ENG. DIV

US Army Corps
of Engineers
New York District

General Design Memorandum

Streams in Westchester County, N.Y.

Flood Control Project for the Mamaroneck and Sheldrake Rivers Basin in the Village of Mamaroneck, N.Y.

Volume 1 of 6 - Main Report

January 1989
Final Report

WESTCHESTER COUNTY STREAMS
MAMARONECK AND SHELDRAKE RIVERS
FLOOD CONTROL PROJECT
VILLAGE OF MAMARONECK, NEW YORK

GENERAL DESIGN MEMORANDUM

MAIN REPORT

VOLUME 1

JANUARY 1989

SYLLABUS

The study along the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, New York was authorized under resolutions adopted 14 September 1955 and 14 November 1955 by the United States Senate Committee on Public Works, and resolution adopted 13 June 1956 by the United States House of Representatives Committee on Public Works. The project recommended by the Corps as a result of studies under these resolutions was authorized for construction by Section 401(a) of the Water Resources Development Act of 1986 (Public Law 99-662, 99th Congress, 2nd Session), adopted 17 November 1986.

It is noted that the Village of Mamaroneck project was one of three independent plans authorized. The other authorized projects were the Sheldrake River in the Town of Mamaroneck, New York, and the Byram River in Greenwich, Connecticut and Port Chester, New York. These latter two projects are not addressed in this General Design Memorandum.

The flood protection project addressed herein is located in Westchester County, New York and is generally within the Village of Mamaroneck. This project is hydraulically independent of the project for the Town of Mamaroneck and the project on the Byram River.

This General Design Memorandum (GDM) presents the design and the evaluation of flood control measures for protection from damage due to fluvial flood events. Evaluation of the alternatives was accomplished within the framework of existing Federal laws and criteria. The plan recommended for construction yields the maximum benefits over cost (NED plan).

The plan recommended in this GDM is essentially the same as the authorized plan and differs only in minor detail.

On the Mamaroneck River, the plan recommended in this GDM provides for modifying approximately 10,400 feet of river channel, constructing about 7,200 feet of retaining walls, replacing six bridges, and removing one bridge.

On the Sheldrake River, the plan recommended in this GDM includes a diversion tunnel 3,550 feet in length from its inlet at Fenimore Road to its outlet in the west basin of Mamaroneck Harbor, channel modification along approximately 4,200 feet, and retaining wall for about 900 feet.

On the Mamaroneck River, the plan recommended in this GDM provides for a 200 year level of protection for the entire length of the project - from Winfield Avenue downstream to just below Tompkins Avenue.

On the Sheldrake River, a 200-year level of protection from the New England Thruway downstream to the confluence with the Mamaroneck River in Columbus Park is provided, the diversion tunnel is designed to carry the flows up to the Standard Project Flood or approximately 4040 cubic feet per second.

The estimated first cost of the plan recommended in this GDM is $67,099,400 (October 1988 price level) of which $50,324,600 is Federal and $16,774,800 is non-Federal. The total annual cost is $5,679,000, the average annual benefits are $7,311,000, and the benefit-cost ratio of the plan recommended in this GDM is 1.1.

The local sponsor, the New York State Department of Environmental Conservation, supports the project.

PERTINENT DATA

A. PROJECT LOCATION

1. Streams	Mamaroneck River Sheldrake River
2. Community	Village of Mamaroneck
3. County	Westchester
4. State	New York

B. CLIMATOLOGY

1. Average Annual Temperature	51 Degrees, Fahrenheit
2. Average Annual Precipitation	44.2 Inches
3. Winds - Prevailing Direction	Northwest
4. Winds - Average Velocity	14 M.P.H.

C. HYDROLOGIC DATA

<u>Mamaroneck River</u>

Drainage Area at Detention Reservoir Dam	DA=15.35 SQ MI
Drainage Area Upstream of Sheldrake R.	DA=17.30 SQ MI
Drainage Area Downstream of Sheldrake R.	DA=23.40 SQ MI
Drainage Area at Mouth	DA=23.63 SQ MI
Largest Flood of Record	September 1975
Discharge for Largest Flood of Record at Gage Station	3700 CFS
Design Flood Frequency	200 Year
Design Flood Discharge at Gage Station (Existing/Improved)	7240/6220 CFS
Design Flood Discharge at Mouth (Existing/Improved)	7270/6220 CFS

<u>Sheldrake River</u>

Drainage Area Downstream of East Branch	DA=5.20 SQ MI
Drainage Area at Fenimore Road	DA=5.57 SQ MI
Drainage Area Sheldrake at Mouth	DA=6.16 SQ MI
Largest Flood of Record	September 1975

Sheldrake River, continued

Discharge for Largest Flood of Record at Mouth	1087 CFS
Design Flood Frequency of Diversion	SPF
Design Flood Discharge at Mouth (Confluence with the Mamaroneck River) (Existing/Improved)	2440/370 CFS
Design Flood Discharge at Fenimore below Tunnel	2410/180 CFS
Design Flood Discharge above Tunnel at Fenimore Road (Existing/Improved)	3090/4040 CFS

D. PLAN OF IMPROVEMENT - FEATURES

1. MAMARONECK RIVER

a. Lower Mamaroneck River (17+00 to 41+40)

Level of Protection	200 yr
Channel Length	2440 ft
Channel Width	60 ft
Channel Deepening	1-3.5 ft
Retaining Walls	2060 ft
Bridge Replacement	4
Tompkins Avenue	
Ward Street	
Valley Place Sewer Bridge	
Halstead Avenue Bridge	
Erosion Protection	
Riprap-Lineal Distance	1395 ft
Relocations	
Utilities - Water, Sewer, Gas, Power line	
USGS Gage Station (39+50 moved to 80+62)	

b. Upper Mamaroneck River (41+40 to 121+20)

Level of Protection	200 yr
Channel Length	7980 ft
Channel Width	45 to 60 ft
Channel Deepening	Up to 4 ft
Retaining Walls	5130 ft
Bridge Replacement	2
Station Plaza Road	
Hillside Avenue	
Bridge Removal	1
Winfield Avenue	

Erosion Protection	
Riprap-Lineal Distance	1670 ft
Relocations	
Utilities - Water, Sewer, Gas, Power line	
USGS Gage Station (39+50 moved to 80+62)	
Environmental Mitigation	
V-Shaped Pilot Channel (1.5 ft deep, 7315 ft long)	
Log Dams	1
Rock Dams	2
Boulder Fields	2

2. SHELDRAKE RIVER

a. Lower Sheldrake River (0+00 to 28+00)

Level of Protection	200 yr
Channel Length	2800 ft
Channel Width	10 ft
Retaining Walls	None
Bridge Replacement	None
Erosion Protection	
Riprap-Lineal Distance	30 ft
Environmental Mitigation	Weir Structure

b. Upper Sheldrake River (39+60 to 69+00)

Level of Protection	200 yr-SPF
Channel Length	2940 ft
Channel Work (39+60 to 53+50)	1390 ft
Clearing and Snagging (53+50 to 69+00)	1550 ft
Channel Width	40 ft
Channel Deepened	1 to 2.5 ft
Retaining Walls	840 ft
Bridge Replacement	None
Erosion Protection	
Riprap-Lineal Distance	1175 ft
Relocations	None
Environmental Mitigation	
1.5 ft deep v-shaped Pilot Channel	1200 ft
Log Dam	1

c. Sheldrake River Diversion Tunnel (0+00 to 39+60)

Level of Protection	SPF
Length of Outlet Structure (0+00 to 1+50)	150 ft
Rock Tunnel Section (1+50 to 19+67)	1817 ft
Transition Section (19+67 to 20+75)	108 ft
Box Culvert Section (20+75 to 37+00)	1625 ft
Inlet Structure (37+00 to 39+60)	160 ft
Tunnel Length without Inlet & Outlet Structure	3550 ft Tunnel
Size	
Rock Tunnel (Horseshoe-diameter)	17.5 ft
Box Culvert (square-width/height)	16.25 ft
Walls	805 ft

Relocations
Water, Sewer, Gas, Power

Erosion Protection
Riprap-Lineal Distance None

E. ESTIMATED COST (October 1988 Price Level)

(a) Federal Cost	50,324,600
(b) Non-Federal Cost	16,774,800
(c) Total Project Cost	67,099,400

F. ECONOMICS (October 1988 Price Level; 8-7/8% Interest Rate; 100-Year Project Life)

1. Annual Charges	$	5,678,000
2. Average Annual Benefits	$	7,311,000
3. Benefit-to-Cost Ratio		1.30
4. Net Benefits	$	1,633,000

WESTCHESTER COUNTY STREAMS
MAMARONECK AND SHELDRAKE RIVERS
FLOOD CONTROL PROJECT
VILLAGE OF MAMARONECK, NEW YORK

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1. INTRODUCTION

1.1 AUTHORIZATION

The study along the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, New York was authorized under resolutions adopted 14 September 1955 and 14 November 1955 by the United States Senate Committee on Public Works, and resolution adopted 13 June 1956 by the United States House of Representatives Committee on Public Works. The project recommended by the Corps as a result of studies under these resolutions was authorized for construction by Section 401(a) of the Water Resources Development Act of 1986 (Public Law 99-662, 99th Congress, 2nd Session), adopted 17 November 1986. The wording of the specific portion of Section 401(a) of this Act which authorized this project is as follows:

> The project for flood control, Mamaroneck and Sheldrake River Basins, New York and Connecticut, and Byram River Basin, New York and Connecticut: Report of the Chief of Engineers, dated April 4, 1979, at a total cost of $68,500,000, with an estimated first Federal cost of $51,400,000 and an estimated first non-Federal cost of $17,100,000. Such project shall include flood protection for the Town of Mamaroneck as recommended in the report of the Division Engineer, North Atlantic Division, dated March 28, 1978.

It is noted that the Village of Mamaroneck project was one of three independent plans authorized. The other authorized projects were the Sheldrake River in the Town of Mamaroneck, New York, and the Byram River in the area of Greenwich, Connecticut and Port Chester, New York. These latter two projects are not addressed in this General Design Memorandum.

The flood protection project addressed herein is located in Westchester County, New York and is generally within the Village of Mamaroneck. This project is hydraulically independent of the project for the Town of Mamaroneck and the project on the Byram River.

1.2 AUTHORIZED PROJECT

1.2.1 Location

The Mamaroneck and Sheldrake River Basins are located along the northern coast of Long Island Sound within the greater New York metropolitan area (Figure 1). This area lies entirely within southeastern Westchester County, New York and contains portions of the Village and Town of Mamaroneck, the Cities of New Rochelle and White Plains, the Towns of Harrison and North Castle, and the Village of Scarsdale.

1.2.2 Description

The plan of protection recommended in the Feasibility Report and authorized by the WRDA of 1986 is described in the Report of the Chief of Engineers, dated 4 April 1979, and is depicted in Figure 1A.

This plan provides for modifying approximately 10,000 feet of river channel, constructing about 3,700 feet of retaining walls, replacing four bridges, and building interior drainage works on the Mamaroneck River. On the Sheldrake River, modifications include a diversion tunnel about 3,000 feet in length from its inlet at Fenimore Road to the west basin of Mamaroneck Harbor, channel modification along approximately 2,700 feet, a retaining wall for about 1,700 feet, and a levee about 1,000 feet long.

The authorized project was designed to protect against a 200-year flood event along the Mamaroneck River from Tompkins Avenue upstream to the New England Thruway, and against a 100 year flood upstream of the New England Thruway to the Westchester County Joint Waterworks Dam. The protection along the Sheldrake River is designed to protect against a 200-year flood event, and extends from the New England Thruway downstream to the waterway's confluence with the Mamaroneck River in Columbus Park. These improvements would substantially reduce flood damages for approximately 370 residences and 160 businesses which are located predominantly in the Village of Mamaroneck. Damages of about $136,500,000 (October 1987 price level) from the 100-year frequency flood would be completely eliminated under the authorized plan.

The total cost of the authorized plan of protection, updated from the Feasibility Report to the October 1988 price level, is $67,099,400, of which $50,324,600 is Federal cost and $16,774,800 is non-Federal cost. The project costs based on the GDM investigations documented in this report are discussed later in this main report and in Appendix E - Cost Estimates.

1.3 PURPOSE OF STUDY

This report presents the results of the final formulation, detailed design, and supporting data for construction of the authorized flood control project along the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, New York. The primary objective of the investigations performed for this GDM was to develop adequate information to reaffirm the authorized plan and purpose, to justify project revisions, and to develop detailed designs, cost estimates and to specify the Federal and non-Federal responsibilities.

1.4 STUDY SCOPE

The plan recommended in this report, when approved, will be the basis for preparation and approval of plans and specifications. Consequently, the scope of the technical analyses performed for this GDM was sufficient for the final design of project features and the preparation of accurate cost estimates.

1.5 BASIS OF STUDY

This report was prepared in accordance with the provisions of ER 1110-2-1150 (as modified), and is based upon the plan of protection contained in the October 1977 feasibility document entitled "Feasibility Report For Flood Control, Mamaroneck and Sheldrake Rivers Basin (Village and Town of Mamaroneck New York) and Byram River Basin (Greenwich, Connecticut and Port Chester, New York)." The plan of protection developed for this GDM is essentially the same as the plan presented in that document; any changes are discussed later in this report.

1.6 EXISTING PROJECTS, PRIOR REPORTS, AND INVESTIGATIONS

1.6.1 Corps of Engineers Projects

There are no prior flood control projects.

There is an existing Corps of Engineers navigation improvement in Mamaroneck Harbor. The first phase of the project completed in 1933 was for an entrance channel and anchorage area in the East Basin to 10 feet below mean low water. In 1939 the project was extended to the West Basin including an entrance channel and an anchorage area to a depth of 6 feet. An additional 6 foot deep anchorage area was completed for the East Basin in 1966.

1.6.2 Projects by Others - None

1.6.3 Prior Reports

Previous reports on all or part of the Mamaroneck and Sheldrake River Basins are described below. Several of the reports investigated flood control improvements along the same reaches of the Mamaroneck and Sheldrake Rivers which are considered in this report. All of these reports were reviewed as part of this study. Table 1 includes a brief summary of prior Corps of Engineers' reports on flood control investigations.

1.6.4 Corps of Engineers Flood Control Reports

A "Preliminary Examination Report on the Mamaroneck and Sheldrake Rivers and Bridges in the Village and Town of Mamaroneck and Town of Harrison," was completed by the New York District on 14 August 1942. This report was marginally favorable and recommended further study in the form of a Survey Report. However, the Survey Report, which was subsequently completed and submitted to Congress on 9 December 1948, was unfavorable.

A "Survey Report for Streams in Westchester County" completed by the New York District in May 1968 considered local protection works at the Village of Mamaroneck consisting of channel modifications with walls and levees along the Mamaroneck and Sheldrake Rivers. The study was favorable, however the Board of Engineers for Rivers and Harbors returned the report to the District for reconsideration of a debris jam occurrence. Restudy indicated the considered project was not economically feasible.

A Reconnaissance Report was completed in April 1973 which considered channel improvements along the Sheldrake River in the Town of Mamaroneck consisting of a reinforced concrete flume. The report was favorable, however, the cost apportioned to Federal interests was in excess of the small project authority limitation, and further study was recommended under the Westchester County Streams Survey authority.

Following the disastrous floods of 1972 and 1975, local interests again requested Federal assistance. The Chief of Engineers, by letter to the North Atlantic Division dated 22 April 1976, granted approval for the preparation of an interim report for the Mamaroneck and Sheldrake Rivers under the Westchester County Streams Survey Investigation.

A "Feasibility Report for Flood Control, Mamaroneck and Sheldrake Rivers Basin and Byram River Basin" was completed in October 1977. The feasibility report recommended a combination of channel widening and deepening, retaining walls, stream realignment, bridge replacement and enlargement, levees, and a diversion tunnel. The recommended plan for Mamaroneck and Sheldrake was economically favorable, and the project was recommended for further development along with projects for the Town of Mamaroneck and for the Byram River.

The Board of Engineers for Rivers and Harbors (BERH), transmitted the Feasibility Report to the Chief of Engineers on 12 July 1978. He supported the plans for the Village of Mamaroneck and for the Byram River but recommended deletion of the plan for the Town of Mamaroneck due to Corps policy which deemed the problem area as local drainage and therefore a local responsibility. General Morris, Chief of Engineers, after commenting and approving the Feasibility Report, transmitted it to the Secretary of the Army, the Secretary of the Interior, the Governor of Connecticut, the Commissioner of the Department of

Environmental Conservation and the Governor of New York, and other agency heads on 4 April 1979. After reviewing and considering comments of these and other agencies and interests, the Secretary of the Army transmitted the report to the Office of Management and Budget on 26 April 1983 and to the Speaker of the House of Representatives of Congress on 25 September 1983.

The plan formulation performed during the Feasibility Study is discussed further in Section 3.1 of this GDM.

1.6.5 Other Corps of Engineers Reports

Navigation Reports. Prior navigation reports within the study area include a Survey Report for the East Basin of Mamaroneck Harbor at the lower estuary of the Mamaroneck River, which was submitted to Congress on 19 June 1959. This report resulted in the authorized Federal navigation project.

Hurricane Reports. The only previous report which includes the study area is an "Interim Survey Report on Hurricane Study of Westchester County, New York along Long Island Sound," which was submitted to Congress on 29 November 1967. This report recommended that no improvements designed to protect the shoreline areas of Westchester County, New York along Long Island Sound against tidal inundation be authorized at that time. Additionally, Part Two, Chapter XXXIX (unpublished) of the report "Land and Water Resources of the New England - New York Region," (Senate Document No. 14, 85th Congress, 1st Session), prepared by the New England-New York Inter-Agency Committee, includes a brief history of hurricane occurrences in this region, a description of the hurricane problem, and a general discussion of methods of reducing damages.

1.6.6 Reports by Other Federal Agencies

The following Type 15 Flood Insurance Studies were prepared for the Flood Emergency Management Agency (FEMA):

a. Village of Mamaroneck, June 1977; Supplements - 3 October 1983.

b. Town of Harrison, 15 September 1981.

c. City of Rye, October 1979; Supplements 1 November 1984.

d. Village of Rye Brook, March 1979.

1.6.7 Reports by Non-Federal Agencies

A report on flood conditions on the various streams in Westchester County, including the Mamaroneck and Sheldrake Rivers, was submitted to the Westchester County Board of Supervisors on Storm Water Control on 27 November 1945. Major flood relief measures considered in this report included: (a) channel improvements along the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, (b) the diversion of flood flows from the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, and (c) flood detention along the Mamaroneck River at the Westchester Joint Water Works Reservoir, and along the Sheldrake River at Larchmont Reservoir #2 and on the East Branch. This report recommended that a project consisting of channel improvement in the Village of Mamaroneck in combination with upstream flood detention be adopted to control floods along the Mamaroneck and Sheldrake Rivers.

A Reconnaissance Report, entitled "Mamaroneck and Sheldrake River Basins - Analyses of Flood Control Studies," was prepared by Dolph Rotfeld Associates and submitted to the Westchester County Department of Planning in April 1968. This report recommended (subject to further detailed studies) the use of the Westchester Joint Waterworks Reservoir, Silver Lake, Larchmont Reservoir, Forest Lake and Spring Lake as flood control facilities in the Mamaroneck and Sheldrake River Basins.

A 27 May 1983 report entitled "Washingtonville Flood Control Project" was prepared by Clarke and Rapuano Inc., consulting engineers to the Village of Mamaroneck. The report recommended a series of staged channel modifications and bridge alterations to reduce flooding along the lower Mamaroneck and lower Sheldrake Rivers. The recommendations were aimed at providing some immediate flood reduction at a much reduced cost when compared to the Federal plan, and was also viewed by the Village as a possible non-Federal contribution toward the larger plan recommended in the Corps' Feasibility Report.

No locally constructed project has been implemented as a result of any of these reports and investigations.

2. PROBLEM IDENTIFICATION

2.1 BASIN DESCRIPTION

The combined watershed of the Mamaroneck and Sheldrake Rivers has a total drainage area of 23.6 square miles. The leaflike, two stem watershed is roughly rectangular shaped, with a maximum length of 9 miles in a north-south direction and a width that varies from 2 to 3 miles. The terrain is gently rolling, lightly wooded in the upper portion and generally cleared in the lower valley. The ridges extend generally in a north-south direction.

Ground elevations range from near sea level at the mouth of the Mamaroneck River to about 500 feet above mean sea level in the northwest corner of the basin. The Mamaroneck River drains into Long Island Sound at the East Basin of Mamaroneck Harbor. The Mamaroneck Harbor consists of an inner landlocked harbor and an outer open harbor, connected by an inlet about 350 feet wide. This inner harbor is divided into two basins, East Basin and West Basin, by a projecting land area known as Harbor Island Park.

The Mamaroneck River rises downstream of Rye Lake, in the northern section of Harrison at an elevation of 520 feet above mean sea level. The river flows generally south for a distance of about 11 miles to Mamaroneck Harbor. The average slope of the Mamaroneck is approximately 10 feet per mile.

The Sheldrake River rises in the northeast portion of Scarsdale, New York, at an elevation of 300 feet above mean sea level. The river flows generally south-southeast for a distance of about 7.0 miles and joins the Mamaroneck River at a point about 0.6 miles above its mouth. One major tributary, known as the East Branch, enters the Sheldrake River at a point 1.8 miles upstream of its junction with the Mamaroneck River. The average slope of the Sheldrake River is approximately 25 feet per mile. The drainage basin is shown in Figure 1.

2.2 THE FLOOD PROBLEM

Flooding in the Mamaroneck and Sheldrake Rivers occurs principally from runoff caused by precipitation of high intensity or prolonged duration, and has an adverse effect on the economy and the general well-being of the flood-prone areas. Flooding causes physical damage to property and loss of commercial, industrial and public activity, with consequent loss of business and wages. Vehicular traffic is also affected adversely with consequent loss to those who depend on this mode of transportation. In addition to the foregoing, recurring flooding represents a threat to the health and safety of those who live or work in these areas.

2.3 DAMAGE AREAS

2.3.1 Location

The flood damage areas are located in the Village of Mamaroneck and the Town of Harrison, New York. On the Mamaroneck River, the damage area extends from below Tompkins Avenue upstream to the Westchester Joint Waterworks Dam. On the Sheldrake River damages occur from the confluence with the Mamaroneck River upstream to the Village line at the New York State Thruway Bridge.

2.3.2 Reach Definition

To facilitate the collection of flood damage data and the calculation of flood damages, the areas susceptible to flooding along the Mamaroneck and Sheldrake Rivers were divided into seven separate areas or reaches.

The first reach extends from Tompkins Avenue upstream to the New Haven Railroad along the Mamaroneck River. Reach 2 extends along the Mamaroneck River from the New Haven Railroad upstream to the First Street Bridge and along the Sheldrake River from the confluence upstream to Mamaroneck Avenue. Reach 3 lies between First Street and the New England Thruway Bridge along the Mamaroneck River. The fourth reach lies along the Mamaroneck River from the New England Thruway Bridge to the Westchester Joint Waterworks Dam. Reach 5 extends along the Sheldrake River from Mamaroneck Avenue to a point 400 feet upstream of the Fenimore Road Bridge where there is a topographical ridge line between Center and Fayette Avenues. On the New Haven Railroad side of this ridge Reach 5 extends as far as Rockland Road. Reach 6, which lies along the Sheldrake River from approximately 400 feet upstream of Fenimore Road to Rockland Road, is contained between the Sheldrake River and the ridge described above. Reach 7 extends from Rockland Road upstream to the New England Thruway. All of these reaches lie within the area to be protected by the recommended plan.

2.4 FLOODS OF RECORD

The most damaging flood of record resulted from the storms of 15-16 October 1955, 16 June 1972, and 26-27 September 1975. Other floods occurred in October 1877, September 1882, July 1889, October 1903, March 1936, July 1938, September 1938, July 1942, August 1942, September 1944, May 1946, March 1953, August 1955, August 1960, April 1961, March 1962, August 1971, September 1974, and April 1983 while other areas in Westchester County suffered floods in 1984, the Village of Mamaroneck received minimal flood damages. Flood damages for the 1972 and the 1975 floods are described in the following paragraphs.

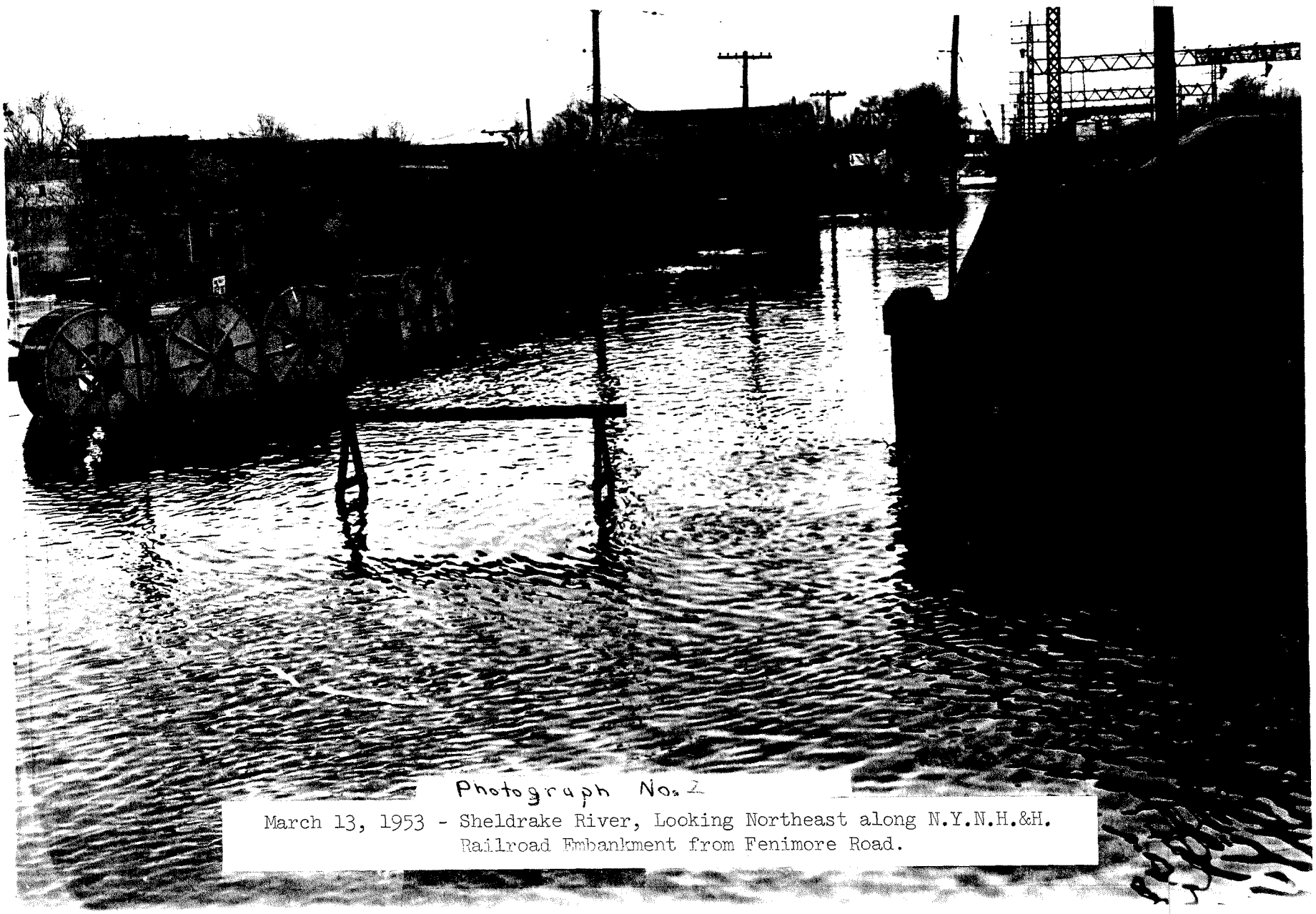
During the June 1972 flood, hundreds of residents, employees and school children were evacuated by boats and trucks as the Mamaroneck and Sheldrake Rivers overflowed their banks, inundating local streets and numerous homes and business establishments. Areas inundated in the Village of Mamaroneck from this flood include approximately 107 acres of industrial, commercial and residential property. Along the Mamaroneck River the flood damage area is located on both banks between Ward Street and First Street. From First Street upstream to the New England Thruway damages are confined to the left bank and in the reach between Chestnut Avenue and the Joint Waterworks Dam; the Village flood damage area lies on the right bank. Along the Sheldrake River the flood damage area is on both banks between the confluence with the Mamaroneck River and Fenimore Road. Between Fenimore Road and the Village line the damage area lies on the right bank. During the June 1972 storm, 26 industrial structures, 33 commercial establishments, 5 public buildings and 207 dwellings were flooded. Columbus Park was completely submerged. The industrial park was inundated to a depth of two feet and many businesses were not able to resume production for a week or more. Hardest hit industrial areas were at the Sealectro Corporation Plant on Hoyt Street, where 60 employees were evacuated, and the Bordow Corporation, located at Mamaroneck and Jefferson Avenues, which had several feet of water in its buildings. The main floors of many dwellings between Mamaroneck Avenue and the Mamaroneck River were flooded to a depth of one foot. Along Chestnut Avenue basements were flooded to a depth of 5 feet causing severe content damage. Several homes along Winfield Avenue suffered first floor flooding when the Winfield Avenue Bridge was overtopped. If the Standard Project Flood were to occur along the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, approximately 300 acres would be inundated up to depths in excess of 16 feet.

The record flood of September 1975 produced stages in the Village of Mamaroneck approximately 1.5 feet higher than those produced during the June 1972 storm. Total flood damages from the September 1975 flood in the Village of Mamaroneck are estimated at $43,507,000 (October 1987 prices). More than 65 percent of these damages were suffered by the industrial and commercial establishments of the Village, particularly at the reach along the right bank of the lower Sheldrake River. This storm resulted in flood stages of up to 3 feet above the main floors of several of the industries in this reach. Again the hardest hit industrial plants along the Sheldrake River included Sealectro Corporation, and also Marval Industries (plastics), Elgene Chemicals, Westchester Light Company and Magnetic Media Corporation (electronics). Additionally, several industries which were not seriously affected by past floods also suffered damages from the September 1975 storm, including Sockolof Brothers (wood products), Philips Offset Company and Schrier Brothers (paper company). The residential areas of the Village were also severely flooded once again during this storm. Photograph No.s 1 - 3 depict flooding conditions in the problem area (pages 10A, 10B, and 10C).

2.5 LOSS OF LIFE

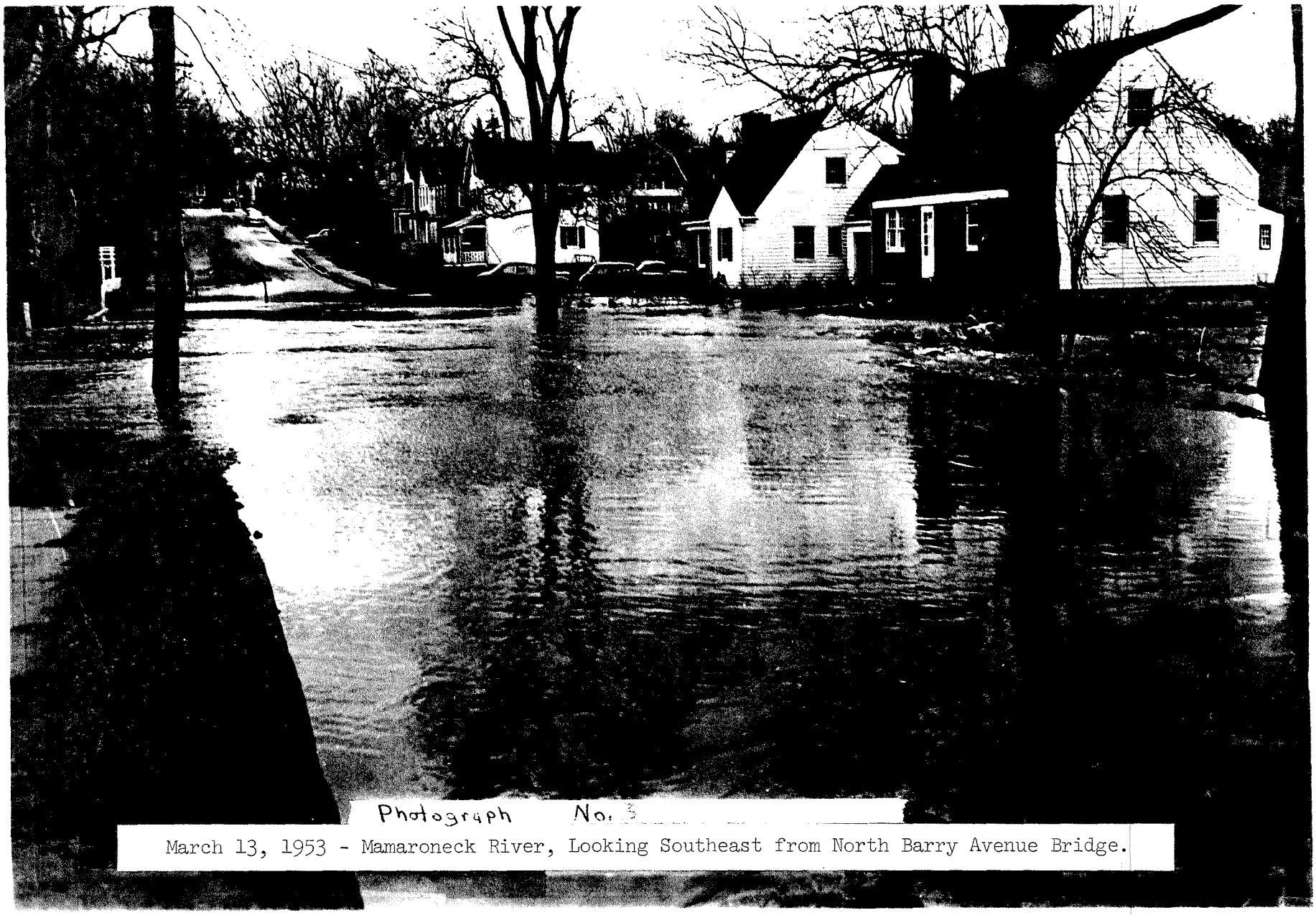
During the September 1975 flood of record on the Mamaroneck River, one person was drowned when the car he was traveling in was submerged. People were evacuated from areas, but precise records of the number of people evacuated or the length of time they were required to stay away from their homes are not available. However, Red Cross estimates indicated that hundreds of people were evacuated in Mamaroneck during the September 1975 flood.

Photograph No. 1
March 13, 1953
Waverly Avenue looking North from
Fenimore Road



Photograph No. 2

March 13, 1953 - Sheldrake River, Looking Northeast along N.Y.N.H.&H. Railroad Embankment from Fenimore Road.



March 13, 1953 - Mamaroneck River, Looking Southeast from North Barry Avenue Bridge.

3. STUDY ACTIVITY PRIOR TO AUTHORIZATION

3.1 FEASIBILITY STUDY

3.1.1 Plans Considered

General. Both structural and nonstructural plans were considered during the Feasibility Study. Nonstructural measures such as floodproofing, raising, or relocating existing structures, and subsequent flood plain management measures were uneconomical and were considered inappropriate in this already fully developed urban area. The initial array of structural measures considered included flood detention reservoirs, diversions of stream flow away from the primary damage areas, local protection measures such as levees floodwalls, and channel modifications and possible combinations of these measures.

Flood Detention. Detentions of floodwaters using one or more of the existing dams and reservoirs in the Mamaroneck and Sheldrake River drainage area was considered. On the Sheldrake River at the Larchmont Reservoir No. 2, a modified dam and reservoir would help to protect the upper reaches of the Sheldrake River in the Town of Mamaroneck, but would afford little flood attenuation in the Village. For similar reasons, possible detention areas at the Maple Moor Golf Course and Silver Lake areas on the Mamaroneck River were rejected as they would afford only limited benefits in the Village's flood problem area. Also on the Mamaroneck River use of the existing Westchester Joint Waterworks Reservoir as a flood detention measure was investigated and rejected because modifications to the existing dam and the need to raise the pool area to provide a significant flood water storage area would be too costly and would require large real estate acquisitions, road raising, and relocations while still calling for downstream flood control measures to provide adequate protection in the problem area.

Diversions. Measures to divert excessive stream flows coming down to the Village into culverts or tunnels before reaching the main flood problem areas were considered very possible because of the close proximity to the harbor and the existence of a reasonable gradient for gravity or pressure flow through conduits. Although engineeringly feasible, the high cost of constructing underground conduits limits the application of diversion measures to locations where they would be very effective in terms of flood carrying capacity, and where the overall length is the shortest. Several inlet locations were considered for diversion conduits that would open into Mamaroneck Harbor.

On the Mamaroneck River four diversion plans were examined. One plan would have an inlet at the downstream face of the New England Thruway Bridge and would extend 6,000 feet to the East Basin of the harbor to divert flows sufficient to provide 50 to

200 year protection. It would require tunnels ranging in diameter from 15.5 to 18.5 feet. This plan was eliminated as clearly economically unfeasible due to a high construction cost and the need for major downstream improvements to provide a 100 year level of protection. Similarly a diversion inlet even further upstream near Winfield Avenue was possible but economically unfeasible.

A third diversion 2,700 feet long from an inlet at the confluence with the Sheldrake River to an outlet just upstream of Boston Post Road was investigated to provide from 50-200 year protection ranged from 16 to 19 feet in diameter. To accommodate the diverted flow and the outlet structure extensive dredging in Mamaroneck Harbor would be needed in addition to the tunnel. Additional channel work would still be necessary as only partial protection would be afforded by the tunnel alone. The fourth diversion would begin at Jefferson Avenue and divert flows to a point just downstream of Halstead Avenue. This plan was considered impractical because the limited slope available between these two points would not yield enough flow diversion for a substantial reduction in flood heights.

Several diversion locations were possible along the Sheldrake River. One would begin at Larchmont Gardens Lake and exit below Boston Post Road into an open channel leading to East Creek. Another alignment diverted the high flows on the Sheldrake River to the West Basin of Mamaroneck Harbor. Both of these diversion plans were found to be economically unfeasible due to excessively high cost.

A diversion at Fenimore Road was found to be considerably less costly than the upstream diversion points because the topography along Fenimore Road would permit a major portion of the diversion conduit construction to be "open cut" instead of more costly tunneling procedures. This scheme, therefore, was not eliminated during the initial screening of plans, and was considered in combination with local protection works that would still be necessary to protect downstream damage areas.

Local Flood Protection Measures. Local protection measures were also investigated. These measures consisted of channel modification schemes, separately and in combination with limited levee and floodwall protection, to provide an overall 100 year level of protection. Three of the channel/levee plans differed primarily in the width of the channels which ranged from 50-70 feet wide on the Mamaroneck River below Jefferson Avenue and 30-45 feet from Jefferson upstream to the New York Thruway. The channel width varied along the Sheldrake River from 20-35 feet up to the Thruway. Plan 1 had the smallest channel width of these alternatives and Plan 3 the largest.

Another channel/levee plan was also considered (Plan 4), which was essentially the same as Plan 3, but with the addition of the diversion conduit on the Sheldrake River that would divert

high flows at Fenimore Road directly to the West Basin of Mamaroneck harbor, as previously described.

3.1.2 Intermediate Screening

The four plans described above and a levee/floodwall only plan were evaluated and compared in the Feasibility Study intermediate screening stage. A comparison of the net annual economic benefits showed that Plan 4 yielded the highest value. The tunnel feature of Plan 4 also had the advantage of making it possible to provide protection against floods up to a 200 year event on the lower

Mamaroneck River from Halstead Avenue downstream and even greater protection for the severe problem area near the confluence with the Sheldrake River.

All four plans were found to be acceptable to the local interests, but Plan 4 was preferred because of the reduced channelization required, which would also reduce real estate acquisitions and have less adverse environmental impacts along the Sheldrake River, while providing an increased level of protection.

Channel-modification-only plans were also investigated, but were eliminated because limited size channel improvements alone would provide a relatively low level of flood protection and larger channels would be economically unfeasible due to a very rapid rise in cost with increased size. The channels considered were Plans 1, 2, and 3 described above, but without the supplemental levee/floodwall measures. The largest plan, Plan 3, with channel sizes of 45 feet and 70 feet on the Mamaroneck River with 25 foot and 30 foot wide channels on the Sheldrake River, would provide only a 50 year level of protection on the Mamaroneck River and only 5 year level of protection along the Sheldrake River. Since the residual damages with the channel-only plans was very high, and since this plan already had the largest feasible channel widths without extensive relocations of existing development, and without additional bridge replacements including the Conrail Railroad bridge, the channel-only plans were economically inferior and were not considered complete enough solutions to the flood problem for this urban area.

