), especially in the city of Harvey and to a lesser degree in the neighboring communities of Hazel Crest, Markham, Phoenix, Dixmoor, and Posen. The area south and west of Hazel Crest and west of Harvey drains into the Calumet Union Drainage System, which has replaced the natural water courses and now carries the flow around Harvey by means of the Robey Street conduit leading to the north and the open channel and smaller conduit leading to the east in One Hundred and Sixty-first Street. This system is inadequate to provide for the surface runoff of its drainage area during storms of great intensity. The runoff frequently exceeds the combined capacity of the system and flows overland follow-

[1] Not printed.

ing the natural downward slope into Harvey, flooding a large part of Harvey to a depth of two feet. This causes substantial damage to mercantile establishments and residences and also results in serious disruption of street traffic and business activities. Other adjacent smaller communities are affected in a similar manner. The storm-sewer systems of Harvey and adjacent communities are inadequate to carry storm runoff from within the communities themselves, and this deficiency adds to the damage caused by overflow of the Calumet Union Drainage System which carries runoff from the relatively large drainage area outside of the communities. In general, the claims of local interests as to frequency and severity of the floods were substantiated. Flood damages due to the overflow of the Calumet Union Drainage System can best be alleviated by enlarging the Calumet Union Drainage Ditch and its connections to carry the design flows. A plan to accomplish this is presented in subsequent paragraphs as plan B. An alternative plan, based either upon an open ditch or an enlarged underground conduit extending north along Robey Street to an outlet to the Little Calumet River would be equally effective. However, replacing the present conduit would be far more expensive than the Calumet Union Drainage Ditch improvement, whereas an open ditch, in addition to being equally expensive, is entirely unsuited to the character of the urban community. Consequently the Robey Street route is not considered further in this report. Another possible alternative, consisting of an open channel extending north along Kedzie Avenue from One Hundred and Eighty-third Street to the Calumet-Sag Channel, was advocated by local interests. The cost of this channel was found to be greatly in excess of the alternative channels previously mentioned and, in addition, it would provide a lesser degree of protection. For these reasons, the Kedzie Avenue route is not considered further. The Illinois Division of Highways has under consideration a plan which would provide for a storm sewer along Park Avenue from Dixie Highway to One Hundred and Seventy-first Street and along One Hundred and Seventy-first Street from Park Avenue eastward to a tributary of Calumet Union Drainage Ditch just east of the Illinois Central Railroad yards (see pl. 2[1]). This plan would provide adequate highway drainage along Park Avenue as requested by local interests (see subpar. 58c). No further consideration is therefore given in this report to the request by local interests for improved drainage along Park Avenue. Improvements to the natural and artificial channels of the Calumet Union Drainage System will substantially reduce flood damages which are now caused by the overflow of these channels during periods of heavy runoff in this basin. Damages caused by deficiencies in the present storm-sewer systems of the communities affected can be reduced by the improvement of the present inadequate systems and by the provision of sump pumps for individual basements. An enlargement of their storm drainage system with outlets into the Little Calumet River, is under consideration by officials of the city of Harvey. Contract plans and specifications have been completed, but it is uncertain when the work can be undertaken.

(*d*) *Calumet Slough.*—A flood problem exists in the area drained by the Calumet Slough. During periods of intense rainfall and run-off the stream overflow passes through the villages of Oak Forest and Midlothian, Ill., and then converges upon Robbins, Ill., situated in

[1] Not printed.

the lower portion of the watershed. The village of Robbins has no adequate storm drainage system, relying entirely upon small roadside ditches to carry the run-off from the local area; as a result, the water overflows the surface and inundates the village. Due to the relatively low divide between the watershed of the Calumet Slough and the Calumet-Sag Channel, the floodwaters rise above the divide and flow northward, inundating nearly the whole village at times of intense rainfall and run-off. The flooding of this area aggravates an already very unhealthy situation caused by inadequate sanitary drainage, water supply, and housing. The most feasible plan of improvement, set forth hereinafter as plan C, would provide for widening the existing earth channel from its mouth to One Hundred and Sixty-seventh Street. As an alternative, a smaller paved channel was considered but found to be more expensive and no more effective. Diversion of Calumet Slough to the Calument-Sag Channel, to achieve a greater fall, would improve the hydraulic efficiency of the channel, but the cost of such channel would be greater than that developed in plan C since the excavation would consist mainly of rock—an exposed Niagaran series of undifferentiated dolomitic formations—and would not provide greater benefits. To alleviate flooding along highways, the Cook County Highway Department plans construction of a storm sewer along Crawford Avenue from about One Hundred and Forty-seventh Street to the Calumet-Sag Channel (see pl. 2 [1]) to divert the flow of a tributary of Calumet Slough. The Cook County Highway Department also has under consideration the diversion of normal flows of Calumet Slough from about mile 2 to the Calumet-Sag Channel to permit the opening of that portion of Kedzie Avenue now occupied by the stream (see pl. 2 [1]).

