AD-A101 704 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
BUFFALO METROPOLITAN AREA, NEW YORK WATER RESOURCES MANAGEMENT.--ETC(U)
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1 OF 5
AD
A101 704

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(12)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO. AD-A101704

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Detailed Project Report for Flood Mangement in Cayuga Creek Watershed

5. TYPE OF REPORT & PERIOD COVERED
Final

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

12. REPORT DATE
1979

13. NUMBER OF PAGES
216

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Flood Management
Flooding
Cayuga Creek
Flood Proofing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
Cayuga Creek overflows it banks almost annually, flooding local areas in the town of Cheektowaga. This flooding subjects the residents and businessmen to inconvenience and finanical loss because of inaccessibility to homes and businesses and causes property damage. The purpose of this report is to identify and develop feasible solutions to these problems based upon sound engineering, economic, environmental and social considerations.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(12)

CAYUGA CREEK

CHEEKTOWAGA, NEW YORK

Buffalo Metropolitan Area, New York. Water Resources Management. Detailed Project Report for Flood Management in Cayuga Creek Watershed.

Aug 77

DETAILED PROJECT REPORT
UNDER
SECTION 205 OF THE 1948 FLOOD CONTROL ACT, AS AMENDED

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

DETAILED PROJECT REPORT
FOR
CAYUGA CREEK WATERSHED, NEW YORK
UNDER
SECTION 205 OF THE 1948 FLOOD CONTROL ACT, AS AMENDED

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DETAILED PROJECT REPORT
FOR
CAYUGA CREEK
CHEEKTOWAGA, NEW YORK

PERTINENT DATA

A. PROJECT AUTHORIZATION: Section 205 of the 1948 Flood Control Act, as amended - Specifically, this project was approved to be completed under the 205 authority by the Chief of Engineers on 16 July 1976.

B. PROJECT PURPOSE: Local Flood Protection

C. PROJECT AREA: Cayuga Creek in vicinity of Union Road and William Street in the town of Cheektowaga, New York.

D. MAJOR PROJECT FEATURES OF THE SELECTED PLAN:

Flood Wall: Concrete tee on right bank beginning at Union Road bridge and extending about 700 feet upstream, two feet of freeboard above 100-year flood stage.

Transverse Levee and Wall: About 600 feet of earth levee and 250 feet of concrete wall, with freeboard of three feet for levee and two feet for wall and an additional amount added for velocity head.

Erosion Protection: On left bank beginning at Union Road Bridge and extending 850 feet upstream; on right bank from 700 feet to 850 feet above bridge, and 400 square yards in vicinity of junction of the floodwall along the creek and the transverse levee.

Channel Work: Removal of earth to bedrock to place tee wall and excavation for bank erosion protection and channel work.

E. PROJECT QUANTITIES:

Lands	9 acres
Excavation	4,420 cy
Erosion Protection	4,650 cy
Levees	9,350 cy
Concrete	1,365 cy
Flap Gates	1-18", 1-24"
Gate Valve	1-24"
Culvert Pipes	1-18", 1-24"

F. PROJECT DESIGN: 14,700 cfs channel design flow to provide 100-year level of protection.

G. PROJECT ECONOMICS:

First Cost:	$962,000
Average Annual Cost:	72,900
Average Annual Benefits:	
Flood Inundation Reduction	74,380
Area Redevelopment	3,380
Affluence	7,970
Total	$ 85,730
Beneiit Cost Ratio	1.2

SYLLABUS

This report summarizes studies made to find an economically feasible, technically practical, and a socially and environmentally acceptable solution to reduce flood damage in the town of Cheektowaga, New York.

The town of Cheektowaga is subject to almost annual overbank flooding from Cayuga Creek. The flooding causes hardship to residents and businessmen through material damage to property and inaccessibility to businesses. Average annual damages from flooding in the area in the vicinity of Union Road and William Street, where the greatest amount of overbank flooding occurs, is estimated to be about $98,600 on April 1979 price levels and 1980 conditions of development.

Following an analysis and evaluation of both structural and nonstructural alternatives, a structural plan immediately upstream of the Union Road bridge was selected as the best plan to reduce flood damage in the vicinity. In general, the plan shown on Plate 4 will consist of: a concrete tee wall on the right bank beginning at the bridge and extending upstream about 700 feet; then erosion protection on the creek bank that continues to a limit about 850 feet upstream of the bridge; about 700 feet upstream of the bridge, the concrete tee wall joins a transverse earth levee that continues northward, parallel to an existing athletic field,.for a distance of about 500 feet to join a concrete wall about 250 feet long between two abandoned quarry ponds and then joins an earth levee that continues about 100 feet further to tie into ground contour elevation 613.5. On the left bank from the bridge to 850 feet upstream, the bank will be protected against erosion. Both banks of the creek will be cleared, cleaned, and seeded from the upstream limits of the erosion protection to a limit about 1,400 feet upstream of the bridge. In addition, an area of approximately 400 square yards, in the vicinity of the junction of the transverse levee and the floodwall along the creek will be protected against erosion. Work in the stream bed will consist of removing earth material down to rock as necessary to place the tee wall and erosion protection material. An 18-inch culvert with flap gate will be installed in the concrete tee wall near the bridge and a 24-inch culvert pipe with flap gate and gate valve will be included in the concrete wall between the quarry ponds. The top of the tee wall along the creek will average about four feet above ground level and the top of the transverse levee would vary from about seven feet above ground level near the creek to no differential at the 613.5 contour where the levee will terminate. Adverse environmental effects resulting from construction will be minor and partially mitigated by vegetative planting, careful site selection, and close adherence to specifications during construction. The economic stability and effect of reducing flood damages will favorably impact on the regional and national economies. The project plan is socially acceptable, with substantial improvement to the social well-being of the community.

The total first cost of the plan based on April 1979 price levels is $962,000; $893,000 Federal and $69,000 non-Federal. Average annual cost based on a 100-year project life and interest rate of 6-7/8 percent is $72,900. Total average annual project bnefits are $85,400 which would result from flood damage reduction, area redevelopment, and affluence. As no new development is anticipated in the project area, benefits to future development are not included. The ratio of average annual benefits and average annual costs is 1.2.

The District Engineer recommends construction of the selected plan generally as described and discussed in the Detailed Project Report.

DETAILED PROJECT REPORT
FOR
CAYUGA CREEK WATERSHED, NEW YORK
UNDER
SECTION 205 OF THE 1948 FLOOD CONTROL ACT, AS AMENDED

THE STUDY AND REPORT

PURPOSE AND AUTHORITY

Cayuga Creek overflows its banks almost annually, flooding local areas in the town of Cheektowaga. This flooding subjects the residents and businessmen to inconvenience and financial loss because of inaccessibility to homes and businesses and causes property damage. The purpose of this report is to identify and develop feasible solutions to these problems based upon sound engineering, economic, environmental and social considerations.

This report is authorized by Section 205 of the 1948 Flood Control Act, as amended. The Act limits Federal spending to $2 million unless the area has been declared a major disaster area during the past five years, then Federal spending is extended to $3 million. The town of Cheektowaga has not been declared a disaster area so Federal spending is limited to $2 million.

Initially, at the request of local interests through their representatives in Congress, the Committee on Public Works of the House of Representatives adopted and passed a resolution on 13 June 1956 that authorized a study of Cazenovia and Cayuga Creeks for flood control. On 10 July 1961, the Committee on Public Works of the Senate adopted and passed a resolution that enlarged the scope to include the entire Buffalo River Basin in the interest of flood control, allied purposes, and water supply. The Chief of Engineers approved combining the two resolutions on 14 December 1961. On 14 June 1972, the House Committee on Public Works adopted and passed a resolution to further expand the study. The Resolution reads as follows:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby required to review the reports of the Chief of Engineers on Cazenovia Creek, and Cayuga Creek, New York, submitted in House Document No. 326, 77th Congress, and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to providing improvements in the interest of flood control,

wastewater management, water supply, water quality, environemntal quality, recreation and fish and wildlife for the Buffalo River Basin, New York."

The Chief of Engineers authorized further enlargement of the study on 5 March 1973 to include the Buffalo Urban Area (SMSA) and redesignated the study "Buffalo Metropolitan Area, NY 44012." The expanded study authorization permitted consideration of all needs and problems required under the Corps Urban Studies Program. This study of the Cayuga Creek portion of the Buffalo Metropolitan Area was authorized for completion under Section 205 by the Chief of Engineers on 16 July 1976.

SCOPE OF THE STUDY

This study is interim to the Buffalo Metropolitan Area, New York, Water Resources Management Feasibility Study with emphasis on consideration of flood management in the Cayuga Creek Watershed.

The Cayuga Creek study area includes the entire 40-mile reach, from the headwaters to the mouth, including tributaries. The major tributaries are Slate Bottom Creek, located about 2.6 miles upstream of the mouth, and the little Buffalo Creek which joins Cayuga Creek approximately three miles above Lancaster, New York. The Cayuga Creek Basin area in relationship to the entire Buffalo River Basin is shown on Plate 1. The location of the local protection project, detailed in this report, and considered reservoir are also indicated on Plate 1. In addition to hydraulic considerations, this study assesses the hydrologic, ecologic, and economic effects that the project will have on the Cayuga Creek Watershed. Investigations were made in sufficient detail to select the best possible plan for construction. The study has been coordinated with individual property owners, the general public, and interested agencies.

STUDY PARTICIPANTS AND COORDINATION

A document entitled "Public and Private Interest Groups of the Cayuga Creek Basin in Erie County: Who They are and What They Think" was prepared by the Corps in June 1974. During preparation of the document, various Federal, State and local Government agencies were consulted, including: The U.S. Soil Conservation Service, U.S. Environmental Protection Agency, the Erie and Niagara Counties Regional Planning Board, Erie County Department of Environmental Quality, New York State Department of Environmental Conservation, the town of West Seneca, the town of Cheektowaga, the village of Depew, the village of Lancaster, the town of Lancaster, the town of Alden, the town of Marilla, the town of Bennington, and the town of Sheldon.

During preparation of this report, coordination was also maintained with the Bureau of Outdoor Recreation, U.S. Fish and Wildlife Service, National Park Service, New York State Office of Planning Service, New York State Department of Transportation, and various organizations and interested individuals. Two workshops were held to obtain information to assist in development of a plan of improvement; the first was held on 8 April 1975 and the second on 22 April 1975. The organizations and interested parties chosen to participate in the workshops were selected based on their assumed interest, ability, and desire to contribute to the study. Those represented at the workshops were: The Town Engineer from West Seneca and Cheektowaga, Mr. Persichini representing the village of Depew, Mr. Deutschlander representing the village of Lancaster, New York State Department of Environmental Conservation, Erie and Niagara Counties Regional Planning Board, Soil Conservation Services, Mr. Repka and Mr. Frankowick representing a town of Cheektowaga developer, Mr. and Mrs. Sitarek representing themselves as affected homeowners in the vicinity of Union and William Streets, Mr. and Mrs. Reinstein representing themselves and the environment, and Mr. Hizby, a homeowner in the area. The workshops were extremely informative and assisted in obtaining a more detailed understanding of needs and desires of local residents and gave each an opportunity to participate in development of the project. All attendees expressed satisfaction with the workshops.

On 3 December 1976, the engineering department of the town of Cheektowaga was contacted to obtain information on available topographic, property maps, and drainage plans in the vicinity of Union and William Streets. The town stated that a local consulting engineering firm was engaged to develop a storm drainage plan in the area and that they furnished topographic and property maps of the area. Nussbaumer and Clark, Inc., the firm retained by the town of Cheektowaga to develop the storm drainage plan, was contacted on 8 December 1976 to obtain further information on the topographic maps and other engineering data. On 15 December 1976, the town of Cheektowaga Engineer and Assessor were invited to discuss the best location for the proposed structures particularly as it would affect property owners and town plans for development. On 21 January 1977, Buffalo District personnel visited a gentleman at the proposed project site who claimed to be a spokesman for the owner of the property where the structures would be built. The man was very receptive and appreciative that we explained the tentative project plan with him and indicated no objection to construction or maintenance of the project. Items of local cooperation were discussed with officials of New York State Department of Environmental Conservation in Albany, NY, on 3 May 1978. On 13 February 1979, Corps staff met with home owners to discuss the relationship of the Selected Plan to their interests. Numerous phone conversations and office visits have been made by Corps personnel to explain the operation and function of the proposed improvements. A Public Notice was issued and distributed on 6 April 1979 to identify the dredged or fill material that will be discharged into Cayuga Creek by implementation of the proposed project, and to provide an opportunity for any persons affected by such discharge of materials, to request a public hearing. The notice was issued in conformance with 40 USC of FR 230 - Section 404, of PL 92-500. No one requested a hearing.

THE REPORT

This report is comprised of a Main Report, Technical Appendices, and a Pertinent Correspondence Appendix. The Main Report is a brief summarized discussion of the study, purpose, scope, considerations, statement of findings, and recommendations. The Main Report is a brief nontechnical condensation while the Technical Appendices contain supporting data, are more detailed and are more technical. The Pertinent Correspondence Appendix contains correspondence associated with the study that reflects views of private and public interests.

PRIOR STUDIES AND REPORTS

As a result of past flooding along Cayuga Creek, a number of studies and reports have been prepared by various Federal, State, and local agencies. These studies and reports provide information on water and related land resource problems in the Cayuga Creek Basin that assisted in developing the plan recommended in this report for reducing flood damage in the town of Cheektowaga. A summary discussion of pertinent prior studies and reports is presented chronologically in the following paragraphs.

A survey report on Cayuga, Buffalo, and Cazenovia Creeks, submitted to Congress 23 July 1941, was subsequently published in House Document No. 326, 77th Congress, First Session, and was the basis for authorization and subsequent construction of the local flood protection project at Lancaster on Cayuga Creek. The project includes channel improvement, earth dikes, and some steel sheet pile flood walls. No other projects investigated at the time were found to be economically feasible.

A definite project report dated 1 July 1943 was prepared prior to the construction of the project at Lancaster. It was recommended in the report that authorization be given for preparation of contract drawings and specifications.

House Document No. 574, 78th Congress, Second Session, 5 May 1977, contained a survey report prepared by the Department of Agriculture describing an investigation of water flow retardation and soil erosion prevention to provide flood and streambank protection. The report recommended a program of farmland treatment and retirement and reforestation of submarginal land.

A Corps of Engineers survey report was submitted to Congress on 7 November 1949. The report contained information on improvements to reduce flood damages along the lower reaches of Cayuga, Buffalo and Cazenovia Creeks, and the possibility of combining water supply for Lockport and other localities with flood control storage in a reservoir on the watershed. No improvement was recommended in the report.

Draft of survey report (Review of Reports for Flood Control and Allied Purposes) recommending four local protection projects, three on Cazenovia Creek and one on Cayuga Creek, was completed and submitted to the Division Engineer, North Central, in April 1967 but was returned for additional information on reservoirs. The Corps assumed that the State of New York Study of reservoirs being made at the time would assist in preparation of the Corps report. However, the State's report, completed in December 1969, did not provide sufficient survey scope information to complete the Corps report.

A flood plain information report on Cayuga Creek in the towns of West Seneca, Cheektowaga, and Lancaster was prepared by the Corps of Engineers in May 1967. This report was furnished to the Erie County Department of Public Works, the requesting agency.

In October 1968, Harza Engineers - Greely and Hansen printed a report entitled "Erie-Niagara Basin, Comprehensive Water Resources Plan, Alternatives for Water Resources Development." The report was the basis for the State of New York report printed the following year. The State of New York report, "Erie-Niagara Basin Comprehensive Water Resources Plan, Main Report," presents a plan for water resources development in western New York State. This report was published by the Erie-Niagara Basin Regional Water Resources Planning Board in December 1969. The Corps of Engineers participated in the State study under Section 214 of the 1965 Flood Control Act. The report summarized investigations that identified available resources, needs, and opportunities for development.

A public meeting was held by the State of New York Department of Environmental Conservation on 29 June 1971 to obtain the views of local interests on various plans and alternatives presented in the report. On 28 October 1971, the State prepared a brief report based upon the opinions expressed at the public meeting.

A Type 15 flood insurance study for the towns of West Seneca, Elma, and Cheektowaga was completed by Corps of Engineers personnel in February 1974. The flood hazard areas in the floodway were delineated for the once in 100-year flood level. A copy of the map outlining these areas is on file at the Buffalo District office of the Corps of Engineers.

An unfavorable reconnaissance report for Cayuga Creek, Lancaster, NY, was submitted to the Division Engineer, North Central on 10 May 1974. A report entitled "Public and Private Interest Groups of the Cayuga Creek Basin in Erie County: Who They are and What They Think" was completed by the Corps in August 1974. A report entitled "Cayuga Creek Erie County, New York Review of Reports for Flood Control and Related Purposes" was completed by the Corps in October 1974. The report identified data that would be useful in preparation of a preliminary feasibility report. A preliminary environmental report with a photographic survey of the Cayuga Creek Basin was also completed in October 1974 for use in preparation of a preliminary feasibility report.

A Preliminary Feasibility Report (PFR) for flood management of the Cayuga Creek Watershed was completed by the Corps of Engineers in May 1975 but the recommended structural alternative was reconsidered and modified so that the modified plan would be well within cost limitations to qualify for completion under Section 205 Authority. Town of Cheektowaga and State of New York officials were consulted and approved of the proposed modification. On 17 November 1975, the New York State Department of Environmental Conservation (NYSDEC) requested the Corps of Engineers to continue study of Cayuga Creek in the William Street-Union Road area under Section 205 of the 1948 Flood Control Act. On 9 December 1975, the District Engineer, Buffalo, recommended that the PFR completed in May 1975 serve as Stage 1 and Stage 2 planning phases of the Section 205 authority. The Chief of Engineers concurred and that the study leading to a Detailed Project Report (DPR) be initiated at Stage 3, Development of a Recommended Plan for construction. The draft report was completed in March 1978 and this is the final report. Approval of this report by OCE is scheduled for October 1979. The New York State Department of Environmental Conservation has the responsibility of acquiring the lands and easements for the project and the Corps will request the State to do this immediately following OCE approval of this DPR if funds are available for plans, specifications, and construction. The NYSDEC requires about 15 months to complete the land acquisition that would then allow the Corps to complete plans and specifications by March 1981, award a construction contract by April 1981, and complete construction of the project in the summer of 1982.

In addition to the reports indicated above, there are numerous other sources of material relevant to the Cayuga Creek Basin that were reviewed during preparation of the PFR completed by the Corps in May 1975. These reports were prepared by State, regional, county, city, and town agencies and are related to a multiplicity of concerns and problem identification, needs, and solutions. The reports contain information on recreation, water quality, the environment, social and economic aspects, storm drainage, land use, and other localized problems and needs in the Cayuga Creek Basin.

RESOURCES AND ECONOMY OF THE STUDY AREA

GENERAL

In the development of a solution to the present and future overbank flooding problem in the vicinity of Union and William Street in the study area, consideration was given to the resources and development trends of the area. This section presents data related to the environment, natural and human resources, land development, and to the economy of the study area. The most detailed data are related to the Union and William Street area in the town of Cheektowaga. Other detailed data on resources and economy of the study area are contained in Appendix B.

Cayuga Creek is the northernmost of the three main tributaries of the Buffalo River and flows through seven towns and two villages in three counties (Erie, Wyoming, and Genesee) as it meanders from its headwaters in the town of Sheldon in Wyoming County to its mouth and confluence with the Buffalo Creek at Harlem Road and Clinton Street to form the Buffalo River. The entire Buffalo River Basin is shown on Plate 1.

The upstream reaches of Cayuga Creek and its major tributary, Little Buffalo Creek, flow in a north-northwest direction through farmlard located in the towns of Sheldon, Bennington, Marilla, and Alden. Near the confluence of these two creeks, Cayuga Creek begins to flow in a more westerly direction through the suburban communities of Lancaster, Depew, Cheektowaga, and West Seneca. The villages of Lancaster and Depew are almost completely developed while in the towns, only a small portion of the land zoned for industrial and commercial development has been utilized. Local planning officials have indicated that, although no development protections have been made, the rate of residential development in the area has been less than anticipated.

Because of the hazard of flooding, most areas immediately adjacent to the creek remain in a natural state and are ideal for park development. Presently, approximately 780 acres of open space exist between the mouth of the creek at Harlem Road and Clinton Street, and Como Lake Park, Lancaster. The Erie and Niagara Counties Regional Planning Board has proposed an open space and recreation plan and program to be completed by 1990 that would effectively double the area presently used for parks and recreation.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

Cayuga Creek drains an area of 128 square miles, is about 40 miles long, and is located in the west central part of New York State. The two major tributaries of Cayuga Creek are Little Buffalo and Slate Bottom Creeks. Little Buffalo Creek is 17 miles long and drains about 23 square miles with headwaters near Folsomdale and Bennington Corners, NY. This tributary flows northwesterly to join Cayuga Creek a short distance southeast of Lancaster. Slate Bottom Creek is 8.4 miles long, drains 11.8 square miles, rises north of Elma, NY, and enters Cayuga Creek about 2.6 miles upstream of its mouth. In addition, Williamstown Brook is a small tributary about 1.0-mile long and drains a 1.0-square mile area that is intensely developed as an apartment complex and a shopping mall. The stream flows southerly through the shopping mall in an underground conduit and under Union Road where the brook becomes an open channel as it flows through the apartment complex. It crosses under William Street and Cayuga Creek Road through another conduit, and enters Cayuga Creek about 3.0 miles upstream of its mouth.

The climatological data applicable to the Cayuga Creek Basin was obtained from 12 weather stations in or near the Buffalo River Basin. Only eight are still in operation, including the U.S. Weather Bureau first order station at the Buffalo International Airport. Generally the climate of the basin can be characterized as humid with temperatures ranging from 24.2°F in January to 69.2°F in July with an average annual precipitation of 36.92 inches. Monthly rainfall averages are fairly constant ranging from 2.53 inches in February to 3.33 inches in May. The records show that snow can be expected during eight months each year with an average annual snowfall of 82.3 inches and the greatest accumulations occurring in January, December, February, and March in that order. This accumulation of snow and spring rains accelerates runoff into Cayuga Creek and is a major cause of annual overbank flooding along Cayuga Creek. Table 1 shows the average monthly climatological data for the Cayuga Creek Basin and in and adjacent to the Buffalo River Basin.

Topographically, Cayuga Creek Basin consists of a succession of nearly level plains rising to the north in a series of steps. In the lower reaches, from the mouth to Lancaster, the course of the creek has been modified by the northward retreat of the ice front during the final stages of the last glaciation. The western deflection of all the creeks in the Buffalo River Basin may have also been the result of that same ice front. In the upper reaches, where the creek borders the northern edge of the Allegheny Plateau, erosion has taken place. This erosion is caused by high stream velocities and non-wooded overbanks. The eroded material then deposits on the Erie

Table 1 - Climatological Data in and Adjacent to the Buffalo River Basin

Twelve Station Monthly Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature Degree Fahrenheit	24.2	25.2	31.0	44.9	55.2	64.9	67.9	67.9	61.2	51.3	39.3	27.7	46.9
Precipitation in Inches	2.78	2.53	2.97	3.30	3.33	3.19	3.16	3.21	3.31	3.18	3.18	2.78	36.92
Snowfall in Inches	18.4	17.0	14.3	3.3	0.1	T	0	0	T	0.4	11.6	16.2	82.3

Plain where the creek widens and velocities decrease. Evidence of this deposition is manifest in the lower reaches where shoals have formed, partially obstructing the channel. Topographic data for Cayuga Creek are given in Table 2.

Table 2 - Cayuga Creek Topographic Data

Reach	Length Mi.	Source El., Ft.	Terminus El., Ft.	Average Slope Ft/Mi.	Drainage Area Sq. Mi.
Cayuga Creek	40	1,640	578	27.5	128
Source to Bennington	(10)	(1,640)	(1,060)	(58.2)	(32)
Bennington to Cowlesville	(5)	(1,060)	(910)	(30.0)	(16)
Cowlesville to Little Buffalo Creek	(12)	(910)	(675)	(19.6)	(7)
Little Buffalo Creek to Lancaster	(3)	(675)	(652)	(7.7)	(15)
Lancaster to Depew	(2)	(652)	(625)	(13.5)	(3)
Depew to Mouth	(8)	(625)	(578)	(5.9)	(27)
Little Buffalo Creek	17	1,340	675	39.1	23

The bedrock geology underlying the area consists of sedimentary formation from the middle and upper Devian age. These strata form an outcrop pattern of east-west trending bands, dipping to south at a slope of about 40 feet per mile. The major units of material underlying deltaic deposits, glacial lake deposits, and recent sediments of alluvial material. These form outcrop patterns which can be seen at various points in the creek bed. The surficial deposits found generally blanketing the study area are the result of Pleistocene glaciation. The area was subjected to a succession of ice advances and retreats which deposited glacial till and complex patterns of fluvio-glacial and lacustrine sediments. These heterogeneous surficial deposits exert a strong influence in ground water behavior.

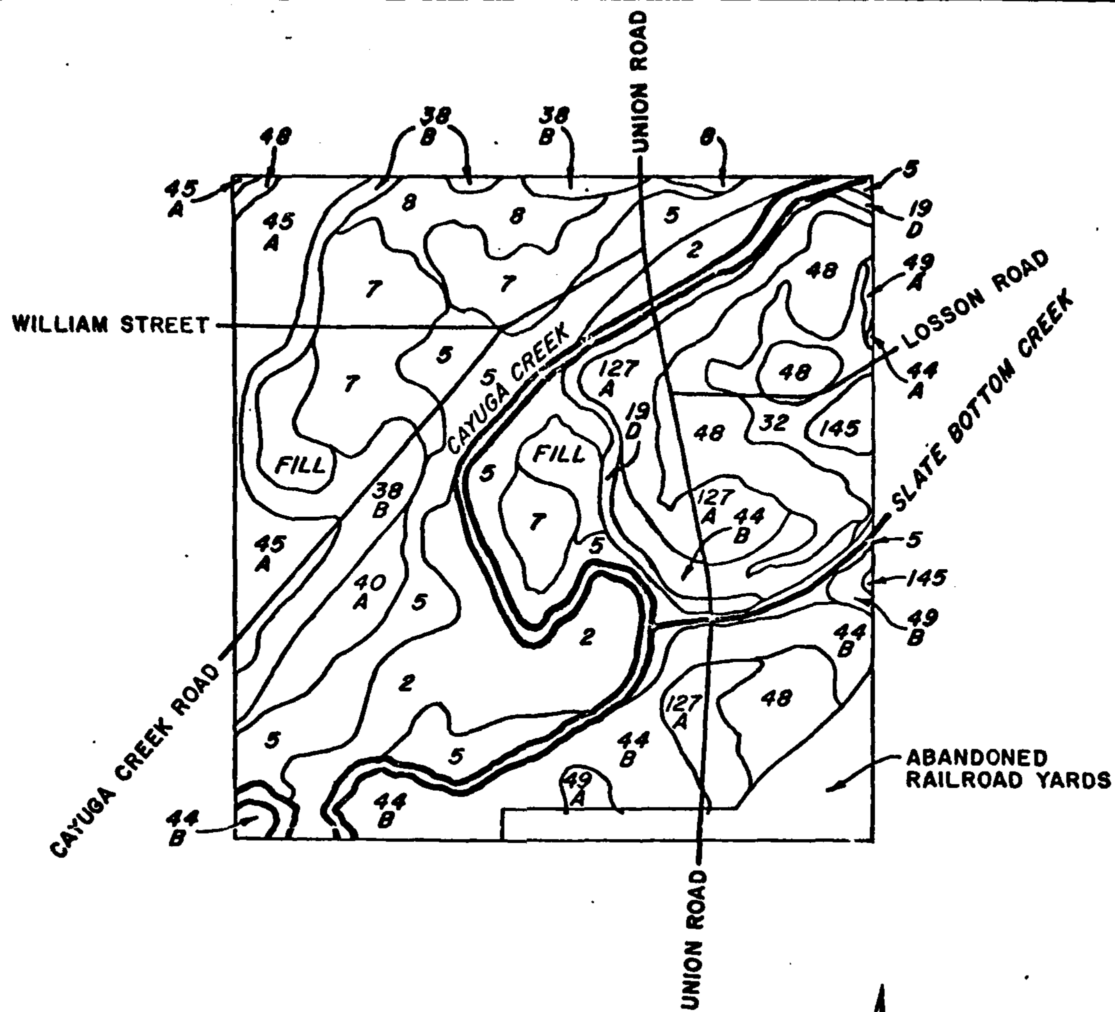
The water supply in the Cayuga Creek Basin is generally obtained from two sources, Lake Erie through the city of Buffalo and the Erie County Water Authority or from wells and springs. The ground water behavior in the area is extremely variable but in most cases the static water levels are generally less than 20 feet below ground level. Overall water movements within overburden are generally controlled by the gradient of bedrock surface beneath, which has low permeability.

Since 1966, the Air Pollution Control Division of the Erie County Department of Health has been gathering data on air quality. The data indicate that suspended particulants and sulfation levels occur in the vicinity of and downwind from industrial zones. The Cayuga Creek Basin is far enough removed from industrial centers of Buffalo to remain unaffected by air pollution problems.

A strip of land along both banks of Cayuga Creek ranging in width from about 50 feet to 100 feet remains undeveloped and lined with trees and a lush vegetation cover. The Cayuga Creek channel from its mouth upstream to the Union Road bridge has about a 12-foot drop from the top of bank to the thalweg and is 120 feet wide at the bottom. Upstream of Union Road the depth from thalweg to the top of bank decreases to about nine feet and the width increases to about 250 feet. Both banks of the creek contain black willow, American sycamore, and eastern cottonwood in abundance. Mixtures of shrubs and weeds such as chokeberry, wild grape, raspberry, thistle, and goldenrod are some of the plants that have established themselves on terrain adjacent to the creek. The dominant ground cover species are wild grape and staghorn sumac occurring in dense thickets further up on the stream banks. Many of the shrubs and trees are so close to the water's edge that, as the creek undercuts its banks, they fall into the channel. In some residential areas near the creek, there is an abundance of low grasses and cleared areas that have been maintained as lawns. In other areas in the villages of Depew and Lancaster, natural vegetation along the streambanks is less extensive due to greater commercial development.

There are 14 different soil types located within and surrounding the project area near Union Road and William Street in the town of Cheektowaga that have been mapped and described by soil scientists. Soil criteria such as depth, drainage, acidity, alkalinity, texture, slope, permeability, stoniness, and water table height are among the factors considered in the descriptions. The following survey map shows the location of the soils in the vicinity of the project area.

The fairly dense streambank vegetation along Cayuga Creek provides an excellent habitat for wild birds and mammals. The Buffalo Ornithological Society lists about 372 different species of birds sighted in the western New York area. Of these, some are non-migrating, others sited only during summer or winter, and others observed only during migration through the area. On a seasonal



LEGEND

2 HAMLIN FINE SANDY LOAM
5 TEEL SILT LOAM
7 WAYLAND SILT LOAM
8 SLOAN SILT LOAM
19 ARKPORT FINE SANDY LOAM
32 CANANDAIGUA SILT LOAM
38 COLLAMER SILT LOAM
40 WALLINGTON SILT LOAM
44 GALEN FINE SANDY LOAM
45 NIAGARA SILT LOAM
48 COSAD FINE SANDY LOAM
49 MINOA VERY FINE SANDY LOAM
127 CLAVERACK LOAMY FINE SAND
145 RAYNHAM CALCAREOUS VARIANT SILT LOAM

SLOPE DESIGNATIONS

A – 0 TO 3%
B – 3 TO 8%
C – 8 TO 15%
D – 15 TO 25%

CAYUGA CREEK NEW YORK

SOILS SURVEY MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

basis, bird life is essentially static during January and February with a noticeable migration beginning in March as some visitors leave for the north and some waterfowl migrate from the south. Some prey birds and land birds are observed leaving the area. Peak migration is reached in April and May. The most common species in the project area include the starling, cardinal, crow, yellow shafted flicker, common grackle, American robin, morning dove, song sparrow, red-winged blackbird, slate-gray juneo, and mallard. The water depth in the Cayuga Creek is too shallow to support large waterfowl or diving ducks. Ring-necked pheasant are often observed especially during the nonhunting season. About 45 species of mammals have been seen in the western New York region and the most common in the vicinity of the project area include mice, chipmunks, squirrels, eastern cottontail rabbit, bats, moles, and skunk. Salamanders, toads, frogs, turtles, and snakes of various types also thrive in and around the Cayuga Creek. A number of plant and animal species, whose existence is considered to be in peril, have present or prior natural ranges which encompass the project vicinity. These species are protected by the Federal Government under the Endangered Species Act of 1978 (16 USC, 1531-1543, 87 Stat 884) and by New York State under jurisdiction of Section 11-0535 and 9-1503 of the Environmental Conservation Law. The Federal Register of 17 January 1979, Vol. 44, No. 12, pp. 3636-3654 gives the most recent list of species protected Federally. Endangered species protected by the State of New York are listed in Section 11-0535 of the Environmental Conservation Law. Only five vertebrate species protected by either law have a possibility of occurring in the Cayuga Creek area; the Osprey, Bald Eagle, Peregrine Falcon, Indiana Bat, and Bog Turtle. No recent sightings of any of these animals have been recorded in the project area. Section 9-1503 of the New York State Conservation Law protects a number of plant species native to New York State. None are known from the project vicinity. The Endangered Species Act protects one plant native to New York State. This plant is the Northern Wild Monkshood (Aconitum noveboracense) a plant of the deep woods and damp slopes. This plant is not known from the project vicinity.

Because of the geological characteristics of Cayuga's streambed, only a few pools exist that are of a quality to support aquatic life. Cayuga Creek in its lower reaches is rather shallow, slugggish, and highly turbid during much of the year and the bed is a pavement of shale or limestone. Some gravel shoals exist where bridge abutments have impeded stream flow. Well developed riffle areas are common only in the creek headwaters a considerable distance upstream of the project area. In the few pools that do exist there can be found small mouth bass, large mouth bass, suckers, minnows, and pan fish. The Little Buffalo Creek, one of the major tributaries to Cayuga Creek, supports brown trout in a 3-1/2 mile reach below the village of Marilla.

Only the town of Lancaster in the Cayuga Creek Basin now discharges the effluent from their waste treatment facilities to Cayuga Creek. Flows from the village of Depew, and village of Lancaster, plants are now directed to the Buffalo Sewer Authority Treatment Plant. The town of Cheektowaga also has an outfall to the Buffalo River just downstream at the confluence of the Cayuga Creek and Buffalo Creek. However, under a State adopted water resource development plan, these discharges will be part of a County Sewer District and be pumped to the city of Buffalo for secondary treatment. The most comprehensive data on Cayuga Creek water quality are that maintained by the Erie County Laboratory Public Health Division. These data published in the 1973 Erie County Stream Survey are presented in Table 3. The data were from samples collected during the summer of 1973, during normal working hours with no attempt to correlate sampling with the time of day.

With its high nutrient content and sluggish plow, Cayuga Creek supports large numbers of algal and higher plant forms, except where septic conditions obtain. Benthic invertebrates of Cayuga Creek are listed in Table 4, based upon collections made during 1973 by Erie County. The midge fly larva is abundant at all stations, reflecting its tolerance to a wide range of conditions. Tubifox worms, which are generally considered to be indicative of sewage sludge, are a dominant organism below the village of Lancaster. Also common in the lower reaches of the creek is Physa, a snail which can breathe air and is able to tolerate low oxygen levels. In contrast, the upper reaches of the creek are dominated by clean water forms such as the magfly and stonefly larvae. Throughout much of its length, Cayuga Creek is a very poor habitat for fish, especially those species of interest to man as a source of recreational pleasure. The upper reaches of Cayuga Creek are narrow and shallow and the lower reaches, while wider and deeper, are grossly polluted. In 1928, before the sewage plants in Depew and Lancaster were in operation, only five species were collected while other local streams had 10-20 species. The fish inhabiting Cayuga Creek are the golden shiner, mud minnow, little pickerel, common sunfish, and rare pirate perch. These types of fish are typically associated with weedy, sluggish ponds and streams. Even though the quality of Cayuga Creek has improved somewhat in recent years, the lower creek downstream of the villages of Lancaster and Depew is still considered one of the lowest quality reaches of stream in the county. Existing waste treatment facilities are inadequate and often overloaded causing partially treated and often raw sewage to enter the creek. During a recent field survey of the immediate project area near the Union Road crossing, decomposed sewage and rotting algae in the creek caused a very undesirable stench.

Table 3 - Cayuga Creek Water Quality

Location	Station Number	BOD-5, mg/L O_2	DO mg/L	Total[1/] Phosphate as Phosphorus mg/L	Ortho-[2/] Phosphate as Phosphorus mg/L	Fecal Coliforms per/100 ml
Four Rod Road	CY-11					
Town of Alden	Max.	1.2	9.0	0.08	0.11	2,340
	Min.	0.2	7.2	0.01	0.01	0
	Mean	0.8	8.0	0.03	0.01	303
Schwartz Road	CY-9					
Town of	Max.	2.4	9.8	0.05	0.02	2,000
Lancaster	Min.	0.4	7.1	0.01	0.01	0
	Mean	1.1	8.6	0.02	0.01	221
Bowen Road	CY-8					
Town of	Max.	1.4	9.6	0.15	0.02	1,400
Lancaster	Min.	0.6	8.0	0.02	0.01	10
	Mean	0.9	8.9	0.08	0.01	245
Calanet Road	CY-6					
Village of	Max.	37.0	11.0	1.00	0.64	7,000
Lancaster	Min.	3.0	2.8	0.24	0.11	770
	Mean	10.5	6.5	0.59	0.38	300
Transit Road	CY-5					
Village of	Max.	17.5	7.4	2.00	1.18	6,000
Depew	Min.	1.8	0.2	0.20	0.07	1,750
	Mean	7.5	2.1	0.99	0.57	2,686
Rowley Street	CY-3					
Town of	Max.	27.0	7.2	2.00	2.00	1,750
Cheektowaga	Min.	4.6	0.4	0.19	0.19	50
	Mean	10.0	4.0	1.02	1.02	590

1/ Total phosphate includes ortho, suspended and inorganic.

2/ Orthophosphate = dissolved phosphates, available for assimilation by stream plantlife.

3/ New York State standards are being revised but as yet the State has not established standards or limits for BOD, total phosphates or Ortho Phosphates. Present standards for DO in the villages of Lancaster and Depew and the town of Cheektowaga are that the minimum shall not be less than 5.0 mg/l and never below 4.0. Upstream the minimum is 7.0 and never less than 6.0. Fecal Coliforms per/100 ml shall not exceed 2,000 based upon five samples.

Table 4 - Benthic Invertebrates Inhabiting Cayuga Creek

Station[1/]	Organisms Collected[2/]
CY-3	*Tendipes* (midge) larvae
	Tubifex (sludgeworms)
	Pentaneura larvae
	Cypris
CY-5	*Tubifex* (sludgeworms)
	Pentaneura larvae
	Tendipes (midge) larvae
	Physa (air-breathing snails)
	Cypris
CY-6	*Nematodes* (roundworms)
	Tubifex (sludgeworms)
	Tendipes (midge) larvae
	Physa (air-breathing snails)
	Simulium (blackfly) larvae
CY-9	Mayfly larvae
	Tendipes (midge) larvae
	Waterbeetles
	Stonefly larvae
	Elmid beetle larvae
CY-11	Stonefly larvae
	Mayfly larvae
	Pentaneura
	Tendipes (midge) larvae

1/ See Cayuga Creek Water Quality Table 3.
2/ Listed in order of decreasing abundance.

Actions Taken to Date - Two cultural resources investigations (Miller and Weil 1977, and Ivey 1979) have been completed within the environmental impact area of the proposed project. The reconnaissance level survey was conducted by Miller and Weil. During this survey the entire environmental impact area was inspected and several cultural resources manifestations identified. The cultural resource survey conducted by Ivey was concentrated on the Creekside Grove Archaeological Site (UB 1503), which will be the only cultural resources manifestation affected by implementation of the selected alternative.

Based on the findings of both of these consultants and the opinion of the New York State Historic Preservation Officer, the Buffalo District on 26 June 1979, requested a determination of eligibility from the National Register of Historic Places (NRHP) pursuant to 36 CFR para 63. The documentation has been reviewed by the NRHP staff and they have determined that the site is eligible for inclusion on the National Register.

Anticipated Actions - During the course of project planning several alternative plans were developed which would have lessened or eliminated the project impacts on UB 1503. All of these plans were rejected as they were either stucturally or economically inefficient or they would have impacted a larger area of other potentially significant cultural resources identified by the reconnaissance survey. The selected plan therefore is the least culturally damaging of the feasible alternatives.

In order to fulfill the mandate of Section 106 of the National Historic Preservation Act of 1966 (PL 85-655) a draft preliminary case report and mitigation plan have been prepared. (The complete test of these documents are contained in Appendix E). The mitigation plan consists of a data recovery program for approximately two thirds of the site impacted by the proposed project and preservation of the remaining one third of the site. The Advisory Council on Historic Preservation and the New York State Historic Preservation Officer have been requested to comment on the mitigation plan. The Buffalo District considers the selected project plan and the proposed mitigation plan to be the most prudent and feasible alternative to deal with the Creekside Grove Archaeological Site.

Imlementation of the Mitigation Plan - The Buffalo District estimates that the proposed mitigation plan will cost about $18,500. The Staff Archaeologist for the New York SHPO concurs in this estimate (see the telephone conversation record in Appendix E). This estimate exceeds the one percent cost limitation imposed by Public Law 93-291 by $9,600. Therefore, additional funds would be necessary to complete the mitigation plan for this project. Without these additional funds, the Buffalo District cannot comply with the mandate of the National Historic Preservation Act.

There has been little development of park and recreational facilities along Cayuga Creek. The only county park in the entire basin is Como Lake Park in Lancaster, owned and maintained by Erie County. This park includes facilities for tennis, baseball, basketball, and picnicking and is heavily utilized. In 1973, over 565,000 people visited the park according to attendance records compiled by the Erie County Division of Parks. The town of Cheektowaga maintains Losson Road Park and the village of Lancaster maintains a small municipal park. The Buffalo Area Council of the Boy Scouts of America owns and maintains a Boy Scout Camp near Bennington.

HUMAN RESOURCES

Tables 5 and 6 present population and some socioeconomic data for Cayuga Creek basin communities. Population data are the most recent projections approved by the Regional Planning Board on 13 May 1976, and to be used for A-95 project reviews. The socioeconomic data are based upon U.S. Census data of 1970.

DEVELOPMENT AND ECONOMY

The land use pattern for the Buffalo Metropolitan area is typical of that of a medium sized central city with a few urban centers developing on the perimeter. The lower reach of Cayuga Creek Basin, in the town of Cheektowaga is presently in this stage of development. The Erie and Niagara Counties Regional Planning Board predicts that by the year 1990, the lands within the Cayuga Creek Basin between the mouth of the creek and its confluence with the Little Buffalo Creek will be completely urbanized. This area includes the towns of Cheektowaga, West Seneca, the villages of Depew and Lancaster, and part of the town of Lancaster. The upper basin is forcasted to undergo development and change at a much slower rate and remain as farmlands. Existing land use within the 100-year flood outline in vicinity of Union Road and William Street is shown on Plate 3.

At present, the most concentrated residential, commericial, and industrial development is taking place in the lower reaches of the Cayuga Creek Basin, between the village of Depew and the city of Buffalo. There are some small industrial parks in West Seneca and Depew but all major industry is within the Buffalo City limits. The towns of Cheektowaga, West Seneca, and the village of Depew serve as residential communities for employees of those major industries. As the residential growth takes place, commercial development, especially large shopping plazas, are constructed to keep pace with the needs of the residents. Most commercial development in Cheektowaga in the project area is occurring rear Union Road near Cayuga Creek where, in the past few years, a 79-building apartment complex containing 864 units has recently been completed and a large shopping mall has been completed a few blocks away. In addition, the lower Cayuga basin with its proximity to the Buffalo International Airport and rail lines is beginning to develop and encourage light industry and warehouse operations to complement Buffalo's heavy industry.

Table 5 - Population in the Cayuga Creek Basin, 1970-2000

	1970		1980		1990		2020
	Area Population	Yearly Increase (+) Decrease (-)	Area Population	Yearly Increase (+) Decrease (-)	Area Population	Yearly Increase (+) Decrease (-)	Area Population
West Seneca (Town)	48,404	+1,057	58,977	+1,179	70,768	+734	78,106
Cheektowaga (Town)	113,844	+1,237	126,210	+1,423	140,443	+56	141,000
Depew (Village)	22,158	-12	22,033	+4	22,071	-134	20,730
Lancaster (Village)	13,365	+130	14,667	+151	16,176	+92	17,098
Lancaster (Town)	30,634	+62	31,254	+90	32,159	+56	32,723
Alden (Town)	9,787	+147	11,258	+166	12,923	+104	13,959
Marilla (Town)	3,250	+153	4,779	+167	6,453	+104	7,497
Bennington (Town)	2,800	+20	3,000	+24	3,240	+22	3,460
Sheldon (Town)	2,269	+40	2,669	+45	3,119	+50	3,619
Total	246,511		274,847		307,352		318,192

Note: Projections for Bennington and Sheldon defined by their township representatives - all others by the Erie Niagara Counties Regional Zoning Board.

Table 6 - Socioeconomic Data for Cayuga Creek Basin Communities

Town	Census Tract	Median Years School Completed	Percent Unemployed	Median Income $	Median Income $	Percent Below Poverty Level	Median Home Value $1,000's	Modal Home Value Class $1,000's
West Seneca	Entire Town	12.1	1.7-4.5	11,751	12,274	1.2-5.9	14.4-22.9	25-30
Cheektowaga	108.01	12.1	7.0	11,496	11,888	3.1	21.7	20-25
	108.2	12.4	3.0	10,895	11,029	3.2	21.5	20-25
	109.02	11.1	3.5	10,566	11,285	3.0	22.2	20-25
Village of Depew	98	11.0	2.5	9,724	9,728	4.5	17.5	15-20
Lancaster	142.01	11.5	4.5	10,616	11,498	6.0	20.9	15-20
	142.02	11.9	4.6	10,926	11,800	5.1	19.3	15-20
Village of Lancaster	145.02	10.4	4.4	9,161	9,867	10.5	16.2	15-20
	144	11.3	7.0	9,943	10,253	5.1	16.3	15-20
	143	12.2	3.7	11,416	12,018	2.7	18.8	15-20
Alden	149.02	10.7	4.4	10,826	11,394	4.4	20.4	15-20
Marilla	150.01	12.1	6.0	12,083	11,797	6.4	20.5	20-25
Erie County	-	12.0	4.4	10,482	12,205	6.9	18.5	15-20
New York State	-	12.1	3.6	10,617	12,498	8.5	28.2	25-35

Note: Data for Bennington and Java not available.

SOURCE: U. S. Government Printing Office, 1970 Census.

PROBLEMS AND NEEDS

GENERAL

The major water resource problems and needs of the Cayuga Creek basin are flooding and bank erosion. Other matters of concern in the basin are to determine the impacts of improvements or no improvements on water quality, land use, economy, public health and safety, fish and wildlife conservation, water supply, water-related recreation, and other aspects of human and natural environment. The problems and needs were determined by field inspections during and after snow melt, rain, and at the request of persons living near areas that suffered overbank flooding and bank erosion. In addition, several public meetings, workshops, contacts with individuals, by phone and in the field, have assisted to clearly identify the problem areas in the Cayuga Creek Basin and to clearly understand the need to attemmpt a solution to the problems.

FLOODING AND BANK EROSION

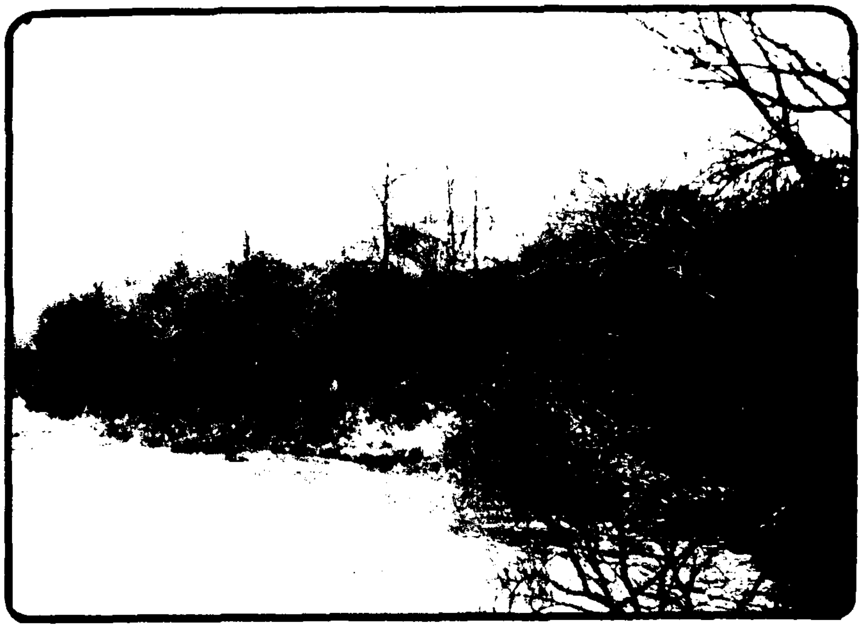
Flooding occurs almost annually along Cayuga Creek. Most of the floods are caused by rapid thawing of snow cover in late winter and early spring, often accelerated by rainfall. Since the ground is still frozen, rapid runoff into Cayuga Creek occurs. Some of the time, ice jams aggravate the problem by clogging bridge openings. During preparation of this report, an analysis of ice effects on stream water surface profile was made and it was verified by field observations that ice does effect levels but the wide, flat, relatively low channel banks upstream of the village of Lancaster provide ice storage that greatly reduces ice jamming potential downstream in the developed areas of the villages of Lancaster, Depew and town of Cheektowaga. Some ice jam related flooding of farmland occurred upstream of the village of Lancaster in March 1977 but no structural damage was caused. In addition to some minor flooding of farmland upstream of the village of Lancaster, caused by ice jams, the topography of the basin contributes to flooding. The Cayuga Creek flood plain is relatively narrow with high banks on the south and relatively low banks on the north. The upstream 27 miles, between the source and Cayuga Creek's confluence with Little Buffalo Creek, has an average slope of 35 ft/mile while the lower reaches between the village of Lancaster and the mouth has a slope of 7.5 ft/mile. This difference in slope tends to concentrate runoff in the lowlands. In addition, low creek banks, meandering channels, and restrictive bridge openings also contribute to the flooding. Most of the flooding occurs at scattered points along the lower seven miles of the basin with the major problem in the vicinity of the Union Road bridge where overbank flooding occurs immediately upstream of the bridge. A high concentration of residential and commercial development is located in this area which becomes severely inundated by the flood water. Lesser flooding problems exist in the area of Como Park Lake where it has been reported that some basements are flooded almost every year.

Bank erosion is a major problem in two areas; downstream of the Borden Road bridge, and upstream of the Ransom Road bridge. Just downstream of the Borden Road bridge, the Creek meanders to the south and then flows north a short distance. Bank erosion just downstream of the Borden Road Bridge could affect the integrity of Rowley Road. However, Erie County completed an extensive rebuilding project on Borden Road during 1977, including a new bridge over Cayuga Creek and erosion control facilities downstream of the bridge. As a result of this work, the threat to Rowley Road from bank erosion downstream of the bridge has been greatly reduced if not eliminated. The photos on the following pages show typical conditions in the vicinity of the Borden Road and Ransom Road Bridges. The most serious erosion problem occurs immediately upstream of the Ransom Road Bridge where the stream takes a sharp bend just before passing under the bridge. Erosion occurs on the left bank at the bend and the eroded material deposits in the creek that often causes ice jams and results in overbank flooding.

According to records, major flooding occurred along Cayuga Creek from storms in June 1937, March 1942, March 1955, March 1956, January 1959, March 1972, and June 1972. Minor flooding occurred in March 1904, January 1929, January 1962, March 1964, September 1967, December 1969, and January 1975. Table 7 shows peak yearly discharges and estimated recurrency interval in years from 1937 to 1975.

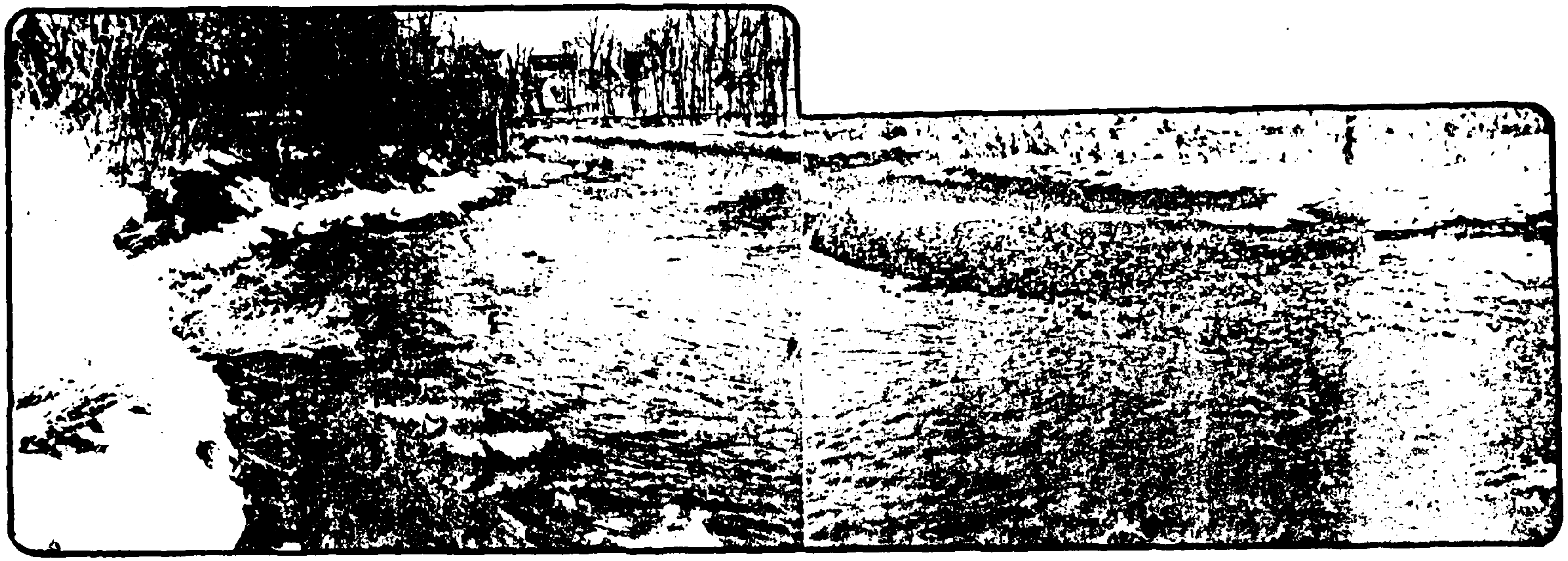
The flood of record along Cayuga Creek occurred in June 1937 and was estimated to have a peak discharge of 18,000 cfs at the gage in Lancaster just downstream of the Borden Road Bridge with estimated damages of about $124,000 on 1966 price levels and conditions of development at the time the damage survey was made. On 1977 price levels and condition of development, the damage cost would be much higher. This flood was caused by a conventional type storm with a sporadic rainfall pattern. Heavy rain fell on western New York on 17, 20, and 21 June 1937, and the maximum precipitation was recorded at the Buffalo International Airport which indicated that 3.0 inches fell in a 6-1/2 hour period.

To facilitate flood damage analysis and evaluation, the damage areas in the vicinity of Union and William, in the town of Cheektowaga, have been divided into reaches, initial damaging elevation, and recurrence interval, as briefly described in Table 8. Other reaches, upstream and downstream of those described in the table, are briefly discussed and described below. Reach 1 extends from the confluence of Cayuga Creek and Buffalo Creek to a limit approximately one mile upstream. Damages in this reach resulting from the January 1959 flood and the June 1972 flood were minor, only affecting one commercial and one residential unit. During the 1959 flood, the most severe damages occurred in Reaches 2, 3, and W-1 described in the table. Most of the damage was attributable to road and public utility damage. The flooding necessitated detouring vehicular traffic. Reach 4 extends from the upstream limit of Reach 3 to a limit about 0.1 miles upstream of the Rowley Road Bridge. Minor residential damage occurred in this area during the 1959 flood. Reach 5 extends from the upper limit of Reach 4 to the headwaters of Cayuga Creek in the vicinity of Bennington and Cowlesville. This reach is principally farmland and suffers little or no damage to structures.



SCOUR AND RIGHT BANK EROSION IMMEDIATELY DOWNSTREAM OF BORDEN ROAD BRIDGE. FEBRUARY 1975

LOOKING UPSTREAM TO CAYUGA CREEK FROM TOP OF BORDEN RD. BRIDGE. FEBRUARY 1975



LOOKING DOWNSTREAM FROM THE LEFT BANK TOWARD RANSOM ROAD. AN ABRUPT DIRECTIONAL CHANGE IN THE CHANNEL IS ERODING THE LEFT BANK AT A RAPID RATE AND LEAVING DEPOSITS ON THE RIGHT SIDE. FEBRUARY 1975.

REDISTRIBUTION OF FLOW IN CONJUNCTION WITH CHANNEL REALIGNMENT WILL REDUCE BANK EROSION AS EVIDENCED IN THIS PHOTOGRAPH. FEBRUARY 1975.

Table 7 - Maximum Discharges on Cayuga Creek

(USGS Gage at Lancaster)
Zero of Gage = 672.80 Mean Sea Level

Water Year	Date	Peak Yearly Discharge (cfs)	Recurrence Intervals in Years
1937	June	18,000 (1)	500
1939	February 20	6,720	5.0
1940	March 31	4,800 (2)	1.7
1941	April 5	5,830	2.8
1942	March 17	7,480	8.3
1943	December 30	3,900 (2)	-
1944	April 12	4,440	1.4
1945	March 3	3,700 (2)	-
1946	October 2	5,910	2.9
1947	April 5	5,690	2.6
1948	March 19	3,820	-
1949	January 5	4,140 (2)	1.3
1950	March 27	5,440	2.2
1951	December 3	6,180 (2)	3.2
1952	March 11	5,600	2.5
1953	August 10	3,710	-
1954	February 16	5,370 (2)	2.2
1955	March 1	7,900	10.5
1956	March 7	8,700	20.0
1957	January 22	7,460 (2)	8.0
1958	November 29	2,400	-
1959	January 22	8,750	20.0
1960	March 30	7,070 (2)	6.1
1961	April 25	5,520	2.3
1962	January 27	3,000 (2)	-
1963	March 17	6,490 (2)	4.2
1964	March 3	5,300 (2)	2.1
1965	February 8	2,960 (2)	-
1966	February 11	5,600 (2)	2.5
1967	September 28	5,350	2.1
1968	January 30	4,220	1.3
1969	Not available	5,881 (1)	2.8
1970	Not available	5,035 (1)	1.8
1971	March	4,280	1.3
1972	June	8,800	20.0
1973	March	2,800	-
1974	March	4,440	1.4
1975	January	8,750	20.0

(1) Estimated by the Army Corps of Engineers.
(2) Stage-discharge relation was affected by ice.

Flood damages in the Cayuga Creek basin include both tangible and intangible losses. Tangible losses during floods include inundation damage to structures, utilities, transportation facilities; flood-fighting costs, post-flood cleanup costs; business losses; and increased expenses for normal operating and living during a flood situation. The estimated average annual flood inundation damages that would result from a recurrence of the January 1959 flood on October 1977 price levels and 1980 conditions of development in Reaches 2, 3, and W-1 total more than $88,000. Intangible losses suffered include: loss of life or limb; human misery during a flood occurrence; disruption of normal community activities; and potential health hazards from contaminated water and food supplies. As new development takes place and changes are made in land use, flood losses will undoubtedly increase unless some flood reduction measures are taken. A more detailed discussion of flood damages with supporting data is presented in Appendix B to this report.

Table 8 - Damage Reaches

Reach	Index Point	Initial Damaging Elevation	Recurrence Interval in Years	Description of Reach
2	1,000 feet downstream from Union Road Bridge	603.0	10	2,600 feet to 1,000 feet downstream from Union Road Bridge
3	400 feet upstream from Union Road Bridge	605.0	2	1,000 feet downstream to 1,300 feet upstream from Union Road Bridge
W-1	At Recreation Center on Williamstowne Brook	600.2	2	William Street upstream to Union Road

Reach 2 is a combination of residential and several small commercial units. The residential units are primarily one-story units of varying value. Located on the left bank is a mobile home park complex. Located on the right bank is a sanitary sewerage pumping station.

Reach 3 is also a combination of residential and several small commercial units. Creekside Park, privately-owned and operated, is located on the right bank just upstream of Union Road.

Reach W-1 is a fairly new residential complex. Included in this reach are the Williamstowne Apartments and recreation center.

WATER SUPPLY AND QUALITY

Most of the residents living in the Cayuga Creek basin are served by municipal water supplies that are obtained either from Lake Erie or Niagara River. Some residents in the rural upstream reaches of the basin obtain water from wells. All of the potable water is of a good quality and meets Federal and State standards.

The Erie County Health Department periodically samples streams in the Buffalo Metropolitan Area to be assured that the stream's quality is maintained. Sampling at six points along Cayuga Creek was accomplished in 1970 and 1973 at the following locations: Four Rod Road; Schwartz Road; Bowen Road; Calumet Street; Transit Road and Rowley Road. Test results indicated that the water quality in 1973 was better than it was in 1970. The Cayuga Creek is rated "B" or "C"; two New York State Department of Environmental classifications. From the mouth to Plum Bottom Creek, the creek is classified "C" (able to support fish propagation); and from Plum Bottom Creek to the headwaters, it is classified "B" (body contact and recreation). The water quality can be expected to improve when the waste treatment facilities now being constructed by Erie County further treat the water now discharging into Cayuga Creek.

RECREATION

Increased residential development in the communities along the Cayuga Creek have generally created an increase in the demand for recreation areas and open space. Additionally, flooding along Cayuga Creek has a long history and there is substantial acreage in the flood plains that can be reserved for recreation and open space areas. This would prevent further urban encroachment and minimize monetary losses due to flooding. The Erie and Niagara Counties Regional Planning Board has developed and adopted a Recreation and Open Space Plan for the Cayuga Creek. The plan is not part of or dependent upon the flood management plan presented in this report and no benefits have been attributed to increased recreational opportunities.

PUBLIC HEALTH AND SAFETY

The health and safety of residents in the floodprone areas of the Cayuga Creek are of prime importance when considering the feasibility of a project. Since the threat to loss of life, limb or future health is always a distinct possibility resulting from flooding. This threat results from flooding of residences and related potential for drowning, heart attacks, electrical shocks, and injurious falls. Other threats are from the backup of sewers into streets and basements, migration of vermin from flooded areas, and contamination of subsurface water supplies.

FISH AND WILDLIFE

In the upstream reaches of Cayuga Creek, wildlife habitats have been relatively unaffected by development. In the lower reaches of the basin, including the study area in the vicinity of Union Road and William Street, studies of fishery populations and habitats have indicated that fish populations are not diverse (primarily as a function of the bedrock bottom of the stream in this area and lack of variability of habitat). Similarly, wildlife populations and habitats are limited to a rather small corridor along the stream due to extreme urbanization in the area. No significant need or possibility for development of fish and wildlife habitats was identified during the course of the study, therefore, the primary planning objective related to the Cayuga Creek study was maintaining existing conditions and minimizing the adverse effects of possible flood management plans for the area.

NAVIGATION

The only navigation on Cayuga Creek occurs when young people attempt to run the Creek's rapids in rafts and small make-shift pleasure crafts. Such occurrences very seldom happen and are discouraged by law enforce-ment agencies.

EXISTING PROJECT

In 1949, a Corps of Engineer Flood Control Project was constructed at Lancaster, NY. The project was authorized on 18 August 1941 by Section 3 of Public Law 228, 77th Congress, First Session. The project was designed for a flood flow of 18,000 cubic feet per second, a freeboard of two feet and consists generally of:

a. Channel enlargement and minor straightening of the Creek from Penora Street to Lake Avenue;

b. Construction of about 8,300 linear feet of earth dike;

c. Construction of about 200 linear feet of concrete faced steel sheet pile wall;

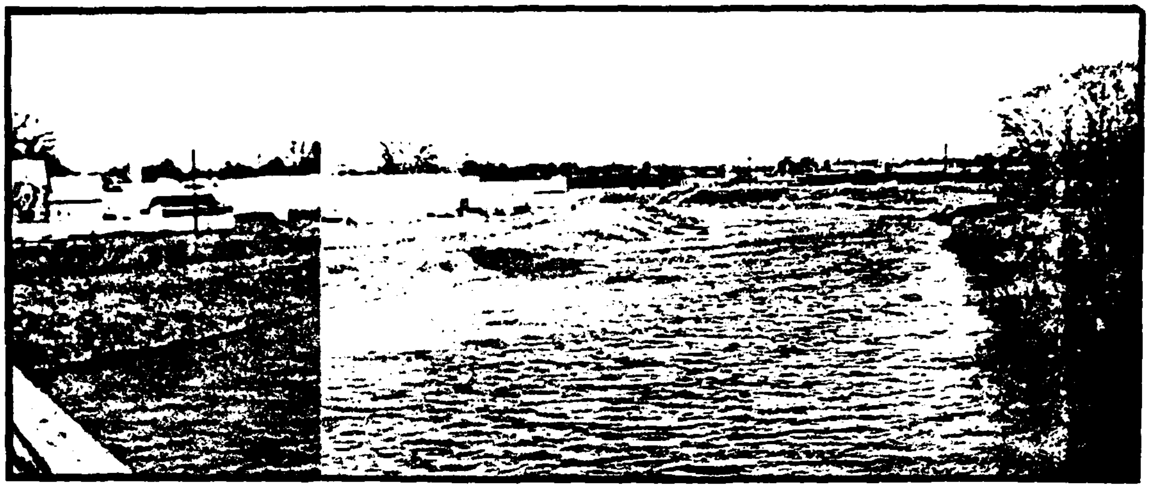
d. Raising the Broadway and Aurora Street bridges;

e. Construction of an internal drainage system along Broadway including a pump station; and

f. Construction of miscellaneous alterations to existing storm sewers.

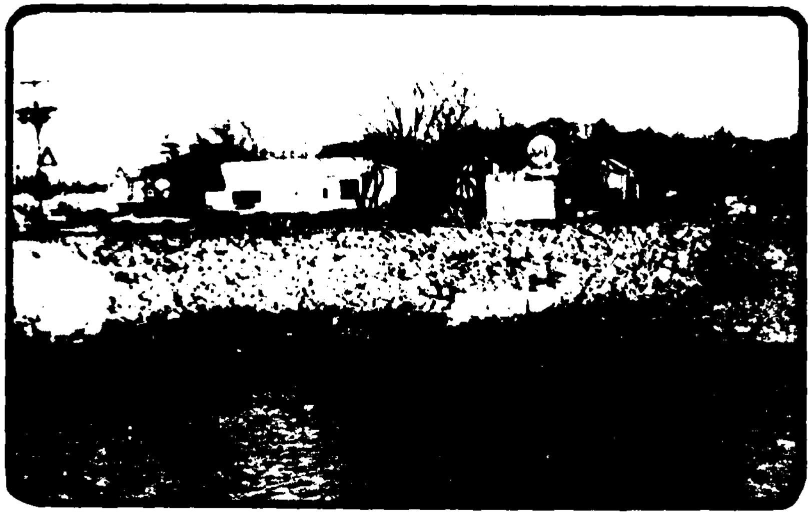
Photos on the following pages depict the project as it looks today. No other improvements for flood management have been made in the Cayuga Creek basin.

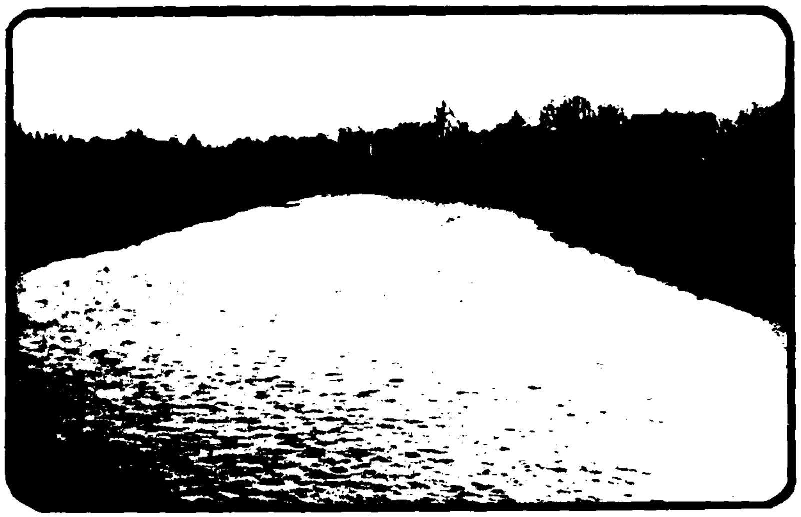
LOOKING DOWNSTREAM FROM THE TOP OF THE BROADWAY (WEST) BRIDGE. CHANNEL IMPROVEMENTS AND THE DIKE ALONG THE LEFT BANK WERE CONSTRUCTED IN 1949 FOR FLOOD PROTECTION. FEBRUARY 1975



CAYUGA CREEK LOOKING UPSTREAM FROM TOP OF PENORA STREET BRIDGE.
FEBRUARY 1975

LEVEE PROTECTION FOR VILLAGE RESIDENTS IN LANCASTER.
RIPRAP USED TO MINIMIZE BANK EROSION ALONG DIKE.
FEBRUARY 1975





THIS SERIES OF PICTURES SHOW FLOOD PROTECTION ALONG BOTH BANKS AND SMOOTH UNIFORM FLOW DUE TO CHANNEL IMPROVEMENT. IN THE TOP PHOTO, NOTE THE PUMPING STATION AND FLAP GATES FOR REMOVING STORM WATER BEHIND THE LEVEE.

FEBRUARY 1975

FLOOD EMERGENCY OPERATIONS

Since construction of the Lancaster flood control project in 1949, the Corps of Engineers has not been requested to perform any flood emergency operations except for some technical assistance and flood warning support. The most recent flood watch by the Corps occurred in March 1977 following the great blizzard in the Buffalo Metropolitan Area. However, prior to 1949, specifically during the 1937 and 1942 floods, the Corps of Engineers was requested to perform emergency rescue operations and assist flood affected residents to cleanup debris resulting from the flood. In the vicinity of the Union Road Bridge over Cayuga Creek in the town of Cheektowaga, flood emergency operations have been confined to local assistance by the police and fire departments.

IMPROVEMENTS DESIRED

Several public meetings, workshops, and field meetings have been held to discuss problems and solutions of flooding along the Cayuga Creek. The most recent meetings and contacts with public and private interests during this present investigation consisted of two workshops, a public meeting, several field meetings and several phone conversations and written communications. All of these were useful in determining details on flood problems and solutions. The workshops were held on 8 April and 22 April 1975, and the public meeting on 15 July 1975. The most recent specific communication to determine the desired improvements to alleviate flooding in Cheektowaga was on 7 March 1977 with the Town Supervisor who responded on 30 March 1977 and suggested improvements that would be acceptable to the town of Cheektowaga. All of the improvements desired were related to overbank flooding in the vicinity of Union Road and William Street in the town of Cheektowaga except for one homeowner on Ransom Road in the town of Lancaster who suffers from overbank flooding and bank erosion and who desires some improvement work to alleviate the overbank flooding near her home.

At a regular Cheektowaga Town Board meeting held on 3 February 1975, the following resolution was passed:

Whereas, the residents of the town of Cheektowaga have been plagued by the constant flooding, and

Whereas, one of the main sources of flooding is Cayuga Creek, and

Whereas, the U.S. Army Corps of Engineers has made a study of the problems involved in correcting the flooding conditions arising out of Cayuga Creek, and

Whereas, no date has been set for the project that would alleviate the flooding conditions, therefore, BE IT

Resolved that the Town Board hereby memorializes the U.S. Army Corps of Engineers and Congressman Jack F. Kemp to intervene on behalf of the Town with the proper authorities and take such action as is necessary to have the U.S. Army Corps of Engineers start the Cayuga Creek project, and, BE IT FURTHER

Resolved that a certified copy of this resolution be forwarded to the U.S. Army Corps of Engineers and Congressman Jack F. Kemp.

Most of the people present at the public meeting held on 15 July 1975 favored construction of a levee plan in vicinity of Union and William to prevent overbank flooding. One gentleman suggested channel deepening in the vicinity of the Union Road Bridge and raising the road level about 15 or 18 inches. Another from Ransom Road in Lancaster, NY, asked if the Corps considered rehabilitation of a dam near Clinton Street to provide flooding relief for residents of Alden and Lancaster. The Erie and Niagara Counties Regional Planning Board recommended consideration of levees, ponding areas, channel excavation, riprap, acquisition of land in Wyoming County for future construction of a flood control dam and reservoir, and application of land use and runoff controls to the rest of the flood plain.

PLAN FORMULATION AND EVALUATION

GENERAL

The purpose of this section is to present the process by which alternatives were formulated, based on the water and related land resource problems and needs of the Cayuga Creek watershed. Basic criteria is outlined and the logic for screening alternatives in the development of an overall plan of improvment. All plans were evaluated using the national objectives of water resource planning and the planning objective specific to the Cayuga Creek watershed. The last part of this section presents the process of selecting the plan that best meets the needs of private, public, and commercial interests suffering flood damage from overbank flooding of Cayuga Creek consistent with the best use of land and water resources in the study area.

OBJECTIVES

A set of national and planning objectives was used as a general guideline for the formulation process. These objectives were identified from an analysis of the problems, needs, concerns, and opportunities within the study area. The objectives not only reflect national development and environmental quality but also the objectives of local, regional, and State interests. The objectives used in the formulation and analysis are discussed in the following paragraphs.

NATIONAL OBJECTIVES

National Economic Development (NED) is achieved by increasing the value of the nation's output of goods and services and improving national economic efficiency.

Environmental quality (EQ) is achieved by the management, conservation, preservation, creation, restoration or improvment of the quality of certain natural and cultural resources and ecological systems.

PLANNING OBJECTIVES

Planning objectives are the national, State, and local water and related land resource management needs (opportunities and problems) specific to a study area that can be addressed to enhance NED and EQ. The basic objective for the Cayuga Creek Basin, New York, is to develop the best plan of improvment to reduce flood damage occurrences and other adverse effects caused by Cayuga Creek that is possible under present Federal, State, and local regulations and laws. To achieve this, the plan must also be compatible to the short and long-term needs and use of other related water and land resources in the watershed. To achieve these general objectives, the following specific planning principles and objectives guided formulation of a plan of improvment:

a. The plan must preserve to the maximum possible extent the quality of the natural and human environment.

b. The plan must be as socially acceptable as possible.

c. The plan must enhance the economic welfare of the local people and add to their security and well-being.

d. The plan must enhance national economic development by increasing the value of the nation's output of goods and improving national economic efficiency.

e. The plan must be technically and economically feasible to implement and maintain.

f. The plan must allow for reasonable growth and regional expansion.

To develop a suitable plan of flood management, the plan should be designed to:

a. Prevent damages up to the design flood.

b. Provide the maximum level of protection possible.

c. Be compatible with water and land resources of the community.

d. Not increase the water surface profile of Cayuga Creek in excess of established Federal, State, and local regulations.

e. Be optimum.

f. Have sufficient freeboard for levees and floodwalls if they are part of a plan.

g. Not preclude other beneficial use of the flood plain.

h. Have the acceptance and approval of other Federal, State, and local interests provided their views are based upon sound engineering, economic, social, and environmental criteria.

social activities that in turn would reduce mental strain now caused by frequent interruption of these activities.

Regional Development - Regional development is the relationship of the enhancement of a region with respect to employment and economic stability for each plan of improvement. The immediate project area, presented in detail in this report, is highly urbanized and occupied by both residential and commercial buildings. In this report, the assessment of regional impacts is limited to the beneficial or adverse effects of each plan on both residential and commercial activity in the area and its relationship and impacts on the region.

Public acceptance of a plan is determined by analyzing its acceptance by concerned local interests. A plan is acceptable if it is, or will likely be, supported by a significant segment of the public. However, every attempt should be made to eliminate, to the extent possible, all controversial aspects of a plan that are unacceptable to the public.

POSSIBLE SOLUTIONS

Several alternative measures and plans to reduce flood damages and satisfy allied water and related land resource needs in the Cayuga Creek Watershed are possible. These solutions may be divided into two categories, nonstructural and structural measures. Nonstructural measures include: no action, floodproofing, flood insurance, and flood plain regulation, flood warning, flood fighting, both temporary and permanent evacuation of flood plain areas, flood insurance and flood disaster relief. Structural measures include reservoirs, land management, channel improvements, and levees.

INITIAL CONSIDERATIONS

Various nonstructural and structural measures were considered initially that could reduce the potential of flood damages in the Cayuga Creek Basin. Nonstructural alternatives included: no action, flood warning and emergency action, permanent flood plain evacuation, flood proofing, flood insurance, and flood plain regulation. Structural considerations included: channel realignment, channel deepening and widening, reservoirs, levees, and combinations of channel deepening summerized on pages following Table 9. The table displays the social, economic and environmental impacts of each of the considered solutions to reducing flood damages in the Cayuga Creek Basin.

EVALUATION CRITERIA

Technical - A basic criteria is that a plan of improvement that includes levees provide three feet of freeboard and that floodwalls provide two feet of freeboard. In an urbanized area, the preferred level of protection provided by all structural alternatives is desired to be adequate to protect against the Standard Project Flood having an assumed average recurrence interval of about one in a 1,000 years, or an occurrence probability of .1 percent in any given year. Such a flood would have a flow in excess of 69,000 cfs. As a minimum, the SPF must be addressed and some comparison made with other levels of protection. A plan that would increase stream velocities and raise stream profiles should include mitigative works such as energy dissipators, riprap of other stream bank treatment measures.

Economic - This criteria consists of identifying and comparing benefits where applicable and the cost of an alternative. Tangible benefits are those resulting from a reduction in flood damages to physical properties and intangibles include reduction of hazards to life, health, interruption to normal community, business, and social activities, elimination of mental strain and anguish, and a reduction in the interruption of normal highway traffic flow. Average annual tangible benefits must exceed average annual charges unless the benefits of environmental measures justify an increase in cost or reduction in benefits. Each separable unit of improvement or purpose must provide benefits at least equal to its costs. The scale of development should provide the maximum net benefits; however, intangible considerations could dictate a project that would forego some of the net benefits. The NED plan should be the most economical evaluated on a comparable basis to other alternative plans that would accomplish the same purpose.

Environmental - All plans of improvement should avoid or minimize objectionable or adverse impacts to aquatic or terrestrail habitat, and maximize environmental benefits prior to, during, and following construction Plans should avoid or minimize water pollution and aesthetically objectionable features. Adherence to these criteria will result in public acceptance and reduce difficulty in obtaining the necessary assurances of local cooperation. Formulation and evaluation of all Federally financed water resource projects must include provisions for maintaining or enhancing the quality of the environment.

Social Well-being - Social well-being is the beneficial and adverse social effect that contributes to or detracts from the equitable distribution of real income and employment and other social opportunities. Therefore, a plan of improvement should provide for the security of life and property, and enhance business and

Table 9 - Economic, Social, and Environmental Impacts of Alternative Flood Damage Reduction Plans for Cayuga Creek

Planning Objective Parameters	Plan 1 No Action	Plan 2 Flood Warning 1/ and Emergency Protection	Plan 3 Permanent Flood Plain Evacuation	Plan 4 Flood Proofing	Plan 5 Flood 2/ Insurance	Plan 6 Flood Plain 2/ Regulation	Plan A Channel 3/ Realignment	Plan B Channel Improvement	Plan C Local Protection	Plan D Local Protection and Channel Imp.	Plan E Reservoir
I. ECONOMIC DEVELOPMENT											
A. Total first cost (dollars) 4/	0	-	14,909,200	256,000	0	-	-	13,136,300	1,173,200	2,392,200	6,578,300
1. Federal first cost (dollars)	0	-	0	204,800	0	-	-	9,212,300	950,600	1,372,800	5,758,000
2. Non-Federal first cost (dollars)	0	-	14,909,200	51,200	0	-	-	3,924,000	222,600	1,019,400	820,400
B. Total average annual cost (dollars) 5/	0	-	875,900	16,600	-	-	-	771,800	74,000	146,500	387,700
1. Federal average annual cost (dollars)	0	-	0	13,300	-	-	-	541,300	55,900	80,650	338,300
2. Non-Federal average annual cost (dollars)	0	-	875,900	3,300	-	-	-	230,500	18,100	65,800	49,400
a. Non-Federal OM&R cost (dollars) 7/	0	-	0	1,500	0	-	-	6,900	4,800	4,800	1,200
C. Average annual benefits (dollars)	0	0	75,600	75,600	-	-	-	86,700	77,900	77,900	86,700
D. Net average annual benefits (dollars)	0	-	-800,300	59,000	-	-	-	-685,100	3,900	-70,600	-301,000
E. Remaining average annual damages (dollars)	0	-	3,900	3,900	-	-	-	3,900	2,725	2,725	3,900
F. Benefit cost ratio	0	-	0.09	4.55	-	-	-	0.11	1.05	0.52	0.22
II. SOCIAL WELL BEING											
A. Flood damage reduction in percent	0	-	97%	95%	0	0	0	96%	97%	97%	97%
B. Number of businesses protected from flooding	0	-	23	23	0	0	0	24	14	14	24
C. Number of homes protected from flooding	0	-	112	112	0	0	0	112	73	73	150
D. Number of homes relocated	0	-	112	0	0	0	0	0	1	1	0
E. Number of businesses relocated	0	-	23	0	0	0	0	0	0	0	0
F. Approximate number of persons relocated	0	-	1,684	0	0	0	0	0	4	4	0
G. Required major relocation of:											
1. Transportation systems (miles)	0	-	0	0	0	0	0	0	0	0	0
2. Power and communication systems (miles)	0	-	0	0	0	0	0	0	0	0	0
3. Water system (miles)	0	-	0	0	0	0	0	0	0	0	0
4. Sewer system (miles)	0	-	0	0	0	0	0	0	0	0	0
H. Required lands. Total											
1. Parkland (acres)	0	-	0	0	0	0	0	0	0	0	0
2. Public land (acres)	0	-	0	0	0	0	0	0	0	0	0
3. Private land (acres)	0	-									
4. University land (acres)	0	-	0	0	0	0	0	0	0	0	0
I. New or modified bridges required											
J. Numbers of roads severed	0	-	0	0	0	0	0	0	0	0	0
K. Number of flood plain acres in Cayuga Creek	525	525	525	525	525	525	525	0	310	310	-
L. Number of land removed from the flood plain	0	-	0	0	0	0	0	525	63	63	-
M. Effects on downstream floodprone communities	Same	Same	Same	Same	Same	Same	Same	Same	Same	Same	Reduced
N. Aesthetic impact	No change	No change	Major	Major	No change	No change	Major	Minor	Minor	Minor	Major
O. Important cultural sites affected	None	None	None	None	None	None	None	None	None	None	None
P. Important historical sites affected	None	None	None	None	None	None	None	None	None	None	None
Q. Improvements in the health, safety of the area	None	Minor	Major	Minor	None	Minor	None	None	Major	Major	Major
R. Effect on current rate of stream erosion	None	None	None	None	None	None	None	None	None	None	None
S. Noise impact	None	None	None	None	None	None	Major 6/	Major 6/	Minor 6/	Major 6/	Moderate
T. Adverse effect on local school district	None	None	Moderate	None	None	None	None	None	None	None	None
U. Adverse effect on local community patterns	Moderate	None	Major	Minor	None	None	None	None	Minor	Minor	None
V. Improved water supply	None	None	None	None	None	None	None	None	None	None	None
W. Number of archeological sites affected	None	None	None known	None	None	None	None known	None known	None known	None known	None known
III. ENVIRONMENTAL QUALITY											
A. Natural resources affected											
1. Potential wildlife ecosystem adversely affected:											
a. Small mammals	No effect	No effect	Improve	No effect	No effect	No effect	Minor 6/	Minor 6/	Moderate	Moderate	Major
b. Rare endangered species	None	None	None	None	None	None	None	None	None	None	None
c. Birds	None	None	Improve	None	None	None	Minor 6/	Minor 6/	Minor	Minor	Moderate
2. Potential natural vegetation ecosystem adversely affected:											
a. Trees	None	None	Improve	None	None	None	Minor 6/	None	Moderate	Moderate	Major
b. Shrubs	None	None	Improve	None	None	None	Minor 6/	None	Minor	Minor	Minor
c. Grasses	None	None	Improve	None	None	None	Minor 6/	None	Minor 6/	Minor 6/	Major
d. Rare endangered species	None	None	Improve	None	None	None	None	None	None	None	?
3. Aquatic ecosystem adversely affected:											
a. Flora	None	None	Improve	None	None	None	Minor 6/	None	Minor	Minor	?
b. Waterfowl	None	None	Improve	None	None	None	Minor 6/	None	None	None	Improve
c. Semiaquatic animals	None	None	Improve	None	None	None	Minor 6/	None	None	None	Improve
d. Fish	None	None	None	None	None	None	Major 6/	Moderate	None	Moderate	Improve
e. Aquatic invertebrates											
B. Natural streams affected (miles)	0	0	0	0	0	0	3.4	3.4	0	0.4	0
C. Effect on water quality in the Creek	None	None	Improve	None	None	None	Reduce 6/	Reduce 6/	None	Reduce 6/	None
D. Reduced air quality	None	None	Improve	None	None	None	None	None	None	None	None
E. Scenic wilderness areas ffected	None	None	Improve	None	None	None	Minor 6/	None	None	None	?
F. Possible lowering of the water table in study area	None	None	None	None	None	None	None	None	None	None	None
G. Recreation opportunities affected.											
1. Fishing	None	None	None	None	None	None	?	?	None	?	Improve
2. Recreation boating	None	None	None	None	None	None	None	None	None	None	None
3. Picknicking	None	None	Improve	None	None	None	None	None	None	None	None
4. Hiking trails	None	None	Improve	None	None	None	None	None	None	None	None
5. Biking trails	None	None	None	None	None	None	None	None	None	None	None
6. Photographic opportunities	None	None	None	None	None	None	None	None	Reduce	Reduce	None
7. Nature observation	None	None	Improve	None	None	None	Reduce 6/	Increase 6/	Reduce	Reduce	Reduce 6/

1/ Costs of emergency measures not estimated.
2/ Costs for Plans 5 and 6 not available at this printing
3/ Channel realignment not effective hydraulically. Cost not estimated
4/ Based on January 1975 price level. Plans C and D estimated for Reaches 2 and 3 only. All other estimated for Reaches 1 through 3
5/ Based on 100-year amortization period and 5-7/8 percent interest
6/ Short term during construction only.
7/ OM&R already included in non-Federal share.

NONSTRUCTURAL CONSIDERATIONS

Plan 1 - No Action - This is not a solution to the potential flooding problem since flood damages would still occur. In fact, damages can be expected to increase due to new development that will probably occur in the flood plain. Plans for further development are already proposed and landfill in the near vicinity of Union and Williams continues reducing the natural storage for overbank flooding. Even though flood plain regulations exist and flood insurance is available, the flooding problem will continue. However, continuance of the regulations and insurance are essential even without action by the Corps of Engineers.

Plan 2 - Flood Warning and Emergency Action - An integral part of this plan is the installation of a flood warning device. Such a device would have to be situated far enough upstream to allow time for evacuating the flood prone areas or to erect emergency flood protection measures such as sandbag barriers, aluminum shields or barrier doors, moving household and commercial building contents to higher elevations, and disconnecting utilities.

This type of action is not a permanent or reliable solution to the flooding problem. The coordination required by agencies, local residents, and other concerned interests could have a misunderstanding of the severity and timing of the flood. Power outages would cause the warning devices to be inoperative. An alert received from the warning device, to be effective, must be transmitted to all concerned parties quickly and they must also act immediately. This system cannot be fail safe. However, in the absence of other flood management plans, some protection can be afforded at a cost that can be economically justified.

A long-term adverse environmental impact can be expected from this type of action since emergency protection equipment would be always visible and affect the scenic quality of the area. The system would not reduce overbank flooding and the flooded area would always have a certain amount of silt, debris, and trash visible after the water receded. A certain amount of stench would also prevail not only in the vacant flood lands but in many homes and business places. Flood waters could also wash toxics, and other pollutants into Cayuga Creek. Human safety would only be slightly improved and many hazards would still exist. Floodwaters could still inundate the areas surrounding structures and trap residents inside. Ambulance, fire, and utility services would be curtailed and perhaps at an inopportune time. Any failure in the warning system and emergency operations could create a serious threat to life and property.

Plan 3 - Permanent Flood Plain Evacuation - Permanent flood plain evacuation of developed areas requires acquisition of lands by purchase; removal, destruction or relocation of structures; evacuation and resettlement of the population; and permanent conversion of lands to uses less susceptible to flood damage. This is the only alternative that could permanently control flood damage. Movement out of the flood plain would result in natural habitat improvement in some evacuated areas and prevent the future loss of flood plain forest acreage. Personal inconvenience would be great but would be offset by residents no longer experiencing flooding. Permanent flood plain evacuation would be unacceptable to many residents with strong ties to their present homes and community. Those with investments in local businesses and real estate that would suffer from a relocation would also oppose evacuation. This alternative would have a first cost of about 15 million dollars on January 1975 price levels for stream reaches 1, 2, and 3 that include and encompass the lower Cayuga Creek from its mouth to about 1-1/2 miles "upstream of the Union Road Bridge. The annual cost was estimated to be $875,900 and average annual benefits estimated to be only $75,600 and, therefore, the plan was not investigated any further.

Ecologically, this plan is very acceptable, since many of the ecosystems in the flood plan could recover and redevelop. However, as with flood emergency action, debris would be left on the overbanks after floods receded. In addition, debris from the initial evacuation activity would leave a long-term scar on the flood plain unless substantial beautification actions were made part of the program.

Plan 4 - Floodproofing - This plan would require structural changes and temporary shields as a means of reducing flood damages. The level of design would be based upon the Regulatory Flood Datum (RFD). The RFD is defined in Federal Flood Proofing Regulation EP 1165-2-314 as the height of the Regulatory Flood plus a freeboard factor of safety. For purposes of making an evaluation in this investigation, the regulatory Flood has been assumed to be a 200-year event, the same as Plan C, the local protection plan, for equal comparison of plans presented in Table 9. Walls and floods below the RFD would be altered to improve structural strength and impermeability. Windows and low elevation would be sealed permanently, perhaps with glass blocks, and temporary removable shields would be placed on doorways or loading docks during flood times. The shields could be made of any structurally sound material that is easily moved such as aluminum or plastics. The shields would be stored as close as possible to the place where they would be used but hidden from view as much as possible. Quick attachment fasteners would be used to allow speedy placement. In determining the cost of floodproofing in reaches 1, 2, and 3, the type and number of residential and commercial establishments were inventoried and classified by elevation and type of layout. The materials necessary to floodproof each type of structure were then estimated. Commercial establishments were estimated individually. The first cost on January 1975 price levels for floodproofing structures in reaches 1, 2, and 3 was estimated to be $256,000 that included floodproofing 87 private residences. The structures would be floodproofed by placing glass blocks in basement windows, relocating some entranceways and openings, sealing cracks, installing sump pumps, and in some cases constructing a wall or levee around an opening in a building. Unit costs were developed for each of these measures and applied to type and number of structures to be protected to develop a total cost. Sliding doors and flood shields, were also a necessary part of floodproofing and the cost is included where needed. Costs for the flood warning system, temporary evacuation and emergency work associated with floodproofing are not included in the cost. The annual cost for this plan is estimated to be $16,600 and would eliminate $75,600 in average anuual damages.