3.1.3 Final Planning Iteration

A final iteration of plan formulation was performed in order to more fully optimize the outputs of each of the plans, compare their effects, and make a final plan selection. Final investigations for the Feasibility Report focused on three plans. These alternatives, with appropriate refinements and reasons for consideration, are described below:

Plan A - The NED Plan. This plan consisted primarily of Plan

4 (discussed above), and was selected as the National Economic Development (NED) Plan because it produced the highest net economic benefits. Final refinements to this plan included of the following:

a. The total diversion of the Sheldrake River at Fenimore Road. This additional diversion capacity up to the Standard Project Flood was preferred by local interests. It would provide greater reliability and reduce the flood risk in the worst damage area, near the confluence of the Mamaroneck and Sheldrake Rivers. It would also allow a higher degree of protection along the Mamaroneck River.

b. Reduction in channel width on the Mamaroneck River from 70 feet to 60 feet and a deeper bottom cut. This resulted in a reduced channel cost and minimized real estate requirements while providing a 200-year level of protection from the mouth to the Thruway and 100-year level of protection from the Thruway upstream to Winfield Avenue.

c. To reduce the adverse fish and wildlife impacts, in-stream mitigation measures developed with the U.S. Fish and Wildlife Service were incorporated, such as V-shaped pilot channels and log deflector and boulder fields.

Plan B - The EQ-Oriented NED Plan. This plan consisted of a combination of intermediate Plans 4 and 1, and included the Sheldrake diversion and the reduced channel width features of Plan 1. This alternative was designated the Environmental Quality-Oriented NED Plan, and would provide a 100-year level of protection. Raising the level of protection would require additional structural features which would diminish the responsiveness to the Environmental Quality (EQ) objective, and a reduced level of protection was not considered appropriate for the urban area. The plan included the acquisition of 16 residences and floodproofing 15 residences. Further coordination with the U.S. Fish and Wildlife Service resulted in the incorporation of additional mitigation measures similar to those in Plan A. (It is noted that under current guidelines, designation of an Environmental Quality plan is no longer required.)

Plan C - Channel/Levee Plan. Plan C was essentially the same as Plan 3 considered previously in the intermediate planning stage. This channel/levee plan, which provided 100-year protection without the diversion tunnel, was carried into the final planning because it represented a substantially different plan for comparison which was also economically feasible. It included the largest channel widths --approximately 70 feet in parts of the lower Mamaroneck River, 45 feet in the upper

Mamaroneck River and 25-30 feet on the Sheldrake River. Levees and floodwalls would be utilized in some areas as necessary to provide a 100-year level of protection. The plan also included the acquisition of one industrial, two commercial and four residential structures. The plan did not include a diversion tunnel.

3.1.4 Plan Selection

The three final plan alternatives, Plans A, B, and C were compared and evaluated. The results of this analysis are summarized below (December 1976 prices):

	PLAN A	PLAN B	PLAN C
TOTAL COST	$32,700,000	$29,550,000	$21,800,000
NET ANNUAL BENEFITS (Annual Benefits less Annual Costs)	$ 725,000	$ 533,000	$ 435,000

Plan A was selected for recommendation for construction authorization. Plan A carried the highest cost, but produced the most net annual benefits. In addition, Plan A required the least amount of real estate easements with no acquisition of structures, provided the highest level of protection, and was favored by the State and local interests. The Village also preferred the total diversion of flows on the Sheldrake River because it would greatly reduce the risk of damages from flood events that might exceed the design level. Residual damages would be nearly completely eliminated with Plan A.

3.2 PRECONSTRUCTION ENGINEERING AND DESIGN

The elements of Plan A for the Village of Mamaroneck were recommended to Congress in 1983. Detailed design of the recommended plan had begun under the Continuation of Planning and Engineering Program in order to be able to move more quickly toward construction in anticipation of eventual construction authorization by Congress. When the project was authorized in the Water Resources Act of 1986, the detailed design effort continued under the Preconstruction Engineering and Design (PED) program.

4. INVESTIGATIONS FOR THE GENERAL DESIGN MEMORANDUM

4.1 OVERVIEW OF INVESTIGATIONS

The following investigations and studies were conducted by the Corps of Engineers during Planning, Engineering and Design (PED) for the authorized flood control project. The extent of field and office studies conducted in connection with these investigations, including hydrology, hydraulics, economics, environmental, cultural, geology and soils, structural design, and other disciplines are outlined in this Main Report and are discussed in detail in Appendices A through J. Some of the special studies are discussed below. Major investigations are discussed in subsequent sections.

a. Aerial photography and field control surveys were performed in December of 1982 in order to develop topographic mapping and stream profiles and cross-sections for the Mamaroneck and Sheldrake flood control project area. The topographic mapping was prepared at the scale of 1 inch = 30 feet, with 1 foot contour intervals, utilizing National Geodetic Vertical Datum which also utilized a 1 foot contour interval (1929 Adjustment) and established benchmarks. The 150 foot grid was based on the New York State Coordinate System, East Zone. Stream cross-sections were prepared through a combination of field surveys for the channel and bridge sections, and photogrammetric procedures for overbanks. A utility survey was also performed in Spring, 1985 to assess project required relocations.

b. The subsurface exploration was conducted at various times throughout the preconstruction engineering and design effort. Drill holes, test pits, auger holes, permeability tests, pressure tests, and borehole television investigations as well as various lab tests were conducted at different times in order to evaluate the foundation conditions. These investigations were performed throughout the project area which included the Upper and Lower Mamaroneck, the present Sheldrake River channel, and the proposed Sheldrake River diversion locations. This extensive soil testing helped to define the soil and foundation parameters for soil analysis and design of the diversion tunnel, retaining walls, the modified channel slope stability, and bedding material for riprap. See Appendix C - Geology and Soils for a more detailed description of the drilling and laboratory testing programs.

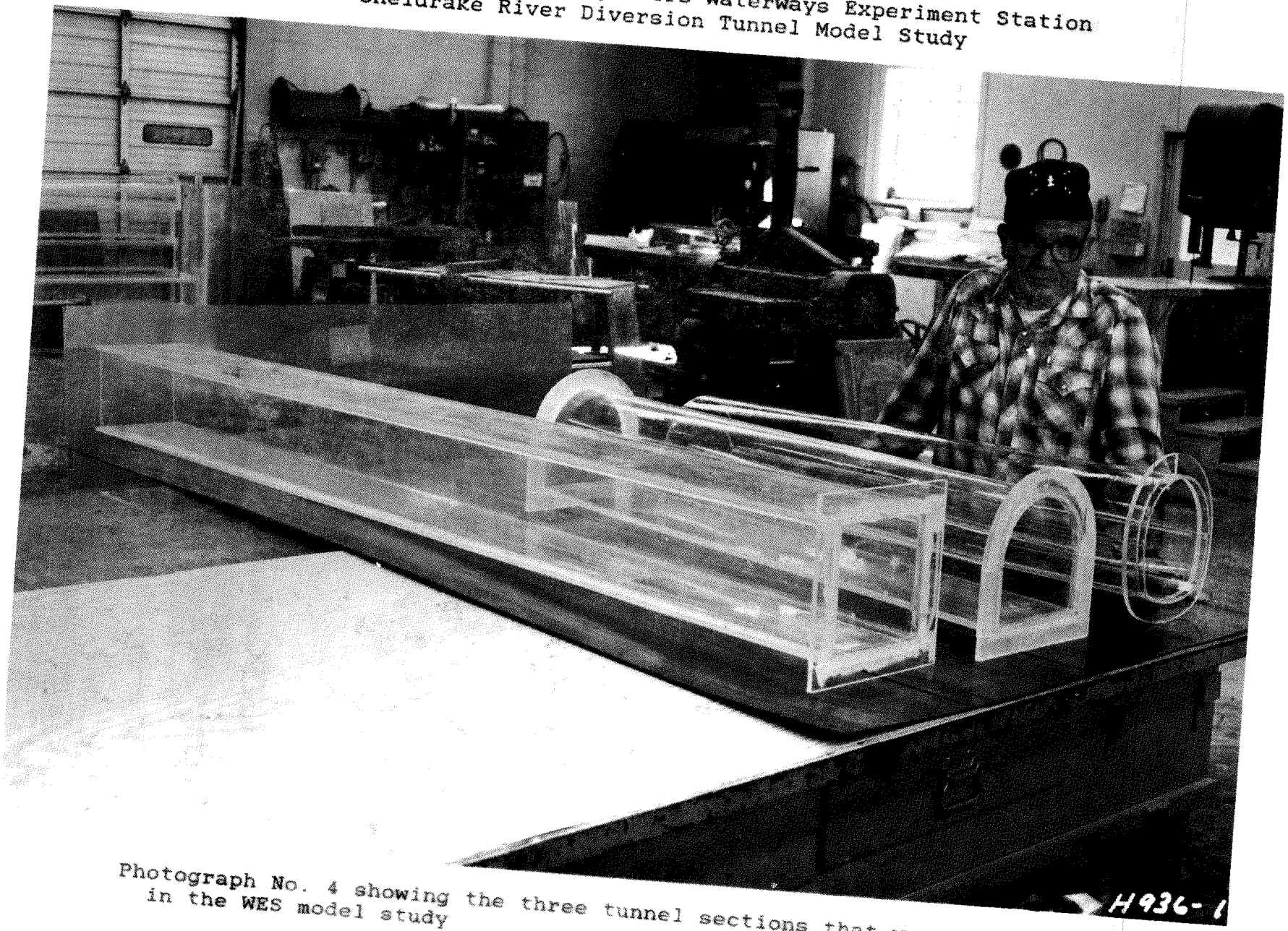
c. Environmental and cultural resource concerns were also investigated. Initially a review of existing documentation was done. The Final EIS, dated January 1979, was filed with EPA in March 1981. Since the preparation of the Final Environmental Impact Statement (FEIS), based on the receipt of the US Fish and Wildlife Service's most recent Planning Aid Reports (i.e. March 26, 1982, and February 9, 1984) there have been no major changes in existing environmental resources for the study area. The main purpose of the environmental studies for the GDM was to examine and review recent water quality testing conducted within or near this study area. This review was utilized to identify possible water quality concerns or problems prior to the preparation of a draft 404(b) (1) evaluation report.

A review of the cultural resources survey report that was prepared in January 1977 for the New York District, Corps of Engineers entitled, "Reconnaissance Level Survey of Cultural Resources Mamaroneck and Sheldrake River Basin and Byram River Basin Flood Control Projects" was made. Conclusions reached by that report indicated that there were no cultural resources present in the project area which would be eligible for listing on the National Register of Historic Places and would be negatively affected by proposed project actions. Further checks (as of May 3, 1988) during the GDM showed no additions to the National Register that would be adversely impacted by the flood control project. A more detailed description of the environmental and cultural resource aspects of the project can be found in Appendix F - Cultural Resources and in Appendix G - Environmental Conditions.

d. Real estate studies were conducted in February 1984 and October 1987 to assess the current value of temporary and permanent easements, acquisitions, and other costs associated with the real estate required for access to, construction of, and operation and maintenance of the Mamaroneck and Sheldrake River flood control project. The resulting appraisal (Gross Value Estimate) is presented in Appendix J - Real Estate.

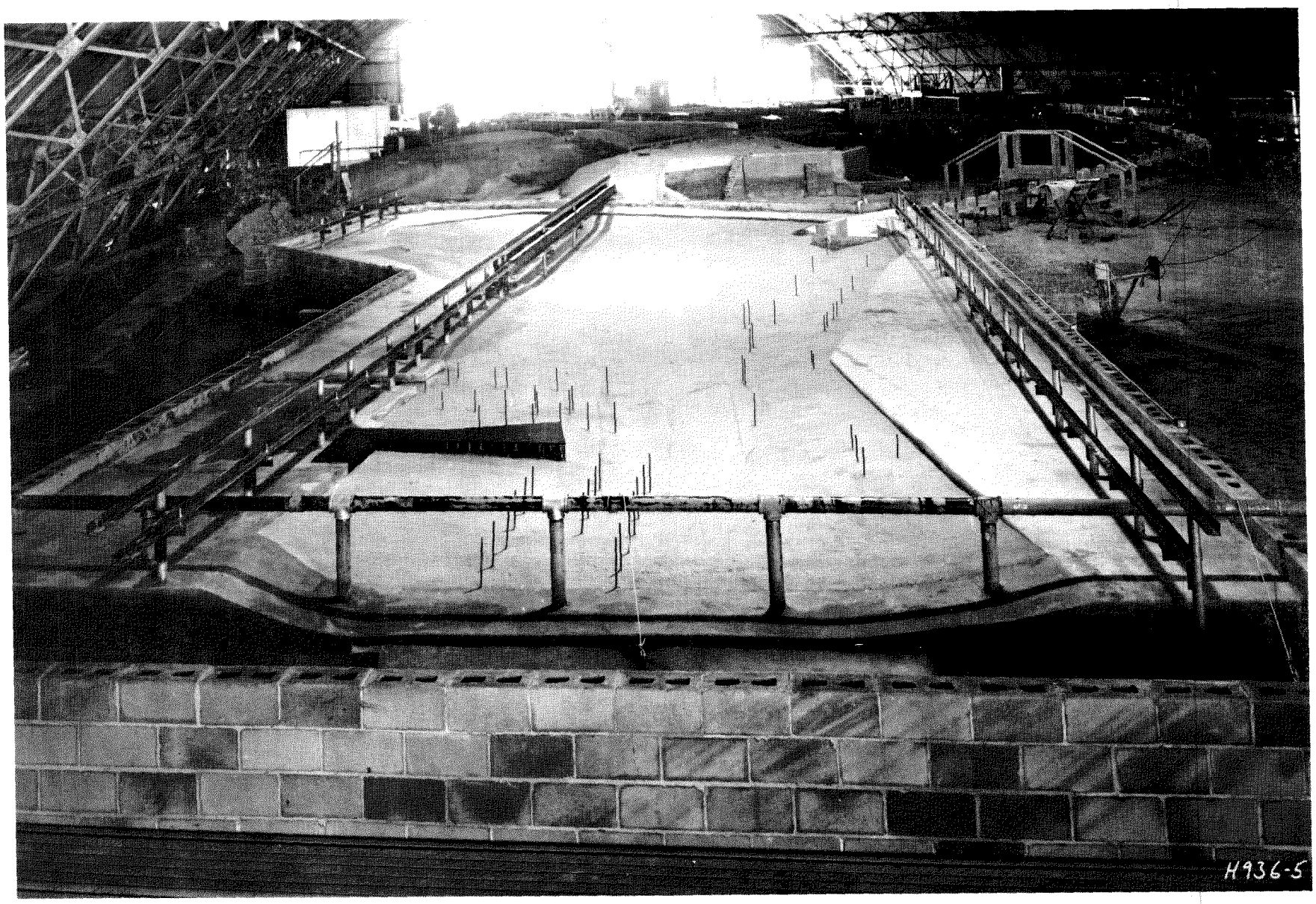
e. Studies were conducted on both the Mamaroneck and Sheldrake Rivers, the diversion tunnel and Mamaroneck Harbor to identify any sediment related problems and project impacts on the sedimentation process. The studies also evaluated lateral and vertical stability. The studies involved field investigations, measurements and analysis, a historic topographic survey investigation and comparison, and sediment transport computations. The studies found that there would be no significant project impacts on sedimentation in the streams or the harbor. A summary of the procedures and conclusions of the sediment studies can be found in Appendix B - Hydraulics.

United States Corps of Engineers Waterways Experiment Station
Sheldrake River Diversion Tunnel Model Study



Photograph No. 4 showing the three tunnel sections that were constructed in the WES model study

DIVERSION TUNNEL MODEL PHOTO



Photograph No. 5 Shows the Harbor Basin Simulated

f. A study was also performed to test the proposed Sheldrake River diversion tunnel. The Sheldrake River diversion tunnel was modeled at the U.S. Army Corps of Engineers Waterways Experiment Station (WES) in Vicksburg, Mississippi utilizing a 1:25 scale physical model. The model reproduced about 400 feet of approach channel, the ogee drop structure and converging approach of the tunnel inlet, the 3550 foot tunnel, the stilling basin at the downstream end of the tunnel, and a portion of the West Basin of Mamaroneck Harbor. Details of the model, tests, results and conclusions are contained in the WES report "Sheldrake River Tunnel, Mamaroneck, N.Y., Hydraulic Model Investigation," published in 1986. The WES physical model study gives a complete description of the system's performance. Tests confirmed the tunnel's original design and recommended various improvements, largely in the tunnel transition and stilling basin dimensions. Photograph Nos. 4 and 5 show the physical model. For more detailed information, refer to Appendix B - Hydraulics.

g. Economic studies were made for this GDM, aimed at verifying and updating previous flood damage information and conducting benefit evaluations for the plans considered in the GDM. An updated structure inventory was completed in 1982, and the damage potential was verified in 1983 and again in 1986. Other flood related damage and benefit categories were investigated and updated as appropriate. The studies found only minor changes in the economic data base, with the level and characteristics of development in the problem areas essentially unchanged. More detailed descriptions of the economic analyses are contained in Appendix H - Economics (Flood Damages and Benefits).

4.2 HYDROLOGY AND HYDRAULICS

4.2.1 General

Flood control improvements for the Mamaroneck and Sheldrake River Flood Control Project area were designed in accordance with prescribed Corps of Engineers procedures for development of design discharges, channel profiles, and channel invert and bank protection requirements. All criteria and results of these analyses are discussed in detail in Appendix A - Hydrology and Appendix B - Hydraulics.

4.2.2 Hydrology

The hydrologic analyses of the Mamaroneck and Sheldrake River Basin utilized the HEC-1 Flood Hydrograph Package. The hydrologic

model was calibrated by reproducing four historical flood events at the U.S. Geological Survey Stream Gage on the Mamaroneck River at Halstead Avenue. The storms used in the calibration were the June 1972, September 1975, November 1977, and April 1980. The September 1975 flood was the flood of record. The model reconstitutions of the Mamaroneck Gage flood hydrographs were of comparable magnitude and timing. A peak discharge vs. frequency analysis was developed through a statistical analysis of the yearly peak discharges at the Mamaroneck River Gage. Because of the urbanization trends in the basin, a detailed review was made of the period of record annuals peaks, precipitation records and the land use and population data. This analysis indicated that the Mamaroneck River Basin did not experience any significant urbanization since 1955. Because of this, an analysis was made of all storms previous to 1955. An upward urbanization adjustment had to be made to the September 1944 flood to reflect post-war development effects. The frequency curve was developed using procedures recommended in, U.S. Water Resources Council Bulletin 17B, "Guidelines for Determining Flood Flow Frequencies." The computer model, HEC-1, was then used to simulate the following hypothetical storms: 1, 2, 10, 50, 100, 500 year and the Standard Project Storm. The hypothetical storm rainfall was developed from technical paper No. 40, "Rainfall Frequency Atlas of the United States." The infiltration loss rates for the hypothetical storm were adjusted until the HEC-1 computed peak flows matched the observed frequency curve at the Mamaroneck Gage.

The hydrologic model was also used to develop the improved condition storage vs. discharge relations in the improvement reaches. A 200 year flood was used to design the channel and the Standard Project Flood was used to design the Sheldrake Diversion tunnel. While the with-project flows increased as much as 31 percent, the increase in design stages was kept to a minimum with only a small cost increase. A detailed description of the hydrologic analysis can be found in the Hydrology Appendix.

4.2.3 Hydraulics

Flowline computations were made to develop the hydraulic radient of the streams in their existing and improved conditions for the purpose of determining their hydraulic characteristics and establishing the extent of protection required. The computations are based on starting at a point of known energy (Mamaroneck Harbor) and determining the changes in the hydraulic gradient by the application of the laws of continuity and conservation of energy.

An analysis was developed to determine the correlation between tailwater conditions in the harbor and flood flows. It was concluded that flowline computations for the Mamaroneck River and the diverted Sheldrake River should be started using a 1 year tidal tailwater of 6.7 feet N.G.V.D.

Flowline computations were accomplished with the use of the HEC-2 "Water Surface Profiles" computer program. The computations were calibrated by using April 1983 floodmarks. Manning's "n" values were adjusted until the computed water surface elevations were reasonably close to the observed April 1983 levels. The computations were further adjusted and verified through comparison to two other events.

Analysis of the flowlines indicates that existing flooding along the Mamaroneck River is caused by a low channel capacity, two 90 degree bends forming an "S" turn at the Station Plaza Bridge, and constrictions at various bridges. Flooding along the Sheldrake River is due to a low channel capacity, and backwater from the Mamaroneck River.

The Sheldrake River diversion tunnel was modeled at the U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi utilizing a 1:25 scale physical model. The model reproduces some of the approach channel, the tunnel inlet structure, the tunnel, the stilling basin at the downstream end of the tunnel, and a portion of the West Basin of Mamaroneck Harbor.

The model studies were conducted with both rough and smooth Manning's "n" values in order to account for capacity and energy dissipation needs. Design of the selected plan was therefore based on both capacity and velocity considerations.

In addition to the above improvements, in-stream mitigation measures developed with the U.S. Fish and Wildlife Service have been incorporated into the Mamaroneck and Sheldrake channel designs.

4.3 GEOTECHNICAL AND SOILS INVESTIGATIONS

Appendix C contains detailed descriptions of the geological and soils design data, a description of the foundation conditions along the alignment of the improvement, the soils design for cut channel slopes, analyses for channel bedding, riprap, and slope stability, structure foundations and the Sheldrake River diversion tunnel with inlet and outlet structures, and a discussion of the availability of construction material and disposal areas. All data were obtained from geological records, field investigations and subsurface exploration, and laboratory soils and rock testing.

The geological, soil, and materials investigations consisted of a study of all available geologic information, topographic, geologic and tectonic maps, site reconnaissance, and a comprehensive review of available subsurface exploration data. This review included extensive efforts to research and compile the data collected from previous reports. Upon completion of review of all available data, additional investigations for this proposed plan were conducted. The most recent investigations in 1987/1988 consisted of borings along the proposed Mamaroneck and Sheldrake

River improvements and the diversion tunnel and a study of the groundwater conditions in the rock along the Sheldrake River diversion tunnel.

The lower courses of the Mamaroneck and Sheldrake Rivers along the general alignment of the considered improvements in Mamaroneck, New York flow over moderately thin alluvial deposits. Bedrock under the channels and along the valley slopes is of metamorphic origin ranging in age from pre-Cambrian to Ordovician. The alluvial deposits are variable in composition and are predominantly gravelly sand with some boulders and a minor amount of clay and silt. Along the Mamaroneck River channel, bedrock crops out at several localities and it is estimated that its maximum depth below the surface is about 40 feet. Lesser outcrops are observed along the Sheldrake River in its lower course, but upstream from Larchmont Garden Lake, bedrock is generally exposed or under a thin sheet of overburden. The findings of the foundations, soils, and geologic studies were generally the same as in the Feasibility Study.

The overall project site is geologically feasible for construction of the proposed channel improvement, retaining walls, and bridge replacements. Some adverse foundations conditions were found, in particular, poor soil conditions near the sea wall and in the West Basin of Mamaroneck Harbor, where the outlet structure and stilling basin will be located. Due to the poor bearing capacity of the material in some areas, additional foundation solidification was designed for. The tunnel outlet structure and the weir structure on the Lower Sheldrake River is supported on piles, and some retaining walls are supported on tremie concrete in the vicinity of Jefferson Avenue.

This information along with the results of the investigations and their impacts on project construction is presented in Appendix C - Geological and Soils Investigations.

4.4 STRUCTURAL DESIGN

4.4.1 General

The recommended flood protection plan in the Mamaroneck and Sheldrake River Basin includes: channel work which includes retaining walls, sheet piling, channel realignment, removing existing fencing, underpinning of embankments, relocation of existing utilities (sewer mains, light boxes, etc.); bridge work which involves the replacement or removal of several bridges to achieve the hydraulic capacity desired; and tunnel work which involves the redirection of the Sheldrake River into a diversion tunnel which discharges into the West Basin of Mamaroneck Harbor.

4.4.2 Retaining Structures

The retaining structures consisted of L-type and T-type retaining walls, concrete-faced sheet pile retaining walls, and concrete channels. The use of L-type versus T-type retaining walls was based generally on available space for construction (proximity to adjacent structures or roadways). The designs are for sections of reinforced concrete cantilever type (both L-type and T-type) and tied back L-type retaining walls, steel sheet pile retaining walls with concrete facing and concrete channel at various locations along the proposed channel modifications of both the Mamaroneck and Sheldrake Rivers. Reinforced concrete cantilever type retaining walls are required at various locations interspersed along the length of both the Mamaroneck and Sheldrake Rivers improvement. The concrete faced steel sheet pile walls are used to create an endwall at the diversion channel outlet and as a cut-off wall on the sloped bank between the Mamaroneck River and the New England Thruway. The concrete channel sections are used for both the flumed intake and outlet structures.

4.4.3 Diversion Tunnel

The diversion tunnel consists of a box culvert, transition culvert and a horseshoe shaped tunnel. The designs are for a reinforced concrete box culvert and transition culvert section to be constructed utilizing cut and cover methods and for a horseshoe tunnel that will be for the most part driven full face utilizing conventional drill and blast techniques. The design of the tunnel is in accordance with applicable portion of the relevant Engineering Manuals. Design sections were selected as representative of the conditions encountered along the tunnel alignment. Various applicable loading conditions were analyzed, as well as uplift and the magnitude of settlement. The design analysis considered temporary support during construction such as the use of steel ribs and sheeting and the design of the permanent concrete liner in the horseshoe shaped, rock cut tunnel. All analyses were based on the particular soil, rock and water conditions evaluated section-by-section as part of the geotechnical investigations. Inlet and outlet structures are also provided as a part of the diversion tunnel, and the design of these structures is also contained in SECTION I of Appendix D.

4.4.4 Local Bridges

The local bridge work involved the Tompkins Avenue, Ward Avenue, Halstead Avenue, Station Plaza, Hillside Avenue, and Winfield Avenue bridges and the Valley Place sewer bridge. The designs are for new bridges as required to replace existing local bridges over the proposed alignment of the Mamaroneck River. The proposed superstructures consist of either prestressed concrete I-beams, box beams or slab units. The box beams and slab units are composite with the concrete deck overlay whereas the I-beams are composite with the spanned concrete deck slab. The beams were

considered composite with the deck. The proposed steel superstructures of the sewer bridge was designed for dead loads only. The abutments design considered appropriate loading cases, and were analyzed for factor of safety for overturning, for sliding stability and for base pressures. Steel reinforcing was also designed.

In conjunction with the construction of the outlet structure, the installation of a pedestrian bridge will be required to provide for continuance of an existing walkway in the park. There are no bridge replacements necessary along the Sheldrake River project area.

4.4.5 Other Structures

A debris control structure will be placed in the Sheldrake River at the Rockland Avenue Bridge to trap objects entering the project area and/or the diversion tunnel. A small concrete weir will be located across the Sheldrake River at Columbus Park. An existing stream flow gage station on the Mamaroneck River just below Halstead Avenue will be replaced with a new gage station located just downstream of the New England Thruway.

Design details, criteria and computations for these structural elements are contained in Appendix D - Structural Design.

4.5 COMPARATIVE STUDIES

4.5.1 Comparison to Feasibility Study

During the Preconstruction Engineering and Design effort, a review of the plans considered during the Feasibility Study was made. The review found that only minimal field and technical changes affecting the problem (area) had occurred which indicated that the selection of the plan recommended to Congress was still valid. The confirmation was based on both site and analytical investigations. The site visits confirmed that no Federal or non-Federal measures had been constructed that would change the flow capacity of the waterways. The floodplain structures were essentially the same as existed during the Feasibility Study. About 30 structures not previously accounted for were added to the economic data base, but no new major developments had occurred. Environmental and cultural conditions also had not changed. Technical investigations showed little overall change. An increase in overall improved condition flows are offset in the hydraulic analysis due to greater efficiency of the hydraulic model. Estimates of expected annual damages showed a small increase in the flood damage potential. The scope of the recommended plan did not change. The size of the recommended improvements to achieve the desired protection required little

overall change in project dimensions. The overall estimated cost of the recommended plan changed approximately 13 percent (after updating to October 1988 price levels). In view of the minimal changes in the flood problem area, the damage potential, the environmental conditions, and in the recommended plan, the plan formulation process and the plan selection basis in the Feasibility Study remains valid.

4.5.2 Optimization

An evaluation of various design levels of protection was also considered during the Preconstruction Engineering and Design study. The variations included a range of channel modification sizes with the recommended SPF tunnel, and also a smaller 100 year tunnel. The analysis showed that the recommended plan yields the highest net benefits confirming its designation as the NED plan. Information on the evaluation of the various plan design levels is included in Table 2.

5. THE RECOMMENDED PROJECT

5.1 DESCRIPTION OF PLAN

5.1.1 General

The plan of improvement for flood control for the Mamaroneck and Sheldrake Rivers Project consists of the following features. The plan on the Mamaroneck River provides for modifying approximately 10,400 feet of river channel, constructing about 7,200 feet of retaining walls, replacing six bridges, one bridge removal and utility relocations. On the Sheldrake River, modifications include a diversion tunnel about 3,550 feet in length from its inlet at Fenimore Road to the west basin of Mamaroneck Harbor, channel modification along approximately 4,200 feet, and a retaining wall for about 900 feet. These improvements will substantially reduce flood damages for approximately 374 residences and 200 businesses which are located predominantly in the Village of Mamaroneck.

The following description of the plan of improvement for the flood control project for the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, New York is broken down into five sections: The Lower Mamaroneck River, the Upper Mamaroneck River, the Lower Sheldrake River, the Upper Sheldrake River, and the Sheldrake River Diversion Tunnel. For each section, the following project features are discussed: physical limits (stationing), average channel bottom width, channel shapes, average side slopes, average wall height, length and layer thickness of riprap lined channel, average depth of fill or cut, and other pertinent project details. The project description addresses each stream section proceeding from the downstream end to the upstream end. The left and right channel bank are defined as looking downstream.

Table 3 presents a more detailed description of the plan of improvement, broken down into subsections defined by points where the channel shape changes or where a bridge is encountered. Table 4 shows additional data on the retaining walls, and Table 5 shows additional information on riprap. Further background may be found in Appendices B (Hydraulics), C (Geology and Soils Investigations), D (Structural Design), and G (Environmental Conditions). For additional information on the plan of improvement, refer to the text of Appendix E - Cost Estimates.

In general, the rationale for providing a particular type of improvement in any given area (i.e., semi- or full trapezoidal sections, L-type or T-type vertical concrete walls) was based on space considerations. When space constraints preclude the employment of a trapezoidal section, a T-wall is used to stabilize the embankment; if existing structures preclude use of a T-wall, an L-wall is utilized. Walls are also to be used under bridges as abutments. The project's walls act as earth retaining walls and not flood walls.

5.1.2 Lower Mamaroneck River

General. This portion of the Mamaroneck River extends from the lower project limit, 600 feet downstream of the Tompkins Avenue Bridge (Station 17+00), to just upstream of the Halstead Avenue Bridge (Station 41+40), a distance of 2,440 feet. The level of protection in this section will be 200-year.

Channel. The channel will be widened to produce an average bottom width of 60 feet throughout this reach, except for a 60-foot section near Tompkins Avenue. The existing channel bottom will be deepened between 1 and 3.5 feet. The modified channel will vary in shape, transitioning intermittently from trapezoidal to semi-trapezoidal to rectangular. The side slopes of the trapezoidal and semi-trapezoidal sections range from 1V:2H to 1V:2.5H. Station limits of the transitions between specific channel shapes and particular side slopes are detailed in Table 3. For locations and physical descriptions of retaining walls refer to Table of Retaining Structures in Table 4.

Bridges. The Tompkins Avenue, Ward Street, Valley Place Sewer Bridge, and Halstead Avenue Bridges will be replaced.

Erosion Protection. Riprap will be placed intermittently throughout this river section, and will include a total length of 275 feet of 12-inch layer, 190 feet of 18-inch layer, 790 feet of 24-inch layer, and 140 feet of 36-inch layer riprap. (See Table 5 for specific limits of riprap placement.)

Relocations. Modification and relocation of existing utilities including water, sewer, gas, and power line will be necessary. In addition, the USGS gage station currently located 200 feet upstream of the Valley Place Sewer Bridge (Station 39+50) will be removed and replaced with a new gage station located at River Street, 750 feet downstream of the New York Thruway (Station 80+62).

5.1.3 Upper Mamaroneck River

General. This portion of the Mamaroneck River extends from the upstream limit of the Lower Mamaroneck River at Halstead Avenue (Station 41+40) to a point 240 feet upstream of the Winfield Avenue Bridge (Station 121+20), a distance of 7980 feet. The level of protection in this section will be 200-year.

Channel. The average channel bottom width between the Halstead Avenue Bridge (Station 41+40) to the Jefferson Avenue Bridge (Station 48+00) will be 60 feet. The channel will be widened to produce an average bottom width of 50 feet between

Jefferson Avenue (Station 48+00) and New Barry Avenue (Station 66+80). From this point, upstream to the project limit, the channel will be widened to an average bottom width of 45 feet. In addition, the stream will be realigned, areas of the abandoned channel will be filled and the channel bottom will be deepened by up to 4 feet. The majority of this river section will be trapezoidal in shape but will also contain intermittent sections of semi-trapezoidal channel and rectangular channel. The side slopes of the full trapezoidal sections are generally 1V:2.5H but vary from 1V:2H to IV:2.5H in several transition sections.

Pilot Channel. A V-shaped pilot channel meandering throughout the bottom of the channel will start at the Station Plaza Bridge (Station 43+40) and continue upstream 1360 feet, gradually increasing in depth until it reaches its maximum depth of 1.5 feet at a point 170 feet downstream of the Hillside Avenue Bridge (Station 57+00). It retains this depth and continues upstream to a point 550 feet downstream of the Winfield Avenue Bridge (Station 114+50) where it tapers down to a zero depth at a point 200 feet downstream of the Winfield Avenue Bridge (Station 116+50). The total length of the pilot channel is 7315 feet. For additional mitigation measures in this reach, see Table 3 in the main body.

Retaining Walls. For location and physical description of retaining walls in this reach refer to Table of Retaining Structures in Table 4.

Bridges. In this reach, the Station Plaza Road Bridge and the Hillside Avenue Bridge will be replaced and the Winfield Avenue Bridge will be removed.

Erosion Protection. Riprap will be placed intermittently throughout this river section, and will include a total length of 480 feet of 12-inch layer, 500 feet of 18-inch layer, and 190 feet of 30-inch layer riprap and 500 feet of 24-inch layer riprap to line the area near Jefferson Avenue where silty material will be exposed by the excavation for the channel. (See Table 5 for specific limits of riprap placement.)

Relocations and Removals. Modification and relocation of existing utilities including water, sewer, gas, and power lines will be necessary. The USGS gage station currently located 20 feet downstream of the Winfield Avenue Bridge (Station 118+80) will be removed.

5.1.4 Lower Sheldrake River

General. This portion of the Sheldrake extends from its confluence with the Mamaroneck River near the Station Plaza Bridge, to Fenimore Road. This river section includes 2800 feet of filled channel between Mamaroneck Avenue and Fenimore Road to provide local drainage and a weir structure for environmental

mitigation 200 feet upstream of its confluence with the Mamaroneck River. No net loss of usable park land will occur at the confluence. The level of protection in this section will be 200-year.

Channel. The improved channel will be fully trapezoidal in shape with 1V:3H side slopes. The existing average channel bottom width of 10 feet will be maintained. The existing channel will be filled in an average depth of one foot to regrade the lower Sheldrake channel bottom to maintain positive drainage and prevent stagnation of water.

Erosion Protection. A 12" layer of riprap will be placed for a distance of 30 feet downstream of the concrete weir.

Retaining Walls. There will be no retaining walls constructed in this river section.

5.1.5 Upper Sheldrake River

General. This portion of the Sheldrake River extends 2200 feet from the tunnel intake structure at Station 39+60 to the N.Y. Thruway at Station 62+00 with channel clearing and snagging extending for an additional 700 feet at station 69+00 upstream of the N.Y. Thruway to the Larchmont Gardens Dam at Station 69+00. The Sheldrake River from the tunnel intake structure to the Rockland Avenue Bridge (Station 53+50), provides essentially an SPF level of flood protection. Upstream of the Rockland Avenue Bridge to the New York State Thruway, the level of protection will be 200-year.

Channel. Channel modifications will be completed from the tunnel intake structure to the Rockland Avenue Bridge. The channel will be widened and deepened (the depth of cut will range from 1 to 2.5 feet) with a 40 foot bottom width. The modified channel will be trapezoidal in shape for a total length of 1340 feet, with side slopes ranging from 1V:2H to 1V:2.5H.

From the Rockland Avenue Bridge upstream through the Larchmont Gardens Dam, 700 feet upstream of the New York Thruway, clearing and snagging will be performed. No major channel modifications will be done in this area.

Pilot Channel. A V-shaped pilot channel with a 1.5 foot depth and 1V:3H side slopes will be provided. This pilot channel will meander within the bottom of the channel, and will extend from a point 550 feet upstream of Fenimore Road (Station 41+00) and continue upstream to the Rockland Avenue Bridge (Station 53+00), a total length of 1200 feet.

Retaining Walls. For the location and physical description of retaining walls in this reach refer to the Table of Retaining Structures, Table 4.

Erosion Protection. Riprap will be placed intermittently throughout this river section, and will include a total length of 190 feet of 12-inch layer, 275 feet of 18-inch layer, 630 feet of 24-inch layer, and 80 feet of 36-inch layer of riprap.

5.1.6 Sheldrake River Diversion Tunnel

General. The Sheldrake River Diversion Tunnel is designed to carry the entire river flow up to the Standard Project Flood. The tunnel consists of a box culvert section, a horseshoe shaped rock tunnel section, a transition and inlet and outlet structures. The tunnel will have an overall length of 3,550 feet, excluding inlet and outlet structures. The tunnel will divert the Sheldrake River flows away from the downstream Sheldrake, Columbus Park, and the Mamaroneck River below the railroad. This will also some what reduce the flooding effects in the area of Jefferson Avenue. The largest flood of record (September 1975) is a low percentage of the Standard Project Flood (42 percent). Therefore this is 2.38 times the discharge capacity of the September 1975 flood.

Outlet Structure. The tunnel outlet structure is 212 feet long, contains a stilling basin, and a concrete flume section and joins the West Basin Mamaroneck Harbor with the lower extent of the horseshoe-shaped rock tunnel. The stilling basin dissipates the high speed energy of the water coming out of the tunnel in a specific location which is designed to withstand that high energy.

Horseshoe Shaped Section. The horseshoe shaped rock tunnel extends from Station 1+50 to a point 1250 feet upstream of Stanley Avenue (Station 19+67), has a 17.5 foot diameter, and is 1817 feet long. Constructed using drill and blast because it is too deep for cut and cover.

Transition Section. The 108 feet long transition section extends from Station 19+67 to a point 200 feet downstream of the New Haven Railroad (Station 20+75), and links the 17.5 diameter horseshoe tunnel to the 16.25 feet square box culvert cut-and-cover section.

Box Culvert Section. The 16.25 feet square box culvert cut-and-cover section extends from Station 20+75 to a point 150 feet upstream of Fenimore Road (Station 37+00), and is 1625 feet long.

Inlet Structure. The 260-foot long tunnel inlet structure extends from Station 37+00 to a point 400 feet upstream of Fenimore Road (Station 39+60), the upstream limit of the tunnel intake structure.

Walls. For location and physical description of the walls for this section refer to the Table of Retaining Structures, Table 4.

Erosion Protection. Riprap protection will be provided at the upstream inlet and just below the stilling basin.

Utilities. Modification of existing utilities including water, sewer, gas, and power lines will be necessary.

5.2 PROJECT ACCOMPLISHMENTS

The plan of improvement for the Mamaroneck and Sheldrake River flood control project in the Village of Mamaroneck will achieve the following objectives. It will provide a 200-year level of flood protection for the Lower and Upper Mamaroneck River sections, as well as for the Lower Sheldrake River and the Sheldrake above the Rockland Avenue Bridge. The Upper Sheldrake River from Fenimore Road to the Rockland Avenue Bridge as well as the Sheldrake River Diversion Tunnel are designed to safely convey the Standard Project Flood.

For a 100-year storm, the plan of improvement will lower the water surface elevation by an average of approximately 8 feet in the Lower Mamaroneck, by 14 feet at the Mamaroneck and Sheldrake River confluence, and by 7.5 feet on the Upper Mamaroneck. On the Sheldrake, the plan of improvement will lower the water surface elevation by 13 feet, along the Lower Sheldrake and by 13 feet in the Upper Sheldrake.

The channel modifications on the lower Mamaroneck River downstream of the Railroad serves to reduce flooding by increasing the flow carry capacity of that portion of the River. The increased capacity in this area will also produce a small reduction in flood stages in the Columbus Park area. The project in this area consists largely of a widened channel with concrete lined retaining walls. The channel is as wide as possible without requiring significant acquistion of homes and buildings.

In order to provide the 200 year level of protection for this urban area, the Sheldrake River diversion tunnel reduces the flow that would pass through the lower Mamaroneck River by one-third. The channel modifications and bridge replacements along the Mamaroneck River from the Metro North Railroad to the upper limit of the project just upstream of Winfield Avenue reduce the flood stages. This area also benefits from the lowered backwater conditions from the channel work in the lower Mamaroneck and especially by the reduced flows allowed with the diversion tunnel.