FLOOD-CONTROL PLANS

61. *Main stem of the Little Calumet River.*—Plan A (see pls. 2,[1] 3,[1] and 5 [1]) to protect the extensive area east of Hart Ditch provides for a small earth dam across the Little Calumet River just upstream (east) of the mouth of Hart Ditch to prevent the eastward flow of flood discharges, together with two 30-inch corrugated metal pipes, with drainage gates, through the base of the fill to permit westward movement of possible future low water diversion from Deep River. The dam would have a maximum height of about 15 feet, which would provide a 2-foot freeboard, top width of 8 feet, and 1 on 3 side slopes. In order that possible damage from increased river stages that would result with westward diversion of Hart Ditch flows may be offset, consideration is given to the enlargement of the Little Calumet River to the west to provide sufficient additional channel capacity for passing the added flows from Hart Ditch with no more overbank flow than would occur under natural conditions without the diverted flow. This enlarged channel along the alinement of, and at approximately the same thalweg as the existing channel, would have a capacity of 8,500 cubic feet per second at Calumet-Sag Channel, and 2,500 cubic feet per second at Hart Ditch at a stage equal to the maximum of record (April 5–6, 1947), and would have side slopes of 1 on 2. Bottom widths would be 120 feet from the Calumet-Sag Channel to Thorn Creek, and 100 feet from Thorn Creek to Hart Ditch. The

[1] Not printed.

hydraulic design is based on a roughness value for an earth channel of 0.030. The maximum velocity is estimated at 5.7 feet per second. The excavated material, consisting mainly of topsoil, sand, and clay and some gravel, shale, and limestone (see pl. 7 [1]) would be deposited along the banks. To provide adequate floodway areas for the considered channel, three highway, one foot, and five railroad bridges would require modifications. Channel modification east of Hart Ditch would not be necessary as the channel has sufficient capacity to carry the local run-off.

62. Under plan A, a large part of the local cooperation would be required in Illinois, whereas the anticipated benefits would be largely in Indiana. It is doubtful if local agencies in Illinois would be willing to provide cooperation for such a plan of improvement. It is likewise doubtful that local interests in Indiana would be in a legal position to furnish the requisite local cooperation outside of that State, except under the provision of special legislative authority.

63. Under this plan, flood flows from Hart Ditch which are now divided, part flowing eastward into Lake Michigan through Burns Waterway and part westward via the Little Calumet River into the Illinois River, would, in their entirety, be directed westward. This increased westward flow would be charged against the average diversion of 1,500 cubic feet per second permitted the Sanitary District of Chicago under the terms of the April 21, 1930, decree of the Supreme Court of the United States. The Sanitary District has indicated that it would be vigorously opposed to absorbing this additional run-off in its authorized diversion.

64. *Calumet Union Drainage System.*—Plan B (see pls. 2 [1] and 6 [1]) provides for enlargement of the Calumet Union Drainage Ditch and some of its connections to carry the design flow, which ranges from 650 cubic feet per second at Hazel Crest to 2,000 cubic feet per second at the mouth, and has an estimated frequency of occurrence of once in 50 years. In the reach between One Hundred and Seventy-first Street and One Hundred and Sixty-ninth Street, in Hazel Crest, the channel would be enlarged to a bottom width of 20 feet, an average depth of 10 feet, and side slopes of 1 on 2. Existing pipe culverts at six street crossings would be replaced by two-cell concrete culverts. With the view of providing a surcharge at the entrance of the existing two-cell conduit, at One Hundred and Sixty-ninth Street and Dixie Highway, thereby increasing the channel capacity of the conduit to 650 cubic feet per second, levees ranging from 2 to 3 feet in height would be constructed for a distance of about 600 feet upstream of the conduit intake, and the concrete head wall at the conduit intake would be raised about 2 feet. The existing two-cell conduit extending along Dixie Highway from One Hundred and Sixty-ninth Street to One Hundred and Sixty-first Street would not require enlargement under this plan of improvement. In the reach between the outlet of the two-cell conduit to the junction with the Robey Street concrete pipe, a distance of 300 feet, the channel would be enlarged to a bottom width of 25 feet, a depth of 10 feet, and side slopes of 1 on 2. A hand-operated 72-inch drainage gate would be installed at the inlet to the Robey Street concrete pipe to prevent flood flows from entering the pipe, and to provide capacity for storm drainage which enters the pipe below the inlet. A 3-foot concrete weir would be constructed in

[1] Not printed.

the channel just downstream of the Robey Street pipe to divert low flows polluted by partially untreated sewage from Hazel Crest into the Robey Street pipe. Bridge modifications would not be required in this reach. Downstream from Robey Street pipe to its mouth, the Calumet Union Drainage Ditch would be enlarged as follows: (*a*) Robey Street to Park Avenue (mile 2.26), bottom width of 20 feet and side slopes of 1 on 2; (*b*) Park Avenue to mile 1.5, bottom width of 12.5 feet and side slopes of 1 on 2.75; and (*c*) mile 1.5 to the mouth, bottom width of 15 feet and side slopes of 1 on 2.5. Depths would range from 11 to 16 feet, and low spots along the bank would be raised by levees having a height of 2 to 4 feet. Four highway bridges, three road culverts, one farm bridge, and one foot bridge would be replaced; five railroad bridges would be modified, and 3 miles of power lines relocated. The existing 60-inch conduit between Robey Street and Park Avenue would be removed. Table 10A of the appendix[1] lists pertinent data of bridge modifications. Hydraulic design of the channel is based on a roughness value for an earth channel of 0.030, and on a freeboard of 2 feet. The maximum velocity in the channel would be 5.7 feet per second; however, velocities under the bridges would reach a maximum of 10.6 feet per second; the plan of improvement therefore provides for concrete paving under all bridges. The excavated material, consisting mainly of silt and clay with some sand and gravel (see pl. 7[1]) would be deposited along the banks.