A flood-warning device would be necessary, similar to that required for plan 2 - flood warning and emergency action, and the successful use of the shields depends upon proper functioning of this warning device. Ample warning would have to be given to place the temporary shields in the various openings of the buildings. Most structures would still need to be evacuated, since residents would be stranded until floodwaters subsided. Structures would only be rated or modified based upon the ability to protect against the RFD. During floods greater than this, the rating would no longer apply. For a 200-year event for natural conditions the depth of flooding would be five feet with a maximum rate of rise on the overbank of one-foot per hour and duration of flooding of about 15 hours.

The environmental impact floodproofing would have on the flood plain would be primarily to the aesthetic qualities of the buildings involved. Windows would be bricked and shields stored on the property. As with other nonstructural plans, debris would remain on the overbank after the flood waters receded, and shrubs, lawns, trees, and other natural features of the environment could be damaged temporarily. Estimates based on January 1975 price levels indicate that the plan could be economically justified with a BCR of 4.55. However, the plan depends upon human action and many of the dangers of flooding that now threatens life and property would still continue. Many roads would still be impassible during floods, restricting emergency services, such as, ambulance, fire, police, gas, electric, and oil for heating.

Plan 5 - Flood Insurance - Flood insurance is available in most of the areas of Cayuga Creek Basin that are in the flood plain. A study made by the FIA for the town of Cheektowaga included the stream reach from the mouth at Harlem Road to Penora Street in the village of Depew. Upstream of Penora Street, a levee system protects low-lying areas. The level of participation is not known. Flood insurance does not prevent damages legislatively through flood plain regulations. Some of the same adverse effects associated with plans 2, 3, and 4 are common to this plan. Overbank flooding would continue and all of the effects during and after the flooding would be present.

Plan 6 - Flood Plain Regulation - Existing flood plain regulations in the towns of Cheektowaga are intended to: prohibit new uses of floodway areas which might cause damaging increases in flood heights; prohibit new uses that would cause erosion; require new uses with structures floodproofed by having the elevation of fill or other structural flood proofing at the 100-year flood elevation; preserve the flood plain in an open condition without structures that would be subject to damage; and prohibit subdivision of lands that have substantial flooding or drainage problems. Development in the flood plain is still possible, although not preferred, but such development is intended to be done in accordance with the spirit of the flood plain regulations. Even if the flood plain regulations are enforced, they must be continually reviewed and appraised with changing needs and conditions of the area. Many localities do not rigidly enforce the regulations, particularly large scale development in the flood plain, since the tax base would be affected adversely without the development. Oftentimes the local Governments do not have an efficient staff or expertise to fully implement the regulations. Upstream of Union Road in the town of Depew and Lancaster, where existing levees protect developed areas, flood plain regulations are not in force.

STRUCTURAL CONSIDERATIONS

Plan A - Channel Realignment - Cayuga Creek is an old, well established meandering stream and an investigation was made to change the hydraulic characteristics of the stream to reduce overbank flooding by cutting a channel through land at several locations to eliminate the largest bends. The new alignment would reduce the overall stream length with fewer obstacles to flow. New channel sections would remain dry most of the year, serving only as overland diversions during peak flows. The existing channel would be unchanged. The long term environmental impact on aquatic life would be small. The flood plain would be changed somewhat by the dry channels cutting across it. This plan was found to make no significant improvement in the water surface profile. Therefore, it would not effectively prevent damages and could not be economically justified.

Plan B - Channel Improvement - Some channel deepening and widening was investigated using the same channel alignment of Plan A.

The capacity of the channel was increased by widening the bottom width to 200 feet at the mouth of the creek and a 140-foot bottom width in the channel upstream to the Transit Road Bridge where it was narrowed to the width of the existing channel. The slope of the stream was also straightened. A total of about 1-1/2 million cubic yards of material would have to be excavated to improve the channel and diversions to these dimensions.

Hydraulically, this improvement would lower the water surface of the creek sufficiently so that the creek could contain the 200-year design flow within channel banks and eliminate overbank flooding that would otherwise occur. However, the cost of channel deepening, widening, and realignment is extremely high and was estimated to have a first cost of $11.8 million on January 1975 price levels that makes it economically unfeasible. After the preliminary investigation was made, an additional field investigation was made that indicated much of the excavation would be in rock that would increase the cost of $11.8 million substantially.

Environmentally, this plan would alter the existing streambed considerably and cut through land that is now mostly in an undeveloped state causing a disruption of life cycles now existing in the flood plain. Short-term environmental impacts that would result from construction would undoubtedly cause some disruption of the ecosystems that would persist for several years. This plan was estimated to have a cost on January 1975 well in excess of the benefits and the benefit cost ratio was found to be 0.52 to 1.

Plan C - Local Protection - A levee system in the vicinity of Union Road in the town of Cheektowaga was investigated to reduce the damages in this area that have been historically the largest in the Cayuga Creek Basin. The plan would extend about 2,500 feet downstream of the Union Road Bridge and about 1,400 feet upstream. The design level was intended to provide 200-year protection from overbank flooding in the area. The level was chosen as the most likely to provide the greatest protection and be economically justified and the difference between the 100-year and 200-year elevations of flooding was found to be sufficiently small enough to result in only a small increase in construction cost. The plan included provision for interior drainage that included a ponding area and a pumping station allowing surface water collecting behind the levees to be discharged into Cayuga Creek. The benefit cost ratio of this Plan was estimated to be 1.05 based upon conditions reflecting 1975 level of development and predicted level of development in 1990.

Another levee system was investigated to provide protection near the confluence of Cayuga Creek and Buffalo Creek. The plan to provide 200-year protection would consist of about 2,600 feet of levee and protect about 48 structures. The plan was not economically justified and on January 1975 price levels, the benefit cost ratio was only 0.14 to 1 based only on existing conditions of development. Because of the extremely low BCR, projections of future development were not made.

Environmentally, local protection works will change some at the flood plain. During construction, natural vegetation would be destroyed but the damage can be mitigated by planting similar vegetation or those types that might be more suitable or of a superior value environmentally. Long-term effects would be minimal, the greatest being the appearance of the levee itself in an area that is predominantly flat.

Levees provide more complete and reliable protection than floodproofing. Floodwaters no longer present the same hazards to structural stability or human life. The levee is always in place and does not require human action to provide reliable protection.

Plan D - Local Protection and Channel Improvement - Channel improvement was investigated in combination with levees in order to lower levee heights and still provide 200-year level of protection. The channel improvement work was only considered in the existing creek alignment and within the upstream and downstream limits of the levee. It was concluded that the localized channel improvement work was very insignificant in lowering the required levee height and very expensive since the creek bottom is rock. The environmental effects would have the same environmental impacts as channelization Plan B, except more localized and the same effects as local protection Plan C, except the levee heights would be about one-foot less. Further investigation to provide 100-year protection was investigated which would allow the levee to be built lower than for the 200-year level of protection but no significant savings were gained to result in an economically justified project.

Plan E - Reservoirs - Small dams and reservoirs were considered at two sites to provide protection against the 200-year level of flooding; one at Bennington and the other at Cowlesville, but neither could be economically justified. On January 1975 price levels, the estimated first cost of the Bennington dam and reservoir was $6.6 million and yielded a benefit cost ratio of 0.22 to 1. The Cowlesville dam and reservoir were investigated in previous studies and a cursory review again indicated that it could not be economically justified. The long term environmental impact of reservoirs are substantial since considerable changes could occur to the aquatic life in the impoundment area. Ordinarily, the surface area would be small, filling up more fully during times of heavy runoff upstream of the dam. A very preliminary evaluation was made to regulate the dam to provide for recreation and water supply but even with these additional purposes, the project could not be economically justified.

All of the plans considered initially are displayed in Table 9. These plan considerations were necessary to ensure that the plan or plans considered in more detail best met or satisfied the objectives of the investigation. A very preliminary investigation was also made of the Williamstown Apartment Complex area. Some data on the investigation are contained in Appendix A.

PLANS CONSIDERED FURTHER

It was concluded, based upon results of investigations of plans considered initially, that local protection measures in the vicinity of Union Road and William Street in the town of Cheektowaga be investigated in more detail, since the benefit-cost ratio for Plan C resulted in a benefit to cost ratio greater than 1 or reasonably close to unity. Floodproofing was also investigated in greater detail to develop a more comprehensive nonstructural plan based upon additional field investigations. The nonstructural plan is discussed in the following section on Selecting a Plan. Plan C of the initial investigation has been investigated more thoroughly and it has been determined that most of the damages from flooding in the vicinity of Union and William where the greatest damages occur is caused by Cayuga Creek overtopping the right bank upstream of the Union Road Bridge. During flood stages the creek, after overtopping the bank, inundates the roads in the area of the Union Road Bridge and causes damage to both residential and commercial properties in the area. The floodwaters reenter the creek downstream of the bridge via the overbanks. The solution to preventing or reducing the damage is to prevent the floodwaters from inundating the roads and damaging structures in the area. Since the creek overtops the right bank upstream of the Union Road Bridge, several types of floodwalls and levees were investigated. The need for levees or floodwalls downstream of the bridge were not considered necessary to protect against most of the flood damage in the vicinity of Union and William. The existing homes and tavern on the right bank of Cayuga Creek immediately upstream of the Union Road Bridge partially governed the type of structure to be considered at least for about 500 feet upstream of the bridge. The distance between the top of bank and structures was not sufficient to construct levees without encroaching on the creek or taking away most of the land between the creek and the tavern and homes now enjoyed by the owners. An earth levee was however initially considered and soon dropped from further consideration.

The various types of floodwalls considered, starting at the Union Road Bridge and continuing upstream about 700 feet in lieu of earth levees, included: a single row of steel sheet pile with tie backs, circular corrugated aluminum cells, timber bulkheads with steel king piles, concrete gravity walls and concrete tee walls. Each of these would minimize the amount of land required, except concrete gravity walls and cells but all would minimize encroachment of the channel. Estimates of cost were not developed for these various types of floodwalls except for the tee wall since the others did not warrant further study or investigation because of certain hydraulic deficiencies, construction difficulties, or potential maintenance problems. Steel sheet pile walls with tie backs were investigated but it was determined that the difficulties that would be encountered in driving the pile sufficiently into the creekbed for proper toe in was not possible because of rock. Rock is exposed in the entire creek bed upstream of Union Road for the entire length of the project area discussed in this report. Rock is also exposed in the draw of the bridge and downstream thereof. The tie rods and anchors for the wall could however be placed to avoid disturbance or destruction of the trees along the creek bank and the land behind the wall backfilled and sloped gradually for aesthetic purposes. Wood bulkheads with steel king piles were considered that would consist of larger timbers 10" X 10" X 10' placed horizontally with the ends in the channel of king pile. As with the steel sheet pile wall, the king pile could not be toed into the bed rock sufficiently and the spacing of tie rods would require the destruction and disturbance of some of the trees. Periodic maintenance and replacement of the wood timbers would be required. Corrugated aluminum cells were investigated but the turbulence that would occur and the resulting adverse aesthetics caused further study to cease. The turbulence would reduce stream flow and raise the water surface. Cells would also require more land since the cells would be about five feet in diameter and placed to avoid channel encroachment that would necessitate cutting about five feet into the creek bank. Concrete gravity walls were considered but the advantages of gravity walls compared to tee walls were less since more excavation and land would be required initially for the base that, even though backfilled, would disturb more property during construction. Concrete tee walls were determined to be the most effective, least destructive and desirable wall to construct as a part of the overall local improvement plan in the vicinity of Union Road Bridge in the town of Cheektowaga.

Various combinations of structural measures were considered along Cayuga Creek from the Union Road Bridge upstream, a distance of 700 feet, to develop the optimum local protection plan to alleviate overbank flooding in the area. Consideration was given to: earth levees on each side of the creek, tee walls on both sides, earth levees with riprap, all of these measures with channel deepening and a tee wall on the right bank with stone riprap on the left bank. A tee wall on the right bank with erosion protection on each bank was determined to be the best combination of measures and was selected for more detailed consideration. The tee wall and the other measures considered on the right bank would all join a transverse earth levee joining a wall separating two abandoned quarry ponds and then the earth levee would continue northward tieing into high ground.

SELECTING A PLAN

The principles, standards, criteria, and directives of plan formulation and evaluation requires that alternatives be measured to determine their efficiency in meeting the objectives of the plan formulation process. A National Economic Development (NED) Plan and an Environmental Quality (EQ) Plan must be identified in the evaluation process. The NED Plan must, from the national point of view, represent the best return on the investment of economic resources needed for construction. The EQ Plan is the alternative plan that contributes to management, conservation, preservation, creation, restoration, or improvement of certain natural and cultural resources and ecological systems. Once identified, the NED Plan and the EQ Plan are compared in a system of accounts against each other, against any other strongly favored or economically feasible plans, and against the "No Action Plan" to select the best plan for recommendation. If the NED Plan and the EQ Plan are the same, that plan is compared against any other strongly favored or economically feasible plans and against the "No Action Plan."

Ten basic plans and a plan of no action were considered within the context of plan formulation discussed above. Two of the ten were found to be economically justified and both the local protection and floodproofing plans, were investigated further. The local protection plan would provide a major improvement in the health and safety of the areas whereas the other, floodproofing, would only provide minor improvement. In addition, the local protection plan would only have a minor aesthetic impact whereas floodproofing would have a major impact. Further investigation of the local protection plan, that included several types of flood walls and erosion protection combinations resulted in the selection of the best of these measures to combine with a transverse earth levee precast wall combination ending at high ground 2-1/2 feet above the 100-year flood level. During the evaluation of the 10 basic plans and the no action plan, 17 specific elements were identified and their impact considered and evaluated. The 17 elements considered in Table 9 and also in Table 10, Systems of Accounts, include: noise, displacement of people, aesthetic value, community cohesion, desirable community growth, tax revenue, displacement of funds, national resources, property values, public facilities, public service, desirable regional growth, employment, business and individual activity, manmade resources, and pollution abatement of air and water. The modification of Plan C, and floodproofing, Plan 4, resulting from further investigation, are identified in Table 10 as the Local Protection Plan and the Floodproofing Plan; no action is the same as in Table 9. Both plans of action reflect similar areas of protection and costs and benefits are on the same price levels (April 1979).

The no action plan and the flood proofing plan have several similar characteristics and overbank flooding would still continue. Highway traffic and public service such as telephone, power, gas, garbage collection, schools, fire, ambulance, police, doctors, social visits, businesses, and many other day-to-day operations and services could be impaired during a flood. As mentioned previously, both would leave debris and tell tale signs of flooding that would not only be aesthetically unattractive but could and probably would discourage home improvement work particularly landscaping, and would probably make it difficult to sell homes when necessary. Neither of these plans are reliable since, for complete safety, the owner or occupants would have to be present to either evacuate as in the case of the no action plan or place flood shields and other devices in place when the flood was imminent. With floodproofing, some of the necessary shields or items to provide protection would have to be stored on the property and it is possible that someone might steal some or they could be damaged or destroyed and become inoperative. A power failure or interruption of telephone service would cause the flood warning system to be ineffective. The first cost of floodproofing cannot be determined without a detailed investigation of each building since improper or inadequate selection of method could cause structural failure or continued flood damages. The costs, benefits, and probable impacts are based upon detailed field investigations made in 1978. Cost for flood warning system, temporary evacuation, and emergency work are included in the cost. During the field investigation, all home and business owners were opposed to floodproofing as a solution to alleviating the flood problem in the area as was the Supervisor of the town of Cheektowaga. The method of insuring that each building was floodproofed in a timely manner with proper design would be difficult. Reimbursement would be cumbersome and confusing. Maintenance would perhaps be the most difficult since, unless supervised or checked, some would delay maintenance or replacement too long and the floodproofing would be inoperative and inaffective. Perhaps the most undesirable feature of a plan of no action or floodproofing would be the continued trauma from inundation. Old and sick people particularly would be adversely affected even to being the indirect cause of their death.

The local protection plan would prevent flood inundation from floods having an average recurrence interval of about once in 100-years. The plan would enhance, with considerable reliability, the economic development of the area by protecting both businesses and residents and would encourage the improvement of landscape, facilities, and homes. Most of the adverse affects associated with a plan of no action and floodproofing would be mitigated with the local protection plan. The most undesirable features would occur during construction and the appearance of the transverse levee would, although easily visible to those frequenting the tavern, soccer field, and Knights of Columbus facilities, be unnoticed by others traveling through the area. A representative of the Knights of Columbus stated that the levee and wall would be desirable since it would provide more privacy. Other features of the local protection plan would not be noticed since traffic moves rapidly over the Union Road Bridge, the only vantage point, and there is no place to park on the bridge. The only ones that could view the flood wall and erosion protection along the creek are pedestrians walking across the bridge, who now are seldom seen in the area doing this. Most of the vegetation and trees that would be destroyed are presently in danger of falling into the creek and the tree root systems on many are now exposed. The land that would be occupied by the transverse levee and wall is not now being used and the alignment of the transverse levee would be located along an existing property line so as not to unfairly impact on either of the owners and still be effective as a flood protection structure.

The selection of an NED and an EQ plan can be accomplished by a system of evaluation and comparison displayed in a matrix such as in Table 10, System of Accounts. Many of the "weights" given to various subsets within the four accounts are judgmental but based upon an interaction with various interests and those with varying expertise. Preliminary to the selection, the affected property owners, the town of Cheektowaga, and the New York State Department of Environmental Conservation were contacted to determine if they would be responsive to a structural plan located within a short distance upstream of the Union Road Bridge and if they concurred in general with a local protection plan in the vicinity of Union Road and William Street. All concurred with the concept and on 30 March 1977 the town of Cheektowaga Supervisor assured us that the Town Board would support a plan that they indicated on a drawing the Corps furnished them. The town's recommended alignment is the same as that selected by the Corps and presented as the local protection plan in the System of Accounts matrix, Table 10. Correspondence with the State and town is contained in Appendix D to this report. Based upon information displayed in Table 10, the NED Plan is the local protection plan since it has the greatest net benefit and the EQ Plan is also the local protection since it has the greatest plus values environmentally, socially, and regionally. Other attributes of the three plans are discussed in the Selected Plan section of this report.

Table 10 - System of Accounts

Account	Footnotes	No Action		Floodproofing*		Local Protection*	
		Base Condition - No Corps Project Non-Federal Interests - Town of Cheektowaga, Erie County, New York State Would Continue Zoning, FPM, Implement Ordinances Land Use Planning		Floodproofing of Structures in Flood Plain from Mouth of Cayuga Creek to About One Mile Upstream of the *Union Road Bridge*		Construction of a Floodwall Earth Levee and Riprap Upstream of the Union Road Bridge With Necessary Ponding Areas, Culvert Pipes and Flap Gates	
		Study Area	Rest of Nation	Study Area	Rest of Nation	Study Area	Rest of Nation
NATIONAL ECONOMIC DEVELOPMENT							
a. Beneficial Impacts							
Value of Average Annual Outputs of Goods and Services							
1. Flood Damage Reduction		None	None	52,400	None	82,300	None
2. Construction Employment		None	None	3,200	None	3,400	None
b. Adverse Impacts							
Average Annual Costs (Study area are non-Federal, rest of nation are Federal)							
1. Project		None	None	12,900	43,300	4,800	61,400
2. Maintenance and Repair		None	None	2,800	4,800	6,500	200
c. Net NED Benefits		None	None	39,900	-48,100	74,400	61,600
ENVIRONMENTAL QUALITY							
d. Beneficial and Adverse Impacts							
Air Quality	(1, 6, 9)	No change	No change	No change	No change	Impaired during construction	No change
Historical Ecosystems	(1, 2, 3, 4)	No change	Not affected	No change	Not affected	Impaired	Not affected
1. Floral Resources							
Woodland acreage	(1, 6, 8, 9)	No change	No change	No change	No change	Reduced during construction	No change
Wetland acreage	(1, 6, 8, 9)	No change	No change	No change	No change	Reduced during construction	No change
Grassland acreage	(1, 3, 6, 8, 9)	Impaired	No change	Impaired	No change	Improved	No change
Endangered species	(6)	Not affected	Not affected	Not affected	Not affected	Not affected	Not affected
2. Faunal Resources							
Fish	(1, 2, 5, 9)	Possible adverse affect	Not affected	Possible adverse affect	Not affected	Adverse during construction	Not affected
Other aquatic wildlife	(1, 2, 5, 9)	Possible adverse affect	Not affected	Possible adverse affect	Not affected	Adverse during construction	Not affected
Terrestrial wildlife	(1, 2, 5, 9)	Possible adverse affect	Not affected	Possible adverse affect	Not affected	Improved	Not affected
Endangered species	(6)	Not affected	Not affected	Not affected	Not affected	Not affected	Not affected
Land Resources	(2, 3, 5, 8, 9)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Water Resources							
1. Groundwater							
Water table level	(6)	No change	No change	No change	No change	No change	No change
Quality	(2, 3, 4, 9, 11)	No change	Not affected	No change	Not affected	Improved	No change
2. Surface Water							
Ponds	(2, 3, 6, 9, 10)	No change	No change	No change	No change	Possible use change	No change
Stream quality	(1, 2, 3, 6, 9)	Possible adverse affect	Not affected	Possible adverse affect	Not affected	Improved	No change
SOCIAL WELL-BEING							
Cultural Resources							
Aesthetics	(2, 3, 6, 9, 11)	Deteriorated	Not affected	Deteriorated	Not affected	Improved	Not affected
**Archeology	(2, 3, 5, 9, 11)	No change	Not affected	No change	Not affected	Impaired	Not affected
Educational Opportunity	(2, 3, 6, 8, 9)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Recreational Opportunity	(2, 3, 5, 9, 10)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Health and Welfare							
Community Cohesion	(2, 3, 4, 9, 10)	Not affected	Not affected	Not affected	Not affected	Not affected	Not affected
Community Growth	(2, 3, 6, 8, 9, 10)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Displacement of People (temporary)	(2, 3, 4, 9, 10)	Some	None	Some	None	None	None
Families Protected	(2, 3, 6, 9, 11)	None	None	Some	None	All	None
Noise	(1, 2, 3, 6, 9, 10)	No change	No change	No change	No change	Increased	No change
REGIONAL DEVELOPMENT							
Economic Effects							
Employment	(1, 2, 3, 6, 8, 9)	No change	No change	No change	No change	No change	No change
Income	(1, 2, 3, 6, 8, 9)	No change	No change	No change	No change	Improved	No change
Public Services	(1, 2, 3, 6, 8, 9)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Property Tax	(1, 2, 3, 6, 8, 9)	No change	No change	Slight improvement	No change	Improved	No change
Property Value	(1, 2, 3, 6, 8, 9)	Decreased	No change	Slight improvement	No change	Improved	No change
Regional Growth	(1, 2, 3, 6,, 8, 9)	Stagnated	Not affected	Stagnated	Not affected	Improved	Not affected
Effects on Manmade Resources							
Farms (open space)	(1, 2, 3, 6, 9, 10, 11)	No change	No change	No change	No change	Improved	No change
Housing	(1, 2, 3, 5, 7, 8, 9)	Stagnated	No change	Stagnated	No change	Possible improvement	No change
Nonfarm Businesses	(1, 2, 3, 6, 7, 9)	Impaired	Not affected	Impaired	Not affected	Improved	Not affected
Public Buildings	(1, 2, 3, 5, 7, 8, 9)	No improvement	Not affected	No improvement	Not affected	Possible improvement	Not affected
Recreational Facilities	(1, 2, 3, 5, 9, 10, 11)	Impaired	Not affected	Impaired	Not affected	Improvement	Not affected
Roads	(1, 2, 3, 6, 7, 8, 9)	Impaired w/each flood	Not affected	Impaired w/each flood	Not affected	Improved	Not affected
Social Effects							
Population Distribution	(2, 3, 5, 9)	Possible slight change	No change	Possible slight change	No change	Possible change	No change
Population Growth	(2, 3, 5, 9)	Impaired	Not affected	Impaired	Not affected	Possible improvement	Not affected

FOOTNOTES:

1. Impact expected before plan is completely implemented.
2. Impact expected within 15 years after plan is implemented.
3. Impact expected 15 or more years after plan is implemented.
4. Certainty of impact is less than 50 percent
5. Certainty of impact is greater than 50 percent.
6. Certainty of impact is greatger than 90 percent.
7. Impact fully monetized in NED account.
8. Impact partially monetized in NED account.
9. Impact caused by plan.
10. Impact caused by *action currently planned* by non-Corps interests.
11. Impact caused by inaction of non-Corps interests.

* BCR for floodproofing is 0.9 and for local protection is 1.2. Discussion of rationale for some of the environmental, social, and economic assessments is given in the following section related to the Selected Plan.

** No Action and floodproofing will not change the existing condition of the site, but the structural plan will impact the site by disturbing approximately 2/3 of it by surface modification and compaction due to levee construction. It is proposed to lessen these impacts by excavation and data recovery. Therefore, the impact would be a "qualified" impaired.

THE SELECTED PLAN

GENERAL

The selected NED plan and the selected EQ plan is Local Protection. Therefore, the plan selected for construction is Local Protection. The reasons for the selection are mostly based upon its reliability to satisfy both the human needs and problems and still be the least destructive to the total environment in the area. Implementation of the local protection plan, displayed in Table 10, would result in a positive contribution to the SWB account and provide some beneficial contributions to Environmental Quality. The Local Protection Plan would be more easily maintained over the project life than the Floodproofing Plan and, based upon discussions with local interests in 1978, be a specific and reasonable solution to the local overbank flood problem in the vicinity of Union Road and William Street. Even though floodproofing has a BCR close to unity, the cost data used could be considerably underestimated because of uncertainties in the structural stability of the residential and commercial buildings that would be floodproofed. If floodproofing were implemented, it is quite possible that some foundations might fail and result in negative benefits. In addition, floodproofing would not allow free and easy access to recreation sites because of the continued inundation of the highways. The cost estimate for the local protection plan is based upon detailed data used at the Scajaquada Creek local protection project now under construction and within a few miles of the Cayuga Creek site.

DESCRIPTION

The selected plan, shown on Plate 4, includes concrete walls, earth levees, erosion protection, ponding areas with culvert pipes and flap gates, and some minor improvement work on the creek banks, all located upstream of the Union Road Bridge over Cayuga Creek. The general location of the local protection plan with respect to the entire Cayuga Creek Basin is shown on Plate 1, the extent of protection that would be afforded is shown on Plate 2, and land use in the project area is shown on Plate 3.

Specifically, the plan shown on Plate 4, consists of: a concrete tee wall on the right bank of Cayuga Creek beginning at the Union Road Bridge (about station 0+50) and extending upstream to Station 7+10; erosion protection on the right bank from station 7+10 to station 8+50 and on the left bank erosion protection from the bridge to about station 8+50; clearing and seeding both creek banks from station 8+50 to station 14+50; a transverse earth levee from Station 7+10 at the concrete tee wall along the creek extending northward, parallel to an athletic field, a distance of about 525 feet to a concrete wall; a concrete wall between two abandoned quarry ponds, about 250 feet long, extending northward from the north end of the aforementioned earth levee; and an earth levee about 100 feet long that extends further northward from the concrete wall to tie into ground contour elevation 613.5. Work in the stream bed consists of removing earth material down to rock as necessary to place the tee wall and erosion protection material. About 400 square yards of erosion protection material will be placed in the vicinity of the junction of the transverse levee and the creek; a ponding area will be maintained near the Union Road Bridge with an 18-inch culvert pipe and flap gate installed in the concrete tee wall, and a ponding area will be maintained in the abandoned quarry with a 24-inch culvert with flap gate and gate valve placed in the concrete wall. The concrete tee wall along the creek averages about four feet above ground level and the transverse levee will vary in height above ground level from about seven feet at the creek to no differential at the north end where the levee terminates at ground elevation 613.5. Adverse environmental effects resulting from construction will be minor and partially mitigated by vegetative plantings. The land side of the tee wall will be backfilled, sloped and dressed with topsoil and seeded to blend into the existing landscape. Other details of the selected plan are given in Appendix C and in subsequent portions of this section.

EVALUATED ACCOMPLISHMENTS

The major accomplishment of the selected plan will be the near elimination of residential and commercial damage in the vicinity of Union Road and William Streets. The selected plan will reduce about 94 percent of the damage that now occurs because of overbank flooding. There are other beneficial affects discussed in Appendix B and in the previous section of this main report that include environmental, social, and regional enhancement. Highway traffic will not be interrupted and tell-tale signs of overbank flooding will be eliminated. The social well being of the community will be improved because of less trauma caused by flood inundation and commercial interests will be able to enjoy uninterrupted business transactions. Other services that would otherwise be interrupted because of inundation such as fire, police, ambulance, and utility services, would be able to respond when necessary and not be delayed because of flooded roads. A monetary value for some of these accomplishments are difficult to determine but are displayed in Table 10 of the preceding section of this report and Appendix B also provides additional data.

ENVIRONMENTAL EFFECTS

The selected plan will result in little change in land use as shown on Plate 3. Since the transverse levee will be located on land that is now mostly unused, vacant land and the wall and erosion protection along the creek will require very little encroachment on park, open space, and residential land along the creek. However, the selected plan will result in several changes in the environment that are displayed in Table 10 as judgmental expressions of the most probable impacts. Other more detailed effects are contained in the environmental statement and in the plan formulation section of this report. Construction activities will have the most adverse effects on the environment although they will be short lived. Some air pollution, noise pollution, and stream turbidity, will result during the construction period with some interference with highway traffic flow. Some destruction of trees, brush, and grass cover, will result although most of the trees are not in danger of falling into the creek and the destruction of grassland will be more than replaced after the levees are dressed with topsoil and seeded.

The concrete tee wall will be unnoticed by the general public and only partially by the owner of the property alongside since the land face of the wall will be backfilled, sloped, dressed with top soil, and seeded. This treatment will result in a more usable and attractive view than now exists since the few trees that will be destroyed have an insecure root system due to erosion of the bank and the trees could be blown down onto the buildings or eventually fall into the creek and create more flood problems than now exist.

Erosion protection along the banks of the creek and the concrete tee wall can only be viewed from the Union Road Bridge or from the creek. The placement of riprap to achieve the protection will be consistent with the USFWS recommendation to protect against erosion and siltation and will also maintain a natural appearance by using stone. Cleaning and seeding the creek banks further upstream will, when the grass cover is established, provide a pleasing view to anyone who might see the slopes. Few people walk across the bridge and cars travel across the bridge at a high rate of speed so that viewing from the bridge will be infrequent. The creek is not conducive to anyone to walk along for fishing, bathing, or other purposes, and seldom if ever is anyone apt to use the creek except children or young people who are not interested in aesthetics per se.

The transverse levee will be seeded on both slopes and will not interfere with sports activities on the athletic field or disassociate the activities of the restaurant and tavern that uses the area for rent and use as a picnic area. Even though the USFWS recommends leaving the levees unmowed, this is not consistent with proper maintenance of the levees to avoid structural failure. An unmowed levee would encourage wildlife such as woodchucks and ground hogs to establish a network of burrows in the levee that would remain unnoticed and eventually cause the levee to fail structurally. The concrete wall between quarry pond will be partially obscured from view by trees and shrubs that now exist and many of which will be left undisturbed.

When the project is completed, businessmen and residents will experience not only economic benefits but see an improvement to the landscape and to their buildings. Debris that previously was strewn about after each flood would not be noticeable nor would one be able to see the scars and tell-tale high water marks and smell the stench that always follows a flood. The owners will be more anxious to improve their properties for resale and property exchanges will be easier. The community will display a much pleasanter image to anyone visiting the area or conducting business. School children will no longer be prevented from going to school because of flooding and utility companies will be able to provide uninterrupted services. All adverse environmental effects will be mitigated where at all possible including any related to cultural resources that might be disturbed or affected as a result of construction of the project. Aquatic and terrestrial life will only be disturbed or impacted on during construction but some beneficial effect to stream water quality and aquatic life can be expected after the project is completed by reducing the amounts of undesirable substances and materials that, under existing conditions of overbank flooding, are flushed into the creek. Some of these materials and substances include: trash and debris from the protected land, salt and oils from the highways, fertilizers and other substances from the nursery, and substances from residential and commercial activities in the protected area. Terrestrial habitat will initially be disturbed during construction but soon have a more dependable, controlled, dry habitat. Most losses attributable to the land space occupied by the base of the transverse levee will be compensated for by the increased surface area of the levee after it is constructed.

ECONOMIC EFFECTS

The selected plan will increase the value of protected properties in the Union Road - William Street area in the town of Cheektowaga. These increases will yield increased tax revenues as assessed valuation increases because of improvements made by the owners or occupants. If commercial interests develop or expand, tax revenues will increase and possibly cause a decrease in tax rates per $1,000 of assessment. A decrease in tax rates will then be more attractive to those who are seeking a residence or a location to establish a business.

Employment and income increases will be slight since the construction cost of the selected plan is less than one million dollars and little labor is expected to be required to maintain the project. The project will, however, probably cause the commercial operations to increase somewhat and allow for hiring a few people in the area as full or part time employees. A flood protected athletic field, picnic area, and parking lot for the Knights of Columbus could possibly be a business inducement.

The cost of maintaining emergency operations during floods, as necessary in the past, will be eliminated. Savings in cost for these services will enable the town to use these funds for other purposes. Similarly, utility companies should be able to reduce their costs somewhat and pass the savings on to the consumers, by slowing down the frequency of utility price increases. Additional details of the economic effects are given in Appendix B.

SOCIAL EFFECTS

The selected plan will have some, although not major, effect on several aspects of social well-being in the area. A field archaeologic investigation was made in the project area and a site was found that indicates some evidence of a late Archaic-Transitional stratified site and appropriate action as discussed in a previous section of this report will be taken as necessary to mitigate any damage. It is significant that without the project investigation, such a site may never have been uncovered. The effect therefore will, if the site is determined to be eligible for inclusion on the National Register of Historic Places result in a mitigation plan being developed and be attributable to construction of the selected project.

The selected project will improve recreational opportunities. The athletic field will be able to be used during flood flows and other open space areas that will be protected can be used for recreation purposes. Access roads to recreational facilities will not be inundated and traffic will be uninterrupted during flood flows. Similarly, access by utility vehicles, health and safety vehicles, school buses, shoppers, visitors, and thru-traffic will be uninterrupted, less aggravating and in total, result in a more pleasant social environment.

Noise during construction of the project will be short lived but the type of maintenance required for the project in the future such as removal of snags in the creek, patching the concrete walls, caring for the vegetation on the earth levees, and maintenance of the ponding areas, conduits, and flap gates will not cause excessive noise. Dust such as generated during construction will not be noticed during maintenance.

REGIONAL EFFECTS

Since the selected plan is a local protection plan, the regional effects are minimal. Inter-community traffic will flow more easily and those living outside the project area will be more attracted to the area than before and this could result in increases in sales and property exchanges. The construction cost of the selected plan is not sufficient to cause any sizable increase in income to otherwise unemployed workers. Maintenance labor required will be minimal and infrequent and probably by those now employed by non-Federal agencies. Changes in population growth or type is not expected to vary as a result of construction of the project.

DESIGN

Design of the selected plan is based on hydrologic and hydraulic data presented in Appendix A to this report, and on data related to foundation materials, structural design, slope stability, and erosion protection discussed in detail in Appendix C. In addition, Appendix B provides data on costs and benefits that influences the size of the project plan and feasibility of the selected plan via a procedure of optimizing. In selection of the optimum economic level of flood protection for the project area, annual costs and benefits were developed for 50-, 100-, and 200-year levels of protection. The general alinement of the structures, particularly the transverse levee and concrete wall between the abandoned quarry ponds, was based on a selection and recommendation by officials of the town of Cheektowaga, NY.

The structural design details are displayed on Plate 4. The selected project plan is designed to protect against an average annual recurrence interval of 100 years. The design flow is 14,700 cfs. More appropriately stated, the project is designed so that there will be a one percent chance flood peak discharge meaning that there is a one percent chance that the design discharge of 14,700 cfs will be exceeded in any given year.

Some of the specific design features are shown on Plate 4 and include the plan, profile, and typical sections of the structures. A discussion of these is contained in Appendix C. Channel work will consist of removing soft material in the creek channel and on creek slopes. Slopes that will have erosion protection are one vertical on two horizontal and channel excavation work in the vicinity of the tee wall will be sufficient to provide the necessary channel width and to construct the tee wall so that the footing is placed and in contact with bedrock. The base of the tee wall will be 10 feet wide and 1.5 feet thick with a one foot protrusion into the channel. The vertical portion of the wall will have a thickness of 1.5 feet and the height varies as shown on the profile on Plate 4. The transverse earth levee will have a side slope of one vertical on three feet horizontal, have a top width of 10 feet, and a height above existing ground level that varies from a maximum of about eight feet near the creek to zero at ground contour elevation 613.5 at the "tie into high ground" at the northerly end of the structural project improvement. The concrete wall that will be constructed between the two abandoned quarry ponds will be a gravity wall with the vertical portion 4.5 feet wide and the base 7.6 feet wide. The base of the wall will have a variable thickness of about five feet and the overall height will vary to a maximum of about 10 feet. The freeboard of the concrete wall along the creek and concrete wall between quarry ponds will be two feet above the 100-year flood stage. The freeboard of the transverse earth levee will be three feet above the 100-year flood stage except for the portion of the levee north of the concrete wall between ponds where the freeboard will be 2.5 feet above the 100-year flood stage. Erosion protection along the creek banks will be placed to the 100-year flood stage elevation. The 18-inch culvert pipe with flap gate will be precast in the concrete tee wall along the creek with inflow invert to best achieve internal drainage from within the protected area that will initially collect in a ponding area that will be maintained free of obstructions to collecting storm water. Similar design will prevail for the 24-inch culvert pipe with flap gate and gate valve that will be installed in the concrete gravity wall separating the two abandoned quarry ponds.

The slopes of the transverse levee and the backfill on the land side of the tee wall along the creek will have vegetative plantings that will not only be aesthetically suitable but also have characteristics that will retard any erosion that might otherwise occur. More specific data on the foundations, materials, design, and rationale on the design of the selected project are contained in the appendices.

RIGHTS-OF-WAY

Lands and rights-of-way required for the selected project plan will be furnished by non-Federal interests and will include project lands for the structures, construction easements, and easements necessary for maintenance of the project. An exact determination has not been made of the lands that are needed but must be determined and acquired before a construction contract is awarded. The probable location of the easements are shown on Plate 4. The land that will be occupied by the levees, walls, and erosion protection will be permanently used for project purposes and permanent acquisition will be necessary. Land for construction equipment use and access will only be necessary during the construction preparation, during construction, and post construction period necessary for site restoration and cleanup. The construction easements, therefore, will only be temporary. Even though the maintenance easements are needed periodically, they must provide for maintenance access and use throughout the life of the project. All land acquisition, easements, rights-of-way and areas needed for construction and subsequent maintenance of the project will comply with applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970," Public Law 91-6, approved 2 January 1971. Furthermore, non-Federal interests will hold and save the United States free from damages due to the construction and maintenance of the work, except for damages due to the fault or negligence of the Government or its Contractor. The estimate of cost for lands and damages shown in Table 11 was prepared by the Buffalo District Representative of the North Central Division Real Estate Office.

CONSTRUCTION

Construction of the selected project will be completed in one construction season provided that a contract is awarded in February or March and construction begins very early in the spring. Quantities of construction materials involved are relatively minor and consist of earth fill for levees, erosion protection material, concrete, culvert pipe, flap gates and gate valve. All of the material and products are available from suppliers in the Buffalo Metropolitan Area. Access to the site for construction purposes should not be an insurmountable problem. Union Road is a main artery for trucks and vehicles of all types and weights and there are several routes of access into the project site that can be considered.

OPERATION AND MAINTENANCE

The normal maintenance of local flood control projects is a non-Federal responsibility and periodic field inspections will be made by both non-Federal representatives and Corps of Engineer personnel. The various items will include: care of vegetative plantings such as mowing and trimming; replacement of erosion protection materials or adjustments; clearing drainage ditches and ponding areas; culvert and flap gate inspection to insure they are free and clear and operable; and inspection of the earth levees, concrete walls, and creek channel to determine if there are any repairs necessary or obstructions in the channel. It will be most important that the project be inspected periodically and maintained to insure that the project is functioning as intended to reduce overbank flooding from flood flows with an average recurrence interval of 100 years based on a design flood flow of 14,700 cfs.

The limit was reached in the 24th year of the project life and the value discounted and transformed to a ratio expressing the effect on residential damages. The average annual equivalent of the rise was determined to be $7,820 and therefore the average annual flood inundation benefit with affluence is $82,220 with construction of the project. Another benefit accrues to project construction based upon utilization of unemployed and underemployed labor resources in the construction and installation of a Federal construction project. The benefit is a quantification of the project's beneficial impact on these labor resources. Total wages paid to local labor were estimated to be 90 percent of the total labor component and locally unemployed or underemployed labor receive 20 percent of all wages paid to local labor. This amount was then amortized over the project life and the average annual benefit then becomes $3,200. In summary then, the total average annual benefit associated with the selected project plan is comprised of three components; flood inundation reduction of $74,400, affluence $7,820, and area redevelopment of $3,200, for a total of $85,420, say $85,400.

COSTS

The costs and annual charges for the selected plan of improvements are presented in the following tables. The costs are on April 1979 price levels and the annual charges are based on a 6-7/8 percent interest rate and an economic life of 100 years. The first cost is the investment costs since the project will be constructed in one construction season and no interest during construction is included. A detailed estimate of first cost is presented in Table 37 of Appendix B.

Table 11 - Estimate of First Cost (1)

Item	Federal	Non-Federal	Total
	$	$	$
Channels	193,000	0	193,000
Levees and floodwalls	349,000	0	349,000
Relocations	0	33,000	33,000
Lands and easements	0	36,000	36,000
Contingencies	108,000	0	108,000
Engineering and design	144,000	0	144,000
Supervision and administration	99,000	0	99,000
TOTAL	893,000	69,000	962,000

(1) Costs are rounded to nearest $1,000.

ECONOMICS OF THE SELECTED PLAN

GENERAL

The economics of the selected plan are presented in detail in Appendix B to this report and include details of the methodology, costs, benefits, damages, justification, and optimization. Pertinent details of these items are discussed below.

METHODOLOGY

Evaluations were made of residential, commercial, public, and other types of buildings, roads, bridges, and utilities to determine damages that could be expected at various flood depths based on depth percent damage relationships. These evaluations were established from field inspection and interviews with owners. Detour costs on roads were based on traffic counts and vehicle operating costs including the cost of driver time for commercial truck operators. Ninety-six residential and 60 commercial units occupy land within the flood plain that will be protected by the selected project.

DAMAGES

Average annual damages were developed based on stage-frequency relationships and stage-damage information. The average annual damages are the expected value of flood damages for any year and specified by reach and activity. The damages were then adjusted to 1980 conditions of development to represent existing conditions. The total average annual inundation damages under existing conditions, April 1979 price levels and 1980 conditions, amounted to $98,620.

BENEFITS

The benefits resulting from flood inundation are the difference between the expected value of damages with and without the project. The average annual damages under existing conditions and under improved conditions were compared and it was determined that the project, after construction, would reduce average annual inundation damages by $74,400 under 1980 conditions of development. In addition, affluence benefits were estimated that are additive to the $74,400. The affluence benefit is a measure of the increased average annual residential inundation damages resulting from the effect of rising per capita income on the value of residential real property and contents in constant dollars. The value is assumed to rise in direct relationship to the rate of growth in per capita income but the content value cannot exceed 75 percent of the residential structures value.

Table 12 - Estimate of Annual Charges

Item	Federal	Non-Federal	Total
	$	$	$
First cost	893,000	69,000	962,000
Investment during construction	0	0	0
Investment Cost	893,000	69,000	962,000
Annual Charges on Investment			
Interest (1)	61,400	4,700	66,100
Amortization (2)	100	0	100
Maintenance (3)	200	6,500	6,700
TOTAL	61,700	11,200	72,900

(1) 6-7/8 percent.
(2) Amortization at 6-7/8 percent, 100-year project life.
(3) Represents Federal inspection cost and non-Federal cost for maintenance and replacements.

JUSTIFICATION

The following table contains a comparison of the average annual benefits with average annual cost. These values, known as the B/C ratio is an indicator of economic efficiency and project justification.

Table 13 - Comparison of Average Annual Benefits and Average Annual Costs

Item	Average Annual Benefits	Average Annual Costs	B/C Ratio
	$	$	$
Existing Conditions			
Flood Inundation Reduction	74,400	-	
Area Redevelopment	3,200	-	
TOTAL EXISTING	77,600	72,900	1.1
Future Conditions			
Affluence	7,800	-	
TOTAL	85,400	72,900	1.2

OPTIMIZATION

The selected plan will provide a 100-year level of protection but other levels of protection were considered to determine the plan with the greatest net average annual benefits. This procedure results in the determination of the optimum plan. The following table displays a comparison of economic data for 50-, 100-, and 200-year levels of protection.

Table 14 - Comparison of Various Levels of Protection

Item	50-Year	100-Year	200-Year
	$	$	$
Average annual benefit	75,600	85,400	95,900
Average annual cost	66,300	72,900	149,800
Net average annual benefits	9,300	12,500	-53,900
Benefit Cost Ratio	1.14	1.17	0.64

The 100-year plan maximizes the average annual net benefits and has the greatest benefit cost ratio. The 100-year plan was, however, selected for several other reasons. The difference of $3,200 in net average annual benefits between the 50-year and 100-year plans is great enough to be reliable for selecting the 100-year level of protection. The difference between the 100-year and the 200-year net average annual benefits of $-66,400 is sizable and a clear indicator that the 200-year level is not feasible. Flood insurance programs are related to the 100-year flood level and the selected plan would be compatible with the flood insurance requirements. Since the area to be protected is in an urbanized area, the greatest level of protection that is possible and economically feasible is the objective of the selection process providing the plan is optimized within reasonable evaluation of data. The selection of a 100-year level of protection is not unreasonable based upon a comparison with the 50-year and the 200-year levels of protection.

DIVISION OF PLAN RESPONSIBILITY

FEDERAL

The Federal Government will design and construct the various features of the selected project plan shown on Plate 4. Section 205 Authority for this project limits Federal construction expenditure to two million dollars. The Federal costs include costs for levees and floodwalls, erosion protection, culverts, flap-gates, gate valve, channel work, preparation of ponding areas and interior drainage systems, and mitigation measures necessary to minimize or prevent adverse environmental impacts. The Corps of Engineers will also periodically field inspect the project to determine if the project works are being properly maintained by non-Federal interests sufficient for its intended functioning. The total Federal first cost is $893,000 and the annual inspection cost is estimated to be $200, both on April 1979 price levels.

NON-FEDERAL

The New York State, Department of Environmental Conservation is the non-Federal (local) sponsor, and will be required to enter into a local cooperation agreement normally required by the Corps of Engineers for local flood protection projects, prior to start of construction and in accordance with Section 221 of the Flood Control Act of 1970 and Section 40 of the Water Resources Development Act of 1974. Some of the items in the agreement reflect current Corps policy regarding claims for damages and reflect items that are current policy of other Federal agencies regarding use of the flood plain. Therefore, the items of local cooperation reflect the spirit of these policies and local interests must furnish assurances to the Secretary of the Army that they will:

a. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for construction and subsequent maintenance of the project works. In acquiring lands, easements and rights-of-way, for construction and subsequent maintenance of the project, the State of New York will comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970," Public Law 91-646, approved 2 January 1971 and prohibit future development within ponding areas;

b. Hold and save the United States free from damages due to the construction and maintenance of the works except for damages due to the fault or negligence of the Government or its Contractors;

c. Take over, maintain, and operate the project after completion, in accordance with regulations prescribed by the Secretary of the Army;

d. Accomplish, without cost to the United States, all necessary change in appurtenant utilities, sewers, and special facilities;

e. Regulate the use of the flood plain so as not to degrade or encroach on project capacities or hinder maintenance and operation; and,

f. Warning property owners annually that the project does not provide protection against floods greater than the design flood elevation; and,

g. Enact and enforce flood plain management regulations between the upstream and downstream project limits, meeting the standards established by the Federal Emergency Management Agency for the National Insurance Program under the National Flood Insurance Act of 1968 and Flood Disaster Act of 1973.

The total estimated non-Federal first cost is $69,000 and the estimated annual cost $11,200, both on April 1979 price levels. The estimated annual maintenance cost included in the annual cost is $6,500. As mentioned previously, non-Federal interests must maintain the project periodically to insure its intended functioning. Vegetative plantings must be cared for, the culverts and gates must be inspected, cleared and checked for proper operation, the channel in the project area cleared of any debris or buildup of shoals, ponding areas, and interior drainage ditches cleared, and the levee and walls repaired when necessary to prevent failure or further deterioration.

PLAN IMPLEMENTATION

Before construction of the selected plan, several steps must be completed as indicated below:

This final report and final ES will be reviewed by Corps echelon, other Federal agencies, and New York State officials;

The Chief of Engineers must approve the project and then include it in a list of other small projects awaiting construction funds under the continuing authorities program for the Section 205 Act as amended;

After funding and prior to preparation of design, plans and specifications; the New York State Department of Environmental Conservation will be required to enter into an agreement with the Federal Government. Bids will then be solicited and a construction contract awarded, after all lands, easements, and rights-of-way, necessary for construction have been obtained;

After construction of the project, expected to be completed in one full construction season, local interests will assume the responsibility for project operations and maintenance.

VIEWS OF NON-FEDERAL INTERESTS

Various plans of improvements have been discussed with non-Federal interests including State, County, Town and Village officials, businessmen, civic and fraternal organizations, and private citizens. Those with whom plans were discussed included:

- Erie and Niagara Counties Regional Planning Board
- Erie County Department of Environmental Quality
- New York State Department of Environmental Conservation and Department of Transportation
- State Historic Preservation Officer
- Towns of West Seneca, Cheektowaga, Alden, Marilla, Bennington, and Sheldon
- Villages of Depew and Lancaster
- New York State Office of Planning Service
- Town of Cheektowaga Developers - Mr. Repka and Mr. Fronckowiak
- Home owners - Mr. & Mrs. Sitarek, Mr. Higby
- Private citizens interested in the environment - Mr. & Mrs. Reinstein
- Nussbaumer and Clark Inc. - AE retained by Town of Cheektowaga to develop storm drainage plan
- Erie County Water Authority
- Town of Cheektowaga, Assessor
- Town of Cheektowaga, Supervisor
- Tavern and picnic ground owner at project site
- A clergyman at project site and Knights of Columbus.

All of those contacted either at public meetings, workshops, in office visit, by telephone, or correspondence, recognized the need to alleviate flooding in the vicinity of Union Road and William Street and agreed that something should be done to reduce or eliminate the flood damage caused and interruption of highway traffic. The greatest concern was to provide flood protection as soon as possible without increasing flooding elsewhere. The most significant view of non-Federal interests is contained in a letter from the Town of Cheektowaga on 30 March 1977 that recommends consideration of construction of a plan that is generally the same as the selected plan discussed in this report. The New York State Department of Environmental Conservation on 17 November 1975 requested further study be continued of the William Street-Union Road area under Section 205 of the 1948 Flood Control Act. A brief description of a plan generally the same as the selected plan was sent to most of these non-Federal interests, except the private interests, on 2 August 1976. At the public meeting held on 15 July 1975, the Erie and Niagara Counties Regional Planning Board submitted a statement that they did not favor localized and limited protection and recommended that the Corps consider the measures outlined in the Corps Cayuga Creek report of 1967 which would benefit the entire watershed. The Board's Statement and other pertinent correspondence including that discussed above is included in Appendix D to the report. The most recent view of non-Federal interest was obtained on 6 March 1978. Corps personnel met with the town of Cheektowaga Supervisor and the Town Engineer to discuss the plan shown on Plate 4. They were receptive to the plan and anxious that it be constructed as soon as possible. They were told that the Corps did not want to finalize the plan unless sure that it represented their desires and would accomplish what they believed necessary. On 19 May 1978, the New York State Department of Environmental Conservation furnished very helpful comments and stated that the Corps had developed a reasonable project to alleviate the almost annual flooding that occurs along Cayuga Creek in the Union Road-William Street area. The Chief, Water Management Group states that he cannot agree with the recommendation of USFWS that the levee be left unmowed to enhance wildlife since mowing, fertilizing, and periodic herbicide treatment are all essential to maintain a healthy sod cover on the levee. An unmown levee would also be an open invitation to woodchucks to establish their destructive network of burrows. On 29 June 1979, NYSDEC furnished a letter of intent to provide assurances of local cooperation for the proposed flood protection project.

REVIEW BY OTHER FEDERAL AGENCIES

Several Federal agencies were advised of the Cayuga Creek Study in its early stages of investigation and more recently during development of the local protection plan in the vicinity of Union Road and William Street. On 2 August 1976 the following agencies were furnished a general description of the local protection plan investigated in detailed and selected plan resulting from the study discussed in this report:

Department of Agriculture - Soil Conservation Service
Department of Interior - Fish and Wildlife Service
Department of Interior - Bureau of Outdoor Recreation
Department of Interior - National Park Service
Environmental Protection Agency

More recently the Department of Interior - National Park Service was furnished data on a cultural resources investigation made of the project site. All of these agencies will be furnished a copy of this report for review and comment. Preliminary comments have been received from the Fish and Wildlife Service that recommends that the bank of Cayuga Creek be preserved in its natural condition and be protected against the effects of erosion and siltation. They further recommend that the levee be immediately planted and that it be left unmowed to enhance wildlife. No specific comments were received from other Federal agencies but their views and comments resulting from a review of this report will be included in the final report.

SUMMARY

Recurring overbank flooding along Cayuga Creek causes damage to residential and commercial properties and causes interruption in highway traffic almost every spring in the vicinity of Union Road and William Street. Several possible solutions to the problem were analyzed and the study investigation progressed through plan formulation. It was determined that two plans in the vicinity would, if implemented, reduce flood damage - floodproofing or a local protection plan. These two plans, eight others, and a plan of no action have been presented in this report. A detail investigation of a plan of no action and of floodproofing have been displayed in a matrix, Systems of Accounts, for comparison purposes with the local protection plan that has been pursued in detail during this study.

The plans of no action and floodproofing are considered to be nonstructural whereas the local protection plan is the structural solution to providing flood protection in the vicinity. There are benefits with each plan that are carefully considered in plan selection and recommendations although there are also several adverse effects and uncertainties that were weighed. The structural plan was discussed with affected property owners and officials of the town of Cheektowaga to insure compatibility with as many interests as is possible before detailed design started.

After carefully considering the three plans, no action, floodproofing, and local protection; the local protection plan was selected as the best to satisfy the water resource problem and needs to reduce flood inundation and damage in the vicinity of Union Road and William Street. The plan, shown on Plate 4, consists of: a concrete tee wall on the right bank of Cayuga Creek beginning at the Union Road Bridge (about Station 0+50) and extending upstream to Station 7+10; erosion protection on the right bank from Station 7+10 to Station 8+50 and on the left bank erosion protection from the bridge to about Station 8+50; clearing and seeding both creek banks from Station 8+50 to Station 14+50; a transverse earth levee from Station 7+10 at the concrete tee wall along the creek extending northward, parallel to an athletic field, a distance of about 525 feet to a concrete wall; a concrete wall between two abandoned quarry ponds, about 250 feet long, extending northward from the north end of the aforementioned earth levee; and an earth levee about 100 feet long that extends further northward from the concrete wall and ties into ground contour elevation 613.5. Work in the stream bed consists of removing earth material down to rock as necessary to place the tee wall and erosion protection material. About 400 square yards of erosion protection material will be placed in the vicinity of the junction of the transverse levee and the creek; a ponding area will be maintained near the Union Road Bridge with an 18-inch culvert and flap gate installed in the concrete tee wall, and a ponding area will be maintained in the abandoned quarry with a 24-inch culvert pipe with flap gate and gate valve placed in the concrete wall. The top of the tee wall along the creek will be about four feet above ground level and the top of the transverse levee would vary from about seven feet above ground level near the creek to no differential at the 613.5 contour where the levee would terminate.

Construction of the plan will provide sufficient flood protection in the area to reduce about 94 percent of the flood damage that will otherwise take place during a 100-year flood level occurrence. Additionally, the mobility of people and highway traffic will be enhanced resulting in a greater feeling of social well-being because of improvement in public service facilities and the environment. The average annual tangible benefits of the project expressed in monetary terms is $85,400 and the average annual costs $72,900, which results in a favorable benefit cost ratio of 1.2.

The Federal first cost for the selected plan of improvement is $893,000 and the non-Federal cost is $69,000. It is estimated that construction of the project could be completed in one full construction season, beginning early in the spring, following completion of plans and specifications. Following construction, maintenance of the walls, levee, channel, and associated project works will be the responsibility of the New York State Department of Environmental Conservation.

The plan has been developed on the basis of the desire of the State of New York that the project be pursued under Section 205 procedure and on the location and alinement of the levee suggested by the town of Cheektowaga officials. Copies of their letters and other pertinent correspondence are included in Appendix D.

CONCLUSIONS

INTRODUCTION

I have reviewed and evaluated, in light of overall public interest, the documents concerning the proposed structural local flood project and various alternatives studied to alleviate flood damage in the Cayuga Creek, New York basin. The possible consequences of the proposed action and the alternatives have been studied for environmental, social well-being, and economic effects, including regional and national economic development and engineering feasibility. Other factors, bearing on my review, include the awareness that the State of New York recognizes the problem of flooding in the area where the local protection would be provided and has stated that further study such as has been accomplished be made under Section 205 authority. I am also aware of the concerns of those living in the area to be protected and of the views of the town of Cheektowaga regarding the location of the protective works.

BACKGROUND

The Cayuga Creek flood management study started as the usual type of feasibility study and several workshops, a public meeting, and field investigations were conducted to identify problems, needs, and then develop various measures and plans to best meet these problems and needs. After analyzing the various plans, I concluded that a localized flood protection project could be implemented in the Union Road-William Street area within the cost range for a Section 205 authority for the town of Cheektowaga, New York State, and the Chief of Engineers. The plan developed under 205 Authority and discussed in this report represents close coordination with affected interests and will alleviate most of the flood damage and inundation that occurs almost annually in the vicinity of Union Road and William Street.

SELECTED PLAN

The selected plan of improvement, that is both the Environmental Quality Plan (EQ), and the National Economic Development Plan (NED), will reduce local flood inundation damage in the vicinity of Union Road and William Street caused by floods with an average recurrence interval of 100 years. More appropriately, a flood of this magnitude with a flow of 14,700 cfs can be referred to as one with a one percent chance that the design flow will be exceeded in any given eyar. The plan, shown on Plate 4, consists of: a concrete tee wall on the right bank of Cayuga Creek beginning at the Union Road Bridge (about

Station 0+50) and extending upstream to Station 7+10; erosion protection on the right bank from Station 7+10 to Station 8+50 and on the left bank erosion protection from the bridge to about Station 8+50; clearing and seeding both creek banks from Station 8+50 to Station 14+50; a transverse earth levee from Station 7+10 at the concrete tee wall along the creek extending northward, parallel to an athletic field, a distance of about 525 feet to a concrete wall; a concrete wall between two abandoned quarry ponds, about 250 feet long, extending northward from the north end of the aforementioned earth levee; and an earth levee about 100 feet long that extends further northward from the concrete wall and ties into ground contour elevation 613.5. Work in the stream bed consists of removing earth material down to rock as necessary to place the tee wall and erosion protection material. About 400 square yards of erosion protection material will be placed in the vicinity of the junction of the transverse levee and the creek; a ponding area will be maintained near the Union Road Bridge with an 18-inch culvert and flap gate installed in the concrete tee wall, and a ponding area will be maintained in the abandoned quarry with a 24-inch culvert pipe with flap gate and gate valve placed in the concrete wall. The top of the tee wall along the creek will be about four feet above ground level and the top of the transverse levee would vary from about seven feet above ground level near the creek to no differential at the 613.5 contour where the levee would terminate.

ALTERNATIVES

Several alternative plans were considered initially to reduce flood damages and satisfy allied water and related land resource needs in the Cayuga Creek Watershed. The plans included both structural and nonstructural solutions. Nonstructural measures considered included: no action, flood warning and emergency action, permanent flood plain evacuation, floodproofing, flood insurance, and flood plain regulation. Structural considerations included: channel realignment, channel deepening and widening, reservoirs, levees and combinations of channel deepening and levees.

It was concluded that only three plans warranted further investigation, no action, floodproofing, and local protection in the vicinity of Union Road and William Street in the town of Cheektowaga, New York. This conclusion was based upon economic feasibility and in recognition that most of the damages from flooding in the vicinity is caused by overbank flooding of Cayuga Creek upstream of the Union Road bridge that could be best reduced structurally by a local protection project. These three plans are those discussed and displayed in the greatest detail in this report.

The plan of no action is not a solution to the potential flooding problem since flood damages would still occur and would probably increase if new development takes place in the flood plain. No action does however serve as a base for comparison to the other two alternative plans. Plans for further development are already proposed and landfill in the near vicinity of Union and William continues, reducing the natural storage for overbank flooding. Even though flood plain regulations exist and flood insurance is available, the flooding problem will continue. However, continuance of the regulations and insurance are essential even without action by the Corps of Engineers.

Floodproofing, would require structural changes to existing homes and commercial building and temporary flood shields as a means of reducing flood damages. The floodproofing plan also includes a flood warning - flood forecasting system, use of rain gages with telemetry capabilities, raising buildings, removing some buildings, sump pumps, ring levees, gate valves and rearranging the contents of buildings. The level of design would be based upon the Regulatory Flood Datum (RFD). The RFD is defined in Federal Flood Proofing Regulation, EP 1165-2-314, as the height of the Regulatory Flood plus a freeboard factor of safety. For purposes of making an evaluation in the initial investigation, the Regulatory Flood was assumed as a 100-year event. Walls and floors below the RFD would be altered to improve structural strength and impermeability. Windows at low elevations would be sealed permanently, perhaps with glass blocks, and temporary removable shields would be placed on doorways or loading docks during flood times. The shields could be made of any structurally sound material that is easily moved such as aluminum or plastics. The shields would be stored as close as possible to the place where they would be used but hidden from view as much as possible. Quick attachment fasteners would be used to allow speedy placement. In determining the cost of floodproofing in Reaches 1, 2, and 3, the type and number of residential and commercial establishments were inventoried and classified by elevation and type of layout. The materials necessary to floodproof each type of structure were then estimated. Commercial establishments were estimated individually. Even though the floodproofing plan was compared to the structural local protection plan, the data used to develop costs and benefits is not as reliable as that developed for the structural plan. A power failure would cause the warning system to be inoperative. Hydrostatic pressure on basement walls could cause the foundations to collapse and emergency vehicles would be hindered from responding to emergency calls including fire and health.

The local protection plan comprised of a levee system and associated works would prevent flood damage and inundation from floods having an average recurrence interval of about once in 100 years and is the NED plan and the most beneficial to the environment. The plan is the most socially acceptable, and would benefit the regional economy more than a plan of no action or floodproofing. The plan, described in a previous section of my statement, is the EQ plan, the NED plan, and the Selected Plan.

EVALUATION

The following considerations were pertinent in determining the Selected Plan:

Economic

The Selected Plan represents the optimum economic level of flood protection consistent with environmental and social values. A lesser level would yield less net benefits, the difference of $3,200 is conclusive enough to select the 100-year level as the optimum plan. The difference between the 100-year and the 200-year net average annual benefits of $-66,400 is sizable and a clear indicator that the 200-year level is not feasible. At a 6-7/8 percent interest rate and an economic life of 100 years, the average annual benefits are $85,400 and the average annual charges are $72,900, resulting in a benefit cost ratio of 1.2 to 1.0.

Environmental

The Selected Plan would physically occupy about 2.67 acres of land, 0.76 acres of which would be required for erosion protection along the creek bank slopes, 0.23 acres for the concrete tee wall along the creek and between two abandoned quarry ponds, 0.64 acres for a transverse levee, 0.34 for cleaning and seeding creek banks, and 0.70 acres for ponding areas associated with interior drainage. Most of the land that would be occupied along the creek is not now used for any purpose except perhaps for some wildlife and a few shallow rooted trees. The land for the ponding area would only be flooded during times of flooding as it presently is, the only difference being that the water is drained to a specific area and then would be released into the creek. Land for the transverse levee would be on land that is now vacant and on a property line to minimize adverse impact on the owners who might wish to develop the land in the future. The levee would be appropriately planted with vegetation for aesthetics, bank stability, and also to replace lost terrestrial habitat. There would be a gain in area of terrestrial habitat along the levee compared to the land the levee would occupy. The wetland acreages, that is to say the land that is inundated during times of overbank flooding, will be improved since debris, possible contamination from the creek, salts from the highways, and possible influx of fertilizers and toxic spray material sold at the nursery establishment located in the area to be protected, would not be washed onto the protected area. Similarly, salts, fertilizers and toxics could be washed into the creek, without the project, and cause some degradation of the water quality and aquatic life. Terrestrial wildlife would also benefit by the project for these same reasons During the investigation of the project site a cultural resources field investigation was made and a late Archaic-Transitional Stratified site was found and flakes and points uncovered that could date to 2,500 BC and represent Indian culture. There is also a possibility that the flakes and points are remains of the quarry operations that took place in the area. A final determination or declaration has not been made. In any event, the Selected Plan for flood protection will have an unavoidable effect on the find since the stratification extends upstream and downstream of the flood control project. If the site find is determined to be eligible for inclusion on the National Register of Historic Places, an appropriate mitigation plan will be developed in coordination with the New York State Historic Preservation Officer and the Advisory Council on Historic Preservation. It is significan however that if this structural plan had not been further investigated, the possibility or the awareness of such a site would not have been known. Properly then, the selected project plan represents an archaeological gain should there be a determination for registry and a mitigative plan developed. There are several negative environmental aspects of the Selected Plan but most are short lived. The air quality will be impaired during construction due to dust and to exhausts from construction equipment. Some trees will be removed for construction purposes but many are now in danger of falling into the creek because of the shallow root system while others could be saved and transplanted if necessary. Fish and other aquatic life will be adversely affected during construction of the walls, levee and erosion protection placed on the banks and levee along the creek. However, after construction is completed, the water quality will be improved. The beneficial effects on the environment will far outweigh the adverse effects after the selected project plan is constructed.

Social well-being

The social well-being impacts of the Selected Plan are mostly beneficial. The aesthetics of the area will be improved since telltale signs of overbank flooding and inundation will be reduced. High water marks on buildings will not continue to be an aftermath of each flood occurrence and scattering of debris and damage to landscape will cease. Flood shields and other measures inherent with floodproofing will not be seen or be necessary. Should a significant cultural site determination be made or mitigation measures taken, the project will then have caused this site to be recorded, and thus be valuable information for those who are interested and concerned about recording and preserving cultural resources. Highway traffic will be improved and be uninterrupted allowing schools, other public services, and businesses to enjoy a better sense of community growth and unimpaired opportunities. Residents will feel more secure physically since their homes will not be inundated and they will be free of the fears often associated with such an experience. Community growth should improve and homeowners and businessmen will be more apt to improve their properties. Recreational opportunities on the athletic field will be improved. An adverse impact will be noise during construction and that associated with increased traffic flow and recreational activity.

Regional development

Many of the impacts on national economic development, environmental quality, and social well-being, are similar in regard to regional development. Some of the impacts unique to regional development are those that will have other than an immediate local effect. For instance, highway traffic that is improved locally also improves regionally. Public buildings in the local area also serve a region in some instances and improvement in property values will allow the total region to benefit. There will be no adverse effects regionally but many improvements as compared to a plan of no action or floodproofing.

Other considerations

I am fully aware of the concerns of affected property owners located at the project site in not wanting their property subdivided that will interfere with their present and future plans for development. Their concern is normal and not selfish. However the selected plan minimizes subdividing or interfering with the present and future use of these properties. The athletic field will not be disassociated from other activities and business endeavors of the owner. The Knights of Columbus parking lot will not be reduced in size, and a Bennett Road property owner will not have his rear lot divided. The transverse levee and wall will be situated close to or on a side property line. I feel confident that the New York State Department of Environmental Conservation, responsible for maintenance of the project, will avoid any adverse impact on these lands in obtaining maintenance easements and in maintaining the project.

SUMMARY

I find that the local protection plan selected and discussed in this report is based on a thorough analysis and evaluation of various alternative actions or achieving the stated objectives. Wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternative courses of action which would achieve the purposes specified by the Congress. Where the proposed action has an adverse effect, this effect has been minimized through remedial, protective, or mitigation measures wherever possible. The proposed action is consistent with Federal statutes, administrative directives, and national environmental policy. Accordingly, the total public interest will best be served by implementation of the selected plan of improvement. Further, Executive Order 11988 has been complied with for this project in that:

(a) Most of the flood plain is developed urban land, and much of the undeveloped acreage within the 100-year flood outline is used for parkland. No new development is expected in the protected area after project construction. In case there is any pressure for further development in the unprotected flood plain area, the regulating flood plain aspect of the chosen plan should prevent incompatible usage. With reduced rise of flooding (degree of protection is 100-year) there could be some expansion and improvement of existing structures.

(b) The flood plain of Cayuga Creek within the project area is primarily residential or recreational in nature. The non-park open spaces that remain are not very productive of wildlife, though some habitat exists for song birds and small mammals and reptiles. Again, no new development in the project area is expected to take place after project construction and the recommended plan includes flood plain management regulation which are expected to prevent incompatible development in the unprotected areas.

(c) Most of the flood plain is already largely developed urban land and flood plain management is expected to minimize the limited amount of future development that could take place. The best non-flood plain alternative for any development with the project would have the limited future development out of the flood plain. Since no new development is anticipated in the flood plain after project construction, there is minimal impact on the community for using the nonflood plain alternative.

(d) The recommended project for Cayuga Creek includes structural measures which will have some adverse impacts on the environment, and nonstructural measures which will minimize any secondary development in the base flood plain. The project would physically occupy about 2.67 acres of land, 0.70 acres of which would be used for ponding areas associated with interior drainage. Most of the land that would be occupied along the creek is not now used for any purpose except perhaps for some wildlife and a few shallow rooted trees. The land for the ponding area would only be inundated during times of flooding as it presently is, the only difference being that water is drained to a specific area and then would be released into the creek. The land that is presently inundated during times of overbank flooding will be improved since debris and possible contamination from the creek and other sources would be eliminated. Similarly, undesirable materials could be washed into the creek, without the project, and cause some degradation of the water quality and aquatic life. Terrestrial wildlife would also benefit by the project for these same reasons. During the investigation of the project site a cultural resources field investigation was made and significant archaeological fines were found in the project area. Should a significant cultural site determination be made or mitigation measures taken, the project will then have caused this site to be recorded. There are several negative environmental aspects of the project but most are short-lived. The air quality will be impaired during construction. Some trees will be removed for construction purposes but many are now in danger of falling into the creek because of the shallow root system while others could be saved and transplanted. Fish and other aquatic life will be adversely affected during project construction, however, the water quality will be improved after construction is completed. No new development in the flood plain is anticipated after project construction, therefore, there is no added flood damage potential due to induced development with the project. Also, a condition has been included in the local cooperation agreement which requires compliance with standards established by the Federal Emergency Management Agency for the National Insurance Program under the National Flood Insurance Act of 1968 and Flood Disaster Act of 1973.

As formulated with 1979 price levels the structural measures of the project plan will reduce annual damages by about $85,000.

The recommended plans are preferred because they serve to reduce flood damages to existing development while regulating expansion on the flood plain. The beneficial effects on the environment will far outweigh the adverse effects after the selected project plan is constructed.

(e) In order to mitigate against adverse effects on archaeological sites, a data recovery program will be implemented prior to construction which will represent adequate mitigation in this situation. The existing strip of vegetation along the north bank of Cayuga Creek will not be disturbed except in areas where the project is actually constructed. Also, the levees will be planted in grasses and allowed to grow except when this interferes with the flood control purpose of the levees.

RECOMMENDATION

I recommend that the selected plan of improvement, shown on Plate 4, for local flood protection on Cayuga Creek in the town of Cheektowaga, NY, as formulated in this Detailed Project Report be used as a basis for preparation of plans and specifications for construction, with such modifications as in the discretion of the Chief of Engineers may be advisable, at a total estimated first cost of $854,000 (August 1977 price levels) consisting of: $820,000 Corps of Engineers, and $34,000 non-Federal. This recommendation is made with the understanding that local interests must furnish assurances satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for construction and subsequent maintenance of the project works. In acquiring lands, easements, and rights-of-way for construction and subsequent maintenance of the project, the State of New York will comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970," Public Law 91-646, approved 2 January 1971 and prohibit future development within ponding areas;

b. Hold and save the United States free from damages due to the construction and maintenance of the works except for damages due to the fault or negligence of the Government or its Contractors;

c. Take over, maintain, and operate the project after completion, in accordance with regulations prescribed by the Secretary of the Army;

d. Accomplish, without cost to the United States, all necessary changes in appurtenant utilities, sewers, and special facilities;

e. Regulate the use of the flood plain so as not to degrade or encroach on project capacities or hinder maintenance asnd operation; and

f. Warning property owners annually that the project does not provide protection against floods greater than the 100-year flood elevation; and,

AD-A101 704 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
BUFFALO METROPOLITAN AREA, NEW YORK WATER RESOURCES MANAGEMENT.--ETC(U)
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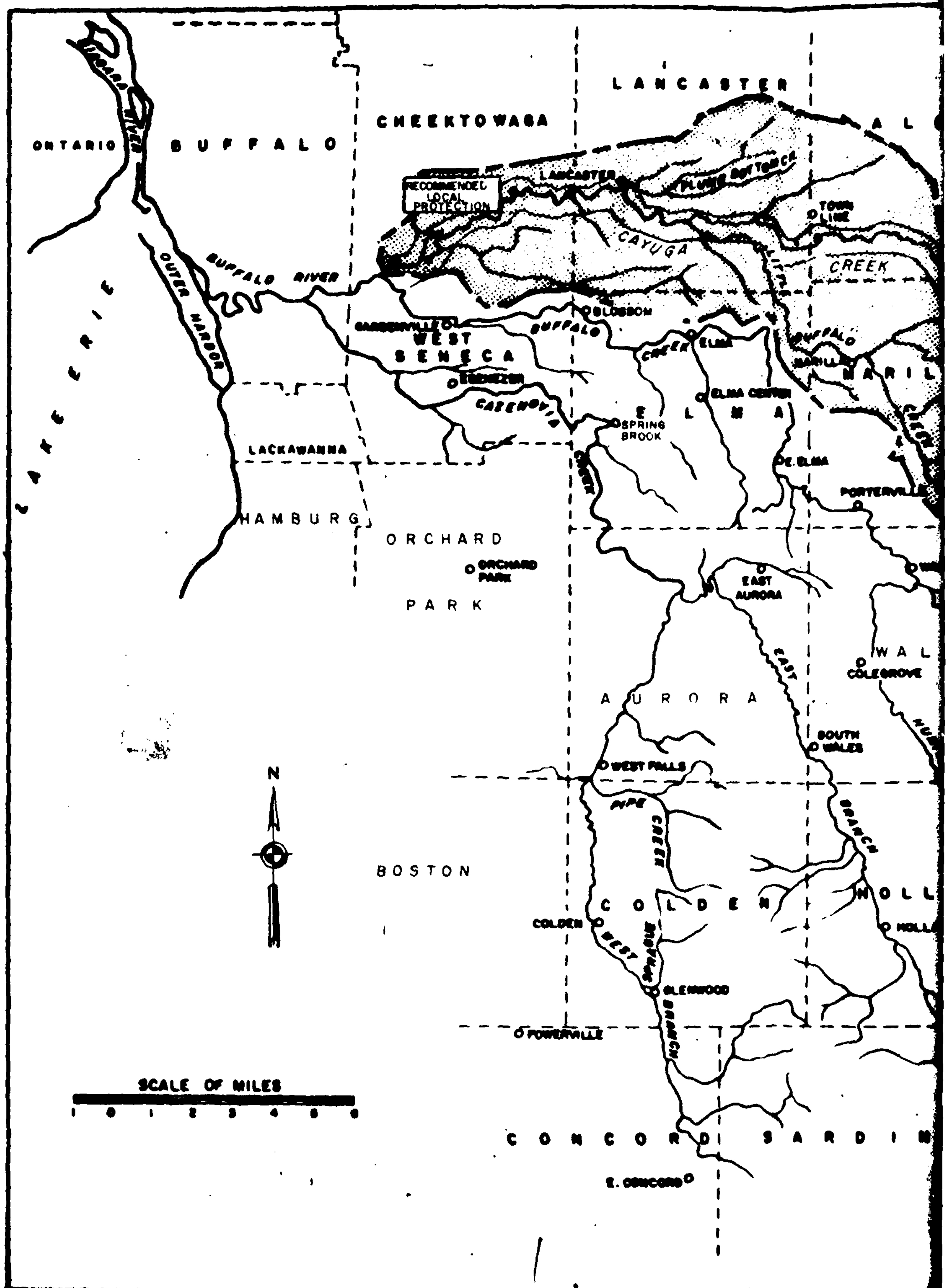
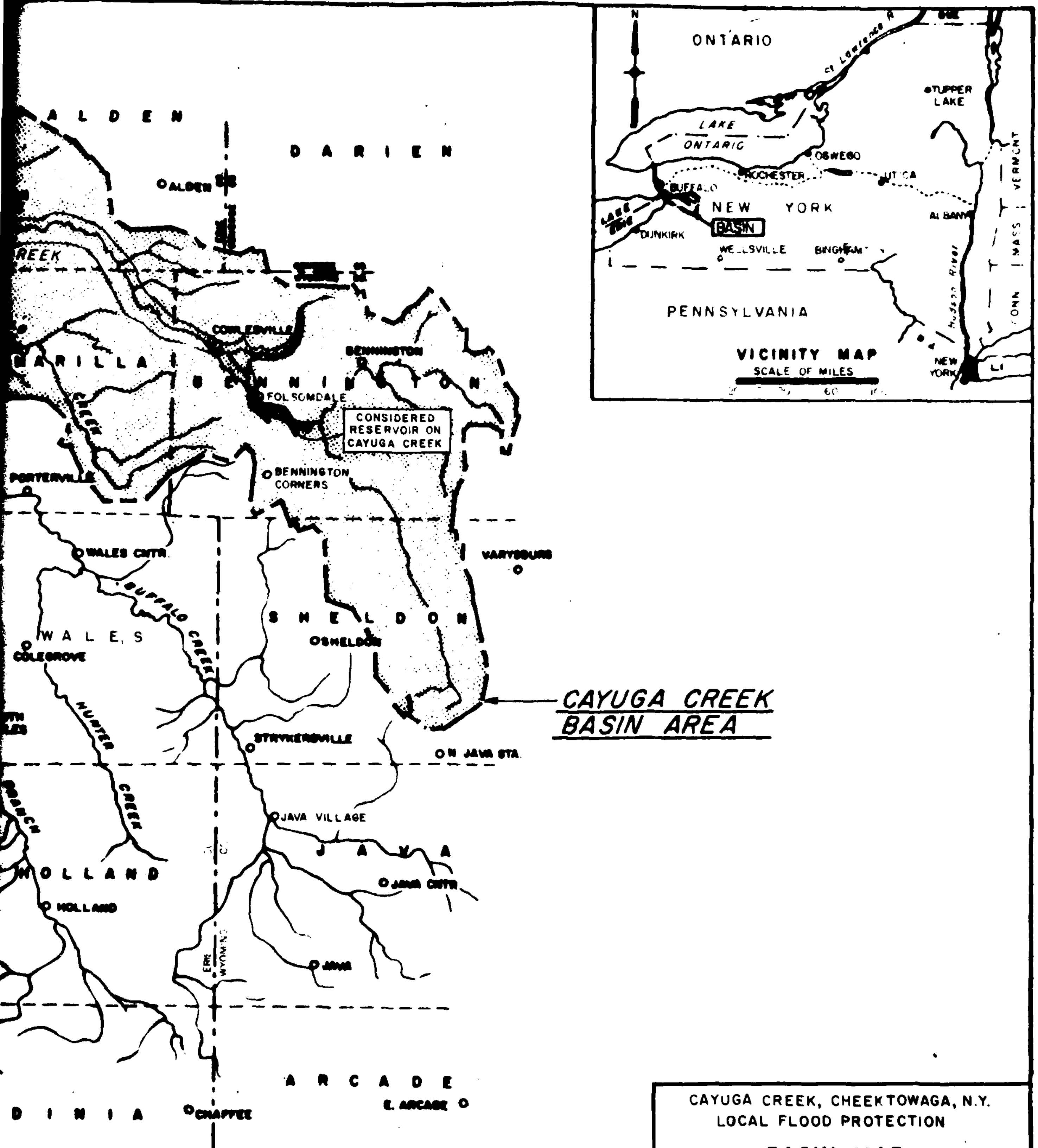
g. Enact and enforce flood plain management regulations between the upstream and downstream project limits, meeting the standards established by the Federal Emergency Management Agency for the National Insurance Program under the National Flood Insurance Act of 1968 and Flood Disaster Act of 1973.