On the Sheldrake River the diversion tunnel will carry all its flow away to the West Basin of Mamaroneck Harbor and eliminating its destructive effects on the lower Sheldrake River

from Fenimore Road to Columbus Park. The provision of flow capacity up to the Standard Project Flood permits the upper Sheldrake River channel to provide a high level of protection with a minimum amount of channel modification. From Rockland Avenue upstream to the project limit only clearing and snagging is necessary. The overall project functions passively without the need for specific actions by a local operator.

5.3 PROJECT COSTS

5.3.1 Estimate of First Cost

The estimated first cost of the plan of improvement is $67,099,400, of which $50,324,600 is Federal and $16,774,800 is non-Federal. The non-Federal share includes for lands, easements, rights-of-way and relocations and a cash contribution of $4,305,700.

The Federal and non-Federal first costs are summarized by feature in Table 6. Detailed cost estimates of the plan of improvement are contained in Appendix E - Cost Estimates. The construction cost estimates are based on October 1987 price levels. The price levels were updated for the Main Report and Appendix H - Economics using the Data Resources, Inc. indices to October 1988 price levels.

5.3.2 Annual Charges

The estimated annual charges at 8-7/8 percent Federal interest rate and 100-year project life at October 1988 price levels, are $6,772,100 of which $4,467,200 is Federal, $1,639,100 is non-Federal and $665,800 is IDC (interest during construction). The non-Federal charges include the annual cost of operation and maintenance estimated at $150,000. A summary of the annual charges is presented in Table 7.

5.3.3 Apportionment of Costs

The non-Federal items include obtaining required lands, easements and rights-of-way, relocations of roads, bridges and utilities, and a cash contribution.

Consistent with the cost-sharing and financing concepts adopted under the WRDA of 1986, local interests will be required to provide lands, easements, rights-of-way and relocations, presently estimated for the Village of Mamaroneck project at $12,469,100; pay 6.4 percent of the costs allocated to flood control, presently estimated at $4,305,700 so that the total construction of the local interests is equal to 25 percent of the cost allocated to flood control, and bear all costs of operation, maintenance and replacement of flood control facilities presently estimated at $150,000 annually.

5.3.4 Comparison of GDM Estimate with PB-3

Changes in the current cost estimate from that of the latest PB-3 approved 11 July 1988 are shown in Table 8, and discussed below. A PB-3 is a Corps of Engineers document which displays the updated authorized project cost. The current GDM project cost estimate is $67,099,400 (October 1988 price level) which represents a $7,599,400 or a 13% increase over the $59,500,000 project cost of the approved PB-3 (October 1988 price level). The basis of the PB-3 estimate is the plan contained in the Feasibility Report for flood control for the Mamaroneck and Sheldrake River Basin, Mamaroneck, N.Y. dated October 1977.

The Federal cost increased from $44,600,000 to $50,324,600 which represents a net increase of $5,724,600, or 13 percent, and includes the following changes in Feature Items:

a) Item 09 - Channels & Canals - A cost increase of $2,212,700 due primarily to design changes and the increase in the length of required retaining walls because more surveys showed greater constrictions precluding the use of trapezoidally shaped channels in certain areas.

b) Item 11 - Levees & Floodwalls - a cost increase of $2,187,000 due primarily to design changes in the tunnel outlet structure.

c) Item 30 - Engineering and Design - a cost decrease of $2,057,000 due primarily to a refinement of E & D costs to eliminate continued Planning and Engineering costs prior to October 1985.

d) Item 31 - Supervision and Administration - a cost increase of $1,388,100 due primarily to a refinement of S & A costs.

The non-Federal cost increased $1,874,800 which includes the following changes in Feature Items:

a) Item 01 - Lands and Damages - a cost increase of $2,065,500 due to an increase in real estate easement acreage required (primarily due to wider channel requirements) and a 260% increase in actual real estate values from P.L.12/76 (Feasibility Study) as opposed to the 185% increase for cost updating applied in the PB-3 estimate.

b) Relocations - A cost increase of $1,803,600 due primarily to the addition of the required replacement of the Tompkins Avenue Bridge, and the refinement of design for utility relocation.

c) Cash Contribution - An decrease of $1,994,300 due to an increase in non-Federal items, i.e. relocations and Lands and Damages. These charges are presented in Table 8.

5.4 ANNUAL BENEFITS

5.4.1 General

The project for the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck will provide an overall 200 year flood level of protection while along portions of the diverted Sheldrake River from Rockland Avenue to Fenimore Road, an SPF Level of protection will be provided. The project life is 100 years. The benefits derived from the recommended plan of protection along the Mamaroneck and Sheldrake Rivers consist of the average annual flood damages that the improvement prevents, benefits from advanced replacement of bridges and less frequent pavement maintenance, traffic and time delay, flood insurance administration costs and Red Cross disaster relief prevention. The benefits have been evaluated in accordance with Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation studies. All estimates of average annual benefits are based on a project life of 100 years. The last damage survey completed on the Mamaroneck and Sheldrake River project area was done in July 1985 to update and verify the 1976 damage survey estimates. These estimates were still found to accurately represent the study area. Also, periodic field visits have been made (the last being 3 March 88) to assure that no major changes have occurred. More detailed information on the inundation and other project related benefits is included in Appendix H -Economics (Flood Damages and Benefits).

Summary tables of the AVERAGE ANNUAL BENEFITS can be found in tables 9A and 9B.

5.4.2 Flood Damage Reduction Benefits

The average annual flood damage reduction benefits for the proposed project was estimated by evaluating damages with and without the proposed projects, under both existing and future conditions. As shown in Table 9A, the average annual benefits that accrue as a result of the proposed flood control plan of protection are estimated at $6,134,900.

Affluence factor benefits were also calculated to evaluate the most probable future value of residential structures and contents. For the Village of Mamaroneck, the average annual benefits from growth in residential content value are estimated at $117,400.

5.4.3 Other Benefit Categories

The benefits from advanced replacement of bridges and less frequent pavement maintenance, traffic and time delay, flood insurance administration costs and Red Cross disaster relief are discussed in Volume 6, Appendix H - Economics. The amount of these benefits is summarized in Table 9B of this main report.

5.4.4 Summary

The total average annual benefits from the recommended plan under existing conditions of development are estimated at $7,288,000. These figures are summarized in Table 9B.

5.5 ECONOMIC JUSTIFICATION

5.5.1 General

Total annual benefits for the plan of improvement are $7,418,000. Total annual charges are $6,772,000. A comparison of average annual benefits and annual charges results in a benefit-to-cost ratio of 1.10 for the Mamaroneck and Sheldrake River flood control project.

The estimated annual costs, the estimated annual benefits, and the ratio of benefits to costs, are summarized in Table 10.

5.6 CORROSION MITIGATION

No detrimental water or sediment conditions have been identified in the project area during the GDM investigations. Therefore, no corrosion mitigation besides that normally used in construction of this type of project is recommended. All material exposed to the projects elements including walls near the harbor, are protected by concrete against corrosion. New bridge construction includes concrete deck & deck support, ie, beams, for corrosion resistance.

5.7 ENVIRONMENTAL CONSIDERATIONS

5.7.1 STATUS OF FEIS Since the filing of the Final Environmental Impact Statement (FEIS), with EPA in March 1981, and the receipt of the US Fish and Wildlife Service's most recent planning aid reports (i.e. March 26, 1982, and February 9, 1984) there have been no major changes to existing environmental resources for the study area. The environmental statement described and analyzed the anticipated temporary and permanent effects that would result with the implementation of the authorized structural plan. The anticipated effects include:

temporary increase in noise and adverse air quality levels due to the construction operations. Channel excavations to widen and deepen the channels would create temporary turbidity and adversely affect water quality downstream. Impacts of a more permanent nature include the removal of streamside vegetation, some loss of fish and wildlife habitat and the aesthetic effect of the modified appearance of the streams and the land due to the presence of structural works. Overall, the habitat resources, the existing levels of water quality, and land-use classification have remained the same for the Mamaroneck - Sheldrake Rivers study area. Recently, a review of water quality data was undertaken. This review was utilized to identify possible water quality concerns or problems prior to the preparation of a 404(b) (1) evaluation report. In addition, by Public Notice (PN) No. 13468 (dated October 13, 1988) coordination has been initiated with the interested public and appropriate governmental agencies with respect to the Clean Water Act and the Coastal Zone Act. Summary paragraphs of environmental concerns are provided below (additional information is presented in Appendix G, technical appendices to the GDM report).

5.7.2 ZONING AND LAND USE The study area's zoning and land use has generally remained the same. The great majority of land use in the Village is residential. There are few remaining vacant parcels of land and the majority of the zones allow only single family dwellings. In general, parks and recreational facilities are concentrated south of the Boston Post Road near Long Island Sound. The main commercial zones are restricted to Boston Post Road, the Village center, Mamaroneck Avenue, Halstead Avenue, and Old White Plains Road. A marine commercial zone exists where the Village center meets Mamaroneck Harbor, and other areas front the Long Island Sound. There is also an industrial zone located to the east and west of Fenimore Road.

5.7.3 COASTAL ZONE MANAGEMENT With the exception of the proposed structural works within or adjacent to the West Basin, the project works are not located in a New York State coastal zone area. As part of the (draft) Section 404 (b) (1) [Clean Water Act] public notice, coordination has been effected with the New York State Department of State, Division of Coastal Resources and Waterfront Revitalization, and the Connecticut Department of Environmental Protection. In addition, it should be noted that the material to be dredged from the West Basin of Mamaroneck Harbor will be disposed of at an approved ocean site. For this material, the Central Long Island Sound (CLIS) is the preferred alternative (with some further coordination needed, the CLIS is presently available if the dredged material is provided with a suitable cap).

5.7.4 WATER QUALITY Historically, the Mamaroneck and Sheldrake Rivers were classified as "D" streams by the State of New York Department of Environmental Conservation (NYSDEC) within the project areas and are considered significantly degraded. The lower tidal portion of the Mamaroneck River is Class "I" while the

East and West Basins of Mamaroneck Harbor are classified as "SB" waters, closed to shellfishing. The upstream reservoirs (Larchmont Reservoirs and Mamaroneck Reservoir) remain classified as "A" (drinking water). However, the main stems of the Mamaroneck and Sheldrake Rivers were proposed to be upgraded to Class "C", and the water quality in some areas appears to be improving. Local hearings were held 1 September 1987, and are required prior to any official changes. In addition, the NYSDEC has not yet established criteria and standards for pollutants in the sediment material. Recommendations and possible standards for certain parameters continue to be reviewed and studied.

5.7.4.1 MAMARONECK HARBOR The study area boat basins remain classified as "SB"; however, as work on the Mamaroneck Sewage Treatment Plant progresses some improvement in the local water quality may be anticipated. A report was issued for the Step II 201 Facilities Plan. Construction of the force mains and pump stations is complete (sewer system rehabilitation and up-grading). The design phase of the Mamaroneck plant upgrading to secondary treatment is complete. June 1, 1993 is the projected start-up date of operation of the 20.6 MGD secondary activated sludge plant. The Town of Mamaroneck is operating under a State of New York "Consent Order" to attain secondary treatment . The upgraded plant will consist of preliminary, primary, and secondary treatment facilities and a new outfall pipeline (Interstate Sanitation Commission, 1987 Annual Report).

5.7.4.2 WATER QUALITY AND BOTTOM SEDIMENT DATA RESULTS The test results, for the sediment and water samples that were collected from locations within or near the project area are presented in Appendix G (in tabular form). A review of the data presented in the data tables, indicates that the bulk sediments are free of any high concentrations of pesticides and PCB's. These results are generally consistent with the nature of the materials to be excavated, since heavier-size materials do not concentrate potential pollutants very well. The only relatively high concentration appeared for PCB's in one of the Harbor samples. However, this was the "highest" re-ported (only 4.0 PPM) from among all samples collected and the elutriate and the site water results reported no concentrations above the detection limits. Relatively high concentrations of heavy metals were clearly de-tected (in the bulk sediments) for the following: iron, copper, lead, chromium, and zinc. However, the elutriate and water column tests again reported low concentrations. In general, the results suggest that the New York State standards for Class C or D streams would not be exceeded during construction. While there is a potential for a temporary contravention of the standards (during dredging or excavation activities) for some of the heavy metals (particularly iron and copper), this is not expected to be a matter for serious concern, since the effects should be temporary and high concentrations of these elements, already occur naturally in sediments of the project riverbeds and other streambeds in Westchester County.

Subsequent to the coordination to the initial coordination of the dredging and disposal for the tunnel outlet structure, a design revision to the structure resulted in a need to excavate and dispose of approximately 45,000 cubic yards of material from the West Basin. Additional environmental documentation such as a supplementary public notice will be done during plans and specifications.

5.7.5 MITIGATION In order to mitigate the adverse effects of the structural works for the Mamaroneck and Sheldrake Rivers, the following measures have been incorporated (Note that these measures will not decrease the flow capacity of the study areas):

(a) On the Mamaroneck river two boulder fields, two rock dams (0.5 ft. high), a log dam (0.5 ft. high), and a low-flow sub-channel about 7,315 ft. long (the sub-channel would be "V" shaped approximately 1.5 ft. deep with 1 on 3 ft. side slopes that meander within the proposed main channel.) (b) On the Sheldrake river (above Fenimore Road bridge) a 0.5 ft. high log dam, and a "V" shaped low-flow channel (1.5 ft. deep), (c) On the lower Sheldrake river (vicinity of Columbus Park within the Village of Mamaroneck) a small concrete weir, about 6 ft. high and 38 ft. long will be placed about 20 ft. downstream of a footbridge. The weir will provide a small natural pool within the village park.

5.7.6 REPLANTING A tree and shrub planting program will be implemented after construction in order to replace some of the trees & shrubs removed by the structural works. Plans will include indigenous trees and shrubs such as; hawthorn, pine, oak, dogwood, maple, as well as, perennial grasses legumes (creeping red fescue, crownvetch, flat pea, tall fescue, or ryegrass). The various trees and shrubs will be chosen for their aesthetic value, as well as their value as a food or cover for the area's wildlife. These replanting items have been included in the project's cost estimates. The specific final array of species will be further coordinated with the local interests and the US Fish and Wildlife Service during the development of the Plans and Specifications.

5.7.7 CULTURAL RESOURCES There will be no effect on historical or archaeological resources eligible for or listed on the National Register of Historic Places within the project area. For additional information, please refer to Appendix F, Cultural Resources Study.

5.8 CONSTRUCTION PROCEDURES

5.8.1 Retaining Walls

General. The construction of the T-type retaining walls will be done by either utilizing temporary sheeting to retain the embankment on the landside of the wall or by open excavation. The construction of the T-type wall will include drainage weepholes, placement of underdrain filter material against the wall stem and select structural fill behind the wall in accordance with standard engineering practice. Due to the proximity of the L-type walls to existing structures, provisions for protecting these structures will be implemented prior to the construction of the permanent wall. In some instances the existing structures will be underpinned to the depth of the proposed excavation and in other cases permanent steel interlocking sheet piling will be used for protection of existing structures.

Protection of Utilities

The construction of the proposed retaining structures will be accomplished so that existing utilities to remain are protected and proposed utility relocations are coordinated with and incorporated as necessary into the new wall construction. Generally, the proposed wall construction will have only minimal impact on the utility systems. The modification of these utility interferences will be completed prior to new wall construction. Service during relocation construction will be maintained to reduce impacts.

5.8.2 Tunnel

General. The reinforced concrete box culvert and transition culvert will be constructed utilizing cut-and-cover methods. The box culvert will be cast-in-place using steel forms for the inside portion.

Tunneling beneath the Boston Post Road will be in mixed face, with soil in the tunnel roof and rock on the sides and invert. The tunnel portal will be stabilized with horizontal rock bolts. The soil in a zone three feet above the tunnel roof will be grouted to increase the soils' stand up time. Groundwater will be controlled by pumping ahead of the face.

The main portion of the horseshoe tunnel will be constructed using standard drill and blast methods. It is not expected that any special construction techniques will be necessary. Costs include a monitoring program to protect existing structures during the drill and blast operations.

The geotechnical investigations indicate that the permeability of the rock mass is low and the seepage into the tunnel excavation will be less than 2 gpm per ft. This inflow will be controlled by letting the water flow to the outlet shaft, from which the water will be pumped out of the tunnel. If joints are encountered where the seepage is excessive, drains will be inserted into the joints and then the joints will be grouted to obtain controlled inflow into the tunnel. The drains will avoid hydrostatic build up in the rock and control the seepage when the concrete liner is being installed. The concrete liner will be reinforced cast-in-place concrete using telescoping metal forms.

Protection of Existing Structures. The construction of the horseshoe-shaped tunnel section will have a relatively small impact on structures. The construction will be done in full compliance with Federal, State, and local regulations. Continuous monitoring of the blasting operations and of adjacent properties will be done to assure that the operation is carried out with minimal adverse effects. (See Appendix C - GEOLOGICAL AND SOILS INVESTIGATIONS, "Blasting Analysis").

Maintenance of Traffic. The construction of the box culvert in Fenimore Road from east of the New England Thruway to Stanley Ave will require a sheeted covered trench excavation of approximately 25 feet in width. Traffic will be maintained throughout construction of the box culvert & tunnel. Access ways and driveways will also be maintained throughout box culvert & tunnel construction. Throughout the length of the open excavation, the trench will have to be decked as required to provide continuous access to the abutting properties and to keep the cross streets open to traffic. The box culvert construction is to proceed in sections to minimize impacts. The box culvert also crosses two railroad track grade crossings of Fenimore Road, both at Railroad Way. The tracks are intermittently used and construction will be staged such that one track is always in service. No disruption of traffic on Boston Post Road (a heavily traveled State Route) will be necessary since the tunnel in this section will be constructed using steel liner plates to retain the earth over the tunnel roof & avoid interference with the street. Traffic maintenance requirements should adhere to the stipulations established by the Village Engineer of the Village of Mamaroneck & other authority as applicable.

Protection of Utilities

Cut and cover construction in general has a disruptive impact on utilities. Utilities that will be influenced by the diversion tunnel construction along Fenimore Road are indicated recorded on the Plan Sheets. Service, will be maintained during utility relocation & cut and cover construction. The horseshoe tunnel construction generally has no impact on utilities.

5.9 BRIDGE REPLACEMENT

5.9.1 Scheduling of Traffic

During the proposed removal and construction of replacement structures at Hillside Avenue, Station Plaza, Ward Avenue and Tompkins Avenue, these bridges will be closed to vehicular and pedestrian traffic and traffic be detoured thru local streets in accordance with stipulations established by the Village Engineer of the Village of Mamaroneck. The reconstruction of the Halstead Avenue Bridge will be done in stages as required to permit traffic to be maintained on the bridge. The scheduling of the bridge reconstruction shall be such that work is not performed simultaneously on the Halstead Avenue, Ward Avenue and Tompkins Avenue Bridges. The Valley Place Bridge functions as a sewer main support only, and as such maintenance of traffic is not a consideration. However, the reconstruction of this bridge will be accomplished such that the sewer main service will be maintained without interruption. Winfield Avenue in the vicinity of the bridge over the Mamaroneck River is presently not a through street and the roadway is barricaded. In conjunction with the removal of the Winfield Avenue Bridge, both approaches will be permanently barricaded.

5.9.2 Utilities at Bridges

In conjunction with the bridge reconstruction, utilities will have to be temporarily diverted to maintain service. Also permanent utility installation to establish normal service conditions upon completion of the bridge construction will be required. In the subsection titled "Utility Notes" of Appendix D -"Structural Design" there are writeups which identify the utilities, their owners and locations for each of the facilities within the limits of the proposed reconstruction.

5.10 CONSTRUCTION MATERIALS AND DISPOSAL AREAS

5.10.1 Sources of Construction Materials

Suitable common backfill material and riprap and bedding stone will be obtained, where qualified, from excavation of the river bed. Several nearby contractors within a 15 to 60 radius are capable of providing sources of concrete components such as cement, fine and coarse sand, fine and coarse concrete aggregate, ready mix concrete, and riprap of various sizes is available from both local contractors & contractors able to barge to Port Chester and truck to the site.

5.10.2 Muck Utilization

It is estimated that 30,000 cubic yards of loose rock muck will be generated from the tunneling operations in connection with the horseshoe and box culvert rock tunnel construction.

The muck will be removed from the tunnel and loaded onto trucks for disposal.

The outcrops at the site indicate that some of the muck is durable and may be used as fill on the project. Otherwise it may be most economical for the contractor to either waste the muck off site or to process the material for general fill after passing the muck through a crusher.

5.10.3 Spoil Areas

A portion of the excavated material from the project construction will meet Corps of Engineers' criteria and will be used for required fill and riprap. An investigation into potential disposal areas for the remaining excavated material was made. The Westchester County Department of Public Works/Solid Waste Management has confirmed in October 1988 that the Croton Dump Site, which is approximately 15 miles from the project area, has the projected capacity to receive all clean disposal material from the project at the time of anticipated commencement of construction (1991). The project cost estimate for disposal material exclusive of the Mamaroneck West Basin, is based on transportation to this site. Pertaining to the Mamaroneck West Basin disposal material, a public notice dated October 13, 1988 (Volume 6, Appendix G, page G-A8) has been published which discusses the disposal of 5,000 cubic yards of excavated material for construction of the diversion tunnel outlet structure. This excavated material is proposed to be disposed at an approved Central Long Island sound offshore disposal site. The material is to be capped upon disposal. This public notice was coordinated with appropriate agencies for approval. Subsequent to the coordination of the dredging and disposal, a design revision for the tunnel outlet structure indicated a need to excavate and dispose of approximately 45,600 cubic yards of material from the West Basin. Approximately 160,000 cubic yards of capping material will be used upon disposal to address environmental concerns and is reflected in the cost estimate. Additional environmental documentation such as a supplementary public notice will be done during plans and specifications.

5.11 REAL ESTATE REQUIREMENTS

In order to construct the plan of improvement, local interests are required to provide, without cost to the Government, all lands, easements and rights-of-way required for the project, including disposal areas necessary for implementation of the

project. Real estate required for construction of channel modifications, any bridges, retaining walls, and for future access for operation and maintenance would be acquired by permanent easement and fee acquisition. Temporary easements are required for filling and grading areas, construction access, and working and staging areas. The delineations of each category of the required real estate for the project are listed in the Real Estate Appendix J.

No new roads are proposed for access to the construction site. Existing roads and lands will be used for access.

The total cost for these requirements is $ 4,791,000 including both permanent and temporary easements at October 1988 price levels. A more comprehensive examination of the real estate requirements, along with the real estate appraisal, is contained in Appendix J - Real Estate.

5.12 RISK AND UNCERTAINTY

The designed plan provides reasonably good assurance that the full expected annual benefits would accrue over the entire economic project life of 100 years. The 200-year level of protection afforded by the plan in nearly all problem areas would have the relatively low probability of being exceeded once in 100 years is 0.30. The probability of the design level of protection being exceeded two or more times in 100 years is 0.09. The events that could exceed the design range from the 201 year flood up to an event that would have an extremely rare chance (e.g., 10,000-year event) of occurrence in the Mamaroneck Sheldrake River Basins. A reasonable estimate of the largest flood likely to be possible in any given area is referred to as the Standard Project Flood (SPF). Even if the Standard Project Flood occurred, the project would reduce flood stages along the Mamaroneck River by approximately 7 feet in upstream of the New England Thruway and as much as 13-15 feet in the Columbus Park and lower Mamaroneck River reaches. The Sheldrake River diversion tunnel is designed to carry the SPF on the Sheldrake River.

The risks described above are generally quantifiable. There are other risks that are quantifiable as well as unpredictable, unquantifiable events which could reduce the full beneficial effects of the project. Risk is the situation in which the outcome can be described in reasonable and well-known probability distribution, and uncertainty is the situation in which the outcome cannot be described in objectively known probability distributions.

Sensitivity analysis is the technique of varying assumptions and then examining the resulting effects on project benefits and costs. The sensitivity includes both risk and uncertainty.

It was determined that risk and uncertainty could be associated with the following areas of work: hydrologic parameters, including frequency; and estimates of stage-damages. A sensitivity analysis was carried out by reducing the total average annual benefits of the detailed plans by factors of 10% and 50% to determine the effect on plan feasibility. The results of this analysis show that the selected plan would still be justified assuming analytical risks and uncertainty caused a large decrease in plan benefits (see Table 12).

5.13 OPERATION AND MAINTENANCE

Upon completion of construction, the Government will turn the flood control project over to the non-Federal sponsors (local cooperating agency). Subsequently, operation and maintenance will be necessary to maintain the project facility at full operating efficiency throughout the project life. Therefore, in accordance with the items of local cooperation, the non-Federal sponsors will be responsible for operation, maintenance, replacement and rehabilitation of project facilities as designed at non Federal cost and per Government regulations or directions.

The operation and maintenance costs were estimated to represent as nearly as possible the average annual economic costs necessary to maintain the project at full operating efficiency throughout the project life. It has been assumed that these activities would be performed by the regular maintenance forces of the local agency and no special contracts or personnel would be required.

Although none of the project facilities would require regular operation, periodic maintenance would be required.

The main features of the recommended project that include routine operation and maintenance are as follows:

1. 16,000 feet of channelization that will require shoal, clearing, snagging and debris removal and replacement of lost riprap.

2. 8,000 feet of concrete retaining walls and 300 ft. concrete flume that require periodic inspection and repair of any cracking and toe scour.

3. 3,600 feet of tunnel system which is self cleaning but will require periodic inspection for cracking, wear, and other possible maintenance needs.

4. The two existing local dams upstream of the project area on the Sheldrake River, the small weir at the entrance to the tunnel as well as the stilling basin at the tunnel outlet structure must be maintained and periodically dredged to remove

trapped sediment.

5. The debris defector on the upstream face of the Rockland Ave. bridge must be periodically cleaned of debris.

6. Cutting grass on the channel banks and along the lower Sheldrake River and maintaining the drainage ditches behind retaining walls. Pruning of trees and shrubbery.

7. Painting of miscellaneous metal parts, fencing, etc.

8. The authorized flood control project may have a small effect on the docking and mooring arrangement currently used in the area of the proposed outlet. Docking and moorings in the vicinity of the tunnel outlet in the West Basin of Mamaroneck Harbor should be controlled so as to avoid any possible high flow velocities or turbulence. The floating docks and moorings can easily be rearranged to orient the boats in a position and direction that will not result in excessive motion.

5.14 PLAN SCHEDULES

A construction and expenditure schedule for the work is presented in Table 13. The estimated construction contract duration is 15 months for Phase I, 24 months for Phase II, and 33 months for Phase III. Phase I, (the lower Mamaroneck River to Halstead Avenue) is scheduled to be constructed first. Phase II, (the upper Mamaroneck River from Halstead Avenue to Winfield Avenue), and Phase III, (the Sheldrake River channel work from Mamaroneck Avenue to the N.Y. Thruway and the diversion tunnel along Fenimore Road) are scheduled to commence at the same time and run concurrently after the completion of Phase I.

Pertaining to Phase III, the diversion tunnel includes a rock tunnel section and a box culvert section each of which are scheduled for an 18 month physical construction period. The construction of the upper Sheldrake River channel work from Fenimore Road to the N.Y. Thruway and the diversion tunnel inlet and outlet structures each of which require less than 18 month construction time are to be scheduled in order to complete the upper Sheldrake and diversion tunnel in 30 months. This would involve concurrent work with the tunnel and box culvert sections. The last 3 months of the 2 year and 9 month construction period for Phase III are to accomplish the lower Sheldrake channel work from Mamaroneck Avenue to Fenimore Road subsequent to the Sheldrake River diversion to the Mamaroneck Harbor West Basin. The Federal and non-Federal funding schedules for the work are summarized in Table 14.

5.15 DEVIATIONS FROM THE PLAN RECOMMENDED IN THE FEASIBILITY REPORT

5.15.1 General

The proposed plan of improvement as described above, is a result of the detailed scope of field investigations, engineering analyses and the design conducted during preparation of this General Design Memorandum. In addition, the plan accommodates any changed physical conditions and new information which have been identified since completion of the Feasibility Report. The updated physical conditions and new information have assisted the refinement of plan features and the development of project details.

In general, since these design refinements are minor and have not altered the scope of the project, these feature modifications are merely design refinements and enhancements to the recommended plan which make for a better engineered plan and provide cost efficiencies to the project. No Post-Authorization Change reports are required.

5.15.2 Changes in Recommended Plan

Since the Feasibility Study, there have been several design changes incorporated into the recommended plan as follows:

(1) Increased improved design flows - from 4700 cfs in the Feasibility Report to 6150 cfs for the GDM on the Mamaroneck River above the Sheldrake River confluence (31%); on the Sheldrake River at Fenimore Road, the design flows increase 17%. These increases were caused by a small increase in the existing conditions peak discharge verses frequency relation at the Mamaroneck gage since the feasibility study, and primarily due to detailed assessments which were made of the impacts of the channel improvements. This was accomplished through detailed flood routing techniques which were used for the GDM analysis.

(2) Due do the 31% increase in design flows on the Mamaroneck River:

(a) The Tompkins Avenue Bridge requires replacement for hydraulic capacity.

(b) The channel width requires an increase from 45 feet to 50 feet between Jefferson Avenue (Sta. 50+00) and New Barry Avenue (Sta. 68+00).

(c) Additional riprap requirements due to higher design velocities and additional criteria.

(3) Due to the 17% increase in design flows on the Sheldrake River:

(a) The tunnel capacity requires increasing from the 15' x 15' box culvert to a 16.25' x 16.25' box culvert and from a 15.5' diameter circular tunnel section to an 18.5' diameter circular tunnel section. In order to implement cost savings, the 18.5' diameter circular shape was developed as a 17.5' diameter horseshoe shape which resulted in an 8% reduction in cost. The 16.25'x16.25' box culvert section was also compared with the hydraulically equivalent 18.5' diameter circular section for cost effectiveness and found to be 19% less costly than the circular shape.

(b) Additional riprap requirements due to higher design velocities and additional criteria.

(4) The plan to replace existing Valley Place sewer bridge crossing over the Mamaroneck River has been changed from an inverted siphon to a new bridge structure to implement a 40% cost savings and to increase functional reliability.

(5) On the upper end of the Sheldrake River between Rockland Avenue and the New England Thruway, the following design changes have been included:

(a) Levees and associated interior drainage are deleted from the plan of improvement since they are no longer necessary to provide a high degree of protection, and are not incrementally justified comparing its benefits to costs.

(b) Due to the identification of a concrete bridge bottom in the river, channel deepening and widening is deleted from the plan of improvement since the resultant cost of lowering the concrete bottom Rockland Avenue Bridge foundation renders this channel improvement incrementally unjustified when comparing benefits to costs. Clearing and snagging has been substituted in this reach for channel improvement. A 200 year level of protection is still provided in the reach from Rockland Avenue to the upper limit of the project.

(6) The lower Sheldrake River between Fenimore Road and its confluence with the Mamaroneck River is to be lined with topsoil and seeded fill to better provide maintenance of local drainage.

(7) Due to model testing study results, the tunnel intake structure is widened and lengthened and the tunnel outlet structure is lengthened to provide better hydraulic conditions. In addition, the lower 370 foot of the tunnel was changed from a box culvert section to a horseshoe section of the same size as the upstream tunnel section to provide better hydraulic conditions.

(8) The cut and cover operation for 200 feet of the lower end of the tunnel in the vicinity of Boston Post Road has been changed to a tunneling operation to reduce cost (approximately $200,000) and preclude traffic disturbance. A cut and cover operation would require a thicker concrete cross section since structural steel support for the construction of the horseshoe tunnel shape is not utilized as it is in the tunneling method. In addition, the cut & cover operation requires extensive temporary decking (32± span), pavement removal & restoration, temporary sheeting, substantial maintenance and protection of traffic and longer construction time which leads to the $200,000 higher costs. The tunneling operation involves chemical grouting of the earth over the tunnel section for temporary support, a mixed face tunnel construction procedure with steel spiling at the upstream end to tie into the full rock section.

The comparison of the design changes between the Feasibility Report and the Phase II GDM discussed above are summarized in Table 12. A few additional, less significant design refinements are also listed in this table. Further details on these design enhancements can be found in the technical appendices, as follows:

Design Refinement	Appendix
Bridge, channel, tunnel, tunnel outlet structure, wall, sheetpile, excavation, fill areas, riprap	D - Structural
Fish and wildlife mitigation measures, footbridge, fill areas	G - Environmental
Tunnel, channel, bridge, riprap, stilling basin, levees, fill areas, local and interior drainage, and fish and wildlife measures	B - Hydraulics

5.16 LOCAL COOPERATION REQUIREMENTS

5.16.1 LOCAL COOPERATION AND FINANCIAL ANALYSIS

By letter dated 29 November 1988 the State of New York Department of Environmental Conservation expressed its intent to be the non-Federal sponsor of the project and expressed agreement with the terms of the draft Local Cooperation Agreement (LCA). A copy of the draft LCA and the States's letter are included in the Pertinent Correspondance Appendix (Appendix I).

The non-Federal share of the project costs would be provided in full by the State of New York. Funds would be made available by means of annual appropriations made by the State Legislature for projects of this type. In spite of recent reports and concern

about the State's ability to balance its FY 1989 and FY 1990 budgets, the NYSDEC is expected to be able to provide the non-Federal funding as it is needed for the project. The State has participated with the Corps of Engineers in many previous projects and has always met its cost-sharing commitments.

While the State will be the sole non-Federal party to the LCA, it will in turn require cost-sharing of the non-Federal amount by the Village of Mamaroneck. Since the changes in Federal and non-Federal cost sharing enacted with the Water Resources Development Act of 1986, the State and local cost sharing formala has been subject to much controversy. Recent attempts by the State legislature to resolve these concerns have not been successful, however renewed efforts to reach a legislative solution are expected shortly. Once an acceptable State and local cost sharing formula is achieved, it is expected that although the State will provide the entire non-Federal amount, the Village of Mamaroneck will provide its designated reimbursement of funds to the State raised by means of a bond issue.

Prior to commencement of construction of the project, local interests will, in addition to the general requirements of law for this type of project, agree to comply with the following:

a. Consistent with the cost-sharing and financing concepts adopted under the WRDA of 1986, local interests will be required to provide without cost to the United States of America (hereinafter referred to as the "GOVERNMENT") all lands, easements, rights-of-way and relocations, required for the project presently estimated for the Village of Mamaroneck project at $12,496,100, including borrow and disposal areas necessary for implementation of the project;

b. Accomplish without cost to the GOVERNMENT all alterations and relocations of buildings, transportation facilities, storm drains, utilities, and other structures and improvements made necessary by the construction;

c. Provide all lands, easements, rights-of-way, and relocations and alterations determined by the GOVERNMENT to be necessary for construction of the project, and a cash contribution of at least five (5) percent of total project costs, so that the total value of the non-Federal contributions of local interests will not be less than twenty-five (25) percent of the cost allocated to flood control, so that the State will be paying 6.4 percent of the costs allocated to flood control, presently estimated at $4,305,700;

d. Hold and save the GOVERNMENT free from damages due to the construction works, not including damages due to the fault or negligence of the GOVERNMENT or its contractors;

e. Contribute in cash a portion of the estimated first cost for fish and wildlife mitigation in the same proportion as the

non-Federal share of all costs for the basic flood control project;

f. Bear all costs of operation, maintenance, and replacement of flood control facilities presently estimated at $150,000 annually and maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

g. Prescribe and enforce regulations or other floodplain management techniques to prevent encroachment on floodplain storage areas, channels, and rights-of-way, necessary for proper functioning of the project;

h. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to ensure compatibility between future development and protection levels provided by the project;

i. At least annually, inform affected interests regarding the limitations of the protection afforded by the project;

j. Comply with the applicable provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved January 2, 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent operation and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act; and

k. Comply with all applicable Federal and State laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

6. RECOMMENDATIONS

6.1 GENERAL

The plan developed in this report for flood control on the Mamaroneck and Sheldrake Rivers, Mamaroneck, New York is based on a thorough analysis and evaluation of the various alternative courses of action and includes channel modification, bridge replacement, and the construction of a stream diversion tunnel. This plan is the most cost effective means of achieving the desired protection from flooding. In deriving the plan, consideration has been given to all significant aspects of this GDM level of study as well as the overall public interest in protective measures for the Mamaroneck and Sheldrake Rivers project area. The aspects considered include engineering feasibility, economic effects, environmental concerns, social concerns and compatibility of the project with the policies desires, and capability of the State and other non-Federal interests.

6.2 RECOMMENDATION

It is recommended that this General Design Memorandum and the plan of improvement contained herein be approved as the basis for preparation of contract plans and specifications for construction of the project.

MARION L. CALDWELL, JR.
Colonel, Corps of Engineers
Commanding

6.3 COST EFFECTIVENESS CERTIFICATION

CERTIFICATION OF THE COST EFFECTIVENESS OF THE
GENERAL DESIGN MEMORANDUM
FOR THE STREAMS IN WESTCHESTER COUNTY, N.Y.
FLOOD CONTROL PROJECT FOR THE
MAMARONECK AND SHELDRAKE RIVERS BASIN
IN THE VILLAGE OF MAMARONECK, NEW YORK

I, Colonel Marion L. Caldwell Jr., Commander, U.S. Army Corps of Engineers, New York District, certify that the General Design Memorandum has been reviewed for cost effectiveness. Based on the review, the contingency allowance for the horseshoe shaped portion of the diversion tunnel was increased from 15 to 20 percent to account for the greater risk of cost increases associated with rock tunneling. Similarly, an additional time period was allowed for the diversion tunnel portion of Contract No. 3 to secure necessary permits, conduct a pre-construction structure survey, establish a blast monitoring program, etc. It was determined from this review that the design is the most viable for this phase of the Preconstruction Engineering and design effort.