65. *Calumet Slough.*—Plan C (see pls. 2[1] and 6[1]) provides for the enlargement of the existing channel from the mouth to One Hundred and Sixty-seventh Street and construction of levees at places where the banks are low to obtain a channel of sufficient capacity to carry the design flow (1,000 cubic feet per second at the mouth) having a frequency of occurrence estimated at about once in 50 years. The enlarged channel would have side slopes of 1 on 2 and a bottom width of 28 feet. Replacement of 6 road bridges, 5 road culverts, 13 foot bridges, 1 farm bridge, and 1 railroad bridge, and modification of 7 road bridges and 6 railroad bridges are required to provide adequate floodway areas. Hydraulic design of the channel is based on a roughness value for an earth channel of 0.030, and on a freeboard of 2 feet. The maximum velocity in the channel would be 5.7 feet per second; however, velocities under some of the bridges would exceed 8 feet per second; the plan of improvement provides for concrete paving under such bridges. The excavated material consisting mainly of silt and clay with some sand and some limestone (see pl. 7[1]) would be deposited along the banks.

66. *Other water uses.*—No consideration was given to improvements in the interests of navigation, hydroelectric power development, irrigation, or water supply. An authorized navigation project for the Illinois Waterway provides for, in addition to other improvements, the enlargement of the Grand Calumet River, which parallels the Little Calumet River at a distance of about 3 miles, and, upon completion, will probably be capable of meeting the presently foreseeable navigation needs of the area. Lack of suitable reservoir sites for impoundment of waters prohibits such development not only for flood-control purposes, but also for hydroelectric purposes. The seasonal distribu-

[1] Not printed.

tion of precipitation within the watershed is generally sufficient for agricultural purposes and irrigation is not a problem in the basin. The proximity of Lake Michigan precludes the necessity of utilizing the Little Calumet River as a potable water supply. It was found that no collateral benefits attributable to purposes other than flood control would accrue to the plans of improvement considered herein.

67. The Chicago Regional Planning Association requested at the public hearing that the original plan of construction of Burns Ditch be reexamined to determine whether the control structures should be replaced. The control structures were constructed to maintain low flows from Deep River into that portion of the Little Calumet River lying west of Deep River. Maintenance of low flows in the Little Calumet River are desirable in view of the present pollution of the stream, particularly in the Illinois portion. No plan of improvement in the interest of flood control could be developed that would maintain the desired low flows and have economic justification. Restoration of the control structures would not be effective in the maintenance of low flows unless accompanied by either channel dredging or levee construction to pass the low flows over the summit now existing in the Little Calumet River at mile 16.67. Improvement in the interest of stream pollution only is considered beyond the scope of this report.

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

68. Estimates of first costs and annual charges are based upon the United States bearing the first cost of channel improvement and modification of railroad bridges, and local interests assuming the costs of acquiring the necessary rights-of-way, of modifying highway bridges and their approaches, of relocating utilities, preventing encroachment on the improvements, and of maintaining the facilities after completion. Costs used in determining the estimates are based upon June 1949 prices. Amortization of both Federal and non-Federal investments was computed on the sinking fund basis for an assumed economic life of 50 years. Interest rates used in determining annual charges are 3 percent on Federal costs and 3½ percent on non-Federal costs. The detailed cost estimates and annual charges for the plans of improvement, for which such data were developed, are shown in tables 11A to 13A of the appendix [1]; the costs are summarized in tables 5 to 8 herein.

[1] Not printed.

TABLE 5.—*Plan A—Estimated first cost and annual charges, channel improvements on Little Calumet River, Calumet-Sag Channel to Hart Ditch*

ESTIMATED FIRST COST

[Including contingencies, engineering, and overhead]

Item	Amount	Total
I. Federal first cost:		
(*a*) Channel improvements	$1,233,500	
(*b*) Dam	6,700	
(*c*) Railroad bridge modifications	127,900	
(*d*) Total Federal first cost		$1,368,100
II. Non-Federal first cost:		
(*a*) Highway bridge modification	179,600	
(*b*) Rights-of-way, 400 acres	404,300	
(*c*) Total non-Federal first cost		583,900
III. Total estimated first cost		1,952,000

ESTIMATED ANNUAL CHARGES

I. Federal investment:		
(*a*) Total Federal first cost	$1,368,100	
(*b*) Interest during construction	41,000	
(*c*) Total Federal investment	1,409,100	
II. Federal annual charges:		
(*a*) Interest on investment	42,300	
(*b*) Amortization of investment	12,500	
(*c*) Total Federal annual charges		$54,800
III. Non-Federal investment:		
(*a*) Total non-Federal first cost	583,900	
(*b*) Interest during construction	20,400	
(*c*) Total non-Federal investment	604,300	
IV. Non-Federal annual charges;		
(*a*) Interest on investment	21,200	
(*b*) Amortization of investment	4,600	
(*c*) Maintenance	19,500	
(*d*) Net loss on taxes	11,000	
(*e*) Credit for advance replacement of bridges	—2,100	
(*f*) Total non-Federal annual charges		54,200
V. Total annual charges		109,000