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer
Buffalo, New York


LANCASTER
CHEEKTOWAGA
ONTARIO
BUFFALO
RECOMMENDED LOCAL PROTECTION
LANCASTER
TOWN LINE
CAYUGA
CREEK
BUFFALO RIVER
OUTER HARBOR
LAKE ERIE
GARDENVILLE
WEST SENECA
BLOSSOM
BUFFALO
CREEK
ELMA
EBENEZER
CAZENOVIA
ELMA CENTER
ELMA
SPRING BROOK
CREEK
LACKAWANNA
E. ELMA
PORTERVILLE
HAMBURG
ORCHARD PARK
ORCHARD PARK
EAST AURORA
EAST
COLEGROVE
AURORA
SOUTH WALES
WEST FALLS
PIPE CREEK
BRANCH
N
BOSTON
COLDEN
COLDEN
WEST BRANCH
GLENWOOD
BRANCH
POWERVILLE
SCALE OF MILES
1 0 1 2 3 4 5 6
CONCORD
E. CONCORD



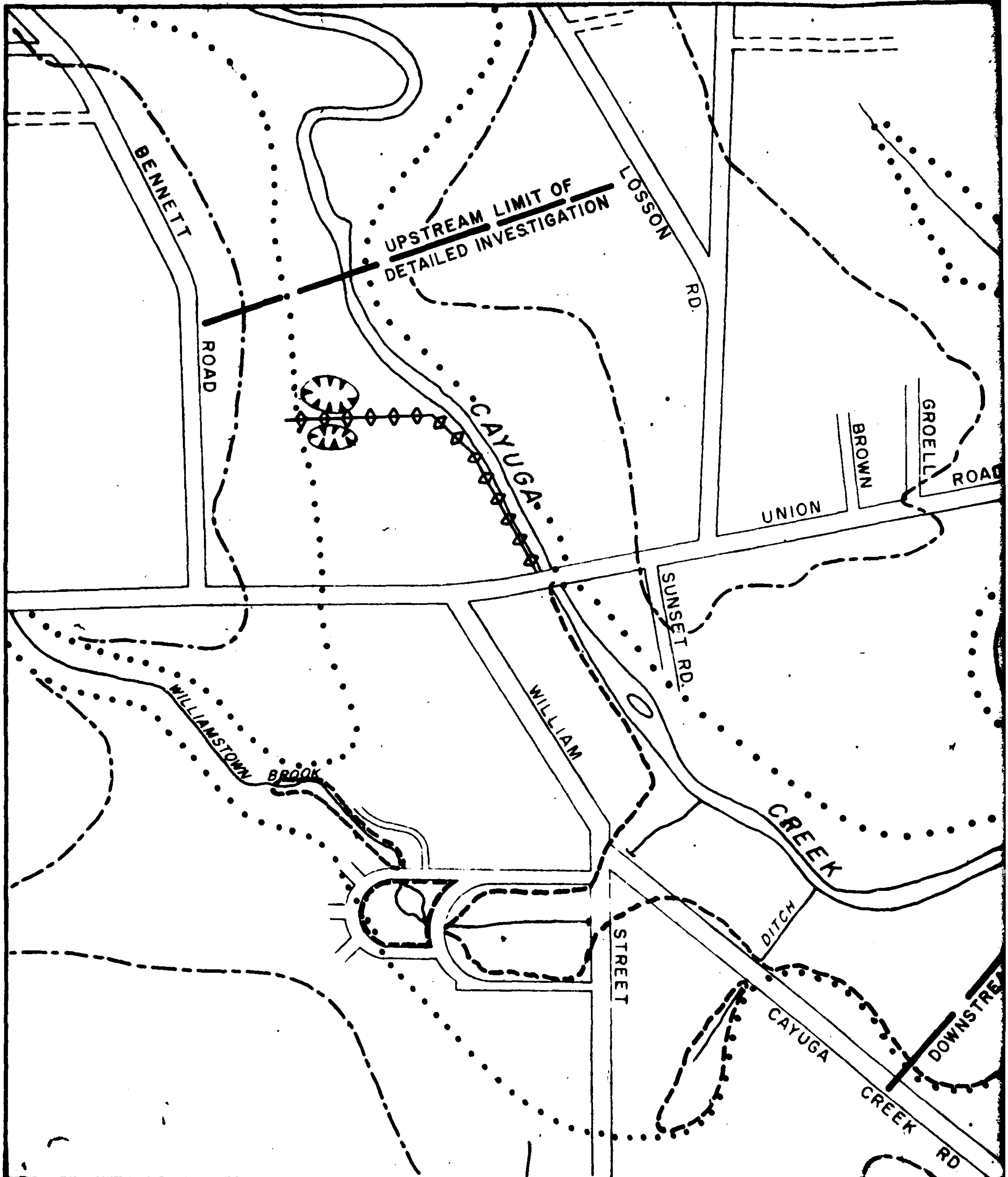
CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION

BASIN MAP

SECTION 205
DETAILED PROJECT REPORT

U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE I



BENNETT
ROAD
UPSTREAM LIMIT OF
DETAILED INVESTIGATION
LOSSON
RD.
CAYUGA
GROELL
BROWN
ROAD
UNION
SUNSET RD.
WILLIAM
WILLIAMSTOWN
BROOK
CREEK
DITCH
STREET
CAYUGA
CREEK
RD
DOWNSTRE

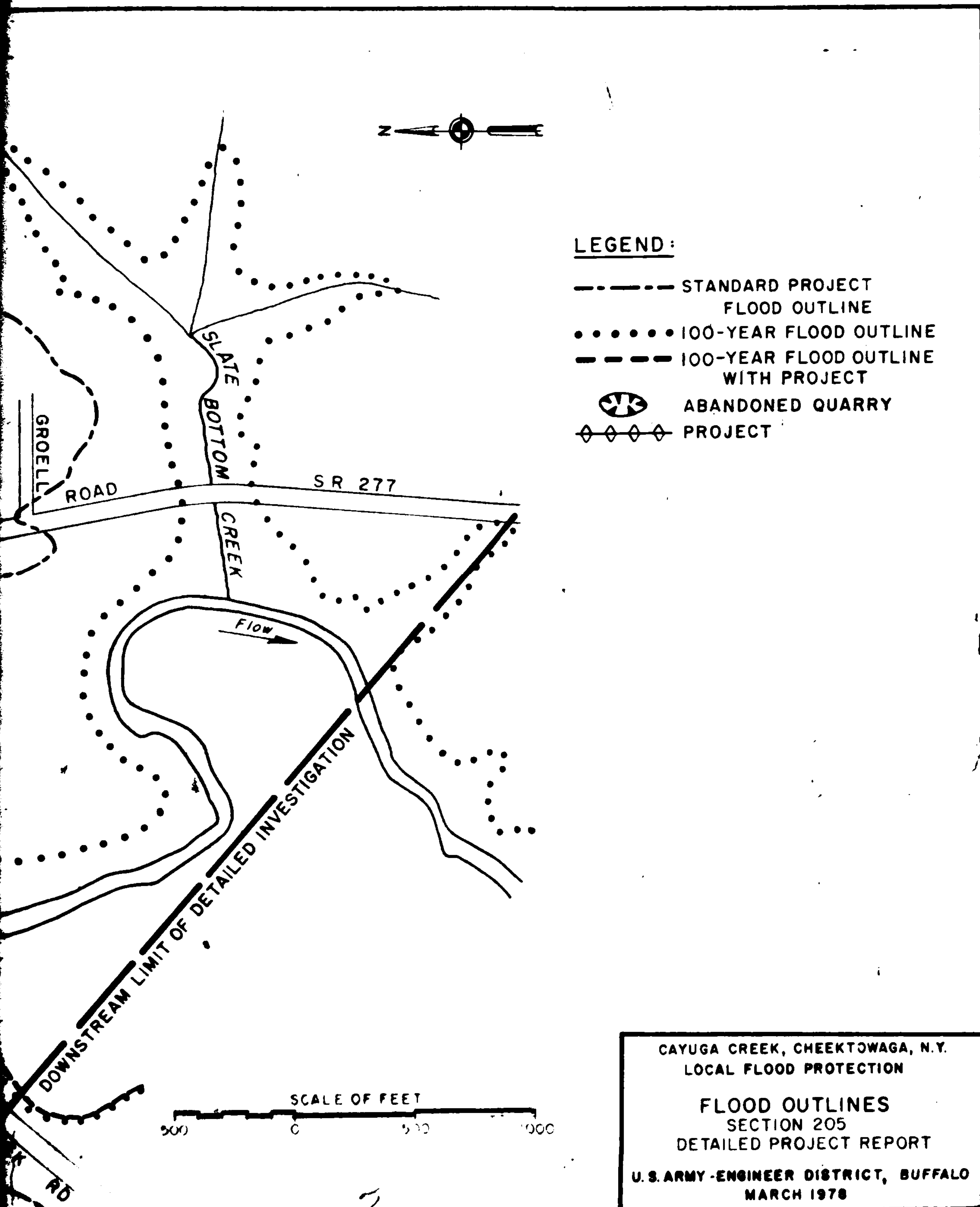
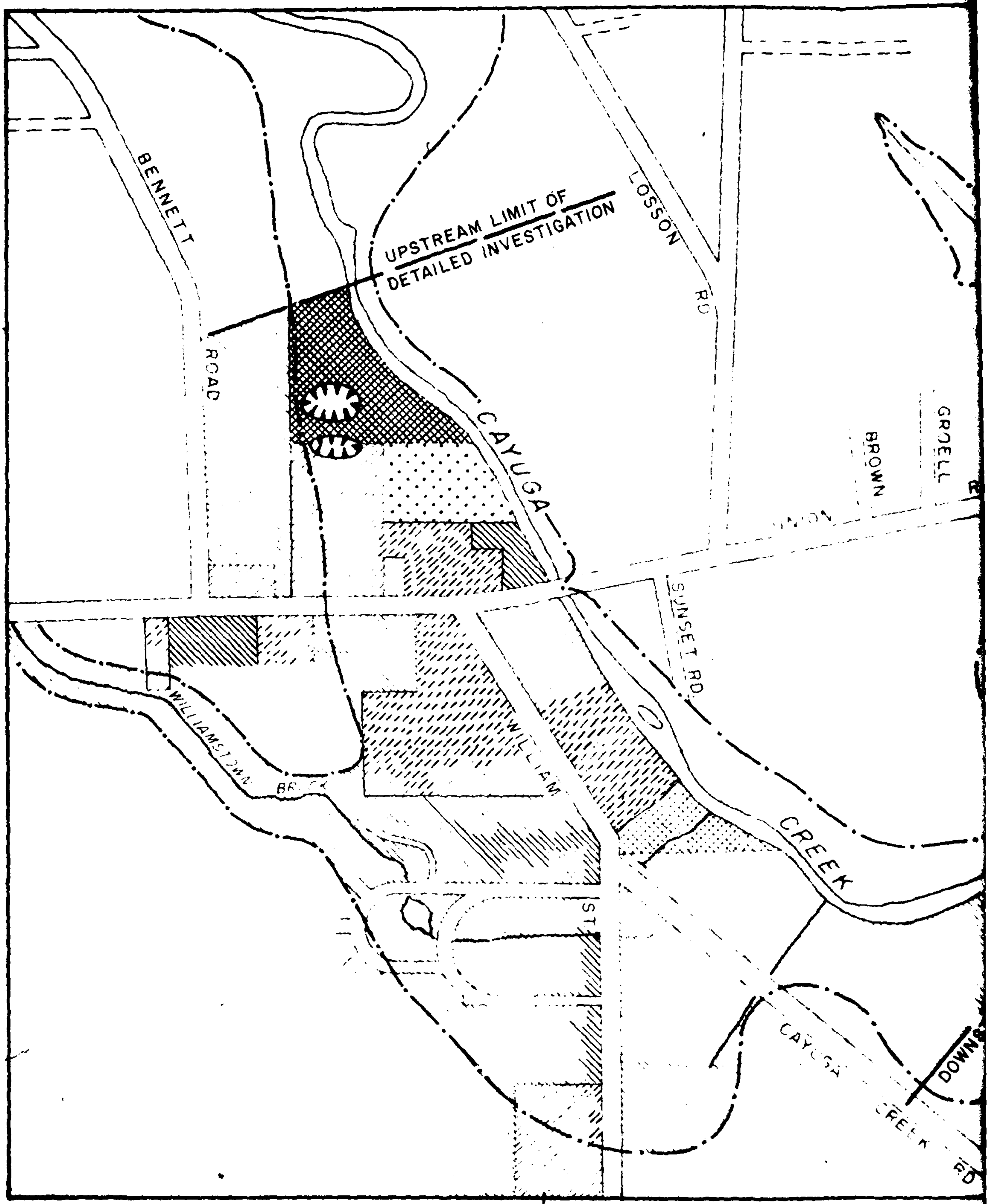
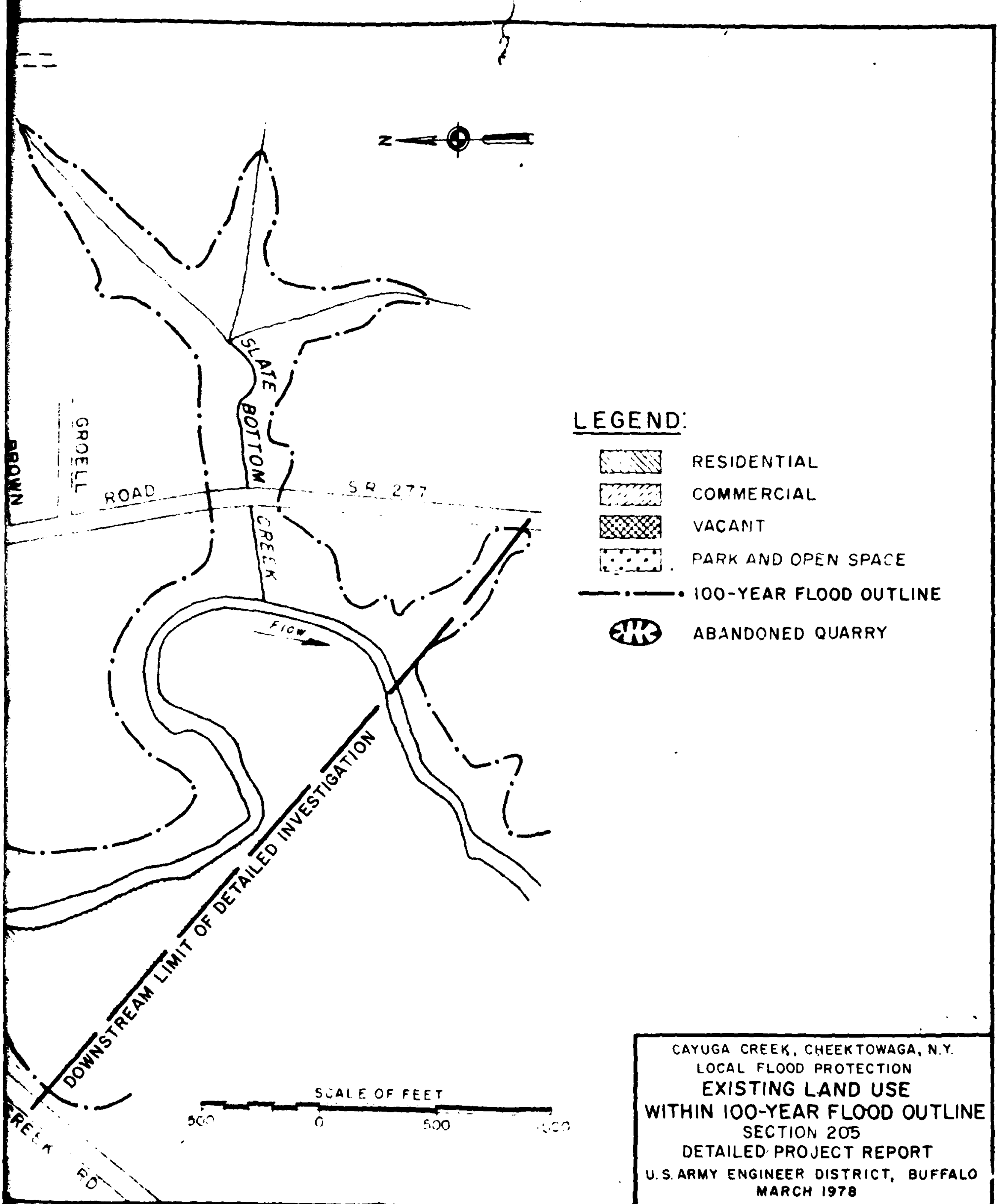

LEGEND:
STANDARD PROJECT FLOOD OUTLINE
100-YEAR FLOOD OUTLINE
100-YEAR FLOOD OUTLINE WITH PROJECT
ABANDONED QUARRY
PROJECT
SLATE BOTTOM CREEK
GROELL ROAD
SR 277
Flow
DOWNSTREAM LIMIT OF DETAILED INVESTIGATION
SCALE OF FEET
0
1000
RD
CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION
FLOOD OUTLINES
SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE 2

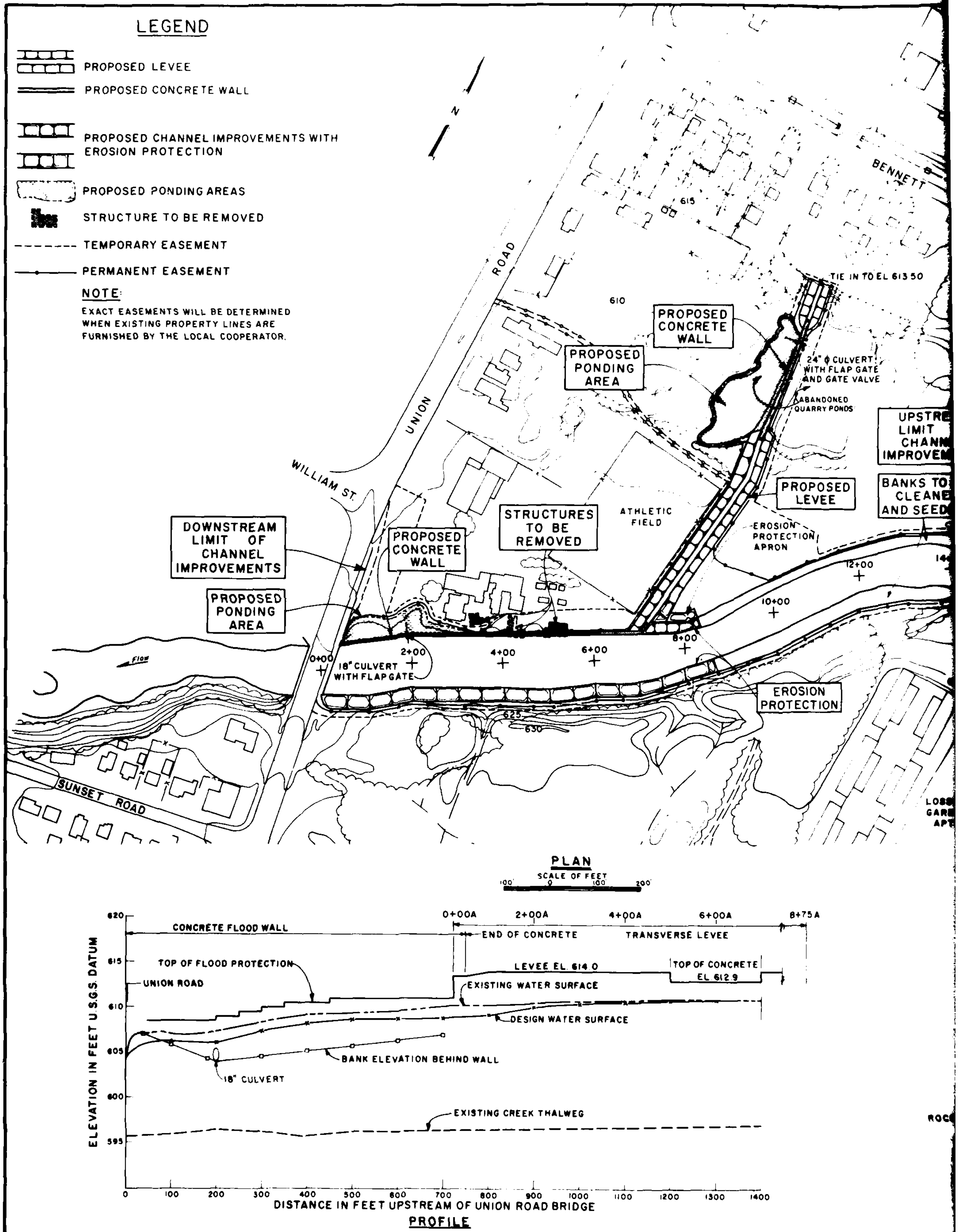


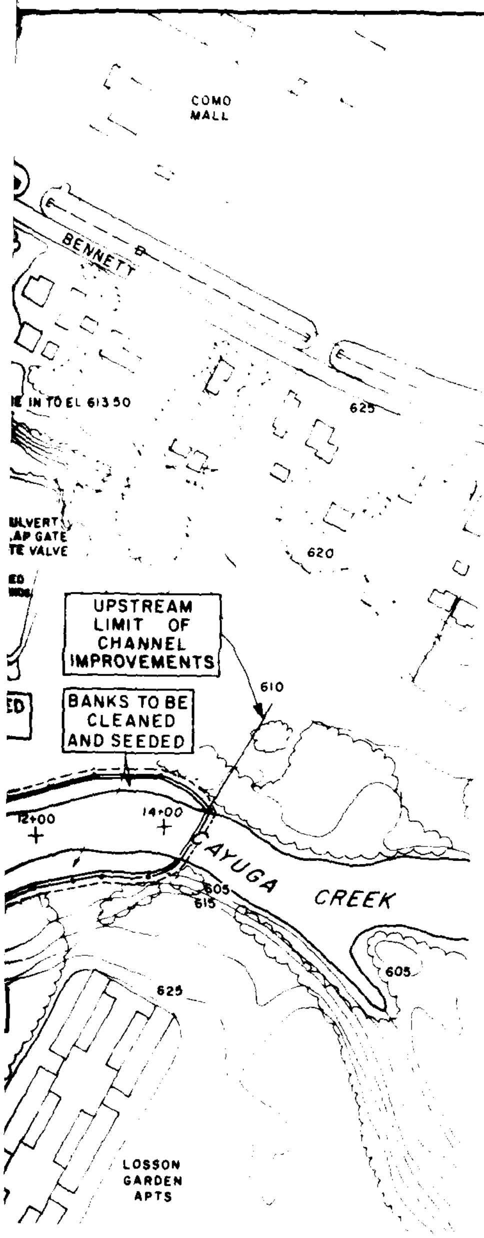
UPSTREAM LIMIT OF
DETAILED INVESTIGATION
BENNETT
ROAD
LOSSON
RD
CAYUGA
CREEK
SUNSET RD
BROWN
GROELL
WILLIAMSTOWN
WILLIAM
ST

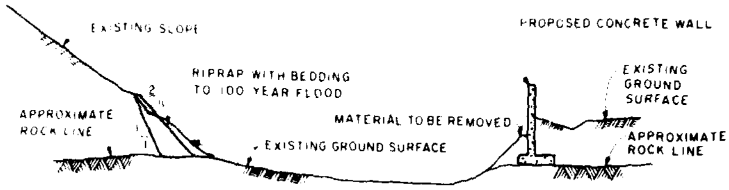


CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION
EXISTING LAND USE
WITHIN 100-YEAR FLOOD OUTLINE
SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE 3

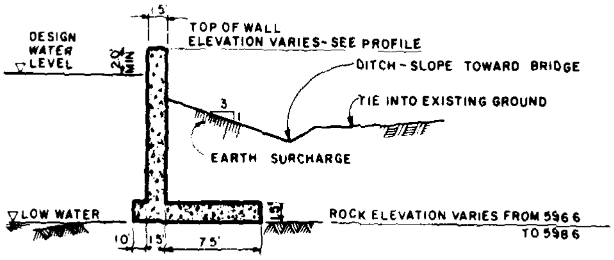

LEGEND
PROPOSED LEVEE
PROPOSED CONCRETE WALL
PROPOSED CHANNEL IMPROVEMENTS WITH EROSION PROTECTION
PROPOSED PONDING AREAS
STRUCTURE TO BE REMOVED
TEMPORARY EASEMENT
PERMANENT EASEMENT
NOTE:
EXACT EASEMENTS WILL BE DETERMINED WHEN EXISTING PROPERTY LINES ARE FURNISHED BY THE LOCAL COOPERATOR.
N
UNION ROAD
BENNETT
615
610
TIE IN TO EL 613.50
PROPOSED CONCRETE WALL
PROPOSED PONDING AREA
24" ϕ CULVERT WITH FLAP GATE AND GATE VALVE
ABANDONED QUARRY PONDS
UPSTRE LIMIT CHANN IMPROVEM
PROPOSED LEVEE
BANKS TO CLEANE AND SEED
WILLIAM ST.
ATHLETIC FIELD
STRUCTURES TO BE REMOVED
EROSION PROTECTION APRON
DOWNSTREAM LIMIT OF CHANNEL IMPROVEMENTS
PROPOSED CONCRETE WALL
PROPOSED PONDING AREA
12+00
10+00
8+00
6+00
4+00
2+00
0+00
FLOW
18" CULVERT WITH FLAP GATE
EROSION PROTECTION
625
630
SUNSET ROAD
LOS GAR APT
ROC
PLAN
SCALE OF FEET
100 0 100 200
ELEVATION IN FEET U.S.G.S. DATUM
620
615
610
605
600
595
0+00A
2+00A
4+00A
6+00A
8+75A
CONCRETE FLOOD WALL
END OF CONCRETE
TRANSVERSE LEVEE
TOP OF FLOOD PROTECTION
UNION ROAD
LEVEE EL. 614.0
TOP OF CONCRETE EL 612.9
EXISTING WATER SURFACE
DESIGN WATER SURFACE
BANK ELEVATION BEHIND WALL
18" CULVERT
EXISTING CREEK THALWEG
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400
DISTANCE IN FEET UPSTREAM OF UNION ROAD BRIDGE
PROFILE





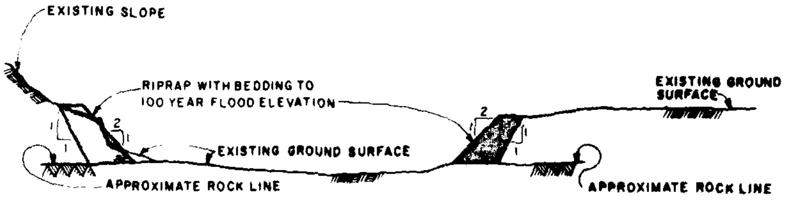
TYPICAL CROSS SECTION THROUGH
CHANNEL AT WALL

SCALE OF FEET
VERTICAL
HORIZONTAL



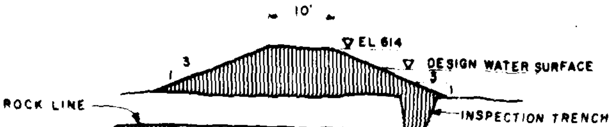
TYPICAL SECTION THROUGH
CONCRETE WALL

SCALE OF FEET



TYPICAL SECTION THROUGH CHANNEL
STATION 7+00 TO STATION 8+50

SCALE OF FEET
VERTICAL
HORIZONTAL



TYPICAL SECTION THROUGH
TRANSVERSE EARTH LEVEE

SCALE OF FEET

CAYUGA CREEK, CHEEKTOWAGA, NEW YORK
LOCAL FLOOD PROTECTION

SELECTED PLAN

SECTION 205
DETAILED PROJECT REPORT

U.S. ARMY ENGINEER DISTRICT BUFFALO
JUNE 1979

PLATE 4

CAYUGA CREEK

CHEEKTOWAGA, NEW YORK

APPENDIX A

HYDROLOGY AND HYDRAULIC DESIGN

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
APPENDIX A
HYDROLOGY AND HYDRAULIC DESIGN

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TABLE OF CONTENTS (CONT'D)

PLATES

APPENDIX A

HYDROLOGY AND HYDRAULIC DESIGN

HYDROLOGY

A1. CLIMATOLOGY

There are 12 climatological stations located in or adjacent to the Cayuga Creek Basin as shown on Plate A1. Of these 12, only eight are still in operation including the Weather Bureau First-Order station at the BuFfalo International Airport.

A2. The average annual precipitation for the 12 stations (through 1966) is 36.92 inches. Monthly averages vary from a minimum of 2.53 inches in February to a maximum of 3.33 inches in May.

A3. The average annual snowfall for the 12 stations (through 1966) is 82.3 inches. The highest average monthly snowfall is 22.4 inches in January at Arcade, NY.

A4. The average annual temperature for 10 of the stations (through 1966) is 46.9 degrees Fahrenheit. The maximum average monthly temperature is 69.2 degrees in July, while the minimum is 24.2 degrees in January.

A5. FLOOD PRODUCING FACTORS

According to records, flooding on Cayuga Creek has usually been caused by precipitation falling on frozen ground along with snowmelt during late winter and early spring. During these periods, the stage-discharge relationships, primarily in Lancaster, are only slightly affected by ice jams. The summer months are generally characterized by very low runoff; however, occasional heavy rainfall over the basin produces high runoff and flooding in various locations along the stream.

A6. FLOODS OF RECORD

According to records, major flooding took place along Cayuga Creek from storms which occurred in June 1937, March 1942, March 1955, March 1956, January 1959, March 1972, June 1972, January 1975, and August 1975. The 1937, 1955, 1959, 1972, and August 1975 events are discussed below.

a. One of the major storms occurred in June 1937 with the rainfall centered in the eastern suburbs of Buffalo in a 6-1/2-hour period. The maximum precipitation was recorded at the Buffalo

Airport station (3.00 inches), downtown Buffalo (2.06 inches), and at South Wales station (1.50 inches).

b. Considerable flooding occurred on 1 March 1955 from a thunderstorm which resulted in heavy rains falling on frozen ground for a period of six hours. Snowmelt did not contribute to the resulting flash floods of this storm.

c. On 6 March 1956, a storm center passed over western New York State producing precipitation of 1.7 inches over Cayuga Creek Basin and produced a peak discharge of 8,700 cfs at Lancaster.

d. On 20 January 1959, a major storm system developed over the central and south central States and moved northeastward bringing heavy rainfall to western New York on 21 January. Due to heavy snow cover (nine inches), precipitation was augmented by snowmelt, and runoff was increased by the frozen ground conditions. Flood conditions were further aggravated when the thick ice cover on the streams broke up causing some ice jams. The combination of all these conditions together, produced a peak discharge of 8,750 cfs, the highest recorded discharge at the Lancaster gage.

e. On 1 March 1972, a low-pressure system developed and moved into the western Great Lakes region. A warm front extended eastward from the low center through western New York near the Pennsylvania border. With temperatures in the 50's, and moderate rainfall, high runoff occurred.

f. On the 22nd of June 1972, the tropical storm "Agnes" center veered westerly and passed over the southern tier of New York State where it was absorbed by a deep extra-tropical low-pressure system. The heavy rains, together with the above-normal moisture conditions of the soil caused by moderate rainfall during the week of 14-20 June 1972, resulted in increased and accelerated runoff.

g. The most recent flooding occurred on 30 August 1975. When a weak low pressure wave, traveling west to east along a low-pressure front, was forced aloft resulting in heavy downpours over the watershed. Aproximately 2.51 inches of rain fell in a six-hour period, with 2.25 inches in the last two hours. The peak yearly discharge (cfs) was 8,150; 600 cfs less than the Janaury 1975 occurrence.

A7. RUNOFF AND STREAMFLOW DATA

The streamflow data for the hydrologic studies of this report were obtained from the records of the United States Geological Survey (USGS) gages on Cayuga, Buffalo, and Cazenovia Creeks at Lancaster, Gardenville, and Ebenezer, NY, respectively. Records of discharges are available from approximately 1939 to the present for all the gages except Cayuga Creek at Lancaster for the period 1969 to 1973 when the gage was discontinued. The locations of these gages are shown on Plate A1.

A8. DISCHARGE-FREQUENCY CURVES, GENERAL

The areas in Cheektowaga, NY, under study include reaches along Cayuga Creek near Union Road and Williamstown Brook, a tributary to Cayuga Creek just downstream from Union Road. These areas are shown on Plate A1-1. Discharge-frequency curves were obtained from regional frequency studies. A discussion of these studies and discharge-frequency determinations is presented below for each area.

A9. DISCHARGE-FREQUENCY CURVES, CAYUGA CREEK

Discharge-frequency curves for Cayuga Creek at the USGS gaging station in Lancaster, NY, and Union Road in Cheektowaga, NY, were determined in the following manner. Streamflow data from the gages described in paragraph A7 were used in a regional frequency analysis to determine relationships for mean annual discharge and standard deviation versus drainage area, shown on Plate A2. The skew for the gages concerned was developed from the computed station skews and the generalized skew from the Water Resources Council generalized skew map. The regional frequency analysis was made using the Water Resources Council "Guidelines for Determining Flood Flow Frequency" and the HEC computer program 723-X6-L7550 "Flood Flow Frequency Analysis" dated October 1976. A partial duration adjustment, developed at the Cayuga Creek gage, was applied to the expected probability curve at the study reach to develop the final curves.

A10. The discharge-frequency curves for the USGS gaging station on Cayuga Creek at Lancaster are shown on Plate A3. The computed frequency curve was developed with the mean and standard deviation from Plate A2 and a skew of -0.1. The expected probability curve was developed for a period of record of 35 years. The peak annual discharges were plotted using Weibull Plotting positions. The partial duration adjustment for this station was developed by plotting the 35 highest independent peaks in the systematic record and one historic discharge using the Weibull plotting positions. The 5 and 95 percent confidence limits for the computed curve are also shown.

A11. The discharge-frequency curves for the study reach are shown on Plate A4. The mean and standard deviation were taken from Plate A2. A skew of -0.1 was used. Based upon a recent regional frequency analysis for the Tonawanda Creek Flood Control Study, a more accurate estimate of the skew coefficient at the project site would be -0.13, which is not significantly different from -0.10. The use of -0.10 for a skew coefficient was considered reasonable. The expected probability curve was developed for a period of record of 35 years. A partial duration adjustment as described in paragraph A10 was applied to the expected probability curve to develop the final curve for the study reach. The 5 and 95 percent confidence limit curves for the computed curve are also included.

A12. DISCHARGE-FREQUENCY CURVE, WILLIAMSTOWN BROOK

Due to the lack of streamflow data for Williamstown Brook, the discharge-frequency curve, shown on Plate A5 was determined using a methodology developed by the USGS in cooperation with New York State and described in USGS Circular 454, "Floods in New York, Magnitude and Frequency," dated 1961. The methodology was developed from a regional frequency study of streamflow data from gaging stations throughout New York State.

A13. DISCHARGE-FREQUCY, MODIFICATION DUE TO CONSIDERED IMPROVEMENTS

When levees are considered as structural alternatives to mitigate flood damages, consideration must be given to possibly modifying peak discharges to reflect the elimination of natural storage. These considerations were made for this study, as presented below, the results of which indicated that modifications would not be required and that the discharge-frequency curve at Union Road, shown on Plate A4, would be used for both existing and improved conditions. Areas referred to in the following discussions are shown on Plate A1-1.

A14. Under existing conditions, for discharges between 6,000 and 9,000 cfs, flow in the right overbank area above Union Road, crosses Union Road and reenters the channel just downstream from the bridge. For discharges in excess of 9,000 cfs, flow over Union Road continues down William Street and reenters the channel near the intersection of William Street and Cayuga Creek Road in reach 2. The stage-discharge curves, discussed in paragraphs A15 and A16, for existing conditions for reaches 2 and 3, shown on Plates A6 and A7, reflect these conditions. In examining backwater computations, high-water mark data and flooded area maps, the conclusion was drawn that the right overbank area in reaches 2 and 3 is "effective" area. That is to say, William Street acts as a "channel" in the overbank area and "dead storage" areas are minimal. As such, it can be said that in eliminating this "effective" flow area, the effect on peak discharges can be considered negligible. Therefore, the discharge-frequency curve at Union Road, shown on Plate A4, was used for existing and improved conditions for this study.

A15. STAGE-DISCHARGE CURVES, EXISTING CONDITIONS

For use in determining the average annual damage for the damage reaches, stage-discharge curves for existing conditions were required. Stage-discharge curves for reaches 2, 3 and W-1, shown on

Plates A6, A7, and A8, respectively, were developed from backwater computations, starting from the mouth of Cayuga Creek, correlated with available high-water mark data. It was found that critical flow conditions exist through Union Road bridge for all flows under existing and improved conditions. Plate A14 shows this for the 100-year flood discharge. Backwater computations, for selected discharges, were performed using computer program 723-X6-L202A, HEC-2, "Water Surface Profiles," developed by the Hydrologic Engineering Center in Davis, CA. To determine the Manning's "n" value under existing conditions, the flood of August 1975 was selected since it was ice free, had relatively low overbank flow, and excellent reconstruction of this flood event was possible. Manning's "n" values for channel and overbank, in reach 2, were found to be 0.040 and 0.060, respectively. In reach 3, "n" values were found to be 0.035 for channel and 0.060 for shallow overbank flooding to 0.050 for higher depths of overbank flooding. In Williamstown Brook, "n" values were found to be 0.060 for both channel and overbank areas. Expansion and contraction coefficient of 0.4 and 0.2, respectively, were used in these computations.

A16. For existing conditions, as mentioned in paragraph A14, a portion of the flow for discharges in excess of 9,000 cfs crosses Union Road and flows down William Street. The stage-discharge curve for reach 2 reflects stages resulting from the overflow.

A17. STAGE-DISCHARGE CURVES, IMPROVED CONDITIONS

Modified rating curves, defining the stage-discharge relationship at the index points assuming proposed improvements were completed, were developed for each index point where the existing stage-discharge relationship would be affected by considered improvements. These modified curves were used to determine the reduction in flood damage that would be produced in the reach by the improvement. The rating curves for improved conditions in reaches 2 and 3 are shown as dashed lines on Plates A6 and A7, respectively, for comparison with the existing conditions rating curves. Plate A8 shows the existing conditions rating curve for reach W-1.

A18. The modified rating curves were developed in the same manner as was accomplished for the existing conditions curves. Backwater computations were made using the existing cross sectional characteristics of the channel and overbank areas as channel modifications are not required for the considered plan of improvement except for a short reach upstream of Union Road. In reach 3, channel "n" values varied depending on the improvements being considered. Where the proposed improvements considered a concrete retaining wall on the right bank and erosion protection material on the left bank, 0.027 was considered appropriate for a channel "n" value. Where erosion protection material was being considered for both banks, 0.030 was used as the "n" value. Overbank "n" values were considered to be the same as under existing conditions.

A19. STAGE-FREQUENCY CURVES, EXISTING AND IMPROVED CONDITIONS, CAYUGA CREEK

Stage-Frequency curves for existing and improved conditions in reaches 2 and 3, shown on Plates A9 and A10, respectively, were developed by use of discharge-frequency and stage-discharge curves.

A20. STAGE-FREQUENCY CURVES WILLIAMSTOWN BROOK

A discharge-frequency, stage-discharge relationship in the Williamstown Brook area, reach W-1, is not sufficient to define the stage-damage-frequency relationship. Stages at the index points are dependent upon the following conditions:

(a) Discharges in Williamstown Brook and low Cayuga Creek stage.

(b) Minimal discharge in Williamstown Brook and high stages on Cayuga Creek from a combination of flow over Union Road and backwater effect from Cayuga Creek under existing conditions, and backwater effect from Cayuga Creek alone after construction of the levee upstream of Union Road.

A21. Flood stages on Williamstown Brook for condition (a) are independent of the stages for condition (b). Therefore, the frequency of a given stage being equalled or exceeded would be determined by the additions of the percent chance of occurrence for both conditions. Stage-frequency curves in reach W-1 for each condition were developed separately and combined accordingly to reflect the following.

(1) Existing Conditions (Combined), Plate A11

(2) Existing conditions-Williamstown Brook, Improved Conditions-Cayuga Creek (Combined), Plate A12

The condition (a) stage-frequency curve for existing conditions was determined by use of the discharge-frequency and stage-discharge curves shown on Plates A5 and A8, respectively. For condition (b) the Cayuga Creek, reach 2, stage-frequency curves for existing and improved conditions shown on Plate A9 were considered applicable. Condition (a) and (b) curves are labeled as such on Plates A11 and A12.

A22. UNIT HYDROGRAPH

In order to compute the standard project flood a three-hour unit hydrograph was developed from actual stream flow and climatological data and then modified to account for the drainage area at the site of the proposed improvements. Two storms, one in June 1944 and the other in October 1944 were used in determining the three-hour unit hydrograph shown on Plate A13.

A23. STANDARD PROJECT FLOOD (SPF)

An SPF estimate at the site of the proposed improvements was deter-mined in accordance with EM 1110-2-1411 "Standard Project Flood Determi-nations", and Hydrometeorological Report No. 33. The SPF peak discharge of 69,000 cfs, approved by OCE 1 May 1962, was used in this study. The SPF hydrograph is shown on Plae A15.

A24. Consideration was given to providing SPF protection in the study area. SPF stages for reaches 2, 3 and W-1 were obtained from the "Flood Plain Information Report", Cheektowaga, NY, dated May 1967. The stages thus determined were 610 for reaches 2 and W-1 and 614 for reach 3. Appendix B contains a discussion of flood damages associated with the SPF.

HYDRAULIC DESIGN

A25. DESIGN DISCHARGES

The design discharge for the considered plan of improvement was selected to provide the highest degree of protection based on the following considerations:

a. Provision of an adequate degree of protection for the type and degree of development in the flooded area;

b. Maximum capacity available through the Union Road Bridge and structures without extensive alteration or replacement;

c. Preserving the natural environment;

d. Maximization of benefits from considered improvements;

e. Consistency with good flood plain management practices, particularly those associated with the National Flood Insurance Program.

A26. A design discharge of 14,700 cfs was adopted for the considered plan of improvement. It has an average recurrence interval of 100 years on a discharge-frequency basis. More appropriately, it is referred to as a one-percent chance flood peak discharge. This means that there is a one percent chance that the design discharge of 14,700 cfs will be exceeded in any given year. Strong consideration was given to the Standard Project Flood discharge of 69,000 cfs but it was not found to be either incrementally economically justified or economically justified as a considered plan. Economic studies indicated that providing protection for a 100-year discharge would prevent 94 percent of the existing average annual damages in the study area. Appendix B contains a discussion of flood damages and benefits.

A27. CHANNEL DESIGN

Channel dimensions and grades were established by backwater computations. Backwater computations were made using the method discussed in paragraph A15. Water surface profiles for both existing and improved conditions were determined by the step solution of Manning's formula beginning at a section where the water surface elevation was known, or computed, and computing the water surface elevation of the next adjacent cross section. This step solution was carried on through the entire reach of the project in the same manner as described above until the entire water surface profile was established for several discharges for both existing and improved conditions. The Manning's "n" values used in the backwater computations are presented in paragraphs A15 and A18. Water surface profiles were computed for several discharges in order to develop a stage-discharge curve for both existing and improved conditions for each index point. Stage-discharge curves for both existing and improved conditions for reaches 2 and 3 on Cayuga Creek and reach W-1 on Williamstown Brook are shown on Plates A6, A7 and A8, respectively. Stage-frequency curves for both existing and improved conditions for the three reaches are shown on Plates A9 through A12.

A28. BANK PROTECTION

In the selection of the improved channels, an attempt was made to design for a mean velocity of six feet per second or less with steady uniform flow. It was assumed that bank protection would be required at those locations where improved average channel velocities of less than six feet per second cannot be attained. Where required, bank erosion protection will be provided. In places where ledge rock is at or near the design bottom grade, a toe similar to that shown on Plate 37 of EM 1110-2-1601 will be designed. Where required at a compacted earth embankment section, it would extend to the top of the embankment. From Station 8+50 to Station 14+00, the stream velocity for the 100-year event is low enough to warrant grass-lined channel slopes on a maximum lV:2H slope.

A29. LEVEE AND/OR FLOODWALL DESIGN

Protection for the design discharge will require the construction of levees and/or floodwalls. Where proposed along the channel the concrete tee wall would provide two feet of freeboard above the design water surface profile. The levees would be seeded on both slopes except where bank erosion protection is required. At these sections, seeding will be required on the top and bank slope only. The levee structures would range from eight feet in height above ground, including freeboard allowances, to no differential where the transverse levee ties into high ground. The transverse levee would have a 10-foot top width and side slopes of one vertical on three horizontal. Where erosion protection is required on a levee slope, the protection would extend to the top of the levee to prevent erosion of the freeboard section at discharges greater than design.

A30. A transverse levee will be required at the upstream end of the athletic field to prevent high flows from bypassing the proposed improvements. This levee will be constructed at a distance of about 800 feet upstream of Union Road and have a concrete wall between quarry ponds. This levee would be designed with three feet of freeboard above the energy grade line for the design discharge under project plan conditions. However, the concrete portion of the transverse levee would be designed with two feet of freeboard above the energy grade line. Freeboard requirements were selected based upon consideration of guidance contained in Civil Works Engineering Bulletin 54-14 and Buffalo District experience with other levee projects.

A31. INTERIOR DRAINAGE

The seleted plan would provide a levee-floodwall system upstream of Union Road along Cayuga Creek that would encompass an interior land area of 12.4 acres. Of this total, 8.3 acres drains to the ponding area near the concrete wall between quarry ponds and 4.1 acres drains to the ponding area at the concrete wall along Cayuga Creek near Union Road (see Plate 4 of the Main Report). Each ponding area has sufficient capacity to contain the volume of water that would result from a 100-year flood event. The storage capacity of each ponding area, as delineated on Plate 4, is 0.94 acre-feet and 1.82 acre-feet for the ponding area near Union Road and the ponding area near the quarry, respectively. A 100-year return interval event was chosen to be consistent with the degree of protection provided by the Selected Plan. Due to the size of the Cayuga Creek Watershed, any coincidental rainfall in the interior area would result from a storm that would affect the entire watershed and the effect on the 12.4-acre interior land area can be accommodated by the ponding areas and outlet works. The volume of ponding needed to contain a 60-minute duration, 100-year rainfall event of 2.33 inches (from NWS HYDRO-35) assuming no losses and blocked outlets (very conservative assumptions) would be 0.71 acre-feet and 1.61 acre-feet for the above mentioned ponding areas, respectively. This shows that more than sufficient ponding capacity is available. The outlet works for each ponding area, an 18.1-inch culvert with flap gate and a 24-inch culvert with flap gate and gate valve, are based upon operation and maintenance criteria compatible to the size of the ponding area and total area to be drained. A ditch with one vertical to three horizontal sideslope will be provided along the landside of the barrier levee and wall to convey the flow that does not drain directly to the ponding area near Union Road. A drainage swale will be constructed to convey outflow from the ponding area near the quarry ponds to Cayuga Creek. This swale will be shown on the Plans and Specifications.

A32. SELECTED PLAN

Several different plans of improvements were considered for the flood control measures on Cayuga Creek. These plans were designed to provide 50-year, 100-year, and 200-year protections for reaches two and three and partial protection for reach W-1. The hydraulic design details of the selected plan described in the Selected Plan Section of the main report, are presented in the following paragraphs.

A33. The selected plan of improvement for flood control on Cayuga Creek consists of improving the capacity of the existing creek and constructing levees and walls to keep the flood waters away from the areas where excessive damage occurs. Channel improvements start from the Union Road bridge at Station 0+00 and continues upstream to Station 14+00. Plate 4 of the main report shows the alignment of the levee and walls used along and perpendicular to the right bank. The longitudinal levee is approximately 700 feet long having varied heights above ground ranging from two feet at Station 0+00 to seven feet at Station 7+00. The transverse levee is approximately 850 feet long and ranges from seven feet above ground at the creek to no differential where it ties into high ground.

A34. The design discharge for the selected plan is 14,700 cfs. The existing channel upstream of the Union Road bridge is enlarged in the reach between Stations 0+00 and 8+50 and the creek is cleared of debris in the remaining reach up to Station 14+00. Existing creek has rock bottom that is undisturbed in vicinity of the proposed channel improvements. The improved channel between Stations 0+00 and 7+00 will have approximately a 115-foot bottom width at the rock level, vertical concrete wall on the right bank, and an erosion protected left bank having one vertical to two horizontal side slope. A trapezoidal transition channel having one vertical to two horizontal side slopes is designed for the reach between 7+00 and 8+50. The existing and improved 100-year water surface and velocity profiles are shown on Plate A14. Note that the design discharge is at critical depth at Union Road. The existing SPF water surface profile is also shown on Plate A14. The improved SPF profile is the same as the existing profile.

A35. The transverse levee and concrete floodwall, that would be constructed between quarry ponds, are designed to provide for 100-year protection and would overtop for floods greater than the design flood. A fuse plug or relief section would be incorporated in the transverse levee north of the concrete wall to avoid a sudden failure of the entire levee system that could create catastrophic conditions. Flood stages of elevation 613 or greater would first overtop the floodwall between quarry ponds that would act as an initial overflow relief section. Flood stages of elevation 613.5 or greater would overtop the relief section of the levee north of the wall. The levee would then gradually erode under sustained flow and allow additional filling of the area on the land side of the transverse levee. This would partially equalize hydrostatic pressure and prevent a catastrophic failure of the entire transverse levee. The area on the land side of the levee would be partially filled with water before the fuse plug section of levee north of the wall overtopped and eroded.

A36. FALSE SENSE OF SECURITY

A design discharge of 14,700 cfs was adopted for the considered plan of improvement. It has an average recurrence interval of 100 years and is also referred to as a one-percent chance flood peak discharge. This means that there is a one-percent chance that the design discharge will be exceeded in any given year. There is also about a 65 percent chance that the design discharge will be exceeded during the 100-year life of the project.

A37. Based on the above, it should be strongly emphasized that the proposed improvements will not protect the damage areas from all floods. Floods in excess of the design flood can occur. Residents in the protected area should not therefore lead themselves into a false sense of security that the project will protect them totally.

overtop the relief section of the levee north of the wall. The levee would then gradually erode under sustained flow and allow additional filling of the area on the land side of the transverse levee. This would partially equalize hydrostatic pressure and prevent a catastrophic failure of the entire transverse levee. The area on the land side of the levee would be partially filled with water before the fuse plug section of levee north of the wall overtopped and eroded.

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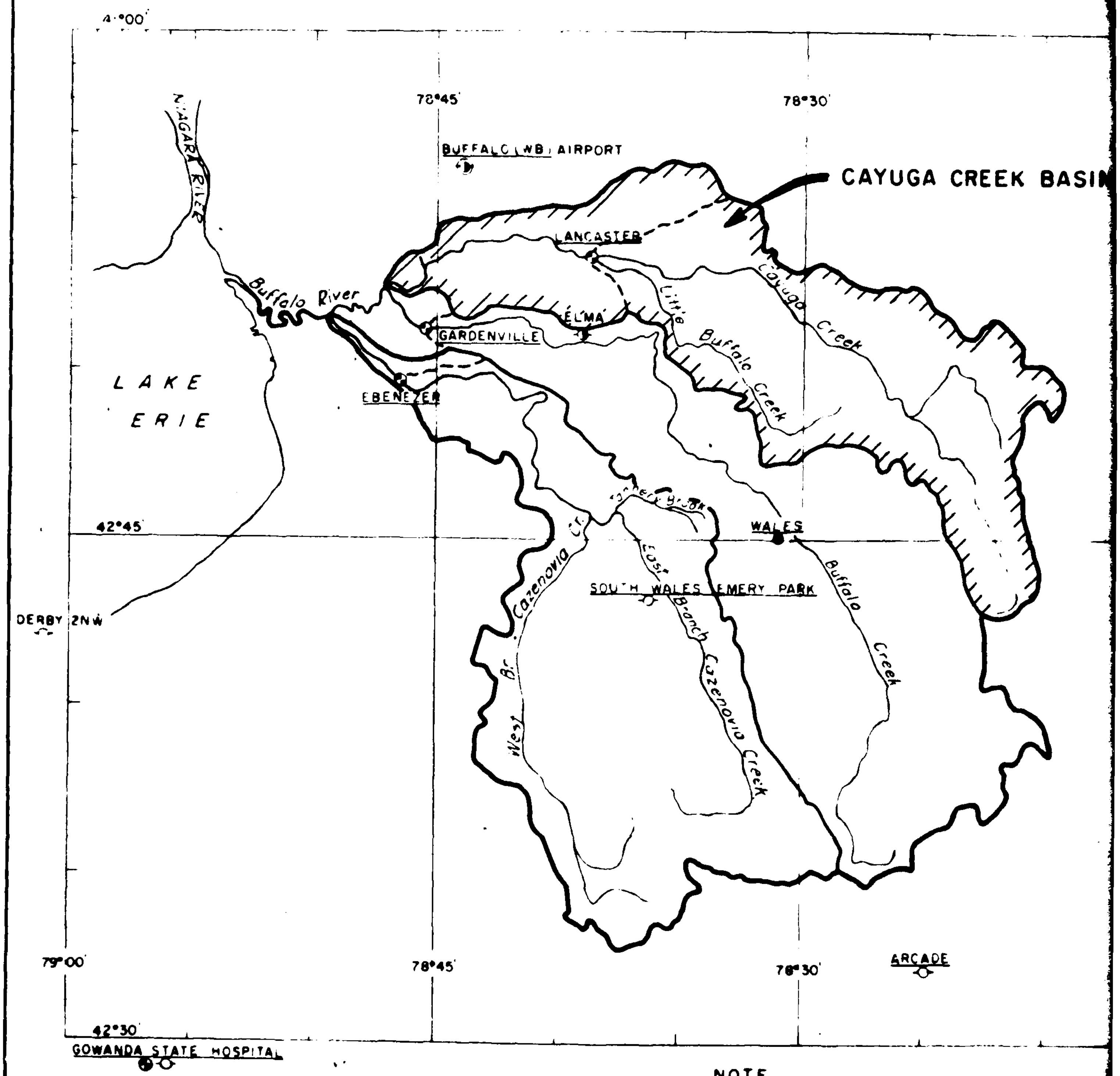
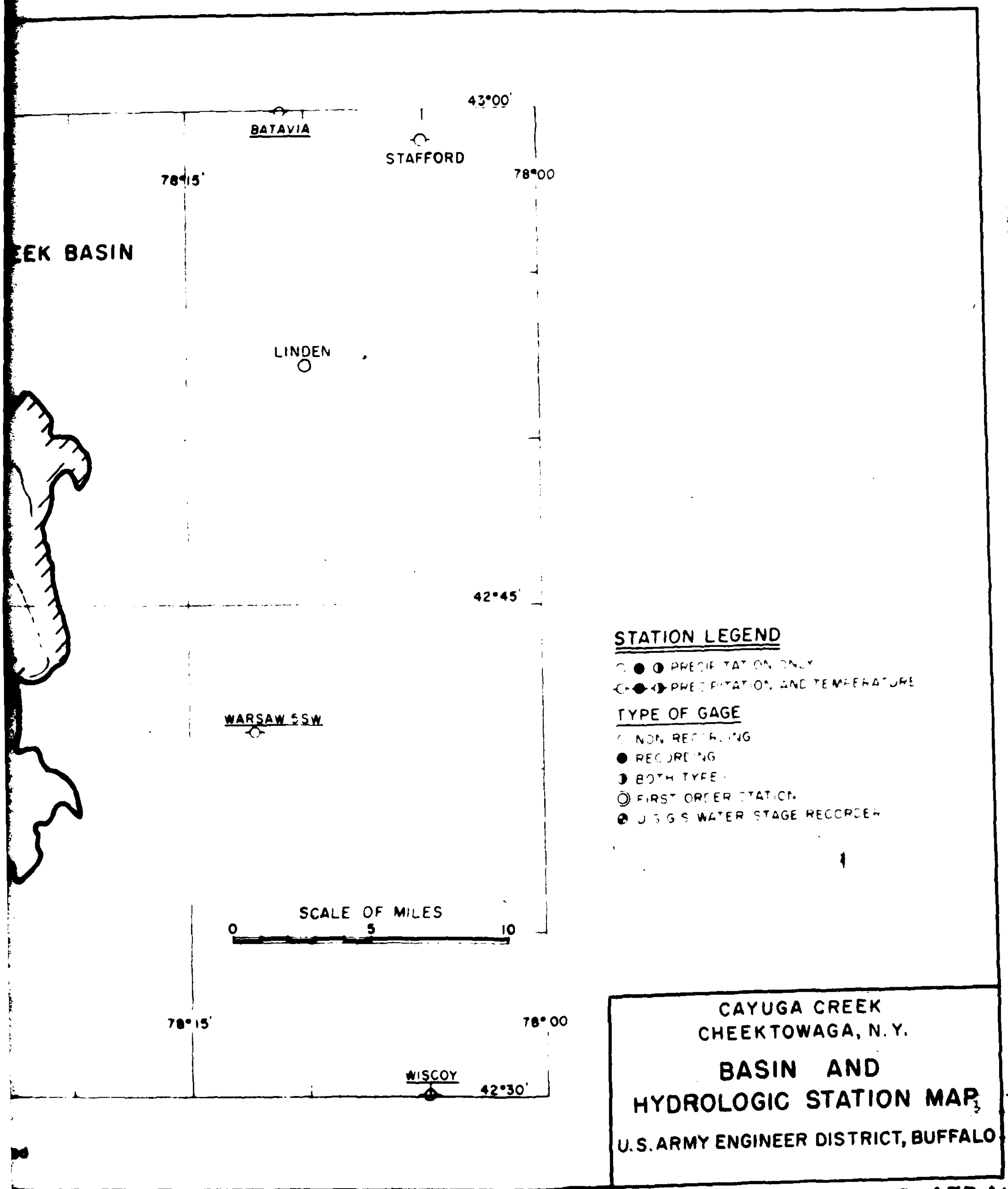


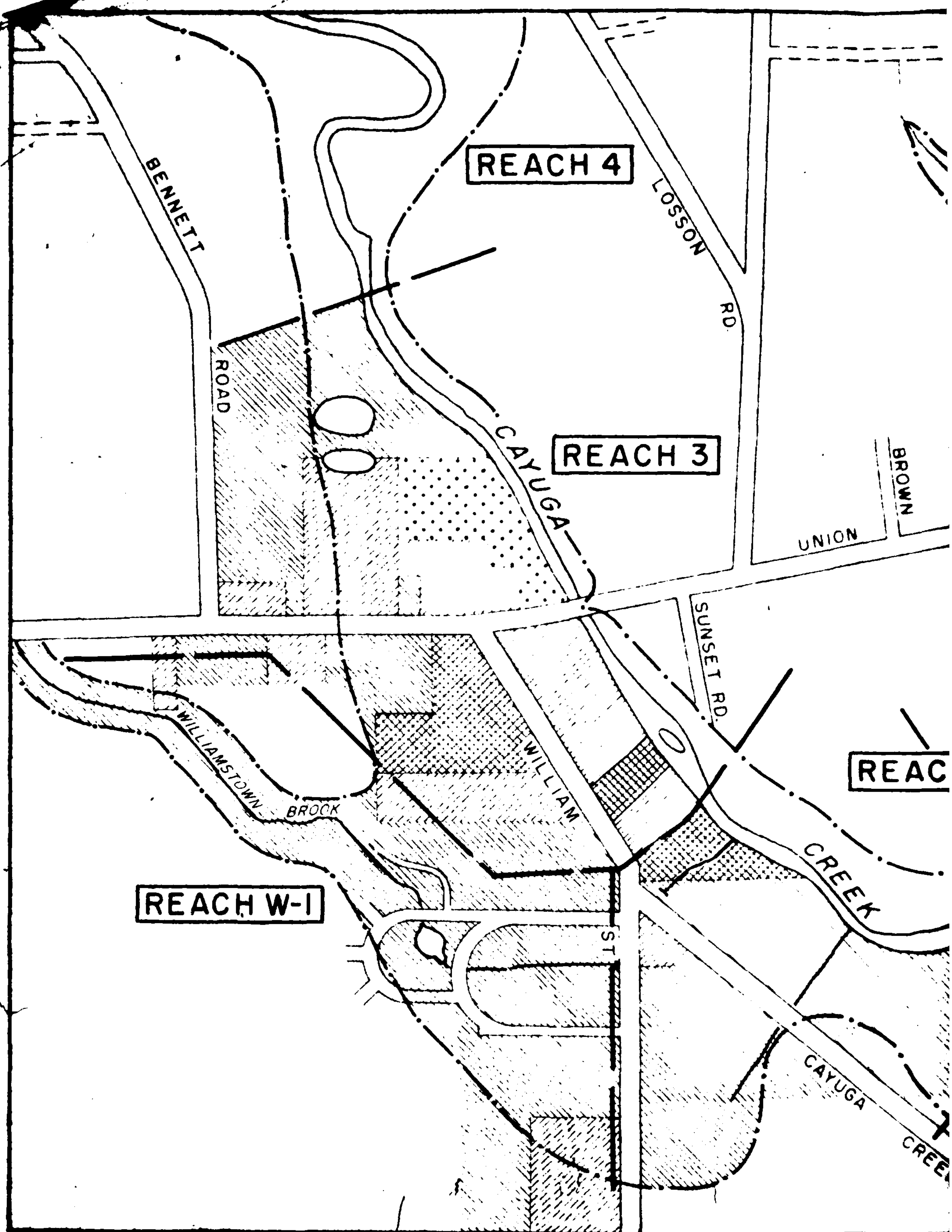
NOTE

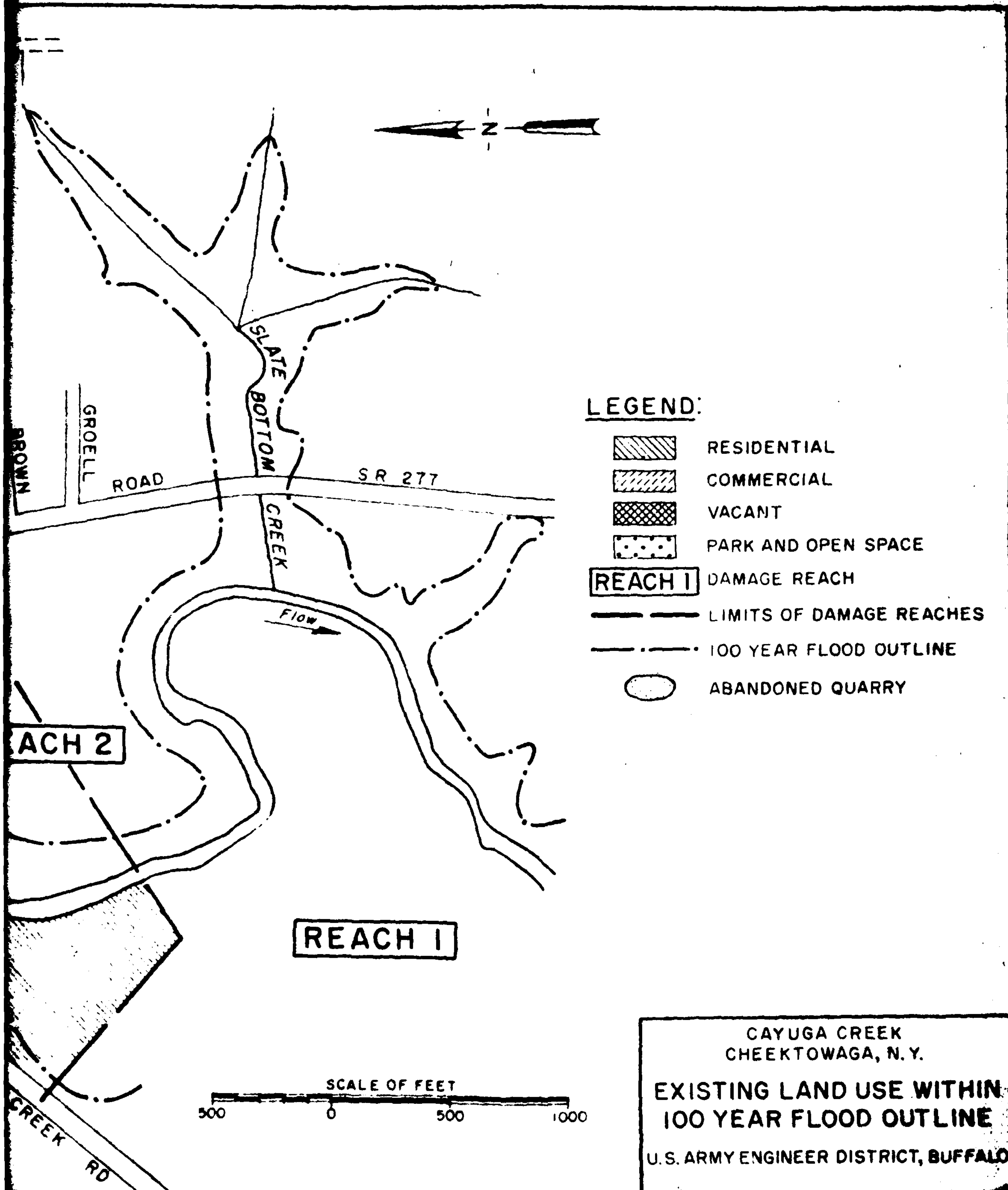
Existing stations are underlined



43°00'
BATAVIA
STAFFORD
78°15'
78°00
EEK BASIN
LINDEN
42°45'
WARSAW SSW
STATION LEGEND
TYPE OF GAGE
SCALE OF MILES
0 5 10
78°15'
78°00
WISCOY
42°30'
CAYUGA CREEK
CHEEKTOWAGA, N.Y.
BASIN AND
HYDROLOGIC STATION MAP
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A1

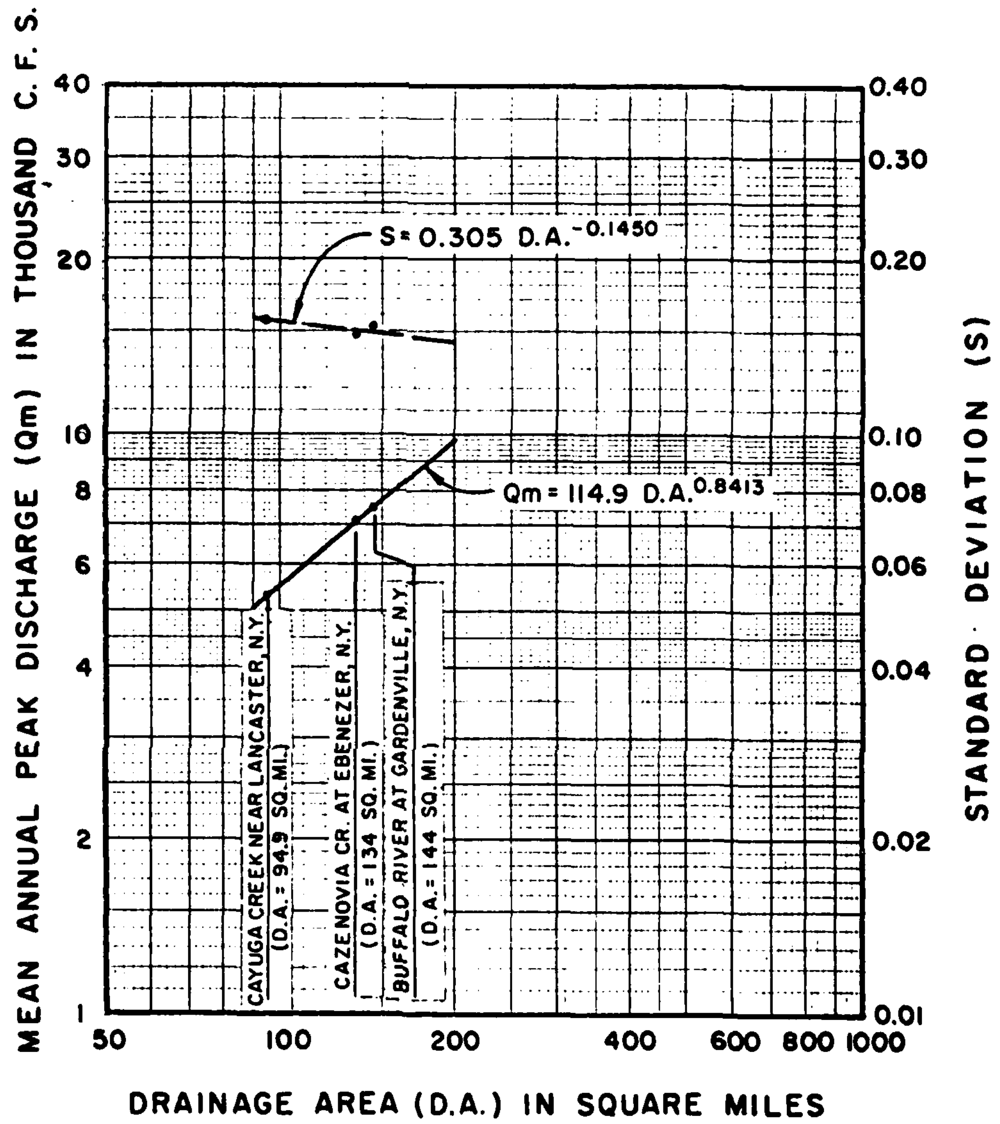

REACH 4
BENNETT
ROAD
LOSSON
RD.
REACH 3
CAYUGA
BROWN
UNION
SUNSET RD.
REAC
WILLIAMSTOWN
BROCK
WILLIAM
ST
CREEK
REACH W-1
CAYUGA
CREE



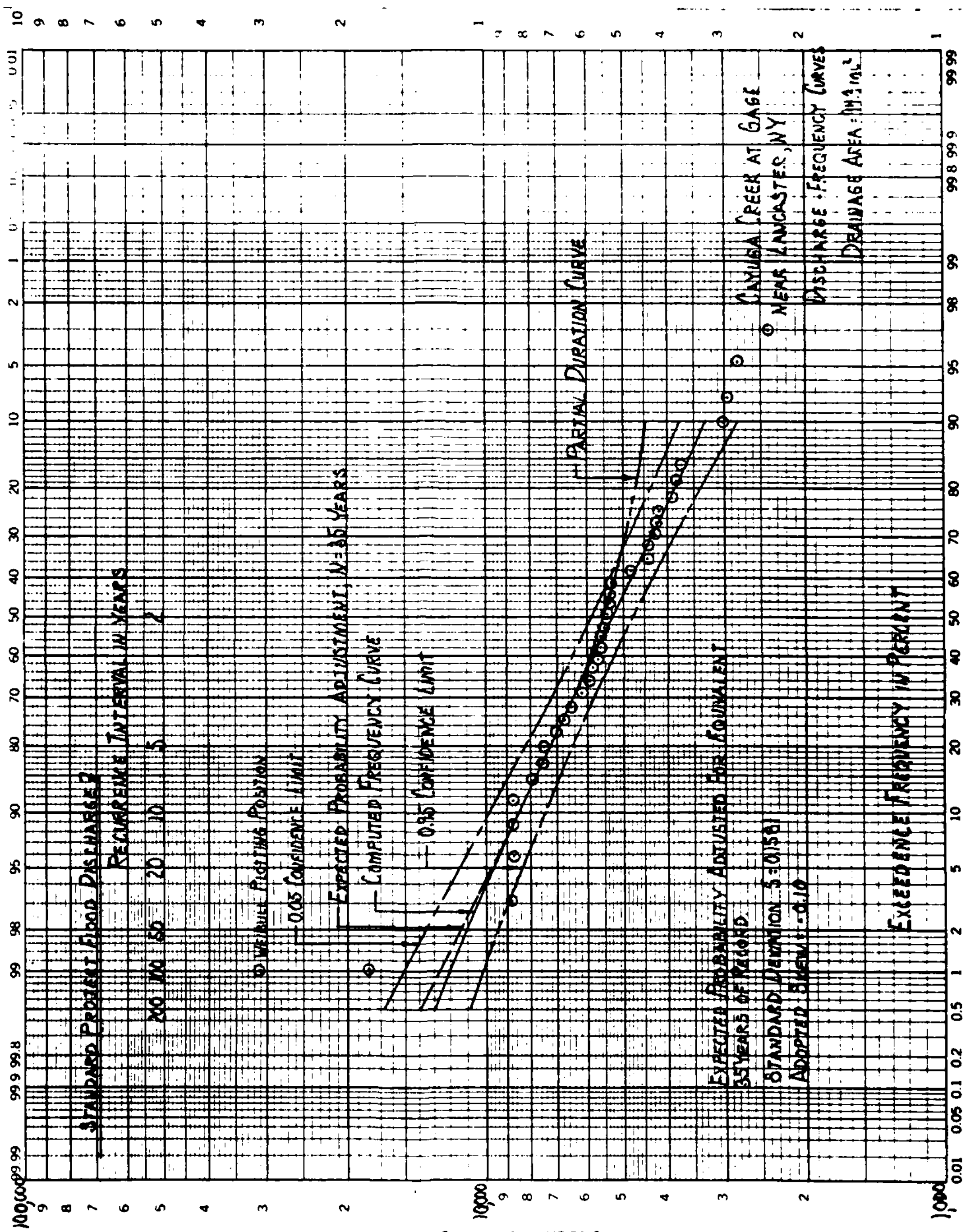
CAYUGA CREEK
CHEEKTOWAGA, N.Y.

EXISTING LAND USE WITHIN 100 YEAR FLOOD OUTLINE

U.S. ARMY ENGINEER DISTRICT, BUFFALO



CAYUGA CREEK
CHEEKTOWAGA, N. Y.
REGIONAL FREQUENCY RELATIONSHIP
Qm AND S VS. DRAINAGE AREA
U.S. ARMY ENGINEER DISTRICT, BUFFALO



STANDARD PROJECT FLOOD DISCHARGE
RECURRENCE INTERVAL IN YEARS
200 100 50 20 10 5 2
⊙ WEIBULL PLOTTING POSITION
0.05 CONFIDENCE LIMIT
EXPECTED PROBABILITY ADJUSTMENT, N=35 YEARS
COMPUTED FREQUENCY CURVE
0.95 CONFIDENCE LIMIT
PARTIAL DURATION CURVE
CAYUGA CREEK AT GAGE
NEAR LANCASTER, NY
DISCHARGE-FREQUENCY CURVES
DRAINAGE AREA:
EXPECTED PROBABILITY ADJUSTED FOR EQUIVALENT
35 YEARS OF RECORD
STANDARD DEVIATION S=0.1581
ADOPTED SKEW=-0.10
EXCEEDENCE FREQUENCY IN PERCENT
DISCHARGE IN CFS

PLATE A3

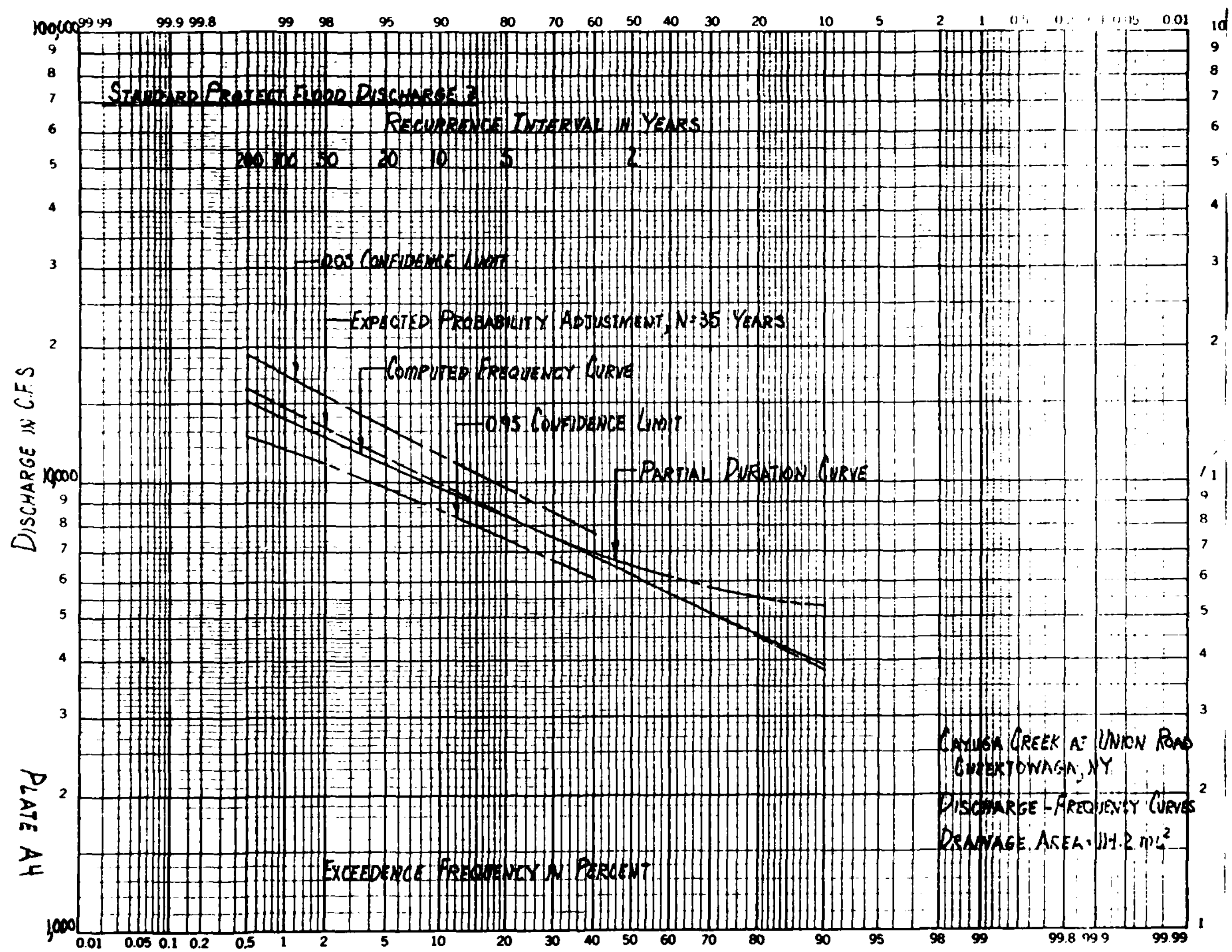

STANDARD PROJECT FLOOD DISCHARGE 2
RECURRENCE INTERVAL IN YEARS
200 100 50 20 10 5 2
.005 CONFIDENCE LIMIT
EXPECTED PROBABILITY ADJUSTMENT, N=35 YEARS
COMPUTED FREQUENCY CURVE
.095 CONFIDENCE LIMIT
PARTIAL DURATION CURVE
DISCHARGE IN C.F.S
EXCEEDENCE FREQUENCY IN PERCENT
CAYUGA CREEK AT UNION ROAD
CHEEKTOWAGA, NY
DISCHARGE - FREQUENCY CURVES
DRAINAGE AREA = 114.2 mi.²

PLATE A4

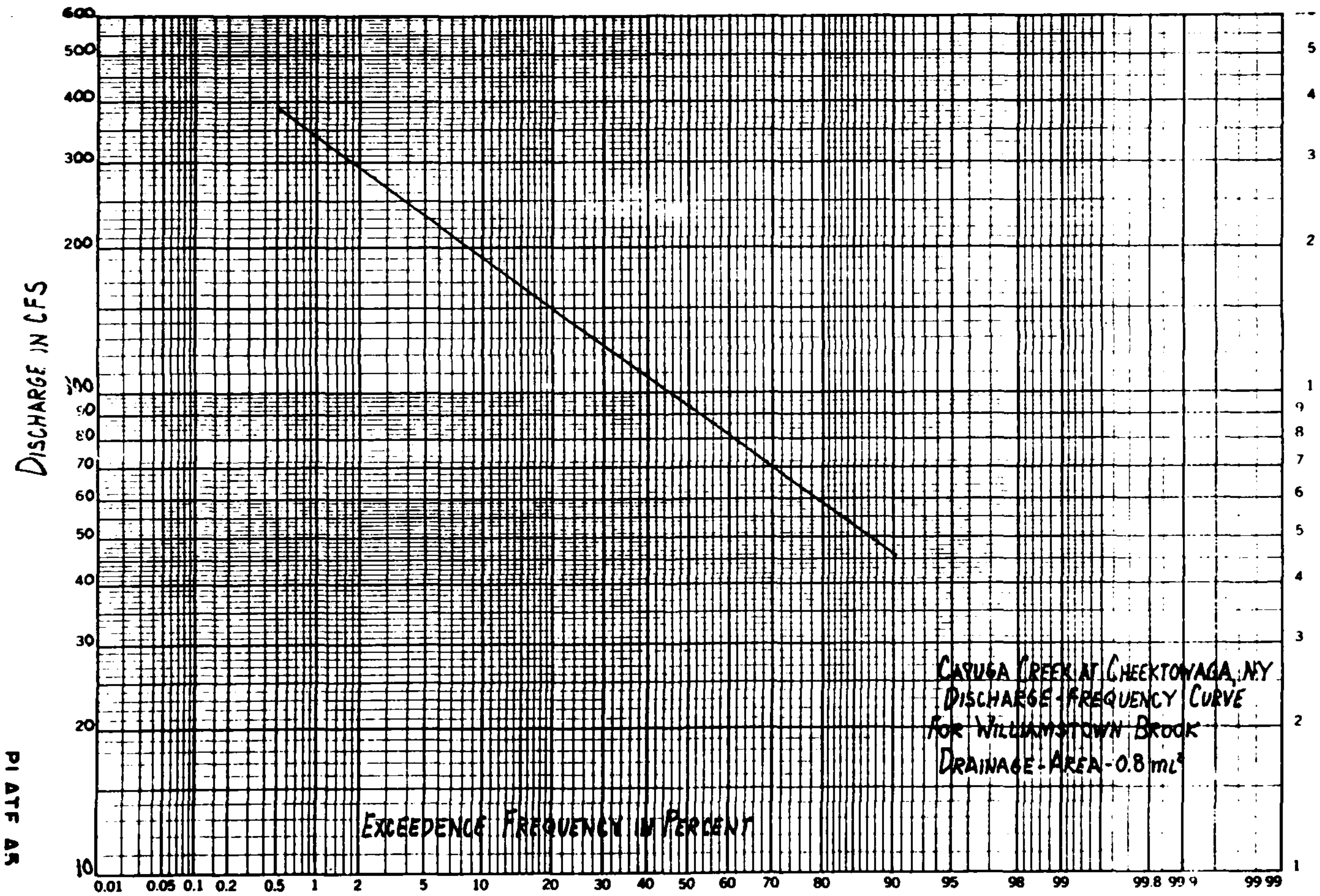
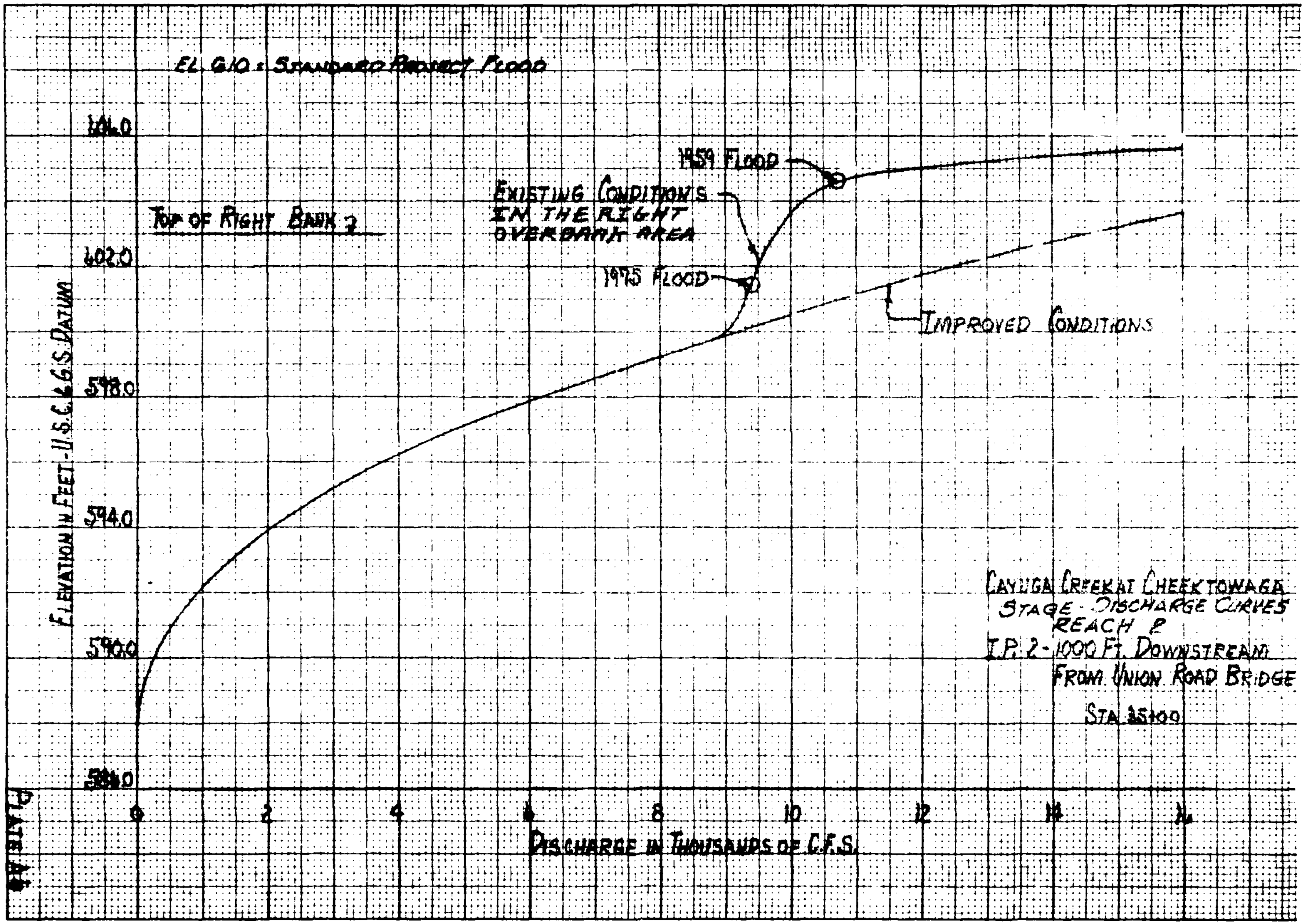
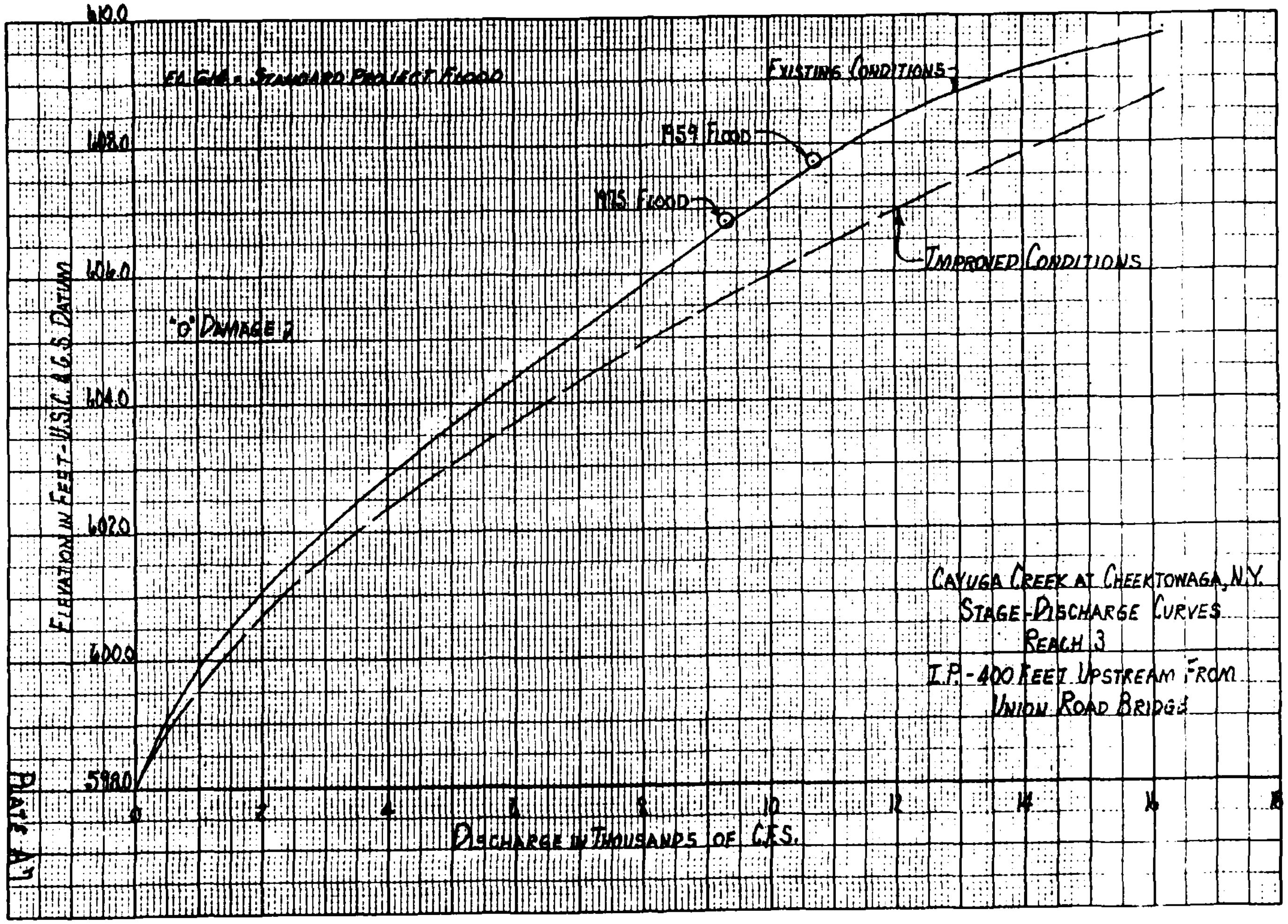

Cayuga Creek at Cheektowaga, N.Y
Discharge-Frequency Curve
For Williamstown Brook
Drainage-Area-0.8 mi²
Discharge in CFS
Exceedence Frequency in Percent
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99

PLATE A5

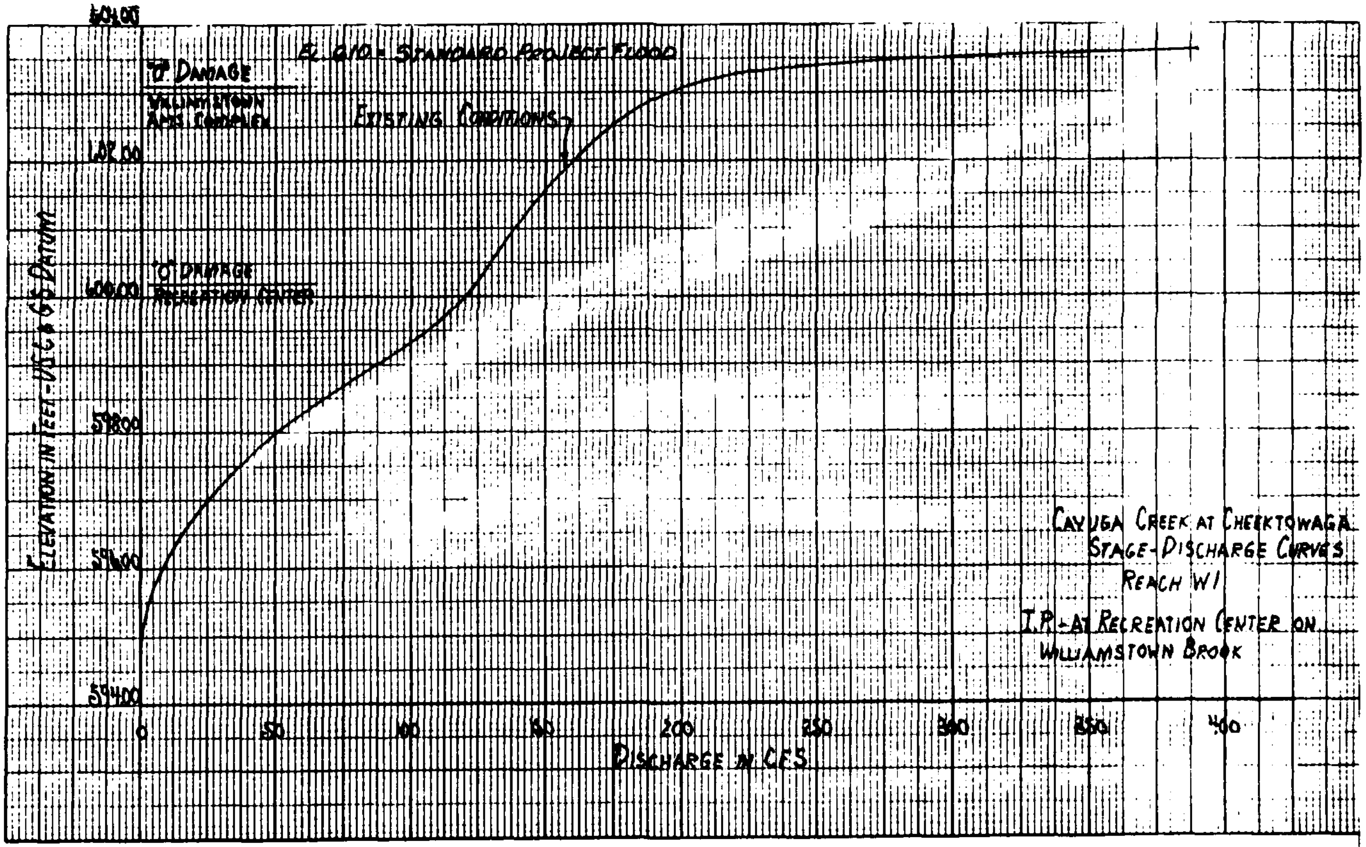


EL. 610 ± STANDARD PROJECT FLOOD
TOP OF RIGHT BANK ?
1959 FLOOD
EXISTING CONDITIONS IN THE RIGHT OVERBANK AREA
1975 FLOOD
IMPROVED CONDITIONS
606.0
602.0
598.0
594.0
590.0
586.0
ELEVATION IN FEET - U.S.C.&G.S. DATUM
0
2
4
6
8
10
12
14
16
DISCHARGE IN THOUSANDS OF C.F.S.
CAYUGA CREEK AT CHEEKTOWAGA
STAGE - DISCHARGE CURVES
REACH 2
I.P. 2 - 1000 FT. DOWNSTREAM
FROM UNION ROAD BRIDGE
STA 35+00
PLATE A8



610.0
608.0
606.0
604.0
602.0
600.0
598.0
0
2
4
6
8
10
12
14
16
18
STANDARD PROJECT FLOOD
EXISTING CONDITIONS
1959 FLOOD
1975 FLOOD
IMPROVED CONDITIONS
"0" DAMAGE
ELEVATION IN FEET - U.S.C. & G.S. DATUM
DISCHARGE IN THOUSANDS OF C.F.S.
CAYUGA CREEK AT CHEEKTOWAGA, N.Y.
STAGE-DISCHARGE CURVES
REACH 3
I.P. - 400 FEET UPSTREAM FROM
UNION ROAD BRIDGE

PLATE A7



EL. 610 = STANDARD PROJECT FLOOD
1' DAMAGE
WILLIAMSTOWN APTS COMPLEX
EXISTING CONDITIONS
1' DAMAGE
RECREATION CENTER
604.00
602.00
600.00
598.00
596.00
594.00
ELEVATION IN FEET - USC & GS DATUM
0
50
100
150
200
250
300
350
400
DISCHARGE IN C.F.S.
CAYUGA CREEK AT CHEEKTOWAGA
STAGE-DISCHARGE CURVES
REACH W1
I.P. - AT RECREATION CENTER ON
WILLIAMSTOWN BROOK

PLATE A8

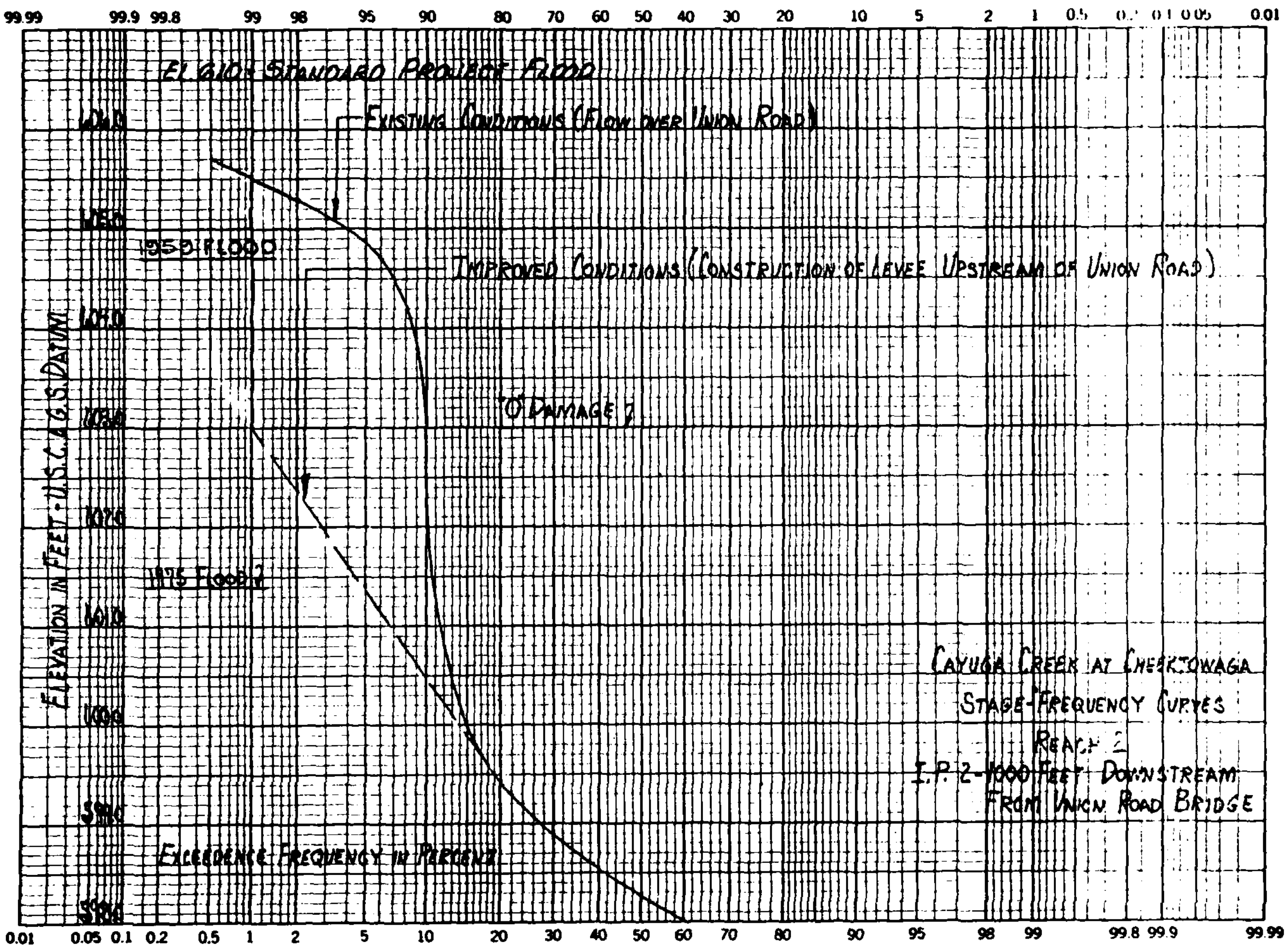
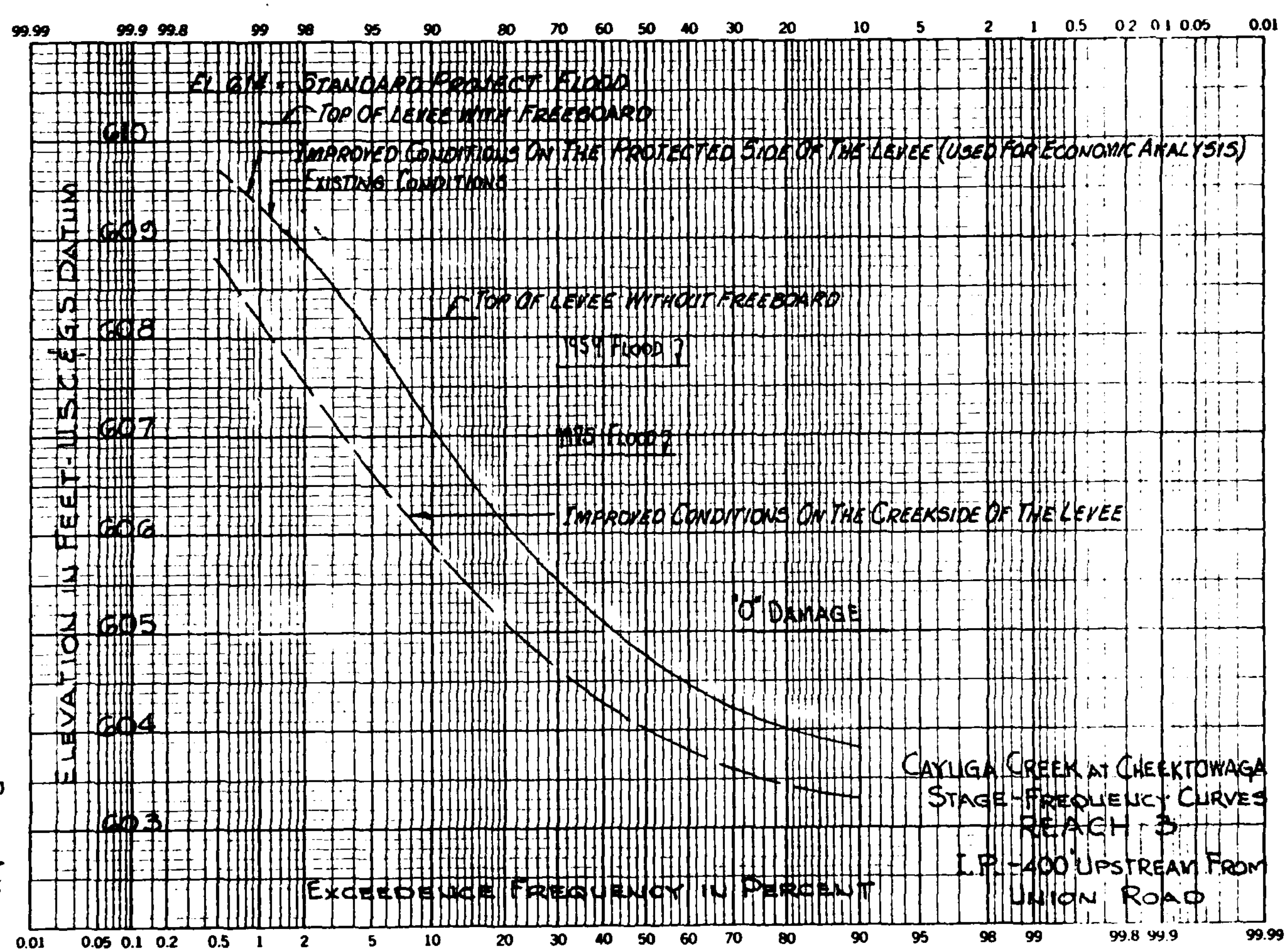
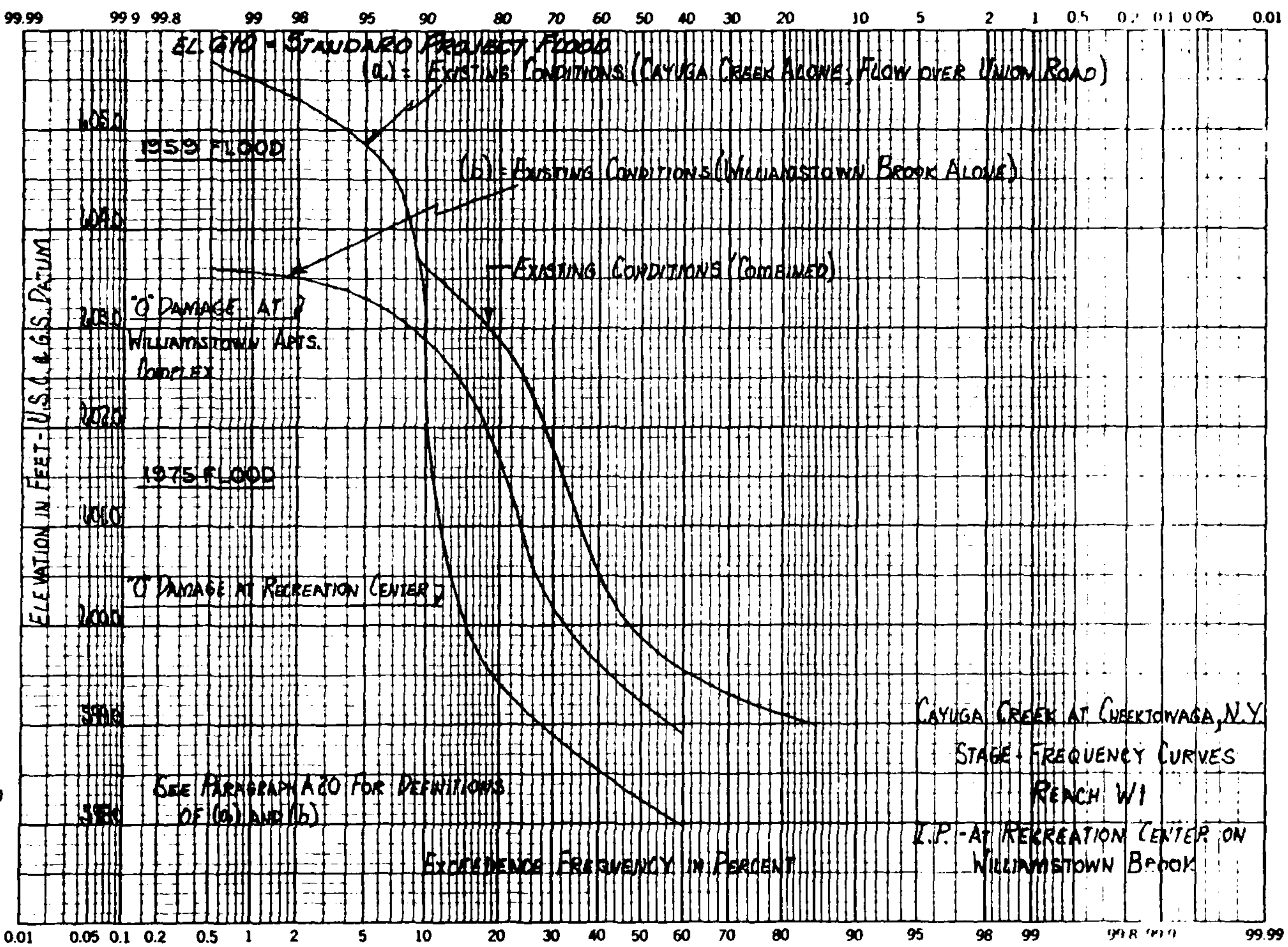