MARION L. CALDWELL, JR.
Colonel, Corps of Engineers
Commanding

WESTCHESTER COUNTY STREAMS
MAMARONECK AND SHELDRAKE RIVERS
FLOOD CONTROL PROJECT
VILLAGE OF MAMARONECK, NEW YORK

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PRIOR FLOOD CONTROL REPORTS BY THE CORPS OF ENGINEERS

Title of Report	Type	Improvements Submitted Considered Division	Date to
Mamaroneck & Sheldrake Rivers and Tributaries	Preliminary Examination	Channel improvement of Mamaroneck River in the Village of Mamaroneck and Town of Harrison and Sheldrake River in the Village and Town of Mamaroneck, and channel clearing, dredging removal of obstruction and reconstruction of bridges. Marginally favorable; recommended authorization for a limited survey.	August, 1942
Mamaroneck and Sheldrake Rivers and Tributaries	Survey	Same as in the Preliminary Examination Report for Mamaroneck and Sheldrake River. Recommendation was unfavorable.	December, 1945
Streams in West-chester County, NY and Fairfield County, Conn.	Survey	Local protection plan at the Village of Mamaroneck River consisting of channel rectification with walls and levees along the Mamaroneck and Sheldrake Rivers. District recommendation was favorable, however, Board of Engineers for Rivers and Harbors returned the report to District for reconsideration of a debris jam occurrence. Restudy indicated the proposed project at Mamaroneck was not economically feasible. There was no justification for improvements along the Bronx River, Hutchinson River, Blind Brook and Byram River, and their tributaries.	May, 1968

Sheldrake River Mamaroneck, NY	Recon-naissance	Channel improvement along the Sheldrake River in the Town of Mamaroneck consisting of reinforced concrete flume. Plan was economically justified, however, the cost apportioned to Federal interests was in excess of the small project authority limitation. Plan was recommended to be considered further under Westchester County Stream Survey investigation.	April, 1973
Streams in Westchester County, NY and Fairfield County, Connecticut.	Feasibility Report	A "Feasibility Report for Flood Control, Mamaroneck and Sheldrake Rivers Basin" was completed in October 1977. The Feasibility Report recommended a combination of channel widening and deepening, interior drainage works, retaining walls, stream realignment, bridge replacement and enlargement, levees, and a diversion tunnel. The recommended plan was economically favorable and was recommended for construction authorization.	October 1977

Table 2

MAMARONECK & SHELDRAKE
PLAN OPTIMIZATION TABLE
OCT. 1988 PRICE LEVEL

Plans	Total Average Annual Benefits	Cost	Total Average Annual Cost	Net Benefits	B/C
Original(GDM) (SPF Tunnel + 200yr. Mam.)	$7,418,000	$67,099,400	$6,772,000	$646,000	1.10
(100yr. Tunnel + 100yr. Mam.)	$6,885,500	$62,990,800	$6,407,300	$478,200	1.08
(SPF Tunnel + 100yr. Mam.)	$7,170,200	$65,920,800	$6,667,400	$502,800	1.08
(SPF Tunnel + SPF Mam.)	$7,301,600	$96,313,600	$9,365,300	($2,063,700)	0.78
(SPF Tunnel + 50yr. Mam.)	$6,521,200	$64,959,700	$6,582,100	($60,900)	0.99

TABLE 3

DETAILED STATION TO STATION DESCRIPTION

GDM PLAN

TABLE 3 - Pg 1/13

LOWER MAMARONECK RIVER PLAN OF IMPROVEMENT

(GOING FROM DOWNSTREAM PROJECT LIMIT ON MAMARONECK RIVER)

NEAR EAST BASIN MAMARONECK HARBOR GOING UPSTREAM TO HALSTEAD AVENUE)

PHYSICAL LOCATION	FEATURES							
	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICK-NESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
Starting at Lower project limit at 600 feet downstream of the Tompkins Avenue Bridge to 250 feet downstream of the Tompkins Avenue Bridge	17+00 to 20+60 (360)	60	Full Trapezoid	1V:2H	None	12,18, 36	1	None
From 250 feet downstream of the Tompkins Avenue Bridge to 190 feet downstream of the Tompkins Avenue Bridge	20+60 to 21+20 (60)	45	Semi-Trapezoid	1V:2H	11	36	3.5	None
From 190 feet downstream of the Tompkins Avenue Bridge to the Tompkins Avenue Bridge	21+20 to 22+85 (165)	60	Semi-Trapezoid	1V:2H	8 to 14	24	2.5	None
From the Tompkins Avenue Bridge to 300 feet upstream of the Tompkins Avenue Bridge	23+40 to 26+60 (320)	60	Semi-Trapezoid	1V:2H	13	Some 24	2.5	None

TABLE 3 - Pg 2/13

LOWER MAMARONECK RIVER PLAN OF IMPROVEMENT

(GOING FROM DOWNSTREAM PROJECT LIMIT ON MAMARONECK RIVER)

NEAR EAST BASIN MAMARONECK HARBOR GOING UPSTREAM TO HALSTEAD AVENUE)

(CONTINUED)

PHYSICAL LOCATION	FEATURES							
	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICK-NESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 300 feet upstream of the Tompkins Avenue Bridge to 90 feet downstream of the Ward Street Bridge	26+60 to 31+00 (440)	60	Full Trapezoid	Varies from 1V:2H to 1V:2.5H	7 to 21.5	18,30	3	None
From 90 feet downstream of the Ward Street Bridge to 50 feet upstream of the Ward Street Bridge	31+00 to 32+60 (160)	60	Rectangular & Semi-Trapezoid	Vertical & 1V:2H	11.5 to 21.5	24, 30	3	None
From 50 feet upstream of the Ward Street Bridge to 240 feet downstream of the Valley Place Sewer Bridge	32+60 to 35+00 (240)	60	Full Trapezoid	1V:2.5H	None	Some 24	3	None
From 240 feet downstream of the Valley Place Sewer Bridge to 150 feet downstream of the Valley Place Sewer Bridge	35+00 to 36+00 (100)	60	Semi-Trapezoid	1V:2.5H	11	24	3	None

TABLE 3 - Pg 3/13
LOWER MAMARONECK RIVER PLAN OF IMPROVEMENT
(GOING FROM DOWNSTREAM PROJECT LIMIT ON MAMARONECK RIVER)
NEAR EAST BASIN MAMARONECK HARBOR GOING UPSTREAM TO HALSTEAD AVENUE)
(CONTINUED)

PHYSICAL LOCATION	FEATURES							
	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 150 feet downstream of the Valley Place Sewer Bridge to the Halstead Avenue Bridge	36+00 to 41+40 (540)	60	Rectangular	Vertical	10.5 to 19.5	12, 24	3	Replacement of one USGS gage station currently located at 200 feet upstream of Valley Place Sewer Bridge (Station 39+50) is being relocated to River Street, 750 feet downstream of the New York Thruway (Station 80+62)

TABLE 3 - Pg 4/13

UPPER MAMARONECK PLAN OF IMPROVEMENT FEATURES

(FROM HALSTEAD AVENUE UPSTREAM TO PROJECT LIMIT AT THE WINFIELD AVENUE BRIDGE)

PHYSICAL LOCATION	FEATURES: STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From Halstead Avenue Bridge to 50 feet upstream of the Station Plaza Bridge	41+40 to 44+00 (260)	60	Rectangular	0	Varies from 12.5 to 36	Some 12	3.5	A V-shaped pilot channel starting with a depth of zero feet at the Station Plaza Bridge increases to .75 feet depth at the Jefferson Avenue Bridge Wall used to retain earth near parking lot

TABLE 3 - Pg 5/13

UPPER MAMARONECK PLAN OF IMPROVEMENT FEATURES

(FROM HALSTEAD AVENUE UPSTREAM TO PROJECT LIMIT AT THE WINFIELD AVENUE BRIDGE)

PHYSICAL LOCATION	FEATURES: STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 50 feet upstream of the Station Plaza Bridge to 100 feet upstream of Jefferson Avenue	44+00 to 49+90 (590)	50 to 60	Semi-Trapezoid	1V:2H to 1V:2.5H	Varies from 7 to 18	Some 18	3.5	The V-shaped pilot channel now at a .75 foot depth (Station 48+00) continues upstream for 900 feet until it reaches a depth of 1.5 feet (Station 57+00), its maximum depth. It then continues upstream at this depth. A Boulder field exists at 300 feet upstream of the Jefferson Avenue Bridge (Station 51+40)
From 100 feet upstream of Jefferson Avenue to 150 feet downstream of Hillside Avenue	49+90 to 57+20 (730)	50	Full Trapezoid	1 on 2 to 1 on 2.5	0			The 1.5 foot deep V-shaped pilot channel continues upstream through reach

TABLE 3 - Pg 6/13
UPPER MAMARONECK PLAN OF IMPROVEMENT FEATURES
(FROM HALSTEAD AVENUE UPSTREAM TO PROJECT LIMIT
AT THE WINFIELD AVENUE BRIDGE)
(CONTINUED)

PHYSICAL LOCATION	FEATURES: STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 150 feet downstream of the Hillside Avenue Bridge to 75 feet upstream of the Hillside Avenue Bridge	57+20 to 59+45 (225)	50	Rectangular	Vertical	Varies from 7 feet to 20 feet	18	3	1.5 foot deep V-shaped pilot channel continues upstream through reach.
From 75 feet upstream of the Hillside Avenue Bridge to New Barry Road	59+45 to 66+80 (735)	50	Semi-Trapezoid (right side) and full trapezoid	1V:2.5H	4.5 to 21	Varies from 12,30	4	1.5 foot deep V-shaped pilot channel continues upstream through reach. A boulder field is located at 270 feet upstream of the Hillside Avenue Bridge (Station 61+50)

TABLE 3 - Pg 7/13

UPPER MAMARONECK PLAN OF IMPROVEMENT FEATURES

(FROM HALSTEAD AVENUE UPSTREAM TO PROJECT LIMIT AT THE WINFIELD AVENUE BRIDGE)

(CONTINUED)

PHYSICAL LOCATION	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	FEATURES SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From New Barry Road to 740 feet upstream of New Barry Road	66+80 to 74+20 (740)	45	Semi-Trapezoid	1V:2H	6 to 19 on right bank 7 to 18 on left bank	None	4	1.5 foot deep V-shaped pilot channel continues upstream through reach
From 740 feet upstream of New Barry Road to 900 feet downstream of the New England Thruway	74+20 to 78+00 (380)	45	Full Trapezoid	1V:2.5H	7 to 14	None	4	1.5 foot deep V-shaped pilot channel continues upstream through reach
From 900 feet downstream of the New England Thruway to 580 feet downstream of the New England Thruway	78+00 to 85+10 (710)	45	Rectangular & Semi-Trapezoid	1V:2H to 1V:2.5H	Varies from 7 to 15	None	3.5	1.5 foot deep V-shaped pilot channel continues upstream through reach.
			Gage Station currently at 200 feet upstream of the Valley Place Sewer Bridge (Station 39+50) is being relocated to Bradley Street, 700 feet downstream of the New England Thruway (Station 80+50). Walls used to retain earth near roadway and structures.					

TABLE 3 - Pg 8/13
UPPER MAMARONECK PLAN OF IMPROVEMENT FEATURES
(FROM HALSTEAD AVENUE UPSTREAM TO PROJECT LIMIT
AT THE WINFIELD AVENUE BRIDGE)
(CONTINUED)

PHYSICAL LOCATION	FEATURES: STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICKNESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 580 feet downstream of the New England Thruway to the end of the project at 180 feet upstream of the Winfield Avenue Bridge (tie end reach)	85+10 to 121+20 (3610)	45	Full Trapezoid	1V:2.5H	0	12, 18	None	The 1.5 foot deep V-shaped pilot channel continues upstream until it tapers out at 550 feet downstream of the Winfield Avenue Bridge (Station 114+50) and incrementally terminates at 200 feet downstream of the Winfield Avenue Bridge (Station 116+50). At 600 feet upstream of the New England Thruway there will be a Log dam (Station 94+00). A rock dam will be located at 940 feet downstream of the Winfield Avenue Bridge (Station 109+60) at Ellis Place. Another rock dam will be located at 220 feet downstream of the Winfield Avenue Bridge (Station 116+80). A USGS gage station located at 20 feet downstream of the Winfield Avenue Bridge (Station 118+80) will be removed. At the end of Chestnut Avenue, 1600 feet downstream of the Winfield Avenue Bridge (Station 103+00) there is a small amount of old channel to be filled in approximately 2 feet. At Urban Street located at 400 feet downstream of the Winfield Avenue Bridge (Station 115+00) 200 feet of old channel will be filled in approximately a maximum of 4 feet.

TABLE 3 - Pg 9/13
THE LOWER SHELDRAKE RIVER
PLAN OF IMPROVEMENT FEATURES
(FROM THE CONFLUENCE WITH THE MAMARONECK RIVER
JUST DOWNSTREAM OF THE FOOTBRIDGE
IN COLUMBUS PARK TO FENIMORE ROAD)

PHYSICAL LOCATION	FEATURES							
	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICK-NESS-IN INCHES	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
Mamaroneck Avenue to Fenimore Road	0+00 to 28+00 (2800)	10	Full Trapezoid	1V:3H	None	None	Existing channel will be filled in an average depth of one foot.	Concrete weir structure 6 feethigh and 20 feet long will be placed near footbridge in Columbus Park (51+96) (200 feet up-stream of the confluence of the Mamaroneck River)

TABLE 3 - Pg 10/13
THE UPPER SHELDRAKE RIVER
PLAN OF IMPROVEMENT FEATURES
(FROM FENIMORE ROAD TO THE LARCHMONT GARDENS DAM)

PHYSICAL LOCATION	FEATURES: STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICK-NESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 360 feet upstream of Fenimore Road to 900 feet upstream of Fenimore Road	39+60 to 45+00 (540)	40	Full Trapezoid	1V:2H	None	Some 24	2.5	A V-shaped pilot channel starts at 550 feet upstream of Fenimore Road (Station 41+00) and becomes 1.5 feet deep. A log dam will b 850 feet above Fenimore Road (Staion 44+00)

TABLE 3 - Pg 11/13
UPPER SHELDRAKE RIVER
PLAN OF IMPROVEMENT FEATURES
(FROM FENIMORE ROAD TO THE LARCHMONT GARDENS DAM)
(CONTINUED)

PHYSICAL LOCATION	STATION LOCATION & LENGTH (FEET)	CHANNEL BOTTOM WIDTH (FEET)	FEATURES CHANNEL SHAPE	SIDE SLOPES	AVERAGE WALL HEIGHT (FEET)	RIPRAP LAYER (THICK-NESS-IN INCHES)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 900 feet upstream of Fenimore Road to 350 feet downstream of the Rockland Avenue Bridge	45+00 to 48+30 (330)	40	Semi Trapezoid (Right side)	1V:2.5H	7 to 10	24	1.5	The 1.5 foot deep V-shaped pilot channel continues upstream through reach.
From 350 feet downstream of the Rockland Avenue Bridge to the Rockland Avenue Bridge	50+00 to 53+00 (300)	40	Full Trapezoid	1V:2.5H	None	18	1	The V-shaped pilot channel tapers and ends at the Rockland Avenue Bridge.
From the Rockland Avenue Bridge to the New York State Thruway	53+50 to 62+00 (850)	Natural	Natural	Natural	None	12, 24, 36 in spots	No channel work 0	Clearing and snagging of channel.
From the New York State Thruway to Larchmont Gardens Dam	62+00 to 69+00 (700)	Natural	Natural	Natural	None	None	No channel work 0	Clearing and snagging of channel.

TABLE 3 - Pg 12/13
SHELDRAKE RIVER DIVERSION TUNNEL
PLAN OF IMPROVEMENT FEATURES
ORGANIZED INTO TUNNEL FEATURE SEGMENTS

PHYSICAL LOCATION	FEATURES: STATION LOCATION	LENGTH (FEET)	DESCRIPTION	WALL HEIGHT (FEET)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
West Basin Mamaroneck Harbor to 40 feet downstream of Boston Post Road	0+00 to 1+50	150	Tunnel outlet structure 212 feet long ends into harbor	26 to 30	Varies from 12 to 25	Stilling Basin at Harbor Entrance 47 feet long and 45 feet wide. Outlet structure connects harbor with 17.5 foot diameter U.S.B.R. horse-shoe shaped diversion tunnel.
From 40 feet downstream of Boston Post Road to Stanley Avenue	1+50 to 19+67	1817	Rock tunnel section having a U.S.B.R. horseshoe shape with a 17.5 foot diameter	None		
From Stanley Avenue to 200 feet downstream of the New Haven Railroad	19+67 to 20+75	108	Transition section (box culvert) linking 17.5 foot diameter (down-stream) horse-shoe shaped rock tunnel section with (up-stream) 16.25 foot square box culvert cut-and-cover tunnel section	None		

TABLE 3 - Pg 13/13
SHELDRAKE RIVER DIVERSION TUNNEL
PLAN OF IMPROVEMENT FEATURES
ORGANIZED INTO TUNNEL FEATURE SEGMENTS
(CONTINUED)

PHYSICAL LOCATION	FEATURES: STATION LOCATION	LENGTH (FEET)	DESCRIPTION	WALL HEIGHT (FEET)	AVERAGE DEPTH OF CUT (FEET)	OTHER PERTINENT PROJECT FEATURES
From 200 feet downstream of the New Haven Railroad to 100 feet upstream of Fenimore Road	20+75 to 37+00	1625	Square cut-and-cover box culvert tunnel section, 16.25 feet high, 16.25 feet wide	None	0	
From 100 feet upstream of Fenimore Road to 360 feet upstream of Fenimore Road	37+00 to 39+60	160	Tunnel inlet structure, 160 ± feet long	16 to 27	0	Transition width converts existing 60 foot channel bottom width to 16.25 tunnel diameter.

TABLE 4

TABLE OF RETAINING STRUCTURES

GDM PLAN

Table 4 - Page 1/5

MAMARONECK AND SHELDRAKE RIVERS
BASIN FLOOD CONTROL PROJECT

TABLE OF RETAINING STRUCTURES

Station	Bank	Length	Type of Wall	Height	Description
20+38 to 20+58	R	27	L w/Anchor	11	Transition from Trapezoidal Channel to Rectangular
20+58 to 21+00	R	42	L w/Anchor	11	In front of residence
21+00 to 21+22	R	34	L w/Anchor	10.5	Transition section
20+87 to 21+00	L	20	L w/Anchor	11	Transition section
21+00 to 22+85	L	185	L w/Anchor	8 to 14	New wall for channel widening
22+63 to 22+85	R	30	L w/Anchor	12.5	Wingwall at Tompkins Ave Bridge
23+38 to 23+65	L	27	L w/Anchor	9	
23+65 to 23+80	L	25	L w/Anchor		
23+38 to 26+24	R	275	L w/Anchor	13	New wall for channel widening and protection of Phillips Park Road
26+24 to 26+60	R	38	L w/Anchor	7	Transition section
30+88 to 31+05	R	30	L w/Anchor	11.5	Transition section
31+05 to 31+80	R	75	L w/Anchor	11.5 to 21.5	New wall for channel realignment
31+50 to 31+80	L	37	L w/Anchor	15.5 to 21.5	Wingwall at Ward Avenue Bridge
32+34 to 32+66	L	32	L w/Anchor	16.5 to 19.5	
32+66 to 32+93	L	45	L w/Anchor		

Table 4 - Page 2/5

MAMARONECK AND SHELDRAKE RIVERS
BASIN FLOOD CONTROL PROJECT

TABLE OF RETAINING STRUCTURES

Station	Bank	Length	Type of Wall	Height	Description
32+34 to 32+55	R	21	L w/Anchor		
32+55 to 32+90	R	45	L w/Anchor	13.5 to 19.5	Wingwall at Ward Avenue Bridge
35+15 to 35+40	R	37	L w/Anchor	11	Transition Section
35+40 to 37+45	R	205	L w/Anchor	10.5	New wall for channel widening and protection of existing structures
36+14 to 36+40	L	37	L w/Anchor	10.5	Transition Section
36+40 to 37+38	L	98	L w/Anchor	10.5	New wall for channel widening and protection of existing structures
37+51 to 40+74 37+58 to 40+66	L R	323 308	L w/Anchor L w/Anchor	10.5to19.5 10 to 10.5	New wall for channel widening and protection of existing structures
41+34 to 41+65 41+34 to 41+65	L R	36 28	Conc Facing IFO Existing Wall	12.5 12.5	18" conc Facing in front of existing wall for channel widening
42+30 to 43+04	L	80	L w/Shear Key	20.5 to 36	New wall in front of existing wall due to channel realignment
42+30 to 43+12	R	78	T	21.5	New wall for channel realignment
43+43 to 48+06	L	400	T on tremie conc	22 to 23	New wall to protect parking lot
43+66 to 44+49	R	85	T	7 to 21.5	Wingwall at New Station Plaza Bridge
47+92 to 48+13	R	45	T on tremie conc	7 to 17	Wingwall at Jefferson Ave Bridge
48+59 to 49+70	L	100	L w/perm sheeting	17.5	Wingwall at Jefferson Ave Bridge & wall protecting existing structure

Table 4 - Page 3/5
MAMARONECK AND SHELDRAKE RIVERS
BASIN FLOOD CONTROL PROJECT

TABLE OF RETAINING STRUCTURES

Station	Bank	Length	Type of Wall	Height	Description
48+65 to 49+33	R	75	T	13 to 16	Wingwall at Jefferson Ave Bridge
54+20 to 55+30	L	110	Conc. Faced Sheet Pile	7' Exposed	Steel Sheeting Wall at top of slope to protect existing residence
56+54 to 56+87	R	40	T	7 to 12	Transition section
56+87 to 58+47	R	160	L w/perm sheeting	12 to 18	New wall for channel widening and protection of existing structures
57+04 to 57+44	L	60	T	9 to 20	Transition section
57+44 to 58+33	L	89	L w/perm sheeting	20	New wall for channel widening and protection of existing structure
58+83 to 59+86	L	125	T	7 to 19	New wingwall at Hillside Ave Bridge
58+96 to 63+14	R	400	T	7 to 19	New wall for minor channel realignment
60+67 to 61+73	L	155	T	4.5 to 21	New wall for channel realignment and protection of end of Cedar Street
64+42 to 65+29	R	105	L on piles w/ perm sheeting	7 to 13	New wall for minor channel realignment and protection of existing structures
65+29 to 66+40	R	111	T on piles	13 to 18	New wall for minor channel realignment
66+10 to 66+36	L	40	T on piles	7 to 18	Wingwall at New Barry Road
66+80 to 67+60	R	100	T on piles	17 to 19	
66+95 to 74+17	L	150 570	T on piles T	7 to 14	New wall for channel widening
68+20 to 71+40	R	320	Conc. Faced Steel Pile	up to 6' Exposed	Steel Sheeting wall at new edge of channel toe of Thruway slope
71+60 to 74+00	R	240	-		

Table 4 - Page 4/5
MAMARONECK AND SHELDRAKE RIVERS
BASIN FLOOD CONTROL PROJECT

TABLE OF RETAINING STRUCTURES

Station	Bank	Length	Type of Wall	Height	Description
77+46 to 79+00	L	170	T	7 to 14	New wall for channel realignment
79+00 to 81+00	L	200	L w/perm sheeting	14	New wall for channel realignment and protection of 66" trunk sewer
81+00 to 85+22	L	435	T	8.5 to 15	New wall for channel widening
77+60 to 78+80	R	120	Conc. Faced Sheet Pile	up to 4.5' Exposed	Steel sheeting wall at new edge of channel toe of Thruway slope
78+73 to 82+75	R	410	T	9 to 12	New wall at new edge of channel/toe of Thruway slope
86+92 to 87+38	R	35	T	7 to 18	Wingwall at Thruway Bridge over Mamaroneck River
87+38 to 87+60	L	35	T	7 to 18	
88+68 to 89+08	R	50	T	3 to 11	
88+94 to 89+37	L	40	T	5 to 13	
			SHELDRAKE RIVER		
45+04 to 48+35	R	340	L on piles w/ perm sheeting	7 to 10	New wall for Sheldrake River widening & protection of existing structures
52+63 to 53+07	L	40	T	6.5 to 13	Wingwall at Rockland Ave Bridge
52+73 to 53+09	R	40	T	7 to 14	

Table 4 - Page 5/5
MAMARONECK AND SHELDRAKE RIVERS
BASIN FLOOD CONTROL PROJECT

TABLE OF RETAINING STRUCTURES

Station	Bank	Length	Type of Wall	Height	Description
			DIVERSION TUNNEL		
(-) 0+97 to (-) 0+62	-	90+80 L R	Conc. Faced Sheet Pile	30' Exposed	Steel Sheeting endwall at channel outlet
(-) 0+62 to 0+40	-	122	Conc. Channel on piles	26-30	Outlet Structure
0+40 to 1+50	-	90	Conc. Channel	26	Outlet Structure
37+00 to 38+17	-	117	Conc. Channel	24	Intake Structure
38+17 to 39+63	-	153 +153 L R	T	16 to 27	Conc. Retaining headwall at Tunnel inlet

Table 5

RIPRAP REQUIREMENTS *

RIVER	STATION FROM	STATION TO	RIPRAP LAYER THICKNESS
Mamaroneck	17+00	18+50	18"
	18+50	20+00	12"
	20+00	21+40	36"
	21+40	23+80	24"
	28+60	29+00	18"
	29+00	31+70	30"
	31+70	33+20	24"
	36+80	40+80	24"
	42+30	43+55	12"
	56+80	59+60	18"
	60+60	60+80	12"
	60+80	62+70	30"
	62+70	62+90	12"
	114+60	119+00	12"
	119+00	121+20	18"
Lower Sheldrake	1+65	1+90	12"
Upper Sheldrake	39+00	39+65	12"
	44+30	49+90	24"
	49+90	52+65	18"
	52+65	53+15	36"
	53+95	54+25	36"
	54+25	54+50	24"
	54+50	55+75	12"
	61+00	61+45	24"

* Notes: A 12" layer of riprap is provided at most of the drainage out falls.

TABLE 6

GDM PLAN OF IMPROVEMENT - SUMMARY OF FIRST COSTS
(OCTOBER 1988 PRICE LEVELS)

FEATURE	DESCRIPTION	ESTIMATED COST
09	CHANNELS AND CANALS	15,062,700
11	LEVEES AND FLOODWALLS	32,607,000
30	ENGINEERING AND DESIGN	2,022,500
31	SUPERVISION AND ADMINISTRATION	4,938,100
	SUB-TOTAL, FEDERAL AND NON-FEDERAL	54,630,300
	CASH CONTRIBUTION	(-)4,305,700
	SUB-TOTAL, FEDERAL COST	50,324,600

II- NON-FEDERAL COST

01	LANDS AND DAMAGES	5,755,500
02	RELOCATIONS	6,713,600
	CASH CONTRIBUTIONS	4,305,700
	SUB-TOTAL, NON-FEDERAL COST	16,774,800

III- TOTAL PROJECT COST

TOTAL FEDERAL COST	50,324,600
TOTAL NON-FEDERAL COST	16,774,800
TOTAL PROJECT COST	67,099,400

Table 7

SUMMARY OF ANNUAL CHARGES
October 1988 Price Level

	Federal	Non-Federal	IDC	Total Investment Cost
First Cost	$50,324,600	$16,774,800	$7,500,000	$74,599,400
Annualized Investment Cost	$ 4,467,200	$ 1,489,100	$ 665,800	$ 6,622,100
O & M	$ 0	$ 150,000	$ 0	$ 150,000
Total Annual Charges	$ 4,467,200	$ 1,639,100	$ 665,800	$ 6,772,100

TABLE 8

COMPARISON OF CURRENT COST ESTIMATE
WITH LATEST APPROVED PB-3
(OCT. 1988 PRICE LEVEL, $1,000)

FEATURE ITEM NO.	DESCRIPTION	LATEST PB-3	CURRENT ESTIMATE	CHANGE
	I FEDERAL			
09	Channels & Canals	$12,850.0	$15,062.7	(+) $2,212.7
11	Levees & Floodwalls	30,420.0	32,607.0	(+) 2,187.0
30	Engineering & Design	4,080.0	2,022.5	(-) 2,057.5
31	Supervision & Admint.	3,550.0	4,938.1	(+) 1,388.1
	Total Federal Cost	50,900.0	54,630.3	(+) $3,730.3
	Cash Contribution	-6,300.0	-4,305.7	(+) $1,994.3
	Total Federal Cost	$44,600.0	$50,324.6	(+) $5,724.6
	II NON-FEDERAL			
01	Lands & Damages	$3,690.0	$5,755.5	(+) $2,065.5
02	Relocations	4,910.0	6,713.6	(+) 1,803.6
	Cash Contribution	6,300.0	4,305.7	(-) 1,994.3
	Total Non-Federal Cost	$14,900.0	$16,774.8	(+) $1,874.8
	Total Project Cost	$59,500.0	$67,099.4	(+) $7,599.4

TABLE 9A
SUMMARY CALCULATION OF AVERAGE ANNUAL BENEFITS
EXISTING CONDITIONS
MAMARONECK AND SHELDRAKE RIVERS BASIN
1988 PRICE LEVEL

GDM PLAN
VILLAGE OF MAMARONECK

AREA		EXISTING ANNUAL DAMAGES	RESIDUAL ANNUAL DAMAGES	AVERAGE ANNUAL BENEFITS
REACH 1		$19,860	$0	$19,860
REACH 2	RB	$859,160	$110	$859,050
	LB	$30,030	$0	$30,030
REACH 3		$106,040	$970	$105,070
REACH 4	RB	$182,390	$4,030	$178,360
	LB	$78,470	$820	$77,650
REACH 5	RB	$4,044,970	$0	$4,044,970
	LB	$229,830	$0	$229,830
REACH 6		$579,980	$0	$579,980
REACH 7		$15,290	$5,240	$10,050
VILLAGE SUBTOTAL		$6,146,000	$11,200	$6,134,900

TABLE 9B
SUMMARY OF BENEFITS
GDM PLAN

ANNUAL BENEFITS	
INUNDATION REDUCTION BENEFITS	$6,134,850
AFFLUENCE FACTOR BENEFITS	$117,400
ADVANCE REPLACEMENT OF BRIDGES	$293,400
LESS FREQUENT PAVEMENT MAINTENANCE	$59,000
TRAFFIC & TIME DELAY	$700
FIA COST SAVINGS	$22,300
RED CROSS DISASTER RELIEF	$37,900
ADVANCE ACCRUAL OF PRE-PROJECT BENEFITS	$752,000
TOTAL AVERAGE ANNUAL BENEFITS (OCTOBER 1988 PRICE LEVEL)	$7,417,550

TABLE 10
SUMMARY OF ANNUAL COSTS
GDM PLAN *

Investment Costs	
Project Costs	67,099,000
Interest During Construction	7,500,000
	74,599,000
Annual Costs	
Interest & Amortization	6,622,000
Operation and Maintenance	150,000
Total Annual Costs	6,772,000

Economic Summary

Average Annual Benefits	7,418,000
Average Annual Costs	6,772,000
Net Annual Benefits	646,000
Benefit-Cost-Ratio	1.10

* Oct 1988 Price Level
8-7/8% Interest Rate
100 Year Project Life

Table 11

SENSITIVITY ANALYSIS

	PERCENT REDUCTION IN BENEFITS			
	0%	10%	25%	50%
ANNUAL COSTS (1) 1/	6,772,000	6,772,000	6,772,000	6,772,000
ANNUAL BENEFITS (1)	7,417,600	6,675,800	5,563,200	3,708,800
B/C RATIO	1.10	.99	.82	.55

1/ Includes interest during construction

Table 12 - Page 1/3
MAMARONECK & SHELDRAKE G.D.M.
PERTINENT DESIGN CHANGES
SINCE FEASIBILITY REPORT

Description	Feasibility Report	GDM	Reason for Change
Mamaroneck downstream of Tompkins Avenue	60' bottom width throughout	60' bottom width with 100' of 45' bottom	Development on the banks prevented channel widening
Tompkins Avenue Bridge	Remains	Replace with a 60' span	Increased capacity to accommodate the 32% increase in flows.
Valley Place Sewer Bridge	Replace with an inverted siphon	Replace with a 60' span	Improved sewage flow, less cost and maintenance, preferred by local officials.
Mamaroneck from Jeff. Ave. to upstream project limit.	45' bottom	45' to 50' bottom	Increased capacity to accommodate the 32% increase in flows.
Fish and Wildlife mitigation measures	All included (except concrete weir) but not detailed	1.5' deep V-shaped pilot channel, 2 log dams, 2 rock dams, 2 boulder fields, and one concrete weir	Finalized design recommendations coordinated with the U.S. Fish and Wildlife Service.
Upstream section of tunnel	15'x15' square cross-section	16.25'x16.25' square cross-section	Accommodate the 17% increase in flows; Detailed hydraulic design.
Upstream/Downstream transition of tunnel	10' length	108' length	Model Study Recommendation

Table 12 - Page 2/3
MAMARONECK & SHELDRAKE G.D.M.
PERTINENT DESIGN CHANGES
SINCE FEASIBILITY REPORT

Description	Feasibility Report	GDM	Reason for Change
Downstream tunnel section	15.5' Diameter circular cross-section	17.5' Diameter U.S.B.R. horseshoe	Accommodate the 17% increase in flows; and detailed hydraulic design.
Stilling Basin	45' Width, 110' length	45' width, 137' length	Model Study Recommendation
Sheldrake below diversion	Remain as existing	Re-grade to maintain positive flow	Prevent stagnant water.
Footbridge in Station Plaza Bridge	Remove	Remain as existing	Cost savings.
Local Drainage	Not specified	Various catch basins, ditches, and headwalls	More detailed level design; maintain overland flow.
Levees on Sheldrake R. near Thruway	300' long. 8' high	None	Channel provides the needed protection. Levees are not economically justified
Interior drainage for levee	Some	None	No levees
Riprap	Minimal	As required	Detailed hydraulic design item.

Table 12 - Page 3/3
MAMARONECK & SHELDRAKE G.D.M.
PERTINENT DESIGN CHANGES
SINCE FEASIBILITY REPORT

Description	Feasibility Report	GDM	Reason for Change
Upstream limit of channel modification project on Sheldrake River	Work extends to the NY Thruway	Channelization extends to Rockland Avenue Bridge. Clearing and de-snagging extends to the Larchmont Gardens Dam	Rockland Ave. bridge found to be concrete lined. Bridge modification and channel work to Thruway not justified.
Excavation	Survey level analysis	Quantities Change	New Survey
Walls	Preliminary Analysis	More retaining walls required discovered in a refined survey	Design Revision
Sheeting (non-tunnel) diversion and dewatering, clearing and grubbing; maintain and protect traffic	Preliminary Analysis	Design Refinements	Cost and Design Refinements
Fill Areas	Preliminary Analysis	Design Refinements	New Survey

TABLE 13 CONSTRUCTION AND EXPENDITURE SCHEDULE (DOLLARS) - OCT. 1988 PRICE LEVELS

	PRIOR TIME	1988	1989	1991	1992	1993	1994	1995	TOTALS
Preparation Of Draft GDM	995,000			NO WORK TO BE DONE IN FY '90					
Review & Approval Of Final GDM									
Preparation Of Plans & Specs.			180,000 Contract I (Lower Mam.)	550,000 Contract II, III (U. Mam. & Sheldrake)	280,000				
Review & Approval Of Plans & Specs.			I	I 80,000*	II, III				
Advertise, Open & Evaluate Bids				I	II, III				
Engineering During Construction				8,200	24,700	59,500	100,400	74,700	2,352,500
Supervision, Inspec. & Administration	430,000	85,000		430,300	550,700	1,010,900	1,706,300	1,270,100	5,483,300
Contract No. I Lower Mam. River - Sta. 17 to 41+40 (Channels & Canals)				1,650,000	4,949,700				6,599,700
(Relocations/Bridges)				(878,900)	(2,636,500)				(3,515,400)
(Relocations/Utilities)				(583,000)	(1,748,900)				(2,331,900)
				(188,100)	(564,300)				(752,400)
Contract No. II Upper Mam. River - Sta. 41+40 to 121+20 (Channels & Canals)						7,551,300	5,033,700		12,585,000
(Relocations/Bridges)						(6,073,700)	(4,048,800)		(10,122,500)
(Relocations/Utilities)						(722,600)	(481,800)		(1,204,400)
						(755,000)	(503,100)		(1,258,100)
Contract No. III Sheldrake River (Channels & Canals)						4,341,800	15,040,800	14,940,800	34,323,400
(Relocations/Utilities)						(4,250,000)	(14,890,800)	(14,890,800)	(34,031,600)
						(91,800)	(150,000)	(50,000)	(291,800)
Real Estate				1,717,700 CONTRACT I; 807,600 Contracts II & III	3,230,200				5,755,500
TOT. EXPENDIT.	1,425,000	265,000		5,243,800	9,035,300	12,963,500	21,881,200	16,285,600	67,099,400
TOTAL FEDERAL	1,425,000	265,000		1,615,000	2,883,000	10,322,900	18,930,500	14,883,200	50,324,600
TOTAL NON-FEDERAL	0	0		3,628,800	6,152,300	2,640,600	2,950,700	1,402,400	16,774,800

* E & D for Contract No. I bridge design by locals.

TABLE 14

FUNDING SCHEDULE

	Federal	Non-Federal	Total
FY 88 and Prior	$1,425,000	0	$1,425,000
FY 89	265,000	0	265,000
FY 90	0	0	0
FY 91	1,615,000	$3,628,800	5,243,800
FY 92	2,883,000	6,152,300	9,035,300
FY 93	10,322,900	2,640,600	12,963,500
FY 94	18,930,500	2,950,700	21,881,200
FY 95	14,883,200	1,402,400	16,285,600
Subtotal	$50,324,600	$16,774,800	
Total	$67,099,400		

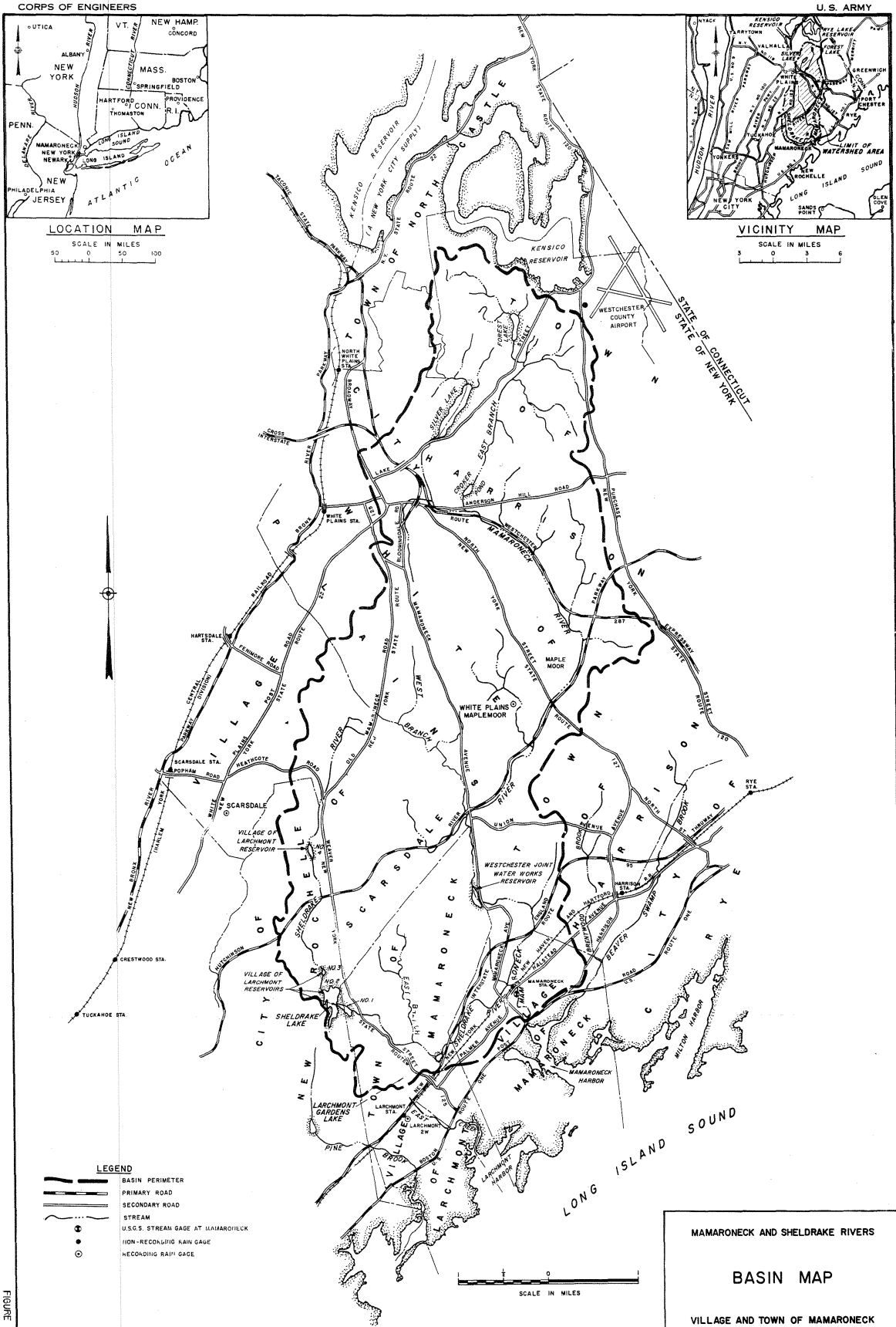
WESTCHESTER COUNTY STREAMS
MAMARONECK AND SHELDRAKE RIVERS
FLOOD CONTROL PROJECT
VILLAGE OF MAMARONECK, NEW YORK

LIST OF FIGURES

FIGURE	TITLE
1	BASIN MAP
1A	GENERAL PLAN - FEASIBILITY REPORT LEVEL OF DESIGN (AUTHORIZED PLAN)
2	GENERAL PLAN - GDM PLAN
3-24	PLAN SHEETS
25-32	CHANNEL PROFILES
33-44	TYPICAL CROSS SECTIONS
45-46	TYPICAL CROSS SECTIONS AND DETAILS - TUNNEL
47	TYPICAL CROSS SECTIONS TUNNEL
48	TYPICAL CHANNEL SECTIONS
49-50	TYPICAL WALLS
51-68	BRIDGES
69-74	UTILITIES
75	USGS GAGE STATION