TABLE 6.—*Plan B—Estimated first cost and annual charges, channel improvements, Calumet Union Drainage Ditch—mouth to 171st St.*

ESTIMATED FIRST COST

[Including contingencies, engineering, and overhead]

Item	Amount	Total
I. Federal first cost:		
(*a*) Channel improvements	$268,400	
(*b*) Railroad bridge modifications	165,900	
(*c*) Total Federal first cost		$434,300
II. Non-Federal first cost:		
(*a*) Highway bridge modifications	503,500	
(*b*) Power line relocation	33,500	
(*c*) Rights-of-way, 43 acres	178,500	
(*d*) Total non-Federal first cost		715,500
III. Total estimated first cost		1,149,800

ESTIMATED ANNUAL CHARGES

I. Federal investment:		
(*a*) Total Federal first cost	$434,300	
(*b*) Interest during construction	6,500	
(*c*) Total Federal investment	440,800	
II. Federal annual charges:		
(*a*) Interest on investment	13,200	
(*b*) Amortization of investment	3,900	
(*c*) Total Federal annual charges		$17,100
III. Non-Federal investment:		
(*a*) Total non-Federal first cost	715,500	
(*b*) Interest during construction	12,500	
(*c*) Total non-Federal investment	728,000	
IV. Non-Federal annual charges:		
(*a*) Interest on investment	25,500	
(*b*) Amortization of investment	5,600	
(*c*) Maintenance	11,500	
(*d*) Net loss on taxes	4,900	
(*e*) Credit for advance replacement of bridges	−4,300	
(*f*) Total non-Federal annual charges		43,200
V. Total annual charges		60,300

TABLE 7.—*Plan C—Estimated first cost and annual charges, channel improvement of Calumet Slough*

ESTIMATED FIRST COST

[Including contingencies, engineering, and overhead]

Item	Amount	Total
I. Federal first cost:		
(*a*) Channel improvement	$711,500	
(*b*) Bridge modifications	247,500	
(*c*) Total Federal first cost		$959,000
II. Non-Federal first cost:		
(*a*) Highway bridge modifications	223,400	
(*b*) Rights-of-way, 63 acres	147,000	
(*c*) Total non-Federal first cost		370,400
III. Total estimated first cost		1,329,400

ESTIMATED ANNUAL CHARGES

I. Federal investment:		
(*a*) Total Federal first cost	$959,000	
(*b*) Interest during construction	14,400	
(*c*) Total Federal investment	973,400	
II. Federal annual charges:		
(*a*) Interest on investment	29,200	
(*b*) Amortization of investment	8,600	
(*c*) Credit for advance replacement of bridges	−400	
(*d*) Total Federal annual charges		$37,400
III. Non-Federal investment:		
(*a*) Total non-Federal first cost	370,400	
(*b*) Interest during construction	6,500	
(*c*) Total non-Federal investment	376,900	
IV. Non-Federal annual charges:		
(*a*) Interest on investment	13,200	
(*b*) Amortization of investment	2,900	
(*c*) Maintenance	13,300	
(*d*) Net loss on taxes	4,000	
(*e*) Credit for advance replacement of bridges	−2,000	
(*f*) Total non-Federal annual charges		31,400
V. Total annual charges		68,800

TABLE 8.—*Summary of first costs and annual charges*

Plan of improvement	First cost			Annual charges		
	Total	Federal	Non-Federal	Total	Federal	Non-Federal
Plan A (Little Calumet River)	$1,952,000	$1,368,100	$583,900	$109,000	$54,800	$54,200
Plan B (Calumet Union Drainage System)	1,149,800	434,300	715,500	60,300	17,100	43,200
Plan C (Calumet Slough)	1,329,400	959,000	370,400	68,800	37,400	31,400

ESTIMATES OF AVERAGE ANNUAL BENEFITS

69. *General.*—The benefits which would result from the plans of improvement considered in this report are described in the paragraphs immediately following.

70. *Little Calumet River.—Plan A.*—The considered channel improvement under plan A as outlined in paragraph 61 would result in the alleviation of property and agricultural damages due to direct overflow

and blocked drainage in the reach between Hart Ditch and the Pennsylvania Railroad (mile 26.54). Since the damage in this reach is practically all caused by flood flows out of Hart Ditch, the diversion of flow westward, provided under this plan would virtually eliminate damage from flood flows not greater than the maximum of record (April 1947) which has an estimated frequency of occurrence of once in 100 years. Plan A provides additional channel capacity in the reach between Calumet-Sag Channel and Hart Ditch sufficient to carry the added flood flows from Hart Ditch with no change in stage of overbank flow for the maximum flow of record. The reduction in stage in the reach between Chicago Road (mile 6.26) and Hart Ditch, ranges from zero for the maximum flow of record (6,800 cubic feet per second under natural conditions) to 1.9 feet for a moderate flood (5,500 cubic feet per second under natural conditions), and averages about 1 foot. Prevention of flood damages in this reach is based on the average stage reduction. Downstream from Chicago Road to Calumet-Sag Channel damages due to floods are negligible. The derivation of the average annual benefits which would result from this plan is discussed in the following subparagraphs.