Standard Project Flood
Existing Conditions (Flow over Union Road)
1950 Flood
Improved Conditions (Construction of Levee Upstream of Union Road)
"0" Damage ?
1975 Flood ?
Elevation in Feet - U.S.C.&G.S. Datum
Exceedence Frequency in Percent
Cayuga Creek at Cheektowaga
Stage-Frequency Curves
Reach 2
I.P. 2-1000 Feet Downstream
From Union Road Bridge

PLATE A9



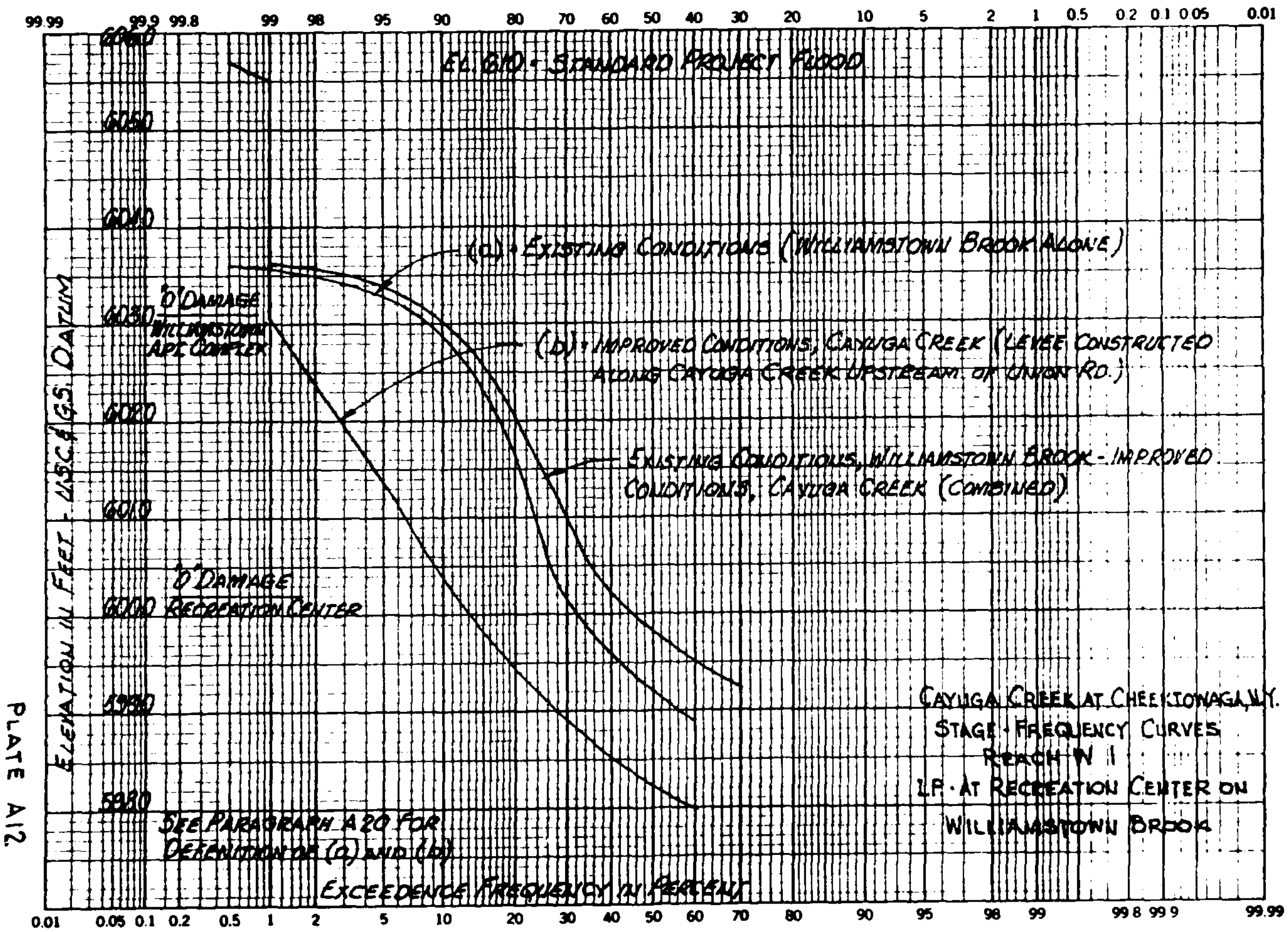
El 614 - Standard Project Flood
Top Of Levee With Freeboard
Improved Conditions On The Protected Side Of The Levee (Used For Economic Analysis)
Existing Conditions
Top Of Levee Without Freeboard
1959 Flood ?
1935 Flood ?
Improved Conditions On The Creekside Of The Levee
"0" Damage
610
609
608
607
606
605
604
603
Elevation In Feet - U.S.C.E.G.S. Datum
Exceedence Frequency In Percent
Cayuga Creek at Cheektowaga
Stage-Frequency Curves
Reach - 3
I.P. - 400' Upstream From Union Road

Plate A 10



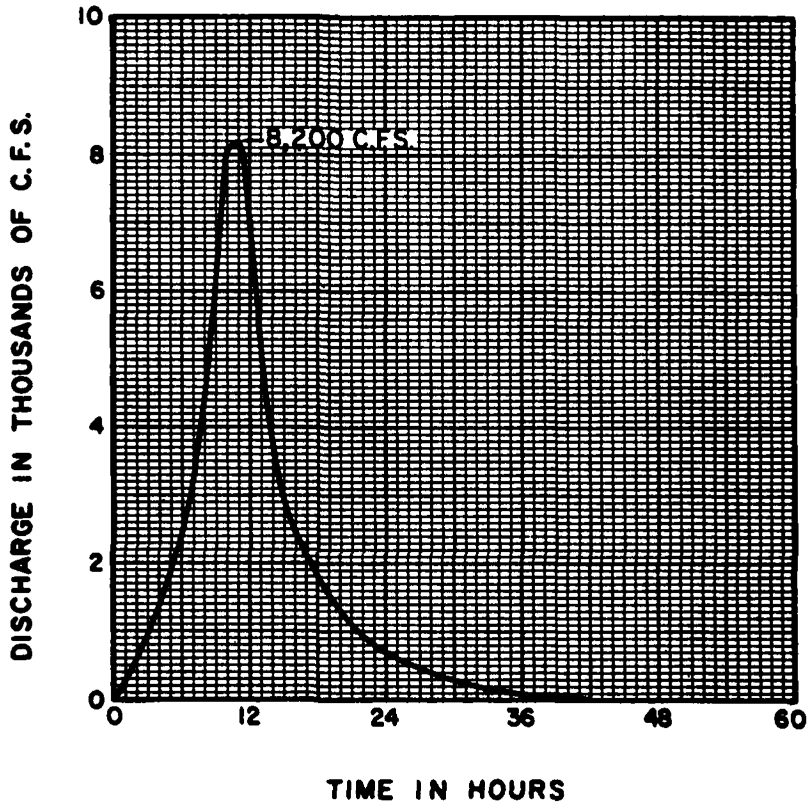
= STANDARD PROJECT FLOOD
(a) = EXISTING CONDITIONS (CAYUGA CREEK ALONE, FLOW OVER UNION ROAD)
1959 FLOOD
(b) = EXISTING CONDITIONS (WILLIAMSTOWN BROOK ALONE)
EXISTING CONDITIONS (COMBINED)
"0" DAMAGE AT WILLIAMSTOWN APTS. COMPLEX
1975 FLOOD
"0" DAMAGE AT RECREATION CENTER
ELEVATION IN FEET - U.S.C.&G.S. DATUM
SEE PARAGRAPH A20 FOR DEFINITIONS OF (a) AND (b)
EXCEEDENCE FREQUENCY IN PERCENT
CAYUGA CREEK AT CHEEKTOWAGA, N.Y.
STAGE - FREQUENCY CURVES
REACH W1
I.P. - AT RECREATION CENTER ON WILLIAMSTOWN BROOK

PLATE A11



STANDARD PROJECT FLOOD
(a) - EXISTING CONDITIONS (WILLIAMSTOWN BROOK ALONE)
(b) - IMPROVED CONDITIONS, CAYUGA CREEK (LEVEE CONSTRUCTED ALONG CAYUGA CREEK UPSTREAM OF UNION RD.)
EXISTING CONDITIONS, WILLIAMSTOWN BROOK - IMPROVED CONDITIONS, CAYUGA CREEK (COMBINED)
"0" DAMAGE WILLIAMSTOWN APT. COMPLEX
"0" DAMAGE RECREATION CENTER
6050
6040
6030
6020
6010
6000
5990
5980
ELEVATION IN FEET - USC & GS DATUM
SEE PARAGRAPH A20 FOR DEFINITION OF (a) AND (b)
EXCEEDENCE FREQUENCY IN PERCENT
CAYUGA CREEK AT CHEEKTOWAGA, N.Y.
STAGE - FREQUENCY CURVES
REACH W 1
I.P. - AT RECREATION CENTER ON WILLIAMSTOWN BROOK
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99

PLATE A12



NOTES:

D.A. = 114.2 SQ. MI.

C_t = 1.25

640Cp = 643

CAYUGA CREEK
CHEEKTOWAGA, N.Y.

3 HOUR UNIT HYDROGRAPH FOR CAYUGA CREEK IN CHEEKTOWAGA

U.S. ARMY ENGINEER DISTRICT, BUFFALO

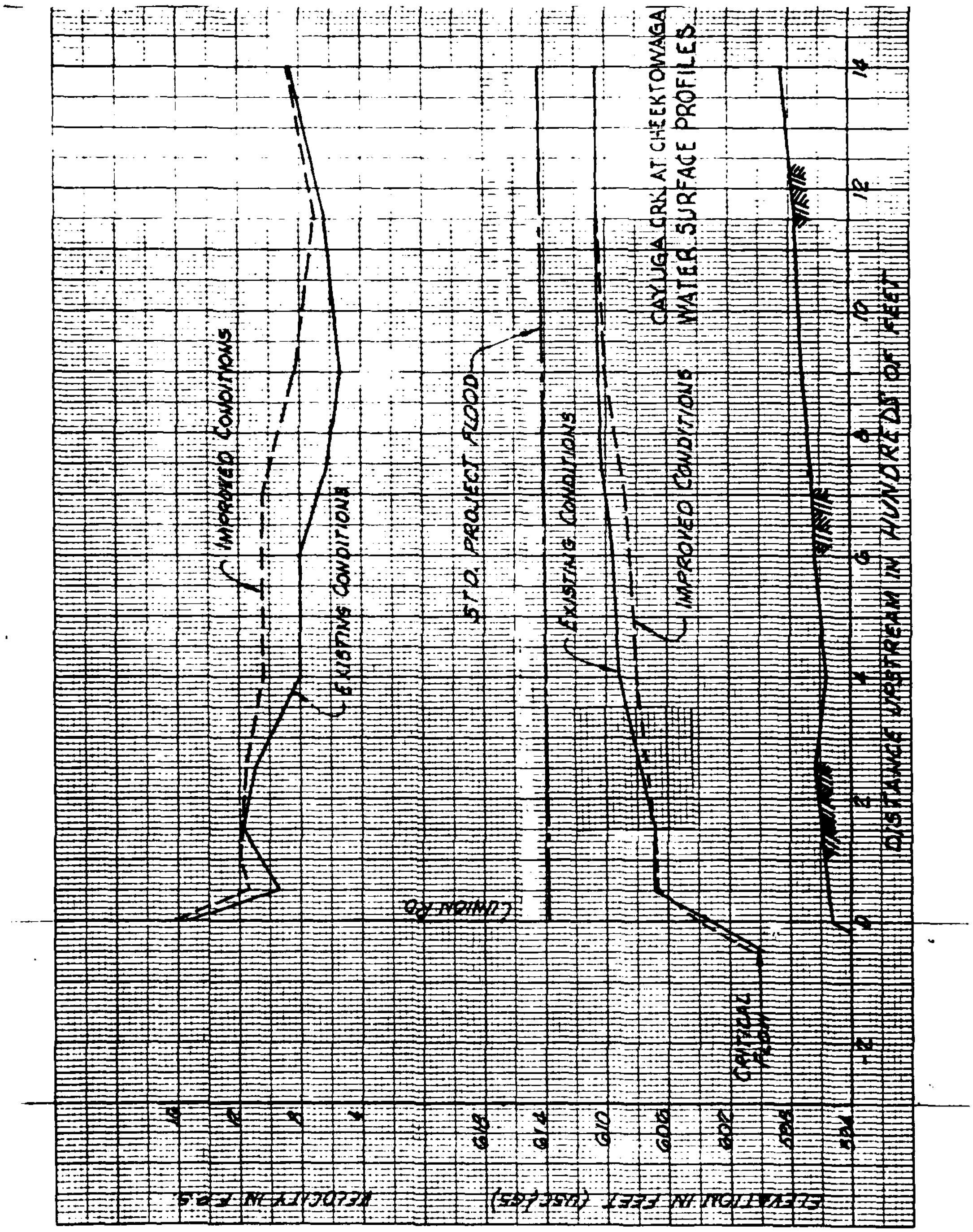
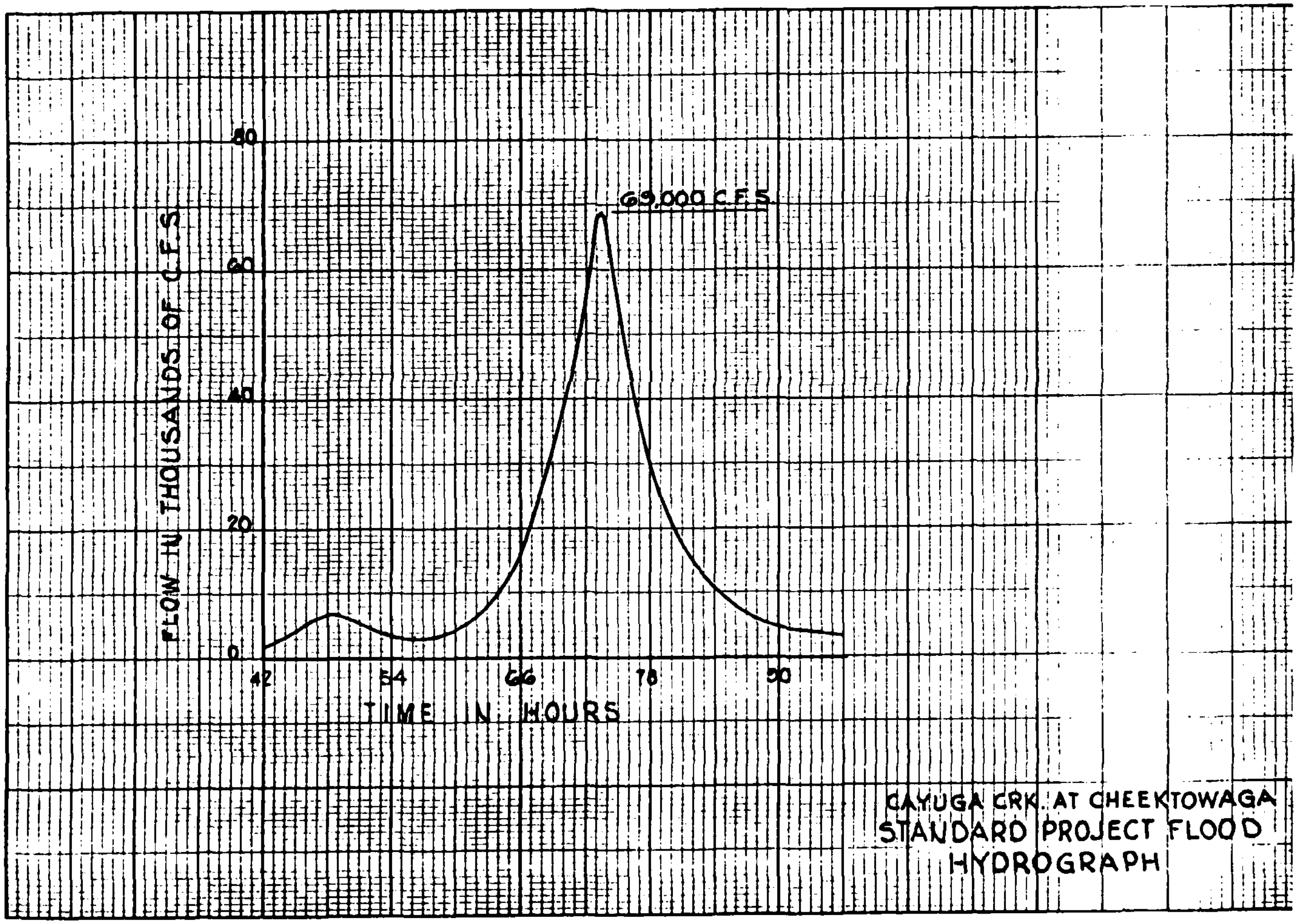

CAYUGA CRK. AT CHEEKTOWAGA
WATER SURFACE PROFILES
IMPROVED CONDITIONS
EXISTING CONDITIONS
STD. PROJECT FLOOD
EXISTING CONDITIONS
IMPROVED CONDITIONS
UNION RD.
CRITICAL FLOW
DISTANCE UPSTREAM IN HUNDREDS OF FEET
VELOCITY IN F.P.S.
ELEVATION IN FEET (USC&GS)

PLATE A14



CAYUGA CRK. AT CHEEKTOWAGA
STANDARD PROJECT FLOOD
HYDROGRAPH

PLATE A15

CAYUGA CREEK

CHEEKTOWAGA, NEW YORK

APPENDIX B

RESOURCES AND ECONOMY

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
APPENDIX B
RESOURCES AND ECONOMY

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PLATES

RESOURCES AND ECONOMY

THE AFFECTED AREA - PAST AND PRESENT

The affected area for the proposed flood control project on Cayuga Creek consists of the flood plain plus all other areas likely to serve as alternative sites for any activity which may use the flood plain if it were protected. The affected area for each major activity category was determined by examining the present and potential land use within the project limits. Table 1 illustrates the existing land use within the town of Cheektowaga, while Plate B1 shows the development within the project area. Major categories of land use within the floodprone areas include residential, commercial, and parks and open space. Plate B2 shows the location of the project area in the town of Cheektowaga, NY.

Residential

The project area lies wholly within the town of Cheektowaga, NY, and a comparison of the quality, type and nature of the housing stock in the project limits and the town of Cheektowaga was used as an input for the delineation of the affected area for residential activity.

Table 2 provides housing data based upon 1970 census information for the town of Cheektowaga and other selected areas in Erie County. In 1968 residential units occupied over 35 percent of the developed land in Cheektowaga. The housing stock in 1970 consisted of 33,608 occupied dwelling units. Cheektowaga displays housing characteristics similar to other first ring suburban communities in Erie County, while being dissimilar to the housing stock in the central city of Buffalo. The housing stock in Cheektowaga has a high percentage of owner occupied housing (73.6%) relative to the city of Buffalo (44.0%) and a predominance of single-family housing units (65.9% vs 27.1% in Buffalo). The age distribution of housing units in Cheektowaga is weighted toward newer units when compared to either Buffalo or Erie County.

Cheektowaga housing units also display similarities with the other suburbs of Buffalo in terms of financial characteristics. Table 3 provides information on the value of owner occupied and rented units in Cheektowaga and other selected areas for 1970. Cheektowaga's owner occupied one family structures are predominently of moderate value having a very low incidence of either high or low value units. The median value in 1970 was $18,800 with 72.0 percent of the units falling in the $15,000 to $24,999 value range. The median values of owner occupied one-family units in the census tracts partly within the project limits were in the $21,000 to $22,000 range. These units compare favorably with single-famiy dwellings in other first ring suburbs of Buffalo and are substantially higher than the median value of $12,800 in the city of Buffalo.

Table 1 - Existing Land Use in the Town of Cheektowaga

Land Use	Areas in Acres	Percent of Developed Land	Percent of Total Land
Residential	3,913	35.2	21.0
Single-Family	(3,378)	(30.4)	(18.1)
Two-Family	(322)	(2.89)	(1.7)
Three and Over	(213)	(1.91)	(1.2)
Commercial	612	5.5	3.3
Retail	(N/A)	(N/A)	(N/A)
Service	(N/A)	(N/A)	(N/A)
Automotive	(N/A)	(N/A)	(N/A)
Offices	(N/A)	(N/A)	(N/A)
Industrial	811	7.28	4.4
Public and Semi-public	721	6.46	3.9
Recreation and Open-space	1,140 2/	10.2	6.1
Trans., Communications & Utilities	3,943 3/	35.36	20.0
Total Developed	11,140	100.0	58.6
Agricultural and Vacant	7,569		40.5
TOTAL	18,710		100.0

1/ Includes 123 acres of streams and drainage ditches.
2/ Initially classified as municipal in Table 1, Comprehensive Plan Study, 1968.
3/ Includes streets and railroads.

SOURCES: Comprehensive Plan Study, Town of Cheektowaga, Tryon-Schwartz and Associates, 1968.

N/A - Exact acreage estimate not available for individual components.

Table 2 - Housing Data, 1970

Area	Total Units[1/]	Occupied: Number	Occupied: Percent Owner Occupied	Seasonally Vacant	Percent of All Year Round Units: Year Structure Built: 1960-1970	1940-1959	Before 1939	Percent of Structures With: One Housing Unit	Two Housing Units	3-9 Housing Units	10 or more Housing Units	Percent in Mobile Homes
New York State	6,299,582	5,913,861	47.3	144,637	16.8	27.7	55.6	40.3	14.6	12.7	31.1	1.3
Buffalo SMSA	435,588	418,255	62.9	2,379	13.4	31.0	55.6	54.6	27.1	13.1	4.4	0.8
Erie County	360,893	346,374	61.5	1,698	13.6	30.5	55.8	52.0	29.4	13.4	4.7	0.5
City of Buffalo	166,142	157,951	44.0	25	1.8	12.5	85.7	27.1	46.3	18.6	7.9	*
Town of Cheektowaga	34,170	33,608	73.6	0	32.3	49.2	18.5	65.9	21.8	10.2	1.0	1.1
Town of Lancaster	9,261	9,033	74.4	3	21.0	35.3	43.7	68.8	20.0	9.9	0.8	0.4

1/ Includes houses, apartments or other groups of rooms, or a single room that is occupied or intended for occupancy as separate living quarters by a household.

* Less than 0.05 percent.

SOURCE: Buffalo Area Business Fact Book, Part 2, 1974 Edition, New York State Department of Commerce

Table 3 - Owner Occupied and Rental Units, 1970

	Owner Occupied One-Family Structures						Rented - Housing Units				
	Median Value 1970	Percentage Reporting Specified Value of					Median Gross Monthly Rent	Percentage Reporting Specified Gross Rent			
		Under $15,000	$15,000 to 24,900	$25,000 to 34,999	$35,000 to 49,999	$50,000 or more		Under $99	$100 to 149	$150 to 199	$ 200 or more
	$						$				
New York State	22,500	21.9	37.6	22.8	11.6	6.1	111	42.1	32.2	15.4	10.2
Buffalo SMSA	17,900	32.0	49.2	12.7	4.5	1.6	99	52.7	35.7	8.9	2.8
Erie County	18,500	28.8	50.7	13.7	5.0	1.8	99	52.6	35.5	9.0	2.9
City of Buffalo	12,800	67.1	27.5	3.1	1.3	1.1	93	61.4	33.9	3.7	1.1
Town of Amherst	26,100	6.4	40.4	29.8	11.0	6.5	167	10.5	29.0	35.1	25.4
Town of Clarence	26,600	6.6	38.3	31.9	18.0	5.2	119	35.4	36.7	19.3	8.6
Town of Cheektowaga	18,800	16.9	72.0	9.7	1.1	0.3	117	33.4	40.4	23.1	3.2
Town of Lancaster	18,800	22.5	59.7	14.0	3.2	0.7	103	48.8	39.5	9.3	2.3
Town of Grand Island	21,500	17.0	43.9	22.7	12.7	3.5	163	9.1	29.2	50.6	11.2
Town of Orchard Park	28,600	3.3	36.0	29.5	19.7	11.4	129	33.2	35.0	17.6	14.2
Town of Elma	23,400	5.4	39.3	34.1	17.3	3.8	114	39.7	44.6	11.4	4.4
Town of Aurora	22,300	12.2	50.9	22.6	10.1	3.5	105	45.7	37.2	12.4	4.7
Town of Tonawanda	19,400	12.9	71.3	12.7	26	0.5	123	23.8	53.2	20.2	2.9

SOURCE: Buffalo Area Business Fact Book, Part 2, 1974 Edition, New York State Department of Commerce.

Table 4 provides real estate transaction statistics for 1974 and 1975 in the Buffalo and Erie County area. The price of housing in Cheektowaga in 1975 was lower than the more affluent suburbs such as Orchard Park, Amherst, Clarence and Elma-Aurora but is in line with many of Buffalo's order and more developed suburban communities.

The affected area for residential activity is defined as Erie County, exclusive of the city of Buffalo. The city of Buffalo was excluded due to the lack of similarities in housing stock in the town of Cheektowaga and the city of Buffalo.

Commercial

Retail Sales in the Buffalo SMSA (Erie and Niagara County) were $2.8 billion in 1972, 35.7 percent greater than in 1967. Erie County generated 84 percent of the areas retail activity. The rapidly growing suburban areas have gained increasing importance in retail sales relative to the city of Buffalo in recent years. The trend toward large "Mall" arrangements with numerous stores and the need for a large land area for auxiliary and indirect selling needs have accentuated this movement. Retail sales in that portion of Erie County outside of Buffalo has risen from 50 percent in 1963 to slightly under 64 percent in 1972.

Factors influential in commercial site location include: ease of entry and exit, relative traffic volumes, the nature and extent of the transportation network, and the purchasing power and distribution of families within the trade area. The existence of extensive suburban traffic systems have reduced the necessity of commercial units located within the historical business center of the central city in order to be near an area's population concentration. Higher family incomes in the suburbs, Table 5; has made locating in these areas more desirable. The affected area for commercial activities is defined as all vacant land within the flood plain and other first ring suburban land zoned for commercial development.

Industrial

There was no industrial activity observed in the project area. The Industrial Directory published by NYS Gas and Electric Corporation indicates a substantial number of industrial firms producing a variety of manufactured products within the town limits. Cheektowaga's industrial work force is much greater than any of the surrounding communities. Table 6 shows the number of firms and combined work force of various areas.

Table 4 - Average Residential Real Estate Transaction Statistics for Selected Areas

Area	1974 $	1975 $	Percent Change
Orchard Park	44,278	51,053	15.3
Amherst	39,983	45,091	12.8
Clarence	39,685	42,991	8.3
Cheektowaga	28,433	30,479	7.2
Lancaster	27,611	31,902	15.5
Elma-Aurora	36,181	42,309	16.9
Alden-Marilla	31,558	38,619	22.4
Boston-Colden	34,960	36,845	5.4
Grand Island	32,259	36,186	12.2
West Seneca	31,070	33,583	8.1
Hamburg	29,262	32,783	12.0
Town of Tonawanda	29,586	32,067	8.4
Buffalo Area	28,504	31,180	9.4

Data compiled by Greater Buffalo Board of Realtors.

SOURCE: Buffalo Courier Express, 2/29/76

Table 5 - Income of Families, 1969

	Median Family Income	Number of Families	Percentage of Families with Income				
			Less Than $9,999	$10,000 to 14,000	$15,000 to 24,999	$25,000 to 49,999	$50,000 or more
	$						
New York State	10,617	4,584,616	46.0	27.5	19.7	5.6	1.2
Buffalo SMSA	10,430	336,163	46.8	31.9	17.2	3.4	0.8
Erie County	10,482	276,621	46.4	31.8	17.4	3.6	0.9
City of Buffalo	8,804	112,508	59.0	26.8	11.6	2.0	0.5
Town of Amherst	13,919	23,854	26.0	30.5	29.5	11.5	2.4
Town of Cheektowaga	10,851	29,799	41.9	39.3	15.8	1.8	1.3
Town of Lancaster	10,570	7,729	44.9	35.8	16.1	2.7	0.3
Town of Clarence	13,755	4,531	26.3	31.1	30.0	11.3	1.3
Town of Grand Island	12,548	3,473	29.8	38.2	25.2	3.8	3.0
Town of Orchard Park	12,419	4,952	32.0	34.7	24.2	7.0	2.0
Town of Elma	12,404	2,511	31.3	40.3	23.3	3.9	1.3
Town of Aurora	12,192	3,619	34.2	32.4	24.1	7.5	1.9

SOURCE: Buffalo Area Business Fact Book, Part 2, 1974 Edition, New York State Department of Commerce

Table 6 - Industrial Work Force

Area	Number of Firms	Combined Work Force
Cheektowaga	51	4,115
Depew	13	2,224
Lancaster	20	1,362
Alden	3	200

The wide diversity of manufacturing activity present within Cheektowaga's industrial base implies that their markets and customers extend throughout the Buffalo SMSA. Although the flood plain does not currently include any industrial firms, the secondary or induced effects of future industrial growth in other portions of the SMSA or the town may impact on the rate of development of other activity types (residential, commercial, etc.) in vacant areas of the flood plain. Therefore, the affected area for future industrial activity is defined as the Buffalo SMSA.

Institutional, Public & Other

A field survey of the project area located only one municipal building: a sewerage pump station located in Reach 2 on the south side of Cayuga Creek Road. All of the existing institutional development, with the exception of the libraries and schools which also serve the surrounding suburbs, orient their services to residents of Cheektowaga. Therefore any expansion of existing municipal facilities or construction of new public buildings would occur within the town. The affected area for institutional activity is delineated by Cheektowaga's corporate limits.

Recreatial and Open Space

Total recreational land owned by the town and devoted to park use in 1970 was 100 acres; additional recreational acreage available on school property increases the total land available to residents by 150 acres to a total of 250 acres. In light of future population growth, there will be an increasing deficit of parks and open space areas over time. The projected rate of population growth, scarcity of vacant land, and rising land costs indicates that flood plain land, where access is provided or maintained by the town, would be ideal sites to develop as riverine recreation and green belt areas.

Creekside Park is the only park and playground located within the project limits. It is privately-owned and operated and includes playfields, picnic shelters and a small restaurant. The park contains 2.35 acres and is frequently inundated when flood waters leave the channel upstream of this park. Creekside Park is located on the right bank just upstream of the Union Road Bridge. Delineation of the affected area for parks and recreation would include other undeveloped or vacant land within the 100-year flood outline plus all other areas within a reasonable driving distance for Cheektowaga's residents. The availability of regional and interregional highways gives these residents a wide choice of alternative parks and recreational areas to choose from.

The number and location of recreation areas which would be considered as alternative sites to those now available within the town are determined in part by the time required to travel to these other areas. It has been established by Ohio in their Outdoor Recreation Plan (published by the Recreation Planning Section, ODNR) that residents in an area will travel various distances to participate in specific outdoor activities. Maximum travel distances are presented by activity type in Table 7.

The existing highway network opens up the complete inventory of park and recreation areas in the Buffalo SMSA to residents in the flood plain and residents in other portions of the town of Cheektowaga.

The limits of the affected area for recreational activities is defined by a combination of three factors: the specific activity, the travel time, and the transportation system available to the participant. Most of western New York is within the maximum distance listed in Table 7. It was assumed that residents would travel a reasonable distance (up to 60 minutes by auto or public transportation) to obtain an alternate site with facilities comparable to the municipal parks and neighborhood play areas in Cheektowaga. Therefore the affected area is delineated as the two-county Buffalo SMSA.

Table 7 - Maximum Travel Distance

Activity	Maximum[1/] Travel Time	Activity	Maximum[1/] Travel Time
Bicycling	120	Picnicking	90
Boating	180	Playground	45
Camping	180	Outdoor games & Sports	60
Canoeing	150	Sailing	105
Fishing	120	Sledding	60
Golf	60	Snowskiing	240
Hiking	120	Swimming	90
Horseback Riding	120	Tennis	30
Hunting	120	Trail Biking	120
Ice Skating	40		

1/ In minutes of driving time.

SOURCE: 1975 Ohio Statewide Comprehensive Outdoor Recreation Plan
Ohio Department of Natural Resources, Recreational Planning Section

PROJECTION OF ANTICIPATED ACTIVITIES IN THE AFFECTED AREAS

Projections of demographic and economic activity within the affected areas were assumed independent of the proposed flood control project because the flood plain makes up only a small portion of the affected area. The following characteristics of the area have been projected to the year 2030; population, employment, and per capita income.

Population

The two county Buffalo SMSA had a 1970 population of 1,350,600. More than 80 percent of this total resided in Erie County which had a density of 1,052 persons per square mile. The population of the SMSA has historically been concentrated along an urban belt fronting on Lake Erie and the Niagara River. Population changes between 1950 and 1970 are indicated in Table 8, "Population and Density for Selected Areas."

The Buffalo SMSA experienced a substantial increase in population during the 1950's, however, this growth subsequently declined to three percent between 1960 and 1970. Erie County has experienced growth patterns similar to many mature areas in the northeast. The population of the central city (Buffalo) has declined as population shifts to the surrounding suburbs.

Populations for the Buffalo SMSA and Erie County were projected using data prepared by the New York State Economic Development Board (NYSEDB). These projections indicate that the Buffalo SMSA will experience only limited growth in the future. The projections at the SMSA level obscure the shifts in population that are expected to occur within Erie County. In 1950, 64.5 percent of Erie County's population resided in the city of Buffalo, by 1970, only 41.6 percent resided in Buffalo. The Erie and Niagara County Regional Planning Board (ENCRPB) has estimated that by the year 2000 only 29 percent of the county's population will reside in the central city. Future levels of population for the Buffalo SMSA, Erie County, Buffalo, and the remainder of Erie County, as well as the town of Cheektowaga are included in Table 9. The Census Bureau has estimated that there has been a net out-migration of approximately 10,000 persons per year from the SMSA. One of the prime reasons for this outflow is the lack of employment opportunities in the area due to its declining economic base. The affect of this trend is to hold down populatior growth in Erie County.

Table 8 - Population and Density for Selected Areas

Area	1950	1960	1970	1970 Population Density	Area in Square Miles
New York State	14,830,192	16,82,304	18,241,266	381.4	47,831.0
Buffalo SMSA	1,089,230	1,306,957	1,349,211	848.6	1,590.0
Erie County	899,238	1,064,688	1,113,491	1,052.4	1,058.0
City of Buffalo	580,132	532,759	462,768	11,205.0	41.3
Town of Cheektowaga	45,354	84,056	113,844	4,139.8	27.5
Town of West Seneca	17,417	33,644	48,404	2,261.9	21.4
Town of Lancaster	18,471	25,605	30,634	765.9	40.0

SOURCE: Buffalo Area Business Fact Book, Part II, 1974 Edition, NYS Department of Commerce

Table 9 - Projected Population in the Affected Area (000)

Area	1970 1/	1980	1990	2000	2010 3/	2020 3/	2030 3/
Buffalo SMSA 2/	1,349.2	1,335.4	1,345.9	1,328.0	1,314.0	1,301.4	1,289.5
Erie County	1,113.5	1,098.4	1,114.8	1,108.3	1,096.5	1,086.0	1,076.1
City of Buffalo 4/	463.8	394.6	350.7	320.8	317.4	314.4	311.5
Erie County 4/ Excluding Buffalo	650.7	703.8	764.2	787.4	779.1	771.6	764.4
Cheektowaga 4/	113.8	123.8	128.9	131.6	130.2	129.0	127.8

1/ Actual
2/ NY State Economic Development Board (NYSEDB) for 1980-2000
3/ Projection based on historical trend
4/ 1980-2000 ENCRPB estimate revised to reflect (NYSEDB) projection, 2010-2030 assumes constant percentage of county population

Employment

The projections of future employment levels were based on projections developed by the Buffalo and Erie County Economic Development Committee released June 1976. The projected labor force is shown in Table 10.

Manufacturing

Manufacturing has historically been the dominant sector of the Buffalo SMSA's economy. Over one-third of the area's work force was employed in some aspect of manufacturing in 1970. Niagara County had the highest percentage (43 percent) of its labor force employed in manufacturing in 1970. This dominance can be attributed to a relatively high concentration of nondurable goods production centering on chemical production in Niagara Falls.

The heavy industrial base of the Niagara Frontier results in greater amplitudes in business fluctuations. The area lacks the nondurable consumer goods industries necessary to offset these fluctuations during the business cycle.

Manufacturing is declining in importance in the economy of the area. Employment in 9 of the 12 manufacturing categories reached their peak in the area between 1947 and 1953. Unlike manufacturing employment in the United States, employment in the Buffalo area has never recovered to the 1947 to 1953 levels. Table 11 indicates the 1976 employment levels in selected industries and their peak World War II employment. The factors causing the decline of manufacturing in the area are of a long-term nature, that cannot be overcome in the short run. They include the growth of markets in the south and west, a high level of taxes, a low level of value added per dollar labor costs, older plants, and a low level of capital investment when compared with other industrial areas in the United States. The Buffalo area is characterized by sustained high unemployment rates which are of a structural nature and cannot be overcome easily in the short run. This leads to a large divergence between the size of the labor force and employment in the short run. It is assumed that unemployment will be brought down to a tolerable level before 1990, by a combination of Government policy and an out-migration of potential job holders as noted above. The Buffalo and Erie Courty Economic Development Committee projects that manufacturing employment will continue to decline in both relative and absolute levels in the Buffalo area, from 155,600 in 1970 to 135,000 in 1990. The recent recession forced manufacturing employment below the long-term trend line to 141,900 in 1975. Table 12 projects manufacturing employment to 2030. It was assumed that after 1990, manufacturing employment will stabilize at a constant percentage of area employment.

Table 10 - Projected Labor Force in the Buffalo SMSA

	1970	1980 1/	1990 1/	2000 2/	2010 2/	2020	2030 2/
Population	1,349,200	1,335,400	1,345,900	1,328,000	1,314,000	1,301,400	1,289,500
Labor Force	535,500	560,000	600,000	597,600	591,300	585,600	580,300
Labor Force Population Factor	.40	.42	.45	.45	.45	.45	.45

1/ Buffalo and Erie County Economic Development Board
2/ Continuation of Historical Trend

Table 11 - Buffalo Area Manufacturing Employment Post WW II Peaks[1/]

Industry	Post WW II Peaks[1/] Year	Employment	Employment 1976	Current Against Peak Percent
Stone, Clay & Glass Products	1956	10.0	6.4	64.0
Primary Metals	1951	42.9	28.2	65.7
Fabricated Metals	1953	18.2	12.2	67.0
Machinery	1947	15.7	13.4	85.4
Electrical Equipment	1953	18.2	12.2	67.0
Transportation Equipment	1953	44.5	21.9	49.2
Food Products	1947	18.6	9.4	50.5
Textiles & Apparel	1947	7.1	3.5	49.3
Paper & Paper Products	1947	8.3	4.3	51.8
Printing & Publishing	1969 & 1970	9.1	8.0	87.9
Chemicals	1953	19.7	11.0	55.8
Rubber Products	1972	6.6	4.6	69.7
All Manufacturing	1953	221.3	141.9	64.1
Construction	1960	25.7	13.7	53.3
Goods Producing		247.0	155.6	63.0

1/ WW II - Second World War

Table 12 - Population and Employment in the Buffalo SMSA (000)

	1970	1980	1990	2000	2010	2020	2030
Population 1/	1,349.2	1,335.4	1,345.9	1,328.0	1,314.0 2/	1,301.4	1,289.5
Labor Force 3/	535.5	560.0	600.0	597.6	591.3	585.6	580.3
As % of Population	50.0	42.0	45.0	45.0	45.0	45.0	45.0
Nonagricultural Employment 3/	509.8	505.0	575.0	571.1	565.0	559.6	554.5
As % of Population	37.8	37.8	42.7	43.0	43.0	43.0	43.0
Manufacturing Employment 3/	168.9	145.0	135.0	133.6	132.2	130.9	129.7
As % of Total Employment	33.1	28.7	23.4	23.4	23.4	23.4	23.4
Commercial Employment 3/	102.2	119.7	137.3	136.5	135.0	133.7	132.5
As % of Total Employment	20.0	23.7	23.9	23.9	23.9	23.9	23.9

1/ New York State population estimates to the year 2000
2/ Continuation of Historic Trend
3/ Greater Buffalo Development Foundation estimates for 1980 and 1990, 2000-2030 as a constant percentage of population

Long-run Equilibrium

The long-run equilibrium in the Buffalo economy will result when only those firms which are offered a comparative advantage by locating in Buffalo continue to exist and the labor force is reduced through either out-migration or a shorter work week so as to equal demand.

Commercial

The loss of employment opportunities in manufacturing will be offset to some extent by projected growth in the commercial and service sectors. Historically, commercial employment has ranged between 19.1 and 20.6 percent of total SMSA nonagricultural employment. The Buffalo and Erie County Economic Development Committee projects that the importance of commercial employment will increase in the future. Table 12 projects commercial employment in the Buffalo SMSA. It is estimated that commercial employment will increase to relative share of employment from 20.0 percent in 1970 to 23.9 percent of total employment by 1990.

The Buffalo area maintains a strong position in wholesale trade, being the largest wholesale center in Upstate New York. Groceries and related items accounted for the largest share of total wholesale merchant sales. However, 12.6 percent of total wholesale activity is attributable to distributors of machinery and equipment. This emphasizes the current importance of industry in the Buffalo's economy.

Per Capita Income

Table 13 provides projections of per capita income for the United States, New York State, and the Buffalo SMSA. The per capita income of the Buffalo SMSA is higher than that of the United States but lower than the State average. The State average is heavily influenced by the high incomes in New York City. The relatively high level of per capita income in the Buffalo SMSA is an outgrowth of the higher than average wages characteristic of the area. Buffalo has the second highest paid blue collar workers in the United States. This reflects the high incidence of transportation and steel industry workers in Buffalo's labor force.

Table .3 - Historical & Projected Per Capita Income Levels

Area	1950	1960	1970	1980	1990	2000*	2010	2020	2030***
	$								
Buffalo SMSA	2,436	2,613	3,569	4,900	6,300	8,400	11,050	13,700	15,944
New York State	2,619	3,135	4,252	5,700	7,300	9,500	12,150	14,800	16,720
United States	2,064	2,770	3,476	4,700	6,100	8,100	10,650	13,200	15,324

* Interpolated Value
** Estimated Value Based on Historical Data

SOURCE: 1972 Obers Projections, Series E Population
U. S. Water Resources Council

ESTIMATION OF LAND DEMAND IN THE AFFECTED AREA

Residential

Land demand projection in the affected area were developed and based on historical trends, projections and estimates of land requirements for various activity types.

Residential land demand in the affected areas was developed by converting the projected household population to acres of residential land required to accommodate them. The number of households in an area can rise due to population growth or a change in the average household size. New York State Economic Development Board's statistics were utilized to project the household population over the planning period. It was assumed that the average household size would decline over the period. This assumption has been substantiated by the Burueau of Census when it established in February 1975 that the number of persons living in the average American family declined from 3.19 in 1969 to 2.97 in 1974. This decline was related to recent increases in the number of unrelated individuals and a declining birth rate.

Although Erie County is projected to have a fairly stable population over the planning period the shift of households from Buffalo to the surrounding towns will create substantial land demand in Erie County outside of the city of Buffalo, Table 14 includes projections of residential land demand within Erie County (excluding Buffalo). The projected land demand was derived by using a range of residential densities per acre. Increases in the number of households in the affected area were distributed between the two major types of dwelling units; single and multi-family.

In 1970, 65.9 percent of the housing stock in Cheektowaga were single family units. During the period 1970-1973, less than one-half of the residential structures erected were single family. The proportion of new single family units can be expected to be significantly lower than the percentage contained in the existing housing of both Cheektowaga and Erie County.

Land demand for single family structures ranged from a low of 7,930 acres at a density of 3.5 units per acre to 11,110 acres at 2.5 units per acre. Multi-family demand ranged from 2,410 to 4,040 acres.

Land demand when viewed as a range of possible values more accurately reflects the potential fluctuations in such variables as; land costs, building and material costs, tastes, technology, and the cost and availability of financing which can not be accurately predicted

Table 14 - Future Residential Land Demand in Erie County, Excluding the City of Buffalo

	1980	1990	2000	2010	2020	2030	Total
Population of Erie County (Excluding Buffalo)	703,810	764,200	787,400	779,100	771,600	764,600	
Average Family Size	2.86	2.64	2.52	2.43	2.35	2.29	
Number of Families	245,970	289,910	312,670	321,100	328,300	334,250	
Increase from Previous Period		43,940	22,760	8,430	7,200	5,950	88,280
Single Family Distribution Factor		.40	.30	.20	.15	.10	
Increase in Single Family Units		17,580	6,830	1,690	1,080	590	27,770
Projected Residential Density (Units per Acre)							
2.5		7,030	2,730	670	430	240	11,110
3.0		5,860	2,280	560	360	200	9,260
3.5		5,020	1,950	480	310	170	7,930
Multi-family Distribution Factor		.60	.70	.80	.85	.90	
Increase in Multi-family Units		26,300	15,930	6,740	6,120	5,360	60,510
Projected Residential Density (Units per Acre)							
15		1,760	1,060	450	410	360	4,040
20		1,320	800	340	310	270	3,040
25		1,050	640	270	240	210	2,410

over a 50-year planning period. These variable do have a significant influence on residential construction. The projections of land demand does not take into account any replacement of substandard housing in the affected area since the extent and timing of such replacement cannot be predicted. As a result, the projections of land demand have a downward bias and can be considered a conservative estimate of future residential land requirements.

A similar method was used to estimate residential land demand within the town of Cheektowaga and is presented in Table 15. Residential land demand ranged from 1,130 acres to 1,570 acres for single family structures and 355 to 605 acres for multi-family development.

Commercial Land Demand

Projected commercial land demand in the affected area was derived by using the projected increase in commercial employment in Erie County (excluding Buffalo). The trend in the number of employees per establishment, and a range of land requirements per establishment were also used.

During the period 1967 to 1972, Erie County witnessed a shift in commercial activity from the city of Buffalo into towns and villages within Erie County. Changes in retail and wholesale trade are shown in Tables 16 and 17. The city of Buffalo experienced a decrease in the number of wholesale and retail trade establishments during this period while Erie County, outside of the city, experienced a substantial increase in commercial activity. Table 18 projects incremental commercial land demand by decade for the affected area. The projection assumes that the rate of rise in employment per establishment will be lower in the future than for the 1967-72 period for both retail and wholesale establishments. Site sizes varied from .75 to 1.0 acre per future retail establishment and 2.0 to 4.0 acres for future wholesale establishments. Aggregate commercial land demand in the affected area ranged from a low of 1,954 acres to a high of 3,154 by the year 2000. After that point the combination of a decreasing population and increasing employment per establishment leads to a surplus in commercially developed land in Erie County. Specific localities within the county may have a positive or zero demand for commercial land during the planning period.

Future population increases within the town of Cheektowaga will require a growing trade sector to service the areas needs. Commercial land demand is ultimately determined by the area's purchasing power, population distribution and age structure, improvement to existing highways or the addition of new transportation networks.

Table 15 - Incremental Residential Land Demand in Town of Cheektowaga

	1980	1990	2000	2010	2020	2030	Total
Population	123,000	128,920	131,640	130,246	128,997	127,820	
Persons per Household	2.86	2.64	2.52	2.43	2.35	2.29	
Number of Households	42,990	48,910	52,270	53,680	54,880	55,880	
Increase over Previous Period		5,920	3,360	1,410	1,200	1,000	12,850
Single Family Distribution Factor		.40	.30	.20	.15	.10	
Increase in Single Family Units		2,370	1,010	280	180	100	3,940
Projected Residential Density (Units per Acre)							
2.5		950	400	110	70	40	1,570
3.0		790	340	90	60	35	1,315
3.5		680	290	80	50	30	1,130
Multi-family Distribution Factor		.6	.7	.8	.85	.90	
Increase in Multi-family Units		3,550	2,350	1,130	1,020	900	8,950
Projected Residential Density (Units per Acre)							
15		240	160	75	70	60	605
20		180	120	55	50	45	450
25		140	95	45	40	35	355

Table 16 - Changes in Retail Trade

	Erie County			Buffalo			Erie Cty. (Excluding Bflo.)		
	1967	1972	% Change	1967	1972	% Change	1967	1972	% Change
No. of Establishments	9,249	8,917	-3.6	4,902	4,047	-17.4	4,347	4,870	12.0
No. of Employees	57,246	67,049	17.1	28,340	26,921	-5.0	28,906	40,128	38.8
Employees per establishment	6.2	7.5		5.8	6.7		6.7	8.2	
Sales ($000)	1,717,900	2,346,400	36.6	796,100	853,200	7.1	921,800	1,493,200	62.0

Table 17 - Changes in Wholesale Trade

	Erie County			Buffalo			Erie Cty. (Excluding Bflo.)		
	1967	1972	% Change	1967	1972	% Change	1967	1972	% Change
No. of Establishments	1,791	1,958	9.3	1,192	995	-16.5	599	963	60.8
No. of Employees	22,282	22,985	3.2	16,431	13,031	-20.5	5,851	9,954	70.1
Employees per Establishment	12.4	11.7		13.8	13.1		9.8	10.3	
Sales ($000)	3,053,594	4,082,444	33.7	2,249,660	1,910,141	-15.1	803,934	2,172,303	170.2

Table 18 - Commercial Land Demand in Erie County (Excluding Buffalo)

	1980	1990	2000	2010	2020	2030
Commercial Employment	65,179	80,922	83,970	83,076	82,285	81,532
Retail - 75 Percent	48,884	60,691	62,977	62,307	61,713	61,149
Employment per Establishment	8.3	8.4	8.5	8.6	8.7	8.7
Number of Retail Establishments	5,899	7,225	7,409	7,245	7,093	7,028
Incremental Establishments		1,326	184			1,510
.75 Acre/Site		994	138			1,132
1.00 Acre/Site		1,326	184			1,510
Wholesale 25 Percent	16,295	20,231	20,993	20,769	20,572	20,383
Employment per Establishment	10.3	10.4	10.5	10.6	10.7	10.8
Number of Wholesale Establishments	1,582	1,945	1,993	1,959	1,922	1,887
Incremental Establishment		363	48			411
2.0 Acre/Site		726	96			822
4.0 Acre/Site		1,452	192			1,644

Additional residential subdivisions are planned for the southeastern quadrant of the town, since this area is expected to become available for development by completion of a new sewerline. These proposed subdivisions, especially in the area bounded by Losson and French Roads, would attract numerous commercial units which are expected to be orientated toward convenience goods. Existing commercial development in this area is orientated toward strip development along French and Transit Roads. All of the land immediately west of Transit Road is zoned for commercial activity while sizeable tracts on the northern side of French Road could also provide the area needed for the anticipated growth in commercial activity.

Industrial Land Demand

The lack of industrial activity within the project limits precludes a detailed discussion of industrial land demand. At the SMSA level there will be some industrial land demand as some firms expand and others open or relocate. With the present projection of a decline in manufacturing activity within the SMSA, it is impossible to estimate industrial land demand with any degree of accuracy.

INHERT CHARACTERISTICS OF A FLOOD PLAIN

Flooding - The greatest flood of historical record occurred in June 1937. Other damaging discharges occurred in March 1955, March 1956, and January 1959. Ice jams have affected some of the winter and spring floods increasing flood stages higher than normal. Data on high water marks and damages are not readily available for all floods on record since there was relatively little development along Cayuga Creek at that time.

a. June 1937: This flood is considered the maximum of record and occurred during the summer months when heavy rain fell on western New York on 17 June and during 20-21 June. This rainfall occurred over the eastern suburbs of Buffalo on wet ground in a period of six hours. The peak discharge on Cayuga Creek produced by this storm was estimated to be 18,000 cfs. Damages along the creek between Harlem Road Bridge and Penora Street in Lancaster were estimated to be $68,400. There was little residential development in the flood plain at this time, and the damages were primarily to agricultural activities and to highways.

b. March 1955: This flash flood was caused by heavy rain and thundershowers falling on frozen ground over a six-hour period. An average precipitation of 1.5 inches over the Basin's drainage area produced a discharge of 7,900 cfs at the Lancaster gage site.

c. March 1956: Precipitation on 5 March over the area combined with additional rainfall on 6 March was augmented by runoff from melting snow over frozen ground which produced 1.9 inches of runoff over the Cayuga Creek Basin and a discharge of 8,700 cfs at the Lancaster gage.

d. January 1959: A major storm over western New York and snowmelt over frozen ground produced the highest recorded discharge at the Lancaster gage of 8,750 cfs. Flooding was aggravated by numerous ice jams created by the breakup of thin ice cover on the creek.

Stream flow records available from the United States Geological Survey since the Lancaster gage site was established in September 1938 are presented in Table 19. From its location, the gage can record creek stages produced from runoff over 94.9 square miles of the watershed located upstream of the site. Total drainage area of the watershed is 128 square miles and the gage site measures almost 75 percent of total creek flow. No official hydrograph record is available for the June 1937 flood, therefore an estimate was required for this flood based upon accepted hydrologic principles.

The only bridge located within the study area is the Union Road Bridge. Technical data for this structure is included in Table 20.

Table 19 - Comparative Data for Floods of Record

Flood	Elevation and Stage Near Lancaster Site (USC&GS)	Peak Discharge at Lancaster cfs (1)	Estimated Peak Discharge at Union Rd. cfs (2)	Estimated Recurrence Interval In Years
June 1937	NA(3)	18,000(4)	20,000(4)	500
March 1955	681.83 9.59	7,900	9,000	10.0
March 1956	682.30 10.06	8,700	10,000	15.0
January 1959	682.33 10.09	8,750	10,000	15.0

(1) Published by the U.S. Geological Survey.
(2) Estimated discharge by a drainage area relationship.
(3) USGS Recording Gage established September 1938.
(4) Estimated by Corps of Engineers.

Table 21 - Soil Limitations

Soils	Low Buildings	Streets and Parking Lots	Play and Picnic Areas	Athletic Fields	Crops	Septic Tanks
Tonawanda	Moderate-Severe A, D	Severe A, D	Moderate A	Severe A	Moderate A	Severe A
Palmyra	Slight-Severe B	Slight-Severe B	Slight-Severe B	Severe B, C	Slight-Severe B, C	Slight-Severe B
Genesee	Severe A	Severe A	Slight	Moderate A	Slight	Severe A

Slight - Relatively free of limitations.
Moderate - Limitations can be overcome through management or design.
Severe - Limitations make use questionable.

A = Flooding
B = Slope Hazard
C = Coarse Fragments
D = Low Bearing Strength

Transportation - Cayuga Creek is not commercially navigable for any portion between its headwaters and its confluence with the Buffalo River. No industrial or commercial activity with a water-related transportation requirement has ever established itself along the creek. Cheektowaga is within an eight-hour drive (one hour flight time) of more than one-half of the population of the United States and 60 percent of the population of Canada. Local expressways link the study area with national and international highways, airways, waterways and railways.

The New York Thruway (Interstate 90)(See Plate B3) passes through the town of Cheektowaga on a north-south axis and provides connections to Boston, New York, Cleveland, Detroit, and Chicago. Manufacturing firms located in this town have access to nine of the nation's twelve largest SMSA's and Toronto, the largest metropolitan area of Canada. In addition to this north-south network, numerous major highways such as Genesee Street (Route 33), Walden Avenue (Route 244), Broadway (Route 130) and the Kensington Expressway provide excellent east-west highways for residential, commercial and industrial user-groups.

Air transportation facilities, provided by the Greater Buffalo International Airport are located 15 minutes north of the project area. This facility provides air freight and passenger service, schedules regular flights of four major airlines and moves in excess of 65,000,000 pounds of air mail, freight and air express each year.

Bulk Transportation - Bulk freight service to the area is provided by the Port of Buffalo and by rail lines. Great Lakes shipping is also available to economically transport bulk freight to Buffalo and from Buffalo to other cities on the Great Lakes. The St. Lawrence Seaway connects waterborne commerce on the Great Lakes to international ocean routes as well.

Railroads - The final Conrail plan has two routes that traverse Cheektowaga. The former Penn Central line crosses the center of town parallel to Walden Avenue. The east and westbound traffic on this line is approximately 25 trains per day. The Erie Lackawanna Railroad operated rail service between Buffalo, NY, and Hornell, NY, which crossed Cheektowaga in the center of the town. The final system plan states that this line was to be acquired by the Chessie system. The existence of a large and extensive railroad network is an advantage to a shipper only if branch lines are available to their plants or if their manufacturing operation requires bulk commodities for which railroad service would be indispensable.

Analysis of current rail service indicate that the existence of rail lines near the project area is important in that it provides an alternative mode of transportation in addition to other surface, water, and air facilities which are also available. If the town has a policy of encouraging light industrial development (which is usually more dependent upon highway networks) in an effort to expand its tax base, the presence of these rail facilities may not act as a strong locational advantage.

AVAILABLE SERVICES

Water - Water is supplied by the Erie County Water Authority. The Transit Road 36-inch line receives its water from Sturgeon Point while the 16-inch and 24-inch lines to the southwest receive their water from the Woodland Water Works. The 24-inch line entering the town from the west originates in the city of Buffalo.

Waste Treatment - Three sewage treatment facilities are located in Cheektowaga; Sewer District No. 5 plant to the north is located on Central Blvd. just west of the Thruway, the village of Depew facility, adjacent to Cayuga Creek, is located on the right bank upstream of the Borden Road Bridge and a treatment plant is located near the confluence of Cayuga Creek and Buffalo Creek with an outfall to the Buffalo Creek.

The Erie and Niagara Regional Planning Board has presented a comprehensive plan of sewage treatment to upgrade existing water quality conditions in the lower reaches of the Cayuga Creek. It is now tentatively planned to abandon the present treatment facilities in the town of Lancaster that discharges effluent into Cayuga Creek and pumps the effluent to Erie County Sewer District No. 4 where it would be treated by the Buffalo treatment plant prior to final discharge into the Niagara River. Erie County has built a pumping station adjacent to Cayuga Creek on Cayuga Creek Road to pump sewage into the Buffalo treatment plant. Under a State adopted water resource development plan, the discharges into Cayuga and Buffalo Creek will be pumped into the Buffalo Treatment plant.

Schools - Five school districts in Cheektowaga overlap on the other surrounding municipalities whereas School Districts No. 2, No. 3, and No. 9 are fairly compact and lie within town limits. School District No. 1, although not the most populated, is the town's largest school district.

Population growth expected to occur in the town has been converted into its school enrollment equivalent. Town planners, making the following assumptions regarding school capacities, have estimated Cheektowaga's future school needs to be as follows.

Table 22 - Future School Facility Needs

Grade	School Sizes	School Needs
K-5	800 - 1,000	5 schools
6, 7, 8	700 - 800	3 schools
9-12	1,000 - 1,200	3 schools

Future enrollment levels are expected to rise by more than 4,500 in grades K-5, over 2,200 in middle schools (grades 6, 7, 8) and 3,000 at the high school level. Expansion at existing school sites should absorb up to one-half of this increase but four additional school sites will be needed. There are no schools planned within the limits of the project area.

Highways - Major road improvements include Borden Road to improve the traffic-carrying ability of this road between Broadway on the north and Clinton Street. Two other road extensions are planned to improve north/south traffic flows in the southeastern portion of town.

Brentwood Drive will be extended through Losson Road, eventually meeting Como Park Boulevard. Towers Boulevard will also be extended to Losson Road. Both extensions currently planned will become increasingly necessary as this area develops residentially. Brentwood's extension would also coincide with an enlargement in its width since it will eventually serve as a residential collector street. Tower Boulevard would also function as a residential collector street.

Growth in the Gardenville Industrial Park complex may require an extension of its access road, Industrial Parkway, possibly across Slate Bottom Creek to Losson Road. This highway extension has two goals in mind; first, it would provide an industrial collector street and stimulate development of industrial land along the New York Central belt line. Second, it would also contribute to north/south traffic flow between Union Road and Transit Road.

Park and Recreation Facilities - Existing recreation facilities currently available to town residents are presented in Plate B4. An analysis of land use reveals that Cheektowaga has only 250 acres including playgrounds on school property which are suitable for recreation facilities to meet the present needs of 120,000 town residents.

Municipal park standards recommended by recreation planners vary by region. Assuming a need of 2.5 acres per 1,000 population, the anticipated population growth in Cheektowaga would require an additional 150 acres of land alone. To alleviate this problem, four large park areas have been designated by the town as preferred sites for future parks. Park areas shown in Plate B4 include the present town park on Harlem Road which serves the eastern portion of the town. Proposed parks for other areas include acquisition of the old gravel pit and quarry to serve the northern portion of town; a park on Rein Road for the eastern and Depew area; and Losson Road park now in the process of acquisition.

Numerous neighborhood parks are also expected to be developed in the future. Town planners have indicated that nine sites are planned for acquisition and development. Two-thirds of this total will be located in the southeastern portion of town. The current objective is to acquire an additional 1,250 acres of land to satisfy even the minimum recreational needs of all town residents. The potential for successfully implementing these recreation standards is greater in the rapidly growing southeast quadrant of town. Table 23 includes data on existing and planned recreation facilities in the town of Cheektowaga.

Municipal Facilities - The Town Hall, incinerator, and highway garage are currently located in the geographic center of town. These facilities will need to be expanded in the future as population increases to about 180,000. A survey of future space requirements by town officials indicates that an additional 48 acres will be needed to house town services and expand office space for future growth in municipal departments. Acquisition of adjacent lands appears to be the best solution and, as such, should not impact upon future land demand in the flood plain.

Three public libraries presently serve the town. Areas serviced by these facilities were assumed to include all residential areas located within one mile from each branch library site. In addition to libraries currently sited within the town limits, branch library facilities in the city of Buffalo and the villages of Depew and Williamsville provide supplemental library service to other residential areas of the town.

Two libraries are now planned which will increase service in the eastern and southeastern portions of Cheektowaga.

No future municipal facilities are expected to impact directly on vacant land now available within the project area.

Fire Protection - Cheektowaga is divided into 12 fire districts, two district. The two fire protection districts do not own any equipment but are serviced by neighboring fire districts.

According to fire underwriters, all districts have a "B" fire insurance rating with the exception of Cleveland Hill ("A") and Highview ("C"). These ratings are partially determined by population, proximity to fire facilities and water supply. However, water supply is usually the most important determinant of an area's fire insurance rating.

The project area is protected by two fire districts, Bellevue Volunteer Fire Co. and Doyle Fire Department. Existing development or future growth anticipated to occur within the study area did not appear to enjoy a greater level of fire protection than other areas of the town with similar "B" fire ratings.

Table 23 - Existing and Planned Recreation Facilities in the Town of Cheektowaga

Type of Facility	Name	Acreage Existing	Acreage Additions	Development Period
Municipal Parks	Cheektowaga Town Park	68	-	
	Losson Road	85	-	-
	Cayuga Creek	-	100	1973-1980
	Nob Hill	-	100	1981-1990
	Town Bird Sanctuary	-	70	1981-1990
	Town Lake & Park	-	135	1981-1990
	Cayuga Creek Road	-	35	1973-1980
	Cheektowaga	-	80	1973-1980
Open-Space Corridors	Cayuga Creek	-	425(1)	1973-1980
	Scajaquada Creek	-	120	1973-1980

SOURCE: Erie and Niagara County Regional Planning Board.

(1) Only partly in the town of Cheektowaga.

Mining, Sand, and Gravel Deposits - An extensive quarrying operation is located near the intersection of Indian Road and Broadway. The company has been in operation since the early 1920's mining the Onondaga Limestone formation. This limestone is used for road construction base material and as an aggregate in Portland Cement. Approximately 140 acres are controlled by this mining concern. Almost 48 of these acres are now vacant and, if actively mined, would provide raw materials at least 20 more years. This firm is the largest mining operation in the area.

In contrast to this large operation, there are no commercially viable mineral deposits in the project area.

LABOR FORCE

Characteristics - The Buffalo Labor Area is composed of Erie and Niagara counties. This labor area has been significantly impacted upon by a general economic recession at the national level in addition to an energy crisis. These events have created significant disruptive influence on the Buffalo area economy over the last few years. The greatest impact was in the manufacturing sector, especially in the primary metals and automobile-related production activities. As a result, large scale layoffs at these operations have sharply increased the number of unemployed semi-skilled and unskilled workers.

The extreme sensitivity of area labor within the durable goods sector to national economic fluctuations will continue to produce cyclic employment prospects for skilled and semi-skilled workers in the Buffalo SMSA. A long-term economic downswing at the national level could produce a prolonged and substantial labor surplus in the Buffalo Metropolitan Area. If these unemployed workers with highly saleable skills were to gravitate towards other areas of the country, as traditional economic theory indicates, it would weaken the long-term attractiveness of this region to potential future employers.

Population patterns also influence the trends affecting the labor force in the area. In 1970, a large number of persons living in the Buffalo Metropolitan Area were between the ages of 10 and 19 and represented 19.7 percent of the total population. The median age of the labor force, which was around 41 years in 1970, will be considerably lowered by the influx of these younger workers. Their lack of experience, relative immobility and high unemployment rates, which are generally characteristic of their group, will have considerable impact on future labor force characteristics in this labor area.

A long-term solution to the labor surplus problem is the ability to create and retain sufficient jobs to hold and attract people in this area. In the last 15 years manufacturing employment declined while growth in the nonmanufacturing sector more than offset losses sustained in the factory sector. One result of the current recession was an increase in the rate of decline in manufacturing jobs while the rate of growth of nonmanufacturing jobs has slowed.

The Buffalo Labor Area has high potential as a labor force exporter. Also lost to other areas may be workers with highly saleable skills and those employees who become dissatisfied with opportunities provided by a stable or declining labor area.

Employment trends in the nonagricultural sector are presented in Table 24 which provides additional insight into the distribution of this area's labor force among the various standard industrial classification (SIC) groups.

Table 24 - Average Nonagricultural Wage and Salaried Employment - Buffalo Labor Area
(in thousands)

	1970	1971	1972	1973	1974	Percent Change 1970-1974
Nonagricultural Wage & Salary	497.5	484.8	485.0	501.6	498.4	*
Manufacturing	168.6	155.8	151.5	159.3	155.6	- 7.7
Durable goods	113.2	103.3	100.1	107.7	105.5	- 6.8
Stone, clay & glass	7.6	6.5	6.3	6.9	7.0	- 7.9
Primary metals	34.1	28.5	26.3	30.3	29.8	-12.6
Fabricated metals	13.2	12.6	13.1	13.9	13.5	+ 2.3
Machinery (except elec.)	13.5	11.8	11.5	12.3	13.1	- 3.0
Electrical machinery	13.8	12.0	11.4	11.2	12.1	-12.3
Transportation equip.	25.6	27.1	26.6	27.8	24.5	- 4.3
Other durable goods	5.2	4.8	4.9	5.3	5.5	+ 5.8
Nondurable goods	55.4	52.4	51.4	51.6	50.1	- 9.6
Food products	12.8	11.6	11.2	10.9	10.3	-19.5
Apparel & textiles	3.7	3.4	3.4	3.5	3.8	+ 2.7
Paper & allied products	6.5	5.6	5.0	5.0	4.6	-29.2
Printing & publishing	9.1	8.6	8.2	8.2	8.2	- 9.9
Chemicals & allied products	13.6	12.5	12.2	11.9	12.0	-11.8
Rubber & misc. plastics	5.9	6.4	6.6	6.6	5.7	- 3.4
Other nondurable goods	3.7	4.3	4.7	5.5	5.5	+48.6
Nonmanufacturing	328.9	329.0	333.5	342.3	342.8	+ 4.2
Construction	19.3	19.0	18.1	19.9	18.3	- 5.2
Transportation	32.1	29.7	29.7	30.8	29.0	- 9.7
Trade	102.3	101.9	104.3	107.5	108.1	+ 5.7
Finance, ins. & real estate	19.4	19.5	19.8	20.1	20.2	+ 4.1
Services, etc.	76.3	78.6	81.3	83.6	84.9	+11.3
Government	79.5	80.3	80.3	80.4	82.3	+ 3.5

* Less than one percent.
SOURCE: Annual Manpower Planning Report, Buffalo Labor Area, New York State Department of Labor, 1976.

The area's industrial base has suffered a setback over the last few years due to a large number of plant closings. Twelve large industrial operations involving a total of 2,200 employees ceased operations in 1974 alone. Western Electric, a large manufacturing firm in the town of Tonawanda, announced in 1975 that their operations in the Buffalo area would be phased out over the next two years. This plant had previously employed 2,000 employees and was one of 17 large employers that ceased operations in the area in 1975.

The geographical distribution of unemployment within the Buffalo Labor Area is presented in Table 25. As can be seen, a considerably different unemployment situation exists in the major cities relative to the suburbs.

Table 25 - Annual Average Unemployment Statistics
For Selected Area - 1975

Area	Number Unemployed	Unemployment Rate
Buffalo SMSA	68,000	11.9
Erie County	54,700	11.6

The large number of suburban residents in the floodprone areas of Amherst employed in white collar occupations has helped to keep down their unemployment rate. These workers have not yet been affected as extensively as their blue collar counterparts. If the recessionary effects filter upward, these occupational groups will feel the impact of the economic downswing to a greater extent.

The short-term outlook for labor resources in this area is not very favorable. This prognosis will persist until monetary and fiscal pump-priming revives sales and production. Gains substantial enough to bring joblessness down to at least the national level are not anticipated.

Availability - The labor force of Erie and Niagara Counties numbered approximately 535,514 in 1970. This figure represents about 57 percent of the population sixteen years old and over in the area. Table 26 presents general labor force participation data for the two county area.

Table 26 - Labor Force Availability for Erie and Niagara Counties

	Total Population: 1970	Population 16 yrs and Older	Total Labor Force	Percent in Labor Force	Number Employed
Erie	1,113,491	774,750	442,867	57.2	422,179
Niagara	235,720	161,202	92,647	57.5	87,610
TOTAL	1,349,211	935,952	535,514	57.2	509,789

SOURCE: Business Fact Book, Part 2, 1974 Edition, New York State Department of Commerce

Distribution by Skills and Occupation - Manufacturing is the largest employer of resident jobholders in the area as a whole as well as in each individual county. The strength of this sector has been historically enhanced by the development of water power in the Niagara Frontier. Nineteenth century manufacturers developed an extensive industrial base along the Niagara River on the basis of abundant water power. Twentieth century industry has also benefited by an abundant supply of hydroelectric power generated by the Robert Moses Power Project, one of the largest water powered generating complexes in existence. In 1970, one-third of the employed residents in the two-county area held manufacturing jobs, slightly above Upstate's 31 percent and much higher than the 24 percent State average. Niagara County had the highest proportion of jobholders in manufacturing with 43 percent of its employed labor force dependent upon the industrial sector in 1970. This is a result of a relatively high ratio of nondurable goods production centering around the manufacture of chemicals.

Table 27 lists the occupations of employed persons by county in 1970. The concentration of employment in heavy industry, such as steel and automobile production, contributes to the high proportion of operatives and craftsmen, and foreman among area workers. These two groups represent the first and third largest job categories in the area.

Although manufacturing is the major economic activity in the area, the service industry (business and repair, personal, professional and entertainment) is also a significant employer. Approximately 25 percent of the area's working residents listed some facet of the service industry as their employer in 1970.

Table 27 - Labor Force Distribution of Employment by Occupation

Occupation	Erie County	Niagara County	Buffalo County
Professional, technical, and kindred workers	64,530	11,441	75,971
Managers and administrators, except farm	30,126	5,655	35,781
Sales workers	33,912	5,466	39,378
Clerical and kindred workers	76,430	13,648	90,078
Craftsmen, foremen, and kindred workers	64,587	14,191	78,778
Operatives, except transport	61,065	17,162	78,227
Transport equipment operatives	15,993	3,415	19,408
Laborers, except farm	19,075	4,080	23,155
Farmers and farm managers	1,142	661	1,803
Farm laborers and farm foremen	970	550	1,520
Service workers, except private household	51,290	10,864	62,154
Private household workers	3,059	477	3,536
Total employed, 16 years old and over	422,179	87,610	509,789

SOURCE: New York State, Volume 1, Part 34, Section 1, 1970 Census of Population, U.S. Department of the Census

The wholesale and retail trade industry was the second largest employer within the Buffalo SMSA in 1970. The commercial sector accounted for approximately 21 percent of all area jobholders compared with 19 percent for all of Upstate New York. Activities at the Port of Buffalo, a high level of tourism in Niagara Falls, and several secondary trade centers within the area contributed towards this high proportion of trade employment.

Training - Academic and vocational training available to existing and future labor resources within the Buffalo SMSA has been heavily influenced by the labor needs of the manufacturing sector. Areas industry has a strong demand for technicians, craftsmen and operatives. This need has had an impact on the median number of school years completed. Since formal training for most factory occupations often terminates upon completion of high school, the median level of education in 1970 in Erie County was 12.0 years, slightly below the Upstate average. Only 30 percent of Erie County's residents finished four years of high school while five percent received at least a college education.

The University of Buffalo is one of a dozen institutions of higher education the Buffalo Metropolitan Area. This University center is in the middle of an expansion program which, when completed, will provide facilities for over 40,000 students. The development of a major university complex and expansion of programs offered at several of the other local colleges during the past decade may have a major long-run impact on the educational characteristics labor force in the area. However, unless job opportunities become available for this educated sector of the labor force, education may become a leading export industry in this region.

FLOOD PLAIN LAND USE

The future land use within a flood plain is determined by a variety of factors including the extent of existing development, zoning, availability of services, the quantity and quality of vacant lands as well as the severity and frequency of flooding.

The flood plain within the project area is primarily residential in nature. Table 28 illustrates the acreage within the 100-year flood outline by reach and zoning type.

Table 28 - Land Use Within the 100-Year Flood Outline (Acres)

	Reach 2	Reach 3	Reach W-1	Total
Residential	55	20	21	96
Commercial	20	30	10	60
Industrial	-	-	-	-
Total	75	50	31	156

Reach 2 is a combination of residential units and a few small commercial units. The residential units are of varied values. A sanitary sewage pumping station in located adjacent to the creek on the right bank. The only vacancy in this reach is a commercially zoned parcel located at William Street and Cayuga Creek Road. The adjacent lots have been recently developed with insurance and medical/dental office buildings. The existing flood hazard was recognized by the office builders in that the first floor elevations are above the 1937 flood levels and land adjacent to the creek is used for parking.

The land use in Reach 3 is similar to Reach 2 with the exception of a privately owned recreation area located adjacent to the creek upstream of the Union Road Bridge. Vacant land in this reach consists of two lots located at the intersection of Union Road and William Street. The parcel closest to the intersection is zoned light industrial and the other parcel is zoned commercial. The two lots have an area of 5.5 acres.

Reach W-1 is the Williamstowne Apartment complex and recreation center.

Table 29 provides information on the number of units affected by the 1959 and standard project flood by reach at October 1974 conditions of development.

Table 29 - Units Affected by the 1959 Flood and Standard Project Flood

Reach	1959 Flood			Standard Project Flood		
	Residential	Commercial	Public	Residential	Commercial	Public
2	24	10	1	184	12	2
3	12	9	0	15	13	-
W-1	31	0	0	33	-	-
Total	67	19	1	232	25	2

All vacant acreage within the 100-year flood outline was assumed to be completely developed by the base year of the project. Therefore, no benefits from future development accrue to the proposed project. This is due to the incorporation of certain criteria for flood plain development into the town's overall zoning regulations. Future development in the flood plain must now meet certain minimum requirements which were adopted 27 December 1969. The purpose of the zoning regulations is to prevent encroachments into the flood plain which may result in increased flood heights and damages. The land subject to these development criteria in the area of Cayuga Creek is considered to be that acreage inundated by the 1937 flood level. Permitted land uses in these areas fall within two groups.

a. Open Uses

(1) raising of agricultural crops

(2) roads, railroads, electric, and other utility transmission lines

(3) open-type public or private recreation facilities

(4) temporary or transient uses such as carnival, circus or other amusement enterprises

(5) storage for equipment/material not subject to movement by flood waters

b. Buildings - no building permit shall be issued within the area designated as "Flood Plain Zone" unless approved by the Town Engineer who shall be guided by the following standards:

(1) all structures shall be designed and placed on the lot so as to offer minimum obstruction to the flow of water

(2) all structures permitted shall be firmly anchored

(3) all structures permitted should be constructed so as to offer minimum obstruction to the flow of water

This vacant acreage was assumed to develop between 1975 and 1980 based upon future growth patterns expected to occur within the town. Future development will not benefit significantly by the proposed levee since all future first floor elevations must be at or above the 1937 flood level.

BENEFITS OF THE PROPOSED PLAN

The benefits attributable to the proposed flood control project are based on the reduction in flood inundation damages resulting from discharges in excess of channel capacity, the reduction in damages to the future stock of residential contents, and from the use of unemployed or underemployed labor resources in project construction. Reduced flood inundation damage and related costs contribute to national economic development. The net productivity of flood plain resources can be increased by either an increase in the output of goods and services or a reduction in the costs associated with the utilization of floodprone lands. Since no future development is contemplated within the project area, 1980 flood damages and benefits are those for existing conditions.

DAMAGES UNDER EXISTING CONDITIONS

Damage Survey - A detailed damages survey was conducted by the Buffalo District during June 1960. The damage survey was updated in October 1974 to reflect current conditions. The results of the 1974 damage survey were used as the basis for determining average annual flood damages from estimated future flood occurrences and benefits that would result from the considered plan of improvement.

Reach Limits - The project was divided into Reach 2 and Reach 3 on Cayuga Creek and Reach W-1 on Williamstowne Brook. The reach limits were developed to insure that areas within each reach exhibited common hydrological characteristics. The location of each reach, the index point, and initial damage stage are presented in Table 30 and Plate B-5.

Table 30 - Damage Reaches

Reach	Index Point	Initial Damaging Elevation	Recurrence Interval In Years	Description of Reach
2	1,000 feet downstream from Union Road Bridge	603.0	10	2,600 feet to 1,000 feet downstream from Union Road Bridge
3	400 feet upstream from Union Road Bridge	605.0	2	1,000 feet downstream to 1,300 feet upstream from Union Road Bridge
W-1	At Recreation Center on Williamstowne Brook	600.2	2	William Street upstream to Union Road

METHODOLOGY

Residential - The value, type of structure, and first floor elevation of each affected unit was established from field inspection. The value of household contents was determined based on structural value. The estimates of structural and content value considered the location of each unit relative to the neighborhood in terms of proximity to commercial development, schools and churches, general appearance of the structure, and the nature and extent of landscaping and other improvements.

Damages were estimated at various flood depths based on depth-percent damage relationships. The initial damage elevation was defined as the flood height at which water entered the unit's lowest opening. Damages to the units were based on cost of repair, the depreciated value or cost of replacement in kind.

Commercial - All commercial damage estimates are based on personal interviews and include estimated damages to machinery and inventory, lost wages, damage, and anticipated cleanup costs. During the interviews with owners and/or managers of commercial units field personnel documented the overall condition of the building and equipment as well as the type and value of inventory.

Public and Other - The estimated damages to public facilities such as buildings, roads, bridges, and utilities were determined by calculated flood depths and field observations. It was assumed that bridges over Cayuga Creek would be destroyed if the flood elevation exceeded the low roadway elevation by two or more feet. Detour costs were based on traffic counts, variable costs of automobile and truck operatios, and a cost of driver time for commercial truck operators. A cost of $2.00 per hour was taken as an inconvenience cost for private automobiles. Emergency operations and cleanup cost incurred by local, State, and Federal agencies were estimated based upon physical characteristics of the flooding (e.g., flood depths and durations), the flood emergency activities of the affected area, and field observations.

AVERAGE ANNUAL DAMAGES

The average annual damages were developed based on stage-frequency relationships and stage-damage information. The stage-damage curves, given in October 1977 price levels, are illustrated on Plates B6-B8. For purposes of computation, the intermediate regional flood was assigned a frequency of once per 100 years. The average annual damages are the expected value of flood damages for any year. The average annual flood inundation damages, 1974 conditions of development, by reach and activity, updated to current price levels

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(April 1979), are presented in Table 31 and are adjusted to 1980 conditions of development exhibited in Table 32. Since future development is not expected in the project area, 1980 damages represent existing conditions with rise in content value.

Table 31 - Estimated Average Annual Damages, Existing Conditions, April 1979 Price Levels and Conditions of Development as of 1974

Reach	Residential	Commercial	Public and Other	Other
	$	$	$	$
2	11,790	5,870	1,230	18,890
3	5,840	32,680	4,350	42,870
W-1	31,780	0	0	31,780
Total	49,410	38,550	5,580	93,540

Table 32 - Average Annual Flood Inundation Damages Under Existing Conditions, April 1979 Price Levels and 1980 Conditions of Development[1/]

Reach	Residential	Commercial	Public and Other	Other
	$	$	$	$
2	12,920	5,870	1,230	20,020
3	6,460	32,680	4,350	43,490
W-1	35,110	-	-	35,110
Total		38,550	5,580	98,620

1/ Though the flood plain is completely developed, a rise in residential content damage is expected resulting from a rise in per capita income of flood plain residents.

BENEFITS

Flood Inundation Reduction - The flood inundation reduction benefit is the difference between the expected value of damages with and without the proposed improvement.

The proposed plan of improvement detailed in Appendices A and C and discussed in the main report calls for the construction of a levee upstream of Union Road. The average annual damages under existing conditions and with the improvements are presented in Table 33. The levee, providing 100-year protection, would reduce average annual flood inundation damages by $82,200 under 1980 conditions of development.

Affluence Benefits - The affluence benefit is a measure of the increased average annual residential flood inundation damages resulting from the effect of rising per capita income on the value of residential real property and contents in constant dollars. It is assumed that the value of the stock of residential contents will rise in direct relationship to the rate of growth in per capita income. Under current guidelines, the rise in content value is limited such that the content value cannot exceed 75 percent of the residential structure's value. OBERS 1972 Series E Income Projections for the Buffalo SMSA were utilized to project residential content value. The limit was reached in the 24th year of project life, 2004, after which the value of residential contents remained constant. The increase in content value was discounted to the project base year and transformed to a ratio expressing the effect on residential damages. The effect is to increase the expected damages under existing and improved conditions during the project life, as shown in Table 34, Flood Inundation Damages and Benefits by Decade. Expected residential flood inundation reduction benefits are projected to rise from $36,270 in 1980 to $52,450 in year 2004. The average annual equivalent of this rise or $7,820 is the affluence factor benefit. The average annual flood inundation benefit with affluence is $82,200 with the construction of a levee. The decadal level of expected flood inundation damages and benefits is presented in Tables 33 and 34.

Area Redevelopment Benefits - Area redevelopment benefits presented in Table 35 are based upon utilization of unemployed or underemployed labor resources in the construction and installation of a Federal construction project. The benefit is a quantification of the project's beneficial impact on these labor resources. Under current guidance, this benefit is applicable in areas classified by the U.S. Department of Labor as having substantial or persistent unemployment.

The Buffalo SMSA is a qualified area under current guidelines. The unemployment rate in Erie County in April 1979 was 6.7 percent. During April 1979, 3,516 contract construction workers were drawing unemployment insurance within Erie County, and 4,427 of the same sector were drawing unemployment insurance in the Buffalo SMSA. The number receiving benefits underestimates actual unemployment since it does not include workers who have exhausted benefits or who are ineligible as well as the number of underemployed construction

Table 33 - Cayuga Creek 100-Year Protection Levee Alternative - Average Annual Flood Inundation Damages and Benefits by Decade with Affluence, April 1979 Price Levels

	1974	1980	1990	2000	2010	2020	2030
	$	$	$	$	$	$	$
Reach 2							
Damages under existing conditions	18,900	20,020	21,860	24,640	25,570	25,570	25,570
Damages under improved conditions	3,580	3,730	3,970	4,350	4,480	4,480	4,480
Flood inundation reduction benefit	15,320	16,290	17,890	20,290	21,090	21,090	21,090
Reach 3							
Damages under existing conditions	42,870	43,480	44,500	46,030	46,580	46,580	46,580
Damages under improved conditions	4,510	4,560	4,640	4,770	4,820	4,820	4,820
Flood inundation reduction benefit	38,360	38,920	39,860	41,260	41,760	41,760	41,760
Reach W-1							
Damages under existing conditions	31,780	35,110	40,200	48,110	50,750	50,750	50,750
Damages under improved conditions	14,430	15,940	18,250	21,810	23,040	23,040	23,040
Flood inundation reduction benefit	17,350	19,170	21,950	26,300	27,710	27,710	27,710
Total damages under existing conditions and with levee upstream of Union Road							
Damages under existing conditions	93,550	98,610	106,560	118,780	122,900	122,900	122,900
Damages under improved conditions	22,520	24,230	26,860	30,930	32,340	32,340	32,340
Flood inundation reduction benefit	71,030	74,380	79,700	87,850	90,560	90,560	90,560

Table 34 - Cayuga Creek - Average Annual Flood Inundation Benefits by Decade with Affluence, April 1979 Price Levels, Project Interest Rate of 6-7/8 Percent

	1974	1980	1990	2000	2010	2020	2030	Average Annual Flood Inundation Reduction Benefits with Affluence
	$	$	$	$	$	$	$	$
Levee upstream of Union Road								
Reach 2								
Residential	10,210	11,180	12,780	15,180	15,980	15,980	15,980	13,510
Commercial	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200
Public & Other	910	910	910	910	910	910	910	910
Total Reach 2	15,320	16,290	17,890	20,290	21,090	21,090	21,090	18,620
Reach 3								
Residential	5,360	5,920	6,860	8,260	8,760	8,760	8,760	7,290
Commercial	29,100	29,100	29,100	29,100	29,100	29,100	29,100	29,100
Public & Other	3,900	3,900	3,900	3,900	3,900	3,900	3,900	3,900
Total Reach 3	38,360	38,920	39,860	41,260	41,760	41,760	41,760	40,290
Reach W-1								
Residential	17,350	19,170	21,950	26,330	27,710	27,710	27,710	23,290
Commercial	-	-	-	-	-	-	-	-
Public & Other	-	-	-	-	-	-	-	-
Total Reach W-1	17,350	19,170	21,950	26,330	27,710	27,710	27,710	23,290
Total flood reduction benefits due to levee upstream Union Road								
Residential	32,920	36,270	41,590	49,740	52,450	52,450	52,450	44,090
Commercial	33,300	33,300	33,300	33,300	33,300	33,300	33,300	33,300
Public & Other	4,810	4,810	4,810	4,810	4,810	4,810	4,810	4,810
Total	71,030	74,380	79,700	87,850	90,560	90,560	90,560	82,200

workers. Total unemployment for April 1979 was 31,300 and 37,900 for Erie County and the Buffalo SMSA, respectively. A little better than half of total unemployment in April 1979 was receiving unemployment insurance in Erie County.