CORPS OF ENGINEERS

U.S. ARMY



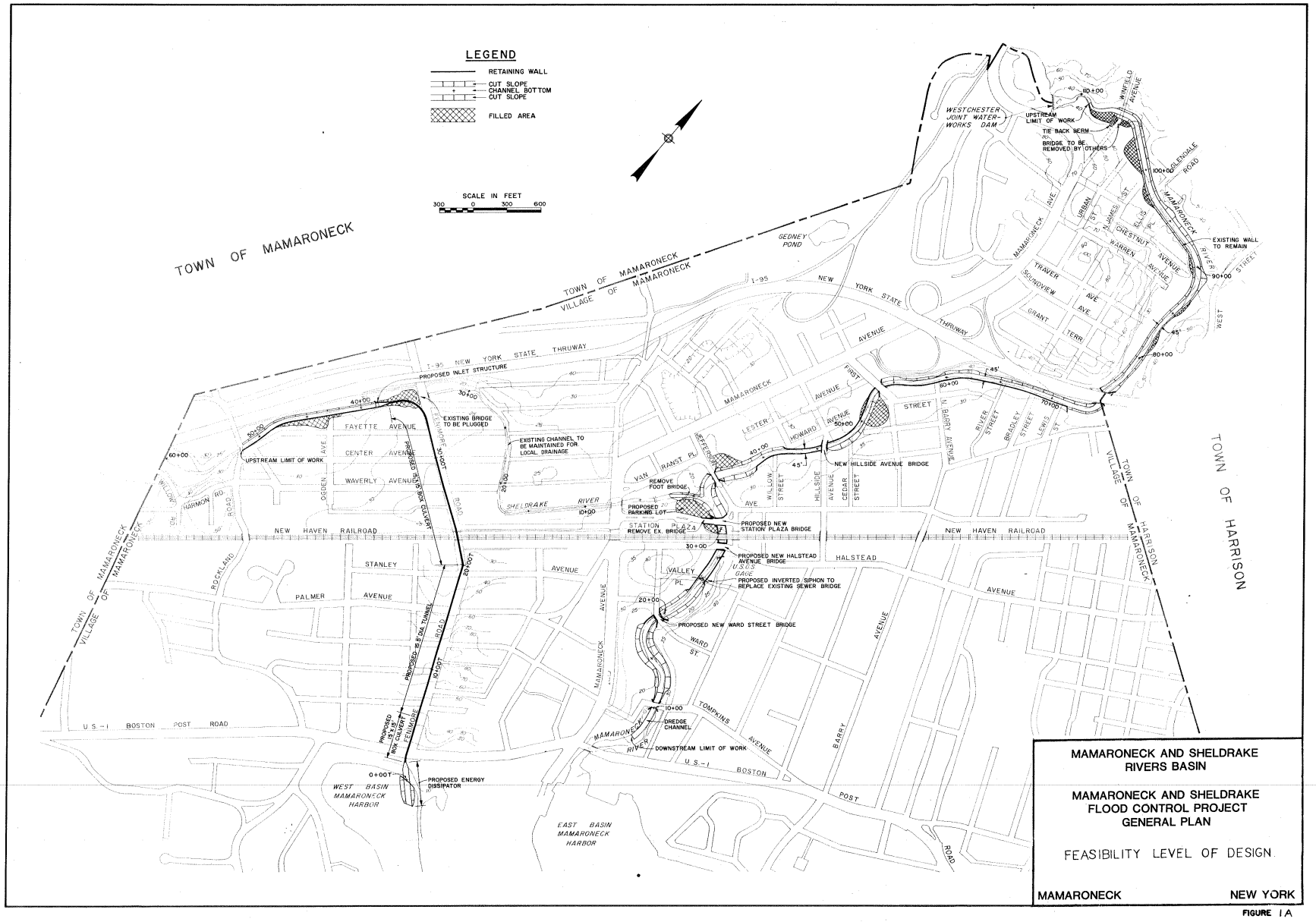
MAMARONECK AND SHELDRAKE RIVERS

BASIN MAP

VILLAGE AND TOWN OF MAMARONECK

FIGURE 1

FIGURE 1



MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT GENERAL PLAN

FEASIBILITY LEVEL OF DESIGN

MAMARONECK **NEW YORK**

FIGURE 1A

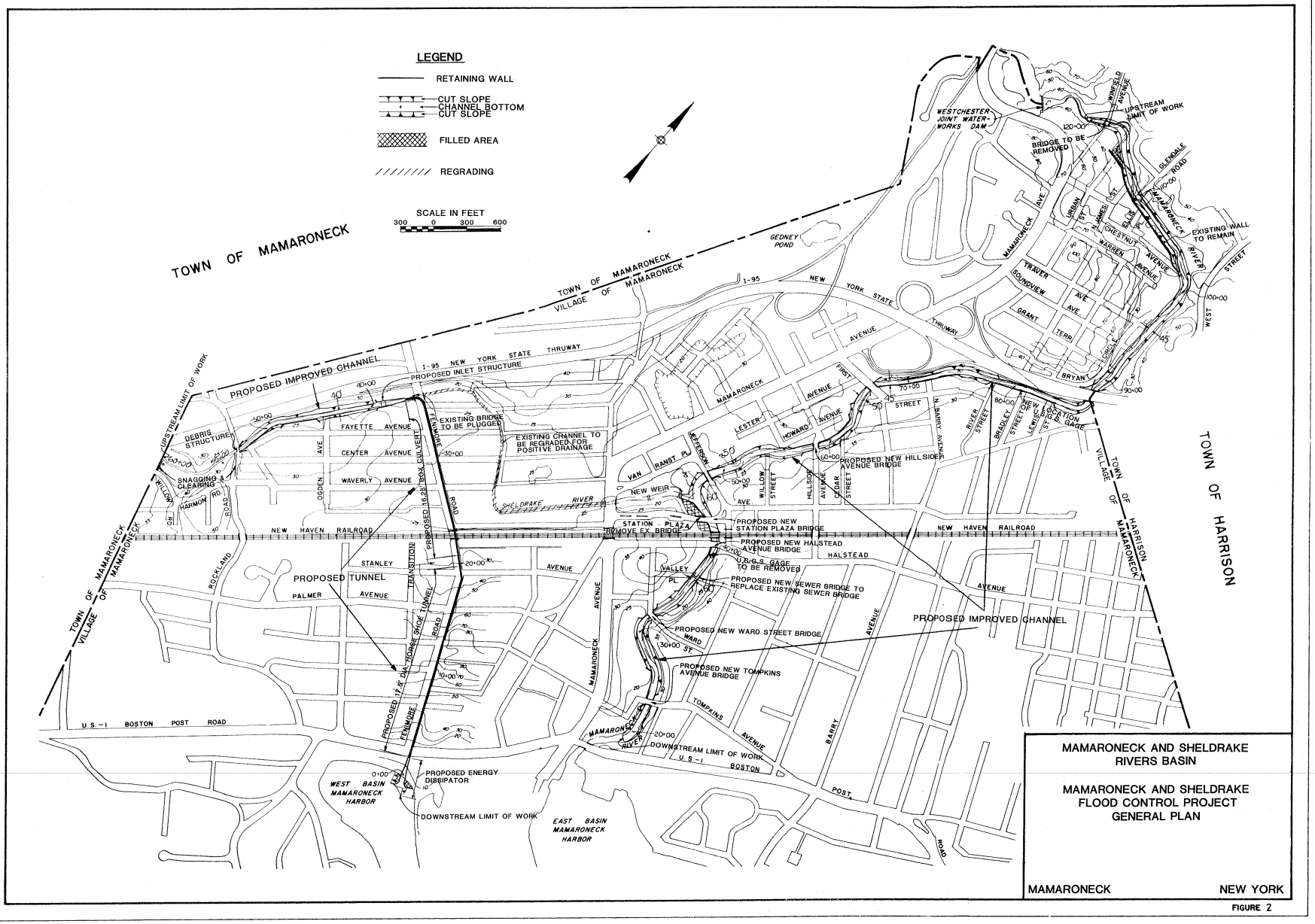
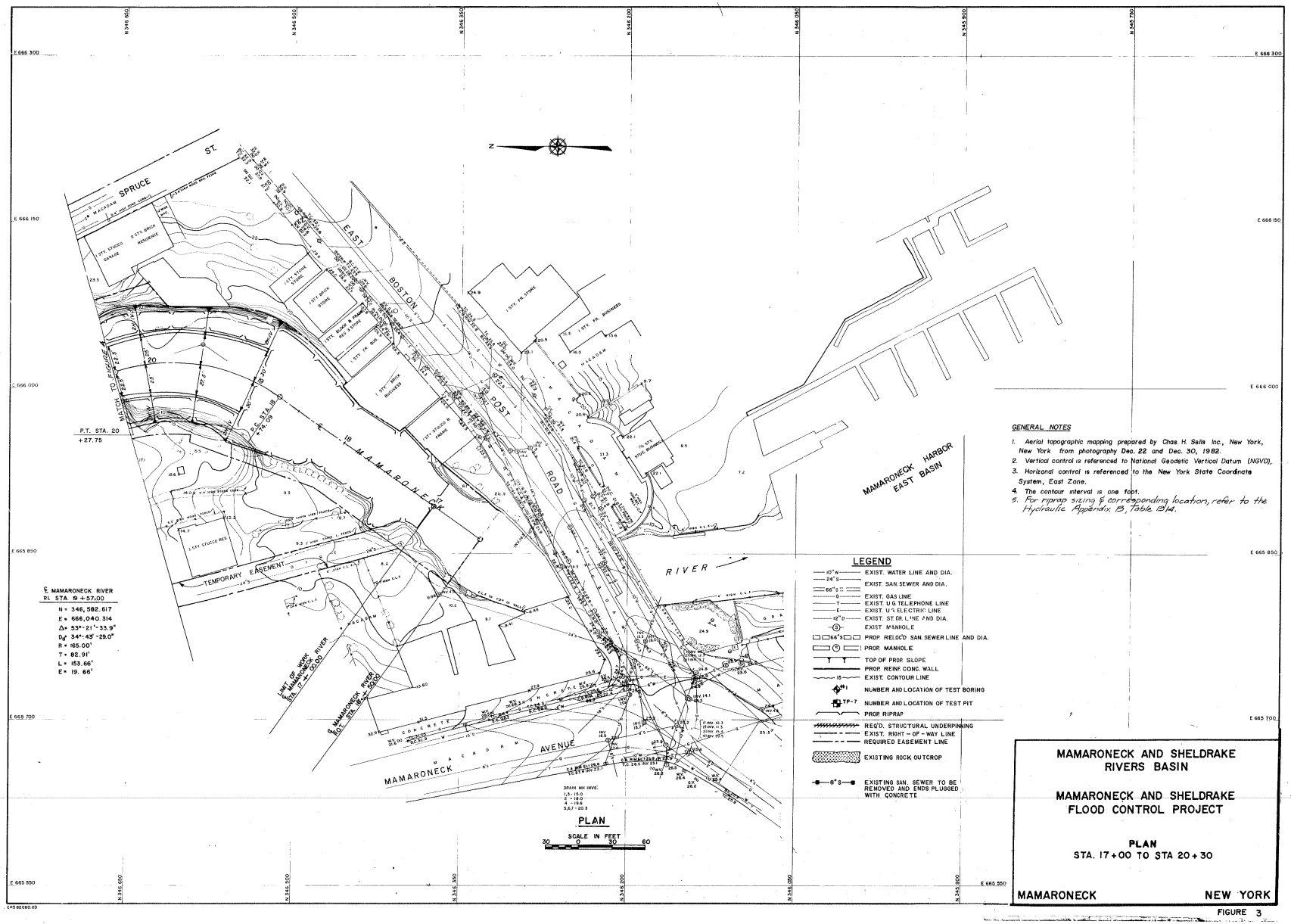

LEGEND
RETAINING WALL
CUT SLOPE
CHANNEL BOTTOM
CUT SLOPE
FILLED AREA
REGRADING
SCALE IN FEET
300 0 300 600
TOWN OF MAMARONECK
TOWN OF HARRISON
VILLAGE OF MAMARONECK
TOWN OF MAMARONECK
VILLAGE OF MAMARONECK
TOWN OF MAMARONECK
VILLAGE OF MAMARONECK
TOWN OF HARRISON
WESTCHESTER JOINT WATER-WORKS DAM
UPSTREAM LIMIT OF WORK
BRIDGE TO BE REMOVED
EXISTING WALL TO REMAIN
GEDNEY POND
I-95 NEW YORK STATE THRUWAY
PROPOSED IMPROVED CHANNEL
PROPOSED INLET STRUCTURE
UPSTREAM LIMIT OF WORK
DEBRIS STRUCTURE
SNAGGING & CLEARING
EXISTING BRIDGE TO BE PLUGGED
EXISTING CHANNEL TO BE REGRADED FOR POSITIVE DRAINAGE
PROPOSED 16.25' DIA. CULVERT
NEW WEIR
SHELDRAKE RIVER
STATION PLAZA
REMOVE EX. BRIDGE
PROPOSED NEW STATION PLAZA BRIDGE
PROPOSED NEW HALSTEAD AVENUE BRIDGE
U.S.G.S. GAGE TO BE REMOVED
PROPOSED NEW SEWER BRIDGE TO REPLACE EXISTING SEWER BRIDGE
PROPOSED NEW WARD STREET BRIDGE
PROPOSED NEW TOMPKINS AVENUE BRIDGE
PROPOSED NEW HILLSIDE AVENUE BRIDGE
NEW HAVEN RAILROAD
PROPOSED TUNNEL
PROPOSED 14.6' DIA. HORSE SHOE TUNNEL
PROPOSED ENERGY DISSIPATOR
DOWNSTREAM LIMIT OF WORK
WEST BASIN MAMARONECK HARBOR
EAST BASIN MAMARONECK HARBOR
U.S.-1 BOSTON POST ROAD
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT GENERAL PLAN
MAMARONECK
NEW YORK

FIGURE 2



GENERAL NOTES

1. Aerial topographic mapping prepared by Chas. H. Sells Inc., New York, New York from photography Dec. 22 and Dec. 30, 1982.
2. Vertical control is referenced to National Geodetic Vertical Datum (NGVD).
3. Horizontal control is referenced to the New York State Coordinate System, East Zone.
4. The contour interval is one foot.
5. For riprap sizing & corresponding location, refer to the Hydraulic Appendix B, Table B14.

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

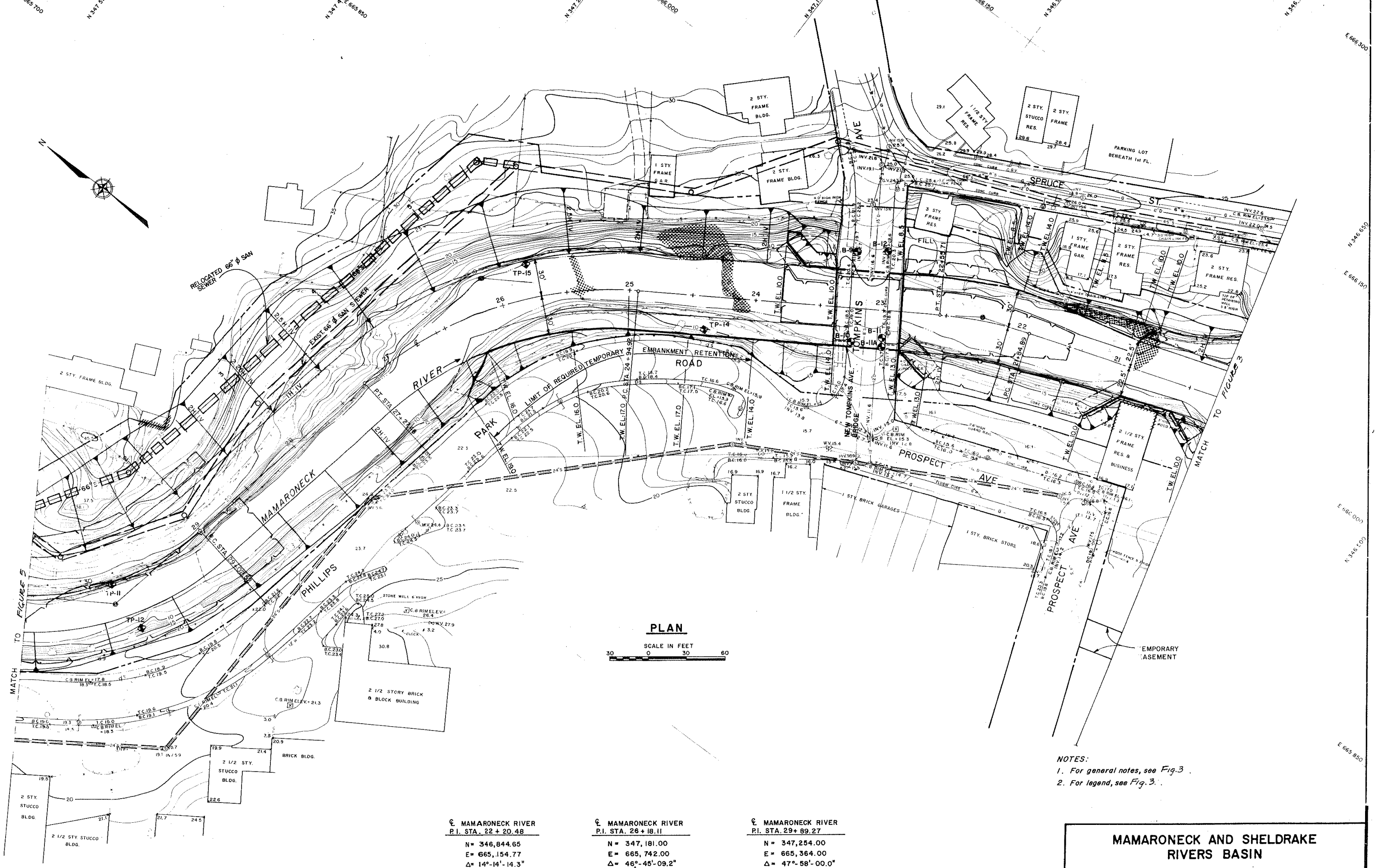
PLAN

STA. 17+00 TO STA 20+30

MAMARONECK NEW YORK

FIGURE 3

CHS 82080.03



℄ MAMARONECK RIVER P.I. STA. 22 + 20.48
N = 346,844.65
E = 665,154.77
Δ = 14°-14'-14.3"
D_a = 20°-06'-13.6"
R = 285.00'
T = 35.59'
L = 70.82'
E = 2.21'

℄ MAMARONECK RIVER P.I. STA. 26 + 18.11
N = 347,181.00
E = 665,742.00
Δ = 46°-45'-09.2"
D_a = 20°-06'-13.6"
R = 285.00'
T = 123.19'
L = 232.56'
E = 25.48'

℄ MAMARONECK RIVER P.I. STA. 29 + 89.27
N = 347,254.00
E = 665,364.00
Δ = 47°-58'-00.0"
D_a = 29°-22'-56.8"
R = 195.00'
T = 86.75'
L = 163.25'
E = 18.43'

NOTES:

1. *For general notes, see Fig. 3.*
2. *For legend, see Fig. 3.*

MAMARONECK AND SHELDRAKE RIVERS BASIN

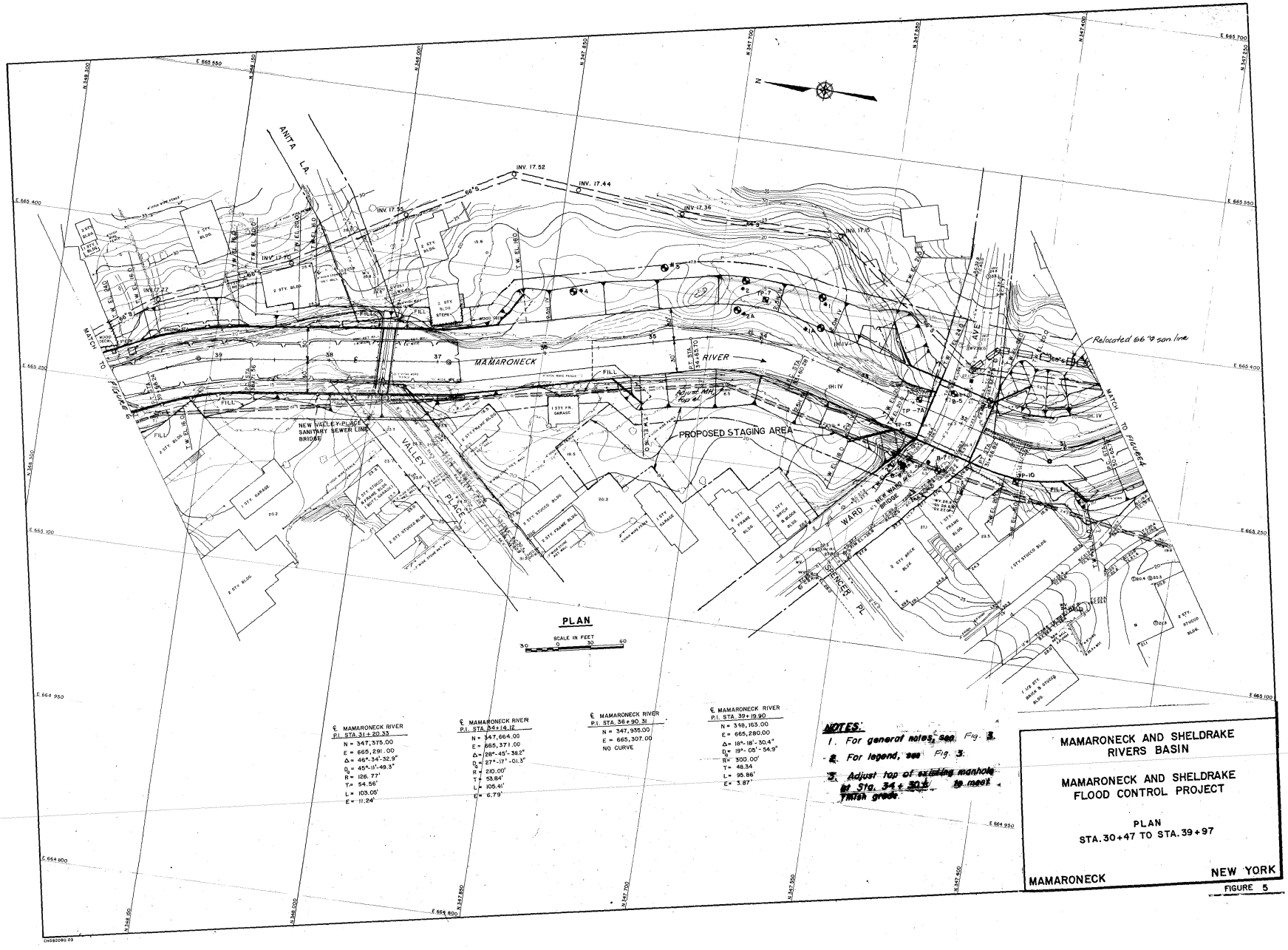
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
STA. 20+30 TO STA. 30+47

MAMARONECK — **NEW YORK**

CHS82080.03

FIGURE 4



℄ MAMARONECK RIVER
P.I. STA. 31 + 20.33
N = 347,375.00
E = 665,291.00
Δ = 46°-34'-32.9"
D_c = 45°-11'-49.3"
R = 126.77'
T = 54.56'
L = 103.09'
E = 11.24'

℄ MAMARONECK RIVER
P.I. STA. 34 + 16.12
N = 347,664.00
E = 665,371.00
Δ = 128°-45'-38.2"
D_c = 27°-17'-01.3"
R = 210.00'
T = 53.84'
L = 105.41'
E = 6.79'

℄ MAMARONECK RIVER
P.I. STA. 36 + 90.31
N = 347,955.00
E = 665,307.00
NO CURVE

℄ MAMARONECK RIVER
P.I. STA. 39 + 19.90
N = 348,163.00
E = 665,280.00
Δ = 18°-18'-30.4"
D_c = 19°-09'-54.9"
R = 300.00'
T = 48.34
L = 95.86'
E = 3.87'

NOTES:

1. For general notes, see Fig. 3.
2. For legend, see Fig. 3.
3. Adjust top of existing manhole at Sta. 34 + 30.5 to meet finish grade.

MAMARONECK AND SHELDRAKE RIVERS BASIN

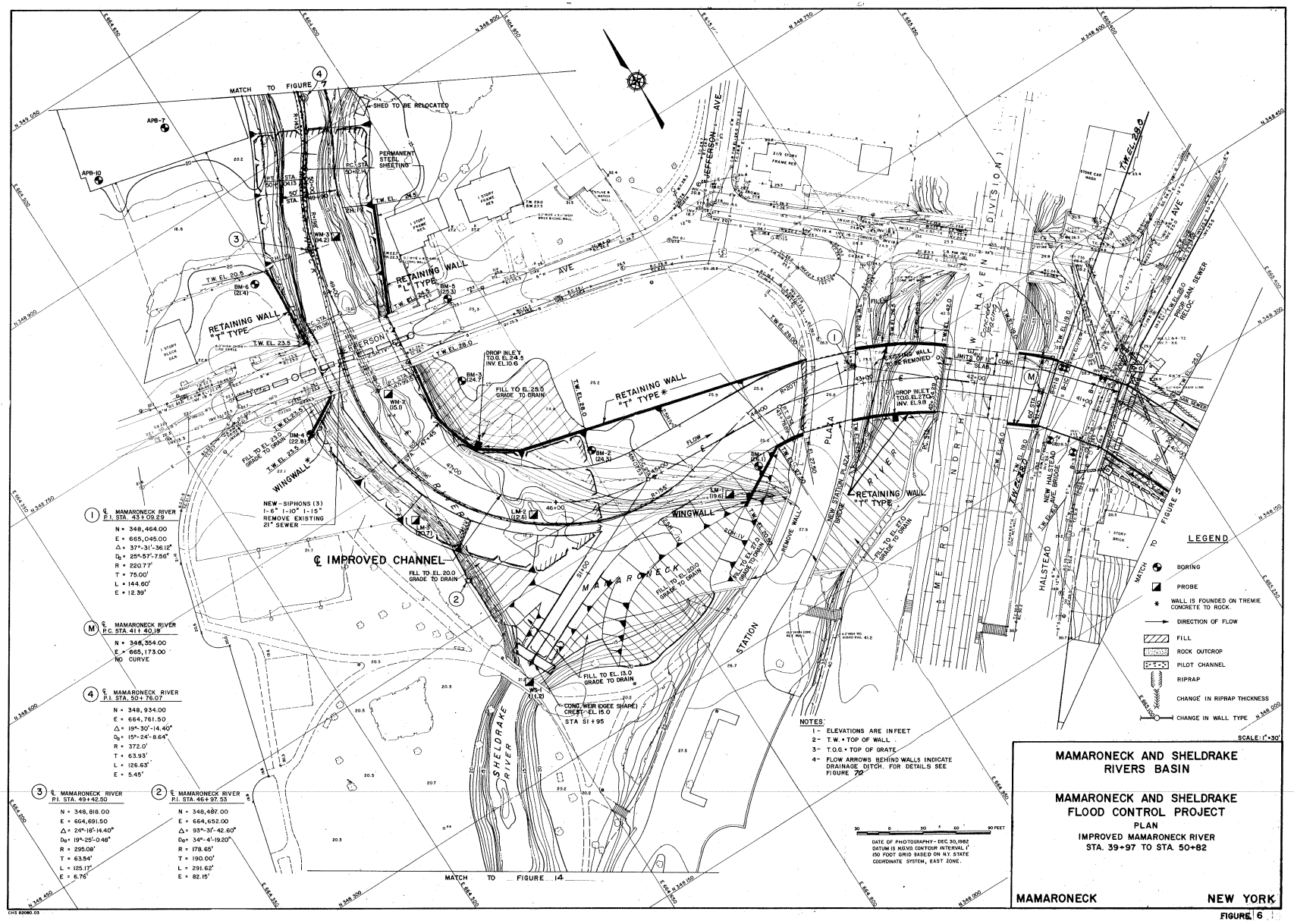
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
STA. 30+47 TO STA. 39+97

MAMARONECK NEW YORK

FIGURE 5

CHG82090.03



(1) ℄ MAMARONECK RIVER
P.I. STA. 43+09.29
N = 348,464.00
E = 665,045.00
Δ = 37°-31'-36.12"
D_B = 25°-57'-7.56"
R = 220.77'
T = 75.00'
L = 144.60'
E = 12.39'

(M) ℄ MAMARONECK RIVER
P.C. STA. 41+40.19
N = 348,354.00
E = 665,173.00
NO CURVE

(4) ℄ MAMARONECK RIVER
P.I. STA. 50+76.07
N = 348,934.00
E = 664,761.50
Δ = 19°-30'-14.40"
D_B = 15°-24'-8.64"
R = 372.0'
T = 63.93'
L = 126.63'
E = 5.45'

(3) ℄ MAMARONECK RIVER
P.I. STA. 49+42.50
N = 348,818.00
E = 664,691.50
Δ = 24°-18'-14.40"
D_B = 19°-25'-0.48"
R = 295.08'
T = 63.54'
L = 125.17'
E = 6.76'

(2) ℄ MAMARONECK RIVER
P.I. STA. 46+97.53
N = 348,487.00
E = 664,652.00
Δ = 93°-31'-42.60"
D_B = 34°-4'-19.20"
R = 178.65'
T = 190.00'
L = 291.62'
E = 82.15'

FIGURE 6

5 ℄ MAMARONECK RIVER
P.I. STA. 54+17.85

N = 349,270.00
E = 664,830.50
Δ = 34°-5'-0.24"
D_G = 15°-24'-7.56"
R = 372.0'
T = 114.02'
L = 221.29'
E = 17.08'

6 ℄ MAMARONECK RIVER
P.I. STA. 56+46.58

N = 349,434.50
E = 664,999.00
Δ = 19°-31'-15.24"
D_G = 8°-12'-47.16"
R = 697.6'
T = 120'
L = 237.68'
E = 10.25'

CHS82080.03

MAMARONECK AND SHELDRAKE RIVERS BASIN

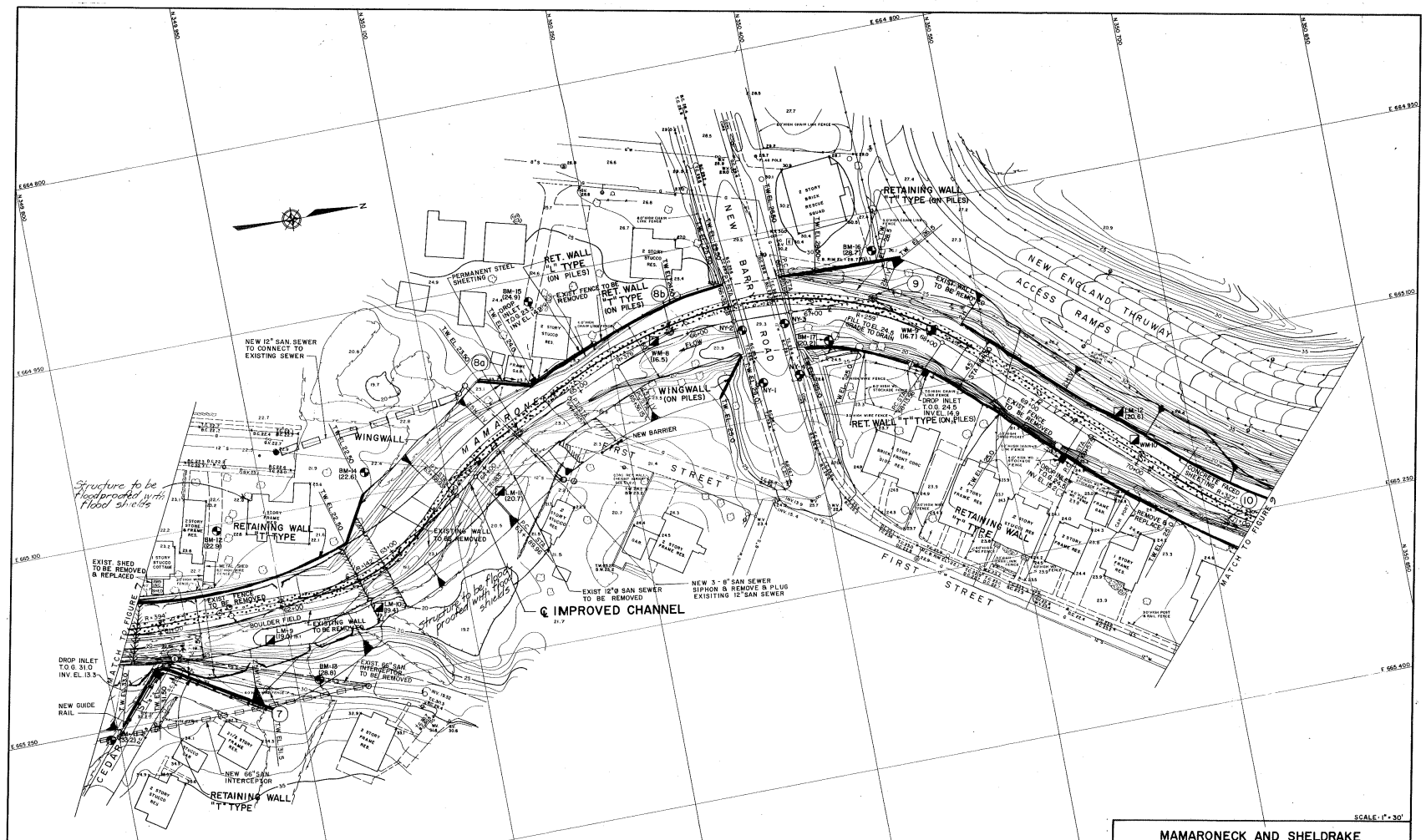
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN

IMPROVED MAMARONECK RIVER
STA. 50+82 TO STA. 60+71

MAMARONECK NEW YORK

FIGURE 7



7 ℄ MAMARONECK RIVER P.I. STA. 61+91.89	8a ℄ MAMARONECK RIVER P.I. STA. 64+39.86	8b ℄ MAMARONECK RIVER P.I. STA. 65+88.15	9 ℄ MAMARONECK RIVER P.I. STA. 67+52.64	10 ℄ MAMARONECK RIVER P.I. STA. 70+87.51
N = 349,926.00	N = 350,164.00	N = 350, 301.00	N = 350,467.00	N = 350,714.00
E = 665,240.50	E = 665,073.00	E = 665, 015.50	E = 665,020.00	E = 665,255.00
Δ = 61°-24'-59.4"	Δ = 12°-22'-8.40"	Δ = 24°- 19'-15.60"	Δ = 42°-1'-15.60"	Δ = 18°-3'-1.44"
D_B = 15°-28'-6.96"	D_B = 12°-25'-2.64"	D_B = 23°- 44'-38.40"	D_B = 32°-50'-39.48"	D_B = 7°-0'-1.08"
R = 370.40'	R = 461.42'	R = 241.31'	R = 174.45'	R = 818.46'
T = 220.00'	T = 50.00'	T = 52.00'	T = 67.00'	T = 130.00'
L = 397.04'	L = 99.61'	L = 102.43'	L = 127.94'	L = 257.85'
E = 60.41'	E = 2.70'	E = 5.54'	E = 12.42'	E = 10.26'

CHS 82080.03

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

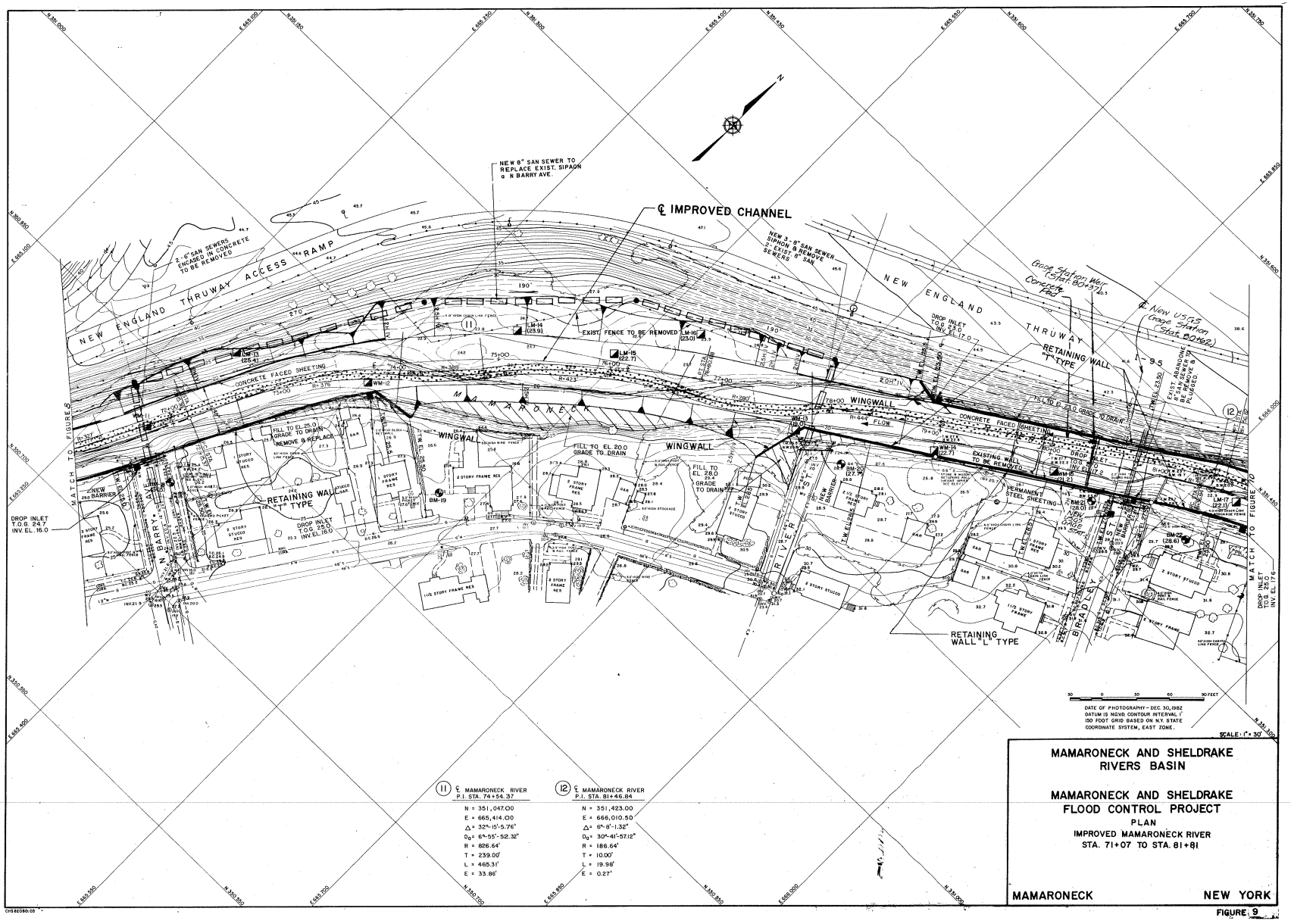
PLAN

IMPROVED MAMARONECK RIVER

STA. 60+71 TO STA. 71+07

MAMARONECK **NEW YORK**

FIGURE 8



(11) ℄ MAMARONECK RIVER
P.I. STA. 74+54.37

N = 351,047.00
E = 665,414.00
Δ = 32°-15'-5.76"
D_G = 6°-55'-52.32"
R = 826.64'
T = 239.00'
L = 465.31'
E = 33.86'

(12) ℄ MAMARONECK RIVER
P.I. STA. 81+46.84

N = 351,423.00
E = 666,010.50
Δ = 6°-8'-1.32"
D_G = 30°-41'-57.12"
R = 186.64'
T = 10.00'
L = 19.98'
E = 0.27'

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

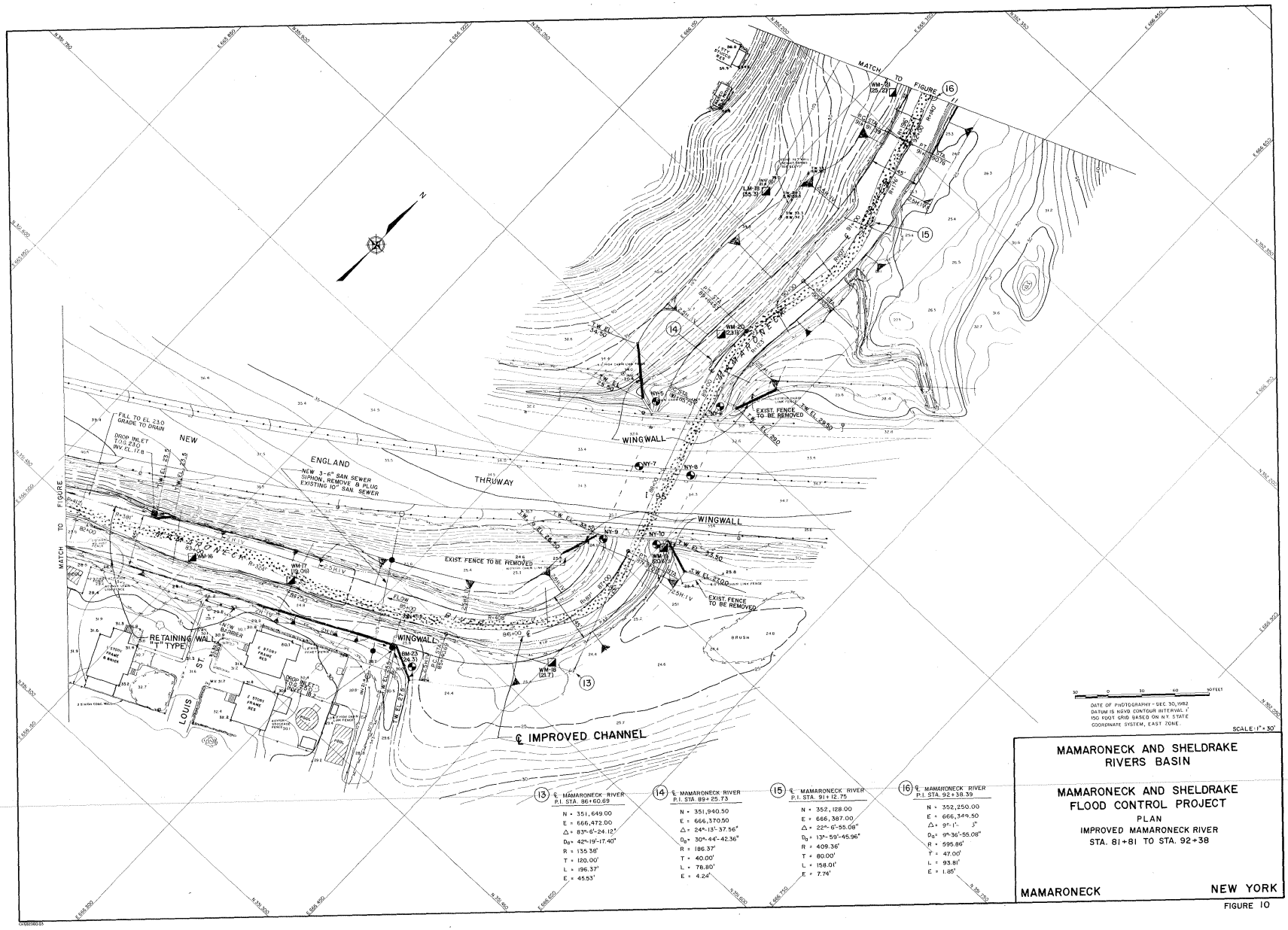
PLAN

IMPROVED MAMARONECK RIVER
STA. 71+07 TO STA. 81+81

MAMARONECK NEW YORK

FIGURE 9

CHS 82080.03



13 ℄ MAMARONECK RIVER P.I. STA. 86+60.69	14 ℄ MAMARONECK RIVER P.I. STA. 89+25.73	15 ℄ MAMARONECK RIVER P.I. STA. 91+12.75	16 ℄ MAMARONECK RIVER P.I. STA. 92+38.39
N = 351,649.00	N = 351,940.50	N = 352,128.00	N = 352,250.00
E = 666,472.00	E = 666,370.50	E = 666,387.00	E = 666,349.50
Δ = 83°-6'-24.12"	Δ = 24°-13'-37.56"	Δ = 22°-6'-55.08"	Δ = 9°-1'- 3"
D_a = 42°-19'-17.40"	D_a = 30°-44'-42.36"	D_a = 13°-59'-45.96"	D_a = 9°-36'-55.08"
R = 135.38'	R = 186.37'	R = 409.36'	R = 595.86'
T = 120.00'	T = 40.00'	T = 80.00'	T = 47.00'
L = 196.37'	L = 78.80'	L = 158.01'	L = 93.81'
E = 45.53'	E = 4.24'	E = 7.74'	E = 1.85'