(*a*) *Prevention of crop damage.*—By using the graphs on plate 8[1] of the accompanying drawings the average areas flooded annually for the reach between Calumet-Sag Channel and the Pennsylvania Railroad (mile 26.54) were obtained and the average annual crop loss determined with the improvements proposed under plan A. The results are summarized in table 9 which follows.

TABLE 9.—*Average area flooded annually along Little Calumet River with improvements proposed under plan A*

Period	Average area flooded annually	Damage per acre	Average annual damage
	Acres		
April to May	38	$5.50	$200
June to July	14	157.40	2,200
August to October	8	151.00	1,200
Total			3,600

Subtracting this average annual damage of $3,600 with the improvements proposed under plan A from the average annual damages as shown in table 4, the average annual damages prevented by plan A are found to be $14,600.

(*b*) *Prevention of urban damage.*—Likewise, the average annual urban loss for the reach between Calumet-Sag Channel and the Pennsylvania Railroad, now $2,000 as shown in table 3, would be reduced to $100 under plan A, and the resulting average annual benefit would thus be $1,900.

(*c*) *Increased utilization of land.*—Substantial benefits from increased land values for the Gary Small Farms subdivision area would be realized under this plan. The land within the subdivision which, under present conditions, is practically a marsh, could, with improved drainage conditions, be utilized for truck gardening. The probable increase in value of this land with plan A in operation is estimated at $600 per acre. Based upon a 5-percent return on the increased land values, it is estimated that the average annual benefits would be $30 per acre, and on an estimated area of 450 acres would be $13,500.

[1] Not printed.

(*d*) *Prevention of indirect damages.*—Under the considered plan, it is estimated that the indirect flood damages, which include the cost of pumping leveed areas, loss of earnings, and traffic diversion, would be reduced from $600 to $100. The average annual benefits for prevention of these indirect damages are therefore estimated at $500.

71. *Calumet Union Drainage Ditch—Plan B.*—The considered plan of improvement would eliminate the damages estimated in subparagraphs 51a and 51b to result from floods caused by overflow of the channels of the Calumet Union Drainage System in Harvey and the neighboring communities of Hazel Crest, Markham, Phoenix, Dixmoor, and Posen. Accordingly, the average annual benefits from direct damages prevented as a result of plan B are estimated at $94,400; the average annual benefits for prevention of indirect damages at $5,500; and the total average annual benefits at $99,900.

72. *Calumet Slough—Plan C.*—The considered plan of improvement along the existing channel would practically eliminate damages caused by floods (stream overflow), having a frequency of as low as 2 percent chance of occurrence in 1 year, in Robbins, Midlothian, and Oak Forest. Therefore the benefits that would accrue to plan C would approximate the sum of the average annual direct damage of $5,000 stated in subparagraph 51a, and the average annual indirect damage of $1,100 given in subparagraph 51b, making a total of $6,100. While there will be additional intangible benefits resulting from elimination of the flood problem, the very unhealthy situation caused by inadequate sanitary drainage, water supply, and housing would still remain. Even with such intangible benefits the considered plan would still lack economic justification.

73. *Total average annual benefits.*—The total average annual flood-control benefits, as outlined in paragraphs 70 to 72 are summarized as follows:

TABLE 10.—*Summary of average annual flood-control benefits*

	Little Calumet River, plan A	Calumet Union Drainage Ditch, plan B	Calumet Slough, plan C
Prevention of direct damages:			
Agricultural	$14,600		
Urban	1,900	$94,400	$5,000
Increased utilization of land	13,500		
Prevention of indirect damages	500	5,500	1,100
Total	30,500	99,900	6,100

COMPARISON OF BENEFITS AND COSTS

74. The following table summarizes the average annual benefits, the first costs, the annual charges, and the ratio of benefits to costs for each of the three plans considered:

TABLE 11.—*Comparison of benefits and costs*

	Average annual benefits	First costs	Annual charges	Ratio of annual benefits to annual charges
Little Calumet River, plan A	$30,500	$1,952,000	$109,000	0.28
Calumet Union Drainage Ditch, plan B	99,900	1,149,800	60,300	1.66
Calumet Slough, plan C	6,100	1,329,400	68,800	.09

PROPOSED LOCAL COOPERATION

75. For the channel and levee improvements herein considered, the requisite local cooperation would consist of: (*a*) Modification of all highway and foot bridges and relocation of all utilities; (*b*) provision, without cost to the United States, of all lands, easements, and rights-of-way necessary for the construction of the channel improvements and deposition of the spoil; (*c*) holding and saving the United States free from damages resulting from the construction works; (*d*) establishing and enforcing regulations, satisfactory to the Secretary of the Army, designed to prevent encroachments on the improved channel; and (*e*) maintenance of the project works after completion in accordance with regulations prescribed by the Secretary of the Army. By resolution of its city council, adopted February 9, 1948, the city of Harvey indicated that it would undertake to provide or obtain the items of local cooperation required for plan B.

ALLOCATION OF COSTS

76. The following table summarizes the allocation of Federal and non-Federal first costs and the costs of maintenance. The entire allocation of Federal costs would be expended by the Corps of Engineers.