Labor costs for the levee construction were estimated at 40 percent of construction cost and contingencies based upon similar construction projects in the District. Labor skills needed are expected to be concentrated in the skilled trades. Heavy equipment operators and related skills are anticipated to comprise most of the skilled labor component.

Total wages paid to local labor resources were estimated to be 90 percent of the total labor component, due to the limited scale of the proposed project. Locally unemployed or underemployed labor resources were assumed to receive 20 percent of all wages paid to local labor. This amount was then amortized over the project life. The average annual area redevelopment benefit of $3,200 is shown in Table 36.

Table 35 - Area Redevelopment Benefits

Construction Cost	Labor Cost .4 x Col. 1	Wage to Local Labor .9 x Col. 2	Wages to Unemployed or Under-Employed Labor .2 x Col. 3	Benefit .06884 x Col. 4
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
$650,100	$260,000	$234,000	$46,800	$3,200

Total Benefits - The total benefits associated with the proposed project are $85,400 and are detailed below:

Table 36 - Total Average Annual Benefits

	$
Existing Conditions	
Flood Inundation Reduction	74,400
Area Redevelopment	3,200
Total Existing Conditions	77,600
Future Conditions	
Affluence	7,800
Total Average Annual Benefits	85,400

PROJECT COSTS

The costs and annual charges for the proposed plan of improvements are presented in Table 37. The annual charges are based on a 6-7/8 percent project interest rate and an economic life of 100 years. Total project annual charges are $72,900, of which $61,700 are Federal and $11,200 non-Federal.

Table 37 - Cayuga Creek, 100-Year Protection, Detailed Project First Costs - 6-7/8 Percent, 100-Year Project Life

Item	Quantity	Unit Cost	Amount Federal	Amount Non-Federal	
		$	$	$	
LANDS AND DAMAGES					
Lands					
Permanent easement	9.0 acres	3,200		28,800	
Temporary easement	3.0 acres	400		1,200	
Contingencies		LS		6,000	
Total lands and damages				36,000	
RELOCATIONS					
Structures	5	5,500		27,500	
Contingencies		LS		5,500	
Total relocations				33,000	
CHANNELS					
Care of water		LS	11,500		
Clearing and grubbing	2.5 acres	2,700	6,750		
Erosion protection material					
27" riprap	3,260 CY	34.35	111,980		
8" bedding	1,390 CY	27.45	38,160		
Excavation - unclassified	4,420 CY	3.55	15,690		
Precast concrete toe	1,000 LF	5.80	5,800		
Fertilizer, seed mulch	2.0 acres	1,350	2,700		
Contingencies		LS	38,420		
Total channels			231,000		
LEVEES AND FLOODWALLS					
Care of water		LS	22,500		
Compacted fill	9,350 CY	3.95	36,930		
Concrete, T-wall	825 CY	225	185,630		
Concrete, transverse wall	540 CY	75	40,500		
Culvert with flap gate and gate valve	1-24 IN	LS	5,600		
Culvert with flap gate	1-18 IN	LS	3,300		
Riprap and bedidng	400 SY	27.00	1,350		
Fertilizer, seed and mulch	1 acre	1,350	1,350		
Inspection trench	1,050 CY	2.55	2,680		
Stripping	1,950 CY	4.40	8,580		
Structural backfill	2,650 CY	3.95	10,470		
Structural excavation	7,600 CY	2.55	19,380		
Anchorage	400 LF	3.50	1,400		
Contingencies	LS		69,880		
Total levees and floodwalls			419,000		
ENGINEERING AND DESIGN		LS	143,540		
SUPERVISION & ADMINISTRATION		LS	99,460		
TOTAL PROJECT COST			893,000	69,000	
ANNUAL CHARGES					
Interest 1/			61,400	4,700	66,100
Amortization 2/			100	-	100
Maintenance 3/			200	6,500	6,700
Total Annual Charges			61,700	11,200	72,900

1/ 6-7/8 percent.
2/ Amortization at 6-7/8 percent for a 100-year project life.
3/ Non-Federal maintenance estimated at one percent of construction costs excluding lands and relocations. Federal maintenance costs are for inspection.

ECONOMIC EFFICIENCY

Four measures of economic efficiency were developed for the proposed plan of improvement. They are: The B/C ratio, net discounted benefits, the payback period, and the internal rate of return as shown in Table 38.

Table 38 - Economic Efficiency of the Proposed Plan

Benefit Cost Ratio at 6-7/8 Percent	Net Discounted Benefits at 6-7/8 Percent	Undiscounted Pay Back Period	Internal Rate of Return
	$		
1.17 to 1	181,200	13 Years	7-13/16

The B/C ratio is the ratio of average annual benefits to average annual costs evaluated at the project interest rate of 6-7/8 percent. A B/C ratio greater than unity indicates that the project yield net economic benefits. The B/C ratio for the plan of improvement is 1.17 to 1.

Net discounted benefits are the present value of benefits in excess of the sum of the project costs plus future operations and maintenance discounted at the project interest rate. Net discounted benefits measure the present value of the project beneficial effect over the planning period. Net discounted benefits are $181,200.

The projects pay back period is 13 years. Over the 13-year period the expected sum of undiscounted annual benefits is equal to the project costs including annual maintenance.

The internal rate of return indicates the rate of return on investment resulting from project implementation. The internal interest rate of 7-13/16 percent is that rate at which the net discounted benefits are zero and the B/C ratio 1 to 1.

OTHER ALTERNATIVES CONSIDERED

Structural - In order to assure that the level of protection provided by the proposed project is at the optimal level, a sensitivity analysis was performed. The analysis tested the degree of protection provided by various heights of the levee system as they compared to their respective costs. In addition to the 100-year protection, 50-year and 200-year protection alternatives were analyzed.

Levees providing 50-year, 100-year, and 200-year protection would reduce average annual flood inundation damages by $22,700, $82,200, and $88,800 respectively under 1980 conditions of development. The economic summary of the various protection plans is presented in Table 39.

Nonstructural - Preliminary investigation of alternative flood damage protection plans (see Table 9 of main report) indicates that in addition to local structural protection measures, nonstructural floodproofing as an alternative should be investigated in greater detail. A nonstructural plan of improvement was evaluated based upon a design elevation associated with the intermediate regional flood event. This elevation was derived using stage-frequency relationships for existing conditions in each reach. Field survey information on the type, value, and first floor elevation of each affected unit was reviewed to determine those units which might be best suited as candidates for floodproofing measures.

Residential protection consists primarily of the installation of sewer line gate valves, sump pumps, and temporary and permanent closures for basement or foundation openings, bracing foundations, and raising certain structures. The apartment building in Reach W-1 would require a small floodwall around its periphery. The improvements were assumed to be in place and the depth-percent-damage curves were adjusted for a range of flood elevations for which these barriers might be considered effective. Commercial units would be floodproofed by construction of ring-levels or floodwalls to the established design elevation, or raised above the IRF elevation. Changes in the public and other sector damages were not considered in the nonstructural elevation. It is very likely that these damages would rise, since many more flood plain occupants would remain within their residences only to realize that their evacuation would be required if the design capacity of their protection were equaled or exceeded.

Calculations of expected benefits of the nonstructural plan was based initially assuming an ideal level of operational efficiency under improved conditions. Engineering design limitations of the floodproofing alternative at the project site prevents the likelihood of 100 percent efficiency. Because leakage, seepage, and malfunction of structures, pumps, and closures will cause a substantial residual damage following flood events, it was determined that the operational efficiency of the nonstructural plan would more likely result in 50 to 75 percent effectiveness. For benefit evaluation purposes, the assumption of 75 percent effectiveness was used. The first cost and annual charges for the nonstructural plan are given in Table 40A and 40B. Total project annual charges are $63,800, of which $43,700 are Federal and $20,100 are non-Federal. The economic summary of the nonstructural alternative, using 50, 75, and 100 percent effectiveness, are presented in Table 41. Assuming 75 percent effectiveness, the benefit-cost ratio is .86 to 1; net average annual benefits are $-9,200.

Table 39 - Summary of Levels of Protection Considered

	Level of Protection		
	50-Year	100-Year	200-Year
	$	$	$
Average Annual Inundation Reduction Benefit	72,700	82,200	88,800
Area Redevelopment Benefit	2,900	3,200	7,100
Total Average Annual Benefit	75,600	85,400	95,900
Average Annual Cost (6-7/8%)	66,300	72,900	149,800
Net Average Annual Benefits	9,300	12,500	53,900
Benefit Cost Ratio	1.14	1.17	.64

The 100-year plan maximizes the average annual net benefits and has the greatest benefit-cost ratio. The structural alternative providing 100-year level of protection is the best plan in terms of economic efficiency.

Table 40A - Cayuga Creek, Nonstructural Plan First Costs

Item	No.	Unit	Cost	%	Total Federal	%	Total Non-Federal
			$		$		$
Flood Shields	84	Ea	317	80	21,300	20	5,300
Sewer Gate Valves	58	Ea	264	100	15,300	0	-
Underpinning	23	Ea	1,443	80	26,600	20	6,600
Brace & Load Structure	4	Ea	1,450	80	4,600	20	1,200
Extend Foundation	4	Ea	2,275	80	7,300	20	1,800
Reconstruct Stairs & Landscape	4	Ea	1,775	80	5,700	20	1,400
Rearrange Damageable Property	27	Ea	263	80	5,700	20	1,400
Rain Gauge	2	Ea	7,200	80	11,500	20	2,900
Computer & Base Station	1	L.S.	9,600	80	7,700	20	1,900
Floodwall	3,600	L.F.	4,740	80	136,600	20	34,200
Levee	4,800	L.F.	2,635	80	101,200	20	25,300
Sump Pump	19	Ea	895	0	-	100	17,000
Generator	19	Ea	421	0	-	100	8,000
Raise Recreation Building	1	L.S.	71,600	80	57,300	20	14,300
Subtotal					400,800		121,300
Contingencies (± 25%)					100,200		30,300
Subtotal w/Contingencies					501,000		151,600
Engineering & Design (± 15%)					75,200		22,700
Supervision & Administr. (± 10%)					50,100		15,200
Total First Cost				77	626,300	23	189,500

Table 40B - Cayuga Creek - Nonstructural Plan
Annual Charges, 100-Year Project Life,
6-7/8 Percent

	Federal	Non-Federal	Total
	$	$	$
Annual Charges			
Interest 1/	43,100	13,000	56,100
Amortization 2/	100	-	100
Replacements 3/	500	1,500	2,000
Maintenance 4/	-	5,600	5,600
Total Annual Charges	43,700	20,100	63,800

1/ .06875
2/ Amortization at 6-7/8 percent for 100-year project life.
3/ Periodic replacements for sump pumps (10 years), flood shields (33 years, generators (25 years), gate valves (50 years), forecast station (25 years) given as average annual values. Discounted at 6-7/8 percent.
4/ Maintenance cost assumed to be 10 percent of average annual first cost.

Table 41 - Cayuga Creek, Nonstructural Plan, Summary of Annual Benefits and Costs

	Percentage Effectiveness		
	50	75	100
Inundation Reduction Benefit			
Existing	30,850	46,300	61,700
Future	3,400	5,100	6,800
Subtotal	34,250	51,400	68,500
Area Redevelopment Benefit	3,200	3,200	3,200
Total Average Annual Benefit	37,450	54,600	71,700
Total Average Annual Cost	63,800	63,800	63,800
Net Average Annual Benefit	-26,350	-9,200	7,900
Benefit Cost Ratio	.59 to 1	.86 to 1	1.12 to 1

Standard Project Flood (SPF) - Investigation has found that providing flood damage protection for the Standard Project Flood in this area is not economically justified. A SPF level of protection would require, as a minimum, a $35 million dollar reservoir at Cowlesville or Bennington, New York, as well as extensive channel and floodwall or levee work downstream. The average annual damages prevented does not warrant a project of this magnitude.

Occurrence of the SPF, with and without the selected project, would result in a catastrophe of major proportions to the people of the considered project area. Flood depths up to eight feet would be accompanied by average channel and overbank velocities of about 15 and 5 feet per second, respectively, with a maximum rate of rise of approximately one foot per hour. The SPF would remain above bankfull stage for approximately 30 hours. Presently there are specific flood warning and forecasting services for the Cayuga Creek Basin, since this area is well within the effective range of the Weather Surveillance Radar operating continuously at the U.S. Weather Bureau, Buffalo Airport Station. This equipment provides for the early detection and plotting of heavy precipitation and makes possible immediate radio and television broadcasts of information concerning the predicted path and amount of rainfall from a particular storm. However, the reliable warning time is not greater than 12 hours. Plate 2 of the main report shows the Standard Project Flood Outline.

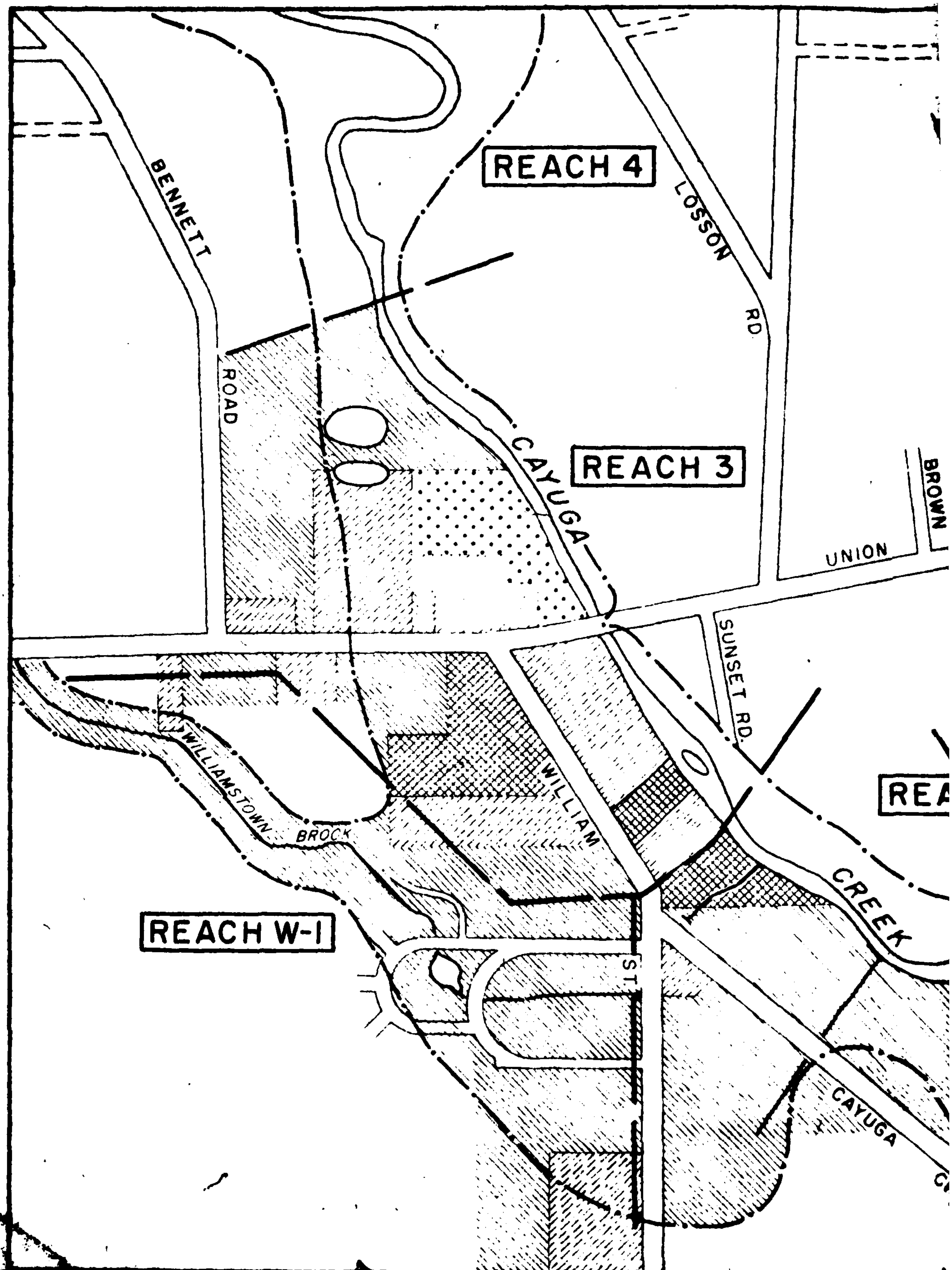
A flood of SPF magnitude would inundate approximately 210 acres in the project area. The number and type of units affected from an occurrence of the SPF are shown in Table 42. The estimated damages that would be incurred from the occurrence of the SPF for base year conditions of development, by activity, are shown in Table 43.

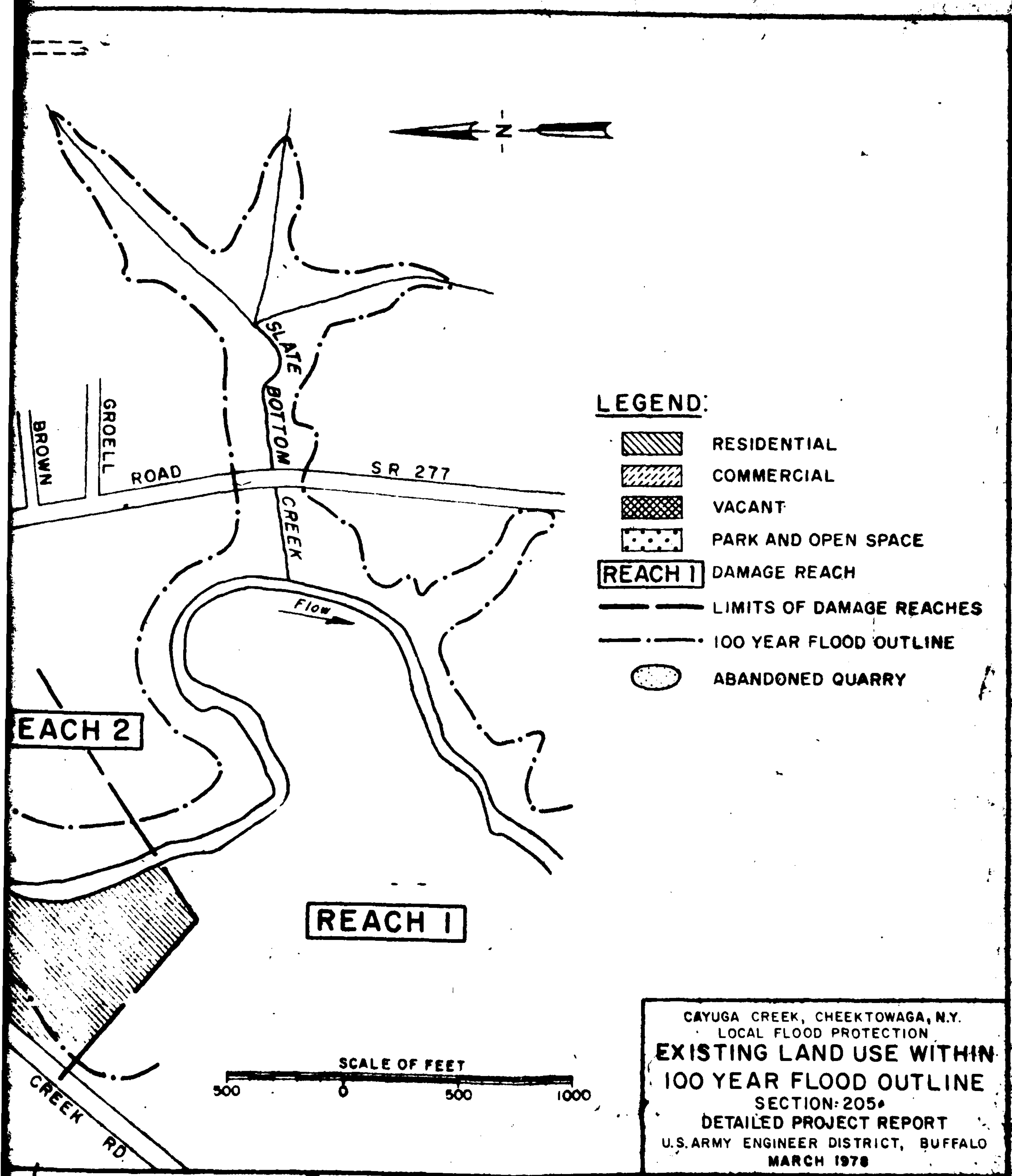
Table 42 - Approximate Number of Units Affected from the Occurrence of the Standard Project Flood, October 1974 Conditions of Development

Reach	Units Affected		
	Residential	Commercial	Public
2	184	12	2
3	15	13	0
W-1	33	0	0
Total	232	25	2

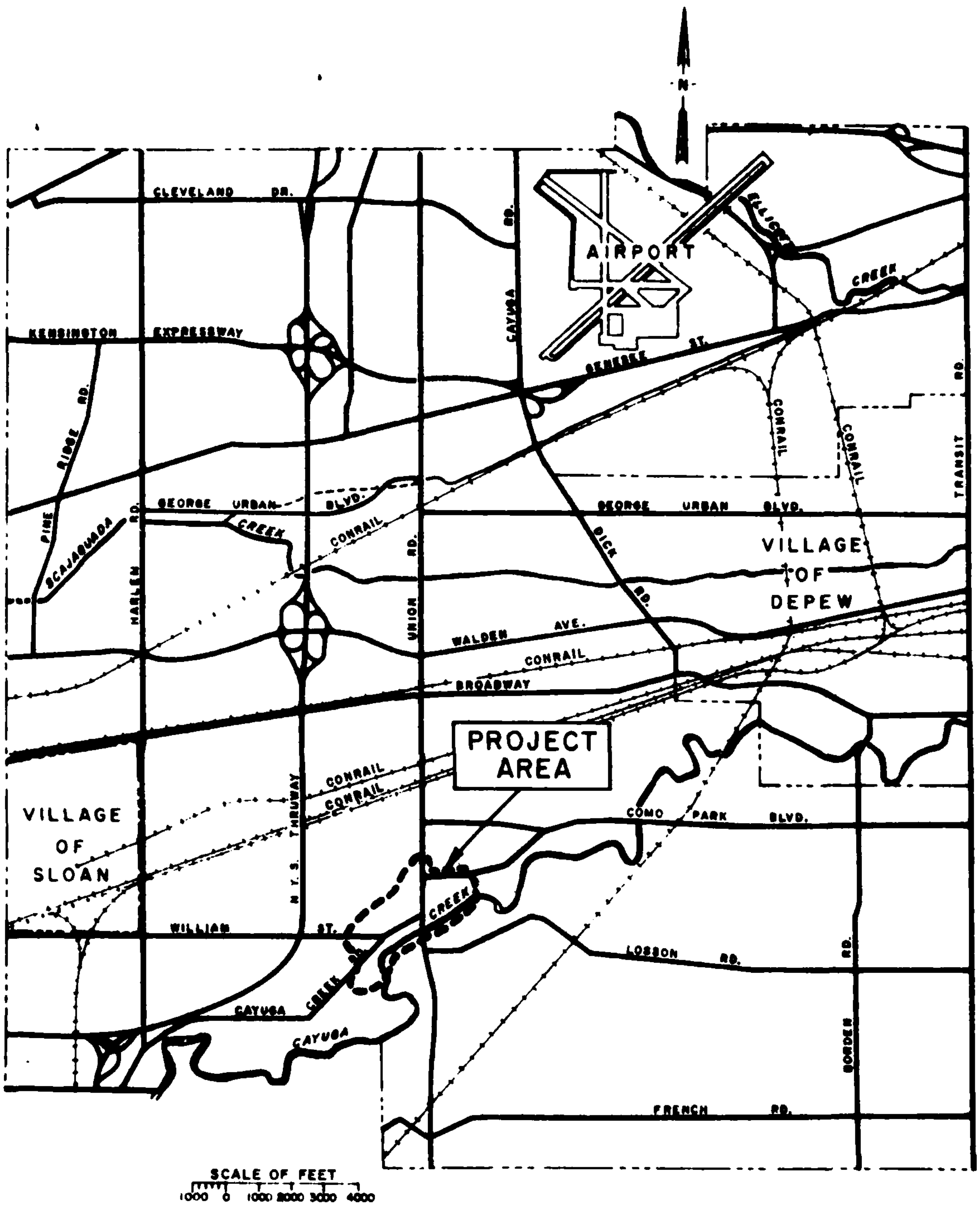
Table 43 - Estimated Damages from the Occurrence of the Standard Project Flood, April 1979 Price Levels and Conditions of Development as of 1980

Reach	Residential	Commercial	Public and Other	Total
	$	$	$	$
2	2,728,100	1,594,400	1,862,500	6,185,000
3	768,300	1,469,600	5,604,400	7,842,300
W-1	2,508,700	-	-	2,508,700
Total	6,005,100	3,064,000	7,466,900	16,536,000


REACH 4
BENNETT
ROAD
LOSSON
RD
REACH 3
CAYUGA
BROWN
UNION
SUNSET RD.
REA
WILLIAMSTOWN
BROCK
WILLIAM
ST
CREEK
REACH W-1
CAYUGA



CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION
EXISTING LAND USE WITHIN
100 YEAR FLOOD OUTLINE
SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

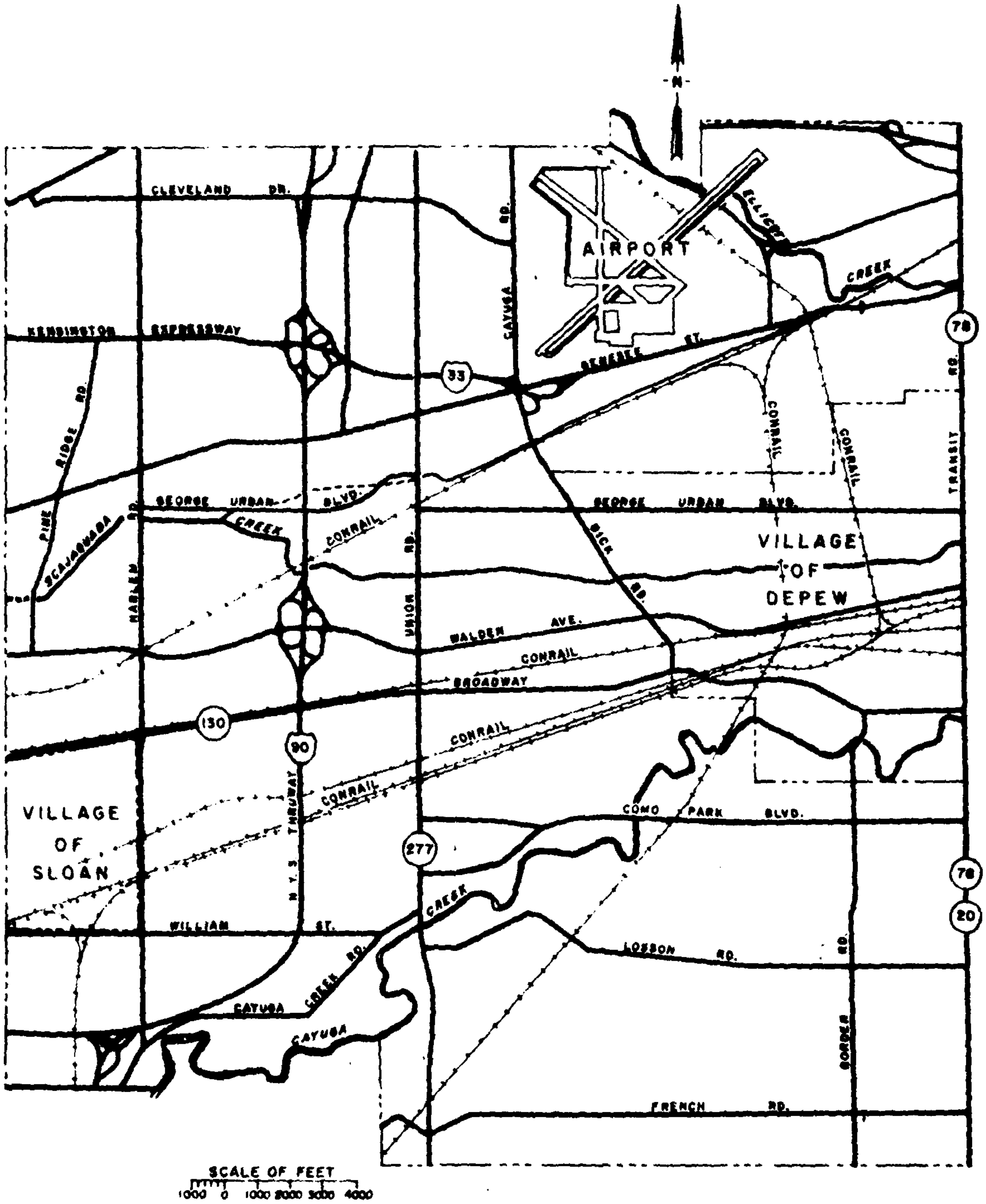


CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION

TOWN OF CHEEKTOWAGA AND PROJECT AREA

SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE B2

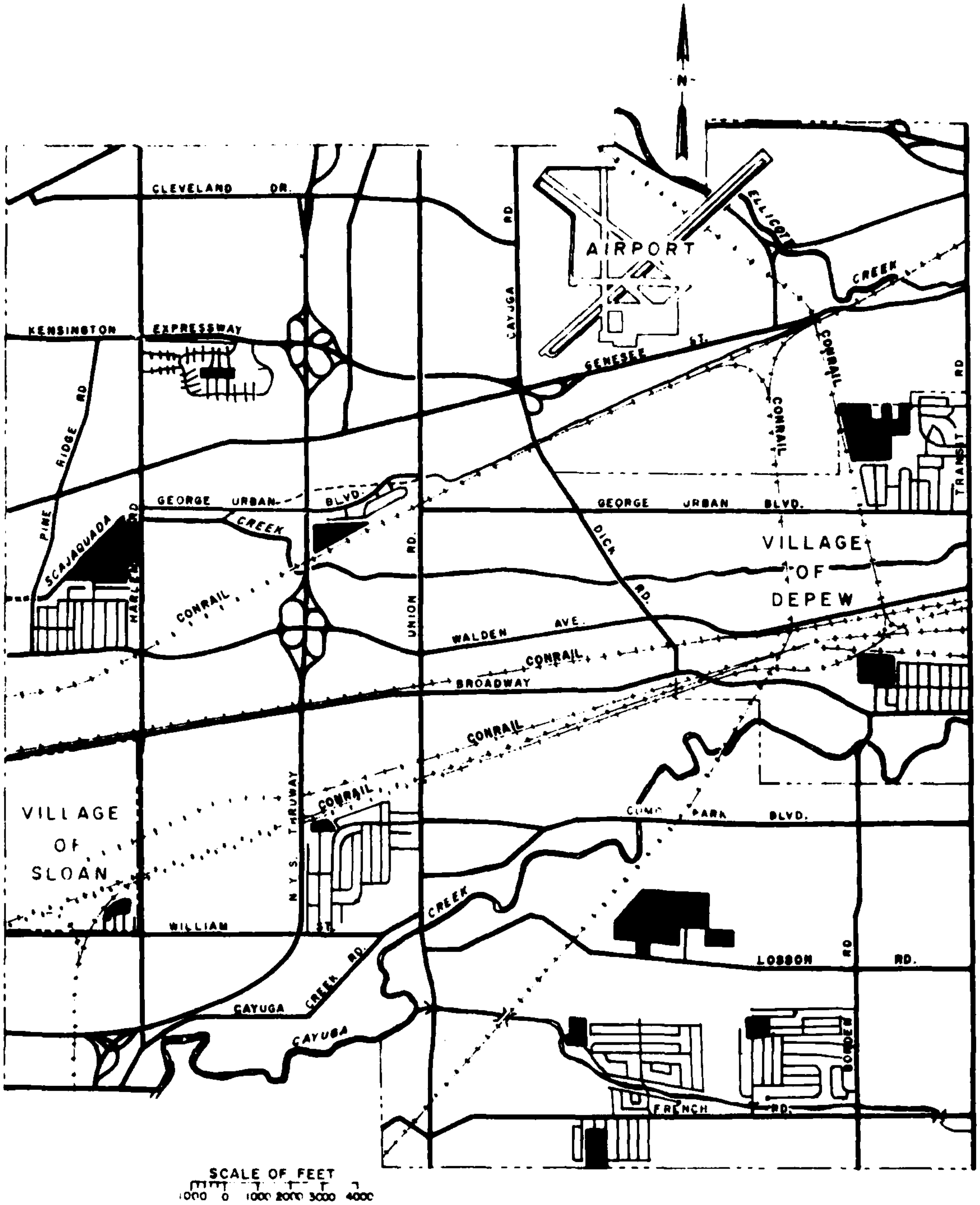


CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION

HIGHWAY SYSTEM

SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE B3



LEGEND

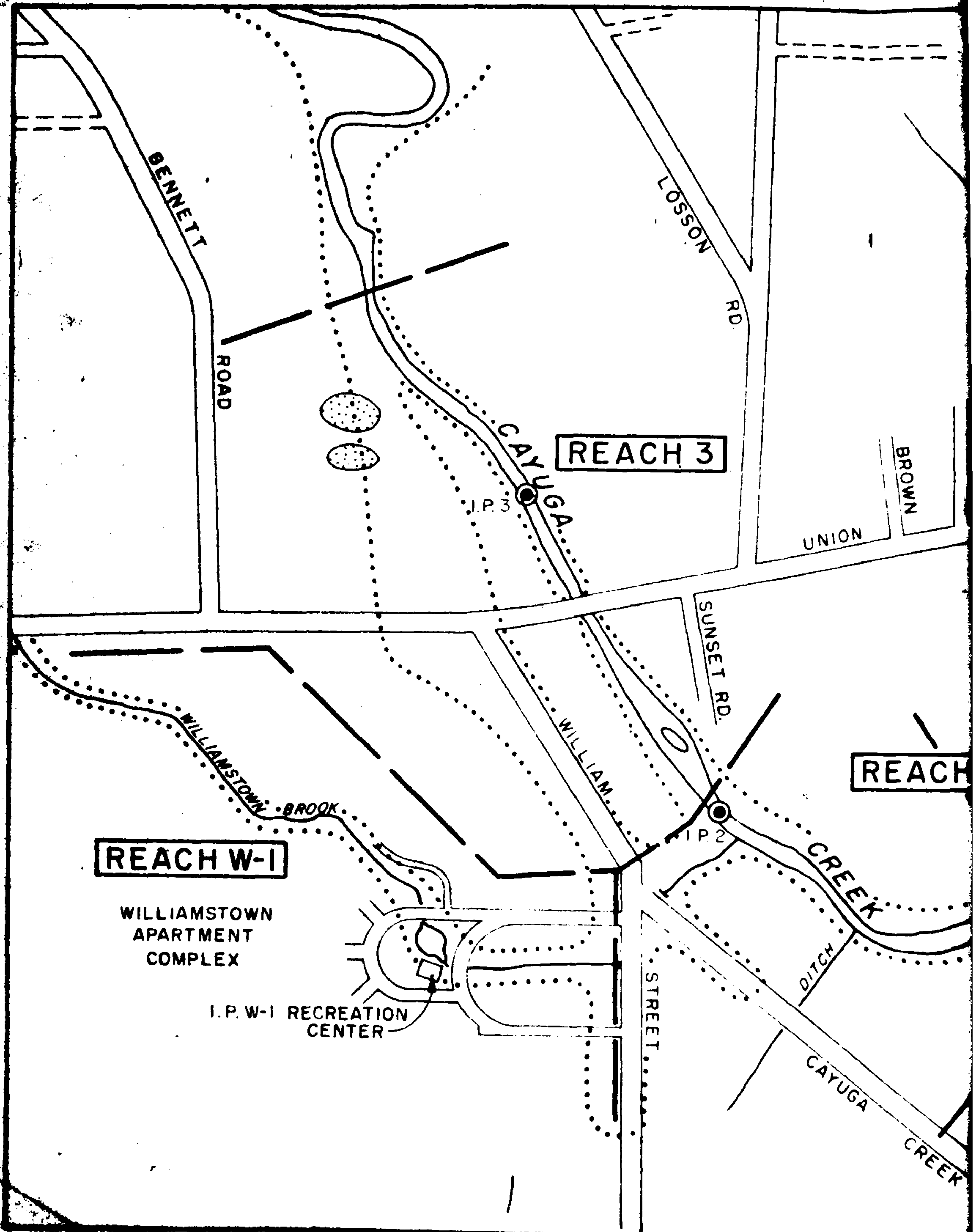
PUBLIC RECREATION AREAS

CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION

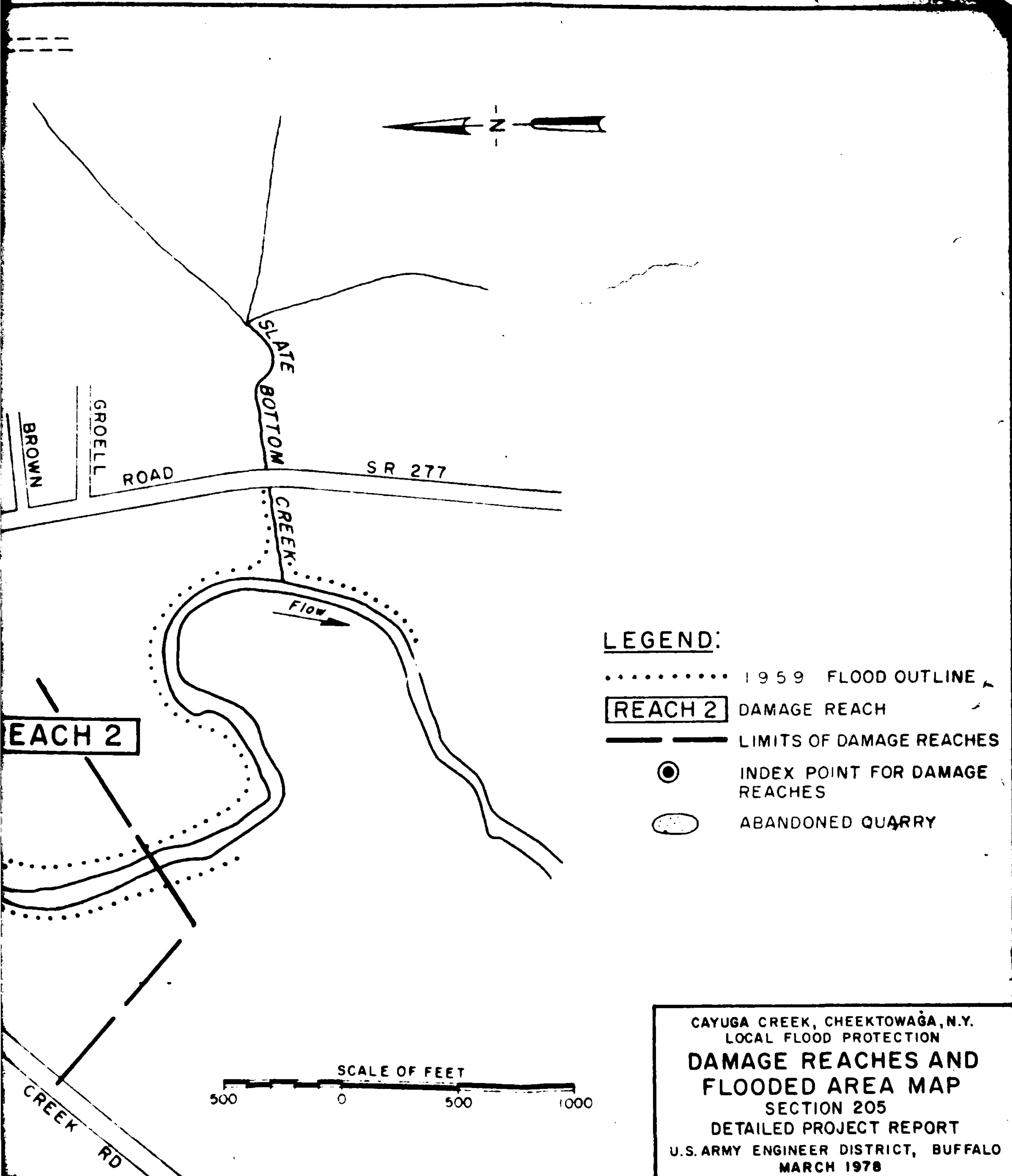
PUBLIC RECREATION AREAS

SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE B4



BENNETT
ROAD
LOSSON
RD.
CAYUGA
REACH 3
I.P. 3
BROWN
UNION
SUNSET RD.
WILLIAM
WILLIAMSTOWN BROOK
REACH W-1
WILLIAMSTOWN
APARTMENT
COMPLEX
I.P. W-1 RECREATION
CENTER
I.P. 2
CREEK
REACH
DITCH
STREET
CAYUGA
CREEK



CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION

DAMAGE REACHES AND FLOODED AREA MAP

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DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE B5

K•E 20 X 20 TO THE INCH KEUFFEL & ESSER CO. 46 1240

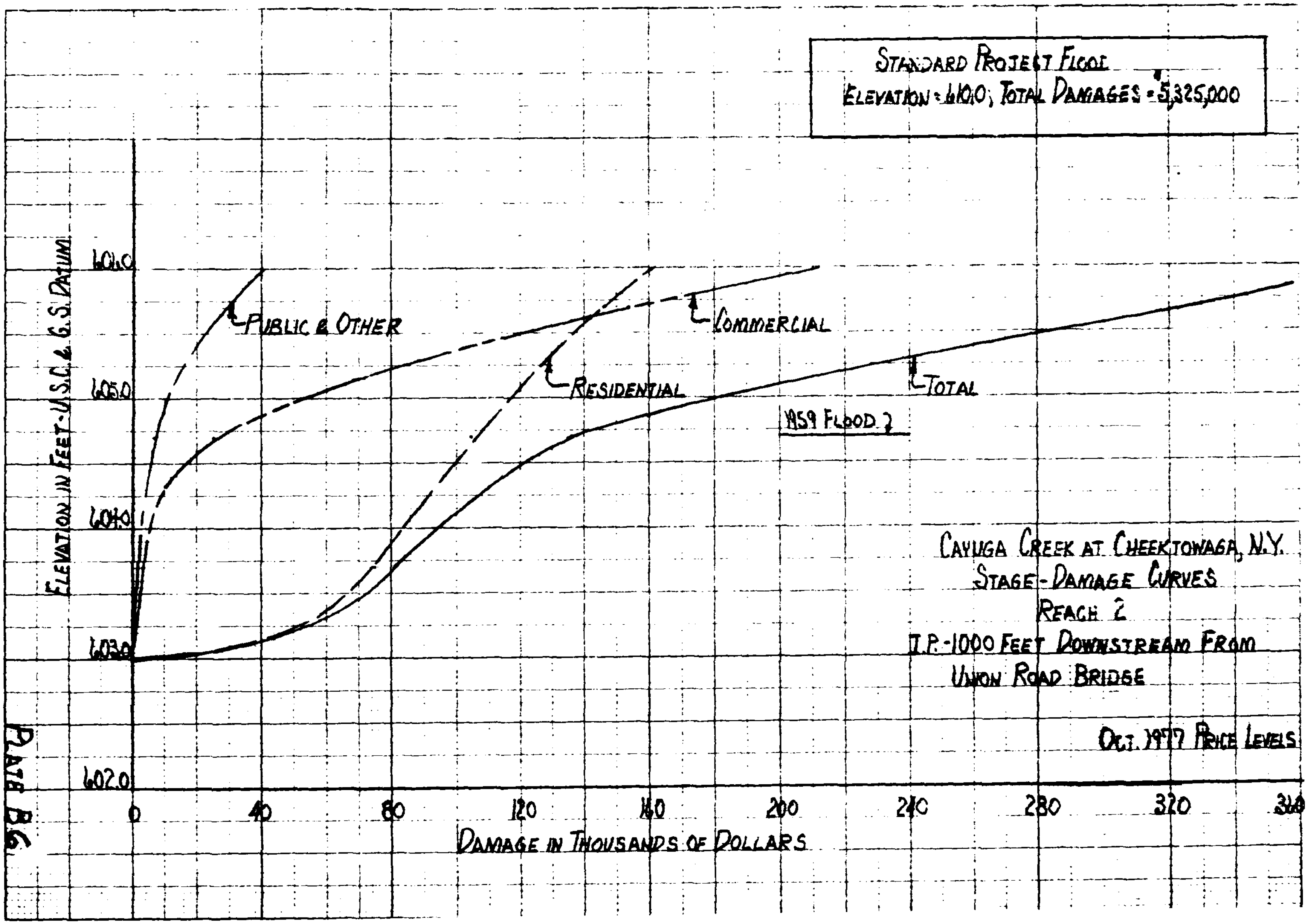


PLATE B6

K•E 20 X 20 TO THE INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1240

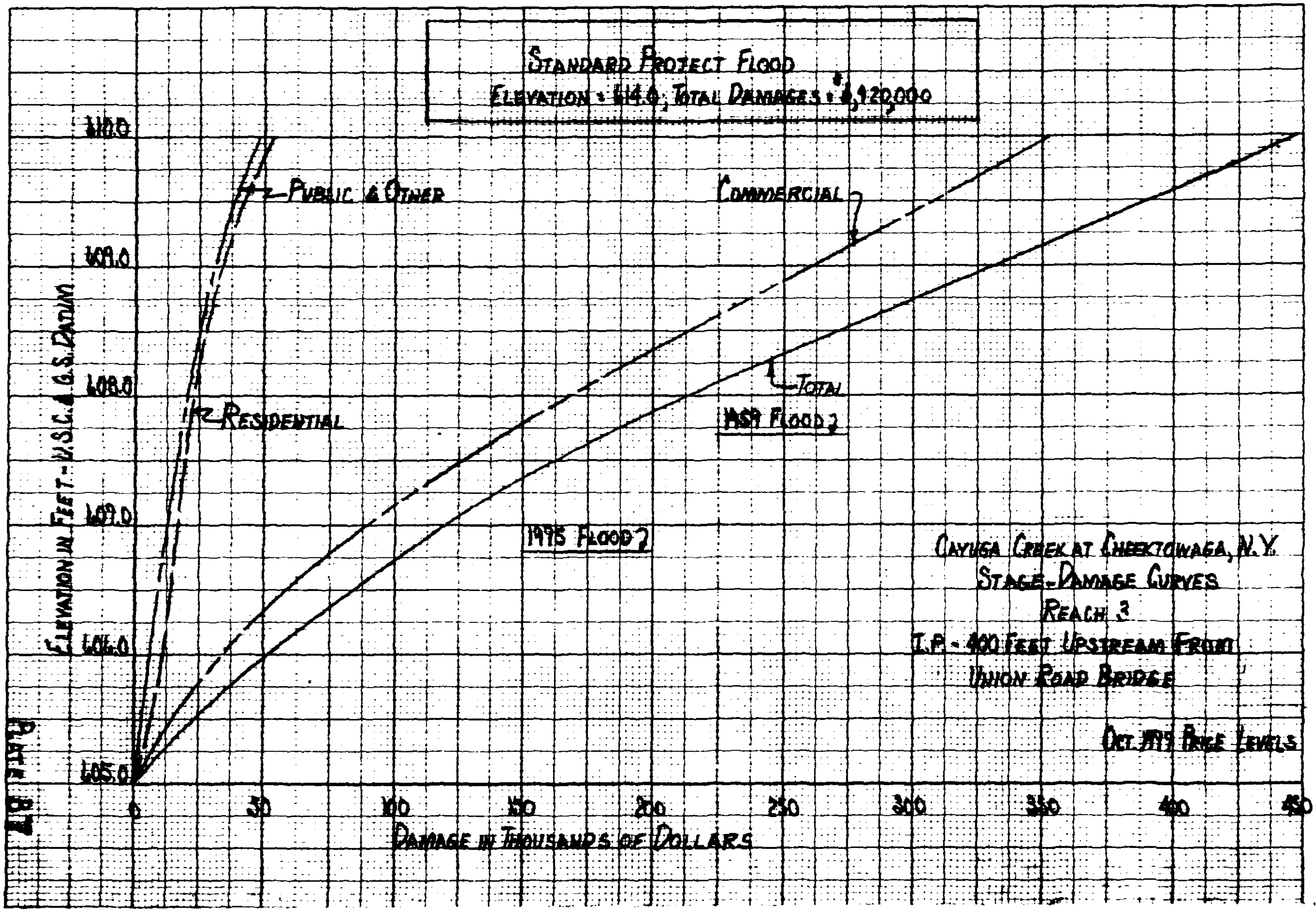
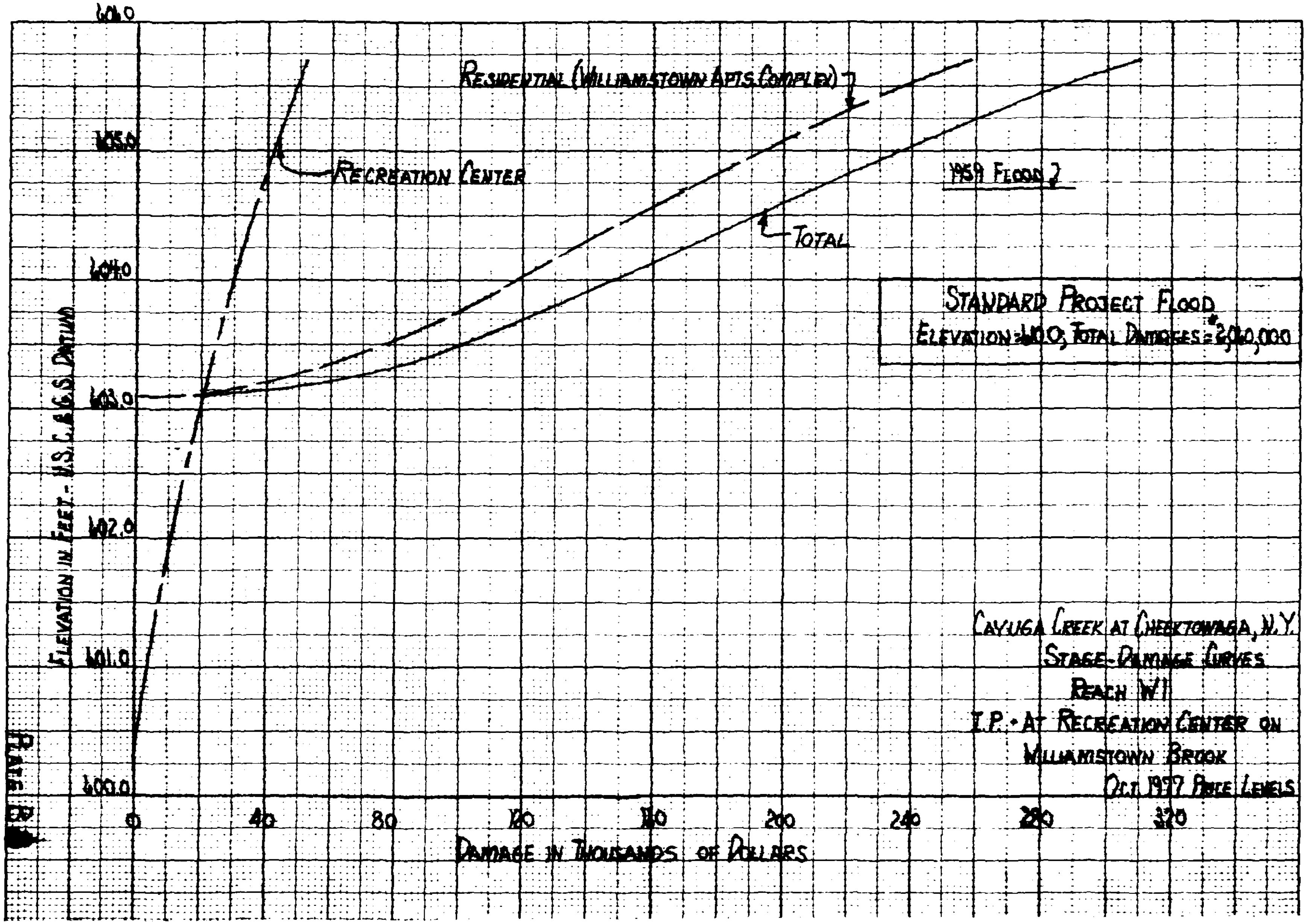


PLATE B7

K•E 20 X 20 TO THE INCH KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1240



CAYUGA CREEK

CHEEKTOWAGA, NEW YORK

APPENDIX C

STRUCTURAL DESIGN

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

Cayuga Creek
Cheektowaga, New York

Appendix C
Structual Design

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Plates

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Table

1. REGIONAL GEOLOGY

1.1 Physiography - Cayuga Creek heads in the glaciated portion of the Allegany Plateau and flows northward through a steep, narrow, drift-filled valley. Upon reaching the Erie-Ontario lowland, its gradient decreases, and it flows westward through flat to gently-rolling topography. In some of its lower reaches, including the project site, it is confined to a shallow channel flowing on bedrock which overflows onto an alluvial plain during floods.

1.2 Surficial Geology - Unconsolidated deposits in the vicinity of the worksite are: dense, silty till, glacio-lacustrine silt and clay, and fluvial deposits of gravel, sand, and silt. Where the structures are planned, these deposits appear to be thin and discontinuous.

1.3 Bedrock Geology - Bedrock in western New York forms a gentle, south-southwestward dipping homocline of Paleozoic strata. Exposed at the worksite is the middle-Devonian Moorehouse member of the Onondaga Limestone. This is a gray, thin to thick-bedded, dolomitic, moderately hard, very crystalline limestone. According to Buehler and Tesmer (1963), the Oatka Creek shale member of the Marcellus formation is exposed in the bed and lower banks of Cayuga Creek. This is a dense, black, fissile shale with a petroliferous odor, containing beds of gray shale, concretionary layers, and pyrite nodules near the base (Plate C-1).

1.4 Near Lancaster, NY, jointing trends north 45° east, and north 80° west (Rose, 1951). These joints are spaced from a few feet to perhaps 30 feet apart, and may be 50 feet to a few hundred feet long at the surface (LaSalla, 1968). In areas where the lithostatic load has been reduced by quarrying or construction, "pop-ups," or buckling of rock, may occur. A typical pop-up described by Sbar and Sykes (1973) may be found in the Federal Crushed Stone quarry in Cheektowaga. This feature has an amplitude of one foot, and a wave length of about 10 feet.

1.5 Solution features such as sinkholes and joints widened by ground water are also common in the area.

2. GROUND WATER

2.1 The Onondaga Limestone, composed of water soluble material, has a coefficient of transmissibility ranging from 300 to 25,000 gpd per foot (LaSalla, 1968). Water percolates through overlying material through vertical joints in the limestone to horizontal bedding joints. Locally, solution along bedding joints has been great enough to cause overlying rock to settle. LaSalla (1968) describes a collapsed solution zone which discharges about 3,000 gpm into a quarry near Harris Hill, about six miles from the project site.

2.2 Bedrock was pressure tested in the vicinity of the two ponds shown on Plate C-2. The results of those tests indicate that the bedrock apparently is tight and groundwater seepage into those ponds is not anticipated.

3. LOCAL GEOLOGY

3.1 Subsurface Exploration Program

3.1.1 A subsurface exploration program was conducted in August 1978, to obtain the soil and rock information necessary to perform the design for the proposed flood control project on Cayuga Creek.

3.2 1978 Program

3.2.1 The subsurface program consisted of 10 borings as shown on Plate C-2. The borings were scheduled in two phases. Phase I contained four borings, and Phase II contained six borings. Continuous drive sampling was performed in all the borings with soil samples continuously taken in 2.0-feet intervals. Bedrock was cored to determine its quality as a bearing medium and bedrock was pressure tested to determine its ability to transmit water.

3.2.2 The soil borings were performed using the standard penetration test. Split spoon sampler sizes ranged from 2 inches O.D., 1-1/2-inch I.D. with a 24-inch drive barrel to a 3-inch O.D., 2-1/2-inch I.D. with a 24-inch drive barrel. Blow counts were recorded every six inches of penetration of each 24-inch drive. No undisturbed samples were obtained as results from previous observations and literature of the surficial geology in the area indicated that bedrock was near the surface and that the shallow soils consisted mainly of gravel, sand, and silt.

3.2.3 Approximately 60 linear feet of rock coring was obtained at several locations along the levee alinement and at one location along the channel. The rock was cored, using a double-tubed NX core barrel with an M series diamond bit.

3.3 Soil and Rock Characteristics

3.3.1 Plate C-3 shows soil and rock profiles for the levee and T-wall structure from Sta 0+00A to Sta 8+00A. Plates C-4, C-5, and C-6 provide soil and rock cross sections at various locations across the creek channel.

3.3.2 The classification of the subsurface soils is based on the visual analyses obtained from the field boring logs and the visual and classification tests performed in the lab. The data is presented on sheets 1 and 2 at the end of Appendix C.

3.3.3 The overburden on the north side of Cayuga Creek consists mainly of silt, mixed with sand and clay, overlying a silt mixed with gravel overlying bedrock. The topography in this area is generally flat, with the ground surface being approximately eight feet higher in elevation than Cayuga Creek. On the left bank of Cayuga Creek, the topography changes. Ground surface elevation is approximately 20 feet above the creek elevation and slopes to the creek on approximately a 1V:3H slope. The overburden consists mainly of a clayey silt from 0.0 feet to approximately eight feet below ground surface. A soft clay layer overlying bedrock and extending from eight feet to 23 feet below ground surface was encountered at D78-10. The hillside slope consists mainly of a clayey silt overlying the bedrock as indicated by D78-4.

3.3.4 The borings indicate that the Onondaga Limestone is very close to the surface. The Onondaga Limestone generally is a medium to thick-bedded, occasionally massive, moderately hard to very hard, and finely crystalline. From Sta 0+00A to Sta 8+50A along the levee and T-wall, the rock elevation varies from -7.6 to -1.5 feet below ground surface. In the area of the abandoned quarry (Sta 5+00A to Sta 7+50A), the rock outcrops and at Sta 6+50A is fractured in the upper five feet. This fracturing probably was caused by former quarrying operations. Along the right bank of the channel from Sta 0+00 to Sta 11+00, the depth of rock varies from eight feet to two feet below ground surface. At Sta 14+00, the rock is five feet below ground surface.

3.3.5 Pressure tests were performed in the field to evaluate the permeability of the rock. Results of the pressure tests (shown at the end of Appendix C) indicate that there is not significant leakage through the rock. The fractures that were located in the core sample obtained at Sta 6+50A probably are discontinuous as indicated by the pressure test results. Slight staining due to surface water or ground water percolation was observed on the rock cores.

4. DESIGN

4.1 Transverse Levee Design - Levee construction will be approximately Sta 7+00 and run north approximately 800 feet (Plate C-2). A portion of the proposed levee alignment lies on a narrow rock ledge that separates two abandoned quarries. In this area, a concrete wall is proposed which will be tied into the levee. Bedrock is relatively close to the ground surface in those areas where the levee is to be constructed.

4.2 The maximum height of the proposed levee is 10 feet above existing ground, with a top width of 10 feet.

4.3 The levee is to be constructed of impervious material (source to be located by Contractor), placed on slopes of 1V:3H, and compacted to 95 percent Standard Proctor. To prevent erosion of the levee material, all areas not covered with erosion protection will be covered with a four-inch layer of topsoil in conjunction with a soil mat to induce the growth of cover vegetation.

4.4 Where the levee is to tie into the existing slope at elevation 614, the existing slope will be cut or notched through any loose or dried material on the surface and rollers will work on both the existing material and on the new fill in order to bond them together.

4.5 <u>Concrete Wall Design</u>

4.5.1 <u>Foundation and Backfill</u> - A concrete wall is proposed along the right bank of Cayuga Creek from the Union Road Bridge to approximately Sta 7+00. A concrete wall is also to be constructed on what appears to be a rock ledge separating the abandoned quarry (Plate C-2). It is proposed to place and anchor the concrete walls on limestone bedrock. From the cores obtained, the compressive strength of the rock is assumed to be approximately 10 TSF.

4.5.2 The rock surface should be carefully cleaned of soil and rock fragments before placing the concrete wall. This may require handwork and compressed-air cleaning. The loads imposed on the rock by the concrete wall are approximately 10 psi (Note the attached analyses at the end of Appendix C). In the vicinity of the abandoned quarry, the rock surface is fractured to a depth of approximately five feet below ground surface. To insure structural stability, the wall will be anchored to a depth of approximately 10 feet into the rock with the anchor spacing being between four to five feet. Since pressure tests performed on the rock indicate that there will be little to no seepage of water through the limestone, uplift pressure will be minimal.

4.5.3 The material behind the wall along Cayuga Creek is to be compacted, brought to the elevation of the existing ground, and seeded. A grass-lined drainage ditch, approximately three feet wide and one foot deep and sloped to drain, is to be placed behind the wall along Cayuga Creek.

4.5.4 In all cases where the concrete wall is to be tied into the levee, the wall will extend into the levee for a minimum of 10 feet. This levee material will then be compacted, covered, and seeded as described in paragraph 4.1, Transition Levee Design.

4.5.5 Culverts will be constructed at the locations shown on Plate C-3. Care will be taken to avoid clogging the drains during the progress of the work, and should any culvert become clogged or obstructed from any cause before final acceptance of the work, it will be cleaned out in a manner approved by the Contracting Officer or replaced. No pipe which has been damaged shall be used in the work if, in the opinion of the Contracting Officer, the pipe is unfit for use. Travel over drainpipe will not be permitted until the pipe has been covered to a depth sufficient to prevent damage to or breakage of the pipe.

Table 1 - Presumptive Rock & Soil Strength Values

Material	Sat (pcf)	0 (degree)	C (psf)	Compressive Strength Rock
Clayey Silt	120	28	250	
Clay	112	0	500	
Toe Material	114	45	0.0	
T-Wall Backfill Material	125	30	0.0	
Limestone Bedrock	150	37	4,000	10 TSF

4.5.6 Structural - The structural design of the concrete walls is based on EM 1110-2-2501 and ACI 318, Building Code Requirements for Reinforced Concrete.

a. Allowable Working Stresses

(1) Concrete

Specified Compressive Strength F = 3,000 psi

All other allowable stresses are in accordance with the ACI Building Code.

(2) Reinforcement - Specified tensile strength of reinforcement is Fy = 40,000 psi. Spacing, splicing, and protective cover of bars are based on recommendations contained in the ACI Building Code.

b. Minimum Allowable Factor of Safety - 1.5

c. Considered Loads

(1) Horizontal Water Loads

(2) Hydrostatic Uplift - The hydrostatic uplift pressure was assumed to act over 100 percent of the base. The uplift gradient was assumed to be a straight line varying between the full hydrostatic heads.

(3) Earth Pressures - Earth pressures were considered where backfill or levee embankment is placed against the structures. The maximum active and passive earth pressures are based on Rankine's formula.

e. Loading Conditions and Assumptions - The walls were analyzed for two loading cases. Case I assumed the structure to be completed with backfill in place and a flood condition such that the creek level is at the top of the wall and the water table behind the wall is at the surface of the backfill. Case II assumed ponding behind the wall to the elevation of drain or backfill elevation whichever is higher and the water level in the creek lower than the base of the wall.

4.6 Seepage - The flood stages on Cayuga Creek are of very short duration (approximately 36 hours). Bedrock is very close to the surface with the overburden being alluvium and fill material in the area of the levee and the floodwall. These factors indicate that uplift pressures should be negligible.

4.6.1 A cutoff will be necessary under the proposed levee to reduce the possibilities of pumping of subgrade materials. The inspection trench will serve as the cutoff trench. This trench will be backfilled with impervious material compacted to 95 percent Standard Proctor and will extend to the bedrock. The rock surface shall be prepared as stated.

4.6.2 Computations - Case I was analyzed at three sensitive locations and Case II at two sensitive locations. The computations were performed using the values listed in Table 1 above. The results of these computations are attached to the end of this appendix.

4.7 Channel Improvements - The channel was analyzed for a 100-year velocity of 13 FPS upstream from the Union Road Bridge to Sta 8+50. It was determined that 27-inch riprap placed on a 1V:2H slope will be required to resist the boundary shearing forces resulting from these high flows. This riprap will require a bedding layer with a gradation as shown on Figure C-2. The design computations are shown on pages C-46 to C-49 of this appendix. Nonwoven filter cloth will be placed beneath the bedding layer material.

Methods of filter cloth installation shall be according to the manufacturer's specifications. From Sta 8+50 to Sta 14+00, the stream velocity for the 100-year event is low enough to warrant grass-lined channel slopes on a maximum IV:2H slope.

4.7.1 On the right bank of Cayuga Creek between Sta 7+00 and Sta 8+50 and the transverse level, protection from scour due to receding floodwaters is required. This protection is in the form of an erosion protection apron with a 25-feet overbank protection of riprap graded into existing ground. (See Plate C-6 for details). Above Sta 8+50, both sides of the creek bank will require only grass-lined slopes.

4.7.2 A concrete curb anchored and grouted into place will be required at the toe of the riprap so as to hold it into place.

4.7.3 On the left bank of Cayuga Creek approximately between Sta 0+00 and Sta 8+50, the stone will serve also to stabilize the existing slope.

4.8 Slope Stability

4.8.1 Due to the topography and nature of the soils as discussed in Section 3.3.3, the slope along the left bank of Cayuga Creek between Sta 0+00 and Sta 8+00 was checked for stability during a rapid drawdown condition. The rapid drawdown condition was assumed to be the most critical condition resulting from the high floodwaters. The values of the soil parameters used were presumed from the field and laboratory descriptions of the soil and blow counts and are listed in Table 1. The proposed left bank configuration was determined to be a 1V:2H slope from the creek bed to the 100-year flood elevation of approximately 12 feet above the creek. The remainder of the slope above 12 feet need not be changed. From available existing information, this slope was assumed to be a 1V:3H stone revetment with a maximum thickness of five feet to be placed at the toe to an elevation of 12 feet (See Plates C-4 and C-6). The revetment will be used to stabilize the slope and to prevent erosion of the bank material during flood flow conditions.

4.8.2 The results of the stability analyses on this configuration indicated a F.S. approximately equal to 1.6. A manual and computer analysis of slope stability is included in Appendix C, Plate C-5.

4.9 Foundation Preparation - Foundation preparation of the levee will be as follows.

4.9.1 When overburden is stripped to rock foundations, the rock surface, including all pockets or depressions, shall be cleaned free of soil or rock fragments before placing the embankment upon it. This may require handwork and compressed-air cleaning. Rock surfaces which disintegrate rapidly on exposure will be covered immediately with embankment material.

4.9.2 When the foundation is earth, all organic or other unsuitable materials, such as stumps, brush, sod, and large roots, will be stripped and wasted prior to the placement of the first lift of fill. Stripping operations will be performed carefully to assure removal of all material that may be rendered unstable by saturation, of all material that may interfere with the creation of a proper bond between the foundation and the embankment, and of all pockets of soils significantly more compressible than the average foundation material. Stripping of pervious materials under the semipervious zone of the embankment will be limited to the removal of surface debris and grass roots. The foundation surface should be kept drained and not scarified until just prior to fill placement in order to avoid saturation from rainfall.

4.9.3 Prior to placing the first layer of embankment on an earth foundation, moistening and compacting the surface by rolling with a tamping roller will be necessary to obtain proper bond. Rock foundation surfaces shall be moistened, but standing water will not permitted when the first lift is placed.

4.9.4 A continuous inspection trench three feet wide, extending the length of the levee to rock will be required. Rock elevation varies from two feet to six feet beneath the levee. The purpose of this trench is to expose or intercept any undesirable underground features such as old drain tile, water or sewer lines, animal burrows, buried logs, pockets of unsuitable material, or other debris. The trench should be located at or near the flood side toe of the fill levee. Side slopes will be vertical except for the deeper sections which will not be steeper than 1V on 1H. Impervious backfill will be placed only after a careful inspection of the excavated trench to ensure that through-going potential seepage channels or undesirable material are not present; if they are, they will be dug out and the excavation backfilled with compacted material.

5. MATERIALS SURVEY

5.1 General - A materials survey was performed to determine construction material sources for the Cayuga Creek Flood Control Project. Available sources were investigated. The survey consisted of an analysis of quarry/pit investigations, laboratory test results, and evaluation of available service records. The survey included contacting individual sources to determine interest and/or ability in producing specified stone materials.

5.2 Material Design Criteria

Material Types and Gradations.

5.2.1 General - Stone materials needed for the construction of the Cayuga Creek Flood Control Project consist of riprap for slope protection and a filter/bedding for the riprap. Concrete aggregates are required for the construction of T-walls.

5.2.2 Riprap, Type A Stone - Twenty-seven inch riprap shall consist of stone materials that are reasonably well-graded within the limits below and shown in Figure 1.

Percent Lighter by Weight	Limits of Stone Weight in Pounds
100	950-380
50	280-190
15	140- 60
5	95- 40

Stones shall be predominantly angular in shape. Not more than 25 percent of the stones reasonably well-distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness. No stone shall have a length exceeding 3.0 times its breadth or thickness.

5.2.3 Filter/Bedding, Type B Stone - A filter/bedding is required for the 27-inch riprap. The filter/bedding material will be a crushed or natural product having the following gradation and will fall within the limits shown below and in Figure 2.

Sieve Designation U.S. Standard Square Mesh	Percent Finer by Weight
8-inch	100
6-inch	80-100
3-inch	40- 70
1-inch	0- 25
1/2-inch	0- 5

Stones shall be predominantly angular in shape. Not more than 25 percent of the stones reasonably well distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness. No stone shall have a length exceeding 3.0 times its breadth or thickness.

5.2.4 Coarse Aggregates for Concrete - Coarse aggregates will consist of a reasonably well-graded crushed stone or crushed gravel having the following gradation (NYS DOT combined #1 and #2) and shall fall within the limits below and in Figure 3.

Sieve Designation U.S. Standard Square Mesh	Percent Finer by Weight
1-1/2-inch	100
1-inch	93-100
1/2-inch	27- 58
1/4-inch	0- 8

5.2.5 Fine Aggregate for Concrete - Fine aggregate for concrete will consist of a reasonably well-graded natural sand or manufactured sand having the following gradation (NYS DOT 703-07 concrete sand) and shall fall within the limtis of gradation curve shown below and in Figure 4.

Sieve Designation U.S. Standard Square Mesh	Percent Finer by Weight
3/8	Maximum size
No. 4	90-100
No. 8	75-100
No. 16	50- 85
No. 30	25- 60
No. 50	10- 30
No. 100	1- 10
No. 200	0- 3

5.2.6 Material Weight - For riprap and filter/bedding (Types A and B Stone) the required minimum specific gravity (Bulk SSD) is 2.56 (160 pcf). Concrete aggregates may vary from 2.5 to 2.8 (156 pcf to 175 pcf).

5.3 Material Quality

5.3.1 General - Quality requirements for each material type are discussed below. Those possible sources listed for riprap have been subjected to tests established by the Ohio River Division Laboratories, Cincinnati, OH. Test No. P-11, "Riprap and Breakwater Stone Evaluation," includes a suite of tests to determine stone durability. Those possible sources listed for graded materials such as coarse aggregates for concrete, filter/bedding, and fine aggregates for concrete, have been subjected to ORDL's tests, C-21 and C-22, "Elementary Acceptance Tests for Fine (C-21), and Coarse (C-22), Aggregates for Civil Works." EM 1110-2-2000, "Standard Practice for Concrete," states that "if it is not feasible to avoid the use of rock classified as potentially reactive, then specify low alkali cement, the minimum aggregate size that is economically feasible, and dilution so that the amount of potentially reactive rock does not exceed 20 percent of the coarse or fine aggregate or 15 percent of the total if reactive material is presented in both." Therefore, sources from which concrete aggregates that contain potentially reactive cherts may be listed; however, low alkali cement will be required if those sources are proposed and used.

5.3.2 Material Quality Criteria - Design criteria is a limiting factor on the number of available stone sources. Some stone producers have been eliminated from the list because their stone failed to meet either the design or quality requirements established for this project. Stone producers whose materials do not meet the minimum specific gravity requirements (2.56) for riprap, or contain an excessive quantity of potentially reactive chert were not listed.

Possible sources capable of producing the stone products for the construction of the Cayuga Creek Flood Control Project are listed on Plates C-8 through C-13. Laboratory test results are summarized on Plates C-14 through C-17.

5.3.3 Riprap (Type A, Fig. 1) - These stones will be a sound, durable material free from visible cracts, seams, chert, and overburden spoil. Only those sources from which the samples did not show significant breakdown during either the freeze-thaw or wet-dry tests are suitable. The freeze-thaw tests were performed for 35 cycles and the wet-dry tests for 80 cycles.

5.3.4 Coarse Aggregate for Concrete - Coarse aggregates for concrete shall be either crushed stone or crushed natural gravel, and will be clean, durable, sharp-angled fragments of uniform rock quality. Aggregates will be free from overburden spoil and laitance. Washing of aggregates may be specified to remove any film of laitance adhering to individual particles.

5.3.5 Fine Aggregate for Concrete - Fine aggregates may be either manufactured sand or natural sand and shall consist of hard, strong, durable particles that are free from any coatings or deleterious materials such as silt, clay, shale, and organic materials.

5.4 Possible Sources

5.4.1 General - Those sources listed on Plates C-9 through C-17 and contain suitable inplace stone to produce the indicated materials. However, all material from those sources may not always be suitable for every material required. Therefore, the specification will contain the reservation to reject certain localized areas, zones, strata, or stockpiles when those materials are deemed unsuitable.

5.4.1.1 It is anticipated that selective quarrying and/or selective loading will be required for some material types, especially the riprap sizes. Special gradation blending techniques will be required for the production of the filter/bedding and the blending of two sizes of coarse aggregates for concrete.

5.4.1.2 Fourteen possible sources within a radius of approximately 41 miles of the project are capable of producing the required stone materials. It is anticipated that all stone materials will be trucked to the construction site.

5.4.2 Type A Stone (27-inch Riprap) - Six possible sources contain suitable inplace stone for the production of the 27-inch riprap. Gradation may be a problem as none of the possible sourdes possesses grizzly equipment, and gradation blends generally are produced on the quarry floor. Contractors may be required to negotiate with quarry operators to produce the graded riprap. In some cases, the quarry operators will permit the Contractor to size and blend the riprap in the quarry, but the producer will not assume the responsibility for the gradation.

5.4.2.1 Ledges within the Niagara Stone Company quarry are capable of producing the 27-inch riprap. However, the DeCew Member is not suitable for any product for Cayuga Creek. At the Frontier Stone Products Company, only the Gasport member is suitable for the production of 27-inch riprap. Selective quarrying and selective loading at the Onondaga Limestone quarries will be required to eliminate chert and chert horizons.

5.4.3 Filter/Bedding Material - Nine possible sources contain suitable ledge rock to produce satisfactory filter/bedding material. However, the DeCew Member at Niagara Stone Company quarry, Frontier Stone Products, and Royalton Stone Products is not suitable for this product. The Goat Island Member at the Frontier Stone Products quarry is too argillaceous for the production of a good quality filter/bedding material. The Onondaga Formation quarries contain suitable in-place rock for the production of the filter/bedding. Selective quarrying and loading may be required to eliminate excessive chert horizons in the Onondaga Formation quarries.

5.4.4 Coarse Aggregates for Concrete - Six possible sources contain suitable in-place rock to produce satisfactory coarse aggregate for concrete. The Niagara Stone Products Company, Frontier Stone Products, and Royalton Stone Products have been approved by NYS Department of Transportation for concrete aggregates. Aggregates from Frontier Stone Products Company only have been tested by the Buffalo District. If the Contractor proposes any one of these three sources, retesting will be required prior to approval or rejection.

5.4.5 Fine Aggregate for Concrete - Eight possible sources are capable of producing fine aggregate for concrete. Listed sources will require retesting prior to use in the work.

5.4.6 Additional Sources - The Contractor will have the right to propose one outside source other than the listed sources. The Government will reserve the right to test or retest the proposed source and to accept or reject that source.

5.4.6.1 Onondaga Formation sources are not listed as possible sources for concrete aggregates. Recent petrographic examination of samples from Federal Crushed Stone quarry shows the presence of 45 percent potentially reactive chert. Other Onondaga Formation quarries also contain excessive quantities of potentially reactive chert. Therefore, those Onondaga Formation sources will not be listed for aggregates for concrete in the specifications.

6. REFERENCES

Buehler, Edward J., and Irving H. Tesmer, 1963, Geology of Erie County, New York, Buffalo Society of Natural Sciences Bulletin, Vol. 21, No. 3, 118 p.

LaSalla, A.M., Jr., 1968, Ground Water Resources of the Erie-Niagara Basin, NY, Basin Planning Report ENB-3, Published by State of New York Conservation Department Water Resources Commission, 114 p.

Rose, C.W., 1951, Niagara River Redevelopment Preliminary Report, Rock "Squeeze" Studies, Unpublished, USAED, Buffalo.

Sbar, Marc L., Lynn R. Sykes, 1973, Contemporary Compressive Stress and Seismicity in Eastern North America: An Example of Intraplate Tectonics, Geol. Soc. America, V. 84, p. 1861-1882.

U.S. Army Corps of Engineers, Design and Construction of Levees, EM 1110-2-1913, 31 March 1978.

Bishops Modified Method

In this procedure, a circular arc failure surface is assumed. The trial failure circle was chosen based on the results of the computer-run stability analysis program which presented us with the critical circle. The sliding mass was divided into a number of vertical slices (See Figure I, Plate C-7). Each slice was analyzed for equilibrium based on the forces acting on it. These include the weight of the soil (Wa) above the water table, the weight of the soil (Wb) below the water table, the weight of the water (Zbw), the shear forces (T), and normal forces (E) on its sides, and by forces acting on its base. The forces acting on the base include the shearing force (S) and the normal force (P). For simplicity and with no appreciable loss in accuracy, the side shear forces (T) are set equal to zero (See Figure II, Plate C-7).

Since the Bishops Modified Method was used for both the computer analysis and the hand analysis presented herein, a brief description of the modifications is necessary. The bottom of each slice is approximated by a straight line, although the failure surface is circular. The water table line is horizontal, and there are no seepage forces or excess porewater pressures. Overall moment equilibrium and vertical equilibrium for each slice are satisfied. However, horizontal force equilibrium is not met even though the site forces, E_n and E_{n+1} were used. This difference is assumed to be negligible.

The final factor of safety in the manual analysis is arrived at through a series of trial and error computations. An initial factor of safety was estimated and used to determine a new factor of safety. Analysis was completed when the assumed factor of safety was approximately equal to the calculated value.

In comparing the computer analysis to the manual calculation for the factor of safety, a difference of 0.30 exists. This can be explained based on the error in measuring the various widths and depths of the slices presented in Figure I. Based on the close agreement between the computer and manual analysis, the remaining results can be accepted as determined by use of the computer program.

Subject: Cayuga Creek D.P.R.
Computation of: T-Wall Design
Computed by: WRP   Reviewed by: IL - PRB   Date: 3/16/78

Rev 4/20/79

Assumed Soil Chracteristics

$W_{moist} = 112\ lb/ft^3$

$W_{sat} = 125\ lb/ft^3$

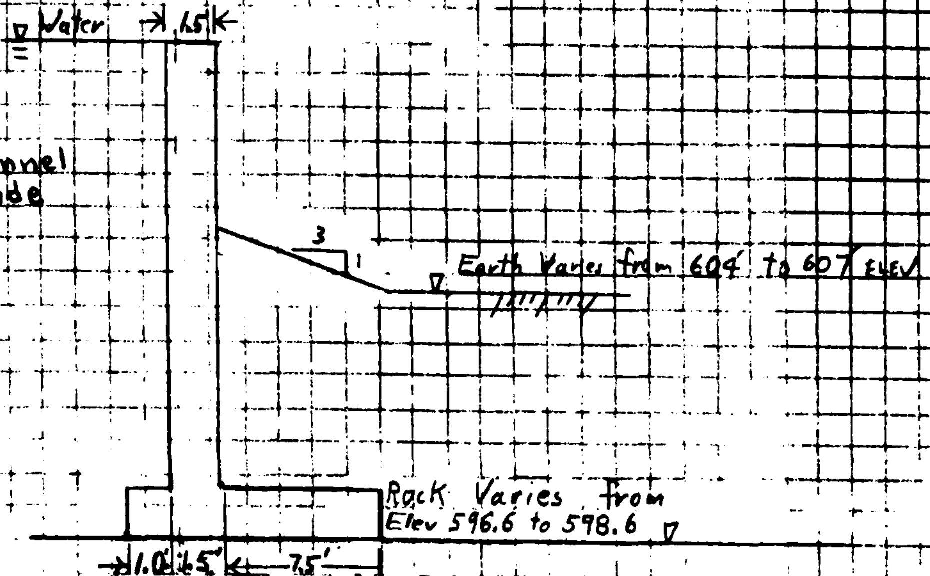
$\phi = 30°$

Assumed Coefficient of Sliding between Concrete and rock: .65

Assumed compressive Strength of rock: 140 psi

Minimum Allowable Factor of Safety: 1.50

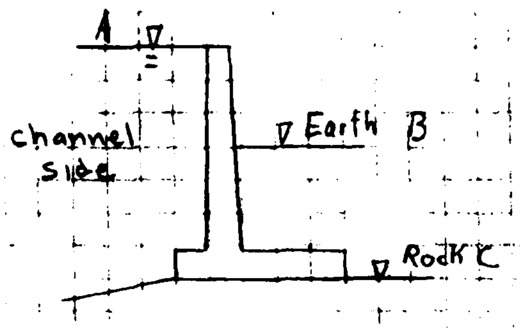
Proportion Wall



Subject: Cayuga Creek D. P. R.
Computation of: T-Wall Design
Computed by: W.R.P. Checked by (Reviewed): [illegible] Date: 3/16/78
Rev 4/20/79

Determine critical cases of loading by inspection of the drawings

Case 1: Flood with water table at surface of ground



Sta 2+00

A = El. 608.5
B = El. 604.0
C = El. 597.0

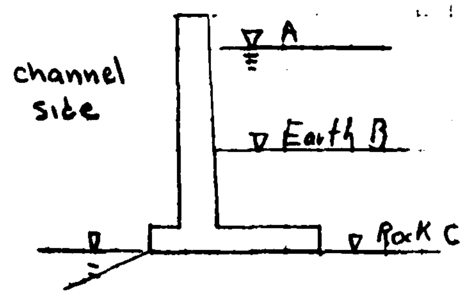
Sta 3+00

A = El 609.5
B = El 604.6
C = El 597.4

Sta 4+50

A = El. 610.5
B = El. 605.6
C = El. 597.8

Case 2: Sudden heavy rain during low flow or following overtopping by flood. El. A same as overflow El. of 18" culvert or same as El. B whichever is higher.



STA. 0+45

A = EL 607.0 (Top of wall: El. 608.5)
B = EL 602.0
C = El 596.6

STA 7+00

A = El 607.0 (Top of wall: El. 611.0)
B = El 607.0
C = El 598.6

OVERTURNING

Calculate stability based on method used in Foundation Engineering, 2nd Ed. by Peck, Hanson and Thornburn.

$$K_a = \frac{1-\sin\phi}{1+\sin\phi} \qquad K_p = \frac{1}{K_a}$$

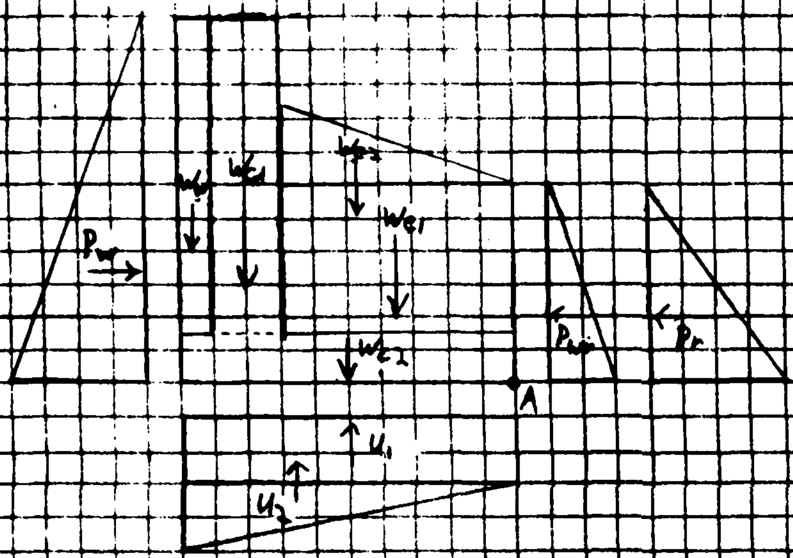
$$K_a = \frac{1-\sin 30^\circ}{1+\sin 30^\circ} \qquad K_p = \frac{1}{.33}$$

$$K_a = .33 \qquad K_p = 3.00$$

Subject: Cayuga Creek D.P.R.
Computation of: T-Wall Design
Computed by: WRP Checked by (Reviewed): LR - DRB Date: 3/16/78
RW 4/30/78

Case 1, Loading 1

A = 603.5 B = 604.0 C = 597.0



Item	Computation	ΣV +↓	ΣH ←	Arm (Ft)	ΣM_A
W_{e1}	(5.5) (7.5) (125.0)	5156.25		3.75	19335.94
W_{e2}	½ (2.50) (7.5) (125.0)	1171.88		5.00	5859.38
W_{c1}	(10) (1.5) (150)	2250.00		8.25	18,562.50
W_{c2}	(1.5) (10.0) (150)	2250.00		5.00	11,250.00
W_w	(1.0) (1.0) (62.5)	625.00		9.50	5,937.50
P_w	½ $(11.5)^2$ (62.5)		-4132.81	3.83	-15842.45
U_1	(10) (7) (62.5)	-4375.00		5.00	-21,875.00
U_2	½ (4.5) (10) (62.5)	-1406.25		6.67	-9,375.00
P_{wr}	½ $(7)^2$ (62.5)		1531.25	2.33	+3572.92
P_r	½ $(7)^2$ (125 - 62.5) (3.0)		4593.75	2.33	+10718.75
		5671.88	1992.19		28,144.53

$$F.S. = \frac{\Sigma M_a \text{ (Resisting)}}{\Sigma M_a \text{ (Overturning)}} = \frac{75,236.98}{47,092.45} = 1.60$$

Subject Cayuga Creek D. P. R.
Computation of I-Wall Design
Computed by VRP Reviewed by IF, PRB Date 3/16/78
Rev 4/20/78

Location of Resultant

From point A, $\frac{28,144.53}{5671.88} = 4.96$ ft

then $e = 4.96 - \frac{10}{2} = -.04 < \frac{10}{6} = 1.67$

Find q_{max} and q_{min}

$$q = \frac{\Sigma V}{L}\left(1 \pm \frac{6e}{L}\right)$$

$$q = \frac{5671.88}{10}\left(1 \pm \frac{6(-.04)}{10}\right)$$

1.02 (+) $q_{max} = 580.80 \ \frac{lbs}{ft^2} = 4.03$ psi << 140 psi

.98 (-) $q_{min} = 553.58 \ \frac{lbs}{ft^2} = 3.84$ psi

∴ 100% of base is in compression

Find F.S. against Sliding

$$FS = \frac{\Sigma V\, f + \Sigma H_{Resist}}{\Sigma H_{Drive}}$$

$$FS = \frac{5671.88(.65) + 6125.00}{4132.81}$$

F.S. = 2.37 > 1.50 OK.

Subject: Cayuga Creek D. P. R.