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

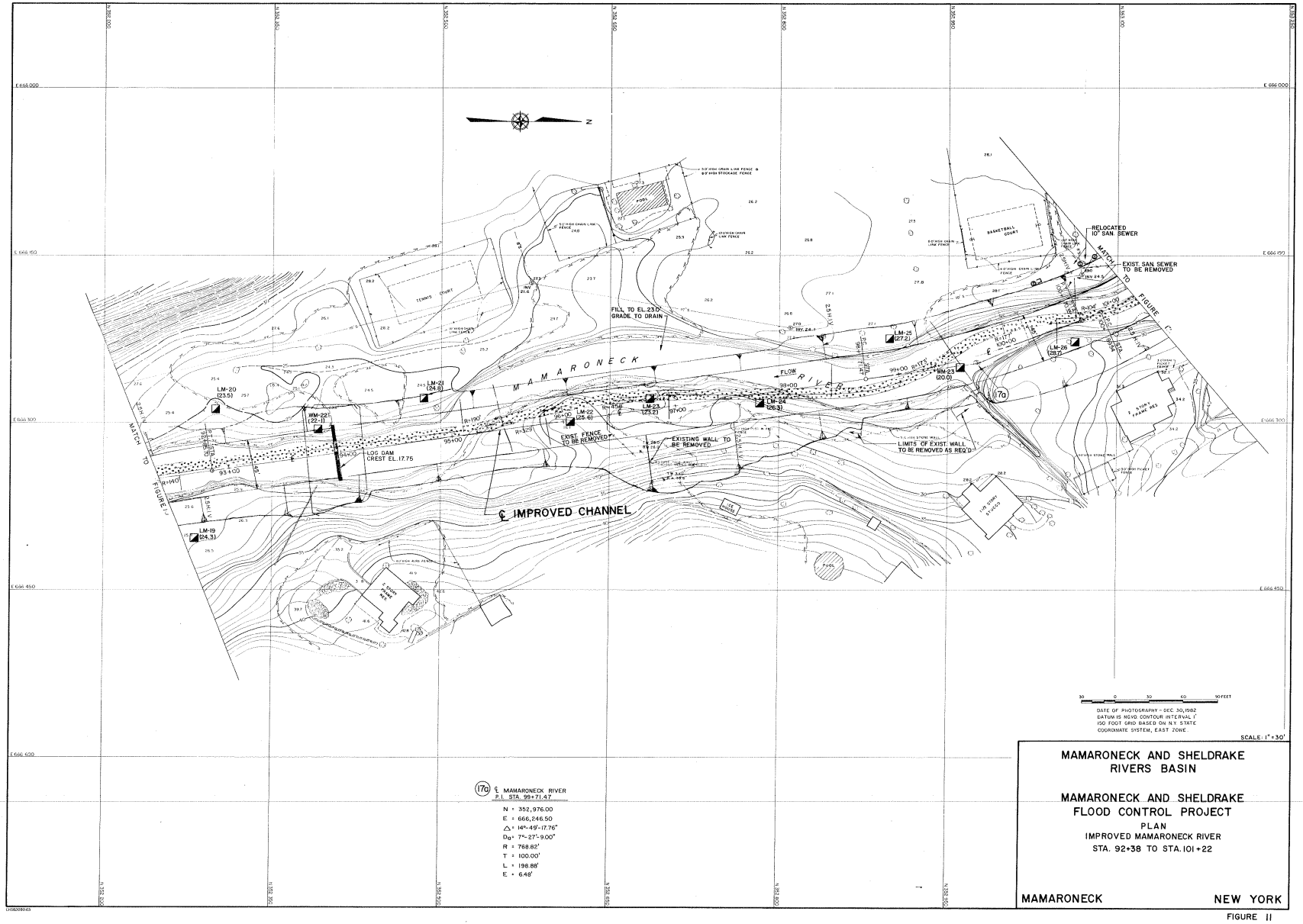
PLAN

IMPROVED MAMARONECK RIVER

STA. 81+81 TO STA. 92+38

MAMARONECK NEW YORK

FIGURE 10



(17a) ℄ MAMARONECK RIVER
P.I. STA. 99+71.47

N = 352,976.00
E = 666,246.50
△ = 14°-49'-17.76"
D_a = 7°-27'-9.00"
R = 768.82'
T = 100.00'
L = 198.88'
E = 6.48'

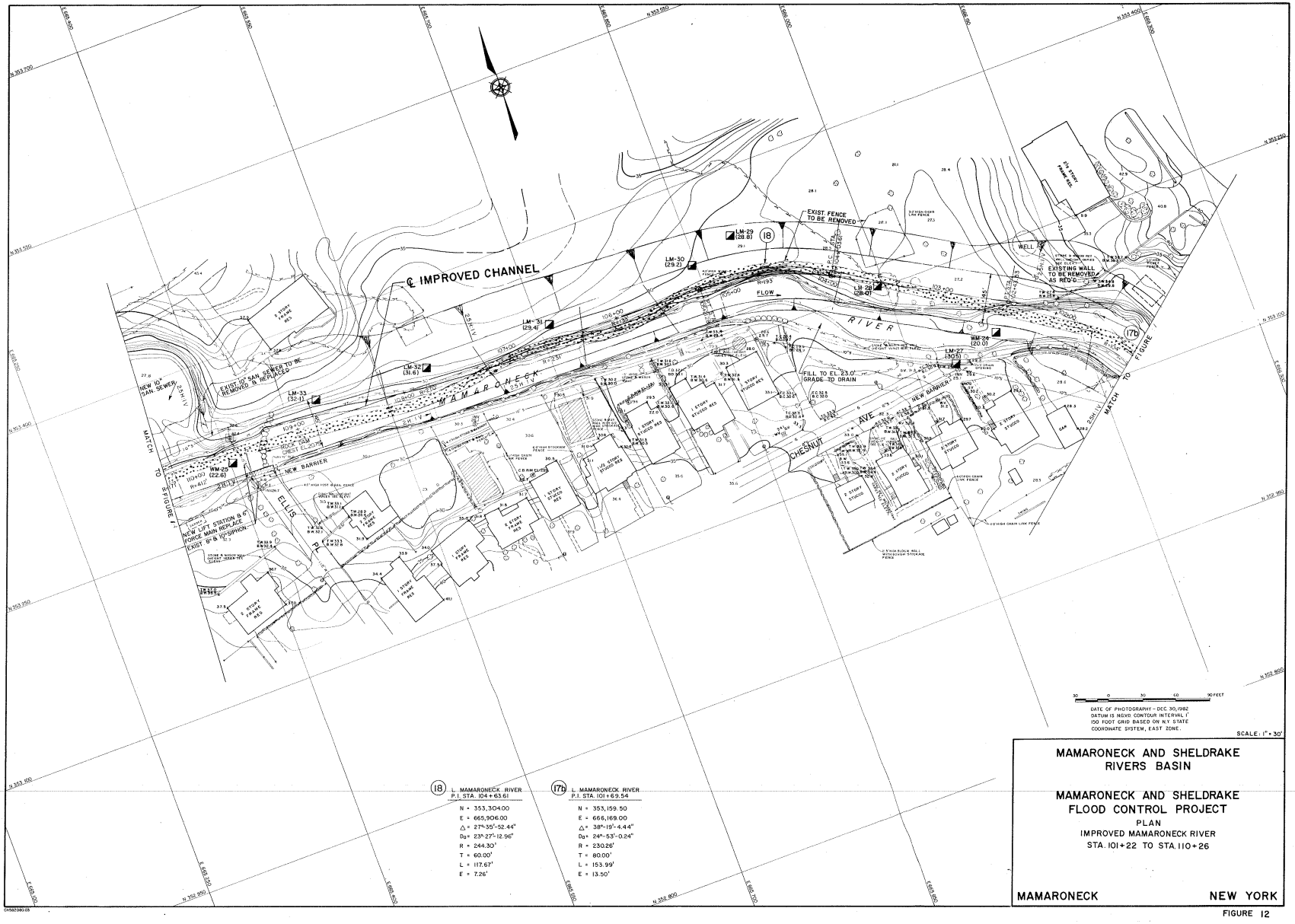
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
IMPROVED MAMARONECK RIVER
STA. 92+38 TO STA. 101+22

MAMARONECK NEW YORK

FIGURE 11



18 L. MAMARONECK RIVER
P.I. STA. 104+63.61

N = 353,304.00
E = 665,906.00
Δ = 27°-35'-52.44"
Dg = 23°-27'-12.96"
R = 244.30'
T = 60.00'
L = 117.67'
E = 7.26'

17b L. MAMARONECK RIVER
P.I. STA. 101+69.54

N = 353,159.50
E = 666,169.00
Δ = 38°-19'-4.44"
Dg = 24°-53'-0.24"
R = 230.26'
T = 80.00'
L = 153.99'
E = 13.50'

MAMARONECK AND SHELDRAKE RIVERS BASIN

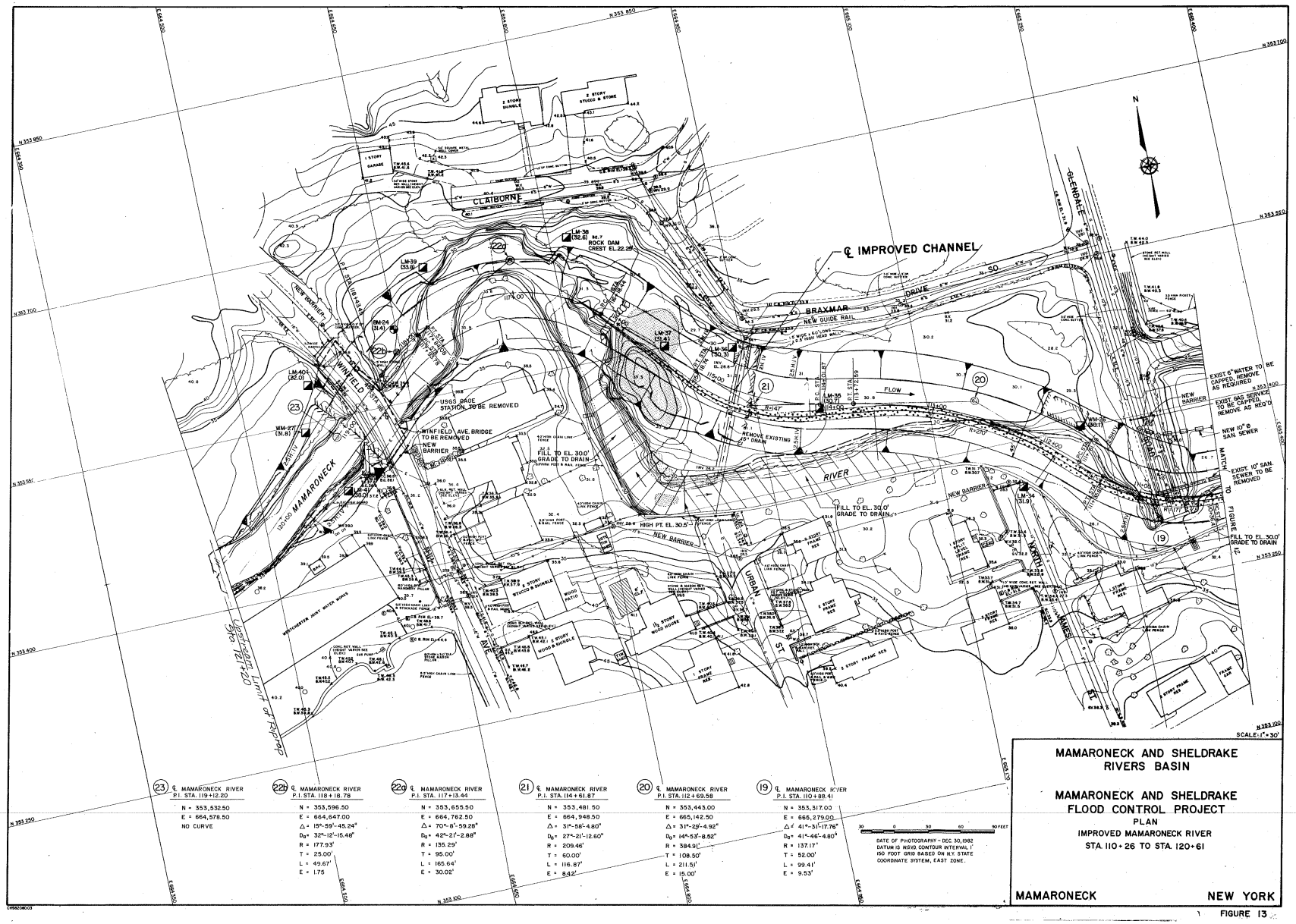
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
IMPROVED MAMARONECK RIVER
STA. 101+22 TO STA. 110+26

MAMARONECK NEW YORK

FIGURE 12

CH5820B0.03



(23) ℄ MAMARONECK RIVER
P.I. STA. 119+12.20

N = 353,532.50
E = 664,578.50
NO CURVE

(22b) ℄ MAMARONECK RIVER
P.I. STA. 118+18.78

N = 353,596.50
E = 664,647.00
Δ = 15°-59'-45.24"
D_B = 32°-12'-15.48"
R = 177.93'
T = 25.00'
L = 49.67'
E = 1.75

(22a) ℄ MAMARONECK RIVER
P.I. STA. 117+13.44

N = 353,655.50
E = 664,762.50
Δ = 70°-8'-59.28"
D_B = 42°-21'-2.88"
R = 135.29'
T = 95.00'
L = 165.64'
E = 30.02'

(21) ℄ MAMARONECK RIVER
P.I. STA. 114+61.87

N = 353,481.50
E = 664,948.50
Δ = 31°-58'-4.80"
D_B = 27°-21'-12.60"
R = 209.46'
T = 60.00'
L = 116.87'
E = 8.42'

(20) ℄ MAMARONECK RIVER
P.I. STA. 112+69.58

N = 353,443.00
E = 665,142.50
Δ = 31°-29'-4.92"
D_B = 14°-53'-8.52"
R = 384.91'
T = 108.50'
L = 211.51'
E = 15.00'

(19) ℄ MAMARONECK RIVER
P.I. STA. 110+88.41

N = 353,317.00
E = 665,279.00
Δ = 41°-31'-17.76"
D_B = 41°-46'-4.80"
R = 137.17'
T = 52.00'
L = 99.41'
E = 9.53'

30 0 30 60 90 FEET

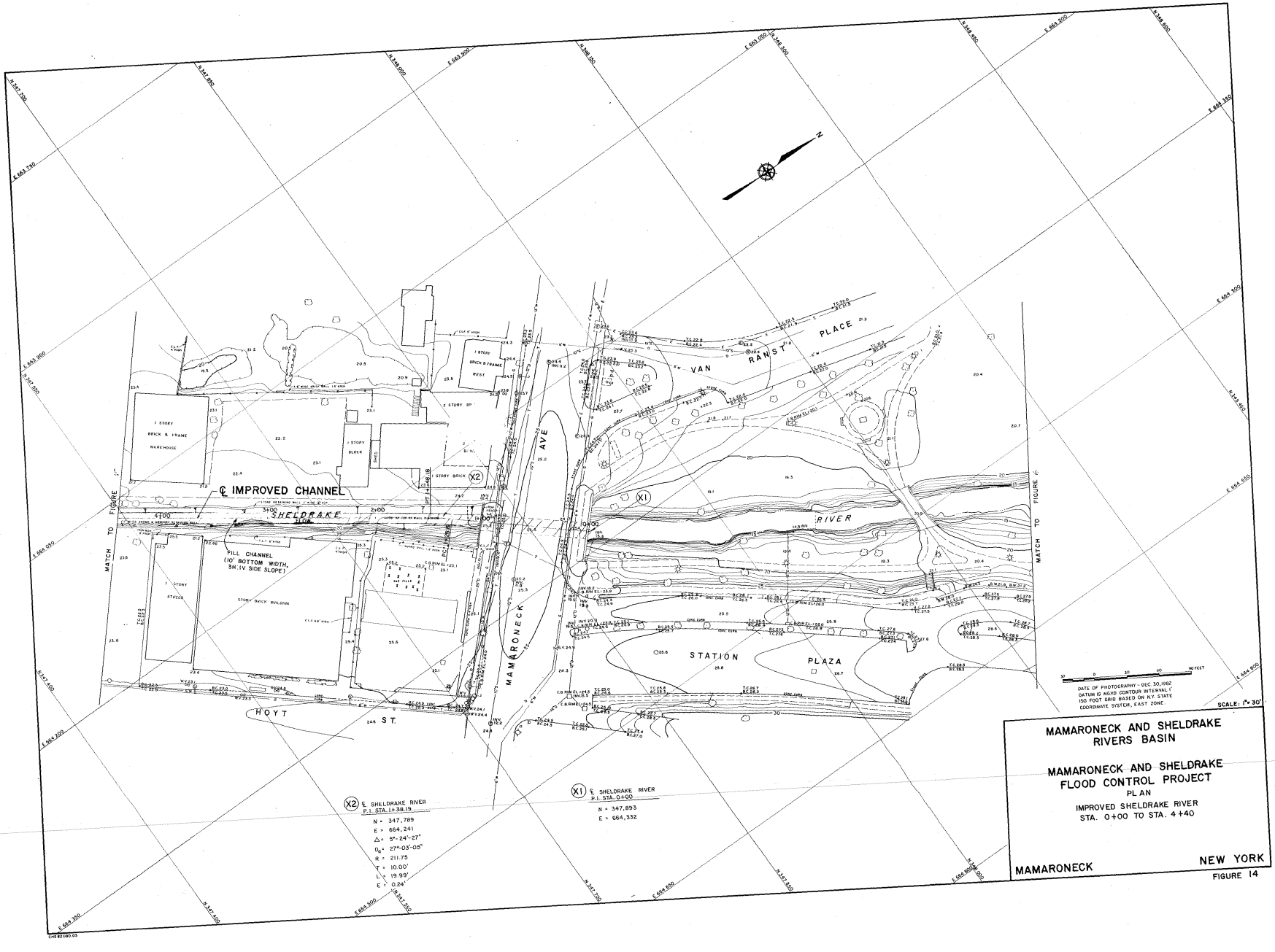
MAMARONECK AND SHELDRAKE RIVERS BASIN

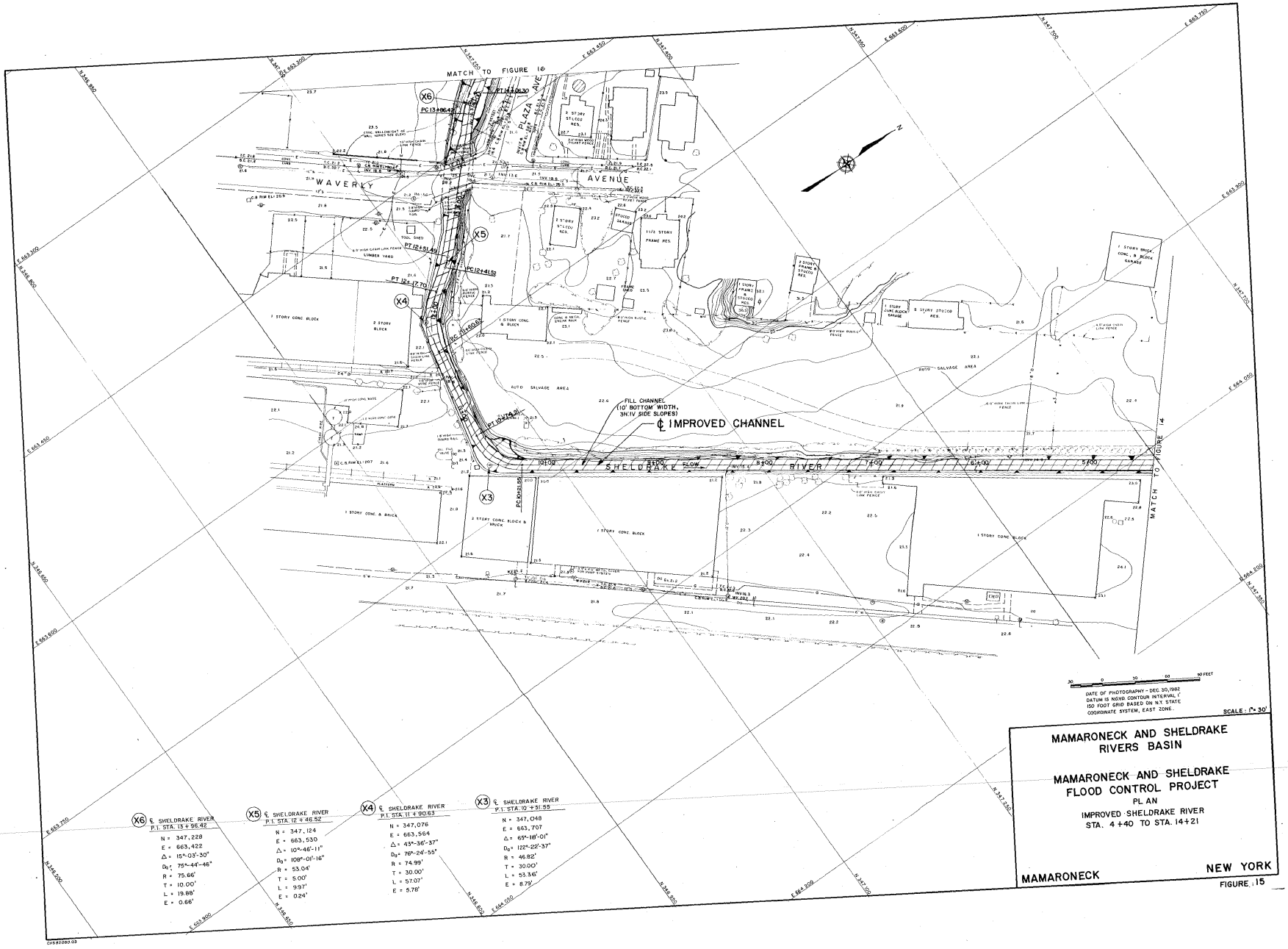
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
IMPROVED MAMARONECK RIVER
STA. 110+26 TO STA. 120+61

MAMARONECK NEW YORK

FIGURE 13


℄ IMPROVED CHANNEL
SHELDRAKE RIVER
FILL CHANNEL (10' BOTTOM WIDTH, 3H:1V SIDE SLOPE)
MAMARONECK AVE
VAN RANST PLACE
STATION PLAZA
HOYT ST.
MATCH TO FIGURE
1 STORY BRICK & FRAME WAREHOUSE
1 STORY BLOCK
1 STORY BRICK & FRAME REST
2 STORY BR
1 STORY BRICK
1 STORY STUCCO
STORY BRICK BUILDING
X2 ℄ SHELDRAKE RIVER
P.I. STA. 1+38.19
N = 347,789
E = 664,241
Δ = 5°-24'-27"
D_B = 27°-03'-05"
R = 211.75
T = 10.00'
L = 19.99'
E = 0.24'
X1 ℄ SHELDRAKE RIVER
P.I. STA. 0+00
N = 347,893
E = 664,332
DATE OF PHOTOGRAPHY - DEC. 30, 1982
DATUM IS MGVD. CONTOUR INTERVAL 1'
150 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
SCALE: 1" = 30'
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
IMPROVED SHELDRAKE RIVER
STA. 0+00 TO STA. 4+40
MAMARONECK
NEW YORK
FIGURE 14



X6 ℄ SHELDRAKE RIVER
P.I. STA. 13 + 96.42

N = 347,228
E = 663,422
Δ = 15°-03'-30"
D_B = 75°-44'-46"
R = 75.66'
T = 10.00'
L = 19.88'
E = 0.66'

X5 ℄ SHELDRAKE RIVER
P.I. STA. 12 + 46.52

N = 347,124
E = 663,530
Δ = 10°-46'-11"
D_B = 108°-01'-16"
R = 53.04'
T = 5.00'
L = 9.97'
E = 0.24'

X4 ℄ SHELDRAKE RIVER
P.I. STA. 11 + 90.63

N = 347,076
E = 663,564
Δ = 43°-36'-37"
D_B = 76°-24'-55"
R = 74.99'
T = 30.00'
L = 57.07'
E = 5.78'

X3 ℄ SHELDRAKE RIVER
P.I. STA. 10 + 51.55

N = 347,048
E = 663,707
Δ = 69°-18'-01"
D_B = 122°-22'-37"
R = 46.82'
T = 30.00'
L = 53.36'
E = 8.79'

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

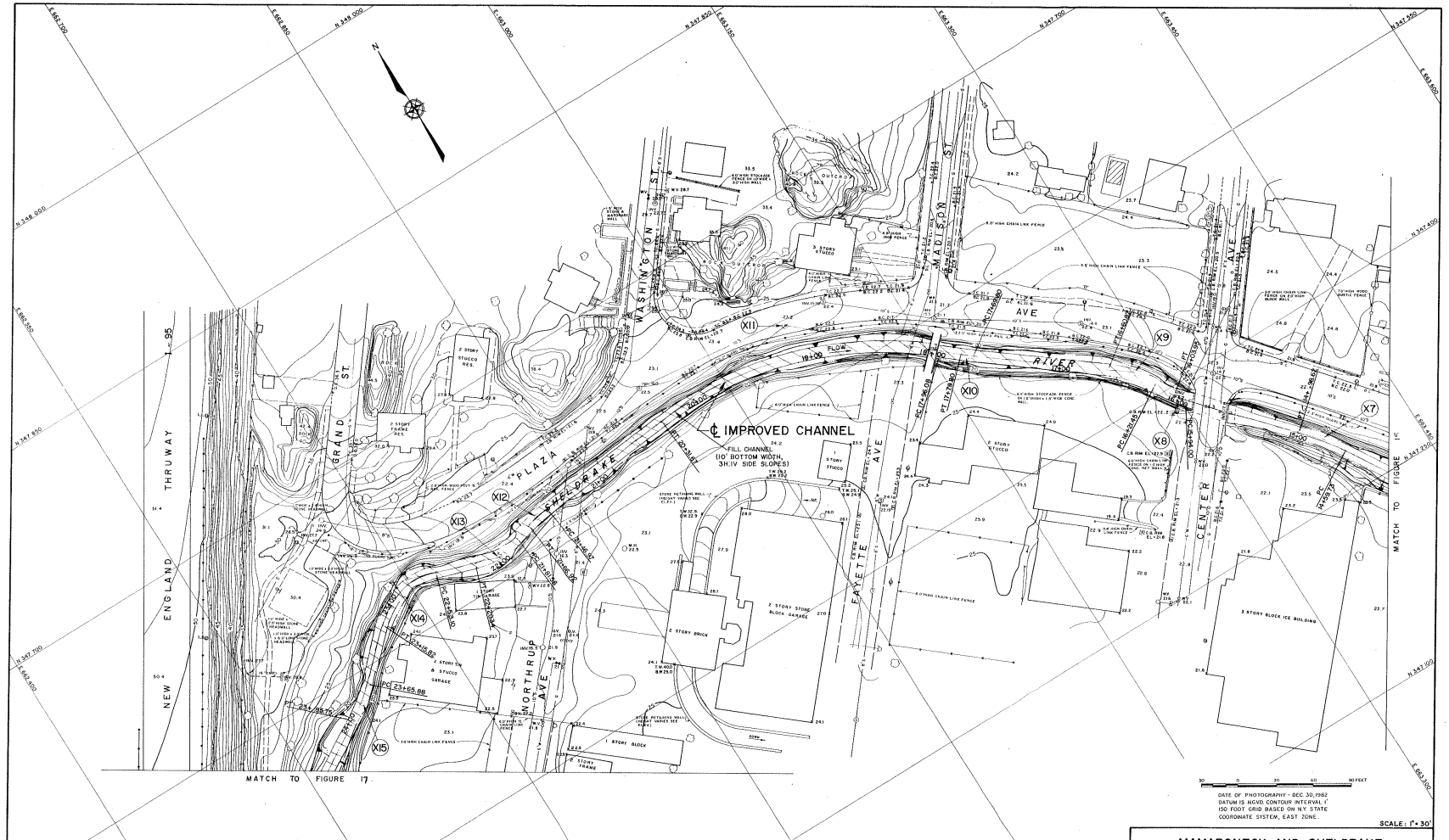
PLAN

IMPROVED SHELDRAKE RIVER
STA. 4 + 40 TO STA. 14 + 21

MAMARONECK NEW YORK

FIGURE 15

CH5820B0.03



X15 ℄ SHELDRAKE RIVER P.I. STA. 23+80.88	X14 ℄ SHELDRAKE RIVER P.I. STA. 22+88.10	X13 ℄ SHELDRAKE RIVER P.I. STA. 22+01.56	X12 ℄ SHELDRAKE RIVER P.I. STA. 21+56.97	X11 ℄ SHELDRAKE RIVER P.I. STA. 19+21.08	X10 ℄ SHELDRAKE RIVER P.I. STA. 17+74.80	X9 ℄ SHELDRAKE RIVER P.I. STA. 16+41.45	X8 ℄ SHELDRAKE RIVER P.I. STA. 15+99.00	X7 ℄ SHELDRAKE RIVER P.I. STA. 14+79.73
N = 347,527.00	N = 347,597.00	N = 347,568.50	N = 347,580.50	N = 347,606.00	N = 347,509.00	N = 347,426.50	N = 347,389.00	N = 347,299.50
E = 662,618.50	E = 662,690.00	E = 662,773.00	E = 662,816.00	E = 663,065.00	E = 663,174.50	E = 663,280.00	E = 663,300.00	E = 663,379.00
Δ = 12°-48'-59"	Δ = 63°-20'-38"	Δ = 34°-32'-38"	Δ = 9°-44'-44"	Δ = 47°-22'-60"	Δ = 3°-30'-39"	Δ = 23°-54'-09"	Δ = 13°-21'-42"	Δ = 10°-34'-34"
D_G = 42°-54'-25"	D_G = 100°-59'-40"	D_G = 89°-04'-36"	D_G = 48°-51'-00"	D_G = 20°-06'-49"	D_G = 35°-06'-32"	D_G = 60°-38'-07"	D_G = 134°-17'-22"	D_G = 26°-30'-48"
R = 133.56'	R = 56.73'	R = 64.32'	R = 117.30'	R = 284.87'	R = 163.14'	R = 94.49'	R = 42.69'	R = 216.08'
T = 15.00'	T = 35.00'	T = 20.00'	T = 10.00'	T = 125.00'	T = 5.00'	T = 20.00'	T = 5.00'	T = 20.00'
L = 29.87'	L = 62.72'	L = 38.78'	L = 19.95'	L = 235.59'	L = 10.00'	L = 39.42'	L = 9.95	L = 39.89'
E = 0.84'	E = 9.93'	E = 3.04'	E = 0.43'	E = 26.22'	E = 0.08'	E = 2.09'	E = 0.29'	E = 0.92'

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

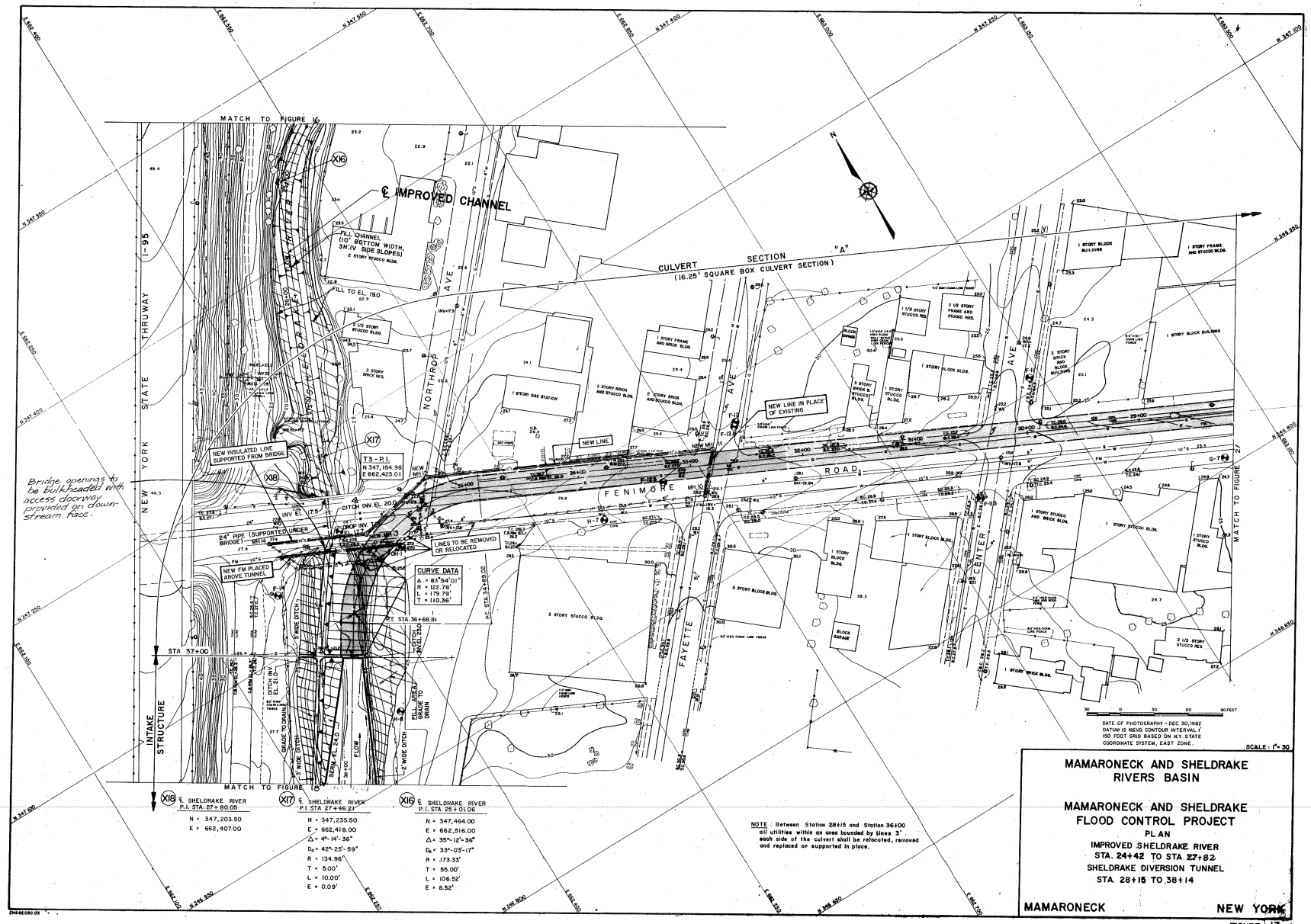
PLAN

IMPROVED SHELDRAKE RIVER
STA. 14+21 TO STA. 24+42

MAMARONECK NEW YORK

CHS 82080.03

FIGURE 16



X16 ℄ SHELDRAKE RIVER P.I. STA. 27+80.05	X17 ℄ SHELDRAKE RIVER P.I. STA. 27+46.21	X16 ℄ SHELDRAKE RIVER P.I. STA. 25+01.06
N = 347,203.50	N = 347,235.50	N = 347,464.00
E = 662,407.00	E = 662,418.00	E = 662,516.00
	Δ = 6°-14'-36"	Δ = 35°-12'-36"
	D_c = 42°-25'-59"	D_c = 33°-03'-17"
	R = 134.96'	R = 173.33'
	T = 5.00'	T = 55.00'
	L = 10.00'	L = 106.52'
	E = 0.09'	E = 8.52'

NOTE: Between Station 28+15 and Station 36+00 all utilities within an area bounded by lines 3' each side of the culvert shall be relocated, removed and replaced or supported in place.