TABLE 12.—*Allocation of first costs and cost of maintenance*

Plan of improvement	First cost		Cost of maintenance	
	Federal	Non-Federal	Federal	Non-Federal
Plan A	$1,368,100	$583,900	0	$19,500
Plan B	434,300	715,500	0	11,500
Plan C	959,000	370,400	0	13,300

COORDINATION WITH OTHER AGENCIES

77. *Coordination with Federal agencies.*—A conference was held with the Fish and Wildlife Service, in Chicago, on January 5, 1948. In a letter dated January 14, 1948, that agency stated that it had no objections to the channel improvements considered in plans B or C, and that a small benefit would accrue to fur animals in the reaches of the river improved by plan A. By letter dated March 14, 1949, the Soil Conservation Service stated that it has no interest in the plan inasmuch as the improvements considered are of an urban nature where the use of agricultural land in the watershed is of little concern. The

United States Public Health Service, in letter dated March 31, 1949, considers that, since the Calumet Union Drainage Ditch flows through a rather heavily populated area, an effective flood-control measure would be of public health significance.

78. *Coordination with State agencies.*—The plans herein considered were discussed with representatives of the Indiana Flood Control and Water Resources Commission and of the Illinois Division of Waterways.

79. The Indiana Flood Control and Water Resources Commission indicated its belief that, if a very high degree of protection were provided, the Little Calumet River flood plain would become a highly developed urban and industrial area, and that the resulting land enhancement would justify the project. The plan favored was based upon a widened channel, flanked by levees, and sufficiently deepened to enable drainage outlets to flow into it even at times of heavy run-off. The district engineer thereupon requested that the Commission submit to this office particulars regarding the land use and enhancement which might reasonably be anticipated. After extended and detailed study, the Commission advised the district engineer that the prospective enhancement of land values was not sufficient to justify improvements other than those recommended herein.

80. The Illinois Division of Waterways suggested that consideration be given to an over-all plan covering the entire Little Calumet River Basin. As indicated in paragraph 59, the studies made in the preparation of this report showed that it was impracticable to develop an over-all basin plan having economic justification, and consideration was therefore concentrated on the specific areas for which it appeared that local protection might be warranted.

81. *Coordination with local communities.*—The communities that would be directly affected by the construction of the plan of improvement developed for the Calumet Union Drainage System were requested to submit their comments relative to the merits of the plan. The authorities of the city of Harvey, Ill., indicated, by letter dated January 5, 1948, that although preferring diversion of the flow from the Calumet Union Drainage System directly into the Calumet-Sag Channel along the line of Kedzie Avenue, they favored the enlargement of the channel considered in plan B over that considered as an alternative along the Robey Street conduit. The authorities of the village of Markham, Ill., stated, in a letter dated January 13, 1948, that they are in full accord with the plan of improvement considered for the Calumet Union Drainage System. In a letter dated January 13, 1948, the president of the village of South Holland, Ill., opposed enlargement of the Calumet Union Drainage Ditch primarily because it would divert polluted stream flow through South Holland. He was informed, by letter dated January 16, 1948, that provision was made in the plan of improvement to divert low flows containing pollution into the existing Robey Street conduit in Harvey, Ill.

DISCUSSION

82. As explained in paragraph 59, it has been found impracticable to develop an over-all basin plan, having economic justification, which would keep maximum floods of record within stream banks by use of channel enlargements and levees or combinations thereof; by detention

reservoirs on tributaries; or by diversion of Little Calumet River flood flows. Consequently, consideration has been given to the feasibility of protecting all areas which appeared to offer some possibility of a project which would have economic justification.

83. The three plans of improvement found most feasible for the protection of certain local areas have been set forth, with appropriate references to costs and benefits, in paragraphs 61 to 74, inclusive. Of these plans, only plan B, for the improvement of Calumet Union Drainage System, is economically justified by benefits which can reasonably be foreseen. The improvements to the natural and artificial channels of the Calumet Union drainage system proposed under this plan will substantially reduce flood damages which are now caused by the overflow of these channels. Damages caused by deficiencies in the present storm sewer systems of the communities affected can be reduced by the improvement of the present inadequate systems and by the provision of sump pumps for individual basements. Plan A (par. 61) for the protection of the area east of Hart Ditch between Hammond and Gary, Ind., and plan C (par. 65) for the region bordering on Calumet Slough, lack economic justification at the present time. Considering the proximity of the damaged areas to the metropolitan Chicago region and to the Hammond-Gary zone of heavy industry, it is of course possible that some sections may develop with unexpected rapidity, in which case plans of improvement lacking justification might become justified. The problems referred to in paragraphs 62 and 63 with respect to local cooperation and diversion appear to render plan A impracticable. A summary of the costs and benefits for the three plans of improvement follows. All Federal costs would be expended by the Corps of Engineers.

	Plan A (Little Calumet River)	Plan B (Calumet Union Drainage System)	Plan C (Calumet Slough)
First cost:			
Federal	$1,368,100	$434,300	$959,000
Non-Federal	583,900	715,500	370,400
Total	1,952,000	1,149,800	1,329,400
Annual charges:			
Federal	54,800	17,100	37,400
Non-Federal	54,200	43,200	31,400
Total	109,000	60,300	68,800
Annual benefits	30,500	99,900	6,100
Ratio of benefits to costs	0.28	1.66	0.09

84. The requisite local cooperation for the plans of improvement considered in this report is described in paragraph 75 and is based upon current statutory requirements. The city of Harvey has indicated that it will undertake to provide or obtain the items of local cooperation required for plan B.