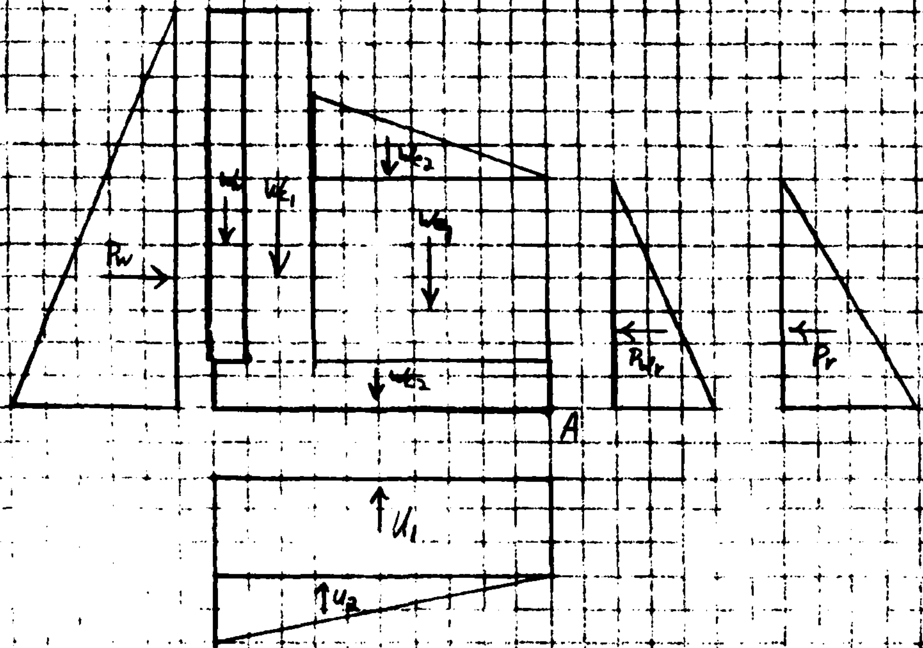
Computation of: T-wall Design

Computed by: VRP   Reviewed ~~Checked~~ by: LR, PAB   Date: 3/16/78

~~Rev 4/20/79~~

Case I Loading 2

A = 609.5   B = 604.6   C = 597.4



Item	Computation	$\Sigma V +\downarrow$	$\Sigma H \leftarrow$	Arm	ΣM_A
W_{e1}	(5.70)(7.5)(125.0)	5343.75		3.75	20,039.06
W_{e2}	$\frac{1}{2}$ ($\frac{7.50}{3}$)(7.5)(125.0)	1171.88		5.00	5859.38
W_{c1}	(10.60)(1.50)(150)	2385.00		8.25	19,676.25
W_{c2}	(1.5)(10.0)(150)	2250.00		5.00	11,250.00
W_w	(10.60)(1.0)(62.5)	662.50		9.50	6,293.75
P_w	$\frac{1}{2}$ (12.10)^2 (62.5)		-4575.31	4.03	-18,443.76
U_1	(7.20)(10.0)(62.5)	-4500.00		5.00	-22,500.00
U_2	$\frac{1}{2}$ (4.9)(10.0)(62.5)	-1531.25		6.67	-10,208.33
P_{wr}	$\frac{1}{2}$ (7.2)^2 (62.5)		1620.00	2.40	3888.00
P_r	$\frac{1}{2}$ (7.2)^2 (125 - 62.5)(3.0)		4860.00	2.40	11,664.00
		5781.88	1904.69		27,508.34

Subject Cayuga Creek D.P.R

Computation of T-wall Design

Computed by VRP ~~Checked~~ Reviewed by IR - PRB Date 3/16/78

Rev 1/29/79

Find F.S. against Overturning

$$F.S. = \frac{\Sigma M_a \text{ (Resisting)}}{\Sigma M_a \text{ (Overturning)}} = \frac{78,670.44}{51,162.09} = 1.54$$

Location of Resultant

From point A $\frac{\Sigma M_a}{\Sigma V} = \frac{27,508.39}{5781.88} = 4.76$ ft.

then $e = 4.76 - \frac{10}{2} = -.24 < \frac{10}{6} = 1.67$

Find q_{max} and q_{min}

$$q = \frac{5781.88}{10}\left(1 \pm \frac{6(-.24)}{10}\right)$$

$q_{max} = 661.45 = 4.59$ psi < 140

$q_{min} = 494.93 = 3.44$ psi

∴ 100% of base is in compression

Find F.S. against Sliding

$$F.S. = \frac{(5781.88)(.65) + 6480}{4575.31}$$

FS = 2.24 > 1.50

Subject: Cayuga Creek D.P.R

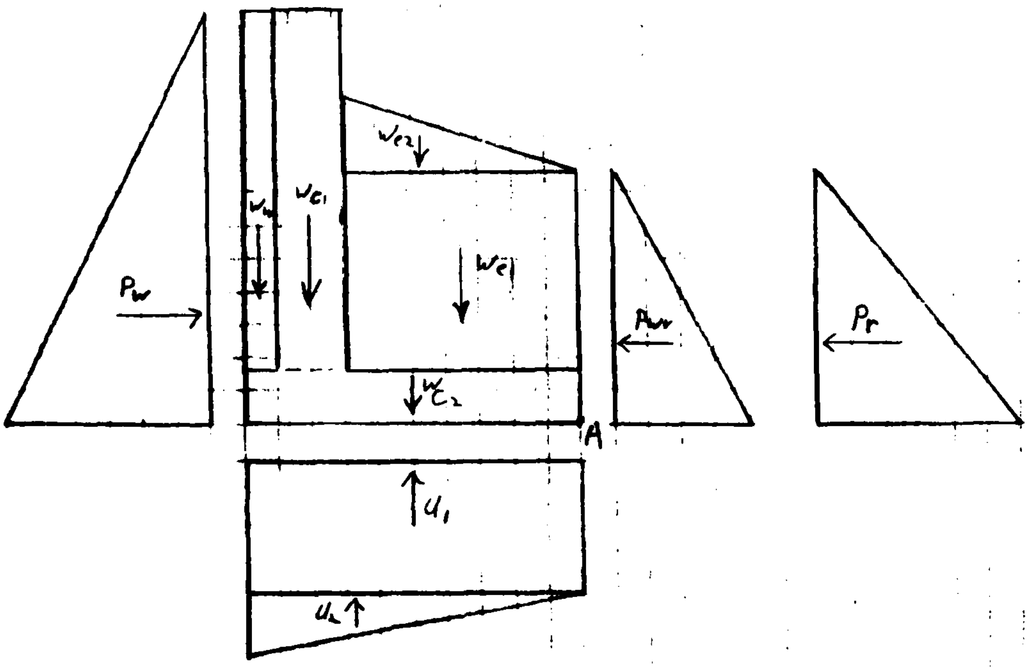
Computation of: T-Wall Design

Computed by: WAP Reviewed by: [illegible] ; PRB Date: 3/16/78

Rev 4/20/79

Case I, Loading 3

A = 610.5 B = 605.6 C = 597.8



Item	Computations	Σ V ↓+	Σ H ←+	Arm	Σ M_A (+)
W_{e1}	(6.30) (7.50) (125)	5906.25		3.75	22,148.94
W_{e2}	½ ($\frac{2.50}{3}$) (7.50) (125)	1171.88		5.00	5,859.38
W_{c1}	(11.20) (1.5) (150)	2520.00		8.25	20,790.00
W_{c2}	(1.50) (10.0) (150)	2250.00		5.00	11,250.00
W_w	(11.20) (1.0) (62.5)	700.00		9.50	6,650.00
P_w	½ $(12.70)^2$ (62.5)		-5040.31	4.23	-21,337.82
U_1	(7.80) (10.0) (62.5)	-4875.00		5.00	-24,375.00
U_2	½ (4.90) (10.0) (62.5)	-1531.25		6.67	-10,208.33
P_{wr}	½ $(7.80)^2$ (62.5)		1901.25	2.60	4943.25
P_r	½ (.3) $(7.80)^2$ (125 - 62.5)		5703.75	2.60	14,829.75
		6141.88	2564.69		30,550.16

Subject: Cayuga Creek D.P.R.
Computation of: T-Wall Design
Computed by: WRP Reviewed by: LF, PKB Date: 3/16/78
Rev 4/20/79

Find F.S. against Overturning

$$F.S. = \frac{86,470.81}{55,920.66}$$

$F.S. = 1.55 > 1.50$

Location of Resultant

From pt A $\frac{\Sigma M_A = 30,550.16}{\Sigma V = 6141.88} = 4.97$

then $e = 4.97 - \frac{10}{2} = -0.03 < \frac{10}{6} = 1.67$

Find q_{max} and q_{min}

$$q = \frac{6141.88}{10.0}\left(1 \mp \frac{6(-.03)}{10}\right)$$

$q_{max} = 623.74 \frac{lbs}{ft^2} = 4.33$ psi $<< 140$ psi

$q_{min} = 604.63 \frac{lbs}{ft^2} = 4.20$ psi

$\therefore$ 100% of base is in compression

Find F.S. against Sliding

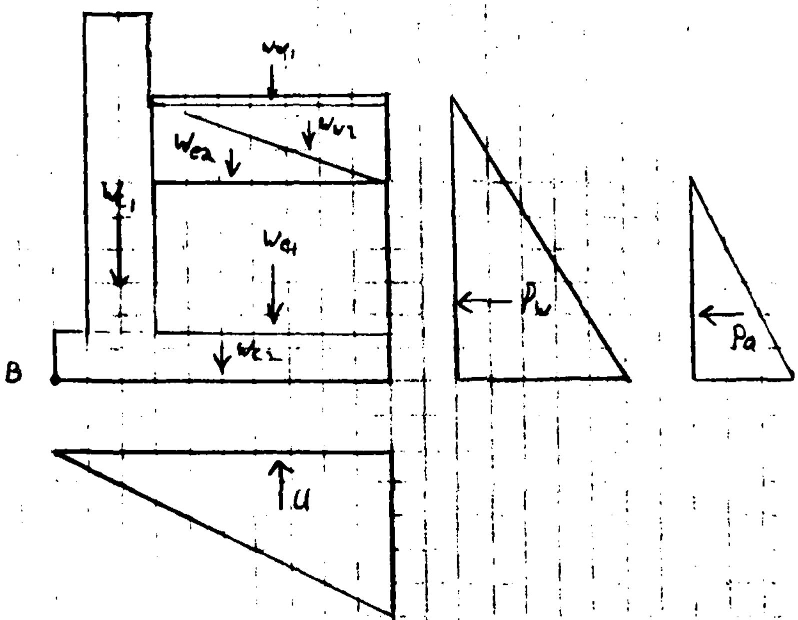
$$F.S. = \frac{(6141.88)(.65) + 7605.00}{5040.31}$$

$F.S. = 2.30 > 1.50$

Subject: Cayuga Creek D.P.R.
Computation of: I-wall Design
Computed by: WRP — ~~Checked~~ reviewed by: J.C. , [illegible] Date: 3/16/78
Rev. 4/20/79

Case II, Loading I

A = 607.0 B = 607.0 C = 596.6 (Top of wall: 608.5)



Item	Computations	ΣV ↓+	ΣH +→	Arm	ΣM_B (+)
W_{e1}	(8.90) (7.50) (125)	8343.75		6.25	52,148.44
W_{e2}	½ (2.50) (7.50) (125)	1171.88		5.00	5859.38
W_{c1}	(10.40) (1.5) (150)	2340.00		1.75	4095.00
W_{c2}	(1.5) (10) (150)	2250.00		5.00	11,250.00
W_{w1}		—		—	—
W_{w2}		—		—	—
U	½ (10.40) (10) (62.5)	-3250.00		6.67	-21,666.67
P_w	½ $(10.40)^2$ (62.5)		-3380.00	3.47	-11,717.33
P_a	½ (.333) $(10.40)^2$ (125-62.5)		-1126.67	3.47	-3,905.78
		10,855.63	-4506.67		36,063.03

Subject Cayuga Creek D.P.R
Computation of T-wall Design
Computed by WRP Checked by Reviewed IR Date 3/16/79
Rev 4/20/79

Find F.S. against Overturning

$$F.S. = \frac{+73,352.81}{(-)37,289.78}$$

$F.S. = 1.97 > 1.50$ O.K.

Location of Resultant

From pt. B $\frac{36,063.03}{10,855.63} = 3.32$

then $e = 3.32 - \frac{10}{2} = 1.68 \nless \frac{10}{6} = 1.67$ but inside 1/4 point

Find q_{max}

$$q = \frac{2V}{3\left(\frac{B}{2} - e\right)} = \frac{2(10,855.63)}{3(3.32)}$$

$q_{max} = 2179.85 \frac{lbs}{ft^2} = 15.14$ psi << 140 psi O.K.

% of base in compression: $\frac{\frac{2(10,855.63)}{2179.85}}{10}(100\%) = 99.6\%$

∴ 99.7% of base is in compression. Since F.S. against overturning is high and q_{max} is less than allowable. This case is allowable

Find F.S against sliding

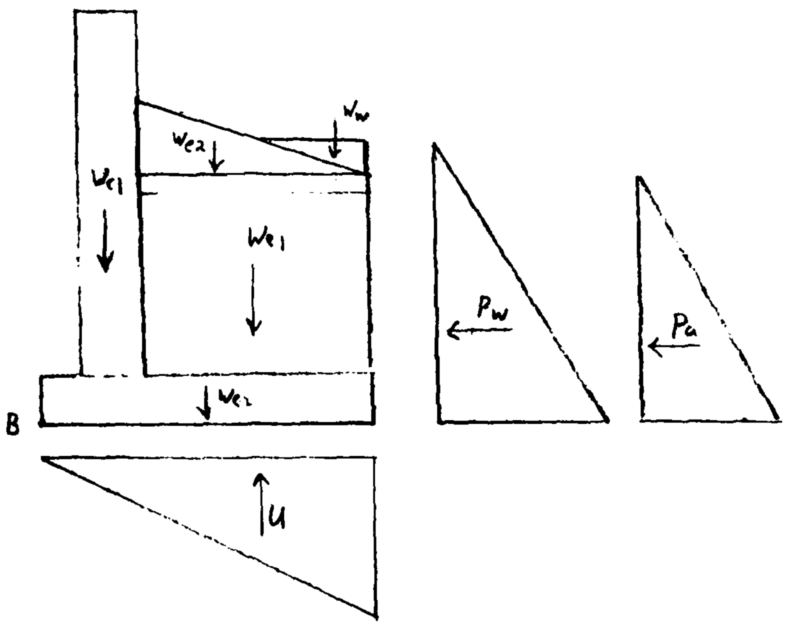
$$F.S = \frac{(10,855.63)(.65)}{4506.67}$$

$F.S. = 1.57 > 1.50$ O.K.

Subject Cayuga Creek D.P.R
Computation of T-wall Design
Computed by RAP Checked by L.C. Date 3/16/78
Rev. 4/20/79

Case II, Loading 2

A = 607.0 B = 607.0 C = 598.6 (Top of wall: El 611.0)



Item	Computations	ΣV↓+	ΣH ⁺→	Arm	ΣM_B (+)
We1	(6.90) (7.50) (125)	6468.75		6.25	40,429.69
We2	½ (2.50) (7.50) (125)	1171.88		5.00	5859.38
Wc1	(10.90) (1.5) (150)	2452.50		1.75	4,291.88
Wc2	(1.5) (10) (150)	2250.00		5.00	11,250.00
Ww					
U	½ (8.40) (10) (62.5)	-2625.00		6.67	-17,500.00
Pw	½ (8.40)² (62.5)		-2205.00	2.80	-6,174.00
Pa	½ (8.40)² (125-62.5)(.333)		-735.00	2.80	-2,058.00
		9718.13	-2940.00		36,098.94

Subject Cayuga Creek D.P.R

Computation of T-wall Design

Computed by ARP Checked by PRB Date 3/16/78

Rev. 4/20/79

Find F.S. against Overturning

$$F.S. = \frac{61,830.94}{25,732.00}$$

$$F.S = 2.40$$

Location of Resultant

From pt. B $\frac{36,098.94}{9,718.13} = 3.71$

then $e = 3.71 - \frac{10}{2} = -1.29 < \frac{10}{6} = 1.67$

$\therefore$ 100% of base is in compression

Find q_{max} and q_{min}

$$q = \frac{9718.13}{10}\left(1 \pm \frac{6(1.29)}{10}\right)$$

$$q_{max} = 1721.31 \frac{lbs}{ft^2} = 11.95 \text{ psi} < 140 \text{ psi}$$

$$q_{min} = 222.31 \frac{lbs}{ft^2} = 1.54 \text{ psi}$$

Find F.S against Sliding

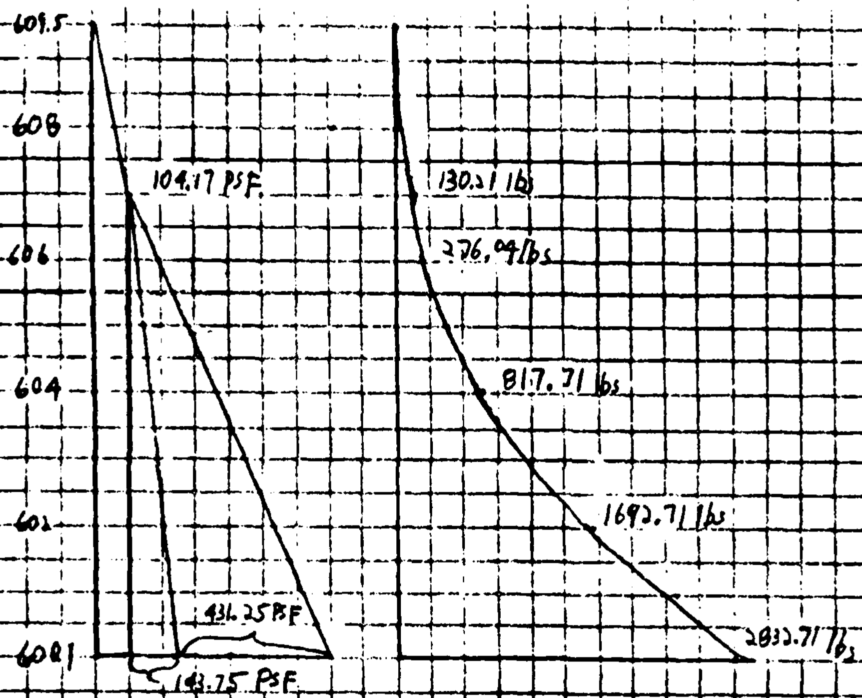
$$F.S. = \frac{9718.13(.65)}{2940.00}$$

$$F.S. = 2.15$$

Subject: Cayuga Creek D.P.R.
Computation of: I-wall Design
Computed by: W.R.P. Checked by: [illegible] Date: 9/20/79

Structural Design of I-wall

Draw loading diagram for Case II, Loading 2



Loading Shear (per lin. ft of wall)

$V_{@607.0} = \frac{1}{2}(2.50)^2(1/3)(125) = 130.21$ lbs / Lin. ft.

$V_{@600.1} = V_{607} + \frac{1}{2}(607-600.1)^2(62.5) + \frac{1}{2}(607-600.1)^2(125-62.5)(1/3)$
$+ (607-600.1)(2.5)(125)(1/3) = 2832.71$

$M_{@607} = (\frac{1}{2})(\frac{1}{3})(2.50)^3(1/3)(125) = 108.51$

$M_{@600.1} = (\frac{1}{2})(2.50)^2(\frac{1}{3})(125)(607 + \frac{2.5}{3} - 600.1) + \frac{1}{2}(607-600.1)^2$
$(62.5)(\frac{1}{3})(607-600.1) + \frac{1}{2}(607-600.1)^2$
$(125-62.5)(\frac{1}{3})(\frac{1}{3})(607-600.1) + (607-600.1)(2.5)$
$(125)(\frac{1}{3})(\frac{1}{2})(607-600.1) = 8049.26$ Ft-lbs

Subject Cayuga Creek D.P.R.
Computation of T-wall Design
Computed by W.R.P Checked by [illegible] Date 4/20/79

Elev. ft	V lbs	M ft-lbs	d in	v psi	Min. Required Steel (in.²) Temperature / Flexure
611	0	0	14.0	0	.2700 / .8400
609.5	0	0	14.0	0	.2700 / .8400
609	5.21	0.87	14.0	0.03	.2700 / .8400
608	46.88	23.44	14.0	0.28	.2700 / .8400
607	130.21	108.51	14.0	0.78	.2700 / .8400
606	276.04	304.69	14.0	1.64	.2700 / .8400
605	505.21	688.37	14.0	3.01	.2700 / .8400
604	817.71	1343.88	14.0	4.87	.2700 / .8400
603	1213.54	2351.56	14.0	7.22	.2700 / .8400
602	1692.71	3797.74	14.0	10.08	.2700 / .8400
601	2255.21	5764.76	14.0	13.42	.2700 / .8400
600.1	2832.71	8042.26	14.0	16.86	.2700 / .8400

Temperature and Shrinkage Reinforcement

Ref: EM 1110-2-2103, Para. 10 b (1)

A_s = 0.20% of gross cross sectional area, half in each face.

Since Cayuga Creek is in a severe climatic temperature region, add 25%

$\therefore A_s = 0.20 + 0.05 = 0.25\%$

A_s = 0.125% of gross cross sectional area in each face

$A_s = 0.00125 \times 18 \times 12 = .27$ in² per lin. ft

try #5 @ 14" $.31 \times \frac{12}{14} = .27 = .27$ O.K.

Subject: Cayuga Creek D.P.R
Computation of: T-wall Design
Computed by: W. R. P Checked by: PRB 4-26 Date: 4/20/79

Minimum Reinforcement for Flexural Members

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{40{,}000}$$ Ref: ACI 318-77 eq. 10-3

$$\rho_{min} = .5\%$$

$$A_s = \rho b d = .005(12)(14)$$

$$A_s = .84 \text{ in}^2/\text{lin. ft. for flexure}$$

Determine strength of Wall

Ref: Commentary on ACI 318-77 para 10.3.1

$$\phi M = \phi\left[A_s f_y \left(d - \frac{a}{2}\right)\right]$$

where $a = \dfrac{A_s f_y}{.85 f'_c b}$

$$\phi M = .90\left[.84\,(40{,}000)\left(14 - \left(\frac{1}{2}\right)\left[\frac{.84\,(40{,}000)}{.85\,(3000)(12)}\right]\right)\right]$$

$$\phi M = 406{,}758 \text{ in-lbs} = 33{,}896 \text{ ft lbs}$$

Determine Required Strength

Ref: ACI 318-77 eq. 9-4

$$U = 1.4D + 1.7L + 1.7H$$

$$U = 1.7\,(8049.26)$$

$$U = 13{,}683.74 \text{ ft-lbs} < 33{,}896 \text{ ft-lbs}$$

Try #9 @ 14 in. $1.00 \text{ in}^2 \times \frac{12}{14} = .86 \text{ in}^2/\text{lin ft} > .84$ ok

Subject: Cayuga Creek D.P.R.
Computation of: T-wall Design
Computed by: W.R.P Checked by: (reviewed) RB Date: 4/20/79

Determine Development Length

Ref: ACI 318-77 para. 12.2

$$l_d = \frac{.04 A_b f_y}{\sqrt{f'_c}}$$

$$l_d > .0004\, d_b f_y$$

$$l_d = \frac{.04(1.00)(40,000)}{\sqrt{3000}} = 29.21 \text{ in.}$$

$$l_d \geq .0004(1.128)(40,000) = 18.05 \text{ in.}$$

$$l_d = 29.21 \text{ in.} > 18.05 \text{ in}^2$$

Since the length available for development is 18 - 3.5 = 14.5 in. < 29.21 in. Try standard hook (Ref ACI 318-77 para. 12.5)

$$f_h - \xi \sqrt{f'_c}$$

$$f_h = 360 \sqrt{3000}$$

$$l_d = \frac{.04 A_b f_h}{\sqrt{f'_c}} = \frac{.04(1.00)(360)(\sqrt{3000})}{\sqrt{3000}}$$

$$l_d = 14.40 \text{ in} < 14.5 \text{ in}$$

Subject Cayuga Creek D.P.R.
Computation of T-wall Design
Computed by W.R.P. Checked by Reviewed by PRB Date 4/20/79

Determine Splice Length

Ref: ACI 318-77 para. 12.16

$l_d = 29.21$

Reduction factors

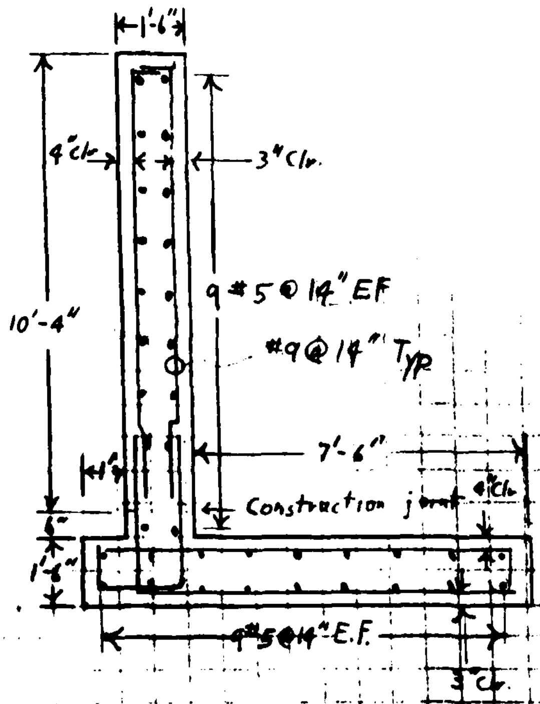
para. 12.2.4 (a): 0.8

para. 12.2.4 (b): $\frac{13,684}{32,512} = 0.42$

para. 12.16.1 : 1.3

$(29.21 \times 0.8 \times 0.42) = 9.81'' < 12''$ use 12"

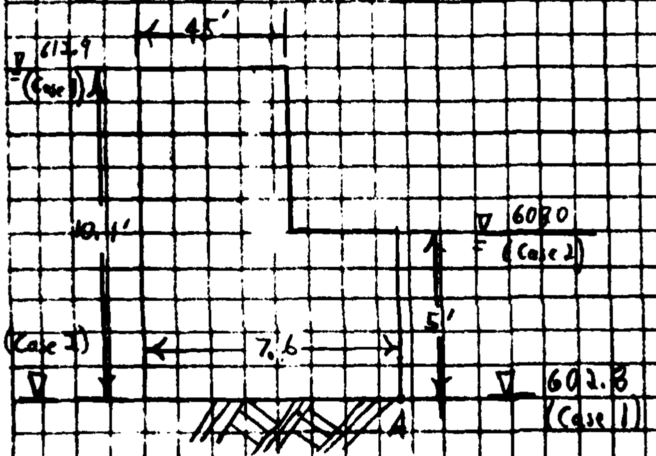
$l = 12'' \times 1.3 = 15.60''$ use 16"



Subject Cayuga Creek D.P.R
Computation of Transverse Wall Design
Computed by W.R.P. Checked by [illegible] Date 4/20/79

Since the transverse wall could be overtopped during storms greater then the 100 yr design, earth behind the wall could be eroded away. Without this surcharge a T-wall is not economical. Therefore a gravity wall will be used.

Proportion Wall



Case 1: Flood with no water behind wall

Case 2: Sudden heavy rain causing flood behind wall. Since this flood is much less than Case 1, then by inspection if Case 1 is stable then Case 2 is stable.

Item	Computation	$\Sigma V \downarrow +$	$\Sigma H \leftarrow +$	Arm	ΣM_A (+)
W_{c1}	(4.5)(5.1)(150)	3442.50		5.35	18,417.38
W_{c2}	(7.6)(5)(150)	5700.00		3.80	21,660.00
P_w	½ (10.1)^2(62.5)		-3187.81	3.37	-10,742.92
U	½ (10.1)(7.6)(62.5)	-2398.75		5.07	-12,161.66
		6748.75	-3187.81		+17,172.80

$$F.S. = \frac{\Sigma M_A \text{ (Resisting)}}{\Sigma M_A \text{ (Overturning)}} = \frac{40077.38}{22904.58} = 1.75$$

Location of Resultant

$$\text{from point A, } \frac{17172.80}{6748.75} = 2.546$$

Subject: Cayuga Creek D.P.R.
Computation of: Transverse Wall Design
Computed by: WRP Checked by: [signature] Date: 4/20/79

then $e = \frac{7.6}{2} - 2.546 = 1.254 < 1.267 = \frac{7.6}{6}$

Find q_{max} and q_{min}

$$q = \frac{\Sigma V}{L}\left(1 \pm \frac{6e_i}{L}\right)$$

$$q = \frac{6743.75}{7.6}\left(1 \pm \frac{6(1.254)}{7.6}\right)$$

$q_{max} = 1765.80\ lb/ft^2 = 12.26\ psi < 140\ psi$

$q_{min} = 8.87\ lb/ft^2 = 0.06\ psi$

Find F.S. against sliding

$$F.S. = \frac{6743.75\ (.65)}{3187.81}$$

$F.S. = 1.38 < 1.50$

Since the factor of safety against sliding is less than 1.5 additional resistance to sliding is required.

Subject: Cayuga Creek D.P.R
Computation of: Transverse Wall Design
Computed by: W. R. P. Checked by: [illegible] Date: 4/20/79

Use #9 rebars grouted in 3" minimum diameter holes drilled 8' into rock. Anchor bars will extend into the wall the length required to obtain full bond.

Compute strength of anchor bar

$F_v = 0.40\ F_y = (.40)(40,000) = 16,000$ psi AISC code

$\therefore F_v A_s = 16,000 \times 1.00 = 16,000$ lbs.

Compute bar spacing. Assume bar takes load and F.S. is provided by friction of wall on rock.

$$\frac{16,000}{(1.0)(3)(817.8)} = 5.02 \approx 5.0'$$ as recommended in para. 4.5.2 of this Appendix

$\therefore$ Use #9 bars @ 5.0' C-C

Check embedment lengths

1. Anchor bar in grout. Assume $f'_c = 4000$ psi for grout

$$l_d = \frac{.04(1.00)(40,000)}{\sqrt{4000}}$$

$$l_d = 25.30" < 96"$$

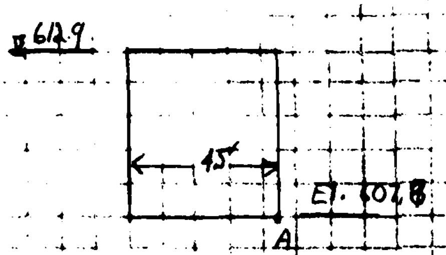
Subject Cayuga Creek D.P.R.
Computation of Transverse Wall Design
Computed by W.R.P **Checked by** [illegible] **Date** 4/20/79

2. Anchor bar in rock. Rewrite formula for l_d to:

$$F'_c = \left(\frac{.04\ A_b\ f_y}{l_d}\right)^2 = \left(\frac{.04(1.00)(40{,}000)}{96''}\right)^2$$

$F'_c = 277.78$ psi. This is less than any calcareous rock listed in ETL 1110-2-184. OK.

Check stability of upper section of wall



Item	Computation	$\Sigma V \downarrow +$	$\Sigma H \leftarrow$	Arm	ΣM_A
W_c	(4.5)(5.1)(150)	3442.50		2.25	7745.63
P_w	$\frac{1}{2}(5.1)^2$ 62.5		-812.81	1.70	-1381.78
U	$\frac{1}{2}$(5.1)(4.5)(62.5)	-717.19		3.00	-2151.57
		2725.31			4212.28

$$F.S. = \frac{\Sigma M_A\ (\text{Resisting})}{\Sigma M_A\ (\text{Overturning})} = \frac{7745.63}{3533.35} = 2.19$$

F.S. = 2.19

Subject: Cayuga Creek D.P.R.
Computation of: Transverse Wall Design
Computed by: W.R.P. Checked by: [illegible] Date: 4/20/79

Location of Resultant

from point A, $\frac{4212.28}{2725.31} = 1.546$

then $e = \frac{4.5}{2} - 1.546 = .704 < .750$

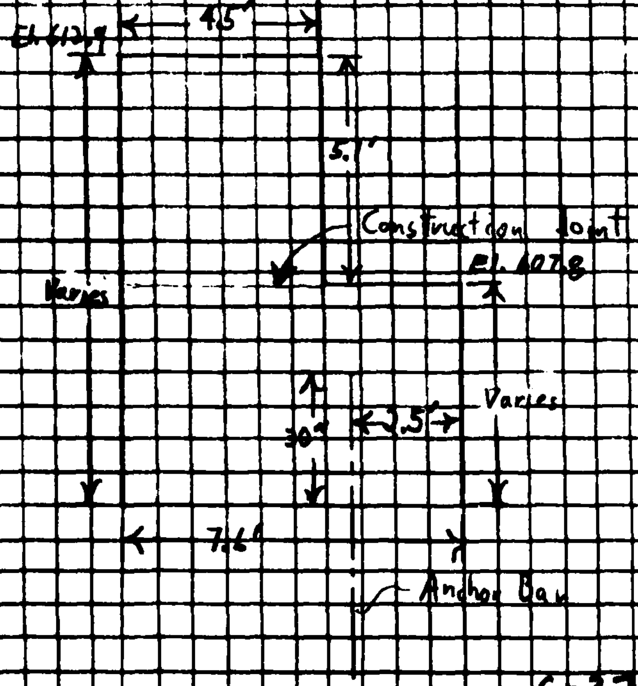
Find q_{max} + q_{min}

$$q = \frac{2725.31}{4.5}\left(1 \pm \frac{6(.704)}{4.5}\right)$$

$q_{max} = 1174.10$ psf $= 8.15$ psi << 3000 psi concrete

$q_{min} = 37.14$ psf $= 0.26$ psi > 0

∴ 100% of plane is in compression.



Subject: Cayuga Creek at Union Road

Computation of: Est. of First Costs for Local Flood Protection

Computed by: W. R. P. Checked by: [illegible] Date: 5/21/79

April 1979 Price Levels

	Quantity	Unit	Unit Price	Total Est. Amount Fed.	Total Est. Amount Non-Fed
1. Lands 1/					
Lands	9	Ac.			
Construction Easement	3	Ac			
Contingencies		L.S			
2. Relocations					
Structural Relocations	5	Ea.	$5500		27,500
Contingencies @ 20%					5,500
Total Relocations					$33,000
3. Channels					
Clearing and Grubbing	2.5	Ac	2700.	6,750.	
Care of Water		L.S		11,500.	
Excavation	4420	C.Y.	3.55	15,690.	
Erosion Protection 27" Riprap	3260	C.Y.	34.35	111,980.	
8" Bedding	1390	C.Y.	27.45	38,160.	
Fert., Seed, + Mulch	2	Ac.	1350.	2,700.	
Pre-cast Concrete Toe	1000	L.F.	5.80	5,800.	
Contingencies @ 20% ±				38,520	
Total Channels				$231,100	
4. Levees and Floodwalls					
Levees					
Stripping	1950	C.Y.	4.40	8,580	
Compacted Fill	9350	C.Y.	3.95	36,930	
Riprap with Bedding	400	S.Y.	27.00	10,800	
Fert., Seed + Mulch	1	Ac.	1350.	1,350	
Care of Water		L.S		4,500	
Inspection Trench	1050	C.Y.	2.55	2,680	
Floodwalls					
Structural Excavation	7600	C.Y.	2.55	19,380	
Structural Backfill	2650	C.Y.	3.95	10,470	
Concrete T-wall	825	C.Y.	225.	185,630	
Transverse Wall	540	C.Y.	75.	40,500	
Anchorage	400	L.F.	3.50	1,400	
24" Culv. w/ Flapgate + Valve		L.S.		5,600	
18" Culv. w/ Flapgate		L.S.		3,300	
Care of Water		L.S.		18,000	
Contingencies @ 20% ±				69,820	
Total Levees + Floodwalls				$418,940	

1/ Cost to be acquired from real estate representative

Subject: Cayuga Creek at Union Road
Computation of: Est. of First Costs for Local Flood Protection
Computed by: WRP Checked by: [illegible] Date: 5/21/79

Total Contractors Earnings plus Contingencies

Channels	#231,100	
Levees and Floodwalls	418,940	
		#650,040

Engineering and Design

#650,040 (0.22) = 143,008.80 use #143,010.

Supervision + Administration

Supervision + Inspection

650,040. (0.10) = 65,004.00

Overhead

E+D	143,008.80 (0.15) = 21,451.32		
S+I	65,004.00 (0.20) = 13,000.80		
	#99,456.12	use	#99,460

Note: Factors based on OCE curves for Floodwalls and Interior Drainage

Total Federal First Costs #892,510.

TEST DATA SUMMARY

SHEET 1 OF 2

PROJECT CAYUGA CREEK FLOOD CONTROL

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	REMARKS
DC 78-2	1	1.0'-2.8'	GRAVELLY SAND (SC)							V.C.
D 78-3	1	0.0'-2.0'	SANDY CLAY (CL)							V.C.
D 78-4	1	0.0'-1.5'	SANDY CLAY (CL)							V.C.
D 78-4	2	1.5'-3.0'	SANDY CLAY (CL)							V.C.
D 78-4	3	3.0'-5.0'	SANDY CLAY (CL)	9	30	61		33	17	
D 78-4	4	5.0'-7.0'	GRAVELLY SAND (SM)	19	35	46			N-P	
D 78-4	5	7.0'-7.1'	SILTY SAND (SM)							V.C.
D 78-5	1	0.0'-1.3'	GRAVELLY SANDY CLAY (CL)							V.C.
D 78-6	1	0.0'-1.5'	GRAVELLY SAND (SC)							V.C.
D 78-6	2	1.5'-3.0'	CLAY (CL)							V.C.
D 78-6	3	3.0'-3.8'	SANDY CLAY (CL)							V.C.
D 78-6	4	4.5'-5.0'	SANDY CLAYEY GRAVEL (GC)							V.C.
D 78-7	1	0.0'-1.5'	SANDY CLAY (CL)							V.C.
D 78-7	2	1.5'-3.0'	CLAYEY GRAVEL (GC)	47	13	40				
D 78-7	3	3.0-5.0'	SANDY GRAVEL (GM)	55	31	14				
D 78-8	1	0.0'-1.5'	SANDY CLAY (CL)							V.C.
D 78-8	2	1.5'-3.0'	SANDY CLAY (CL)							V.C.
D 78-8	3	3.0'-5.0'	SANDY CLAY (CL)		10	90		33	19	
D 78-8	4	5.0'-7.0'	SANDY CLAY (CL)		10	90		26	16	
D78-8	5	7.0'-7.6'	LIMESTONE FRAGS							V.C.

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

V.C. – VISUAL CLASSIFICATION

TEST DATA SUMMARY

SHEET 2 OF 2

PROJECT CAYUGA CREEK FLOOD CONTROL

BORING NO.	SAM. NO.	DEPTH OR ELEV. OF SAMPLE	LABORATORY CLASSIFICATION	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10}	ATTERBERG LIMITS LL	PL	REMARKS
DC 78-9	1	0.0'-1.5'	SANDY CLAY (CL)							V.C.
DC 78-9	2	1.5'-3.0'	SANDY CLAY (CL)							V.C.
DC 78-9	3	3.0'-4.5'	SANDY CLAY (CL)							V.C.
DC 78-9	4	4.5'-6.0'	SANDY CLAY (CL)							V.C.
DC 78-9	5	6.0'-8.0'	SANDY CLAY (CL)							V.C.
D 78-10	1	1.0'-2.5'	SILTY SAND (SM)							V.C.
D 78-10	2	3.0'-5.0'	CLAY (CL)							V.C.
D 78-10	3	5.0'-7.0'	CLAY (CL)							V.C.
D 78-10	4	7.0'-9.0'	CLAY (CL)							V.C.
D 78-10	5	9.0' 11.0'	CLAY (CL)							V.C.
D 78-10	6	11.0-12.0'	CLAY (CL)							V.C.
D 78-10	7	13.0-15.0'	CLAY (CL)			100		38	19	V.C.
D 78-10	8	15.0-17.0'	CLAY (CL)							
D 78-10	9	17.0-19.0'	CLAY (CL)		2	98		38	18	
D 78-10	10	19.0-21.0'	CLAY (CL)							V.C.
D 78-10	11	21.0-23.0'	CLAY (CL)	15	30	55		36	18	
D 78-10	12	23.0-23.1'	GRAVELLY SANDY CLAY (CL)							V.C.

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

V.C. - VISUAL CLASSIFICATION

WASHING AND PRESSURE TESTING

Sheet No. 1 of 1

[illegible]	CAYUGA CR.	DATE	8/7/78	SHIFT	DAY	INSPECTORS	Philip Schmitt
[illegible] NO.	DC 7B-1	CLASS	–	ELEVATIONS			
[illegible]	7+10A	ZONE	–	COLLAR	–	STAGE TOP	–
[illegible]	10' Rt	STAGE	–	ROCK	–	STAGE BOT.	–

TIME: STARTED: 10:00; COMPLETED:

	DEPTH		PRESSURE-P.S.I.			METER READINGS-CU.FT.			TIME			PRESSURE DROP lbs/min.	GAL/min.	REMARKS
	TOP	BOT.	GAGE	STATIC	ACTUAL	START	END	TOTAL	START	STOP	TOTAL			
#1	1.8	6.8	10	4.5	14.5	24179	24179	0	10:12	10:17	5 min	–	0/min	
#	6.4	11.4	10	4.5	14.5	24179	24179	0	10:20	10:25	5 min	–	0/min	After completion of Timed Test pressure was raised to 40 psi with no signs of leakage.

NCB Form 555
3 Mar 56

* Volume read to the nearest Gallon

WASHING AND PRESSURE TESTING

Sheet No. 1 of 1

SITE: CAYUGA Creek | DATE: 4 August 78 | SHIFT: DAY | INSPECTORS: Philip Schmitt

HOLE NO.: DC 78-2 | CLASS: -

STATION: 5+25 A | ZONE: -

OFFSET: 10' Rt | STAGE: -

ELEVATIONS: COLLAR: - | ROCK: - | STAGE TOP | STAGE BOT.

TIME: STARTED: 8:25 | COMPLETED: 9:20

	DEPTH TOP	DEPTH BOT.	PRESSURE-P.S.I. GAGE	STATIC	ACTUAL	METER READINGS-CU.FT. START	END	TOTAL	TIME START	STOP	TOTAL	PRESSURE DROP lbs/min.	FLOW cu.ft/min.	REMARKS
	-	-	4.0	.9	4.9	23900	23943		8:25	8:30	5 min	-	8.6	Above grd. Test
	-	-	8.0	.9	8.9	23960	24024		8:32	8:37	5 min	-	12.8	for frictional
	-	-	12.0	.9	12.9	24050	24130		8:40	8:45	5 min	-	16.2	Resistance
#1	3.0	8.0	4.0	4.5	8.5	24167	24167	0	9:00	9:05	5 min	-	0/min	3.0' to 8.0'
#2	7.5	12.5	4.0	4.5	8.5	24167	24167	0	9:15	9:20	5 min	-	0/min	7.5' to 12.5'

Vertical Distance from Top Packer to Gage = 10.5'

10.5' x .433 ≅ 4.5 PSI (STATIC)

DUE TO INTEGRITY OF ROCK, A Pressure of 8.5 PSI (ACTUAL) WAS APPLIED. ROCK SHOWED NO LEAKAGE.

NCB Form 555
3 Mar 56

WASHING AND PRESSURE TESTING

Sheet No. 1 of 1

SITE	CAYUGA Cr.	DATE	4 AUG 78	SHIFT	DAY	INSPECTORS	Philip Schmitt		
HOLE NO.	DC 78-5	CLASS		ELEVATIONS				TIME	STARTED: 3:45
STATION	6+55 A	ZONE		COLLAR		STAGE TOP			
OFFSET	10' RT	STAGE		ROCK		STAGE BOT.			COMPLETED:

	DEPTH		PRESSURE-P.S.I.			METER READINGS-CU.FT.			TIME			PRESSURE DROP		REMARKS
	TOP	BOT.	GAGE	STATIC	ACTUAL	START	END	TOTAL	START	STOP	TOTAL	lbs/min.	GAL/min.	
#1	0	5	10	0	10	24178.5	24179.0	.5	3:49	3:54	5 min	-	.1	
#2	5.3	9.9	7	3	10	24179.2	24179.2	0.0	3:59	4:04	5 min	-	0.0	After completion of test pressure was increased to 30 psi. Rock showed no signs of leakage.

NCB Form 555
3 Mar 56

WASHING AND PRESSURE TESTING

Sheet No. 1 of 1

SITE	CAYUGA CREEK	DATE	8/8/78	SHIFT	DAY	INSPECTORS	Phil Schmitz	
HOLE NO.	DC 78-9A	CLASS	-	ELEVATIONS			TIME	STARTED: 11:15
STATION	1+40	ZONE	-	COLLAR	-	STAGE TOP	-	
OFFSET	20' Lt	STAGE	-	ROCK	-	STAGE BOT.	-	COMPLETED: 11: 40

	DEPTH		PRESSURE-P.S.I.			METER READINGS-CU.FT.			TIME			PRESSURE DROP lbs/min.	FLOW cu.ft/min.	REMARKS
	TOP	BOT.	GAGE	STATIC	ACTUAL	START	END	TOTAL	START	STOP	TOTAL			
#1	7.7	12.5	10	4.5	14.5	024179	024179	0	11:20	11:25	5 min	-	0/min	Pressure after completion of timed test was raised to 40 psi; with no sign of leakage
#2	12.9	17.5	10	4.5	14.5	024179	024179	0	11:30	11:35	5 min	-	0/min	

NCB Form 555
3 Mar 56

C-45

Subject: Cayuga Creek Flood Control
Computation of: Riprap-Filter Bedding
Computed by: PKB   Checked by: JAG   Date: 1-19-79

REF. ETL 1110-2-60
ETL 1110-2-120

Data:

Side Slopes	=	1V:2H = 26.56°
Velocity	=	13 FPS
γ_{sat}	=	160 pcf
γ_w	=	62.4 pcf
y	=	12 ft.
θ	=	40°
$\sin^2\theta$	=	.413
ϕ	=	26.56°
$\sin^2\phi$	=	.2

Thickness Determination & Design Shear

1st Trial

24" Thick Layer → $D_{50} = 134^{\#}$
$D_{50} = 1.18$ ft

Local Boundary Shear

EQ 1

$$\tau_0 = \frac{\gamma_w v^2}{32.6 \log_{10} \frac{12.2y}{D_{50}}} \times 1.5 \text{ - Safety Factor}$$

$$\tau_0 = 62.4\text{pcf}\,(13\text{fps})^2 \Big/ \left(32.6 \log_{10} \frac{12.2(12)}{1.18}\right)^2 \times 1.5$$

$$\tau_0 = 3.39 \text{ psf}$$

Level Bottom

EQ 2.

$$\tau = a(\gamma_s - \gamma_w) D_{50}$$

$$= .04(160-62.4)1.18$$

$$\tau = 4.606 \text{ psf}$$

Subject Cayuga Creek F.C.P.
Computation of Rip rap - Filter & Bedding
Computed by PKB Checked by JAG Date 1-18-79

Side Slopes

Eq 3. $\tau_1 = \tau\left(1 - \frac{\sin^2\phi}{\sin^2\theta}\right)^{.5}$

$\tau_1 = 3.307$ psf

Criteria: Eq 2 or Eq 3 > Eq 1, stone OK to use.

24" stone on borderline, use, 27" stone

2ND Trial

27" Thick Stone $D_{50} = 191^{\#}$
$D_{50} = 1.32$ ft

$\tau_0 = 62.4(13)^2 \Big/ \left(32.6 \log_{10} \frac{12.2(13)}{1.32}\right)^2$ $\times 1.5$

$\tau_0 = 3.559$

$\tau = .04(160 - 62.4)(1.32)$
$= 5.15$

$\tau_1 = 5.15\left(1 - \frac{.3}{.4472}\right)^{0.5}$
$= 3.70$

$\therefore \tau_1$ & $\tau > \tau_0$ OK to use stone

27" Thick Stone Gradation (ETL 1110-2-120)

% Lighter by Wt.	Wt Limits	Stone
W_{100}	954	382
W_{50}	283	191
W_{15}	141	60

Subject: Cayuga Creek F.C.P.
Computation of: Filter Design
Computed by: PKB Checked by: JAG Date: 1-19-78

Filter/Bedding Design

Reference: Gradation curve from D78-4. This represents an approximation of gradation curve of material that will be riprapped.

Exis. Soil: From Lab analysis

$D_{15} = 0.015$ mm
$D_{50} = 0.10$ mm
$D_{85} = 6.00$ mm

Guideline from p 17 EM 1110-2-1901

a) $\dfrac{15\% \text{ (Filter Material)}}{15\% \text{ (Base Material)}} \geq 5$

b) $\dfrac{15\% \text{ (Filter Material)}}{85\% \text{ (Base Material)}} \leq 5$

c) Grain-size curve of Filter material should roughly parallel base Material

Soil-Filter Relationship

$\dfrac{15\% \text{ Filter}}{15\% \text{ Soil}} \geq 5$

D_{15} Filter $\geq 5(D_{15}$ soil$)$

D_{15} Filter $\geq 5(0.013$ mm$)$

D_{15} Filter ≥ 0.065 — Limit

$\dfrac{15\% \text{ Filter}}{85\% \text{ Soil}} \leq 5$

D_{15} Filter $\leq 5(D_{85}$ Soil$)$

D_{15} Filter $\leq 5(6.0$ mm$)$

D_{15} Filter ≤ 30 mm — Limit

Subject CAYUGA Creek F.C.P
Computation of Riprap / Filter
Computed by PKB Checked by JAG Date 1-19-78

Riprap- Filter Relationship

First obtain diameter from weight limits

From: ETL 1110-2-120
From Chart 1 for $\gamma = 160$ pcf

D_{15} min → 60# yields Diam .9' = 274mm

D_{15} max → 141# yields Diam 1.17' = 357mm

D_{15} Riprap ≥ 5 (D_{15} Filter)

D_{15} min $274/5 \geq D_{15}$ Filter

55mm ≥ D_{15} Filter — Limit

D_{15} Riprap ≥ 5(D_{15} Filter)

D_{15} max : $357/5 \geq D_{15}$ Filter

72 mm ≥ D_{15} Filter — Limit

D_{15} Riprap ≤ 5 (D_{85} Filter)

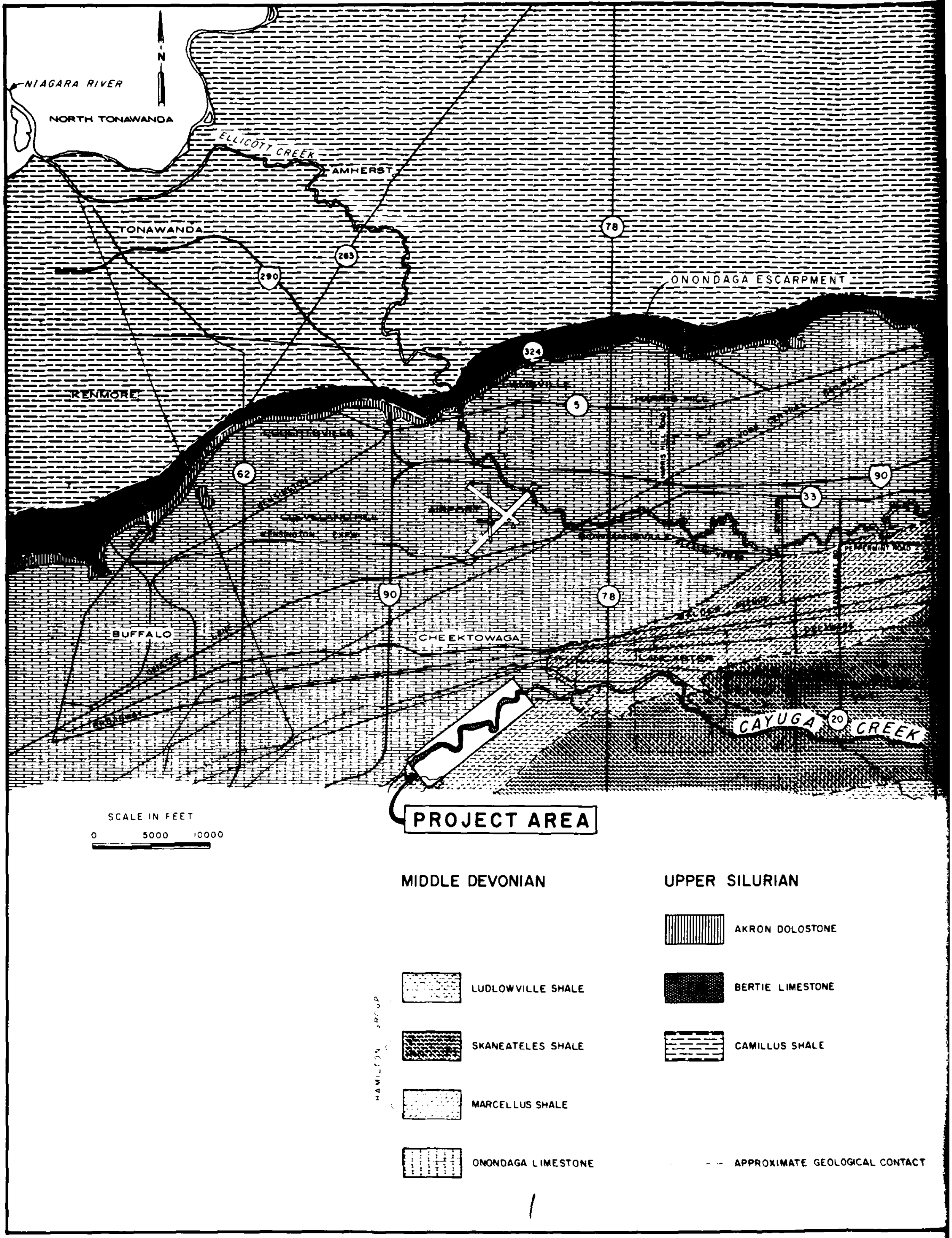
$274/5 \leq D_{85}$ Filter

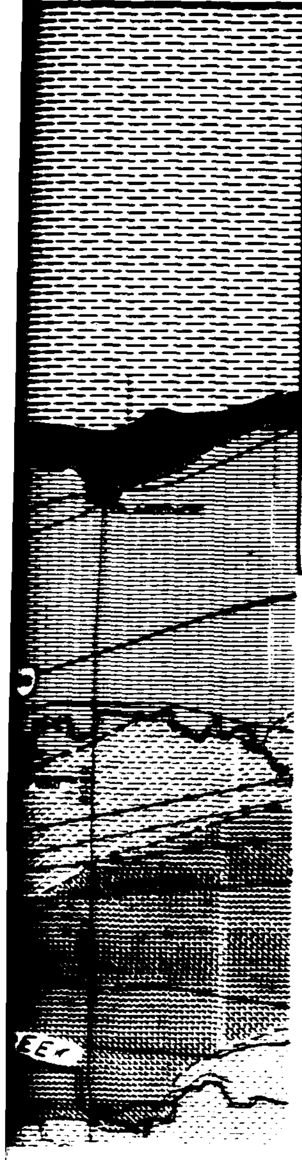
55 mm ≤ D_{85} Filter

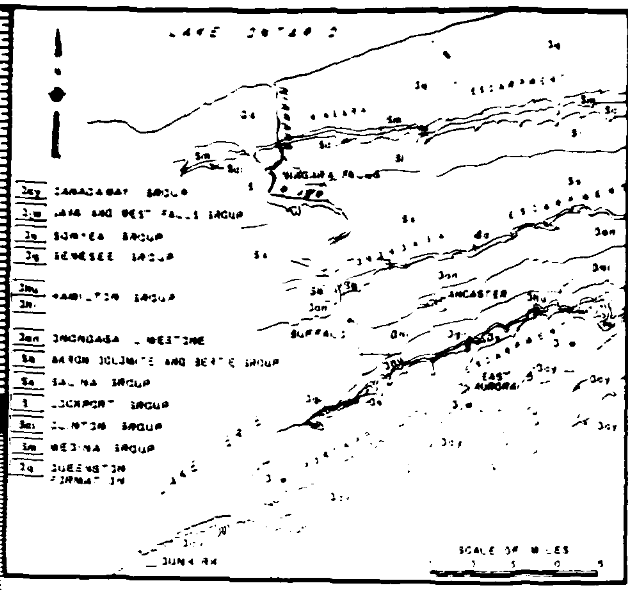
D_{15} Riprap ≤ 5 (D_{85} Filter)

72mm ≤ D_{85} filter — Limit

Also . 5% passing by wt thru 200 Sieve

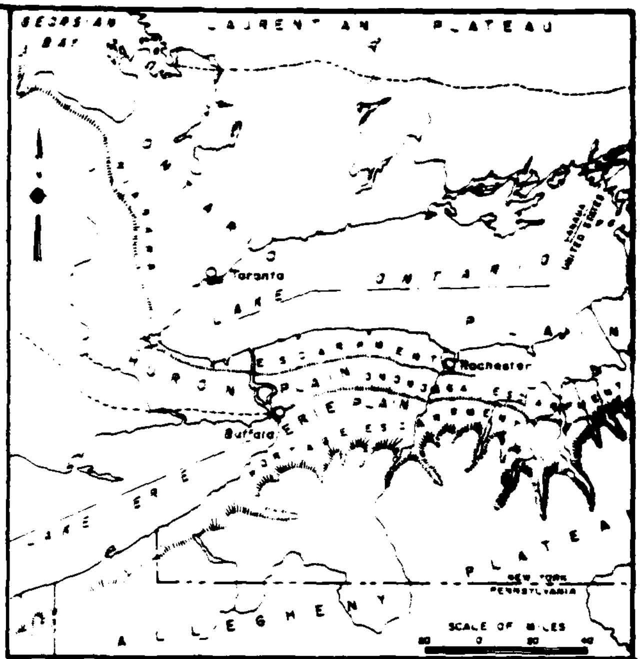

N
NIAGARA RIVER
NORTH TONAWANDA
ELLICOTT CREEK
AMHERST
TONAWANDA
KENMORE
ONONDAGA ESCARPMENT
AIRPORT
BUFFALO
CHEEKTOWAGA
CAYUGA CREEK
78
263
290
324
5
62
90
33
20
PROJECT AREA
SCALE IN FEET
0 5000 10000
MIDDLE DEVONIAN
HAMILTON GROUP
LUDLOWVILLE SHALE
SKANEATELES SHALE
MARCELLUS SHALE
ONONDAGA LIMESTONE
UPPER SILURIAN
AKRON DOLOSTONE
BERTIE LIMESTONE
CAMILLUS SHALE
APPROXIMATE GEOLOGICAL CONTACT





BEDROCK GEOLOGY OF NORTHWESTERN NEW YORK

SOURCE: [illegible] GEOLOGY OF WESTERN NEW YORK. NEW YORK STATE GEOLOGY [illegible] ANNUAL MEETING [illegible]



SKETCH MAP OF PHYSIOGRAPHIC DIVISIONS IN THE LAKE ONTARIO - LAKE ERIE REGION

SOURCE: [illegible] THE NIAGARA QUADRANGLE [illegible] GEOL. SURVEY GEOL. ATLAS [illegible]

NOTES:

GEOLOGICAL INFORMATION IS BASED ON THE FOLLOWING PUBLICATIONS

NEW YORK STATE GEOLOGIC MAP 1961. SCALE 1: 250,000.

BUEHLER, E.J. AND TESMER, I.H. GEOLOGY OF ERIE COUNTY, NEW YORK BUFFALO SOCIETY OF NATURAL SCIENCES BULLETIN VOL. 21, NO. 3, 1963.

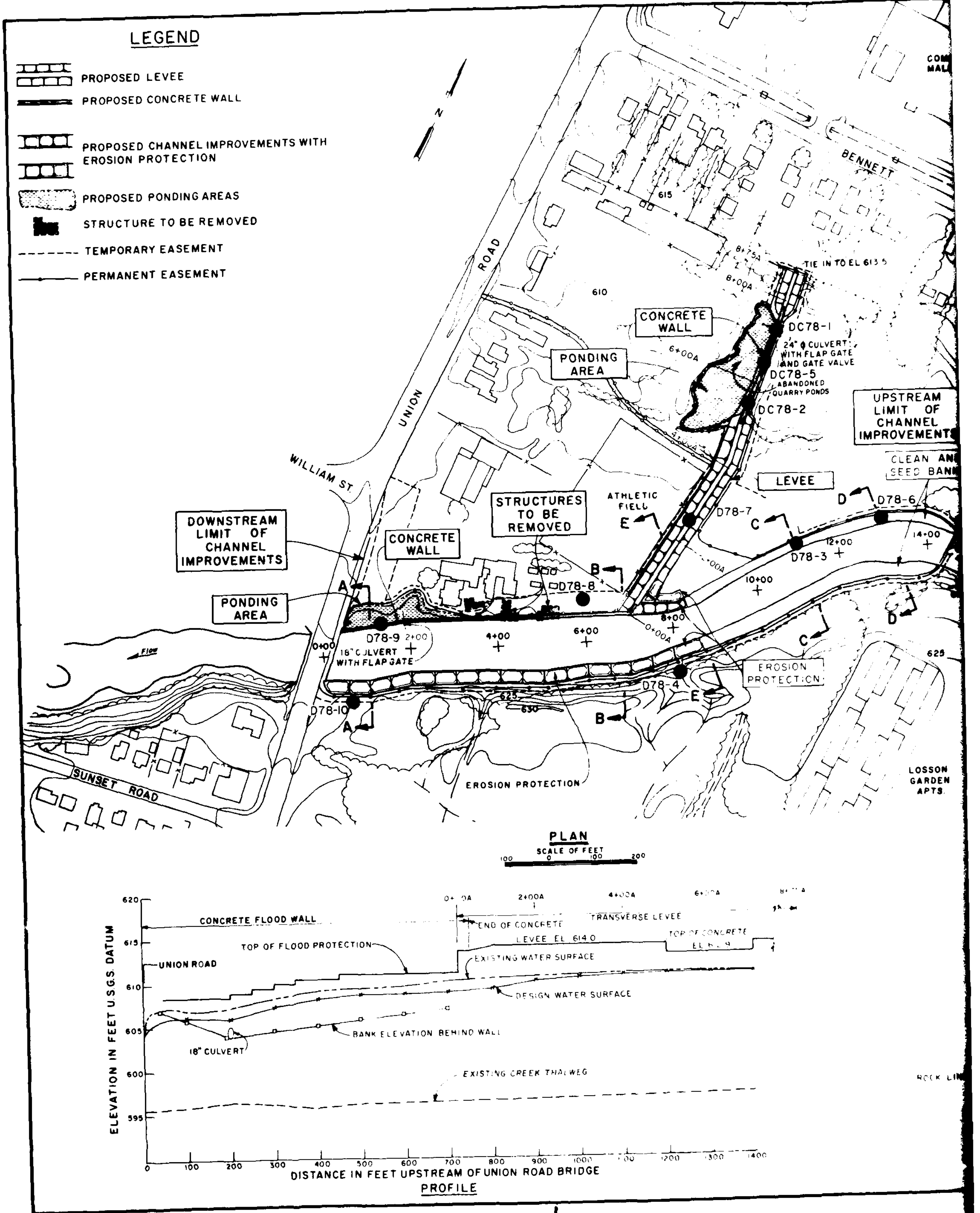
LA SALA, A.M., JR.
GROUND WATER RESOURCES OF THE ERIE-NIAGARA BASIN, NEW YORK
U.S. GEOLOGICAL SURVEY, NEW YORK STATE CONSERVATION DEPARTMENT - DIVISION OF WATER RESOURCES
BASIN PLANNING REPORT ENB-3, 1968.

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

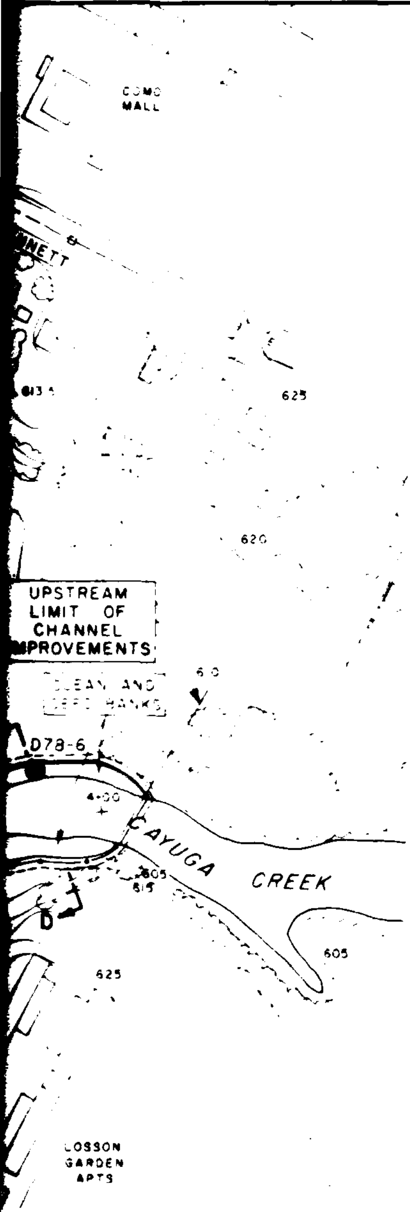
REGIONAL BEDROCK GEOLOGY OF CAYUGA CREEK BASIN

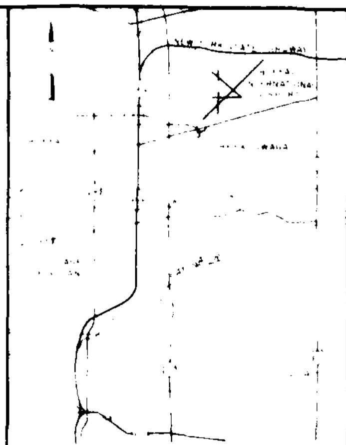
U.S. ARMY ENGINEER DISTRICT BUFFALO
DETAILED PROJECT REPORT DATED [illegible] 1979

PLATE C1

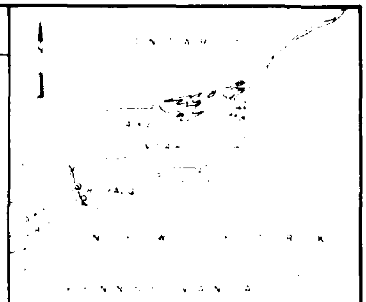


LEGEND
PROPOSED LEVEE
PROPOSED CONCRETE WALL
PROPOSED CHANNEL IMPROVEMENTS WITH EROSION PROTECTION
PROPOSED PONDING AREAS
STRUCTURE TO BE REMOVED
TEMPORARY EASEMENT
PERMANENT EASEMENT
N
UNION ROAD
BENNETT
WILLIAM ST.
SUNSET ROAD
CONCRETE WALL
PONDING AREA
DC78-1
24" ϕ CULVERT WITH FLAP GATE AND GATE VALVE
DC78-5
ABANDONED QUARRY PONDS
DC78-2
UPSTREAM LIMIT OF CHANNEL IMPROVEMENTS
CLEAN AND SEED BANK
LEVEE
TIE IN TO EL 613.5
STRUCTURES TO BE REMOVED
ATHLETIC FIELD
DOWNSTREAM LIMIT OF CHANNEL IMPROVEMENTS
D78-7
D78-6
D78-3
D78-8
D78-9
D78-10
D78-4
18" CULVERT WITH FLAP GATE
EROSION PROTECTION
LOSSON GARDEN APTS.
FLOW
PLAN
SCALE OF FEET
100 0 100 200
CONCRETE FLOOD WALL
TOP OF FLOOD PROTECTION
UNION ROAD
END OF CONCRETE
TRANSVERSE LEVEE
LEVEE EL 614.0
TOP OF CONCRETE
EXISTING WATER SURFACE
DESIGN WATER SURFACE
BANK ELEVATION BEHIND WALL
18" CULVERT
EXISTING CREEK THALWEG
ELEVATION IN FEET U.S.G.S. DATUM
DISTANCE IN FEET UPSTREAM OF UNION ROAD BRIDGE
PROFILE

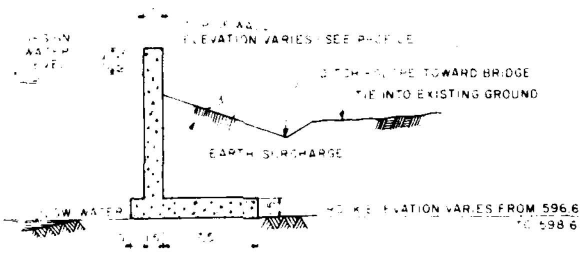




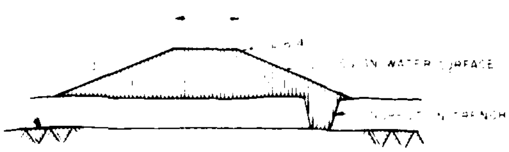
LOCALITY MAP



VICINITY MAP



TYPICAL SECTION THROUGH CONCRETE WALL



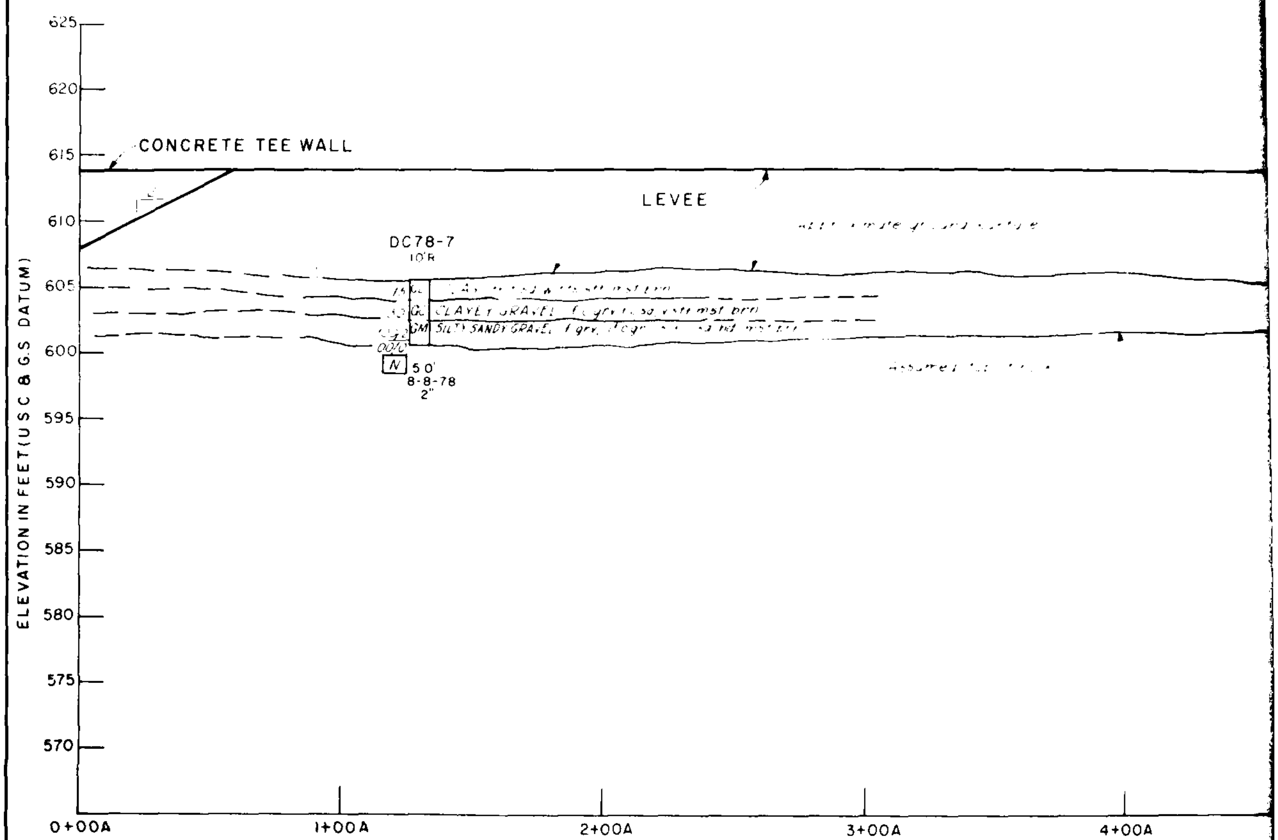
TYPICAL SECTION THROUGH TRANSVERSE EARTH LEVEE

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

SELECTED PLAN

U.S. ARMY ENGINEER DISTRICT BUFFALO
DETAILED PROJECT REPORT DATED JUNE 1979

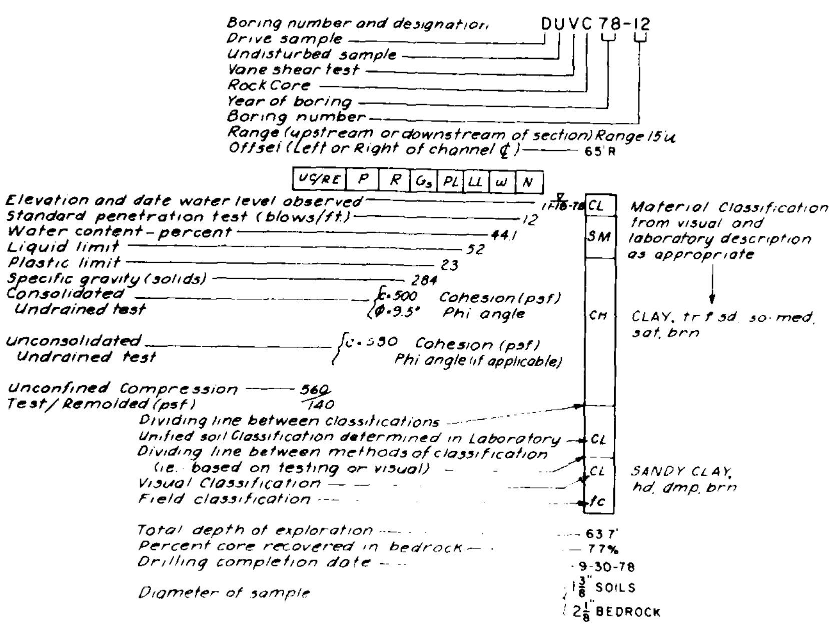
PLATE C2



DISTANCE I

PROFILE ALONG

LEGEND FOR BORINGS



ABBREVIATIONS

ang - angular
ar - argillaceous
bdd - bed
bbd - broken by drilling
blk - black
brn - brown
bkn - broken
bks - breaks
c - coarse
calc - calcareous
cre - core
crs - coarse
cht - chert
cl(y) - clay(ey)
dk - dark
dmp - damp
den - dense
dy - dry
DON - DOVONIAN ONONDAGA
f - fine
fos - fossil
frac - fracture
frag - fragmented

gr - grain
grv - gravel
grl - granular
gry - gray
ha - high angle
hd - hard
hor - horizontal
jt - joint
la - low angle
lit - little
ls - limestone
lt - light
lo - loose
L.C. - lost core
med - medium
mst - moist
mtl - material
nod - nodules
num - numerous
op - open
org - organic
pl - plastic
ptg(s) - parting(s)

rnd -
rts -
rk -
se -
sd(y)
sh(y)
si(y)
slcs
so -
som -
st -
stf -
sty -
sub -
tht -
tr -
thk -
tn -
v -
vert
w -
x -
wea -
wt. -

UNIFIED SOIL CLASSIFICATI

GW WELL GRADED GRAVELS GRAVEL SAND MIXTURES. LITTLE OR NO FINES

GP POORLY GRADED GRAVELS OR GRAVEL SAND MIXTURES. LITTLE OR NO FINES

GM SILTY GRAVELS GRAVEL SAND SILT MIXTURES

GC CLAYEY GRAVELS GRAVEL SAND CLAY MIXTURES

SW WELL GRADED SANDS GRAVELLY SANDS. LITTLE OR NO FINES

SP POORLY GRADED SANDS OR GRAVELLY SANDS LITTLE OR NO FINES

SM SILTY SANDS SAND SILT MIXTURES

SC CLAYEY SANDS. SAND CLAY MIXTURES

ML

CL

OL

MH

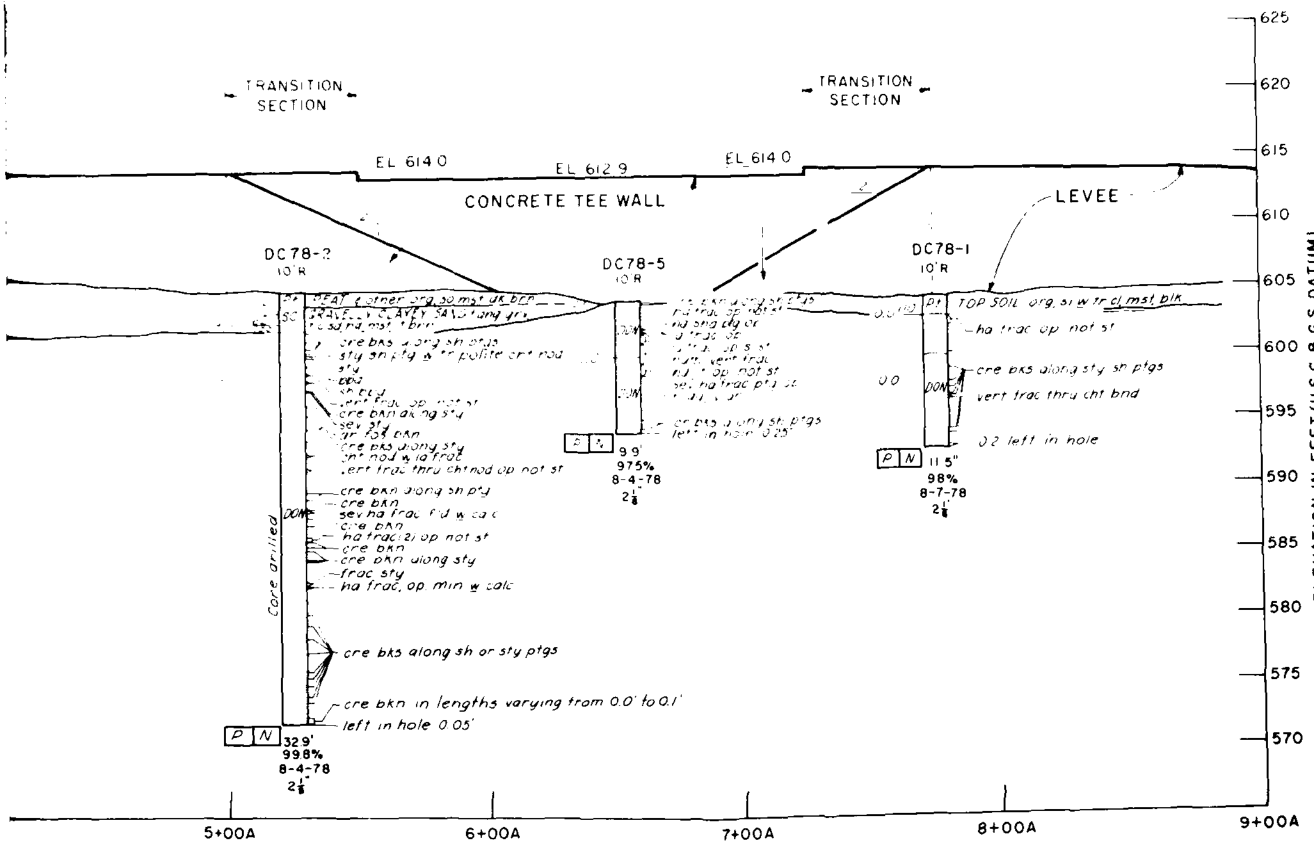
CH

OH

PT

CLASSIFICATION FROM ACTUAL LABORATORY TESTS WHE
DUAL CLASSIFICATION WHERE USED IN ACCORDANCE WIT
FOR DETAILS ON THE UNIFIED SOILS CLASSIFICATION
TECHNICAL MEMORANDUM NO.3 357 DATED MARCH 1953

DON DOVONIAN ONONDAGA LIMESTONE THIN TO THIC
ZONES LIGHT TO BLUISH GRAY CHERT. NUMER
MEDIUM TO LIGHT GRAY MODERATELY HARD, V



DISTANCE IN FEET

E ALONG ℄ OF LEVEE

TERMS FOR RELATIVE DENSITY AND CONSISTENCY

RELATIVE DENSITY OF SAND		STRENGTH OF CLAY	
PENETRATION RESISTANCE, N (BLOWS FT.)	RELATIVE DENSITY	PENETRATION RESISTANCE, N (BLOWS FT.)	CONSISTENCY
0 - 4	VERY LOOSE	< 2	VERY SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	MEDIUM DENSE	4 - 8	MEDIUM
30 - 50	DENSE	8 - 15	STIFF
> 50	VERY DENSE	15 - 30	VERY STIFF
		> 30	HARD

* STANDARD PENETRATION TEST

SAMPLER 2" O.D. (1 3/8" I.D.) SPLIT SPOON

HAMMER WGT. FALL 30"

TERZAGHI AND PECK 1948.

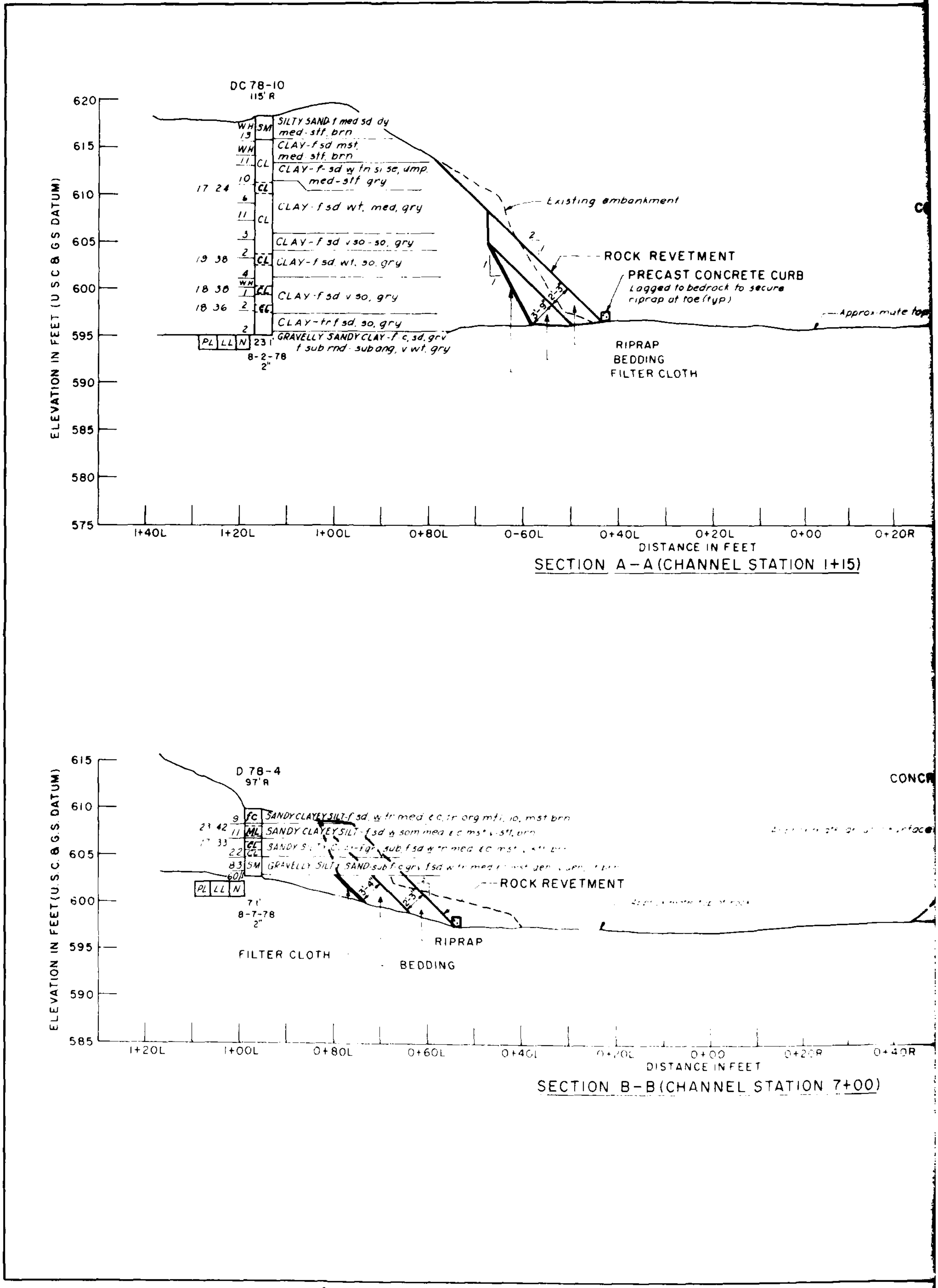
CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

GEOLOGIC PROFILE ALONG ℄ OF LEVEE

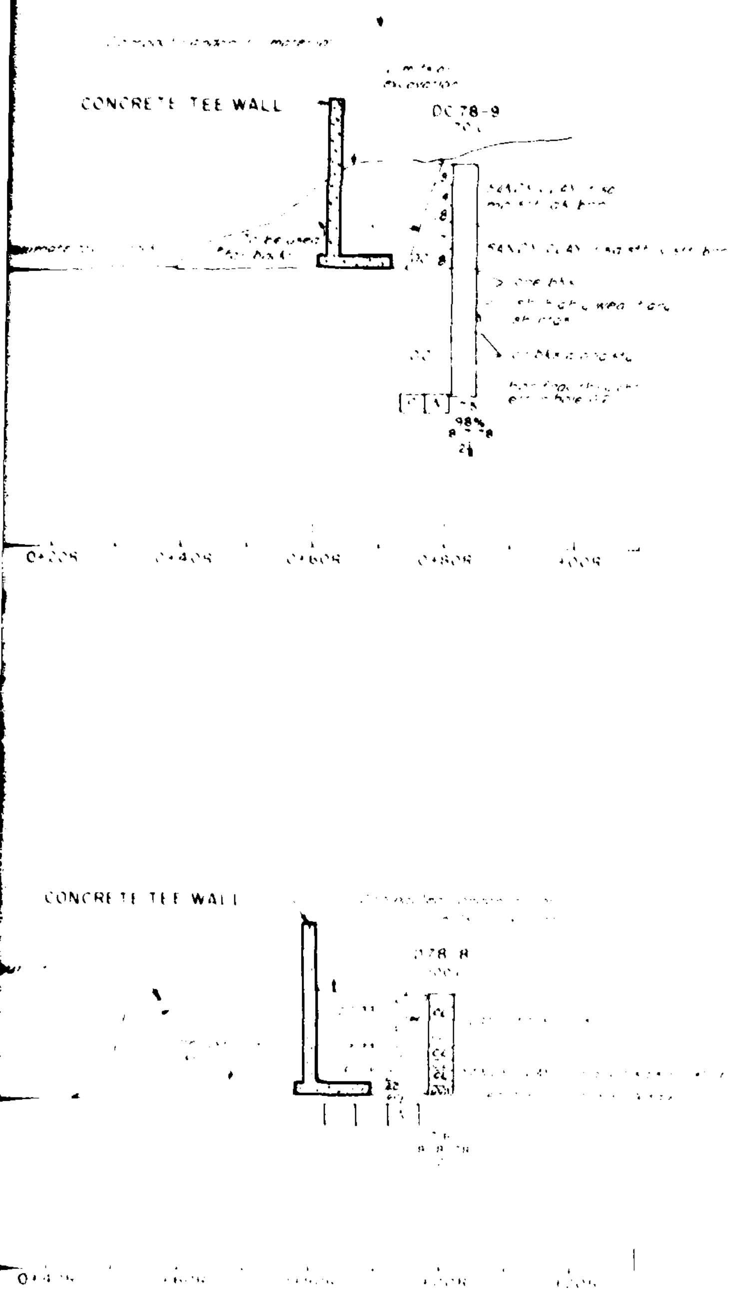
U.S. ARMY ENGINEER DISTRICT BUFFALO

DETAILED PROJECT REPORT DATED JUNE 1979

PLATE C3



DC 78-10
115' R
ELEVATION IN FEET (U S C & G S DATUM)
SILTY SAND-f med sd dy med-stf brn
CLAY-f sd mst med stf brn
CLAY-f-sd w tn si se, dmp med-stf gry
CLAY-f sd wt, med, gry
CLAY-f sd v so-so, gry
CLAY-f sd wt. so, gry
CLAY-f sd v so, gry
CLAY-tr f sd, so, gry
GRAVELLY SANDY CLAY-f c, sd, grv f sub rnd-sub ang, v wt, gry
PL LL N
8-2-78
2"
Existing embankment
ROCK REVETMENT
PRECAST CONCRETE CURB
Lagged to bedrock to secure riprap at toe (typ)
RIPRAP
BEDDING
FILTER CLOTH
DISTANCE IN FEET
SECTION A-A (CHANNEL STATION 1+15)
D 78-4
97' R
ELEVATION IN FEET (U.S.C. & G.S. DATUM)
ROCK REVETMENT
RIPRAP
FILTER CLOTH
BEDDING
DISTANCE IN FEET
SECTION B-B (CHANNEL STATION 7+00)

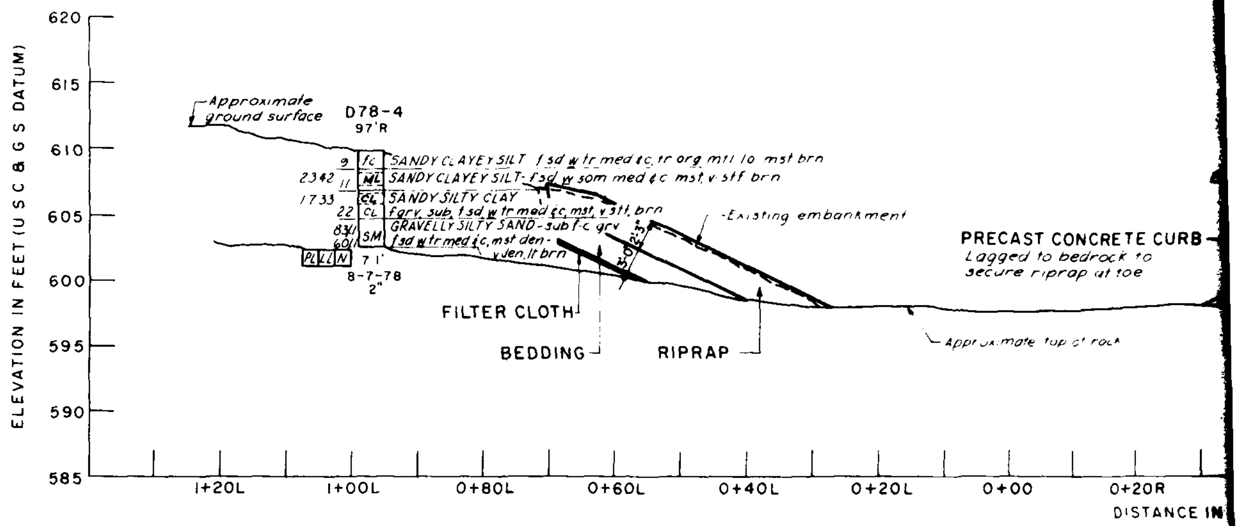


CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

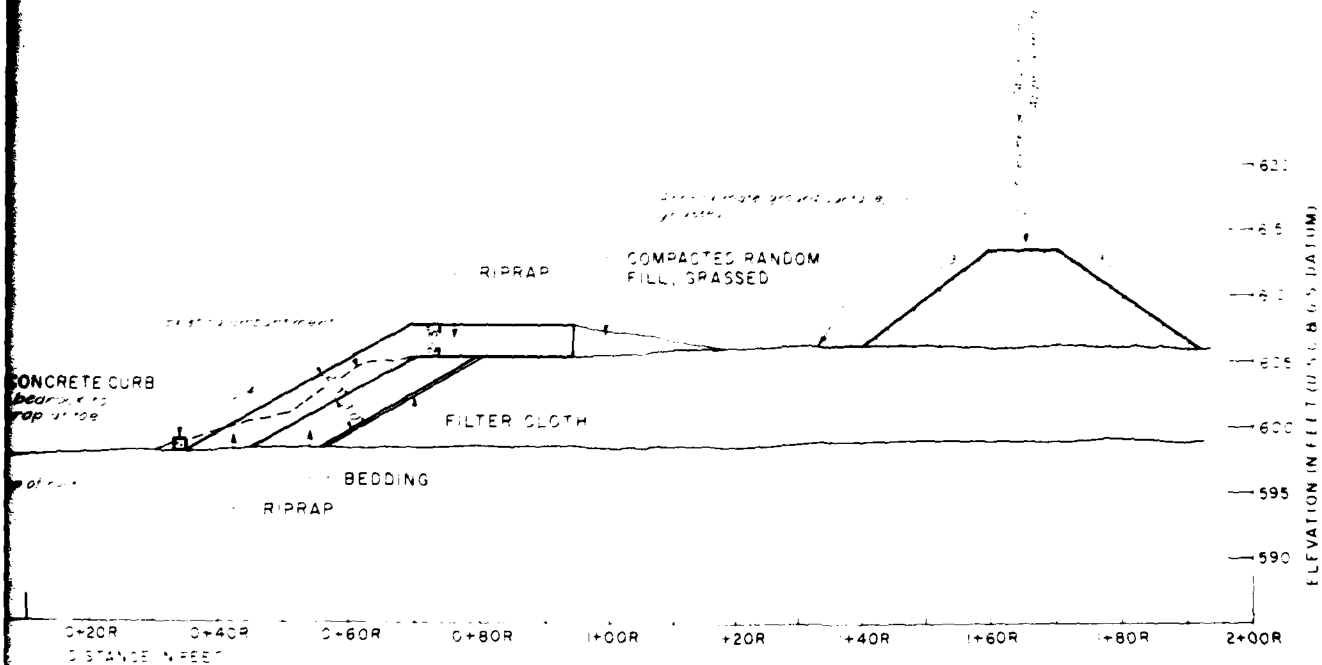
GEOLOGIC SECTIONS
CHANNEL STATIONS 1+15 AND 7+00

BUFFALO

PLATE C-4



SECTION E-E(CHANN



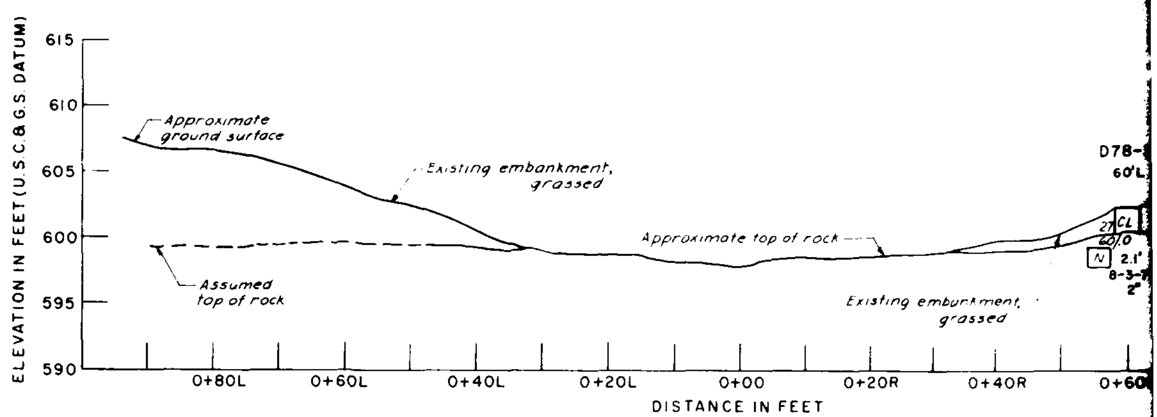
E-E(CHANNEL STATION 8+25)