MAMARONECK AND SHELDRAKE RIVERS BASIN

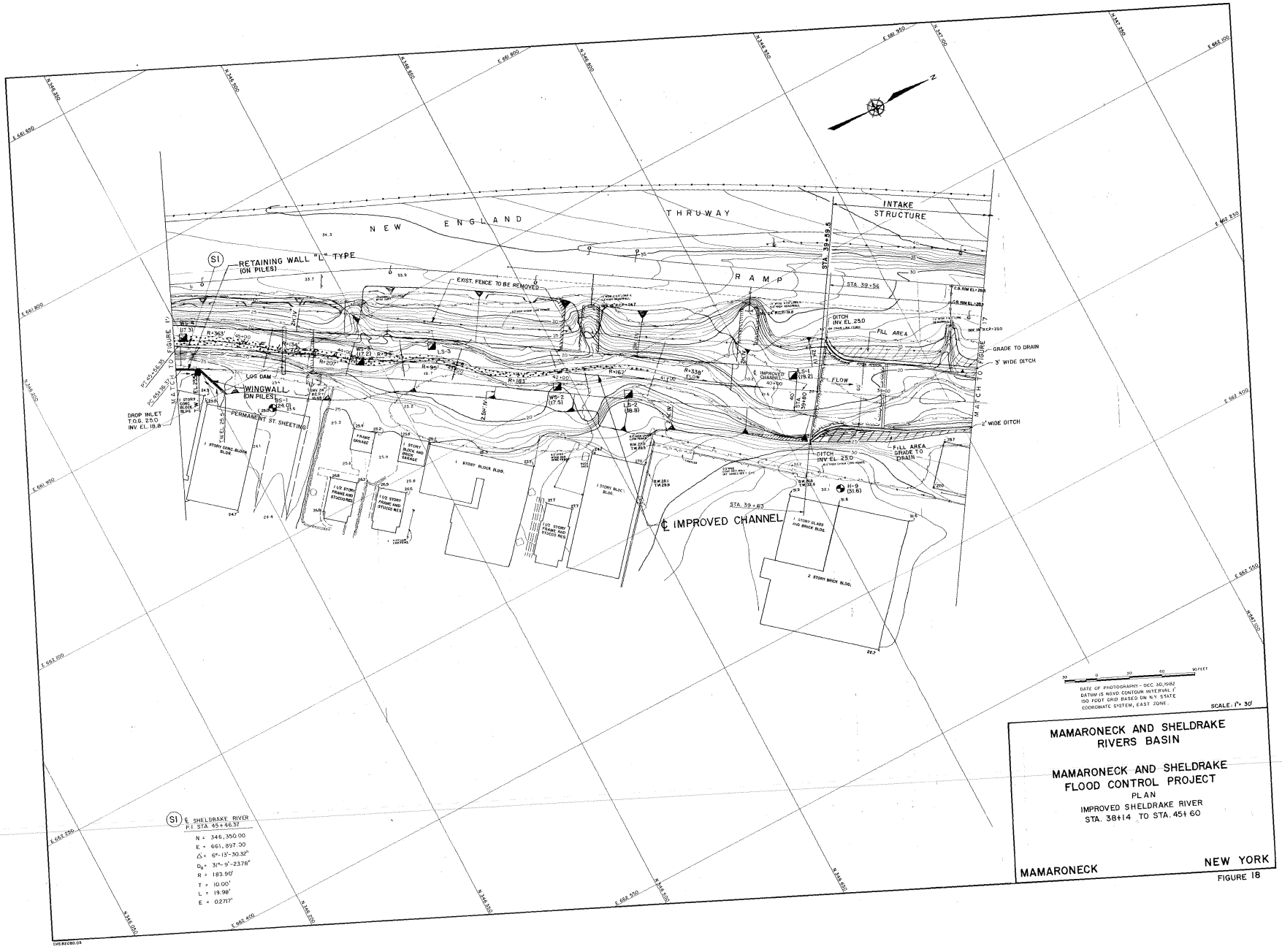
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN

IMPROVED SHELDRAKE RIVER
STA. 24+42 TO STA. 27+82
SHELDRAKE DIVERSION TUNNEL
STA. 28+15 TO 38+14

MAMARONECK NEW YORK

FIGURE 17


NEW ENGLAND THRUWAY
INTAKE STRUCTURE
RETAINING WALL "L" TYPE (ON PILES)
EXIST. FENCE TO BE REMOVED
RAMP
STA. 39+56
DITCH INV. EL. 25.0
FILL AREA
GRADE TO DRAIN
3' WIDE DITCH
2' WIDE DITCH
LOG DAM
WINGWALL (ON PILES)
PERMANENT ST. SHEETING
DROP INLET T.O.G. 25.0 INV. EL. 19.8
1 STORY CONC. BLOCK BLDG.
1 STORY BLOCK BLDG.
1 STORY BLOCK AND BRICK GARAGE
1 STORY FRAME GARAGE
1 1/2 STORY FRAME AND STUCCO RES.
1 STORY GLASS AND BRICK BLDG.
2 STORY BRICK BLDG.
℄ IMPROVED CHANNEL
STA. 39+63
STA. 39+59.5
MATCH TO FIGURE 17
MATCH TO FIGURE 14
DATE OF PHOTOGRAPHY - DEC. 30, 1982
DATUM IS NGVD CONTOUR INTERVAL 1'
150 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
SCALE: 1" = 30'
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
IMPROVED SHELDRAKE RIVER
STA. 38+14 TO STA. 45+60
MAMARONECK
NEW YORK
FIGURE 18
SI ℄ SHELDRAKE RIVER
P.I. STA. 45+46.37
N = 346,350.00
E = 661,897.30
Δ = 6°-13'-30.32"
D_R = 31°-9'-23.78"
R = 183.90'
T = 10.00'
L = 19.98'
E = 0.2717'

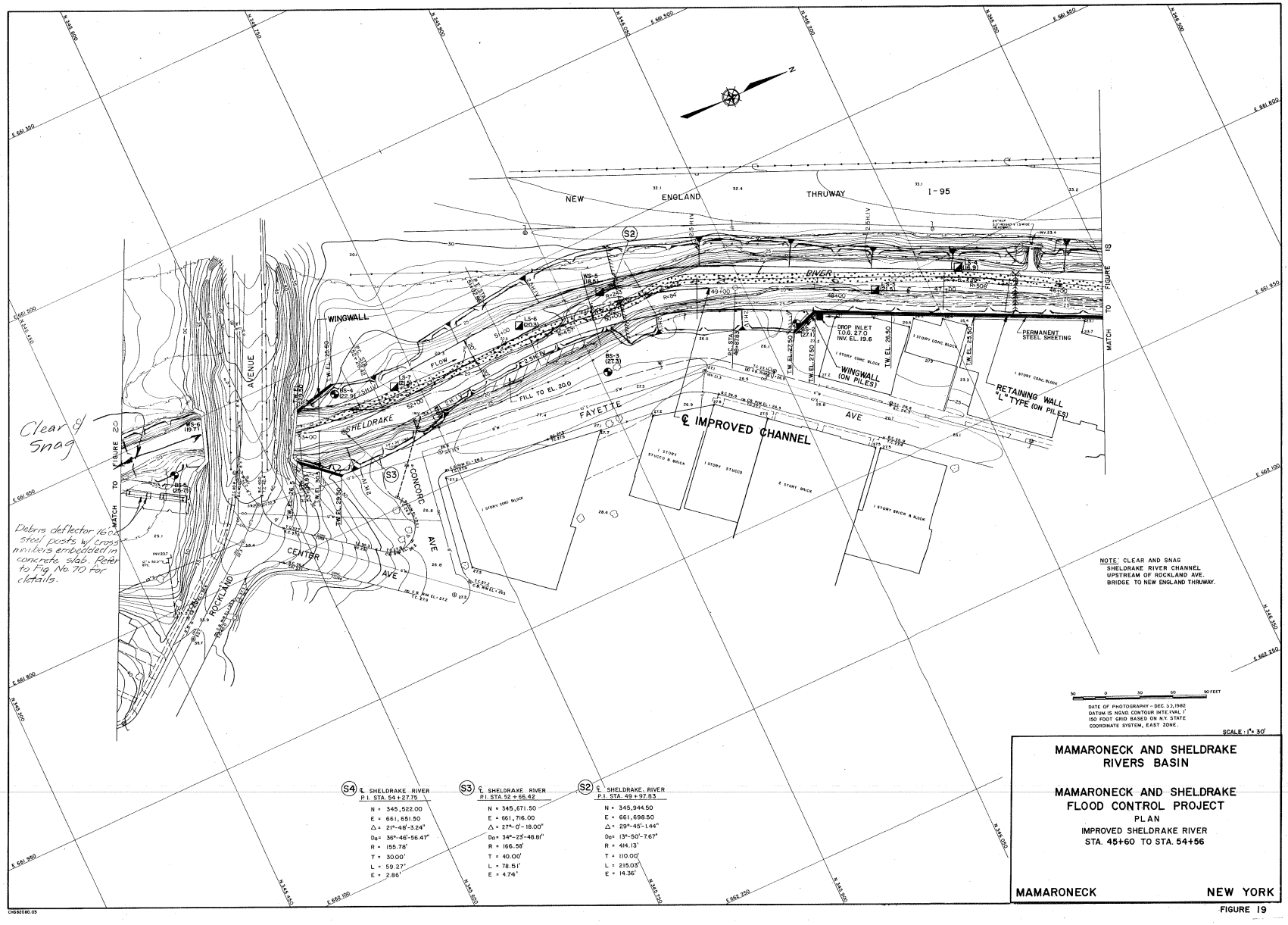

NEW ENGLAND THRUWAY
I-95
S2
S3
S4
WINGWALL
WS-5 (18.4)
LS-5 (20.3)
LS-7 (21.9)
WS-6 (19.7)
BS-3 (27.3)
BS-5 (27.1)
BS-4 (26.9)
DROP INLET T.O.G. 27.0 INV. EL. 19.6
WINGWALL (ON PILES)
PERMANENT STEEL SHEETING
RETAINING WALL "L" TYPE (ON PILES)
MATCH TO FIGURE 20
MATCH TO FIGURE 19
SHELDRAKE RIVER
FLOW
FILL TO EL 20.0
FAYETTE AVE
CONCORD AVE
CENTER AVE
ROCKLAND AVENUE
℄ IMPROVED CHANNEL
1 STORY CONC BLOCK
1 STORY STUCCO & BRICK
1 STORY STUCCO
2 STORY BRICK
1 STORY BRICK & BLOCK
Clear & Snag
Debris deflector 16 ea. steel posts w/ cross members embedded in concrete slab. Refer to Fig. No. 70 for details.
NOTE: CLEAR AND SNAG SHELDRAKE RIVER CHANNEL UPSTREAM OF ROCKLAND AVE. BRIDGE TO NEW ENGLAND THRUWAY.
DATE OF PHOTOGRAPHY - DEC. 23, 1982
DATUM IS NGVD CONTOUR INTERVAL 1'
150 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
SCALE: 1" = 30'
S4 ℄ SHELDRAKE RIVER
P.I. STA. 54+27.75
N = 345,522.00
E = 661,651.50
Δ = 21°-48'-3.24"
Dg = 36°-46'-56.47"
R = 155.78'
T = 30.00'
L = 59.27'
E = 2.86'
S3 ℄ SHELDRAKE RIVER
P.I. STA. 52+66.42
N = 345,671.50
E = 661,716.00
Δ = 27°-0'-18.00"
Dg = 34°-23'-48.81"
R = 166.58'
T = 40.00'
L = 78.51'
E = 4.74'
S2 ℄ SHELDRAKE RIVER
P.I. STA. 49+97.93
N = 345,944.50
E = 661,698.50
Δ = 29°-45'-1.44"
Dg = 13°-50'-7.67"
R = 414.13'
T = 110.00'
L = 215.03'
E = 14.36'
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
IMPROVED SHELDRAKE RIVER
STA. 45+60 TO STA. 54+56
MAMARONECK
NEW YORK
CHS82080.03

FIGURE 19

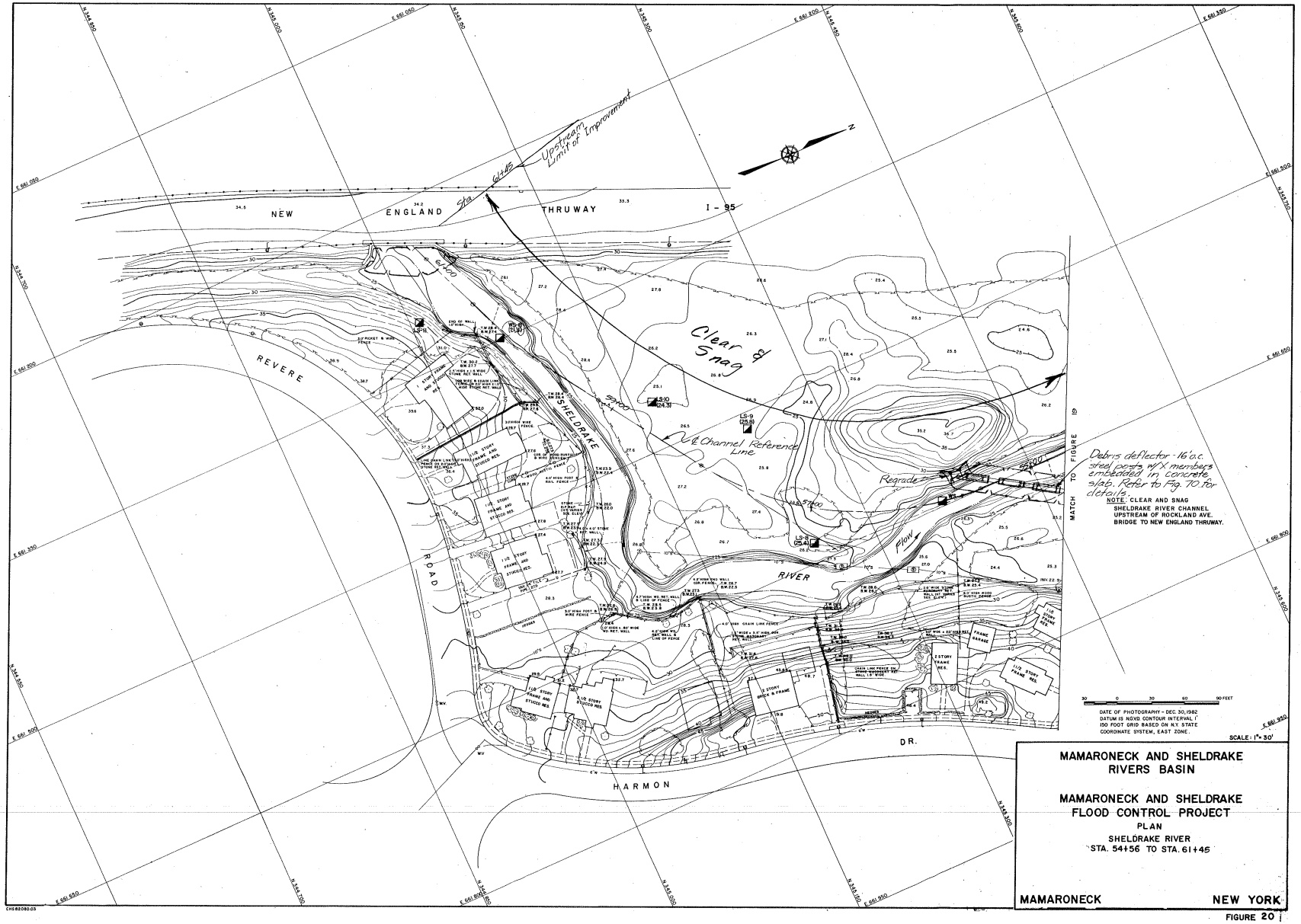
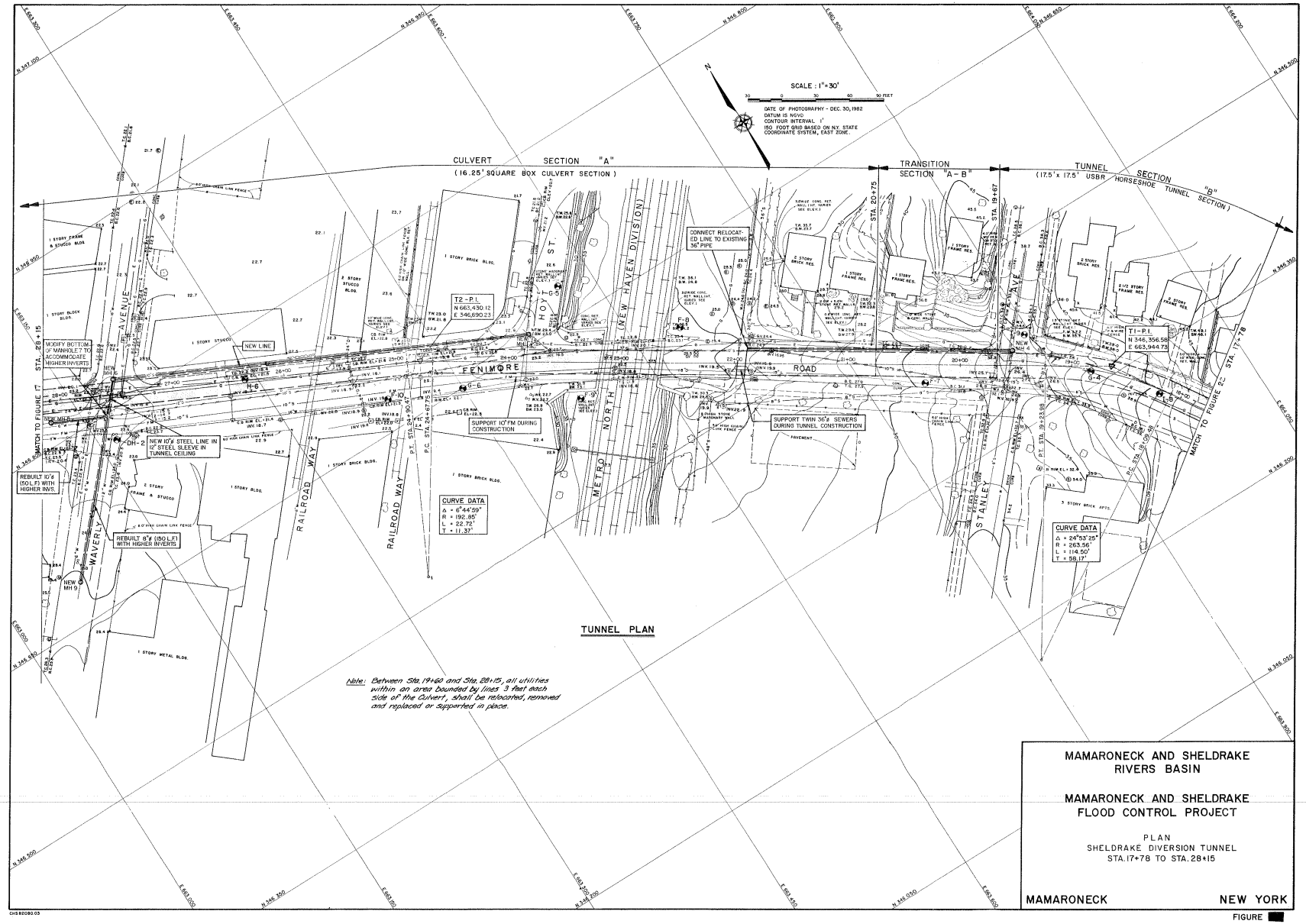
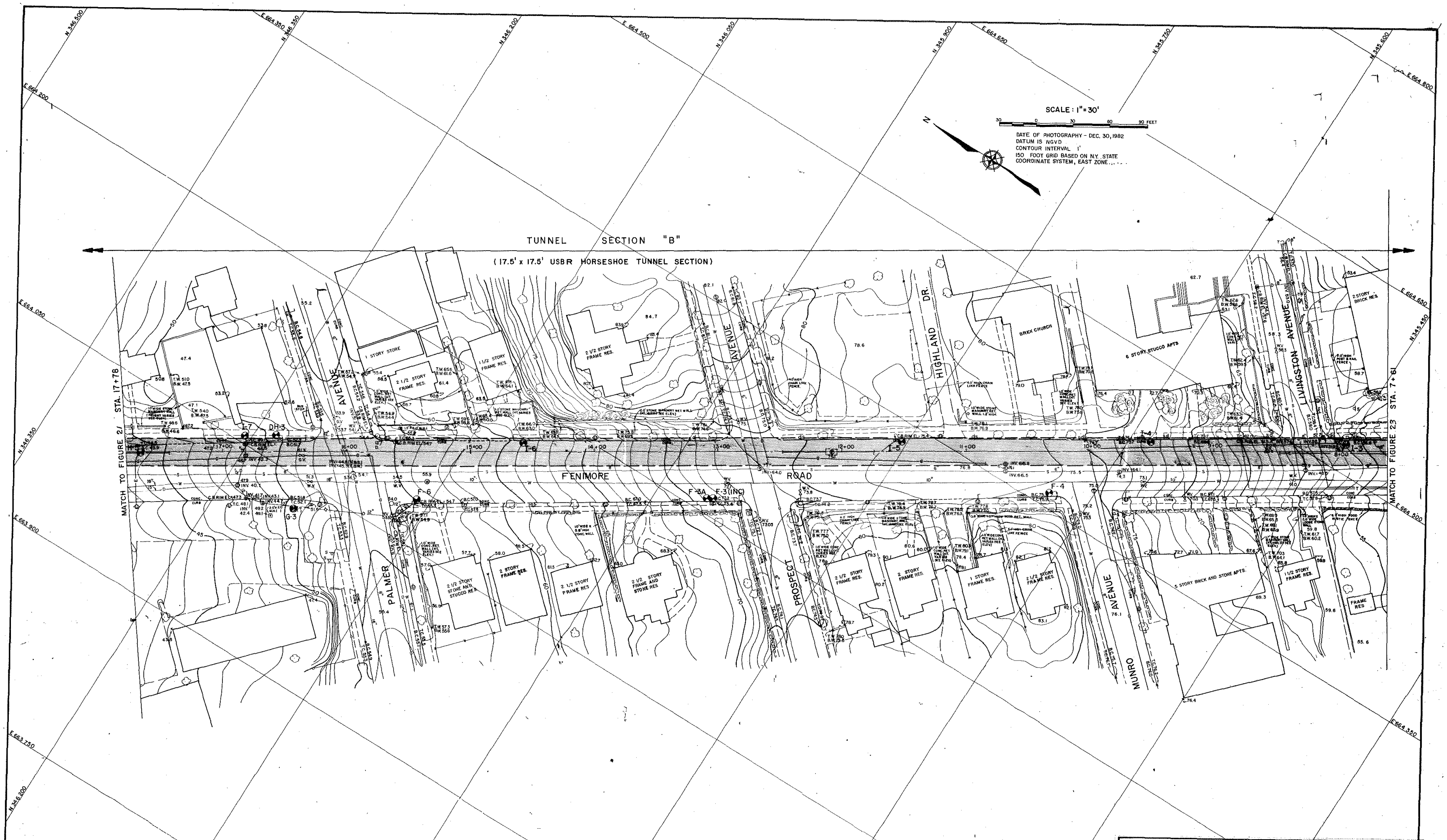

NEW ENGLAND THRUWAY
I - 95
Upstream Limit of Improvement
Sta. 61+45
Clear & Snag
Channel Reference Line
Regrade
Flow
SHELDRAKE RIVER
REVERE ROAD
HARMON DR.
MATCH TO FIGURE 19
Debris deflector - 16' o.c. steel posts w/ X members embedded in concrete slab. Refer to Fig. 10 for details.
NOTE: CLEAR AND SNAG SHELDRAKE RIVER CHANNEL UPSTREAM OF ROCKLAND AVE. BRIDGE TO NEW ENGLAND THRUWAY.
DATE OF PHOTOGRAPHY - DEC. 30, 1982
DATUM IS NGVD. CONTOUR INTERVAL 1'
100 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
SCALE: 1" = 30'
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
SHELDRAKE RIVER
STA. 54+56 TO STA. 61+45
MAMARONECK
NEW YORK
CHER2080.03

FIGURE 20


SCALE : 1" = 30'
30 0 30 60 90 FEET
DATE OF PHOTOGRAPHY - DEC. 30, 1982
DATUM IS NGVD
CONTOUR INTERVAL 1'
150 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
CULVERT SECTION "A"
(16.25' SQUARE BOX CULVERT SECTION)
TRANSITION SECTION "A-B"
TUNNEL SECTION "B"
(17.5' x 17.5' USBR HORSESHOE TUNNEL SECTION)
MATCH TO FIGURE 17
MATCH TO FIGURE 22
STA. 26+15
STA. 17+78
STA. 20+75
STA. 19+67
STA. 24+95.67
P.C. STA. 24+67.75
P.T. STA. 19+23.98
WAVERLY AVENUE
HOYT ST.
NEW HAVEN DIVISION
NORTH METRO
FENIMORE ROAD
RAILROAD WAY
STANLEY AVE.
MODIFY BOTTOM OF MANHOLE 7 TO ACCOMMODATE HIGHER INVERTS
NEW LINE
NEW MH 6
NEW MH 9
REBUILT 10'ø (150 L.F.) WITH HIGHER INVS.
NEW 10'ø STEEL LINE IN 12" STEEL SLEEVE IN TUNNEL CEILING
REBUILT 8'ø (150 L.F.) WITH HIGHER INVERTS
T2 - P.I.
N 663,430.12
E 346,690.23
CONNECT RELOCATED LINE TO EXISTING 36" PIPE
SUPPORT 10" FM DURING CONSTRUCTION
SUPPORT TWIN 36"ø SEWERS DURING TUNNEL CONSTRUCTION
T1 - P.I.
N 346,356.58
E 663,944.73
CURVE DATA
Δ = 6°44'59"
R = 192.85'
L = 22.72'
T = 11.37'
CURVE DATA
Δ = 24°53'25"
R = 263.56'
L = 114.50'
T = 58.17'
TUNNEL PLAN
Note: Between Sta. 19+60 and Sta. 28+15, all utilities within an area bounded by lines 3 feet each side of the Culvert, shall be relocated, removed and replaced or supported in place.
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
SHELDRAKE DIVERSION TUNNEL
STA. 17+78 TO STA. 28+15
MAMARONECK
NEW YORK
FIGURE
CHS 82090.03



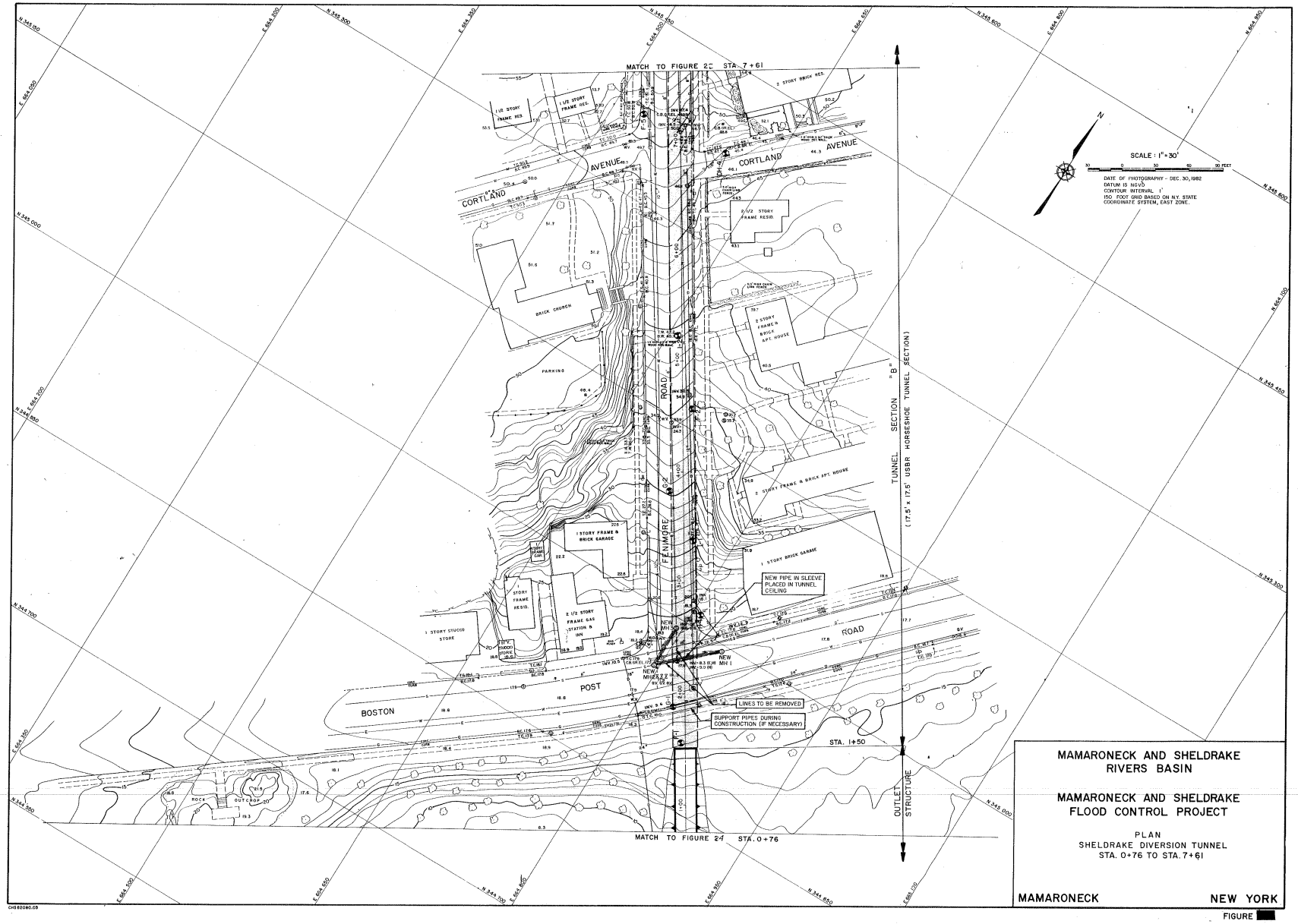
MAMARONECK AND SHELDRAKE RIVERS BASIN

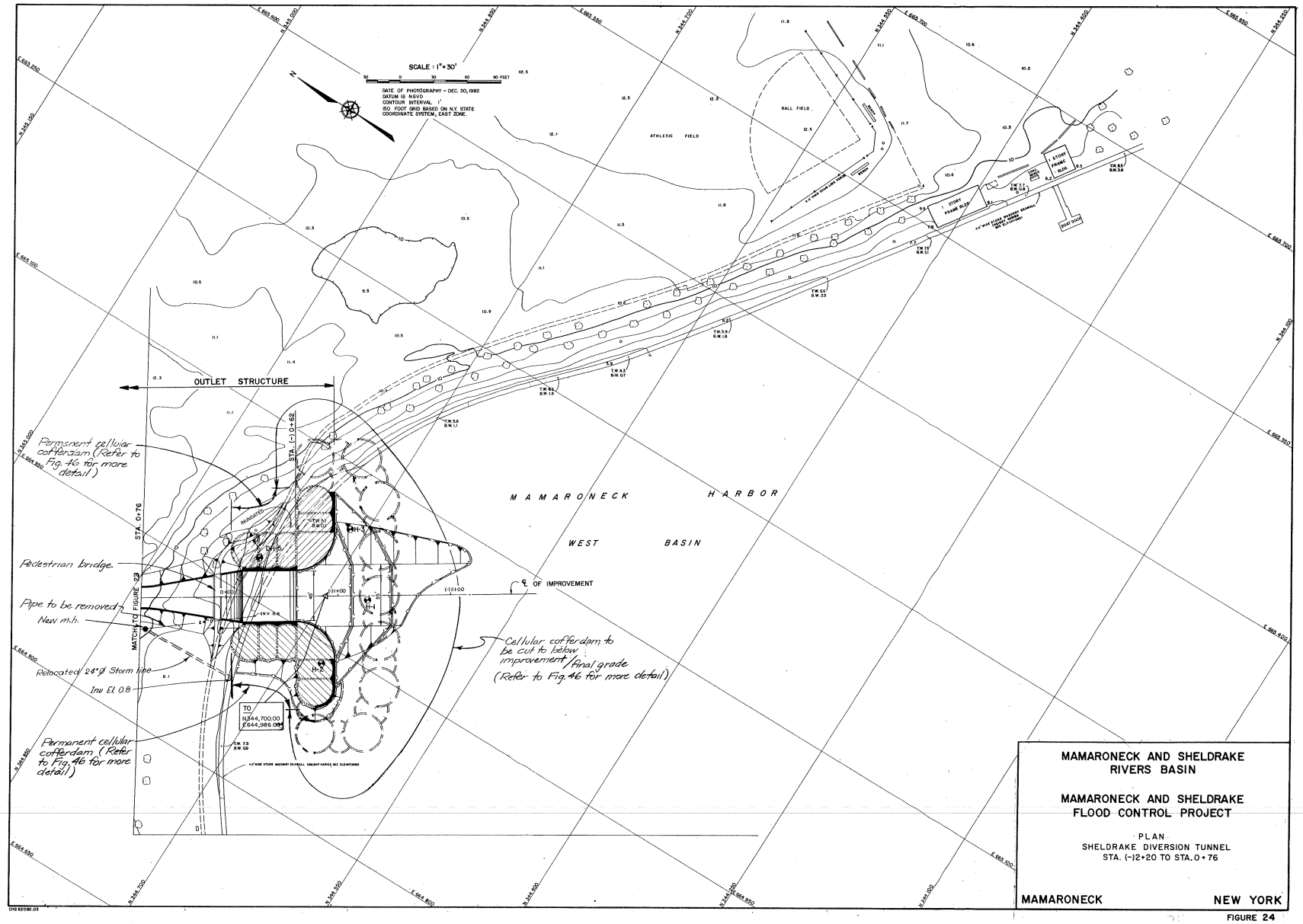
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
SHELDRAKE DIVERSION TUNNEL
STA. 7+61 TO STA. 17+78

MAMARONECK NEW YORK

FIGURE 22


MATCH TO FIGURE 2C STA. 7+61
MATCH TO FIGURE 2A STA. 0+76
CORTLAND AVENUE
BOSTON POST ROAD
FENIMORE ROAD
BRICK CHURCH
PARKING
2 STORY BRICK RES.
1 1/2 STORY FRAME RES.
2 1/2 STORY FRAME RESID.
2 STORY FRAME & BRICK APT. HOUSE
2 STORY FRAME & BRICK APT. HOUSE
1 STORY BRICK GARAGE
1 STORY FRAME & BRICK GARAGE
STORY FRAME RESID.
2 1/2 STORY FRAME GAS STATION & INN
1 STORY STUCCO STORE
ROCK OUTCROP
NEW PIPE IN SLEEVE PLACED IN TUNNEL CEILING
LINES TO BE REMOVED
SUPPORT PIPES DURING CONSTRUCTION (IF NECESSARY)
NEW MH 2
NEW MH 1
STA. 1+50
TUNNEL SECTION "B" (17.5' x 17.5' USBR HORSESHOE TUNNEL SECTION)
OUTLET STRUCTURE
N
SCALE: 1" = 30'
30 0 30 60 90 FEET
DATE OF PHOTOGRAPHY - DEC. 30, 1982
DATUM IS NGVD
CONTOUR INTERVAL 1'
150 FOOT GRID BASED ON N.Y. STATE COORDINATE SYSTEM, EAST ZONE.
MAMARONECK AND SHELDRAKE RIVERS BASIN
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT
PLAN
SHELDRAKE DIVERSION TUNNEL
STA. 0+76 TO STA. 7+61
MAMARONECK
NEW YORK
FIGURE



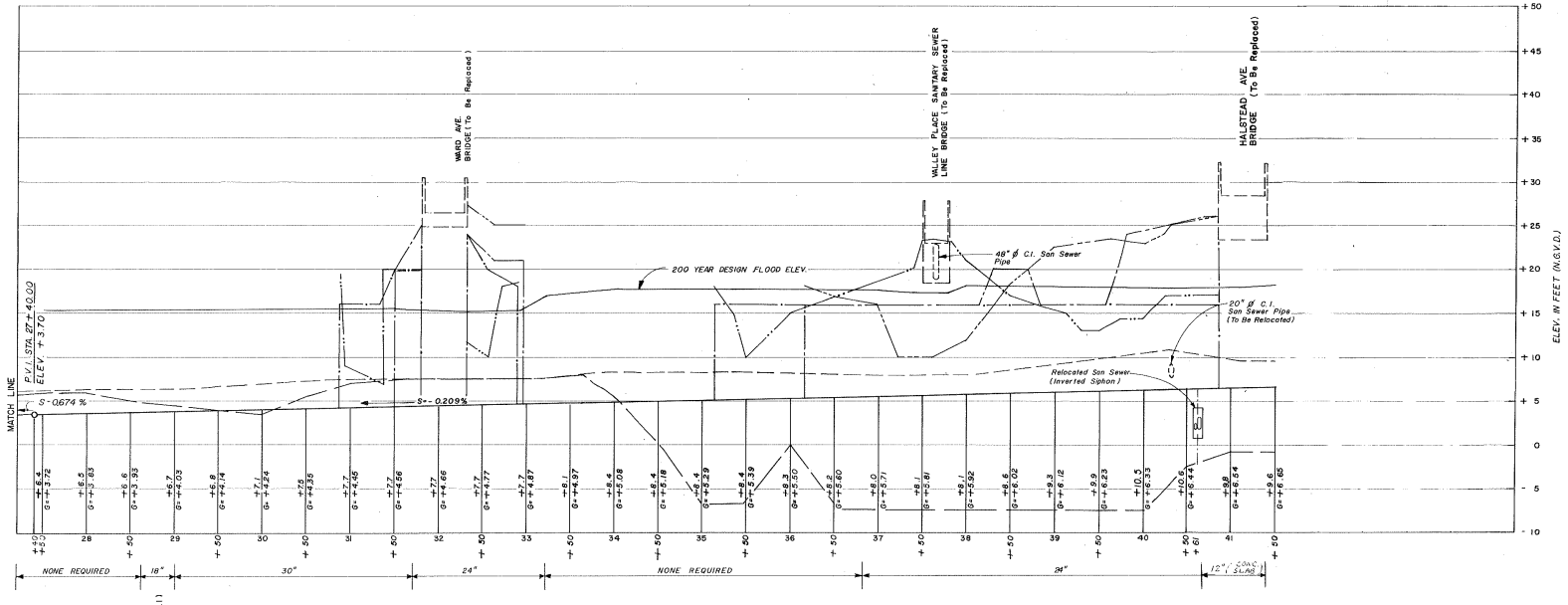
MAMARONECK AND SHELDRAKE RIVERS BASIN

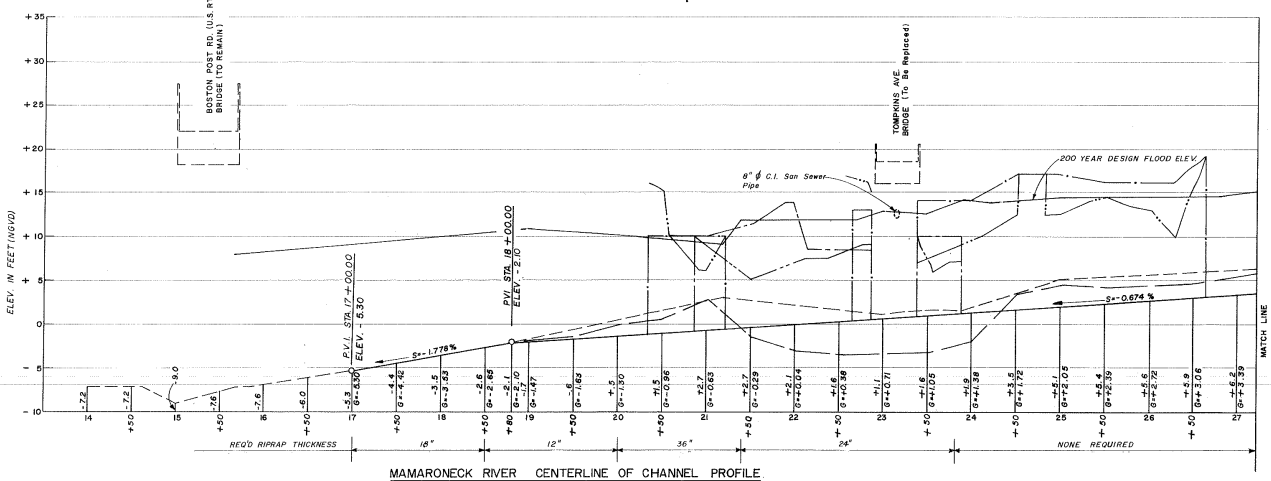
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PLAN
SHELDRAKE DIVERSION TUNNEL
STA. (-)12+20 TO STA. 0+76

MAMARONECK NEW YORK

FIGURE 24





MAMARONECK RIVER CENTERLINE OF CHANNEL PROFILE

SCALE IN FEET
HOR. 50' 0' 50' 100'
VERT. 5 0 5 10

LEGEND

- Existing ground elevation or structure at centerline of stream
- Top elevation or limit of wall (left bank)
- Top elevation or limit of wall (right bank)
- Existing ground elevation (left bank wall)
- Existing ground elevation (right bank wall)
- Existing rock elevation at centerline of stream

NOTES:
1. For General Notes, see [illegible]
2. Left and right bank is referenced looking downstream.

MAMARONECK AND SHELDRAKE RIVERS BASIN

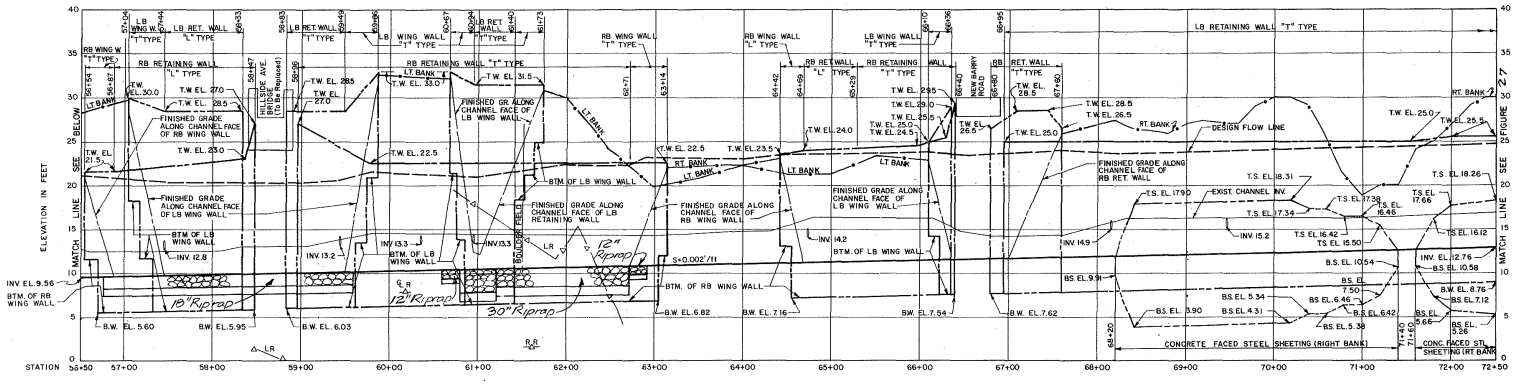
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

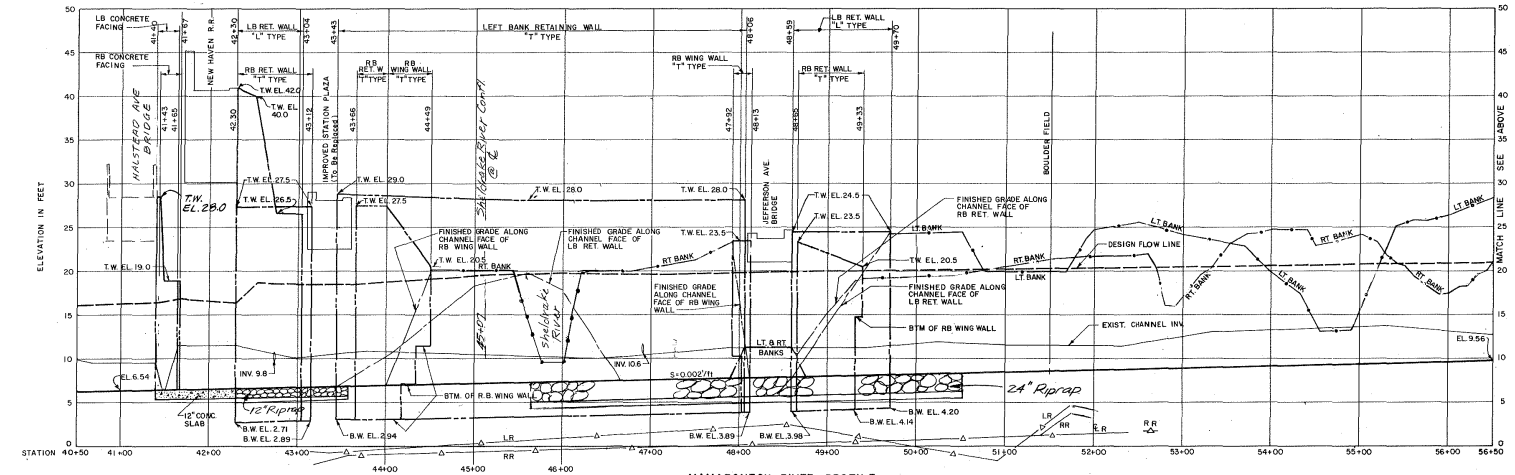
CHANNEL PROFILE

IMPROVED MAMARONECK RIVER
STA. 14+00 TO STA. 41+40

MAMARONECK NEW YORK

FIGURE 25





MAMARONECK RIVER PROFILE

Scale: Horiz. 1" = 50'
Vert. 1" = 5'

LEGEND

- Concrete Faced Steel Sheeting (T.S. – Top Sht. / B.S. – Bot. Sht.)
- Existing Ground Or Structure At ℄ Of Stream
- Proposed Grade
- 200 Year Flood
- Top Elev. Of Walls
- Top Of Bank (Lt Bank / Rt Bank)
- Top Of Rock Elevation (LR – Left Bank / RR – Right Bank / ℄R – Center Line)
- Drop Inlet (12" Ø Pipe)
- Riprap
- Bedding Material

NOTES:
1. Top Of Rock Is Based On Linear Interpolation Between Borings.
2. Some Borings Were Projected On To The Section To Define The Rock Line.
3. Pilot Channel is not indicated.