CONCLUSION AND RECOMMENDATIONS

85. *Conclusion.*—The district engineer concludes that the only feasible and economically justifiable plan of improvement for reducing flood losses in the Little Calumet River Basin at the present time is

improvement of the Calumet Union Drainage System as provided under plan B (par. 64), and that reasonable assurances have been given that the requisite local cooperation will be furnished.

86. *Recommendations.*—It is recommended that a flood-protection project be adopted to provide for improvement of the Calumet Union Drainage System, Illinois, in the Little Calumet River Basin in general conformity with plan B of this report, and with such modifications as the Secretary of the Army and the Chief of Engineers may consider advisable, at an estimated cost to the United States of $434,300 for construction, subject to the condition that local agencies will furnish assurances satisfactory to the Secretary of the Army that they will: (*a*) Bear the cost of and be responsible for modification of all highway and foot bridges and relocation of all utilities; (*b*) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the channel improvements and deposition of the spoil; (*c*) hold and save the United States free from damages resulting from the construction works; (*d*) establish and enforce regulations satisfactory to the Secretary of the Army designed to prevent encroachments on the improved channel; and (*e*) maintain the project works, after completion, in accordance with regulations prescribed by the Secretary of the Army.

W. P. TROWER,
Colonel, Corps of Engineers,
District Engineer.

[First endorsement]

OFFICE, DIVISION ENGINEER, GREAT LAKES DIVISION,
CORPS OF ENGINEERS,
Chicago, Ill., November 18, 1949.

To: The Chief of Engineers, United States Army, Washington, D. C.

I concur in the conclusions and recommendation of the district engineer.

JOHN R. HARDIN,
Colonel, Corps of Engineers,
Division Engineer.