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

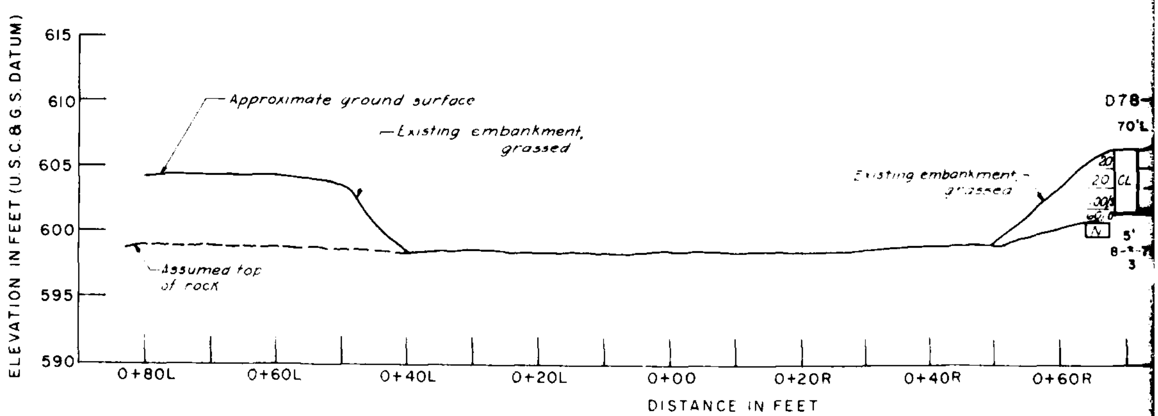
GEOLOGIC SECTION
CHANNEL STATION 8+25

U S ARMY ENGINEER DISTRICT BUFFALO
DETAILED PROJECT REPORT DATED JUNE 1979

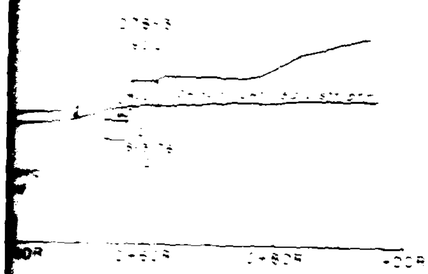
PLATE C5

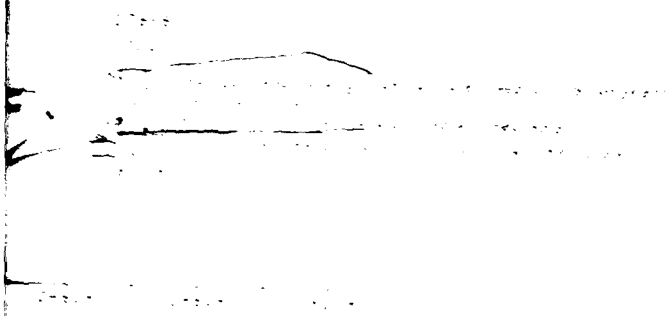


SECTION C–C (CHANNEL STATION 10+10)



SECTION D–D (CHANNEL STATION 13+15)



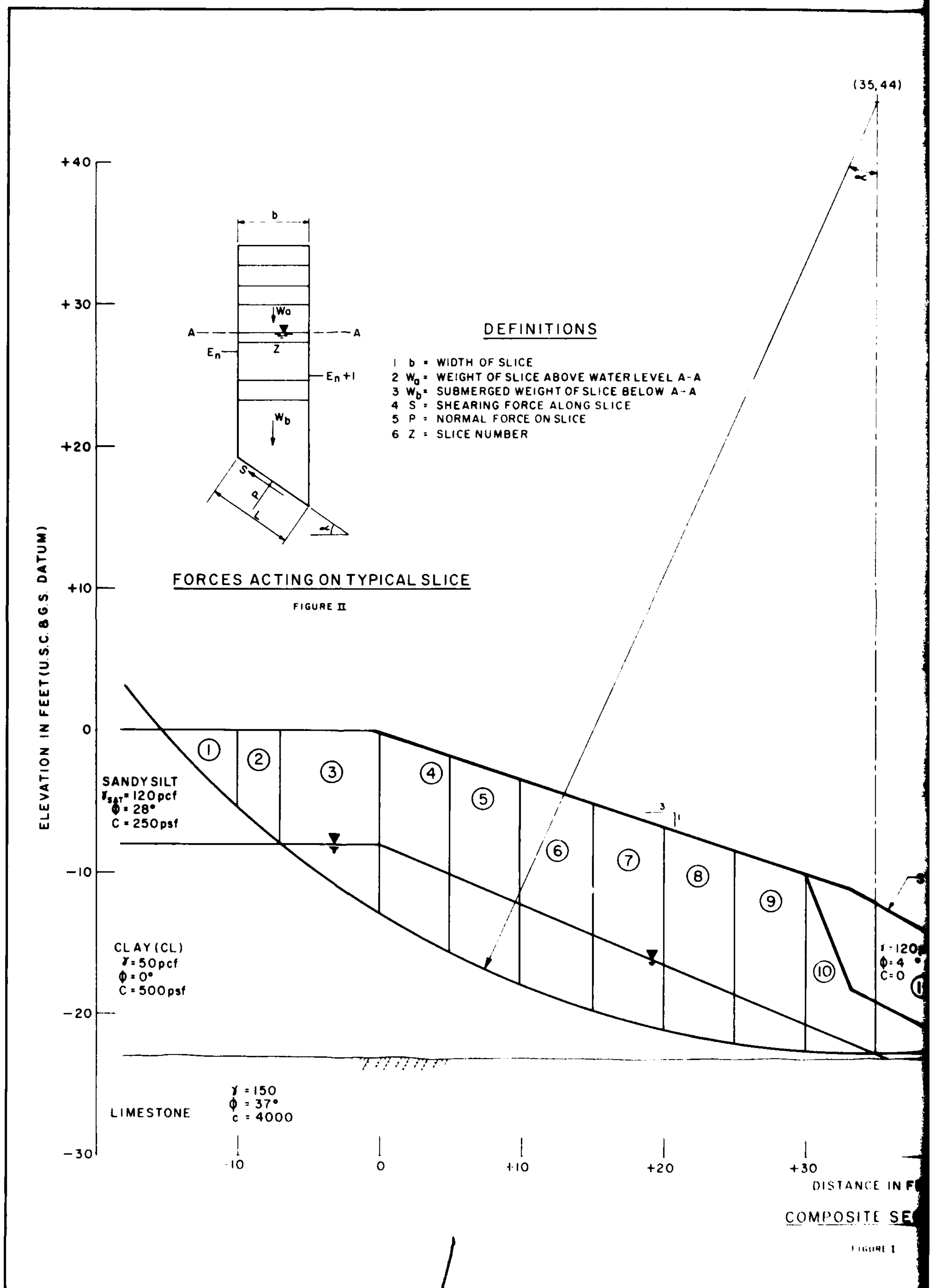


CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

GEOLOGIC SECTIONS
CHANNEL STATIONS 10+10 AND 13+15

ARMY ENGINEER DISTRICT BUFFALO
... REPORT DATED JUNE 1979

PLATE C6



(35, 44)
+40
+30
+20
+10
0
−10
−20
−30
ELEVATION IN FEET (U.S.C.&G.S. DATUM)
b
A
A
Wa
Z
En
En+1
Wb
S
P
L
DEFINITIONS
1 b = WIDTH OF SLICE
2 Wa = WEIGHT OF SLICE ABOVE WATER LEVEL A-A
3 Wb = SUBMERGED WEIGHT OF SLICE BELOW A-A
4 S = SHEARING FORCE ALONG SLICE
5 P = NORMAL FORCE ON SLICE
6 Z = SLICE NUMBER
FORCES ACTING ON TYPICAL SLICE
FIGURE II
SANDY SILT
γsat = 120 pcf
φ = 28°
C = 250 psf
CLAY (CL)
γ = 50 pcf
φ = 0°
C = 500 psf
LIMESTONE
γ = 150
φ = 37°
c = 4000
3
1
-10
0
+10
+20
+30
DISTANCE IN F
COMPOSITE SE
FIGURE I

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SLICE NO.	α	sin α	cos α	ϕ	tan ϕ	b	c	W_a+W_b	8x2	$7+\frac{8x5}{6}$	10x6	$3+\frac{2x5}{F_1}$	11/12	$3+\frac{2x5}{F_2}$	11/14	$3+\frac{2x5}{F_3}$	11/16
1	45.0°	0.707	0.707	28°	0.532	5.0	250	1704	1205	431	2155	0.911	2366	.896	2405	.896	2405
2	40.5°	0.649	0.760	28°	0 532	3.0	250	2398	1556	675	2025	0.948	2136	.934	2168	.934	2168
3	34.8°	0.571	0.821	0°	0 0	7.0	500	7574	4325	500	3500	0.821	4263	.821	4263	.821	4263
4	28.7°	0.480	0.877	0°	0.0	5.0	500	6151	2952	500	2500	0.877	2851	.877	2851	.877	2851
5	24.5°	0.415	0.910	0°	0.0	5.0	500	6634	2753	500	2500	0.910	2747	.910	2747	.910	2747
6	19.5°	0.334	0.943	0°	0.0	5.0	500	6803	2272	500	2500	0.943	2651	.943	2651	.943	2651
7	15.0°	0.259	0.966	0°	0.0	5.0	500	6877	1781	500	2500	0.966	2587	.966	2587	.966	2587
8	10.6°	0.184	0.983	0°	0.0	5.0	500	6895	1269	500	2500	0.983	2543	.983	2543	.983	2543
9	6.5°	0.113	0.994	0°	0.0	5.0	500	6337	716	500	2500	0.994	2515	.994	2515	.994	2515
10	2.4°	0.042	0.999	0°	0.0	5.0	500	6153	258	500	2500	0.999	2503	.999	2503	.999	2503
11	-2.0°	-0.035	0.999	28°	0.532	5.0	250	4963	-174	778	3890	0.989	3933	.990	3929	.990	3929
12	-6.0°	-0.105	0.995	45°	1.00	5.0	0	3249	-341	650	3250	0.938	3466	.942	3450	.942	3450
13	-10.2°	-0.177	0.984	45°	1.00	5.0	0	1433	254	287	1435	0.888	1616	.894	1605	.894	1605
14	-12.7°	-0.220	0.976	45°	1.00	1.0	0	57	-13	57	57	0.856	67	.864	66	.864	66
									Σ18305		Σ33,812		Σ36,243		Σ36,283		Σ36,283

9: $(W_a+W_b)\sin\alpha$

10: $C+\frac{W_a+W_b}{b}\tan\phi$

11: $C_b+(W_a+W_b)\tan\phi$

12: $\cos\alpha+\frac{\sin\alpha\tan\phi}{F_1}$

13: $\frac{cb+(W_a+W_b)\tan\phi}{\cos\alpha+\frac{\sin\alpha\tan\phi}{F_1}}$

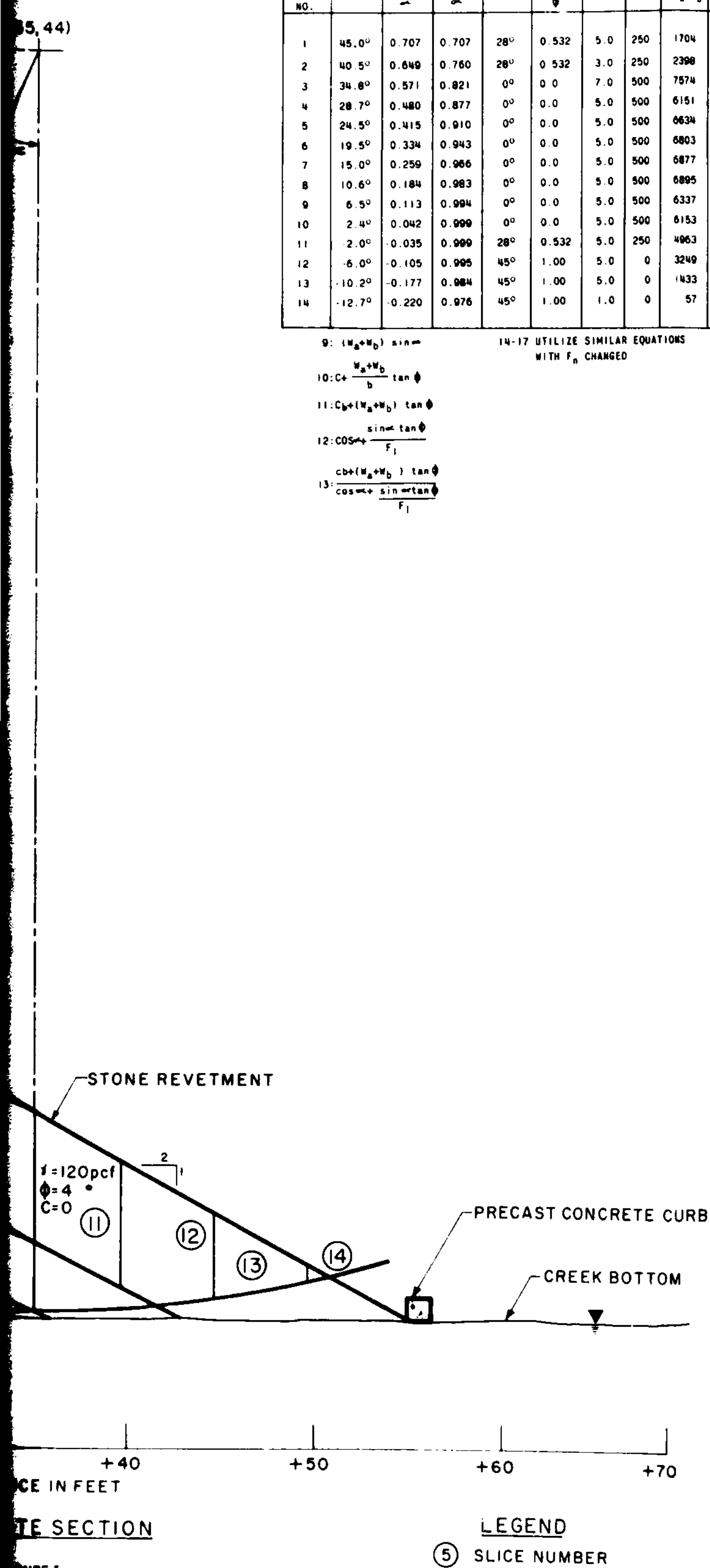
14-17 UTILIZE SIMILAR EQUATIONS WITH F_n CHANGED

$F_1=\frac{\Sigma 11}{\Sigma 9}=1.84$

$F_2=\frac{\Sigma 13}{\Sigma 9}=1.98$

$F_3=\frac{\Sigma 15}{\Sigma 9}=1.98$

$F_4=\frac{\Sigma 17}{\Sigma 9}=1.98$



LEGEND

(5) SLICE NUMBER

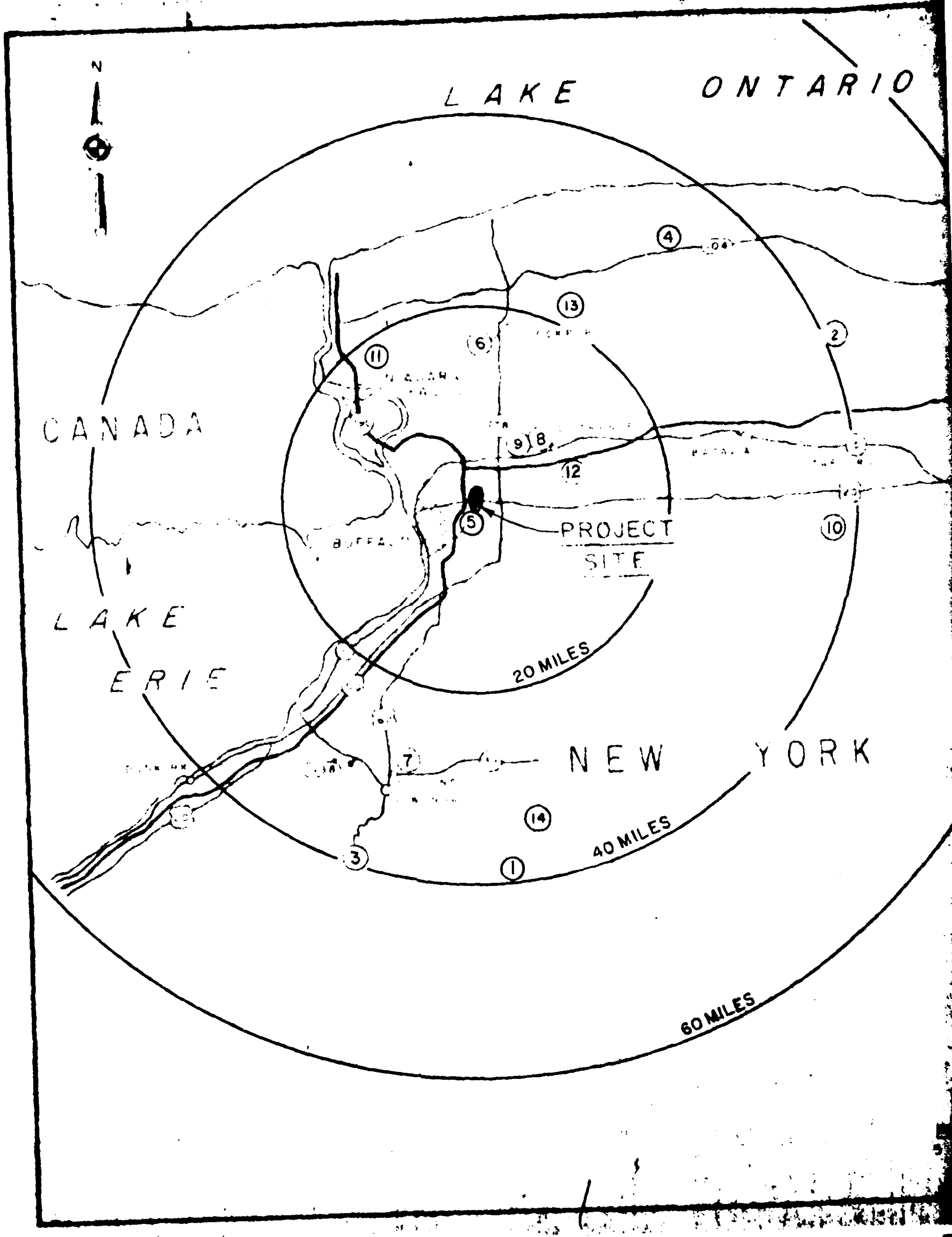
WATER LEVEL

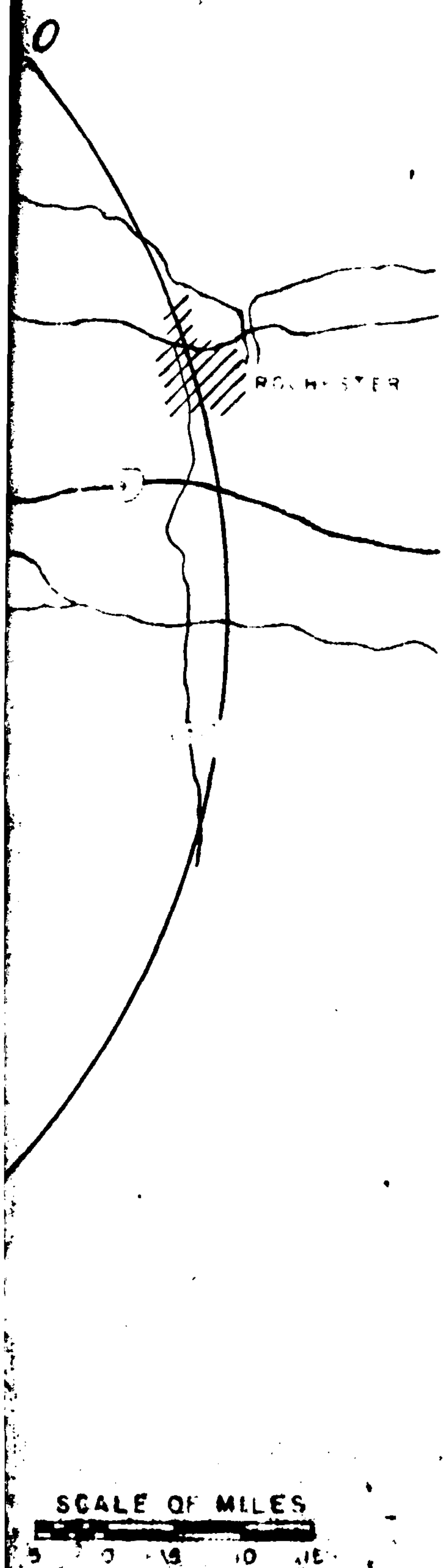
CAYUGA CREEK
CHEEKTOWAGA, NEW YORK
FLOOD CONTROL PROJECT

SLOPE STABILITY ANALYSIS BY MANUAL COMPUTATION

U S ARMY ENGINEER DISTRICT BUFFALO
DETAILED PROJECT REPORT DATED JUNE 1979

PLATE C7


N
LAKE ONTARIO
CANADA
LAKE ERIE
NEW YORK
PROJECT SITE
BUFFALO
20 MILES
40 MILES
60 MILES
1
2
3
4
5
6
7
8
9
10
11
12
13
14



NOTES:

1. (2) NUMBER IN CIRCLE INDICATES QUARRY SITE.
2. FOR QUARRY NAMES AND PRODUCTS, SEE PLATE 2.

CAYUGA CREEK, NEW YORK

LOCATION MAP

POSSIBLE MATERIAL SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR
CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE	TYPE A STONE	FILTER BEDDING	COARSE AGGREGATE	FINE AGGREGATE
1	BUFFALO SLAG CO.	MACHIAS, N.Y.	38				X
2.	COUNTY LINE STONE CO.	AKRON, N.Y.	16	X	X		
3.	COUNTRYSIDE SAND AND GRAVEL CO.	DAYTON, N.Y.	38			X	X
4.	B.R. DEWITT	RIDGEWAY, N.Y.	34				X
5.	FEDERAL CRUSHED STONE CO.	CHEEKTOWAGA, N.Y.	01		X		
6.	FRONTIER STONE PRODUCTS CO.	LOCKPORT, N.Y.	19	X	X	X	X
7.	DAN GERNATT GRAVEL PRODUCTS	COLLINS, N.Y.	28			X	X
8.	LANCASTER STONE PRODUCTS CO.	CLARENCE, N.Y.	7	X	X		
9.	BUFFALO CRUSHED STONE	CLARENCE, N.Y.	6	X	X		
10.	LEROY LIME AND CRUSHED STONE	LEROY, N.Y.	41	X	X		
11.	NIAGARA STONE PRODUCTS	PLETCHERS CORNERS N.Y.	20	X	X		X
12.	PINE HILL CONCRETE MIX CO.	NEWSTEAD, N.Y.	10				X
13.	ROYALTON STONE PRODUCTS	GASPORT, N.Y.	24		X	X	X
14.	SPENCER AND HALEY INC.	DELEVAN, N.Y.	34		X	X	X

1 2

NOTES:

RIPRAP TYPE A 40 POUNDS - 950 POUNDS

FILTER/BEDDING TYPE B #200 SIEVE TO 8 INCHES

COARSE AGGREGATE FOR CONCRETE 1/4 INCH TO 1 1/2 INCH

FINE AGGREGATE FOR CONCRETE #200 TO 3/8 INCH.

X - LISTED SOURCES HAVE SUITABLE INPLACE MATERIALS TO PRODUCE THE MAT

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
SUMMARY OF SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

AD-A101 704 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
BUFFALO METROPOLITAN AREA, NEW YORK WATER RESOURCES MANAGEMENT.--ETC(U)
AUG 79

UNCLASSIFIED NL

4 OF 5
AD
A101704

POUNDS - 950 POUNDS

TYPE B #200 SIEVE TO 8 INCHES

FOR CONCRETE 1/4 INCH TO 1 1/2 INCH

FOR CONCRETE #200 TO 3/8 INCH.

ES HAVE SUITABLE INPLACE MATERIALS TO PRODUCE THE MATERIALS SHOWN.

3

POSSIBLE SOURCES FOR RIPRAP AND FILTER/BEDDING

SOURCE	ROCK TYPE	PROPOSED USE	R DI
COUNTY LINE STONE CO. QUARRY AT AKRON, N.Y. OFFICE AT AKRON, N.Y.	ONONDAGA FORMATION (LIMESTONE)	RIPRAP TYPE A FILTER/BEDDING	
FEDERAL CRUSHED STONE DIV. BUFFALO SLAG CO., QUARRY AT CHEEKTOWAGA N.Y., OFFICE AT BUFFALO, N.Y.	ONONDAGA FORMATION (LIMESTONE)	FILTER/BEDDING	
FRONTIER STONE PRODUCTS, INC. QUARRY AT LOCKPORT, N.Y. OFFICE AT LOCKPORT, N.Y.	LOCKPORT FORMATION (DOLOMITE)	RIPRAP TYPE A FILTER/BEDDING	
LANCASTER STONE PRODUCTS QUARRY AT CLARENCE, N.Y. OFFICE AT WILLIAMSVILLE, N.Y.	ONONDAGA LIMESTONE	RIPRAP TYPE A FILTER/BEDDING	

NG

SE	RADIAL DISTANCE	LABORATORY TEST RECORD			
		DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	
	16 MI.	MAY 1967	ORD LAB LAB # 103/67.605C	WARSAW, N.Y. FLOOD CONTROL PROJECT (RIPRAP)	1967
		FEB. 1971	ORD LAB LAB #103/71.612C	BUFFALO DIKED AREA #2 (RIPRAP)	1971
		NOV. 1974	ORD LAB LAB #103/75.614B	CONFINED DREDGE SPOIL DISPOSAL PROGRAM (RIPRAP)	1974
	1 MI.	NOV. 1965	ORD LAB LAB #103/66.605C	LOCAL FLOOD PROTECTION PROJECT SMOKES CREEK, STAGE II (RIPRAP)	UNKN
		FEB 1971	ORD LAB LAB #103/71.612C	BUFFALO DIKED DISPOSAL AREA #2 (RIPRAP)	UNKN
	19 MI.	FEB. 1971	ORD LAB LAB #103/71.612C	BUFFALO DIKED DISPOSAL AREA #2 (RIPRAP)	UNKN
		AUG. 1974	ORD LAB LAB #103/75.604B	CONFINED DIKE DISPOSAL PROGRAM BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)	JUNE
		FEB. 1976	ORD LAB LAB #103/76.603B	CONFINED DIKED DISPOSAL PROGRAM BUFFALO HARBOR, N.Y. SITE 4 (ARMOR STONE)	JUNE
	7 MI.	OCT. 1967	ORD LAB LAB #103/68.605C	BUFFALO DIKED DISPOSAL AREA SITE I (RIPRAP)	UNKN

1 2

SERVICE RECORD

DATE USED	PROJECT	EVALUATION	
1967	WARSAW, N.Y. FLOOD CONTROL, PROJECT (RIPRAP)	APPEARS SATISFACTORY	THE SECOND L MEMBER OF TH
1971	BUFFALO DIKED DISPOSAL AREA #2 (RIPRAP)	TOO EARLY TO EVALUATE	ONLY THE SEC AVERAGES 16
1974 - 1975	REPAIRS TO BUFFALO DIKED DISPOSAL AREAS 1 AND 2	TOO EARLY TO EVALUATE	UNIT WEIGHT FOR REPAIRS
UNKNOWN	UNKNOWN	UNKNOWN	UNIT WEIGHT
UNKNOWN	UNKNOWN	UNKNOWN	ONLY THE FI 166 TO 169 P
UNKNOWN	UNKNOWN	UNKNOWN	THE DECEW ME FROM 162 P.C
JUNE 1975	CONFINED DIKED DISPOSAL PROGRAM BUFFALO HARBOR SITE 4 (ARMOR STONE)	TOO EARLY TO EVALUATE	DECEW MEMBER
JUNE 1976	CONFINED DIKE DISPOSAL PROGRAM BUFFALO HARBOR, N.Y. SITE 4	TOO EARLY TO EVALUATE	SPECIFIC GRA NOT ACCEPTA
UNKNOWN	UNKNOWN	UNKNOWN	ONLY THE LOW TESTED (1967) WEIGHT VARIES P.C.F. TO 16 RETESTING RE PRIOR TO USE.

REMARKS
APPROVED FOR RIPRAP AND IS FROM THE MOOREHOUSE FORMATION.
EAST FACE TESTED FOR THIS PROJECT. UNIT WEIGHT
M 166 TO 169 P.C.F. FIRST LIFT WEST FACE USED DIKES 1 AND 2.
68 P.C.F.
WEST QUARRY TESTED. UNIT WEIGHT VARIES FROM
CCEPTABLE FOR THIS PROJECT. UNIT WEIGHT VARIES
TABLE. ONLY THE GASPORT MEMBER ACCEPTABLE.
S FROM 160 P.C.F. TO 169 P.C.F. DECEW MEMBER

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
RIPRAP AND FILTER / BEDDING

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

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POSSIBLE SOURCES FOR RIPRAP AND FILTER/BEDDING

SOURCE	ROCK TYPE	PROPOSED USE
LEROY LIME AND CRUSHED STONE CO. QUARRY AT LEROY, N.Y. OFFICE AT PAVILLION, N.Y.	ONONDAGA LIMESTONE	RIPRAP TYPE A FILTER/BEDDING
NIAGARA STONE PRODUCTS CO. QUARRY AT PLETCHER'S CORNERS, N.Y. OFFICE AT NIAGARA FALLS, N.Y.	LOCKPORT DOLOMITE	RIPRAP TYPE A FILTER/BEDDING

E	RADIAL DISTANCE	LABORATORY TEST RECORD				D
		DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED		
	41 MI.	JULY 1976	ORD LAB LAB # 103/76.623B	OSWEGO HARBOR DREDGE DISPOSAL DIKE, PHASE I (RIPRAP)		UNKNOW
	20 MI.	FEBRUARY 1971	ORD LAB LAB # 103/71.612C	BUFFALO HARBOR DIKED DISPOSAL AREA #2 (RIPRAP)		UNKNOW

SERVICE RECORD

DATE USED	PROJECT	EVALUATION	
UNKNOWN	LAKE ONTARIO SHORELINE PROTECTION PROJECT	UNKNOWN	MOOREHOUSE IS NOT. SP
UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GR PRODUCING R

REMARKS
SE MEMBER IS CAPABLE OF PRODUCING RIPRAP, THE NEDROW MEMBER SPECIFIC GRAVITY VARIES FROM 2.63 TO 2.69.
C GRAVITY VARIES FROM 2.65 TO 2.80. THIS SOURCE CAPABLE OF NG RIPRAP; HOWEVER MANAGEMENT IS RELUCTANT TO DO SO.

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
RIPRAP AND FILTER/BEDDING

U.S. ARMY ENGINEER DISTRICT, BUFFALO
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POSSIBLE SOURCES OF COARSE AND FINE AGGREGATE

SOURCE	ROCK TYPE	PROPOSED USE
BUFFALO SLAG CO. PIT AT MACHIAS, N.Y. OFFICE AT BUFFALO, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE
COUNTRY SIDE SAND AND GRAVEL CO. PIT AT DAYTON, N.Y. OFFICE AT COLLINS, N.Y.	GLACIAL DEPOSIT	COARSE AGGREGATE FINE AGGREGATE
B.R. DEWITT PIT AT RIDGEWAY, N.Y. OFFICE AT PAVILION, N.Y.	BEACH DEPOSIT	FINE AGGREGATE

AGGREGATES FOR CONCRETE

ED USE	RADIAL DISTANCE	LABORATORY TEST RECORD		
		DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED
ATE	20 MI.	APRIL 1972	ORD LAB LAB #103/72.606C	BLACK ROCK LOCK REHABILITATION (NATURAL SAND)
EGATE ATE	22 MI.	FEBRUARY 1970	NYSDOT LAB #69AF261	UNKNOWN
		NOVEMBER 1974	ORD LAB LAB #103/75.606B	CONFINED DIKE DISPOSAL BUFFALO HARBOR N.Y. SITE 4 (SAND BLANKET)
ATE	18 MI.	DECEMBER 1970	ORD LAB LAB #103/72.610C	ROCHESTER HARBOR, N.Y. EAST PIER REPAIR (NATURAL SAND)
		MAY 1972	ORD LAB LAB #103/72.610C	OAK ORCHARD HARBOR, N.Y. (NATURAL SAND)
		MAY 1974	ORD LAB LAB #103/74.624C	OAK ORCHARD HARBOR, N.Y. (NATURAL SAND)
		APRIL 1976	ORD LAB LAB #103/76.630B	CONFINED DIKED DISPOSAL BUFFALO HARBOR, N.Y. SITE 4 (NATURAL SAND)

TED	SERVICE RECORD			
TED	DATE USED	PROJECT	EVALUATION	
	MAY 1973	BLACK ROCK REHABILITATION	TOO EARLY TO EVALUATE	SPECIF ALKALI PROJEC
	UNKNOWN	UNKNOWN	UNKNOWN	SPECIF WILL R
KET)	JUNE 1974	CONFINED DIKE DISPOSAL BUFFALO HARBOR N.Y. SITE 4 (SAND BLANKET)	UNKNOWN	SPECIF
)	1973	ROCHESTER HARBOR, N.Y. EAST PIER REPAIR	SATISFACTORY	SPECIF
	UNKNOWN	UNKNOWN	UNKNOWN	SPECIF
	UNKNOWN	UNKNOWN	UNKNOWN	PETROG
	UNKNOWN	UNKNOWN	UNKNOWN	SPECIF

REMARKS
SPECIFIC GRAVITY IS 2.59 (NATURAL SAND) AND 2.64 (N.Y. #1). LOW ALKALI CEMENT REQUIRED. RETESTING REQUIRED PRIOR TO USE ON THIS PROJECT.
SPECIFIC GRAVITY IS 2.62. COARSE AGGREGATE IS NYS DOT APPROVED BUT WILL REQUIRE TESTING BY ORDL BEFORE USE.
SPECIFIC GRAVITY IS 2.60.
SPECIFIC GRAVITY IS 2.58.
SPECIFIC GRAVITY IS 2.62.
PETROGRAPHIC EXAMINATION ONLY.
SPECIFIC GRAVITY IS 2.50.

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
AGGREGATES FOR CONCRETE

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

POSSIBLE SOURCES OF CONCRETE AGGREGATES AND FILTE		
SOURCE	ROCK TYPE	PROPOSED USE
FRONTIER STONE PRODUCTS CO. QUARRY AT LOCKPORT, N.Y. OFFICE AT LOCKPORT, N.Y.	LOCKPORT DOLOMITE	FILTER/BEDDING COARSE AGGREGATE FINE AGGREGATE
GERNATT GRAVEL PRODUCTS PIT AT COLLINS, N.Y. OFFICE AT COLLINS, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE
PINE HILL CONCRETE MIX CO. PIT AT NEWSTEAD, N.Y. OFFICE AT BUFFALO, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE
ROYALTON STONE PRODUCTS CO. QUARRY AT GASPORT, N.Y. OFFICE AT GASPORT, N.Y.	LOCKPORT DOLOMITE	COARSE AGGREGATE FINE AGGREGATE
SPENCER AND HALEY, INC. PIT AT FREEDOM, N.Y. OFFICE AT DELEVAN, N.Y.	GLACIAL DEPOSIT	COARSE AGGREGATE FINE AGGREGATE FILTER/BEDDING

FILTER/BEDDING

SE	RADIAL DISTANCE	LABORATORY TEST RECORD			
		DATE TESTED	LABORATORY	PROJECT FOR WHICH TESTED	
	19 MI.	DECEMBER 1974	ORD LAB LAB #103/75.614B	CONFINED DREDGE DIKE DISPOSAL PROGRAM	UNKNO
	28 MI.	FEBRUARY 1971	NYSDOT LAB #70AF188	UNKNOWN	UNKNO
		JUNE 1975	ORD LAB LAB #103/76.631B	CONFINED DIKED DISPOSAL, BUFFALO HARBOR, SITE 4	UNKNO
	10 MI.	AUGUST 1965	ORD LAB LAB #101/66.310C	SMOKES CREEK PROJECT, BUFFALO, N.Y. (CONCRETE AGGREGATE)	1965
		MARCH 1972	NYSDOT LAB #71AF257	UNKNOWN	UNKNO
		APRIL 1976	ORD LAB LAB #103.76.630B	CONFINED DIKE DISPOSAL, BUFFALO HARBOR, N.Y. SITE 4 (CONCRETE AGGREGATE)	1976
	14 MI.	AUGUST 1978	ORD LAB LAB #103/78.623B	BUFFALO DISTRICT WAREHOUSE (SIDEWALKS AND DRIVEWAY)	SEP. -
	24 MI.	DECEMBER 1976	NYS LAB LAB #75AR63	UNKNOWN	UNKNO
	34 MI.	JANUARY 1972	NYSDOT LAB #71AF152	UNKNOWN	UNKNO
		NOVEMBER 1974	ORD LAB LAB #103/75.6C6B	CONFINED DIKED DISPOSAL PROGRAM	JULY
	42 MI.	SEPTEMBER 1978	ORD LAB LAB #103/78.625B	BUFFALO DISTRICT WAREHOUSE (FLOOR)	SEPT

SERVICE RECORD			
DATE USED	PROJECT	EVALUATION	
UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRA PRIOR TO USE
UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRA
UNKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRA
1965	SMOKES CREEK PROJECT, N.Y.	SATISFACTORY	SPECIFIC GRA
NKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRA
1976	CONFINED DIKE DISPOSAL, BUFFALO HARBOR, N.Y. SITE 4	TOO EARLY TO EVALUATE	SPECIFIC GRA
SEP. - OCT. 1978	BUFFALO DISTRICT WAREHOUSE	TOO EARLY TO EVALUATE	SPECIFIC GRA SAMPLED RIEF
NKNOWN	UNKNOWN	UNKNOWN	NYSDOT APPRO FINE AGGREGA
NKNOWN	UNKNOWN	UNKNOWN	SPECIFIC GRA FOR CONCRETE TESTING REQU
ULY 1976	WELLSVILLE 2ND RECTIFICATION PROJECT (BEDDING)	TOO EARLY TO EVALUATE	SPECIFIC GRA RIES FROM 2.
EPTEMBER 1978	BUFFALO DISTRICT WAREHOUSE	TOO EARLY TO EVALUATE	SPECIFIC GRAVITY IS 2.(SIZE #1), 2.60 (NYS SIZE #2) MATERIAL SAMPLED A (READY MIX PLANT) HAMBURG, N.Y.

REMARKS
GRAVITY IS 2.75. CONCRETE AGGREGATES WILL REQUIRE RETESTING USE FOR THIS PROJECT.
GRAVITY IS 2.57.
GRAVITY IS 2.58
GRAVITY IS 2.66
GRAVITY IS 2.64
GRAVITY IS 2.50
GRAVITY IS 2.63 (NYS SIZE #1) W.YP (NYS SIZE #2). MATERIAL RIEFLER, (READY MIX PLANT) HAMBURG, N.Y.
PPROVED SPECIFIC GRAVITY IS 2.76. ORDL TEST REQUIRED FOR REGATE AND COARSE AGGREGATE.
GRAVITY 2.57. RETE AGG. ORDL REQUIRED.
GRAVITY VA- M 2.59 TO 2.64.
2.63 (NYS AT RIEFLER,

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES AGGREGATES FOR CONCRETE

U.S. ARMY ENGINEER DISTRICT, BUFFALO
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SOURCE	FORMATION	PROPOSED USE	LAB. NO.
COUNTY LINE STONE CO. QUARRY AT AKRON, N.Y. OFFICE AT AKRON, N.Y.	LOCKPORT DOLOMITE	RIPRAP TYPE A FILTER/BEDDING	ORD 103/67.605C
			ORD 103/71.612C
			ORD 103/75.614B
FEDERAL CRUSHED STONE QUARRY AT CHEEKTOWAGA, N.Y. OFFICE AT BUFFALO, N.Y.	ONONDAGA LIMESTONE	FILTER/BEDDING	ORD 103/71.612C
FRONTIER STONE PRODS. CO. QUARRY AT LOCKPORT, N.Y. OFFICE AT LOCKPORT, N.Y.	LOCKPORT DOLOMITE	RIPRAP TYPE A FILTER/BEDDING	ORD 103/71.612C
			ORD 103/75.604B
			ORD 103/76.603B
LANCASTER STONE PRODUCTS CO. QUARRY AT CLARENCE, N.Y. OFFICE AT WILLIAMSVILLE, N.Y.	ONONDAGA LIMESTONE	RIPRAP TYPE A FILTER/BEDDING	ORD 103/68.605C

SUMMARY SHEET FOR LABORATORY

(RIPRAP AND FILTER/BEDDING)

NO.	TEST RESULTS					
	PETROGRAPHIC ANALYSIS	SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E
06C	CHERTY LIMESTONE, FINE-GRAINED, SLIGHTLY DOLOMITIC; DOLOMITE, FINE-GRAINED, MICROPOROUS	2.50	0.2%			
12C	LIMESTONE-DARK ', MEDIUM-GRAINED, WITH SCATTERED ENLARGED CALCITE, CRYSTALS; SLIGH... DOLOMITIC, VERY EVEN TEXTURED, DENSE, HARD, TOUGH WITH SEMI CONCOIDAL FRACTURE: CONTAINS LARGE CHERT NODULES.	2.69 TO 2.70	0.0% TO 0.0%			
14B	FOSSILIFEROUS LIMESTONE-DARK YELLOWISH BROWN, FINE TO VERY COARSE GRAINED; MOD. HARD, DENSE, CONSISTING OF FOSSIL FRAGMENTS FLOATING IN A FINE-GRAINED CARBONATE MATRIX; SLIGHTLY ARGILLACEOUS SEAMS.	2.66 TO 2.71	.21 TO .76%			
12C	LIMESTONE-DUSKY YELLOW BROWN; FINE-GRAINED EVEN TEXTURED TO MEDIUM GRAINED AND FOSSILIFEROUS; ROCK IS DENSE, HARD, TOUGH WITH SUB CONCOIDAL FRACTURE, CONTAINS NUMEROUS WAVY, THIN INTERNAL BEDDING SEAMS.	2.66 TO 2.71	0.10 TO 0.68%			
2C	DOLOMITE-OLIVE GRAY, FINE-GRAINED, DENSE, BUT CONTAINING NUMEROUS VUGS 1" DIA. LINED WITH DOLOMITE CRYSTALS, ROCK IS HARD, TOUGH AND APPEARS MASSIVE.	2.63 TO 2.66	0.81 TO 1.34%			
4B	DOLOMITE-LIGHT MEDIUM GRAY, FINE-GRAINED, DENSE TO SLIGHTLY POROUS, MODERATELY HARD AND TOUGH WITH BLOCKY FRACTURE, CONTAINS MANY STYLOLITES, AND GYPSUM FILLED VUGS.	2.65 TO 2.75	0.95 TO 1.68%			
08	DOLOMITE-MEDIUM GRAYISH BROWN, FINE TO MEDIUM-GRAINED, SUGARY-TEXTURED, DENSE, HEMOGENOUS, MOD., HARD, TOUGH, CONTAINS A FEW STYLOLITE SEAMS.	2.57 TO 2.73	0.51 TO 2.79%			
C	CHERTY LIMESTONE-YELLOWISH BROWN, VARIABLY FINE TO COARSE-GRAINED, DENSE, HARD, TOUGH, DURABLE, FOSSILIFEROUS CONTAINING LARGE FOSSIL CORALS AND LARGE NODULES OF MEDIUM GRAY SPECKLED, DENSE, FRACTURED, CHALCEDONIC CHERT.	2.66 TO 2.7				

ORY TESTING

ESULTS

F&E PART	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)
				NO EFFECT	NO EFFECT
				PARTING AT BEDDING SEAMS, SPALLING	NO EFFECT
				SOME PARTING ALONG SHALE SEAMS	SEVERAL BEDDING PLANE FRACTURES
				SPALLING OF BEDDING PLANE SURFACE	SPALLING AT BEDDING PLANE SURFACE.
				NO EFFECT	NO EFFECT
				NO EFFECT	SOME PARTING ALONG STYLOLITES
				SOME PARTING ALONG BEDDING SEAMS.	NO EFFECT RETESTING REQUIRED.

REMARKS

IRED.

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
SUMMARY OF LAB TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

PLATE C-14

SOURCE	FORMATION	PROPOSED USE	LAB. NO.
LEROY LIME AND CRUSHED STONE CO. QUARRY AT LEROY, N.Y.	ONONDAGA LIMESTONE	RIPRAP TYPE A	ORD 103/76.623B
NIAGARA STONE PRODUCTS CO. QUARRY AT PLETCHER'S CORNERS, N.Y. OFFICE AT NIAGARA FALLS, N.Y.	LOCKPORT DOLOMITE	RIPRAP TYPE A	ORD 103/71.612C

SUMMARY SHEET FOR LABORATORY

(RIPRAP)

O.	TEST RESULT					
	PETROGRAPHIC ANALYSIS	SP. GRAV.	ABS.	$MgSO_4$	L.A.A.	F&E P
B	LIMESTONE - HARD, FINE-GRAINED, V. CHERTY, ARGILLACEOUS, MEDIUM GRAY. THE CHERT LENSES ARE VERY DENSE BUT HIGHLY FRACTURED.	2.63 TO 2.69	0.2%			
C	DOLOMITE - HARD, TOUGH, FINE-GRAINED, SMALL CALCITE AND/OR GYPSUM FILLED VUGS, YELLOWISH BROWN. ROCK BREAKS WITH A BLOCKY TO SEMI-CONCHOIDAL FRACTURE.	2.71 TO 2.80	0.26 TO 0.95%			

RY TESTING

ULTS

E PART	L.W PART	SO. PART	CLAY LUMPS	WET-DRY(80 CYCLES)	FREEZE-THAW(35CYCLES)	
				CRACKING ALONG CLAY SEAMS IN THE ROCK.	NO EFFECT	
				PARTIAL DISSOLUTION OF GYPSUM NODULES	PARTIAL DISSOLUTION OF GYPSUM NODULES. DEVELOPMENT OF CRACKS ALONG SHALY BEDDING SEAMS.	

SUM

U.S

DE

REMARKS

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
SUMMARY OF LAB TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

SOURCE	FORMATION	PROPOSED USE	LAB. N
BUFFALO SLAG CO, PIT AT MACHIAS, N.Y. OFFICE AT BUFFALO, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE	ORD 103/72.60
			ORD 103/72.60
COUNTRYSIDE SAND AND GRAVEL CO. PIT AT DAYTON, N.Y. OFFICE AT NORTH COLLINS, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE COARSE AGGREGATE	ORD 103/75.6
B.R. DEWITT PIT AT RIDGEWAY, N.Y. OFFICE AT PAVILLION, N.Y.	BEACH DEPOSIT	FINE AGGREGATE	ORD 103/72.61
FEDERAL CRUSHED STONE CO. DIV. BUFFALO SLAG CO. QUARRY AT CHEEKTOWAGA, N.Y. OFFICE AT BUFFALO, N.Y.	ONONDAGA LIMESTONE	RIPRAP FILTER/BEDDING	ORD 103/72.60
			ORD 101/73.3
			ORD 103/75.6
			ORD 103/76.6
			ORD 103/78.62
FRONTIER STONE PRODUCTS CO. QUARRY AT LOCKPORT, N.Y. OFFICE AT LOCKPORT, N.Y.	LOCKPORT DOLOMITE	COARSE AGGREGATE FINE AGGREGATE	ORD 103/75.61
GERNATT GRAVEL PRODUCTS PIT AT COLLINS, N.Y. OFFICE AT COLLINS, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE	ORD 103/76.63
			ORD 103/78.6

SUMMARY SHEET FOR LABORAT

(CONCRETE AGGREGATES, FILTER/BEDDING AND

LAB. NO.	TEST RE				
	PETROGRAPHIC ANALYSIS	SP. GRAV.	ABS.	$MgSO_4$	L.A.A.
ORD 103/72.606C	QUARTZ AND QUARTZITE - 27%; LIMESTONE - DOLOMITE - 10%; SANDSTONE-SILT STONE - 46%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS - 4%; CHERT - 5%; WEATHERED ROCK - 4%; SHALE-4%.	2.69	1.52%	21%	
ORD 103/72.606C	QUARTZ - 1%; LIMESTONE-DOLOMITE - 24%; SANDSTONE-SILTSTONE - 5%; IGNEOUS -METAMORPHIC ROCK FRAGMENTS - 3%; WEATHERED ROCK FRAGMENTS - 5%; SHALE - 1%.	2.64	1.52%	12%	18%
ORD 103/75.606B	QUARTZ-31%; LIMESTONE-DOLOMITE-31%; SANDSTONE-SILTSTONE-30%; IGNEOUS METAMORPHIC ROCK FRAGMENTS-1%; CHERT-0.5%; SHALE-6%.	2.60	1.30%	21%	
ORD 103/72.610C	QUARTZ-39%; LIMESTONE-DOLOMITE-5%; SANDSTONE-SILTSTONE-40%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS-14%; WEATHERED ROCK FRAGMENTS-2%.	2.58	1.37%	15%	
ORD 103/72.606C	LIMESTONE, ARGILLACEOUS, DOLOMITIC - 45 67%; LIMESTONE, ARGILLACEOUS LAMINATED - 3 7%; LIMESTONE - 8 10%; CHERTY LIMESTONE - 17 37%.				
ORD 301/73.337C	LIMESTONE, ARGILLACEOUS, DOLOMITIC-80%; LIMESTONE, HIGHLY ARGILLACEOUS, DOLOMITIC-3%; LIMESTONE, LAMINATED, ARGILLACEOUS, DOLOMITIC-3%; LIMESTONE -6%; CHERT-8%.				
RD 03/75.632B	LIMESTONE-40%; LIMESTONE, ARGILLACEOUS DOLOMITIC-17%; LIMESTONE, MODERATELY ARGILLACEOUS, DOLOMITIC-26%; LIMESTONE, SHALY, DOLOMITIC-3%; LIMESTONE, CHERTY-7%; CHERT-7%.	2.69	0.7%	10.4%	19.1%
RD 03/76.630B	LIMESTONE-21%; LIMESTONE, ARGILLACEOUS, DOLOMITIC-34%; LIMESTONE, MODERATELY ARGILLACEOUS, DOLOMITIC-16%; LIMESTONE, SHALY LAMINATED-4%; CHERTY-LIMESTONE-11%; CHERT-14%.	2.69	0.7%		
RD 03/78.623B	FOSSILIFEROUS LIMESTONE-9%; SILTY FOSSILIFEROUS LIMESTONE-62%; SHALY FOSSILIFEROUS LIMESTONE-3%; DOLOMITIC LIMESTONE-6%; CHERTY LIMESTONE-6%; FOSSILIFEROUS CHERT-14% (POTENTIALLY REACTIVE)	2.688	0.47%		0.4%
RD 03/75.614B	DOLOMITE-13 16%; DOLOMITE, FOSSILIFEROUS-21 27 ; DOLOMITE-HARD, TOUGH, OLIVE GRAY-51 65%; DOLOMITE, LIGHT TO MEDIUM GRAY-2%; DOLOMITE, MOTTLED YELLOWISH BROWN-TRACE-4%.	2.74 TO 2.76	1.3%	7.3 TO 8.7%	24.4 TO 24.6%
3/76.631B	QUARTZ-33%; LIMESTONE-DOLOMITE-7%; SANDSTONE-SILTSTONE-42%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS-3%; CHERT-4%; SHALE-8%; WEATHERED ROCK FRAGMENTS-4%.	2.58	2.6%	25.8%	
/78.625B	QUARTZ-30%; SANDSTONE AND SILTSTONE-44%; LIMESTONE AND DOLOMITE-8%; IGNEOUS AND METAMORPHIC ROCK FRAGMENTS-5%; SHALE-8%; WEATHERED ROCK FRAGMENTS-2%; CHERT-3% (POTENTIALLY REACTIVE)	2.489	2.68%		30.1%

2

RATORY TESTING

NG AND RIPRAP)

RESULTS

L.A.A.	F&E PART	L.W. PART	SO. PART	CLAY LUMPS	WET-DRY (80 CYCLES)	FREEZE-THAW (35 CYCLES)
	18%					
0%	16%					
	12%					
	3%					
	9-17%					
	17%					
.1%	16%					
.4%	5.2%					
.4 TO .6%						
			%			
.1%	7.7%		8% (SHALE)			

	REMARKS
(S)	
	NATURAL SAND, LOW ALKALI CEMENT REQUIRED.
	NY#1
	USED AS SAND BLANKET FOR BUFFALO DIKE 4. TESTED FOR FINE AGGREGATE. COARSE AGGREGATE REQUIRES TESTING PRIOR TO USE.
	NATURAL SAND
	NY#1 TESTED
	NY #1 TESTED
	COARSE AGGREGATE TESTED. LOW ALKALI CEMENT REQUIRED.
	FINE AGGREGATE REQUIRES TESTING.

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
SUMMARY OF LAB TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

SOURCE	FORMATION	PROPOSED USE	LAB. NO.
LANCASTER STONE PRODUCTS QUARRY AT CLARENCE, N.Y. OFFICE AT WILLIAMSVILLE, N.Y.	ONONDAGA LIMESTONE	FILTER BEDDING	ORD 103/72.606C
LEROY LIME AND CRUSHED STONE CO. QUARRY AT LEROY, N.Y. OFFICE AT PAVILLION, N.Y.	ONONDAGA LIMESTONE	RIPRAP TYPE A	ORD 101/71.332C
PINE HILL CONCRETE CORP. PIT AT NEWSTEAD, N.Y. OFFICE AT BUFFALO, N.Y.	GLACIAL DEPOSIT	FINE AGGREGATE	ORD 103/76.630B
			ORD 103/78.623B
ROYALTON STONE PRODUCTS QUARRY AT GASPORT, N.Y. OFFICE AT GASPORT, N.Y.	LOCKPORT DOLOMITE	COARSE AGGREGATE FINE AGGREGATE	NYSDOT 75AR63
SPENCER AND HALEY, INC. PIT AT FREEDOM, N.Y. OFFICE AT DELEVAN, N.Y.	GLACIAL DEPOSIT	COARSE AGGREGATE FINE AGGREGATE	ORD 103/75.606B
			ORD 103/75.606B
			ORD 103/78.625B
			ORD 103/78.625B

SUMMARY SHEET FOR LABORATOR

(CONCRETE AGGREGATES AND RIPRAP)

.NO.	TEST RESU					
	PETROGRAPHIC ANALYSIS	SP.GRAV.	ABS.	$MgSO_4$	L.A.A.	F&
.606C	LIMESTONE-11%; LIMESTONE, ARGILLACEOUS, DOLOMITIC-25%; LIMESTONE, HIGHLY ARGILLACEOUS, DOLOMITIC-4%; CHERTY LIMESTONE-17%; CHERT 43%.	2.65	0.58%	1%	18%	
.382C	NYS #3: LIMESTONE-37%; CHERTY LIMESTONE-47%; CHERT-8%; ARGILLACEOUS LIMESTONE-7%.	2.62 TO 2.71				
.630B	QUARTZ-32%; LIMESTONE-DOLOMITE-42%; SANDSTONE AND SILTSTONE-16%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS-4%; CHERT-1%; WEATHERED ROCK FRAGMENTS-TRACE; SHALE-5%.	2.50	1.2%	20.9%		5%
.623B	QUARTZ AND QUARTZITE-34%; LIMESTONE AND DOLOMITE-22%; SANDSTONE AND CALCAREOUS SILTSTONE-35%; IGNEOUS AND METAMORPHIC ROCK FRAGMENTS-7%; SHALE-TRACE; WEATHERED PARTICLES-1%; CHERT-TRACE.	2.577	1.72%		26.5%	
	NOT AVAILABLE	2.76	1.0%			
5.606B	QUARTZ-36%; LIMESTONE-DOLOSTONE-26%; SANDSTONE-SILTSTONE-34%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS-2%; CHERT-1%; WEATHERED ROCK FRAGMENTS-1%; SHALE-1%.	2.59	1.52%	19%		10
5.606B	QUARTZ-TRACE; LIMESTONE-DOLOSTONE-44%; SANDSTONE AND SILTSTONE-44%; IGNEOUS-METAMORPHIC ROCK FRAGMENTS-6%; CHERT-2%; WEATHERED ROCK FRAGMENTS-2%; SHALE-2%.	2.64	1.63%	11%	20%	1
0.625B	SANDSTONE, QUARTZITE AND SILTSTONE-69%; LIMESTONE AND DOLOMITE-20%; IGNEOUS AND METAMORPHIC ROCK FRAGMENTS-5%; SHALE AND CLAYSTONE-3%; CHERT AND CHERTY LIMESTONE-3%. (POTENTIALLY REACTIVE)	2.620	1.72%		6.35%	6.
0.625B	QUARTZ-TRACE: SANDSTONE, QUARTZITE AND SILTSTONE-73%; LIMESTONE AND DOLOMITE-9%; SHALE-9%; CHERT-5% (POTENTIALLY REACTIVE)	2.600	1.851%		8.80%	

2

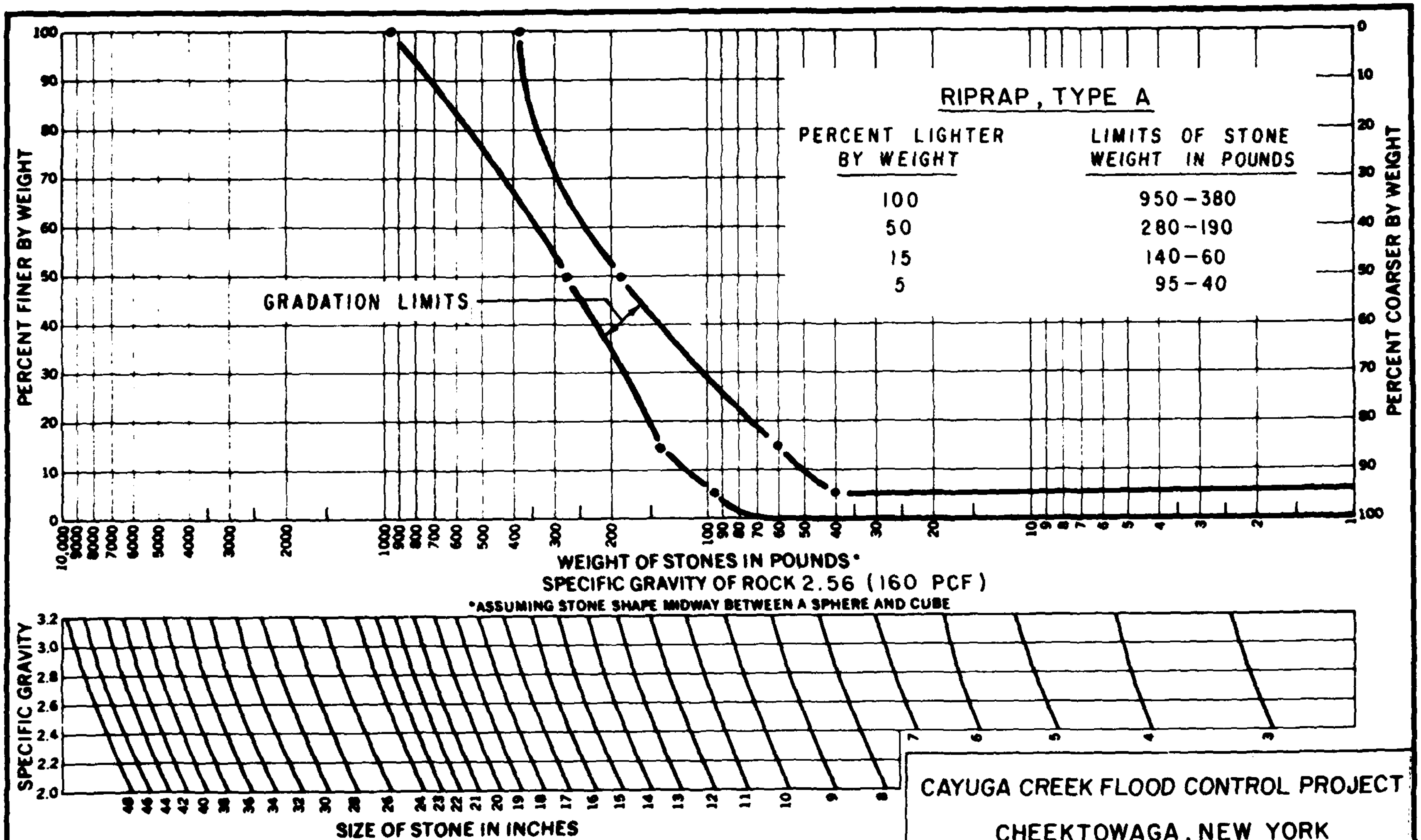
ES)	REMARKS
	TESTED FOR CONCRETE AGGREGATE AND CELL FILL. NOT ACCEPTABLE FOR CONCRETE AGGREGATE.
	TESTED FOR CONCRETE AGGREGATE AND DEEMED UNSUITABLE DUE TO HIGH CHERT CONTENT.
	SAMPLED FROM STOCKPILE AT PINE HILL CONCRETE PLANT (READY MIX)
	NYS APPROVED FOR CONCRETE AGGREGATE. WILL REQUIRE ORDL TESTING BEFORE USE.
	NATURAL SAND
	GRAVEL NY #1 AND 2.
	NYSDOT #1
NYSDOT #2	

CAYUGA CREEK, NEW YORK

MATERIAL SOURCES
SUMMARY OF LAB TEST RESULTS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
DETAILED PROJECT REPORT, APRIL 1979

4



CAYUGA CREEK FLOOD CONTROL PROJECT

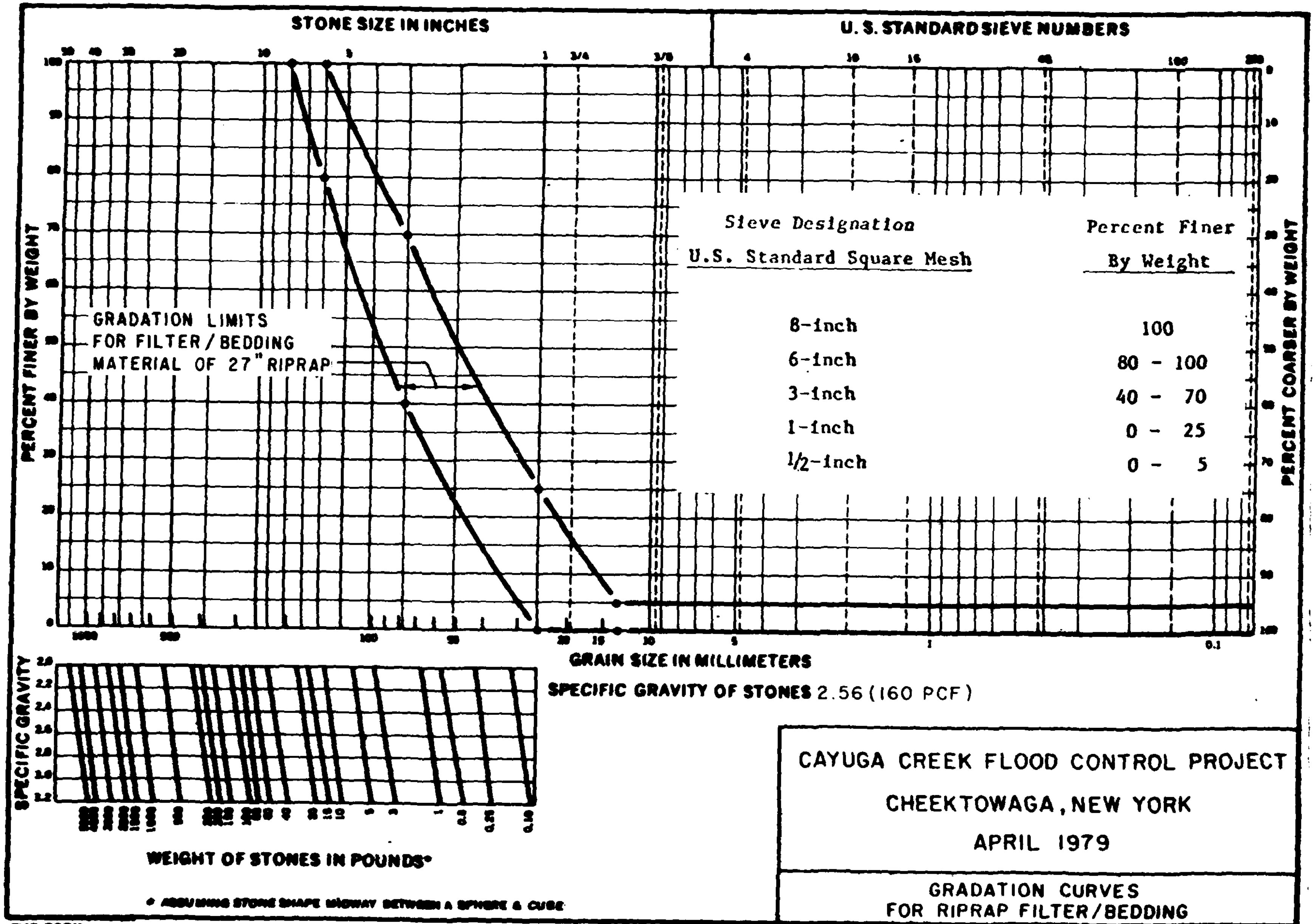
CHEEKTOWAGA, NEW YORK

APRIL 1979

27" RIPRAP GRADATION CURVES

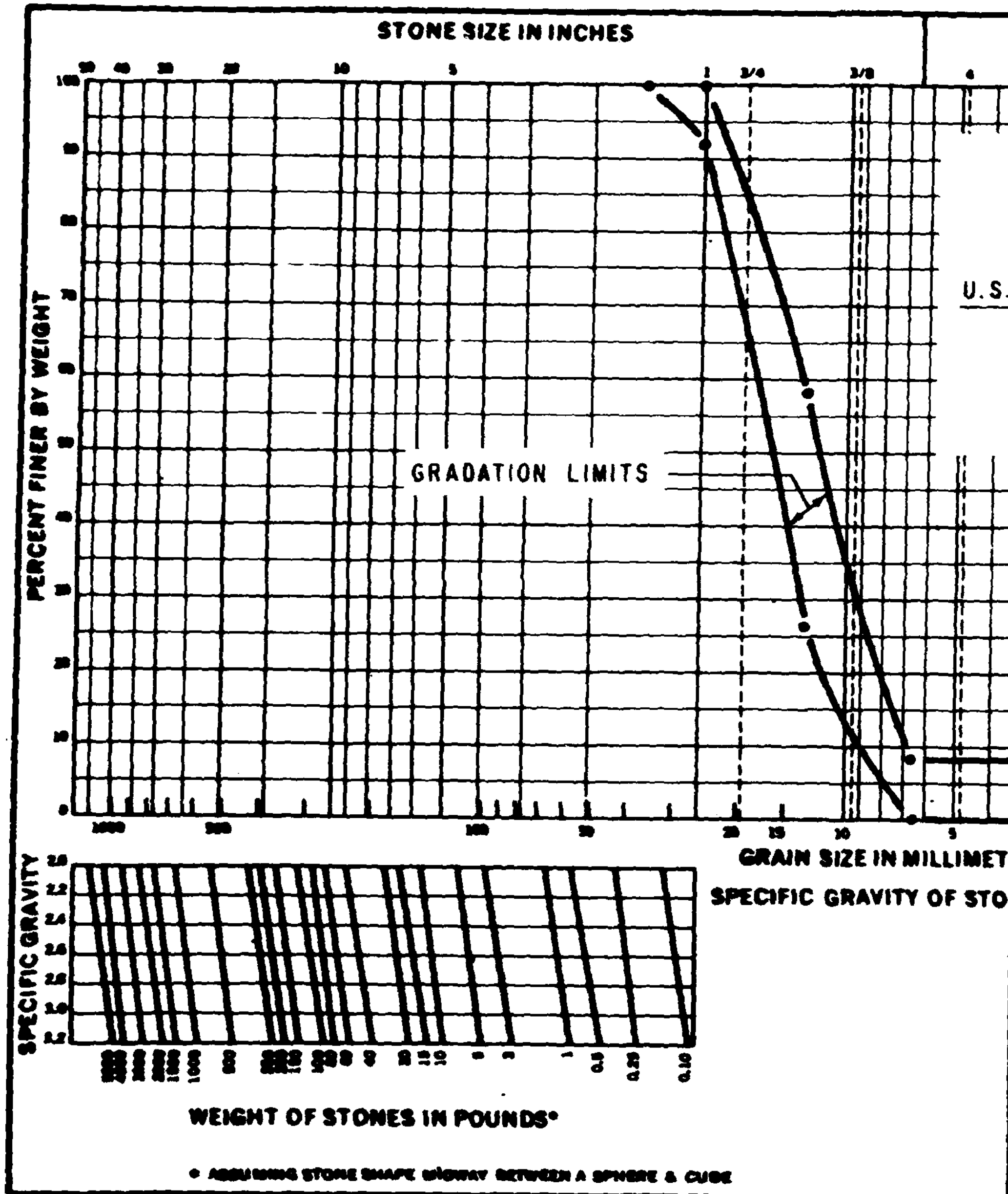
ENG FORM 4055
APR 67

FIGURE 1



ENG FORM 4056
APR 67

FIGURE 2



CAYUGA CREEK FLOOD CONTROL PROJECT

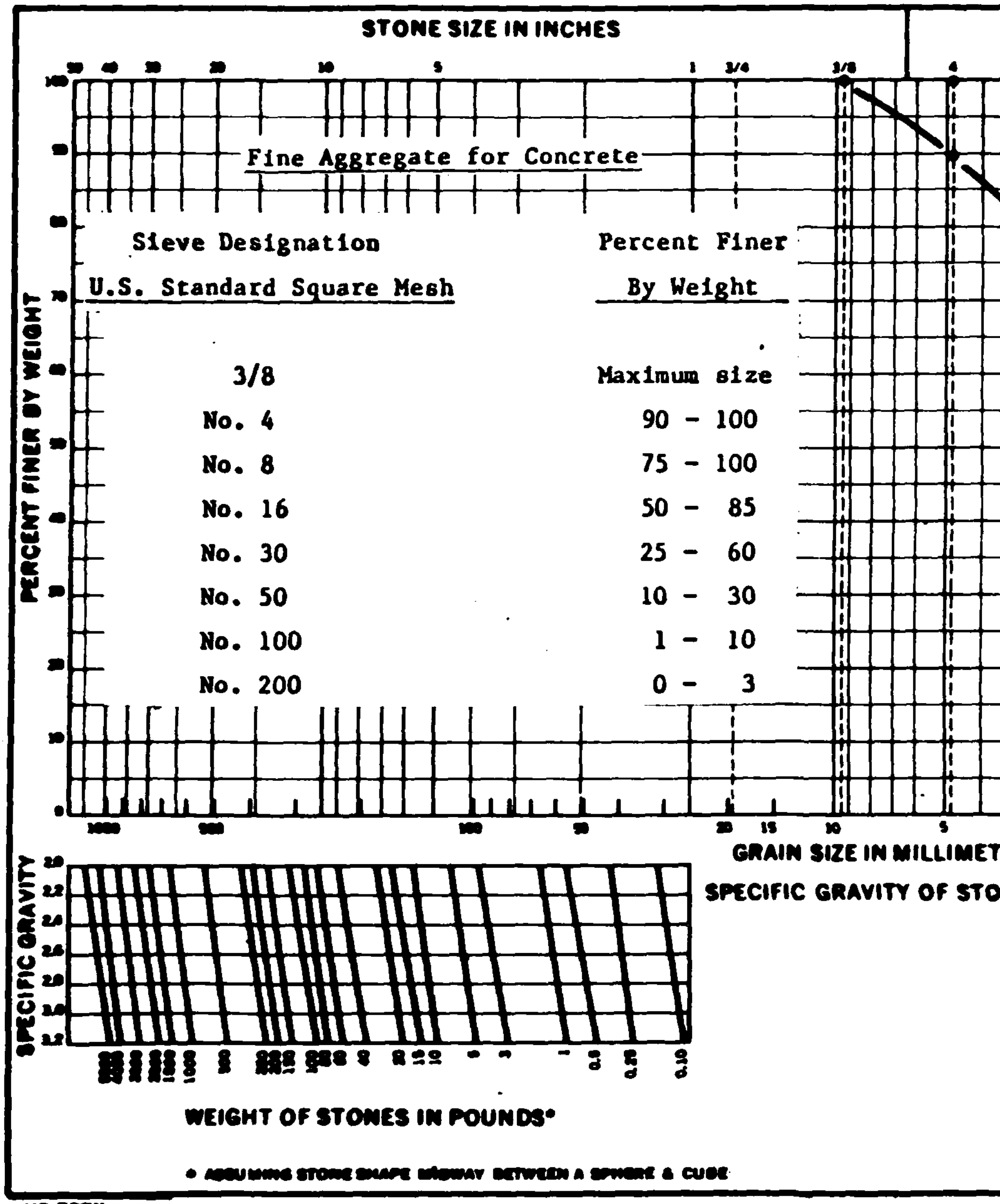
CHEEKTOWAGA, NEW YORK

APRIL 1979

GRADATION CURVES
FOR COARSE AGGREGATE FOR CONCRETE

ENG FORM 4056
APR 67

FIGURE 3



Fine Aggregate for Concrete

Sieve Designation U.S. Standard Square Mesh	Percent Finer By Weight
3/8	Maximum size
No. 4	90 - 100
No. 8	75 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	1 - 10
No. 200	0 - 3

CAYUGA CREEK FLOOD CONTROL PROJECT

CHEEKTOWAGA, NEW YORK

APRIL 1979

GRADATION CURVES
FOR FINE AGGREGATE FOR CONCRETE

FIGURE 4

CAYUGA CREEK
CHEEKTOWAGA, NEW YORK

APPENDIX D
PERTINENT CORRESPONDENCE

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Peter A. A. Berle,
Commissioner

DIVISION OF WATER
FLOOD PROTECTION BUREAU

June 29, 1979

Colonel George P. Johnson
District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

This is in reply to your letter of June 26, 1979, requesting a letter of intent to provide assurances of local cooperation for a proposed local flood protection project on Cayuga Creek in the Town of Cheektowaga, New York. Please be assured that, at the appropriate time, this Department will provide the necessary items of local cooperation as noted in your letter for any project which is economically justified, engineeringly and environmentally sound and meets local needs.

Sincerely,

James Kelley

James F. Kelley
Chief, Water Management Group

cc: P. Buechi, w/incoming
C. Bryan, w/incoming
RLK/ea

ps2225

NCBED-PN 26 June 1979

James F. Kelley, Chief of Water
Management Group
New York State Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233

Dear Mr. Kelley:

The purpose of this letter is to request a letter of intent to provide assurances of local cooperation on the Cayuga Creek flood control project in Cheektowaga, NY.

In late March 1978, copies of the draft Detailed Project Report were forwarded for your agency's review and comment. I have received a reply from you regarding that draft. However, I have not received any indication concerning the State's intentions regarding the articles of local cooperation that are discussed in the draft DPR.

I am presently completing the final Detailed Project Report. The report is scheduled to be submitted through my Division Office to Office, Chief of Engineers on 27 July 1979. The report must contain a letter of intent from the non-Federal sponsor expressing its willingness to provide the required assurances of local cooperation at the appropriate time.

Please send me your letter indicating that NYSDEC does intend to act as local cooperator for the Cayuga Creek flood control project and that they will furnish assurances satisfactory to the Secretary of the Army; to wit:

a. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for construction and subsequent maintenance of the project works. In acquiring lands, easements and rights-of-way for construction and subsequent maintenance of the project, the State of New York will comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property

Acquisition Policies Act of 1970, "Public Law 91-646, approved 2 January 1971 and prohibit future development within ponding areas;

b. Hold and save the United States free from damages due to the construction and maintenance of the works except for damages due to the fault or negligence of the Government or its Contractors;

c. Take over, maintain, and operate the project after completion, in accordance with regulations prescribed by the Secretary of the Army;

d. Accomplish, without cost to the United States, all necessary changes in appurtenant utilities, sewers and special facilities;

e. Regulate the use of the flood plain so as not to degrade or encroch on project capacities or hinder maintenance and operation; and

f. Effect flood plain management between the upstream and downstreat project limits by:

1. Regulating future development in accordance with regulations developed by the Federal Insurance Administration, Department of Housing and Urban Development; and

2. Warning property owners annually that the project does not provide protection against floods greater than the 100-year flood elevation.

If you or your staff have any questions regarding this matter, please contact Mr. Joseph Hassey of my office, the Study Manager for Cayuga Creek.

Sincerely yours,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

CF:
NCDRE-B
NCBED-D
NCBED-P

Hassey ________
Kelly ________
Nicaise ________
Gilbert ________
Bogzczyk ________
Hallock/Liddell ________
Braun ________
Johnson ________

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Peter A. A. Berle,
Commissioner

OFFICE OF REGIONAL OPERATIONS
WATER MANAGEMENT GROUP

May 19, 1978

Mr. Donald M. Liddell
Chief, Engineering Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Cayuga Creek Watershed Detailed Project Report

Dear Mr. Liddell:

We have reviewed the draft detailed project report for the Cayuga Creek Watershed Section 205 Project and have the following comments:

1. Page iii - The 24-inch pipe passing through the concrete wall between the quarry ponds will have both a flap gate and a sluice gate, while the 18-inch pipe through the concrete wall near the bridge will only have a flap gate. To provide additional protection against floodwater backup through the 18-inch pipe, it is recommended that a sluice gate be provided on this pipe as well.

2. Page 13 - Regarding wastewater treatment plant discharges to Cayuga Creek, only the Town of Lancaster plant is still discharging to the creek. Flows from the Village of Lancaster and Village of Depew plants are now directed to the Buffalo Sewer Authority treatment plant. The treatment plant just downstream of the confluence of Cayuga Creek and Buffalo Creek is a Town of Cheektowaga facility.

3. Page 24 - Erie County completed an extensive rebuilding project on Borden Road during 1977, including a new bridge over Cayuga Creek and erosion control facilities downstream of the bridge. As a result of this work, the threat to Rowley Road from bank erosion downstream of the Borden Road bridge has been greatly reduced if not eliminated.

4. Page 55 - Construction of the project will prevent floodwaters from the creek from picking up salt from the adjoining highways, however, salt from the highways will continue to enter the creek from normal storm sewer discharges to the creek. The beneficial effect of the project on streamwater quality from the standpoint of reduction in highway salt is, therefore, questionable.

5. <u>Page 69</u> - The writer cannot agree with the recommendation of the Department of Interior, Fish and Wildlife Service that the levee be left unmowed to enhance wildlife. Mowing, fertilizing ~~the~~ and periodic herbicide treatment are all essential to maintain a healthy sod cover on the levee. An unmown levee would also be an open invitation to woodchucks to establish their destructive network of burrows.

6. <u>Page A-1</u> - In reviewing the floods of record, the flood of August 30, 1975 is noted as being the most recent significant flood. However, the table on page 28 does not indicate that a significant discharge took place in August 1975. Rather, the table indicates that the peak discharge for 1975 occurred in January. It would appear that the table is in error.

7. <u>Page A-10</u> - The text indicates that the transverse levee is designed to provide 100-year flood protection and overtops for any flood greater than the design flood. This does not agree with the major project features presented on page i, where it is stated that the transverse levee will have three feet of freeboard and the transverse wall will have two feet of freeboard. The text on page A-10 further states that the levee will have a "fuse plug" placed in it to avoid sudden failure for floods greater than the design flood. This is the only place in the report where the existence of a fuse plug is mentioned. No other details are provided, which leads the writer to question what is meant by a "fuse plug" in the proposed levee and how will it operate?

8. <u>Page B-35</u> - The description of wastewater treatment facilities does not reflect current conditions as noted in comment 2 above.

9. <u>Page C-5</u> - It is noted with approval that the Corps proposes to use precast concrete blocks for erosion protection rather than their normal stone riprap. The use of these blocks will not only provide the erosion protection needed, but should also help to alleviate the usual vandalism problems associated with the Corps stone riprap.

In summary, it appears that the Corps has develpped a reasonable project to alleviate the almost annual flooding that occurs along Cayuga Creek in the Union Road-William Street area.

Sincerely,

James F. Kelley
Chief, Water Management Group

cc: P. Buechi
TEA/ea

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
U. S. Courthouse and Federal Building, Syracuse, New York 13260

May 17, 1978

Mr. Donald M. Liddell
Chief, Engineering Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

We have reviewed the March 1978 (Draft) Detailed Project Report for Flood Management in the Cayuga Creek Watershed prepared by your office.

The proposal does not appear to have any effect on planned or existing projects which involve the Soil Conservation Service.

We suggest that your agency involve the Erie County Soil and Water Conservation District located at the Farm and Home Center, 21 South Grove Street, East Aurora, New York in your coordination activities. The district has an interest in erosion control and water management activities.

We appreciate the opportunity to review and comment on this proposal.

Sincerely,

Paul A. Dodd /for

Robert L. Hilliard
State Conservationist

cc: Herbert J. Lyford, AC, SCS, Batavia, New York
Douglas J. Dettenrieder, DC, SCS, East Aurora, New York

ERIE COUNTY WATER AUTHORITY

ELLICOTT SQUARE BUILDING / BUFFALO, NEW YORK 14203

TELEPHONE (716) 856-9500

April 10, 1978

Mr. Donald M. Liddell
Chief, Engineering Division
Department of the Army
Buffalo Dist., Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

I have reviewed the detailed project report for flood management in the Cayuga Creek watershed and I am greatly impressed with the thoroughness and diligence that was rendered in collecting the data informing the public in preparing the necessary alternatives to arrive at a solution.

I can offer nothing to improve upon the recommendations, which to me seem most adequate and economic for the purpose.

Yours very truly,

ERIE COUNTY WATER AUTHORITY

Roy W. Van De Bogart

Roy W. Van De Bogart, P. E.
Senior Distribution Engineer

mbm

cc: C. J. Henningson

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

April 6, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This is in response to a request by Mr. Liddell of your office in his letter of March 31, 1978, requesting our comments on the draft Detailed Project Report (DPR) for Flood Management in Cayuga Creek, Cheektowaga, New York. This office submitted a detailed Fish and Wildlife Report under the authority of the Fish and Wildlife Coordination Act on February 8, 1978. This letter will serve to revise that report in light of the recent changes in our understanding of the project resulting from clarification of details in your draft DPR.

As we now understand it, the selected plan includes concrete walls, earth levees, erosion protection, ponding areas with culvert pipes and flap gates, and some minor channel improvement work all located upstream of the Union Road bridge over Cayuga Creek.

Streamside vegetation will be destroyed along 1400 feet of the creek comprising about 1.7 acres. This represents a loss of riverine wildlife habitat and loss of cover and food supply to fish in the creek. Grading of banks and minor channelization will cause problems of sedimentation and turbidity in the creek, probably resulting in mortality of aquatic organisms.

The transverse levee will occupy about 1.2 acres of land vegetated primarily with shrubs and herbaceous plants having some value for wildlife. The two small ponds to be used as a ponding area will not be significantly affected and do not represent important natural resources.

We recognize that it will be impossible to maintain existing streamside vegetation within the project area. We recommend, however, that streambanks be planted with riparian shrubs and herbaceous plants up to the edge of the project immediately after construction as a mitigatory measure. We continue to recommend a plan to minimize erosion, siltation, and pollution, and plantings on the levee as outlined in our previous report.

Please continue to coordinate this project with us as it develops, and advise us of any changes or additions to the project so that we may revise or supplement our report as necessary.

Sincerely,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

CHEEKTOWAGA PLANNING BOARD

TOWN OF CHEEKTOWAGA

ERIE COUNTY, NEW YORK

TOWN HALL, BROADWAY AND UNION ROAD
CHEEKTOWAGA, NEW YORK 14227
(716) 683-2800

CONSULTANT
A. [illegible] Tryon
[illegible] Main Street, East Aurora
NL2-6182

MEMBERS
Theodore Doktor
2304 William Street
TX 6-7691

Charles J. Hauser
183 Farmingdale Road
633-4110

~~[illegible]~~

Henry J. Ksiezarczyk
249 N. Meadowbrook Pkwy.
TX 9-7810

Salvatore LaGreca
563 Roycroft Boulevard
637-7272

Walter R. Wolniewicz
117 Vern Lane
896-5936

Edward Ziarnowski
7 Sandra Drive
NF 2-8790

Joseph Lipowski
43 Mona Ct.
684-1714

March 15, 1978

Daniel D. Ludwig
Colonel, Corps of Engineers
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

RE: Flood Control Project Cayuga Creek
Town of Cheektowaga

Dear Mr. Ludwig:

In response to your request for input from the Town of Cheektowaga dated March 1, 1978 attached hereto please find a letter by our Town Engineer Mr. Chester L. Bryan. The Planning Board concurs with the comments of Mr. Bryan.

Thank you for the opportunity to comment on this matter.

Sincerely yours,

Salvatore La Greca
Chairman, Planning Board

SLG:kmb

Attachment

Public Meetings Held At Council Chambers On Second Thursday Of Each Month

Town of Cheektowaga

TOWN HALL – BROADWAY AND UNION ROAD – CHEEKTOWAGA, NEW YORK 14227

CHESTER L. BRYAN, P.E.
TOWN ENGINEER
716-683-2200

March 10, 1978

Mr. Salvatore LaGreca,
Chairman
Cheektowaga Planning Commission

Dear Sal:

We reviewed the letter of March 1, 1978 from the Corps of Engineers to you about their proposal to construct a levee as shown on their map. This levee would be constructed in the Cayuga Creek Flood Plain in order to protect properties in the vicinity of Union and William from flooding. In the past few years this area was flooded resulting in damages to the contents of several commercial buildings.

We see no violation of any Town land use for this area. The levee will be constructed in an area zoned CM and R. There will probably be minor air pollution due to dust while the work is under construction and some siltation is possible in Cayuga Creek. Other than some small inconveniences to Creek Side Park and traffic in the area we see no other short term problems. The long term benefits from this project are needed. The map shows two (2) abandoned quarries. The one (1) at the rear of the Knights of Columbus Building seems pretty shallow and contains unsightly debris. The levee should not cause any worsening of the existing conditions.

Since the letter was addressed to you as Chairman of the Planning Commission you may want to reply to the Corps of Engineers on this project.

Very truly yours,

TOWN OF CHEEKTOWAGA

C. L. Bryan/mjh

Chester L. Bryan, P.E.
Town Engineer

CLB:mjh

enc.

2

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

February 8, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This constitutes our detailed report on effects the proposed Flood Management Project on Cayuga Creek, Town of Cheektowaga, Erie County, New York would have on fish and wildlife. It has been prepared under the authority of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The project was authorized under Section 205 of the Flood Control Act of 1948. This report is based on the preliminary feasibility of May, 1975 and other information provided by your staff. The report has the concurrence of the Division of Fish and Wildlife of the New York State Department of Environmental Conservation as signified by the attached letter from Director Herbert F. Doig, dated January 3, 1978.

Description of the Project

Under the recommended plan, Plan C with modifications, the project would be located in the Town of Cheektowaga, Erie County, New York. The proposed project would be located on the north bank of Cayuga Creek, east of the intersection of Union Road and William Street. The project would consist of construction of approximately 1,200 feet of levee in two connected sections. The levee would begin at Union Road and proceed approximately 400 feet eastward along the creek bank. Another section would be constructed from that point approximately 800 feet northward. Most of the levee would be approximately 10 feet high. An interior drainage system and ponding area would be built behind the levee. Design specifications have not yet been issued for the project. The levee would provide 200 year flood protection to areas of Cheektowaga.

AMERICAN REVOLUTION BICENTENNIAL 1776 1976

Aquatic and Terrestrial Ecosystems

Aquatic Resources

Cayuga Creek is a tributary of the Buffalo River which flows eastward to Lake Erie. The creek is presently one of the last undeveloped corridors through the Buffalo metropolitan area. In the project area, the creek is normally 1/2 to 2 1/2 feet deep and 30 to 80 feet wide. The bottom has a pool and riffle configuration, consisting of boulders, cobbles and gravel over bedrock and some silt and sand in the pools. Banks are undercut in some places. Water quality in the project area is affected by the discharge of effluent from three waste treatment facilities upstream. A strip of vegetation lines the creek on both sides dominated by overhanging eastern cottonwood, black willow and white ash in the overstory, and various shrubs and herbaceous plants in the understory. Large number of certain pollution tolerant benthic organisms inhabit the stream. The creek supports a limited warmwater fishery in that stretch which includes the project area. Among the fish species recorded there are carp, smallmouth bass, largemouth bass, white sucker, bluegill, and several minnows. Fishing pressure is thought to be light in this area due to restricted access and low quality fishing. Opportunities could be improved in the future, however, with scheduled improvements in water quality and opening of new parklands.

Two small ponds totaling about two acres are located near the north bank of the creek, interconnected at their north ends and separated by a narrow strip of land. They were apparently created by a quarrying operation to remove stone for construction. Several cottonwoods grow at the north end of the ponds and a dense group of shrubs, including hawthorn, grow at the south end. A parking lot extends to the western edge, and lawn to the eastern edge. The ponds have not been surveyed but their fisheries value is thought to be low.

Terrestrial Resources

Lands north of the Creek associated with the project are generally low quality habitat for wildlife. Most of the levee would cross fields of mown grass. It would also cross an abandoned field and the ponds described above. No wildlife inventory is available for the project area, but songbirds and small mammals occur here. Hunting and trapping pressure is unknown but thought to be nonexistent.

Project Impacts on Aquatic and Terrestrial Ecosystems

One section of levee would extend along the north bank of the creek for approximately 400 feet. Because of the proximity of the levee construction to the creek bank, a 400 foot strip of streamside vegetation may or may not be destroyed, depending on the exact location of the levee. This would represent a loss of cover and food supply to fish and wildlife in and along the creek. Erosion and siltation into the creek presents another potential problem, especially during construction. The resulting turbidity could cause fish mortality downstream from the project.

The other section of levee would extend northward away from the creek for approximately 800 feet, crossing and destroying the two small ponds. Because of the low quality of fish and wildlife habitat represented by these ponds, no significant fish and wildlife losses are expected. The construction of this levee system would mean the loss of approsimately 1-3 acres of terrestrial habitat, which may or may not include the riparian vegetation discussed above. The construction phase of this project would cause some displacement and subsequent loss of wildlife in the immediate area.

Plan of Development for Aquatic and Terrestrial Ecosystems

Streamside vegetation should be left undisturbed along Cayuga Creek to prevent the loss of this fish and wildlife habitat. Measures should be taken to prevent erosion and siltation of the creek, especially during and immediately after construction. One way to accomplish this and to mitigate the loss of terrestrial habitat would be to plant grasses on the levee as soon as possible after construction. The levee should be left in its natural condition to grow in a natural succession, thus reestablishing wildlife habitat. This would also save on maintenance costs.

Recommendations

We recommend that:

1. The Cayuga Creek Flood Management Project be designed such that the existing strip of vegetation along the north bank of Cayuga Creek will remain unaltered during construction.

2. Prior to construction, a plan be developed by the Corps of Engineers in cooperation with other responsible Federal and State agencies, to minimize the effects of erosion, siltation, and water pollution in Cayuga Creek downstream from the project during and after construction.

3. To mitigate project-caused destruction of wildlife habitat, the levee should be planted in grasses as soon as possible after construction, and be subsequently left to natural succession.

Please continute to coordinate this project with us as it develops, and advise us of any changes or additions to the project so that we may revise or supplement this report or, if necessary, prepare a new one.

Sincerely yours,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

December 7, 1977

Colonel Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Enclosed please find 2 copies of our preliminary draft of the fish and wildlife report on the proposed Flood Management Project on Cayuga Creek, Cheektowaga, New York.