○

CORPS OF ENGINEERS

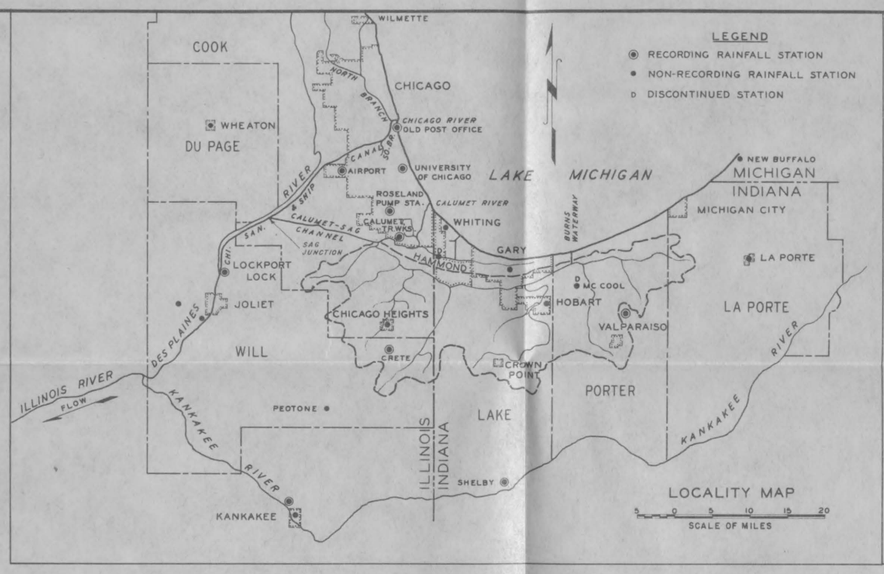
U. S. ARMY

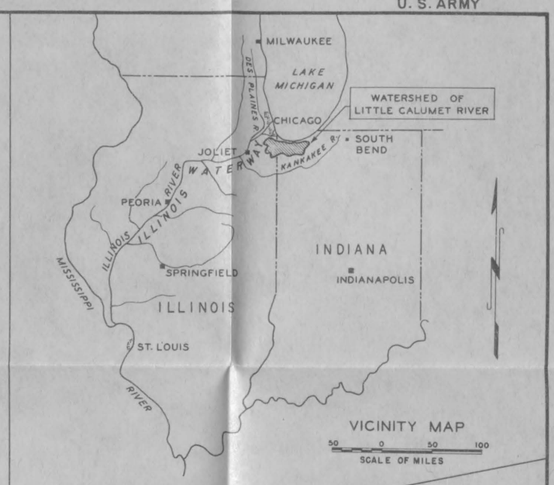
LEGEND

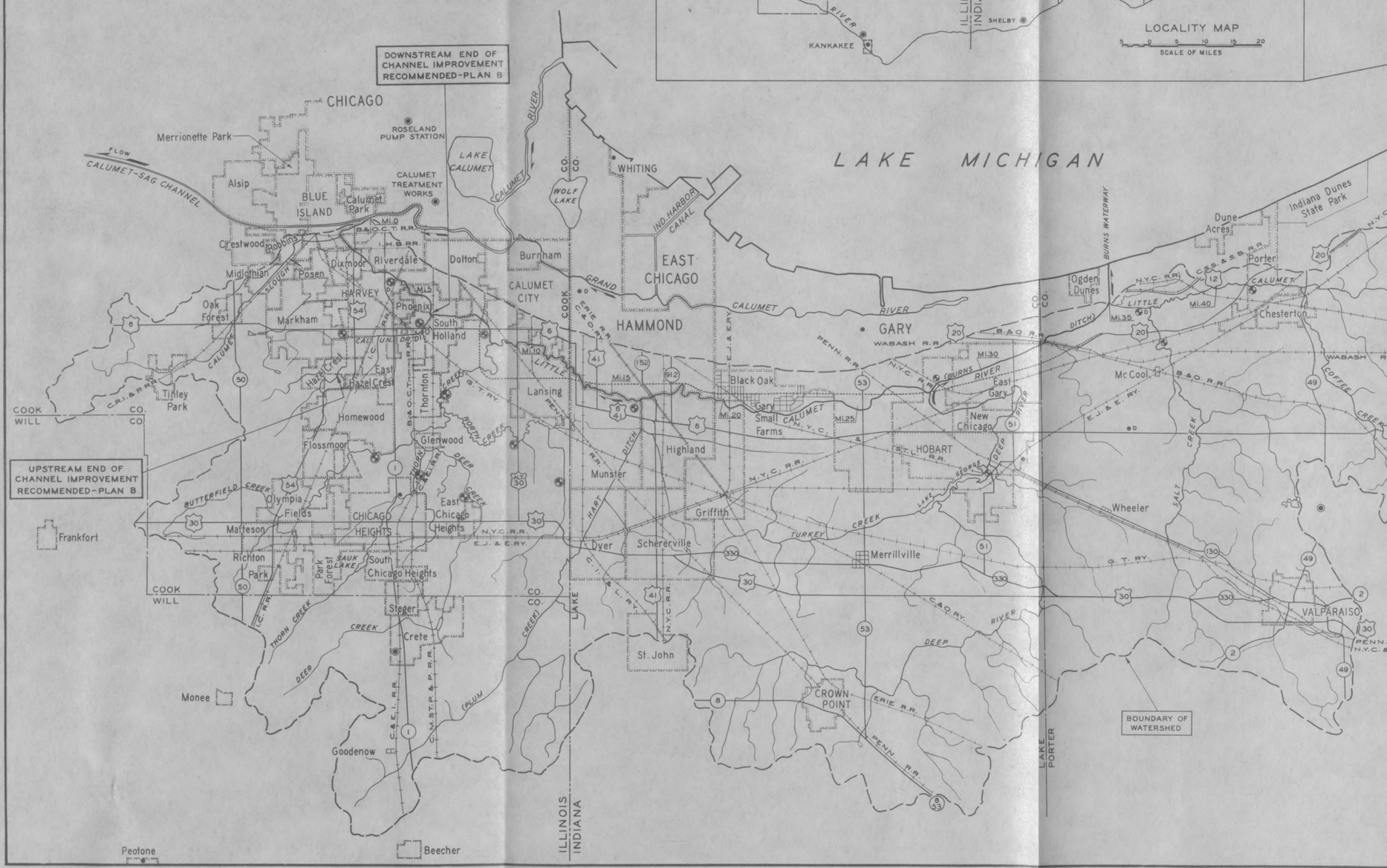
- INCORPORATED PLACES
- UNINCORPORATED PLACES
- RECORDING RAINFALL STATION
- NON-RECORDING RAINFALL STATION
- RECORDING STREAM GAGING STATION
- NON-RECORDING STREAM GAGING STATION
- D DISCONTINUED STATION
- Mi.20 RIVER MILEAGE MEASURED FROM CALUMET-SAG CHANNEL
- CONDUIT
- PROPOSED PARKWAY (SUPER-HIGHWAY)

DOWNSTREAM END OF CHANNEL IMPROVEMENT RECOMMENDED-PLAN B

UPSTREAM END OF CHANNEL IMPROVEMENT RECOMMENDED-PLAN B







NOTE:

LIMITS OF PLANS OF IMPROVEMENT ARE SHOWN AS FOLLOWS:

PLAN		PLATE
A	CONSIDERED	2 & 3
B	RECOMMENDED	2
C	CONSIDERED	2

SURVEY FOR FLOOD CONTROL LITTLE CALUMET RIVER AND TRIBUTARIES ILLINOIS AND INDIANA

GENERAL MAP

IN 8 SHEETS — SHEET NO. 1 — SCALE: SEE GRAPHIC

SCALE OF MILES

CORPS OF ENGINEERS — U.S. ARMY — CHICAGO DISTRICT

OFFICE OF THE DISTRICT ENGINEER — CHICAGO, ILLINOIS — 4 AUG. 1949

SUBMITTED: K. Keefer, CHIEF, CIVIL WORKS ENGR. BR.

APPROVAL RECOMMENDED: R. A. Thompson, CHIEF, ENGR. DIVISION

APPROVED: [signature], COL. CORPS OF ENGINEERS

DRAWN BY: R.A.L. — CHECKED BY: E.M.T.

TRANSMITTED WITH REPORT DATED: 15 AUGUST 1949

FILE NO. 9-R2/16