Please review this draft and provide us with any appropriate comments by December 30, 1977. If we do not hear from you by that date, we will assume that you have no objections or substantive comments, and we will issue the final report.

Sincerely yours,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

Enclosures

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

PRELIMINARY DRAFT
For Review Purposes Only

Colonel Daniel D. Ludwig (December 7, 1977)
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This constitutes our fish and wildlife report on the proposed Flood Management Project on Cayuga Creek, Cheektowaga, New York. It has been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661). We are reporting on the effects of Plan C, with modifications, as outlined in the preliminary feasibility report of May, 1975.

This report was coordinated with the Division of Fish and Wildlife of the New York State Department of Environmental Conservation, who by Mr. Doig's letter of , concur with the findings and recommendations of the report.

Description of the Project

The project is located in the Town of Cheektowaga in Erie County, New York. The proposed local protection plan is located on the north bank of Cayuga Creek, east of the intersection of Union Road and William Street. The plan consists of construction of 1,200 feet of levee upstream of the Union Road Bridge, with an internal drainage system. There are no recreational facilities associated with this project.

Aquatic and Terrestrial Resources

The project area is located in a primarily residential, suburban community near the City of Buffalo. Habitats in this area have, for the most part, been disturbed by housing and commercial development. Cayuga Creek is presently one of the last undeveloped corridors through the Buffalo metropolitan area.

In and near the project area, a narrow strip of natural vegetation exists along the Creek banks. The banks are tree-lined, primarily with Eastern Cottonwood, and have an understory of various shrubs and herbaceous plants. The Creek supports a limited warm-water fishery of small and large mouth bass, suckers, minnows, carp, and panfish. Sport fishing opportunities are limited in this area due to limited access and low quality fishing. Fishing quality in the Creek could be improved in the future, however, with improved water quality.

Two small ponds totaling about two acres are located near the north bank of the Creek, interconnected at their north ends and separated by a narrow strip of land. These ponds were, apparently, created by a quarrying operation to remove stone for construction. Several cottonwood trees grow at the north end of the ponds, and a dense group of shrubs, including hawthorn and others, exist at the south end. A parking lot extends to the western edge, and lawn to the eastern edge. The fish and wildlife value of these ponds is low.

Lands north of the Creek associated with the project are generally low quality habitat for wildlife. Most of the levee crosses fields of mown grass. It also crosses a small area of abandoned field and the dense shrubs mentioned above at the ponds' edge, which harbor songbirds and small mammals.

Effects of the Project on Aquatic and Terrestrial Resources

One stretch of levee extends along the north bank of Cayuga Creek from Union Road east. Because of the proximity of the levee construction to the Creek bank, it is probable that some streamside vegetation will be destroyed. There also exists the possibility of erosion and siltation into the Creek, especially during construction. These problems could have a deleterious effect on fish resources in the Creek.

The other stretch of levee extends northward, passing between and over the two small ponds. The ponds will, for all practical purposes, cease to exist. Because of the low quality of fish and wildlife habitat represented by these ponds, no significant fish and wildlife losses are expected. The construction of this levee system will mean the loss of several acres of low quality wildlife habitat. The construction phase of the project would cause temporary displacement of wildlife, primarily songbirds and small mammals, in a wider area.

Plan of Development for Fish and Wildlife Resources

Care should be exercised during construction so that no significant fish and wildlife habitat will be lost. Streamside vegetation should be left undisturbed along Cayuga Creek. Measures should be taken to prevent erosion and siltation of the Creek, especially during and immediately after construction. The levee should be seeded and fertilized immediately after construction. To enhance the habitat, the levee should be left unmowed and allowed to grow up in a natural succession. The resulting plants would have value as food and cover for wildlife. This would also save on maintenance costs.

Conclusions

The Cayuga Creek Flood Management Plan is a small project that will not result in the loss of significant fish and wildlife habitat if care is exercised during construction.

Recommendations

1) It is recommended that the bank of Cayuga Creek be preserved in its natural condition and be protected against the effects of erosion and siltation.

2) It is recommended that the levee be immediately planted and that it be left unmowed to enhance wildlife habitat.

Please continue to coordinate this project with us as it develops, and advise us on any changes or additions to the prefeasibility study.

Sincerely yours,

Paul P. Hamilton
Field Supervisor
Cortland, New York

12 April 1977

Kenneth Meyers, Supervisor
Town of Cheektowaga
Town Hall
Broadway & Union Road
Cheektowaga, NY 14227

Dear Mr. Meyers:

Thank you for your letter of 30 March 1977 regarding the possible construction of a levee and floodwall in the vicinity of the Union Road Bridge over Cayuga Creek.

We are considering the Town of Cheektowaga's suggested alignment identified as Plan 3 shown on a sketch accompanying your letter of 30 March. My staff will contact you to discuss Plan 3 as soon as preliminary designs, costs, and feasibility analyses are completed. If you desire further information on the project, please call me or Mr. Joseph Hassey, my project manager.

Sincerely yours,

BYRON G. WALKER
LTC, Corps of Engineers
Acting District Engineer

The Town of Cheektowaga

KENNETH J MEYERS
SUPERVISOR

ERIE COUNTY, NEW YORK
TOWN HALL BROADWAY AND UNION ROAD
CHEEKTOWAGA, NEW YORK 14227

716-683-2200

March 30, 1977

Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

ATTENTION: Daniel D. Ludwig, Colonel
District Engineer

Dear Mr. Ludwig:

We have reviewed the proposal you made in your letter of March 7, 1977 relative to construction of a levee and flood wall for the Cayuga Creek Flood Protection Project.

Your proposal to construct a levee shown on your attachement and identified as Plan I and Plan II is not acceptable. We recommend you consider construction of the levee at the location shown on our attached sketch that we identified as Plan 3. It is obvious that your plans were drawn so as to avoid any conflict with the two ponds situated in this construction area. Since our proposal is to bisect the ponds, we consulted with the New York State Department of Environmental Conservation to determine if this would present a problem under the Wet Lands Legislation. Mr. Russ Chaney of NYSDEC and Mr. Chester L. Bryan, our Town Engineer, made a site inspection on March 17, 1977. It was Mr. Chaney's opinion that our suggested location would not be affected by any Wet Lands Legislation. The Town Board would commit itself to this project and would support your efforts if you would locate the levee at our suggested site or some other location that may be acceptable to our Governing Body.

Sincerely yours,

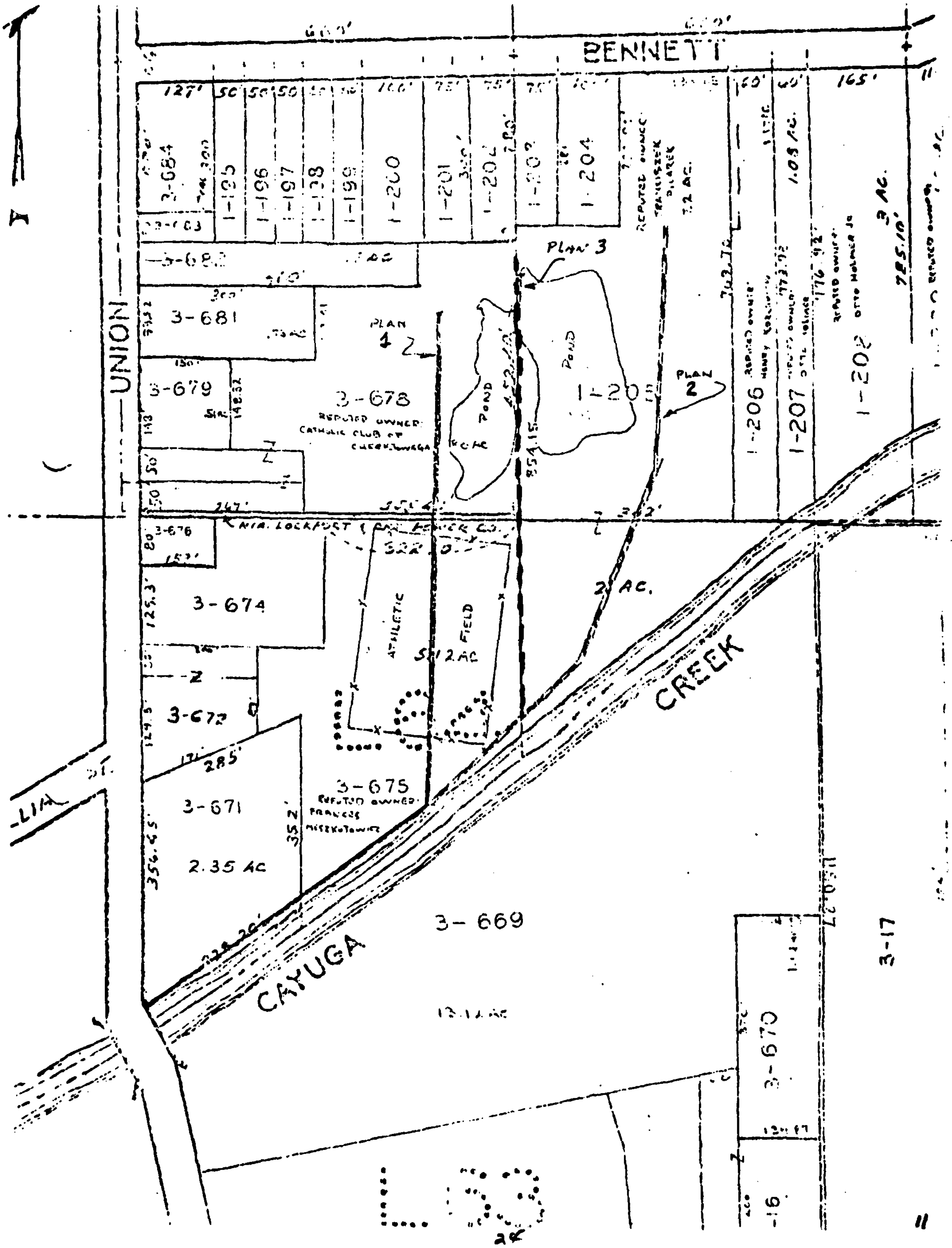
Kenneth J Meyers

Kenneth J. Meyers, Supervisor
Town of Cheektowaga

KJM/df
cc: Town Engineer

OFFICE OF THE SUPERVISOR

10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UNION
CAYUGA
CREEK
PLAN 1
PLAN 2
PLAN 3
POND
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2 AC.
NIA. LOCKPORT & ONT. POWER CO.

7 March 1977

Kenneth Meyers, Supervisor
Town of Cheektowaga
Town Hall
Broadway & Union Road
Cheektowaga, NY 14225

Dear Mr. Meyers:

The purpose of this letter is to determine the most acceptable alignment for possible construction of a levee and floodwall in the vicinity of the Union Road Bridge over Cayuga Creek.

The Corps is preparing a detailed report on overbank flooding from Cayuga Creek in the town of Cheektowaga, in the vicinity of Union Road and William Street, that will include a detailed plan for reducing flood damages. This plan will serve as the basis for preparing final plans and specifications and if constructed will be the permanent flood control project.

Recently, you and Chester Bryan, Town Engineer, considered an emergency levee project suggested for construction by the Corps of Engineers at the same location as the permanent project. On 24 February 1977, Mr. Bryan called and stated that you and he didn't believe it was advisable to construct the temporary levee because of the cost but that the Town is still interested in the permanent project.

Before the Corps of Engineers can continue with planning for the permanent structures, there are certain items of local cooperation that must be assured. Non-Federal interests must provide the necessary lands, easements, rights-of-way; hold and save the U.S. free from claims for damages; and operate and maintain the project structures after construction. The U.S. will bear all other costs for initial construction. In New York State, the Department of Environmental Conservation is the designated agency to provide the assurances. However, they require the support of local agencies and interests before they enter into project participation.

25

Kenneth Meyers, Supervisor

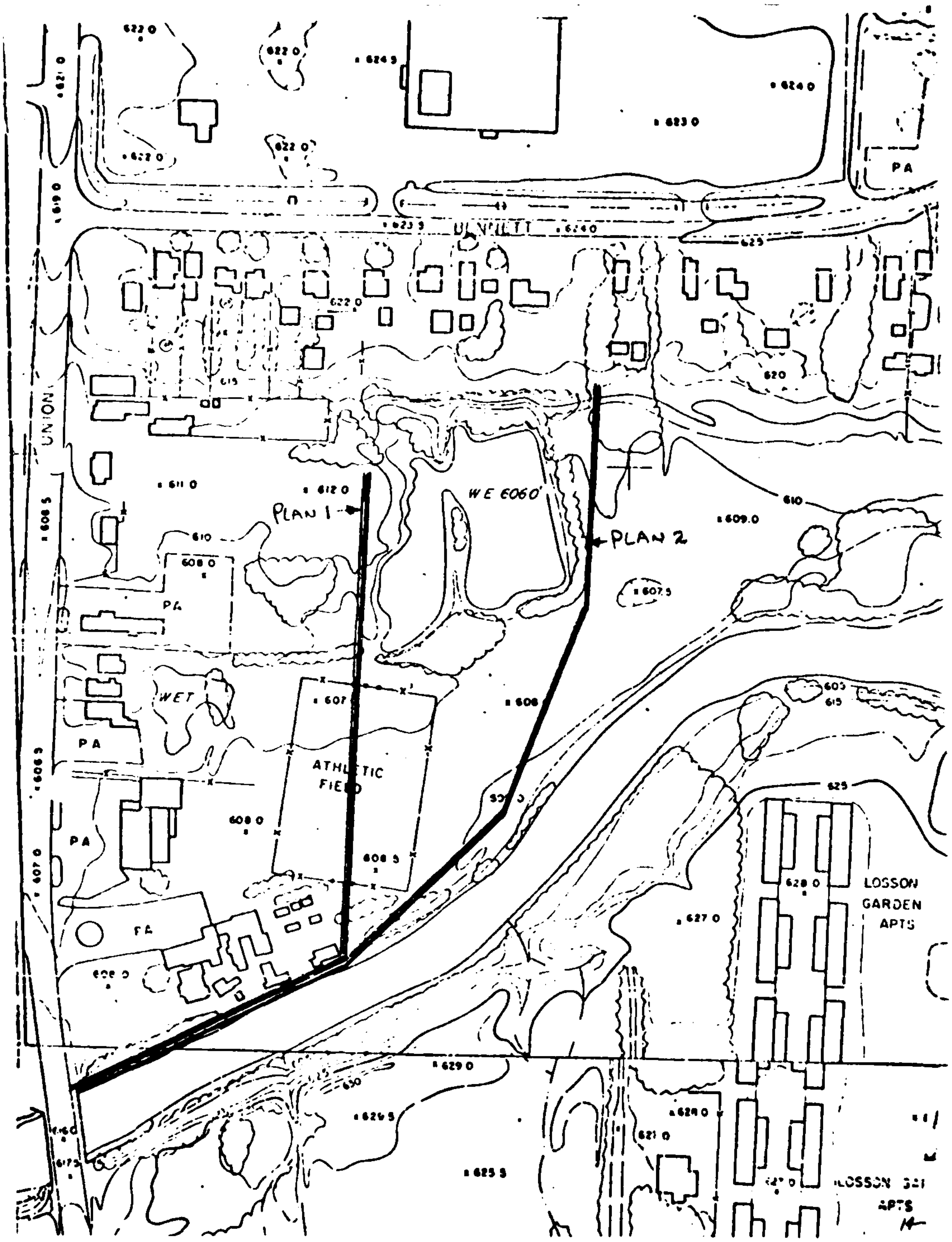
There is some preliminary indication that the affected property owners, where the proposed permanent structures would be constructed, may not favor the proposed locations as shown on the enclosed drawings. I suggest that the town of Cheektowaga officials consider these proposed locations, discuss them with affected property owners, and furnish us your decision on a location by 18 March 1977 so that we can continue our planning and design effort. If you and your constituents prefer a different alignment or solution to the flood problem in the area, please let us know.

Your response will be greatly appreciated and will allow us to continue design of the permanent project.

Sincerely yours,

Incl
Drawings

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer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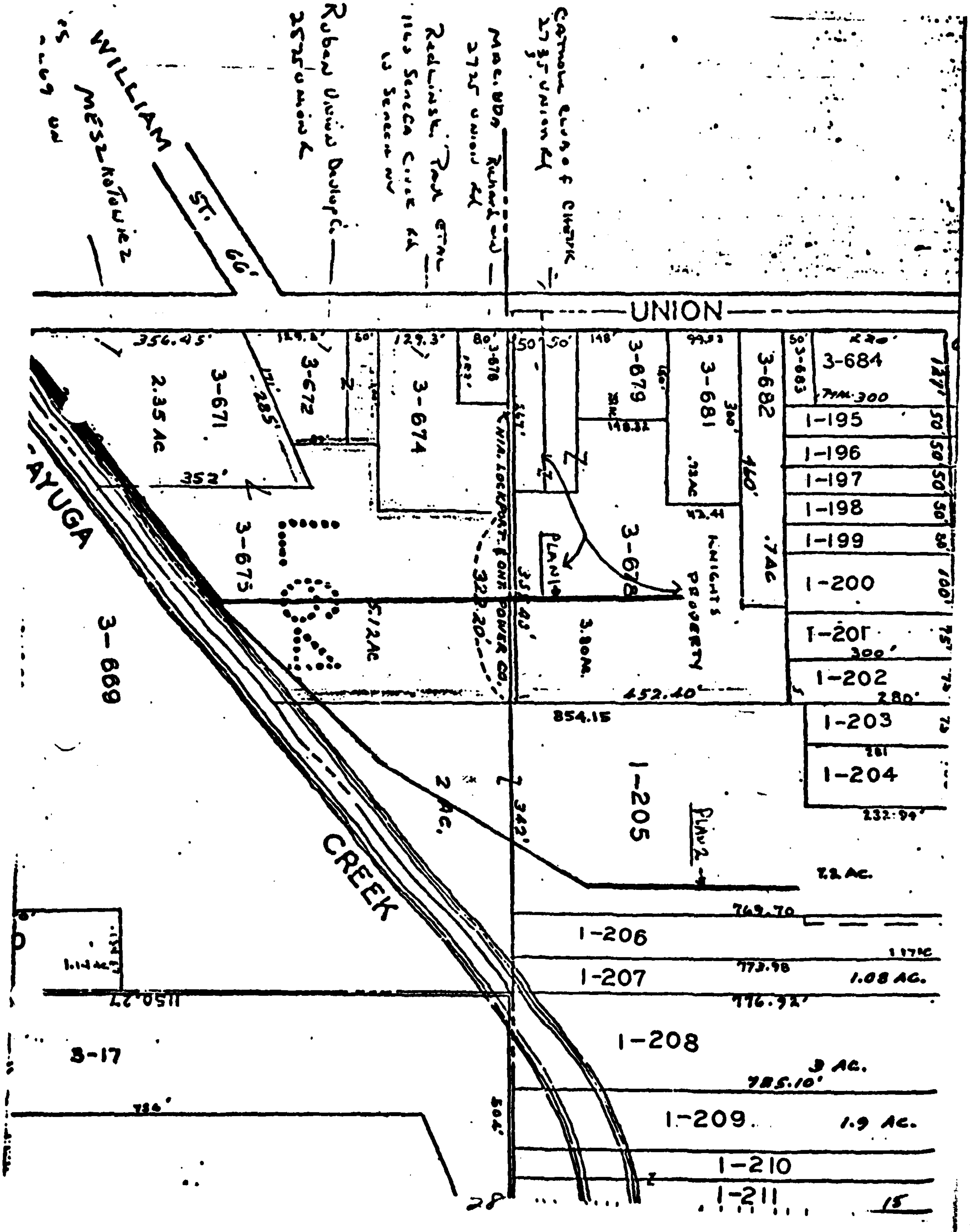
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3 AC.
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1.9 AC.
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Ruban Union Develop Co.
Redlinski Paul ETAL
Macioda Richard
Catholic Church of Christ
MESZKOTOWICZ
15

2 August 1976

Dear:

The purpose of this letter is to provide you the status of the Cayuga Creek study and the remaining steps leading to construction of facilities recommended in the study.

Inclosed for your information and retention is a copy of our latest flood management report for Cayuga Creek under Section 205 of the Flood Control Act of 1948.

The inclosed Preliminary Feasibility Report, (PFR), was submitted to the North Central Division Engineer who approved it in August 1975. This PFR was an interim report on feasibility of flood management in Cayuga Creek under the authority of the Buffalo Metropolitan Area Study. It is now apparent, however, that due to recent modifications, Plan C, the recommended structural alternative in the PFR, is well within the monetary authorities of Section 205. This letter, the modification information, and PFR serve as the stage 1 and stage 2 planning phases of the Section 205 authority.

The three pages of the inclosed report that precede the Table of Contents are an outline of the recent modifications, a revised map of Plan C, and a copy of a letter from the New York State Department of Environmental Conservation recommending that this study be further investigated under Section 205.

Some funds have been made available, and the Detailed Project Report, (DPR), has been initiated in conjunction with an Environmental Impact Statement (EIS). Additional funds will be required in Fiscal Year 1977 to complete the feasibility study and detailed design. The DPR, which is the 3rd stage of the planning phases of the Section 205 authority, will complete our feasibility study, and will provide a detailed design of the recommended project leading to plans and specifications and subsequent construction.

Thank you for your past cooperation in this study. We will keep you informed of our progress.

Sincerely yours,

Incl
as stated

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

LETTER WAS SENT TO THE FOLLOWING:

Mr. Paul Weiser
Northeast Regional Office
Bureau of Outdoor Recreation
600 Arch Street
Philadelphia, PA 19106

Mr. Willard Cole
Area Supervisor
U. S. Fish and Wildlife Service
100 Grange Place
Cortland, NY 13045

Mr. Robert C. Flint
Environmental Protection Agency
P.O. Box 5036, River Station
Rochester, NY 14627

Mr. Charles Durfor
Region II, EPA
26 Federal Plaza, Room 847
New York, NY 10007

Mr. Charles Frisa
Fish and Wildlife
NYS Dept. of Environmental
Conservation
128 South St.
Olean, NY 14760

Mr. Merriman
U. S. Soil Conservation Service
21 South Grove St.
East Aurora, NY 14052

Mr. John McMahon
NYS Department of Environmental
Conservation
584 Delaware Avenue
Buffalo, NY 14202

Robert Floyd, Engineer
Erie-Niagara Counties Regional
Planning Board
Northtown Plaza
3103 Sheridan Drive
Amherst, NY 14226

Thomas P. Eichler, Director
Office of Program Development
Planning and Research
NYS Department of Environmental
  Conservation
50 Wolf Road
Albany, NY 12223

Mr. Chester Bryan
Town of Cheektowaga Engineer
Town Hall
Broadway & Union Rd.
Cheektowaga, NY 14225

Mr. Edward V. Regan
Erie County Executive
Rath Building
95 Franklin Street
Buffalo, NY 14202

Honorable Jack F. Kemp
Representative in Congress
New Federal Bldg., Room 1101
111 W. Huron St.
Buffalo, NY 14202

Honorable John LaFalce
Representative in Congress
618 Federal Building
111 West Huron St.
Buffalo, NY 14202

Kenneth J. Meyers, Supervisor
Town of Cheektowaga
Broadway and Union Road
Cheektowaga, NY 14225

Mr. Richard Skop
Section 208 Water Quality Study
Erie and Niagara Counties Regional
  Planning Board
3103 Sheridan Drive
Amherst, NY 14226

Mr. Tom McDonald
NYS Office of Planning Services
488 Broadway
Albany, NY 12207

Mr. Charles Brown
Director, Division of Planning
Erie County Office Building
95 Franklin Street
Buffalo, NY 14202

Mr. Edward P. Lasewing
NYS DOT
General Donovan Office Building
125 Main St.
Buffalo, NY 14202

18 May 1976

Honorable Urban M. Rosler
Mayor, Village of Lancaster
Municipal Building
Lancaster, NY 14086

Dear Mayor Rosler:

This letter is further to my letter of 31 March 1976 and the field inspection of Plumbottom Creek within the village on 13 May 1976 made by Mr. Fred Lombardo of my office, Mr. Richard Bulman and yourself.

Based on the field investigation made by Mr. Lombardo, it does not appear that the Corps of Engineers can provide any remedial assistance for the limited stream bank erosion and minor flooding of Plumbottom Creek within the village. I suggest that the village consider limiting development or encroachment within the flood plain area to prevent further areas from sustaining flood and/or erosion damage.

Mr. Lombardo sent information to Mr. Dudas concerning various methods of minimizing and/or eliminating streambank erosion. If any of your constituents would like similar information, please refer them to Mr. Lombardo and he will be pleased to assist them. If you would like any further information regarding this matter, do not hesitate to contact us.

Sincerely yours,

BERNARD C. HUGHES
Colonel, Corps of Engineers
District Engineer

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Ogden Reid,
Commissioner

November 17, 1975

Colonel Bernard C. Hughes
District Engineer
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hughes:

In your letter of October 24, 1975, you indicated that structural flood protection measures for Cayuga Creek in the Williams Street-Union Road area were economically feasible. Mr. Dan Kelly of your staff, subsequently indicated that total projects costs were estimated to be $250,000.

Since the project cost is well within the range of the Section 205 small project authority, we request that further studies be continued under Section 205 of the 1948 Flood Control Act.

Sincerely,

ELDRED RICH
Assistant Director for
Programming & Analysis

ANG:cf

cc: Messrs. P. Buechi
C. Bryan

22

24 October 1975

Mr. Eldred Rich
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, NY 12201

Dear Mr. Rich:

This letter is further to a telephone conversation on 21 October 1975 between your Mr. J. Kelley and Mr. D. Kelly of my staff concerning our Cayuga Creek flood management study.

Our preliminary flood management studies for Cayuga Creek indicate that structural measures are feasible in the William Street-Union Road area. The estimated costs for a levee project with minor channel work are well within the cost range for a Section 205 project.

In the interest of conserving time and funds, we believe that it would be beneficial to complete the Cayuga report as a reconnaissance report under Section 205 of the 1948 Flood Control Act. The report, however, would contain more data than the normal reconnaissance report since it would include all the information developed under the present study.

If you concur with the above approach, it is requested that you furnish a letter requesting this office to change our reporting procedure from the authorized feasibility study route to preparing a report under Section 205 of the 1948 Flood Control Act.

Sincerely yours,

BERNARD C. HUGHES
Colonel, Corps of Engineers
District Engineer

NEWS FROM THE
BUFFALO DISTRICT CORPS OF ENGINEERS
1776 NIAGARA STREET - BUFFALO, NEW YORK 14207

COLONEL DANIEL D. LUDWIG
District Engineer

THOMAS D. MALONEY
AC716 876-5454

BUFFALO, NEW YORK, October 21, 1976: Colonel Daniel D. Ludwig, district engineer, Buffalo District, US Army Corps of Engineers, has awarded two contracts in the amounts of $6,600 and $1,682 to determine if proposed flood control projects on Scajaquada and Cayuga Creeks in Cheektowaga may affect historic or prehistoric sites. Both contracts were awarded to the University of Buffalo Foundation, with the larger amount covering the Scajaquada Creek Project.

The study procedures will be the same in both cases. The Foundation will perform a comprehensive review of existing literature and records and conduct an intensive field survey of the proposed project area. The field survey will include small test pits and if artifacts are found larger areas will be excavated to determine the extent of the sites. The Foundation will analyze the data collected and will recommend measures to mitigate the project's impact on any significant prehistoric and historic sites that are discovered.

Construction of the improvements on Scajaquada Creek, to begin next summer, is scheduled for completion in 1979. The work will include a combination of channel enlargement and the construction of levees and diversion channels on the main stem of the creek from the Thruway to Pine Ridge Road and on tributaries to the creek, stretching to Dick Road on the east and the Kensington Expressway on the north.

The plan for flood control on Cayuga Creek involves the construction of a levee in the area of Union Road and William Street in Cheektowaga. The

(MORE)

design of the project will be completed next year and, with the appropriate funding, construction could begin in 1978.

# # #

Incl
Scajaquada Creek Project Map

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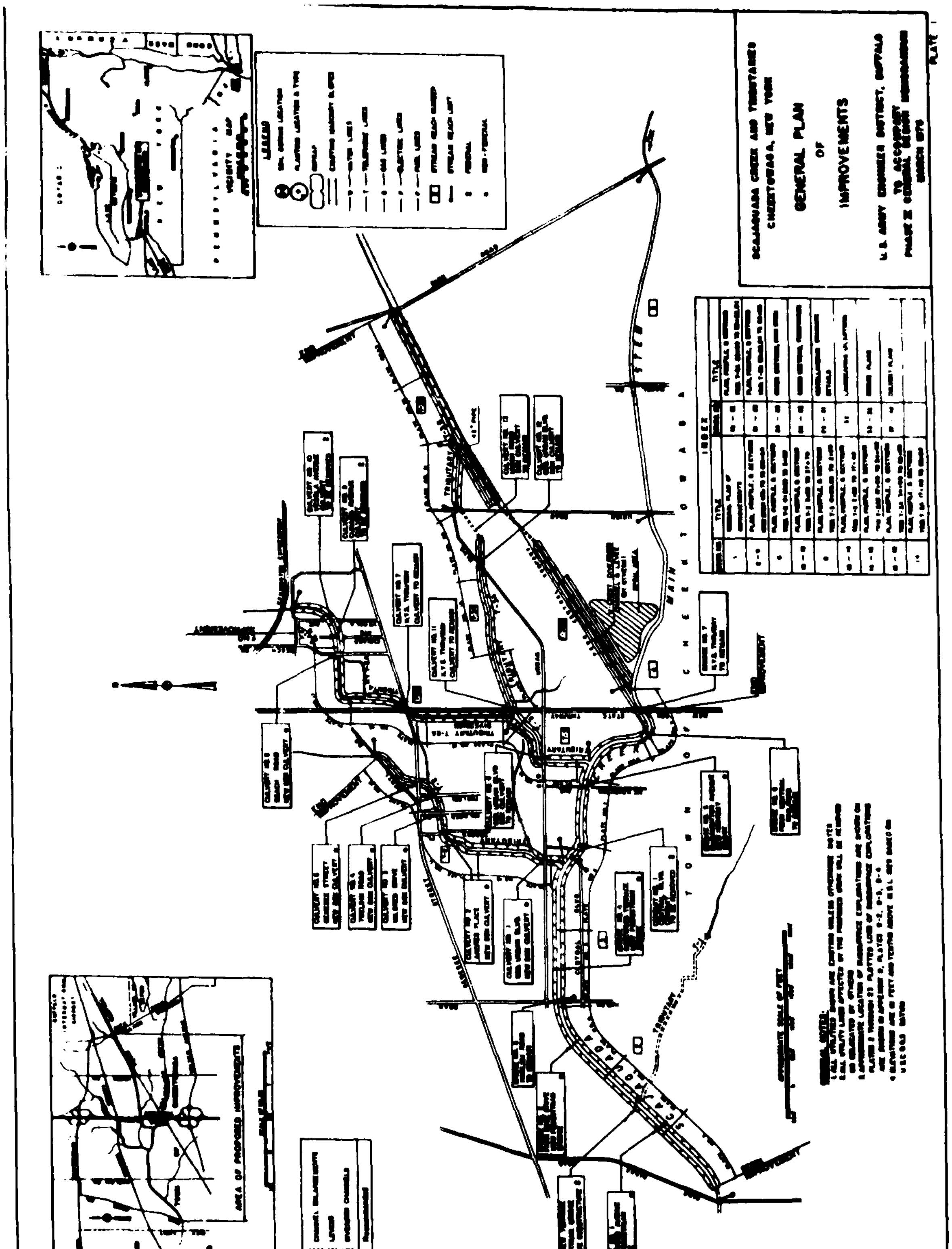
SCAJAQUADA CREEK AND TRIBUTARIES
CHEEKTOWAGA, NEW YORK
GENERAL PLAN
OF
IMPROVEMENTS
TO ACCOMPANY
PLATE
INDEX
TITLE
LEGEND
AREA OF PROPOSED IMPROVEMENTS
CHEEKTOWAGA
MAIN
TOWN OF

39

26

29 September 1975

Chester L. Bryan, P.E.
Town Engineer, Town of Cheektowaga
Town Hall, Broadway and Union Road
Cheektowaga, NY 14227

Dear Mr. Bryan:

This is in reply to your letter of 19 September 1975 concerning emergency remedial measures to protect properties from flooding in the Union Road-William Street area of the Cayuga Creek flood plain.

I have no objections to the Town of Cheektowaga undertaking the construction of an emergency earthen levee parallel to and east of Union Road. If the levee is constructed as an emergency measure and under emergency construction criteria, it will have no impact on benefits that may be derived from any future Federal project in the area. An inexpensive emergency structure will require repair after each high flow to maintain protective capability.

My staff will continue to provide technical assistance in this matter in order to help you provide as much protection as possible to the area. The occupants of the area must be warned that the levee you are building can be very helpful but is not a permanent structure and could possibly be breached or eroded away.

I commend you and the Town of Cheektowaga for this timely and positive approach to reducing flood damages on an emergency basis.

Sincerely yours,

BERNARD C. HUGHES
Colonel, Corps of Engineers
District Engineer

40

15 September 1975

Mrs. Charles W. Wohlford
197 Treehaven Road
Cheektowaga, NY 14215

Dear Mrs. Wohlford:

I am replying to your recent letter concerning a flood problem in the town of Cheektowaga.

As previously stated in our 12 February 1974 letter, the flood problem in the Treehaven Road area appears to be the result of sewer backup rather than overland flow. The Corps of Engineers has authority to undertake flood control studies directly related to overland flow from a stream but not from sewer backup.

The U. S. Housing and Urban Development is authorized to provide grants to public agencies in urban areas to finance up to 50 percent of the cost of building new water or sewer systems or for improving present facilities. To qualify for assistance, a proposed water or sewer facility must be necessary to improve health or living standards and to promote orderly growth of communities. Eligible facilities include storm sewers that handle intermittent surface water runoff. I suggest you contact your town officials concerning this program since the Corps has no authority to provide storm drain systems.

I regret that I cannot be of more assistance in this matter.

Sincerely yours,

BERNARD C. HUGHES
Colonel, Corps of Engineers
District Engineer

BUFFALO EVENING NEWS - 12 Sep 75

Cheektowagans Hear of Relief Plans in $5 Million Flooding

By CEASER WILLIAMS

Cheektowaga residents seeking relief from flooding that caused an estimated $5 million in damage this past Labor Day week-end received some good news and a few "maybes" during a public hearing Thursday in the Town Hall.

The good news came from Robert Winner of the State Office of Disaster preparedness. He said Governor Carey is expected to approve very shortly, perhaps today the submission of an application to President Ford for emergency aid to the town.

If Governor Carey's expected approval of the application is followed by similar presidential action, Cheektowaga residents and businessmen will be eligible for low interest loans from the Small Business Administration, according to Mr. Winner.

Additional good news came from Joseph Horvatis of the Internal Revenue Service, who told the standing room crowd of about 150 that the IRS would allow tax relief for flood damage on 1975 returns.

* * *

HE SAID the IRS office, at 111 West Huron in Buffalo, will assist persons who seek aid in filing such returns.

These were two of the more immediate forms of relief discussed for Cheektowaga residents still re-grouping from the town's worse flooding since 1963.

Councilman Frank Swiatek said the town board on Monday will consider two resolutions that could result in the undertaking of two flood-control projects by this fall.

Referring to a comprehensive plan for flood control drawn by the Army Corps of Engineers, Mr. Swiatek said the resolutions would seek to amend the town's application for Community Development funds so that two parts of the plan could be undertaken immediately.

* * *

MR. SWIATEK'S resolutions seek to use federal revenue sharing funds for a water diversion channel from Genesee St. to George Urban Blvd. via the State Thruway and for clearing of trees along both banks of Scajaquada Creek.

"The Department of Housing and Urban Development has told me that these amendments are possible," Mr. Swiatek said. "Our application for about $200,000 has been approved and we could use $160,000 of it for these projects."

Although short-term relief and improvements are in the works, town residents seem to face a long hard fight before the problem of flooding is erased.

"It's a complex problem with no simple solutions," according to Lt. Col. Byron G. Walker of the Corps of Engineers.

* * *

HE DISCLOSED the Corps' $4 million comprehensive plan for Scajaquada Creek that included channel enlargements, levees, diversion channels and bridge replacements.

"It's not too difficult to design these improvements," he noted, "but it is a difficult problem to get the funding for them."

Col. Walker said half of the $4 million would have to be raised locally with the remainder coming from federal sources.

A levee at Cayuga Creek and Union Rd. would cost another $1.1 million, according to the colonel.

Officials from state and county governments also discussed the status of various flood-control projects.

42

12 August 1975

Dear :

Inclosed is a copy of the Preliminary Feasibility Report on Flood Management in Cayuga Creek Watershed, Erie County, NY. The Final Feasibility Report is expected to be completed in June 1976.

Sincerely yours,

1 Incl
as stated

BYRON G. WALKER
Major, Corps of Engineers
Acting District Engineer

THE ATTACHED LETTER WAS SENT TO THE FOLLOWING:

Mr. Wallace Ochterski
Town of West Seneca Engineer
1250 Union Road
West Seneca, NY 14224

Mr. Chester Bryan
Town of Cheektowaga Engineer
Town Hall
Broadway & Union Rd.
Cheektowaga, NY 14225

Mr. Joseph Persichini
Depew Planning Board
400 Columbia Avenue
Depew, NY 14043

Mr. Robert Deutschlander
Village of Lancaster Planning Board
94 Holland Avenue
Lancaster, NY 14086

Leo J. Weimer, Supervisor
Town of Lancaster
24 Central Avenue
Lancaster, NY 14086

Mr. John McMahon
New York State Department of
Environmental Conservation
584 Delaware Avenue
Buffalo, NY 14202

Robert Floyd, Engineer
Erie-Niagara Counties Regional Planning Board
2085 Baseline Road
Grand Island, NY 14072

Thomas P. Eichler, Director
Office of Program Development
Planning and Research
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, NY 12223

Mr. Merriman
U. S. Soil Conservation Service
21 South Grove St.
East Aurora, NY 14052

Mr. John Hickey
U. S. Fish & Wildlife Service
Federal Building
Cortland, NY 13045

BUFFALO EVENING NEWS - 16 Jul 75

Residents Express Fear Over Cayuga Creek Levee

A number of Cheektowaga residents expressed fear Tuesday night that a levee proposed for the north side of Cayuga Creek will push spring flood waters onto their property on the south bank.

Consultants for the U. S. Army Corps of Engineers assured them, however, that the high bank on their side of the creek would be sufficient to prevent flooding.

Others among the 80 who attended a hearing in Cheektowaga Town Hall wondered about the effect that landfills for one trailer park already in existence in the flood plain area and another one that has been proposed will have on flood patterns.

This will be considered in the consultant's final report, scheduled for release next February. Another public hearing will then be held the following May.

The levee would be 16 feet high and 3890 feet long and placed near the intersection of William St. and Union Rd. The federal government would provide $950,600 of the $1,173,200 cost, said Maj. Byron G. Walker.

A representative of the State Department of Environmental Conservation said the state usually pays for acquisition of the necessary right of way, with the benefitting municipality providing maintenance of the area.

A second alternative also will be considered in the report. Leaving the creek alone but floodproofing area homes would cost about $256,000, with an estimated $205,000 the federal share.

This plan, a Corps spokesman said, has a much more attractive cost-to-benefit ratio in the Corps' view.

The Corps has rejected as not economically justified another alternative involving a more elaborate system of levees, retention basins and channel improvements proposed by the Erie-Niagara Regional Planning Board.

45

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BUFFALO COURIER EXPRESS - 15 Jul 75

Cheektowaga

Flooding Hearing Disappoints Many

By LINDA A. SMITH

Hope faded to disappointment for many Cheektowaga residents Tuesday when they attended a public hearing on Cayuga Creek flooding that failed to produce any immediate solutions to the problem.

Maj. Byron G. Walker, a deputy engineer for the Buffalo Dist. of the U.S Army Corps of Engineers, explained to almost 100 persons in the Town Hall that the hearing was simply to air study findings and gain their opinions.

The corps sponsored the session devoted to discussing alternatives for abating Cayuga Creek's history of flooding in the town.

Levee Project

The most feasible plans, Maj. Walker said, were those for a levee and a flood warning and emergency protection program.

However, his estimate that "maybe six to eight years from now we'll have something on the ground" on the levee project brought grumbling from the audience.

The levee's first-year cost would total $1,173,000, with an annual upkeep price of $74,000, said the major.

The plan is outlined in the corps' recently completed preliminary feasibility report for the Cayuga Creek Flood Management Study.

Another report will be compiled, and Walker said the corps has been studying the creek's problems since 1959.

The levee's length would total 3,890 feet, with 2,490 feet downstream of the William-Union bridge. The William-Union area is where the town's greatest flood damage usually occurs.

Made of Earth

The levee would extend to Bennett Rd., be made of earth and would raise from ground level to 15 feet above it at points.

The flood warning and emergency protection plan would include relocating utility lines, reinforcing existing structures, watertight doors on structures, landscaping to minimize flooding, portable pumps and sandbagging.

Citizens were most inquisitive about the levee plan, with many charging that water behind it would flood their property.

Walker insisted that much time and computer-aided study was behind the plan and flooding from built-up water could not occur.

A worried citizen asked when and how land acquisition would be done, but Walker interjected that "you're jumping the gun."

PUBLIC SERVICE ANNOUNCEMENT

PUBLIC AFFAIRS OFFICE
1776 Niagara Street, Buffalo, New York 14207
(716-876-5454)

LENGTH 20 seconds **START DATE** on receipt **KILL DATE** 7:30 pm 15 Jul

ANNOUNCER:

The Army Corps of Engineers will hold a public meeting on July 15th to discuss flood management measures for the Cayuga Creek basin. The meeting will take place at 7:30 P-M at Cheektowaga Town Hall, Broadway and Union Road. Further information can be obtained by calling the Corps of Engineers in Buffalo. The number is 876-5454.

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BUFFALO EVENING NEWS - 27 Jun 75

Corps Brochure Outlines Plans On Cayuga Creek

A range of plans and protective measures for flood control along Cayuga Creek in the Depew-Lancaster-Cheektowaga area is outlined in a brochure released today by the U. S. Corps of Engineers.

The brochure is being distributed to residents and officials in the area in preparation for a public meeting at 7:30 PM July 15 in the Cheektowaga Town Hall.

The corps has found only one of the plans to be economically feasible — a $1.2 million levee along the north side of the creek in the vicinity of Union Rd.

Other possible plans include realignment, additional levees and creek widening and deepening. But the corps said the costs of the other projects outweigh benefits.

The Erie & Niagara Counties Regional Planning Board, which recently objected to the corp's plans on Cazenovia Creek, has also objected to the Cayuga Creek proposals as too limited in scope.

ERIE & NIAGARA COUNTIES REGIONAL PLANNING BOARD

Leo J. Nowak, Jr.
DIRECTOR

Donald P. Lane
CHAIRMAN
Susan N. Green
VICE CHAIRMAN
M. William Steder
SECRETARY

May 27, 1975

Col. Bernard C. Hughes, Dist. Eng.
U. S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

SUBJECT: Corps of Engineers, Buffalo Metro Comprehensive Study,
Cayuga Creek (Erie County) Flood Control Investigation

Dear Col. Hughes:

The Erie and Niagara Counties Regional Planning Board has recently participated in the two Workshops on the proposed plans for Cayuga Creek (Erie County). After a thorough review of the Corps of Engineers' work proposals, the Staff and the Utilities Committee is transmitting their findings in the form of a statement for your consideration.

Sincerely yours,

Robert Floyd

Robert Floyd, P. E.
Senior Civil Engineer

RF:sy
Enc.

2085 BASELINE ROAD, GRAND ISLAND, NEW YORK 14072 TELEPHONE 773-7611 – AREA CODE 716

JC

STATEMENT FOR RECORD, CORPS OF ENGINEERS, BUFFALO METRO COMPREHENSIVE STUDY, CAYUGA CREEK (ERIE COUNTY) FLOOD CONTROL INVESTIGATION

The Erie and Niagara Counties Regional Planning Board has participated in the workshop meetings sponsored by the Corps of Engineers on April 8, 1975 and April 22, 1975. At the second and final workshop, the Corps of Engineers indicated that the Workshop Plan D will be submitted to the Chicago Corps of Engineers office in order to obtain permission for the Buffalo District to proceed with Phase II of this Study.

Phase D consists of local protection in the Union-William Street area by the construction of a levee and some retention basins. No creek channelization is being proposed, therefore, only minor changes to the existing flood plain will occur and basically only the current existing structures will be protected.

The Regional Planning Board has recently completed a Storm Drainage Plan through a grant from the United States Department of Housing and Urban Development. The recommended program for Cayuga Creek (Erie County) proposed by this study consists of the following measures which would have regional significance and be of benefit to the entire Cayuga Creek watershed.

1. A proposed levee extending from Fronckowiak Street to Union Road and upstream to Bennett Road. Three areas to pond drainage water during high water level are recommended behind the proposed levee

2. The channel to be excavated and riprap bank protection would be required on the levee and on the adjacent channel sides. The right bank of the channel improvements would also be riprapped.

3. Right-of-way for channel improvements in Cheektowaga to be reserved and improvements constructed immediately. Since Wyoming County offers the best potential site for a large flood control reservoir in the future if needed, land should be purchased and set aside for that evantuality.

4. Land Use and Runoff Controls to be applied to the rest of the flood plain.

These regional Board proposals are consistent with all of the Regional Plans and Programs developed to date as well as Corps of Engineers Study on Cayuga Creek dated 1967.

Since Plan D. as proposed in the Cayuga Creek Workshop is of localized and limited nature, while the Corps of Engineers Study on Cayuga Creek dated 1967 proposes programs having regional significance, the Regional Board would like to go on record as being not in favor of Plan D.

We would also like to recommend that Corps of Engineers consider adding the additional remedial measures as outlined in their Cayuga Creek Report of 1967 which would benefit the entire watershed.

Cheektowaga PUBLIC LIBRARY

[illegible] HARLEM ROAD
CHEEKTOWAGA, N.Y. 14225

May 15,1975
11 Danforth St
Cheektowaga, NY, 14227

McPhee, Smith, Rosenstein, Engineers
625 Delaware, Buffalo, NY

Attention: Mr. Peck

Dear Mr. Peck,

The maps arrived yesterday, and Victor and I have already spent several hours pouring over them. We thank you so much, for taking time from your busy schedule to get them ready for us.

I understand that you have an interesting, and I hope fruitful visit along Cayuga Creek with Victor. I am sorry that I couldnt be along, for I have walked that creek a number of times from our home to its mouth at Buffalo Creek. I just can't keep up in the walking game with Victor, so I presently spend my time more in our sanctuary.

The maps will be added to my collection of maps of the Office of the Town Historian - which is in my home. Between Victor and me, we have probably a thousand related to Cheektowaga, Erie County and New York State, besides the dozens and dozens of manuscript maps which he and I have made for certain projects over the past 30 years. Hopefully in time this entire collection will be a part of the Reinstein research area of one of the Cheektowaga Libraries, for future researchers to use.

Thank you again, for both of us.

Sincerely,

Julia Boyer Reinstein

Mrs. Victor Reinstein

57A.

New York State Department of Environmental Conservation
Region 9 - Fish & Wildlife Office
128 South Street
Olean, New York 14760

Ogden Reid,
Commissioner

May 8, 1975

Philip Berkley
Environmental Research Section
Dept. of Army
Buffalo District Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207

Dear Berkley:

At your request through Charles Frisa, Fish Manager for Region 9, I have searched our files and have found absolutely no recent or usable data pertaining to the fisheries in Cayuga Creek from its mouth to Union Road.

Sincerely,

James K. Pomeroy

James K. Pomeroy
Conservation Biologist
Region 9

JKP/dcs

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NCBED-PN Second Workshop Meeting on Cayuga Creek Feasibility Study

Files /Basin Manager, NY 7 May 75

1. Date: 22 April 1975 at 1300.

2. Place: Buffalo District, Corps of Engineers, Conference room.

3. Purpose: To discuss the feasibility of providing flood control measures for Cayuga Creek.

4. Participants: See Incl 1.

5. Summary: Mr. Gilbert opened the meeting and discussed the purpose of the meeting. The Corps is in the initial study phase and ~~we~~ are determining whether or not it appears feasible to pursue structural measures into detailed studies. Mr. Hassey presented the results of the study to date.

6. Mr. Hassey gave a brief recap of the first workshop held on 8 April 1975. A number of alternative solutions have been looked at and a number have been eliminated. Structural measures for an area downstream at the confluence with Buffalo Creek and in reaches four and five were found to be economically unfeasible. Reservoir sites at Bennington and Cowlesville were also found to be uneconomical. One structural solution in the vicinity of William and Union appears to be economically feasible. The plan would essentially consist of a levee with ponding area, pumping station, and other interior drainage facilities. The project would protect against the 200-year occurrence, a design flow of 13,000cfs. The 100-year protection was investigated but it was found that providing 200-year protection optimizes the project. The levee would be eight to eleven feet above the existing ground with sideslopes of 1-V on 3-H. Total project costs are estimated to be $1.0M+. With the levee plan the existing structures in the William and Union area would be protected, the transportation network would be protected, there would be no major changes to the existing channel, and the project would be environmentally sound. The project would not effect the floodplain upstream and downstream of the project area.

7. Eleven slides were shown which depicted examples of flooded conditions and types of levee projects. The slides were beneficial in demonstrating to the workshop participants how levee construction could blend in with the natural topography.

8. Dr. Reinstein questioned whether or not the opening of the Union Road bridge would accommodate the 200-year flood. He was told that the bridge opening was adequate. He also believes that the slopes on the levee should be one on four instead of one on three for ease in mowing. Dr. Reinstein also asked for a breakdown of the public and private damages. This information is being furnished by the A-E.

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9. Chester Bryan, Town Engineer, Cheektowaga asked if the Corps was developing a floodway. He was told that a floodway had already been developed as required by FIA for the flood insurance program. If the project is constructed, the floodway would have to be redefined. Development in the area between the floodway and the 100-year floodplain would be controlled by zoning as required by local ordinance. One criterion has been that development can take place in this fringe area as long as the elevation of the water surface of the 100-year occurrence does not increase by more than one-foot.

10. Mr. Frankowiak suggested that the downstream end of the levee be extended and turned to tie in with a high point on his property. He was told that this would be considered and the additional reach of levee would have to be incrementally justified.

11. Mr. Gilbert stated that we have established project feasibility and that we are not tied down to the plan as shown at this time. Mr. Hassey mentioned other alternatives that will be addressed include: floodproofing, evacuation, public acquisition, and no Corps action. On 28 April Messrs. Hassey, Bryniarski, and Peck will walk the alinement of the proposed levee to assess the environmental impacts.

12. The meeting adjourned at 1440.

1 Incl
as

DANIEL T. KELLY
Basin Manager, NY

Workshop Meeting on Cayuga Creek 4/22/75

Name	Representing
D. Kelly	Buffalo Dist. Corps of Engrs.
RN Schmidt 1Lt, CE	" " " " "
Francis L. Zaik	USDA - SCS
Russ Tryon	Town of Cheektowaga
C. L. Brown	" "
[illegible]	" " "
Julia Boyer Reinstein	" "
Dr. Victor Reinstein	" "
Henry Jasvor	Erie & Niagara County Planning Board
Irwin Rosenstein	McPhee, Smith, Rosenstein Engrs
Kenneth Peck	McPhee, Smith, Rosenstein Engrs
Ira Ann Sterek	
Irving K. [illegible]	Property owner
Raymond Repha	2520 Union Road
[illegible]	2520 Union Road
Joe Persichini	Depew Planning Board
William J Rugg	Depew - Village Engineer
C. Gilbert	Buffalo Dist., Corps of Engrs.
J. Hussey	" " " " "
T. Pieczynski	" " " " "

H

MR. RAYMOND REPKA
SO. 7 CAREFREE LANE
SO. CHEEKTOWAGA, N. Y. 14227

April 23, 1975

Mr. Kenneth Peck, P.E.
Mc Phee, Smith, Rosenstein Engineers
625 Delaware Avenue
Buffalo, New York

Dear Mr. Peck:

My associate, Henry Fronckowiak and I had an opportunity to discuss the proposed levee, which was presented at the April 22nd., workshop.

We own 42 acres with about 1800' of creek front, which may be designated floodway. It is feared this will leave us without any possibility of development.

Before this land acquisition was made, we had discussions with responsible persons relative to the development of this area. This would be done in a manner not to increase the danger of flooding. We have a letter from the Corps of Engineers outlining steps permitting development.

At the last workshop we suggested the proposed levee be placed so that some development could take place. If remedial work to the creek is undertaken, we offer our services of a joint effort so that our investment be protected. We are available to meet with you and add input at any time.

Two of Cheektowaga's representatives at the 22nd., workshop indicated that owners of land would seek permission from the Town to develop their property.

We feel that the two workshops were very worthwhile and because of them an acceptable solution, strengthening the economic potential, permitting some form of construction, acceptable to the Town and the Corps can be achieved. We hereby want to assure you of our full cooperation in attaining an acceptable plan.

It is a simple matter to write a letter criticizing a plan, therefore let me be more specific, about our plans. We feel that the proposed red area as indicated on the map may be too extensive. The restrictions may be very difficult to live with. This land has a tremendous value and potential for development. A flood control project would be compatible and harmoniously blend with the projects we propose. We strongly feel that the land owners rights must be protected. We pledge that if any monetary consideration for our land is realized, we will

MR. RAYMOND REPKA
80. 7 CAREFREE LANE
SO. CHEEKTOWAGA, N. Y. 14227

reinvest and foster a development producing revenue and service to the Town of Cheektowaga. Therefore we will disclose our plans, in the area under study.

Specifically we know that there is a tremendous need for medium or high density quality housing. Such a development must have a goal of providing maximum security, in a secluded environment.

Another proposal would be to interest, one or all of our major league teams in a facility. We followed the events of the players requests to management at their time of negotiation. A key issue was housing. In addition to housing, we feel a total complex, featuring natural turf, recreation areas and training facilities, be incorporated into a package. This idea is unique and could be of great financial benefit to the Flood Control Project and the Town of Cheektowaga. It would focus National attention to our area and hopefully act as a model project.

The third proposal would be to expand the mobile home park. We have tested this market and know there is a tremendous void in the existing housing market. We would continue to feature a park for adults, again with maximum security.

It should be noted that construction for all these projects is above grade, minimizing danger of flood damage.

Trusting that you will give consideration to our land holdings and weigh the benefits of adding developable acreage in this strategic location.

Respectfully yours

Raymond Repka

Raymond Repka

Henry Fronckowiak

Henry Fronckowiak

Copy: Mr. Bryan
Town Engineer

NCBED-PN First Workshop Meeting on Cayuga Creek Feasibility Study

Files Basin Manager, NY 15 Apr 75

1. Date: 8 April 1975 at 1300.

2. Place: Buffalo District, Corps of Engineers, Conference room.

3. Purpose: See Incl 1.

4. Participants: See Incl 2.

5. Summary: Mr. Gilbert explained the purpose fo the meeting, purpose of the study, and explained the A-E's role in the study. Mr. Irving Rosenstein of McPhee, Smith, and Rosenstein presented the findings of the study to date. Mr. Rosenstein referred to the handout (Incl 3) and stated that they divided the stream into five reaches and addressed eight different plans for the basin. The A-E looked at 100-year protection, something way out, and settled on 200-year protection. There is not much difference between the 100-year and 200-year as far as discharge. There is about a 15 percent difference in discharge. The A-E considered a number of alternative solutions and has eliminated a number of solutions. Channel improvement along the entire reach from the mouth to Transit Road could not be economically justified. Channel work with levees and walls, and levees and walls by themselves in specific areas appear to have possibilities. In the Union-William area the A-E has looked at channel work with levees and floodwalls with pumping of the drainage behind the levees. They are going to look at ponding as an alternative to pumping as it would be less expensive. The ponding area would be designed for a lesser frequency occurrence, perhaps the 50-year level. The A-E looked at upstream reservoir sites at Bennington and Cowlesville and both were found to be economically unfeasible.

6. Mr. Sitarek is concerned about the flooding in the Union-William area. Dr. Reinstein indicated that this area was the only bad spot on Cayuga Creek as far as flooding is concerned. One of the adverse impacts of flooding in this area is that Union and William are not open to traffic for 10 to 12 hours during flood times which results in a 6-8 mile detour. Mr. Rosenstein indicated that the effects of these road closings was costed in the damage survey.

7. There is a serious erosion problem at Ransom Road which is due to ice conditions. Structural measures are not economically feasible. However, technical assistance could be provided for this area.

8. Ken Peck, A-E, asked for information on planned future development. Bob Floyd, ENCRPB, indicated that Erie County Planning has a map indicating all development in Erie County. The map indicates all land remaining to be developed. Chet Bryan, Town

AD-A101 704 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
BUFFALO METROPOLITAN AREA, NEW YORK WATER RESOURCES MANAGEMENT.--ETC(U)
AUG 79

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Engineer - Cheektowaga, will try to obtain Cheektowaga Planning Board input into planned future development in the William-Union area.

9. One individual from Depew indicated that in about five years Rowley Road, from Borden west, will be lost due to effects of flooding. However, there are only three homes that are affected by flooding in this locality. There has been a big land fill operation in Depew from the Erie-Lackawanna Railroad tracks east to about 60-feet from the channel bank. The fill is on the same level as Broadway Street. Mrs. Reinstein mentioned that a swamp below Indian Road use to be a natural retention basin but this area has been filled in.

10. Mr. Rosenstein summarized the A-E's findings to date. Refer to the last page of Incl 3. Alternatives A and B were eliminated as they are uneconomical. Alternative C would not give as high a degree of protection as D and E. Alternatives D and E should be further pursued. Alternative F was eliminated as it is too costly. Alternatives G and H were eliminated as they are not practical.

11. Mr. Hassey announced that the next workshop meeting would be on 22 April 1975 at 1:00 p.m.

12. The meeting adjourned at 2:30 p.m.

3 Incl

DANIEL T. KELLY
Basin Manager, New York

PROPOSED AGENDA FOR FIRST WORKSHOP MEETING

- BUFFALO METRO COMPREHENSIVE STUDY -
CAYUGA CREEK
PHASE I - 8 April 1975

1. Purpose of Meeting
2. Introduction of those present (See attached list)
3. Purpose of Study (Planning Process)
4. Explanation of AE's Role in Study
5. Introduction of AE (See attached list)
6. AE Presentation
7. Question and Answer Period - Opportunity for Comments and Input
8. Summary

PURPOSE OF MEETING

a. To insure that all levels of affected interests are aware of investigation being made.

b. To insure that these interests are given an "informal opportunity" to comment on progress of investigation and to furnish input.

c. To insure that these interests are given pertinent information to take back to their groups or agencies for further review and comment.

d. To assist the Corps in its investigation to the end that we properly consider the most current needs of the BUFFALO METRO AREA and develop plans to satisfy the needs.

PURPOSE OF STUDY

To develop methods of meeting water resource needs in Buffalo Metro Area - Phase I Feasibility - Phase II Feasibility - Authorization - Phase I GDM - Phase II GDM. The process could stop at end of this Phase I Feasibility.

EXPLANATION OF AE'S ROLE IN STUDY

An arm of the Corps - due to lack of time and manpower - the Corps has retained AE to assist the Corps. The AE is working on Phase I Feasibility Study. The draft of the Phase I Report is scheduled to be completed by May 1975.

PUBLIC AND PRIVATE INTEREST GROUPS OF CAYUGA CREEK BASIN IN ERIE COUNTY TO BE INVITED TO THE FIRST CAYUGA CREEK WORK SHOP

This list is presented in the sequence according to the opposite direction of the Creek's flow. (ie. From downstream to upstream).

Level I - Publics

1. Town of West Seneca
   Mr. W. Ochterski (Town Engineer)
   1250 Union Road
   West Seneca, N.Y.

2. Town of Cheektowaga
   Mr. C. Brian (Town Engineer)
   Town Hall
   Broadway & Union Road
   Cheektowaga, N.Y.

3. Village of Depew
   John Potter (Mayor)
   or
   *Joseph Persichini (Planning Board)
   Owner of Transit Cleaners, Transit Road
   Depew, N.Y.

4. Village of Lancaster
   Urban Rozler (Mayor)
   or
   *Robert Deutschlander (Planning Board)
   94 Holland Avenue
   Lancaster, N.Y.

5. Town of Lancaster
   Leo Weimer (Supervisor)
   or
   Village Hall
   5423 Broadway
   Lancaster, N.Y.

* Indicates order of preference

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Level I - Governmental Agencies

6. New York State Department of Environmental Conservation
   Mr. John McMahon
   584 Delaware Avenue
   Buffalo, N.Y.

7. Erie-Niagara Planning Board
   Mr. Robert Floyd
   2085 Baseline Road
   Grand Island, N.Y.

8. U.S. Soil Conservation Service
   Mr. Merriman
   So. Grove Street
   East Aurora, N.Y.

9. Erie County Dept. of Environmental Quality
   Mr. George Meliose (Chairman of the Environmental Management Council)
   95 Franklin Street
   Buffalo, N.Y.

Level II B

10. Mr. Raymond Repka
    Carefree Living Trailor Park
    Cheektowaga, N.Y.

11. Mrs. Alvin W. Schleicher
    325 Ransom Road
    Lancaster, N.Y.

12. Dr. Victor Reinstein
    11 Danforth Street
    Cheektowaga, N.Y.

CORPS OF ENGINEERS

BUFFALO METRO COMPREHENSIVE STUDY

CAYUGA CREEK FLOOD CONTROL INVESTIGATION

FIRST WORKSHOP MEETING

April 8, 1975

64

CAYUGA CREEK, NEW YORK
REACH LIMITS

REACH	
1	HARLEM ROAD BRIDGE TO A POINT APPROXIMATELY ONE MILE UPSTREAM
2	UPSTREAM LIMIT OF REACH 1 TO UNION ROAD BRIDGE
3	UNION ROAD BRIDGE TO POINT IN VICINITY OF COMO PARK BOULEVARD INTERSECTION WITH BENNETT ROAD
4	UPSTREAM LIMIT OF REACH 3 TO POINT JUST UPSTREAM OF ROWLEY ROAD BRIDGE
5	JUST UPSTREAM OF ROWLEY ROAD BRIDGE TO THE CONSIDERED RESERVOIR SITE IN BENNINGTON

CHANNEL IMPROVEMENTS
PLANS A, B, C

	PLANS	ANNUAL BENEFIT	ANNUAL COST
A.	Channel Realignment	-	-
B.	Channel Improvement	$48,000	$517,400*
C.	Channel Improvement	$48,000	$114,000*

CONSIDER THE FOLLOWING

1. Plan A ineffective means of reducing flooding.
2. Plan B 200-yr storm contained in channel.
3. Plan B based on realignment used in Plan A.
4. Major changes in channel by Plans A and B.
5. Smaller, more localized channel work of Plan C will cause the least environmental impact.

* All costs and benefits for Reach 2 and 3 only.
Benefits refer to preventable damages.

LOCAL PROTECTION
PLAN D

PLAN	ANNUAL BENEFIT	ANNUAL COST
D. Levees and floodwalls	$48,000	*

CONSIDER THE FOLLOWING

1. Existing structures effectively protected from floodwaters.

2. Protected areas can be developed more extensively with increased security.

3. Most of transportation network protected.

4. Minor changes to flood plain; no change to channel.

5. Will not greatly increase land available for development in flood plain, since only current existing structures are protected.

* All benefits for Reach 2 and 3 only.
Costs to be investigated in detail.
Benefits refer to preventable damages.

LOCAL PROTECTION AND CHANNEL IMPORVEMENT
PLAN E

	PLAN	ANNUAL BENEFIT	ANNUAL COST
E.	Local Protection and Channel Improvement	$48,000	*

CONSIDER THE FOLLOWING

1. Channel Improvement in selected locations allows lowering of levee and floodwall heights.
2. Less channel work than plans A or B.
3. Not based on Realignment scheme of Plan A.

* All benefits for Reach 2 and 3 only.
Costs to be investigated in detail.
Benefits refer to preventable damages.

CAYUGA CREEK

PRELIMINARY ESTIMATE OF COSTS AND BENEFITS

RESERVOIRS

PLAN F

	PLAN	ANNUAL BENEFIT	ANNUAL COST
F.	Reservoir (Bennington)	$48,000+	$427,000

CONSIDER THE FOLLOWING

1. Plan F does not have a favorable benefit/cost ratio.

2. Reservoir covers only a small portion of basin. Most of flood plain will remain unchanged.

3. Affects stream life by restricting natural flow.

4. Possibility of recreational use.

NON-STRUCTURAL*
PLANS G+H

	PLAN	ANNUAL BENEFIT	ANNUAL COST
G.	Non-structural (Removal)	$57,000	$615,000
H.	Non-structural (Flood Proofing)	$48,000	*

CONSIDER THE FOLLOWING

1. Plan G difficult measure to initiate.

2. Flood Plain management policy that will necessarily accompany Plan G will stifle development of flood plain, causing wiser planning patterns.

3. No relief for transportation network from either of the above measures.

* Annual cost not yet developed.

CAYUGA CREEK FLOOD CONTROL FEASIBILITY STUDY
MEASURES FOR CONSIDERATION

Study Objective	National Economic Development	Environmental Quality	Social Well Being	Regional Development	Effect on Water Surface
A. Channel Realignment Mouth to Transit Road	Very ineffective. Will not allow any additional flood plain development. B/C very low.	Major construction of overflow channels through flood plain. Low flow flow maintined in existing channel so water life unaffected.	Changes in flood plain will not afford any better flood protection. No security increase, for some sacrifice.	Will keep flood plain undevelopable.	Virtually no improvement in water surface at 200 yr. level.
B. Channel Improvement Mouth to Transit Road	Effective means of preventing flood plain damages. B/C very low. Future damages reduced.	Major relocation of channel. Some water life affected. Nature of flood plain changed.	Increased sense of security to local damage victims. Drastic changes in channel would be opposed.	Would allow development of flood plains in currently unusable areas.	Water surface will remain in new banks.
C. Channel Improvement Reaches 2+3 only	Will prevent some damages	Less effect on water life than measure B. Flood plain largely unchanged.	Increased	Moderately effective means of protecting flood plain.	Lowers water surface but flooding still occurs.
D. Local Protection 200 year Level	Will prevent damage to existing sturctures.	Will not effect channel life. Levees reasonably homogenous with rest of environment.	Damage areas will be protected increasing security in area.	Allows more extensive development of protected area. Low lying flood plain still undeveloped.	Increased water surface due to construction effects but does not cause flooding.
E. Channel Improvement Reaches 2+3 local Protection	Effective combination for prevention of present damages. Allows more extensive development of protected areas.	Changes to a limited portion of flood plain. Levee will not effect ecosytem. Channel work will change temporarily.	Prevention of damages, at cost of altering existing flood plain. Increased security, if environmentally acceptable.	Allows some development of fringe areas. Transportation network not entirely protected.	Lower water surface, reduces height of levees.
F. Reservoir	Not cost effective. Damages completely eliminated.	Some adverse effect on natural and man-made environment due to constricted waterflow.	Invisible throughout most of creek. Security increased, without local restraint or alterations.	Allows development of flood plain with few visible changes to flood plain. Protects transportation and work.	Keeps water surface in banks.
G. Non-Structural-Removal	Expensive means of eliminating flood damages in flood plain. Not cost effective. Will not prevent future damages.	Increased open lands in flood plain. Maintains complete preservation of life cycles in flood plain.	Major upset to people who would be effected.	Encourages wiser use of lands. Stifles development in flood plain. No relief for transportation and work subject to flood.	No change in water surface.
H. Flood Proofing	Reduction in damages, Minimal federal involvement. Future damage not prevented.	Slight change in aesthetic quality of flood proofed structures. No effect on ecosystem of flood plain.	Damages prevented, but hazard of flood waters still threatened. Very little increase in security.	Allows limited development of flood plain. No relief for transportation network subject to flooding.	No change in water surface.

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EXTRACTS FROM MINUTES OF CHEEKTOWAGA TOWN BOARD

At a regular meeting of the Town Board of the Town of Cheektowaga, Erie County, New York held at the Town Hall, corner of Broadway and Union Road, in said Town on the ......3rd...... day of ......February......, 19..75.. at ..2:30... o'clock p. m. Eastern ......Standard...... Time there were:

PRESENT: Supervisor Daniel E. Weber
Councilman Felix T. Wroblewski
~~Councilman Frank E. Swiatek~~
Councilman Kenneth J. Meyers
~~Councilman Joseph R. Obstarczyk~~
Councilman Donald A. Halicki
Councilman Raymond J. Wasielewski

ABSENT: Councilman Thomas M. Johnson
Councilman Frank E. Swiatek

....

Motion by Councilman Meyers **seconded by** Councilman Johnson

WHEREAS, the residents of the Town of Cheektowaga have been plagued by constant flooding, and

WHEREAS, one of the main sources of flooding is Cayuga Creek, and

WHEREAS, the U.S. Army Corps of Engineers has made a study of the problems involved in correcting the flooding conditions arising out of Cayuga Creek, and

WHEREAS, no date has been set for the project that would alleviate the flooding conditions, therefore, BE IT

RESOLVED that the Town Board hereby memorializes the U.S. Army Corps of Engineers and Congressman Jack F. Kemp to intervene on behalf of the Town with the proper authorities and take such action as is necessary to have the U.S. Army Corps of Engineers start the Cayuga Creek project, and, BE IT FURTHER

RESOLVED that a certified copy of this resolution be forwarded to the U.S. Army Corps of Engineers and Congressman Jack F. Kemp.

Councilman Donald A. Halicki
Councilman Raymond J. Wasielewski

ABSENT: Councilman Thomas M. Johnson
Councilman Frank E. Swiatek

....

Motion by Councilman Meyers **seconded by** Councilman Johnson

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WHEREAS, one of the main sources of flooding is Cayuga Creek, and

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RESOLVED that a certified copy of this resolution be forwarded to the U.S. Army Corps of Engineers and Congressman Jack F. Kemp.

Upon roll call.....

Supervisor Weber	**Voting**	AYE
Councilman Wroblewski	**Voting**	AYE
Councilman Swiatek	**Voting**	ABSENT
Councilman Meyers	**Voting**	AYE
~~**Councilman Obstarczyk**~~	**Voting**	
Councilman Halicki	**Voting**	AYE
Councilman Wasielewski	**Voting**	AYE
Councilman Johnson	Voting	AYE

AYES: 6
NAYES: 0
ABSENT: Councilman Swiatek

STATE OF NEW YORK
ERIE COUNTY
OFFICE OF THE CLERK OF THE
TOWN OF CHEEKTOWAGA
} ss:

This is to certify that I, *BENEDICT T. HOLTZ*, Clerk of the *Town of Cheektowaga, in the said County of Erie*, have compared the foregoing copy of resolution with the original resolution now on file at this office, and which was passed by the Town Board of the *Town of Cheektowaga* in said *County of Erie*, on the 3rd day of February 1975, and that the same is a correct and true transcript of such original resolution and the whole thereof.

(SEAL)

In Witness Whereof, I have hereunto set my hand and affixed the seal of said Town this 7th day of February 1975

Benedict T. Holtz

CLERK OF THE TOWN BOARD, TOWN OF CHEEKTOWAGA, N. Y.

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NEWS FROM THE

BUFFALO DISTRICT

CORPS OF ENGINEERS

1776 NIAGARA STREET - BUFFALO, NEW YORK 14207

COLONEL BERNARD C. HUGHES
District Engineer

THOMAS D. MALONEY
AC716 876-5454

BUFFALO, NEW YORK, December 6, 1974: Colonel Bernard C. Hughes, district engineer, Buffalo District, U. S. Army Corps of Engineers, recently awarded a contract in the amount of $52,000 to the architect-engineering firm, McPhee, Smith, Rosenstein Engineers of Buffalo, for a study of possible methods of flood management for Cayuga Creek. The firm will be completing the first phase of a two-part study.

The study of Cayuga Creek is part of the current Corps study of the entire Buffalo metropolitan area. The metro area study will develop, with cooperation from all concerned Federal and Stage agencies and local governments, plans to increase or improve flood management, streambank protection, water-related recreation, fish and wildlife management and water-related environmental quality. The study area includes all of Erie and Niagara Counties as well as significant portions of Cattaraugus, Genesee and Wyoming Counties.

The first phase of the Cayuga Creek study is scheduled for completion in April 1975. The entire study of Cayuga Creek is scheduled to be finished in June 1976.

# # #

CAYUGA CREEK

CHEEKTOWAGA, NEW YORK

APPENDIX E

CULTURAL RESOURCES CORRESPONDENCE

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

United States Department of the Interior

HERITAGE CONSERVATION AND RECREATION SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO: 661

JUL 16 1979

Lt Col, Thomas R. Braun
Deputy District Engineer
Department of the Army
Buffalo District, Corps of
Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Braun:

Thank you for your letter requesting a determination of eligibility for inclusion in the National Register pursuant to Executive Order 11593 or the National Historic Preservation Act of 1966, as amended. Our determination appears on the enclosed material.

As you understand, your request for our professional judgment constitutes a part of the Federal planning process. We urge that this information be integrated into the National Environmental Policy Act analysis in order to bring about the best possible program decisions. This determination does not serve in any manner as a veto to uses of property, with or without Federal participation or assistance. Any decision on the property in question and the responsibility for program planning concerning such properties lie with the agency or block grant recipient after the Advisory Council on Historic Preservation has had an opportunity to comment.

We are pleased to be of assistance in the consideration of historic resources in the planning process.

Sincerely yours,

Charles A. Herrington

Charles A. Herrington
Acting Keeper of the National Register

Enclosure

E.O. 11593

DETERMINATION OF ELIGIBILITY NOTIFICATION

National Register of Historic Places
Heritage Conservation and Recreation Service

Name of property: Creekside Grove Site UB 1503

Location: Union Road, Vicinity of Cheektowaga, Erie County **State:** NY

Request submitted by: DOD/COE/Thomas R. Braun

Date received: 7/5/79 **Additional information received:**

Opinion of the State Historic Preservation Officer:

☒ Eligible ☐ Not Eligible ☐ No Response

Comments:

The Secretary of the Interior has determined that this property is:

☒ Eligible **Applicable criteria:** D ☐ Not Eligible

Comments:

36 CFR Part 63.3
Determination

☐ **Documentation insufficient**
(Please see accompanying sheet explaining additional materials required)

Charles Herrington

Keeper of the National Register

Date: 7-26-79

FHR 8-265 2/79

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-PE

9 July 1979

Orin Lehman, Commissioner
State Historic Preservation Office
Division for Historic Preservation
New York State Office of Parks and
Recreation
Empire State Plaza, Agency Building 1
Albany, New York 12238

Dear Commissioner Lehman:

Inclosed are a draft scope of work and preliminary case report detailing the Buffalo District's anticipated actions regarding the Creekside Grove Archaeological Site (UB 1503). A request for a determination of eligibility has been forwarded to the National Register of Historic Places. The preliminary case report details the alternative actions considered and concludes that mitigation of the adverse effects of the Cayuga Creek Flood Control project (on UB 1503) through a program of excavation and data recovery is the only prudent and feasible alternative. The scope of work details the requirements for implementation of the anticipated data recovery plan.

Please review the enclosed documentation and provide comments within 30 days of your receipt of this letter. A copy of the documentation has been forwarded to the Advisory Council on Historic Preservation.

If you have any questions regarding this matter, please contact Staff Archaeologist Richard H. Lewis at (716) 876-5454, extension 2171.

Thank you for your consideration in this matter.

Sincerely yours,

2 Incl
as stated

DONALD M. LIDDELL
Chief, Engineering Division

Draft Preliminary Case Report
for the Creekside Grove Archaeological
Site (UB 1503) Erie County, NY

Description of the Property.

Site UB 1503 is located in the town of Cheektowaga, Erie County, NY, along the Cayuga Creek in the general vicinity of Union Road and William Street. UTM coordinates for UB 1503, Creekside Grove Site, are 17T E82550 N50340. Elevation of the site is 605-615 feet (181.5-184.5 meters) above sea level. The Creekside Grove site is situated on a fairly level silt flood plain terrace adjacent and north of Cayuga Creek.

Site UB 1503 is known on the basis of information and artifacts recovered from archaeological testing conducted by SUNY Buffalo (1977) and Rensselaer Polytechnic Institute (1979). During the SUNY Buffalo study, archaeologists recovered approximately 1,038 artifacts which included 879 prehistoric artifacts and 159 historic artifacts from four 5' X 5' square units and 23, 1' X 1' shovel stest pits. During RPI's additional Stage II examination of UB 1503, archaeologists recovered about 1,800 artifacts which included approximately 1,435 prehistoric artifacts, 125 ambiguous finds, and 240 historic items from two 5' X 5' square units and 29 shovel test pits.

In total, archaeologists have excavated less than 1.5 percent of artifact bearing deposits found within the area of project impact. This less than 1.5 percent estimate is based on evidence that: (a) the site area within the project direct impact zone is approximately 16,000 square feet (1,520 square meters) in area, and (b) that archaeological excavation accounts for about 200 square feet (19 square meters.) Thus, from less than 1.5 percent of the site, archaeologists have recovered over 2,300 prehistoric atrifacts, including modified and unmodified flakes, bifaces, cores and core fragments, preforms, one projectile point fragment and one projectile point.

Archaeologists were able to observe no subsurface features such as pits, postmolds, and the like. Archaeologists neither observed nor were able to collect any organic matter (charcoal, shell, bone, etc.) suitable for Radiocarbon 14 dating of the site.

Over 95 percent of all prehistoric artifacts recovered during our excavations of UB 1503, the Creekside Grove site, consisted of flint manufacturing debris. Recognizable tools were mostly fragments, with the exception of the Brewerton projectile point. Laboratory workers were able to identify gross functions, but not an accurate chronology of recovered tool forms. Items recovered from UB 1503 are common utilitatian forms often found in abundance on sites dating to the Late Archaic and Transitional Periods (3500-1000 BC). The absolute lack of prehistoric ceramics in the area tested suggests a preceramic (Archaic or perhaps Transitional Period) date for the site. We note, toward this issue, that the one projectile point recovered in the undisturbed Level II of STP #19, is a Brewerton point dating to the Late Archaic Period. All of these facts are interpreted to suggest probable Late Archaic Period occupation or use of the site. (Ivey 1979, pp. 33-35)

National Register of Historic Places Status.

On 26 June 1979 a determination of eligibility was requested for the Creekside Grove Archaeological Site (UB 1503.) It is the opinion of the New York State Historic Preservation Officer and the Buffalo District that the site is eligible for inclusion on the National Register of Historic Places. At present, the documentation is undergoing review by the NRHP staff.

Description of the Proposed Undertaking which will Affect the Property.

The selected plan includes concrete walls, earth levees, erosion protection, ponding areas with culvert pipes and flap gates, and some minor channel improvement work all located upstream of the Union Road bridge over Cayuga Creek.

Specifically, the plan will consist of: a 710-foot concrete floodwall extending along the north bank of the creek from the Union Road bridge to Station 7+10; from Station 7+10 to 8+50 erosion protection will be provided; the remaining area along the north bank to Station 14+50, the banks will be cleaned and seeded. Commencing at Station 7+10 and running directly north from the north bank of the creek, protection will be provided by 525 feet of earthen levee, 290 feet of concrete walls, and 100 additional feet of levee. The work on the south bank will be limited to 850 feet of erosion protection and 600 feet of cleaned and seeded bank. The total area impacted by the project is 1.97 acres

Effects of the Undertaking on the Property.

The property will be adversely affected by the project as it lies directly in the proposed alignment of the project.

Alternatives to the Proposed Action Considered but No Selected.

Pursuant to the terms of the National Historic Preservation Act (PL 89-655); EO 11593; 36 CFR, part 800; and 33 CFR, part 305 consideration was given to preservation of the property through project modification or use of nonstructural alternatives to solve the flooding problems along Cayuga. The alternatives were rejected from further consideration for the following reasons:

a. Project Modification.

This alternative was rejected because the selected alternative is the least environmentally damaging structural solution. Any other feasible structural plan would involve a larger impact area and impact a larger area of UB 1503 or other archaeological manifestations identified in the area. In addition, the selected alternative is the most economically efficient plan.

b. Nonstructural Solutions.

Several nonstructural solutions consisting of singly and in various combinations; floodproofing, flood fighting, flood plain management temporary and permanent evacuation and flood warning. These alternative solutions were rejected for the following reasons: They do not offer a permanent or reliable solution nor are they acceptable to the residents.

c. A No-Action Alternative.

A no-action alternative was also considered, but was rejected as it was not a solution to the identified flooding problem.

Selected Alternative.

The selected alternative consists of the construction of the project as described in Section 3 coupled with a data recovery plan consistent with 36 CFR, part 66 and preservation of one-third of the site which will not be impacted by project actions. The Scope of Work for the data recovery plan is attached as Exhibit A.

DATA RECOVERY PROGRAM FOR
THE CREEKSIDE GROVE ARCHAEOLOGICAL
SITE (UB 1503) ERIE COUNTY, NY

INTRODUCTION

The Creekside Grove Archaeological Site (UB 1503) is located in the town of Cheektowaga, Erie County, NY, in the general vicinity of Union Road and William Street. The site extends 380 feet (114 meters) north of the north bank of Cayuga Creek. The east-west extent of the site which is defined by the project boundaries is approximately 400 feet (120 meters). The Creekside Grove site occupies 16,000 square feet (1,520 square meters) and is situated on a fairly level silt flood plain terrace adjacent to Cayuga Creek. The site area and proposed project are shown on plate 1.

GENERAL REQUIREMENTS

1. The purpose of this contract is to mitigate against the adverse effects which will be caused by the construction of the Cayuga Creek Flood Control Project, through a program of archaeological excavation and data recovery. This action is being taken pursuant to the National Historic Preservation Act of 1966 (P.L. 89-665); the National Environment Policy Act of 1969 (P.L. 91-190); Executive Order 11593, "Protection and Enhancement of the Cultural Environment," 13 May 1971 (36 F.R. 8921); Preservation of Historic and Archeological Data, 1974 (P.L. 93-291); the Advisory Council on Historic Preservation, "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800); and 33 CFR Part 305, Identification and Administration of Cultural Resources.

2. The site report resulting from the data recovery program shall be a comprehensive, scholarly document that not only fulfills mandated legal requirements but also serves as a scientific reference for future professional studies. As such, the report's content must not only be descriptive but also analytic in nature (P.L. 93-291, proposed rulemaking 36 CFR Part 66).

3. The Contractor shall perform this work in a manner which will insure the greatest contribution to the history and prehistory of New York.

4. The Contractor shall conduct this work in close cooperation with the State Historic Preservation Officer. Evidence of such cooperation will be documented in the report.

5. The extent and character of the work to be accomplished by the Contractor shall be subject to the general supervision, direction, control, and approval of the Contracting Officer.

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SPECIFIC REQUIREMENTS

1. The Contractor shall conduct a data recovery program in accordance with current professional standards and using the techniques and methodologies consistent with the accomplishment of such a program. This shall be performed using as a minimum the standards set forth in 36 CFR Part 60, 36 CFR Part 63, 36 CFR Part 66, and 33 CFR Part 305. A research design will be constructed which will address but not be limited to answering the following research questions:

a. Is UB 1503 single or multi-component site?

b. What is/are the cultural affiliation(s) represented at the site?

c. What was the function of the site?

d. What is the horizontal and vertical distribution of the cultural material?

e. How does the site relate to the larger local and regional framework?

2. The Contractor shall keep standard field records which may be reviewed by the Contracting Officer. These records shall include, but not be limited to, field notebooks, site survey forms, field maps, photographs, and stratigraphic profiles.

3. The Contractor shall obtain permission from the appropriate landowners to enter their property for the purposes of conducting the field survey and testing. The Contracting Officer will provide a letter of introduction to the Contractor to aid in obtaining access to this private property.

4. The field survey shall be closely coordinated with the Contracting Officer. The Contracting Officer reserves the right to have a representative of the Buffalo District present during the excavation.

REPORT REQUIREMENTS

5. The Contractor shall prepare a report detailing the work done, study rationale, results, and recommendations for preservation of the unaffected portion of the site. The report shall include, but not be limited to, the following sections: an abstract, an introduction, a brief section placing the project area in a regional context, a section on the methodology employed, a brief evaluation of previous work done in the area, an evaluative inventory of cultural resources in

the project area, a concise definitive summary, and references. The above items may not necessarily be discrete units but shall be readily discernible to the reader.

6. The abstract shall be a synopsis of the report where the reader may find the general conclusions and recommendations resulting from the cultural resource reconnaissance survey.

7. The introduction shall include, but is not limited to, the following: the purpose of the study, delineation of the site boundaries, and a general statement on the nature of the study conducted.

8. The regional setting, including environmental factors affecting the location of site and the known culture history, should be briefly summarized.

9. The methodology used for data collection and analysis shall be described in sufficient detail for a reviewer to understand what was done and why. This shall include, but not be limited to, a discussion of sampling procedures, the types of data collected, artifact retrieval procedures, recording techniques, classificatory schemes, methods of chronological determination, and any special analytical methods and techniques used. Maps which show the site area, locations of excavations, and location of artifacts recorded shall be included.

10. Typical soil profiles and drawings and/or clear photographs of any anomalies that are discussed in the report shall be included. Examples of standard forms used in recording and/or analyzing data shall be included.

11. There shall be a brief summary of the study findings and recommendations. It should be clear from this exactly what, if any, additional studies are recommended prior to construction of the proposed project.

12. All references cited and/or utilized shall be listed in American Anthropological Association format. Contacts with other individuals shall also be cited.

13. Information shall be presented in textual, tabular, and graphic forms, whichever are most appropriate, effective, and advantageous to communicate necessary information. The Contractor shall give every consideration to the use of nontextual forms of presentation, particularly profile (cross section) drawings in combination with maps, to maximize the quantity and quality of information presented.

14. If the report is authored by someone other than the principal investigator, the principal investigator shall prepare the foreward

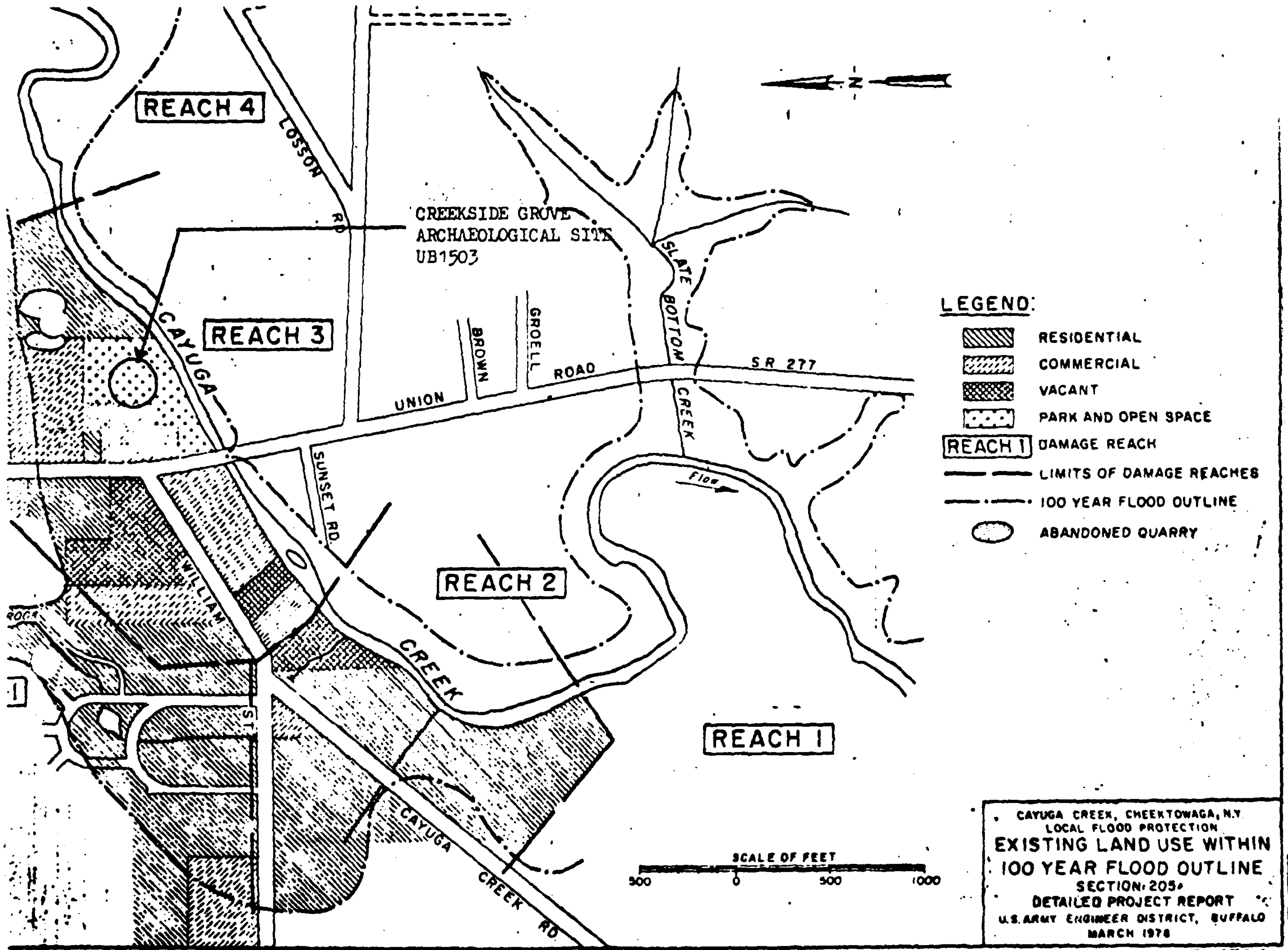
describing the overall research context of the report, the significance of the work, and any other related background circumstances relating to the manner in which the work was undertaken.

15. The following items shall be included as appendices to the report: the vitae of the principal investigator and any consulting professionals, this Scope of Work, the research design submitted as a result of this procurement action, mitigation plan, any letters of comment on the draft report from other agencies forwarded by the Contracting Officer, and the comments on the draft report offered by the Contracting Officer.

SUBMITTALS

1. The Contractor shall submit six copies of a double-spaced draft report within 120 calendar days after receipt of the Notice to Proceed. The Contracting Officer will provide the Contractor with comments on the draft report within 45 days after receipt of the draft. If for any reason this review period is not sufficient, the Contracting Officer shall so notify the Contractor. The Contractor shall submit one original and 10 copies, single-spaced, of the final report, including appropriate revisions in response to the Contracting Officer's comments within 30 days of receipt of those comments.

2. Neither the Contractor nor his representatives shall release any sketch, photograph, report, or other material of any nature obtained or prepared under the contract without specific written approval of the Contracting Officer prior to the time of final acceptance of the report by the Government.



N
REACH 4
REACH 3
REACH 2
REACH 1
LOSSON RD
CREEKSIDE GROVE
ARCHAEOLOGICAL SITE
UB1503
CAYUGA CREEK
SLATE BOTTOM CREEK
SR 277
UNION ROAD
BROWN
GROELL
SUNSET RD.
WILLIAM
ST
CAYUGA CREEK RD
Flow
LEGEND:
RESIDENTIAL
COMMERCIAL
VACANT
PARK AND OPEN SPACE
REACH 1 DAMAGE REACH
LIMITS OF DAMAGE REACHES
100 YEAR FLOOD OUTLINE
ABANDONED QUARRY
SCALE OF FEET
500 0 500 1000
CAYUGA CREEK, CHEEKTOWAGA, N.Y.
LOCAL FLOOD PROTECTION
EXISTING LAND USE WITHIN
100 YEAR FLOOD OUTLINE
SECTION 205
DETAILED PROJECT REPORT
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MARCH 1978

PLATE 2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