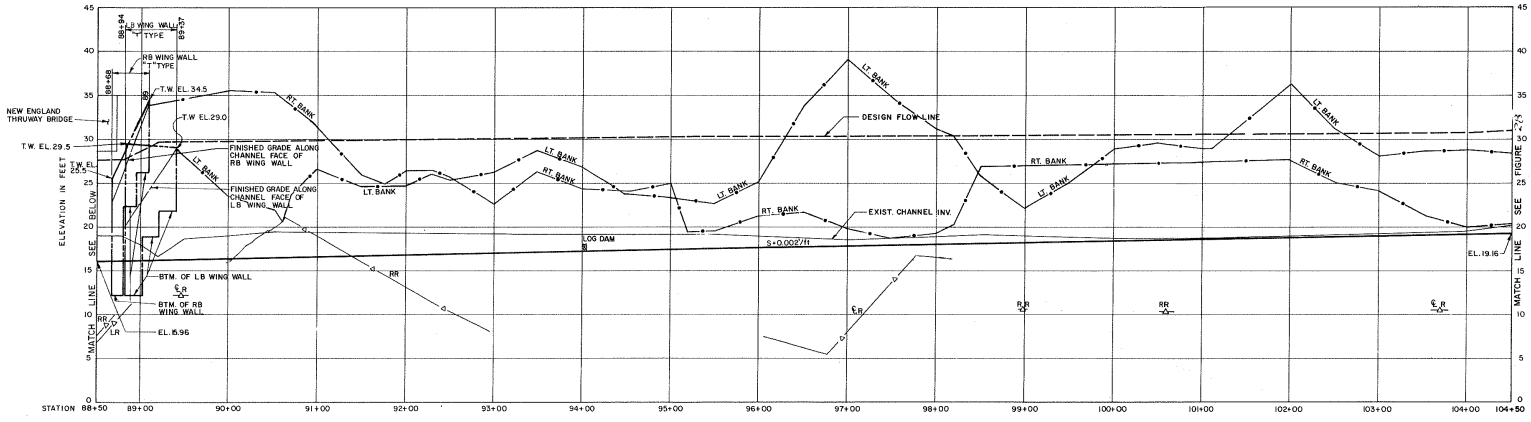
MAMARONECK AND SHELDRAKE RIVERS BASIN

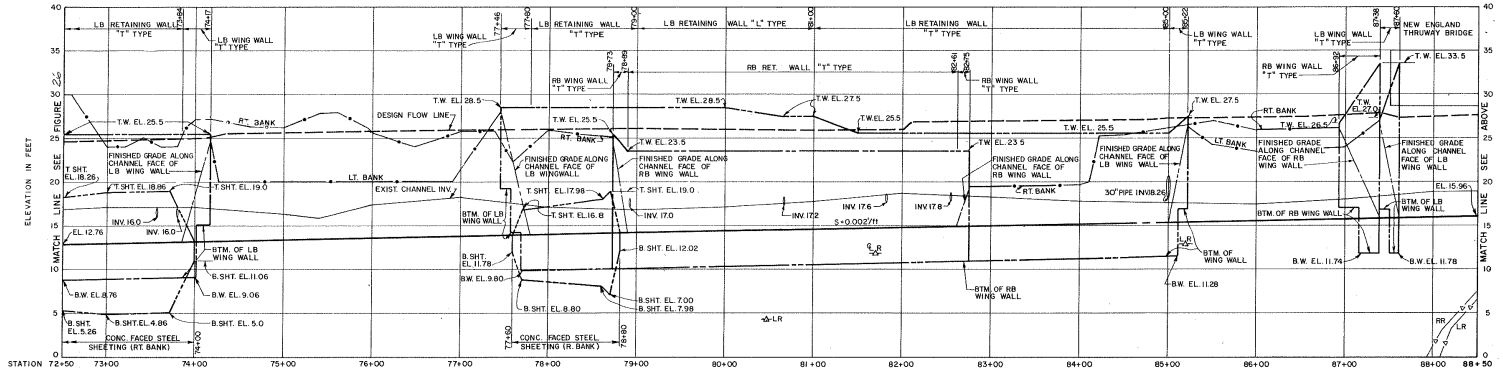
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
IMPROVED MAMARONECK RIVER
STA. 41+40 TO STA. 72+50

MAMARONECK **NEW YORK**

FIGURE 26





MAMARONECK RIVER PROFILE

Scale: Horiz. 1" = 50'
Vert. 1" = 5'

LEGEND

- Concrete Faced Steel Sheeting
- Existing Ground Or Structure At ℄ Of Stream
- Proposed Grade
- 200 Year Flood
- Top Elev. Of Walls
- Top of Bank (Lt. Bank / Rt. Bank)
- Top Of Rock Elevation (LR – Left Bank, RR – Right Bank, ℄R – Center Line)
- Riprap
- Drop Inlet (12" Ø Pipe)

For Notes See Figure P1

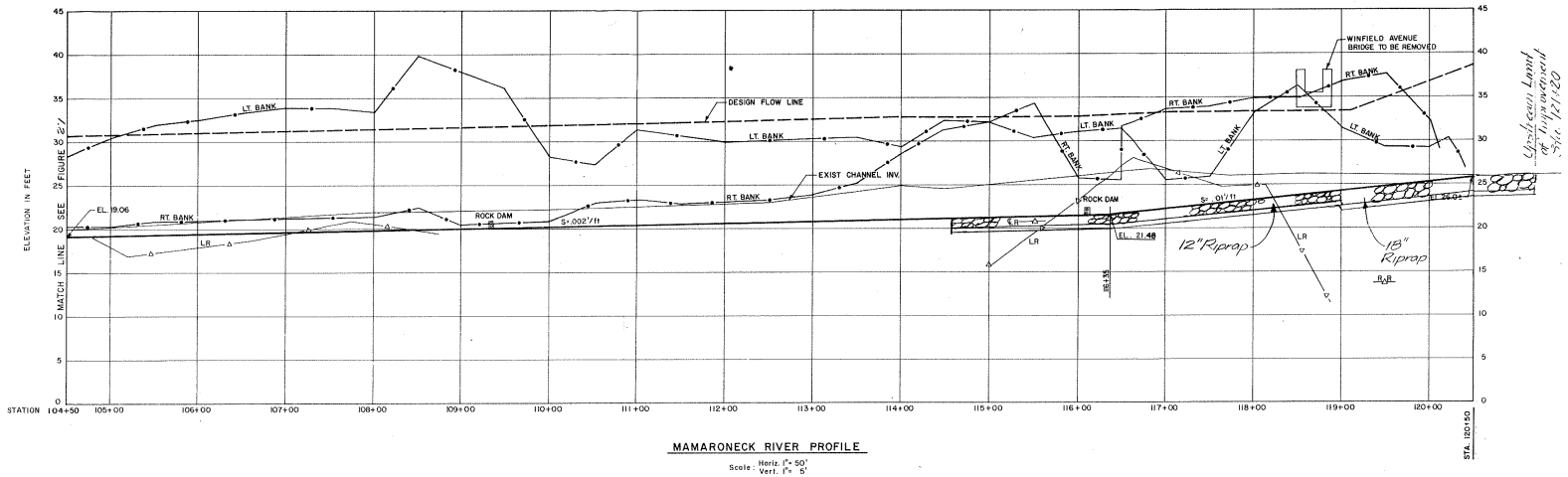
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
IMPROVED MAMARONECK RIVER
STA. 72+50 TO STA. 104+50

MAMARONECK NEW YORK

FIGURE 27



MAMARONECK RIVER PROFILE

Scale: Horiz. 1" = 50'
Vert. 1" = 5'

LEGEND

	Existing Ground Or Structure At ℄ Of Stream
	Proposed Grade
	200 Year Flood
	Top Elev. Of Walls
	Top of Bank {Lt. Bank, Rt. Bank}
	Top Of Rock Elevation {LR - Left Bank, RR - Right Bank, ℄R - Center Line}
	Riprap

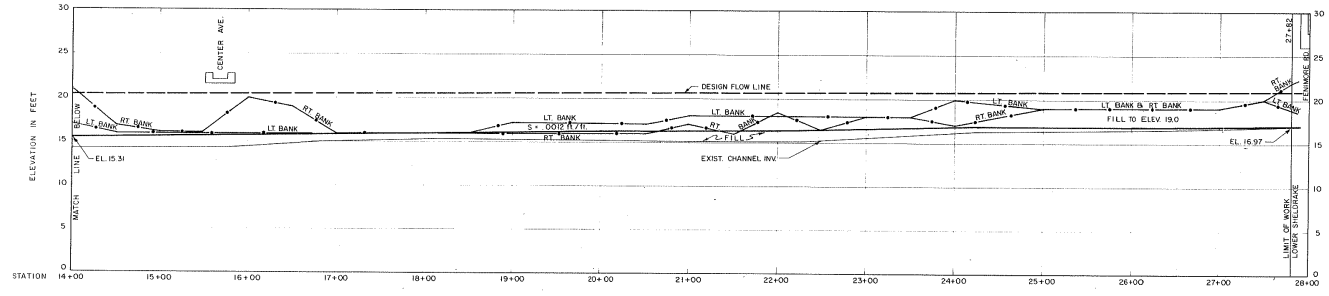
MAMARONECK AND SHELDRAKE RIVERS BASIN

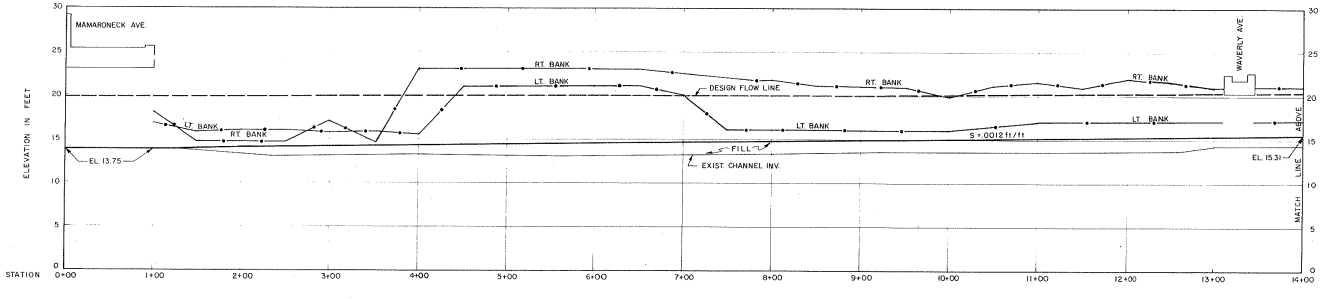
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
IMPROVED MAMARONECK RIVER
STA. 104+50 TO STA. 121+20

MAMARONECK NEW YORK

FIGURE 28





SHELDRAKE RIVER PROFILE

Scale: Horiz. 1" = 50'
Vert. 1" = 5'

LEGEND

- Existing Ground Or Structure At ℄ Of Stream
- Proposed Grade
- 200 Year Flood
- Top Elev. Of Walls
- Top Of Bank { Lt Bank / Rt Bank
- Top Of Rock Elevation { LR – Left Bank / RR – Right Bank

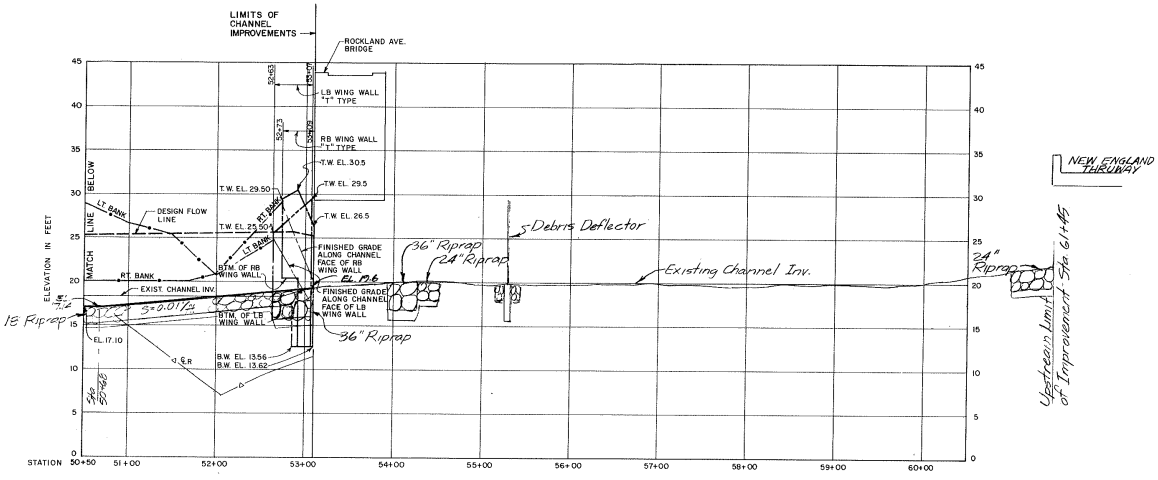
MAMARONECK AND SHELDRAKE RIVERS BASIN

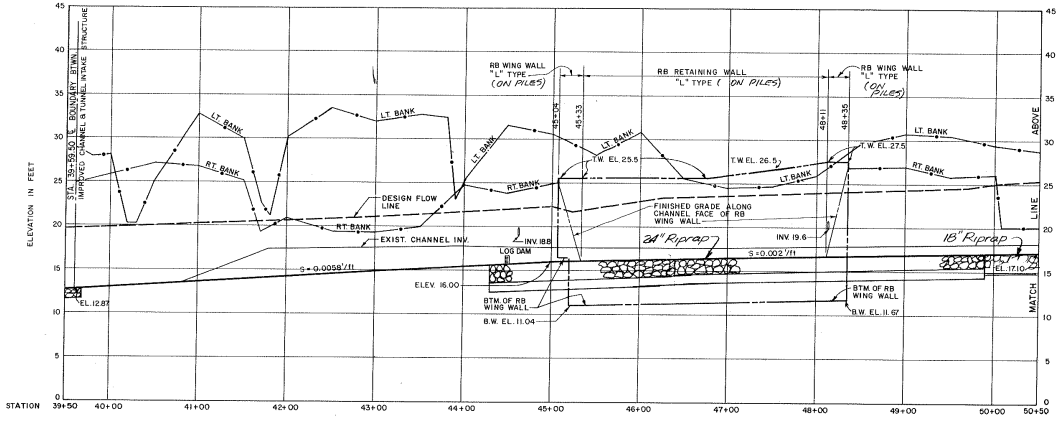
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
IMPROVED SHELDRAKE RIVER
STA. 0+00 TO STA. 28+00

MAMARONECK NEW YORK

FIGURE 29





SHELDRAKE RIVER PROFILE

Scale: Horiz. 1" = 50'
Vert. 1" = 5'

LEGEND

- Existing Ground Or Structure At ℄ Of Stream
- Proposed Grade
- 200 Year Flood
- Top Elev. Of Walls
- Top Of Bank { Lt. Bank / Rt. Bank
- Top Of Rock Elevation { LR – Left Bank / RR – Right Bank / ℄R – Center Line
- Riprap
- Drop Inlet (12" Ø Pipe)
- Bedding Material

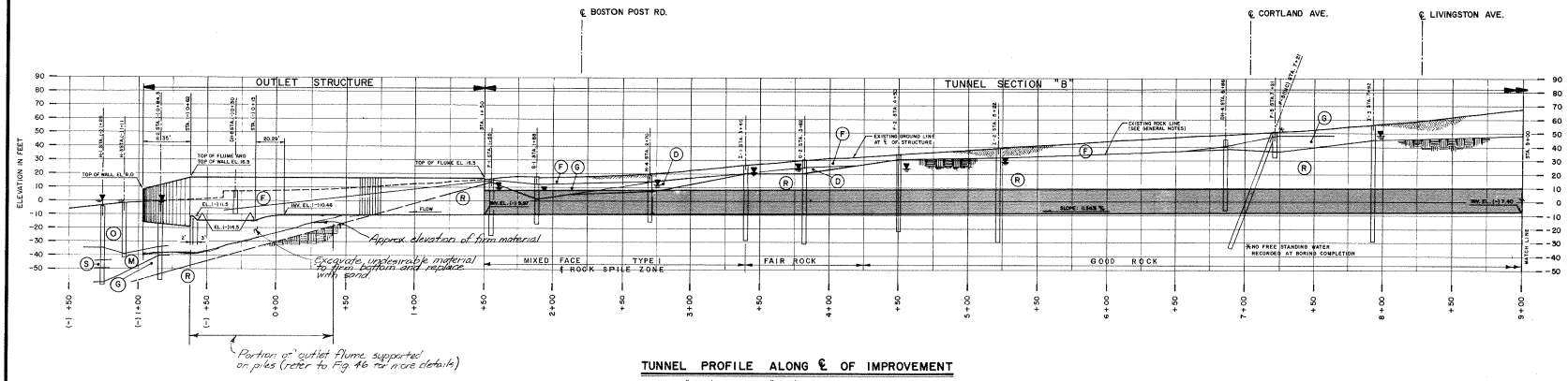
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
IMPROVED SHELDRAKE RIVER
STA. 39+50 TO STA. 61+45

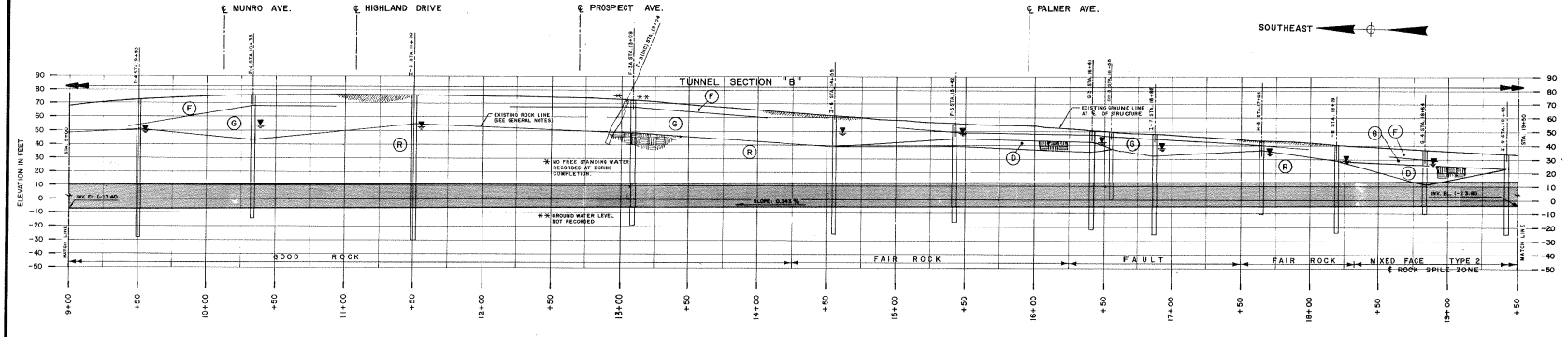
MAMARONECK **NEW YORK**

FIGURE 30



TUNNEL PROFILE ALONG ℄ OF IMPROVEMENT

SCALE: 1" = 30' HORIZ. & 1" = 30' VERT.



TUNNEL PROFILE ALONG ℄ OF IMPROVEMENT

SCALE: 1" = 30' HORIZ. & 1" = 30' VERT.

GENERAL NOTES

1. TOP OF ROCK LINE IS BASED ON LINEAR INTERPOLATION BETWEEN BORINGS.
2. SOME BORINGS WERE PROJECTED ON TO THE SECTION TO DEFINE THE ROCK LINE.
3. SOIL PROFILE SHOWN IS APPROXIMATE.

LEGEND:

- EXISTING GROUND SURFACE ALONG ℄ OF THE TUNNEL
- GROUD WATER LEVEL RECORDED DURING DRILLING OPERATION
- ROCK LINE

GENERAL STRATA DESCRIPTIONS

- (F) – FILL
- (O) – ORGANIC SILTY CLAY & PEAT.
- (S) – GRAY FINE TO MEDIUM SAND, TRACE MICA.
- (M) – GRAY FINE SAND AND SILT, VARVED WITH TRACE CLAY.
- (G) – GRAY BROWN FINE TO COARSE SAND, LITTLE GRAVEL AND SILT.
- (D) – DECOMPOSED ROCK.
- (R) – GRAY AND BLACK WEATHERED TO SOUND, SLIGHTLY JOINTED TO HIGHLY JOINTED GNEISS.

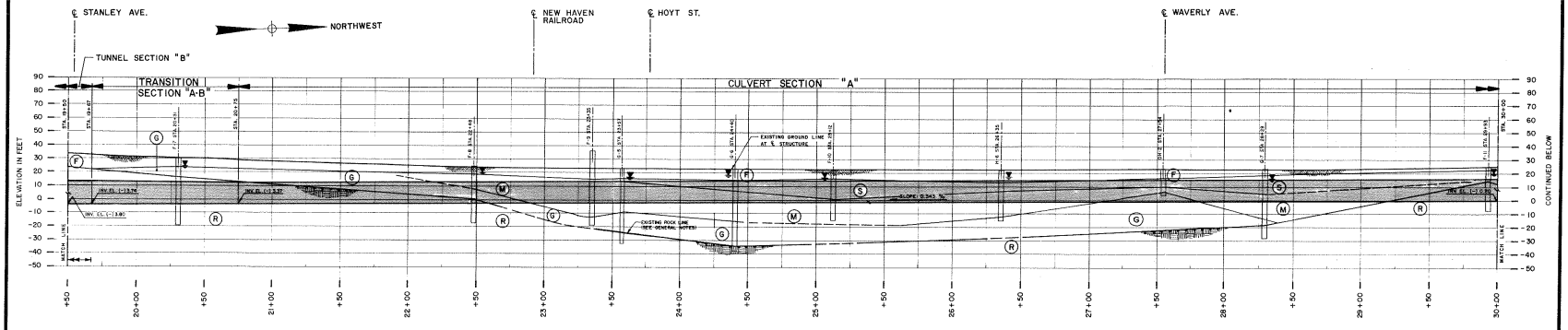
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE
SHELDRAKE DIVERSION TUNNEL
STA. (-) 0+97 TO STA. 19+50

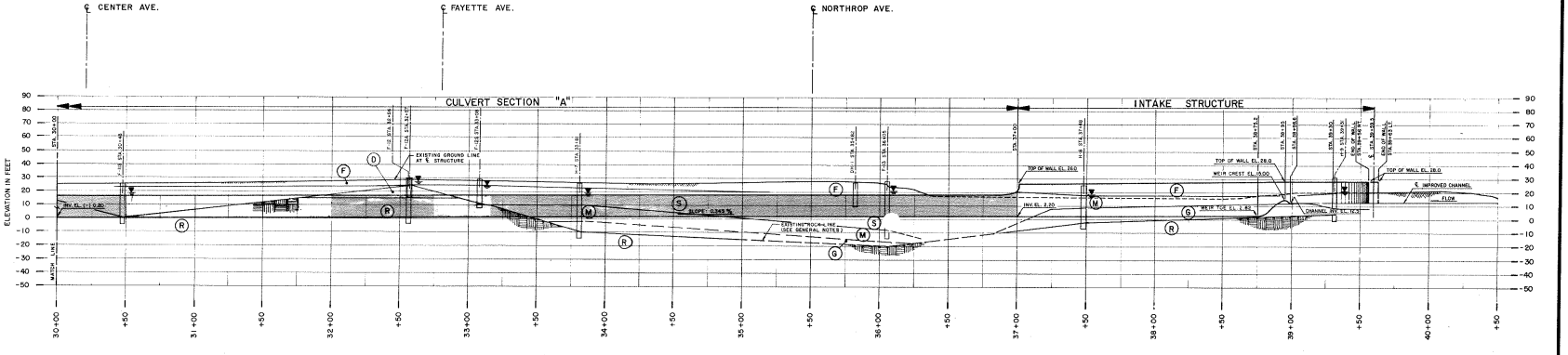
MAMARONECK **NEW YORK**

FIGURE 31



TUNNEL PROFILE ALONG ℄ OF IMPROVEMENT

SCALE: 1" = 30' HORIZ. & 1" = 30' VERT.



TUNNEL PROFILE ALONG ℄ OF IMPROVEMENT

SCALE: 1" = 30' HORIZ. & 1" = 30' VERT.

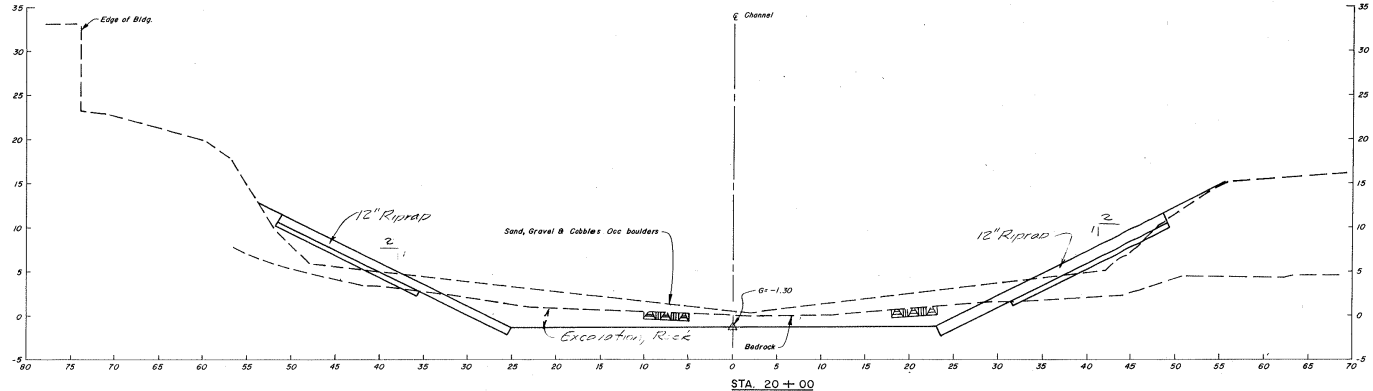
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

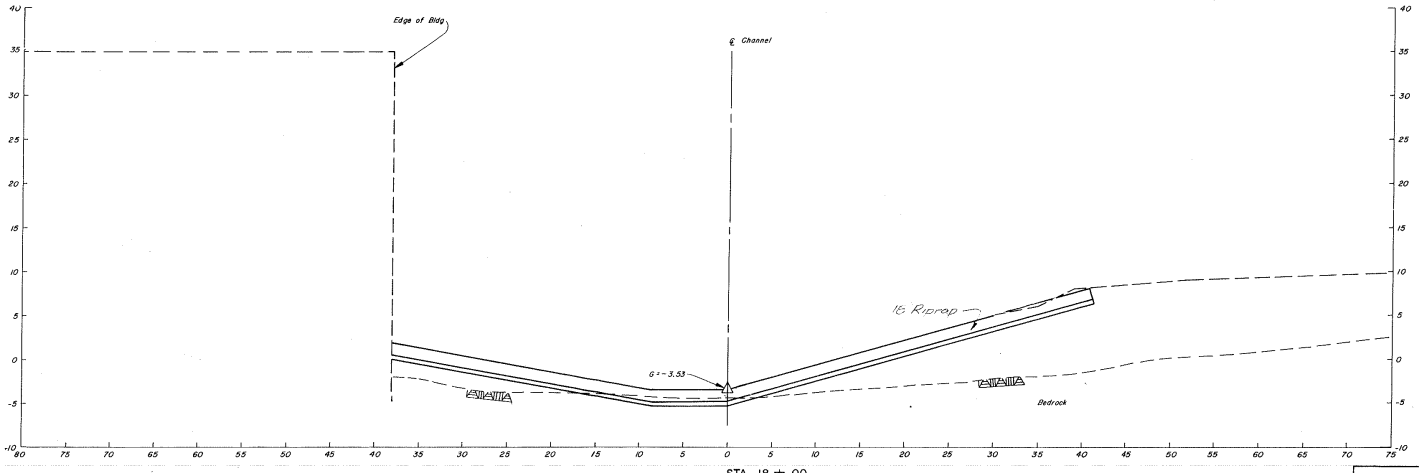
PROFILE
SHELDRAKE DIVERSION TUNNEL
STA. 19+50 TO STA. 39+63

MAMARONECK **NEW YORK**

FIGURE 32



STA. 20 + 00



STA. 18 + 00

LEGEND:

- Existing Ground
- Approximate location of top of existing rock line.
- Limit of wall excavation
- Proposed construction, see typical section sheets for details.

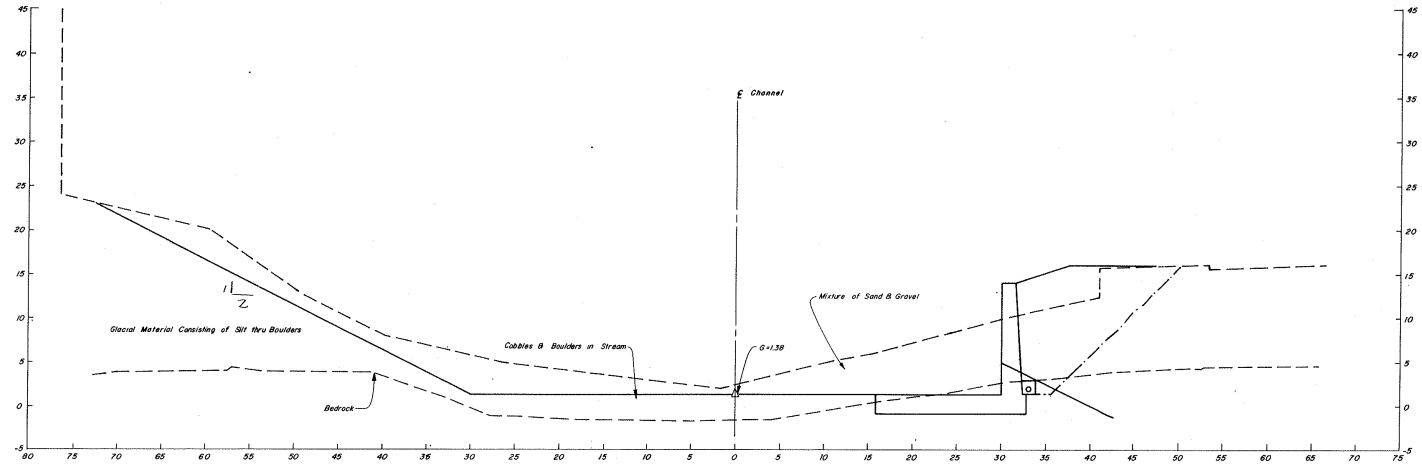
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

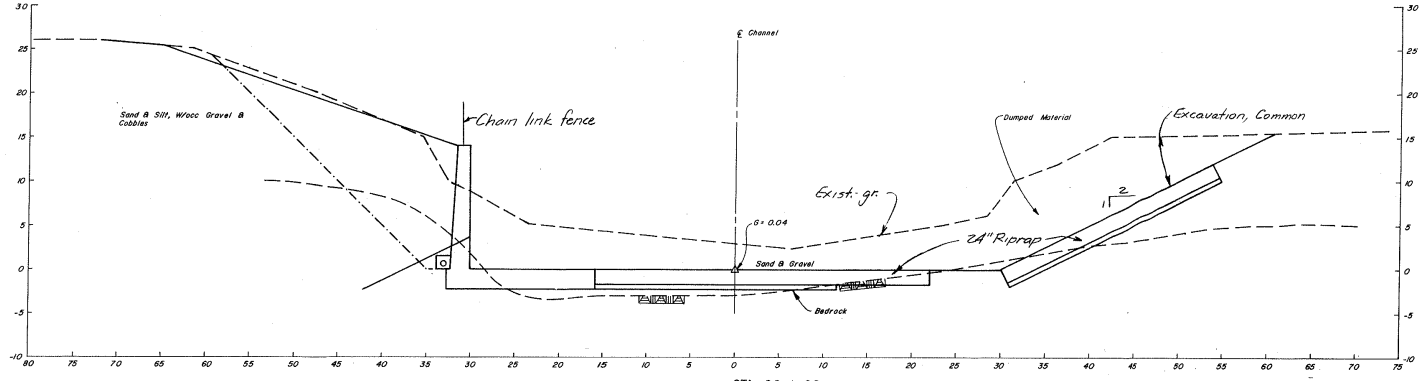
CROSS SECTIONS
STA. 18+00 and STA. 20+00

MAMARONECK NEW YORK

FIGURE 33



STA. 24 + 00



STA. 22 + 00

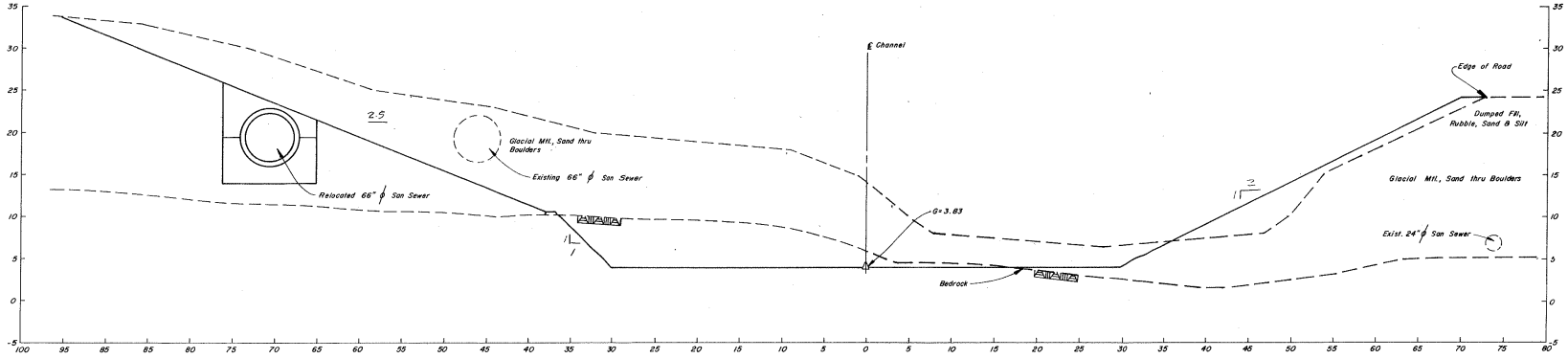
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

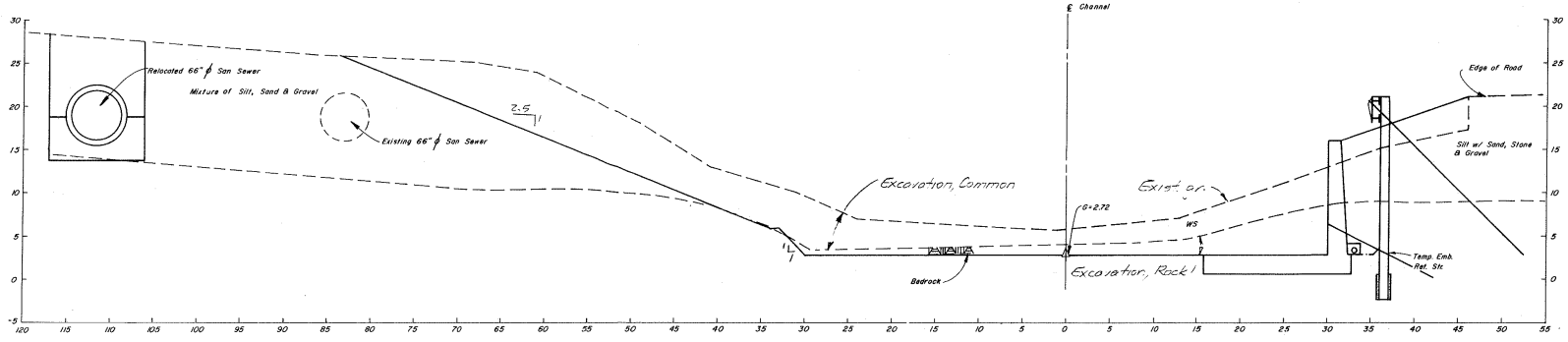
CROSS SECTIONS
STA. 22+00 and STA. 24+00

MAMARONECK NEW YORK

FIGURE 34



STA. 28+00



STA. 26+00

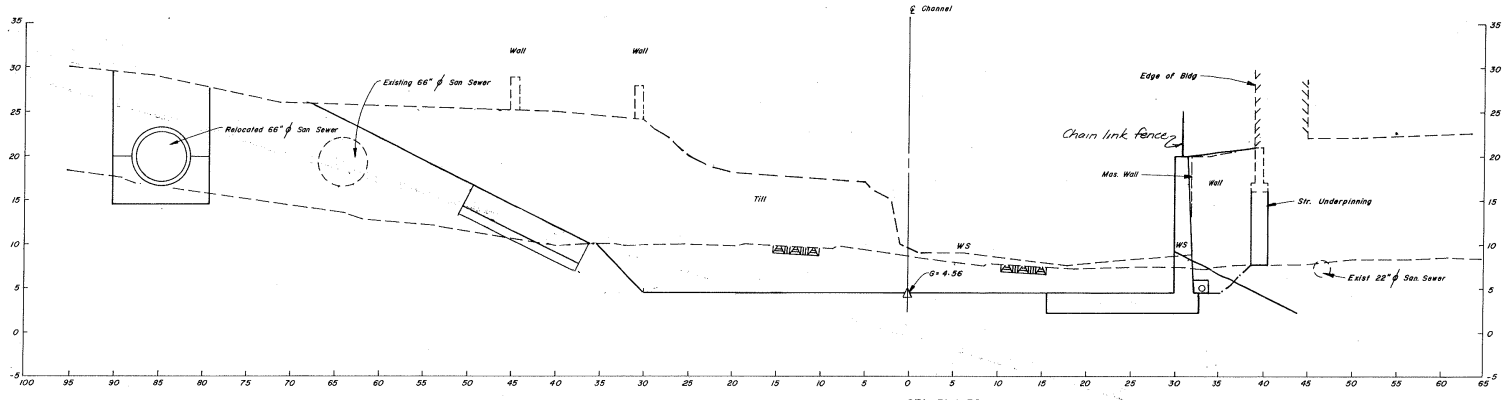
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

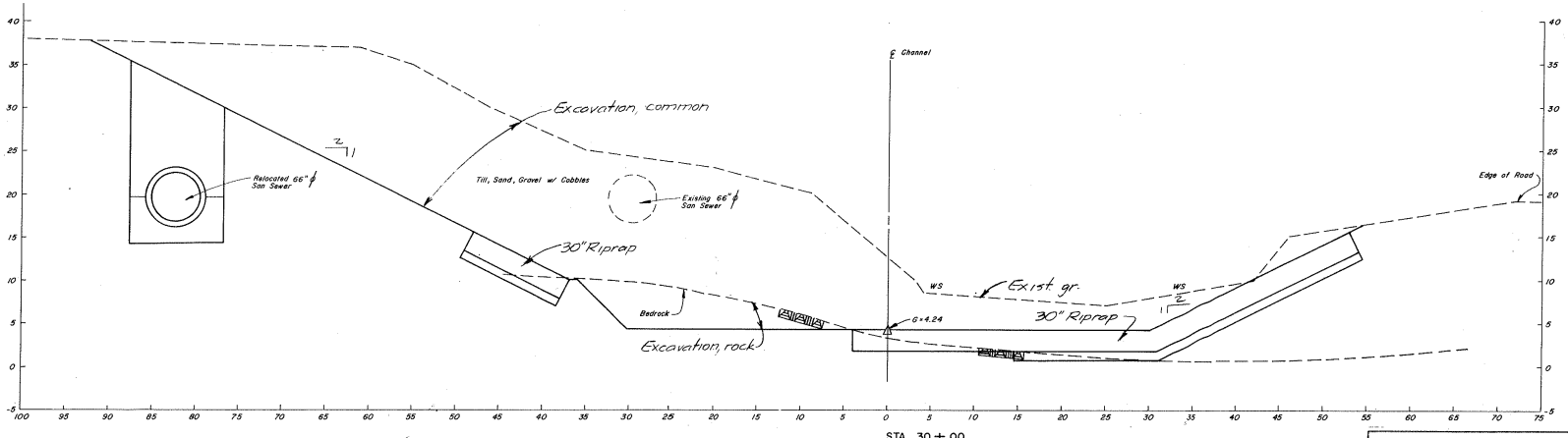
CROSS SECTIONS
STA. 26+00 and STA. 28+00

MAMARONECK NEW YORK

FIGURE 35



STA. 31 + 50



STA. 30 + 00

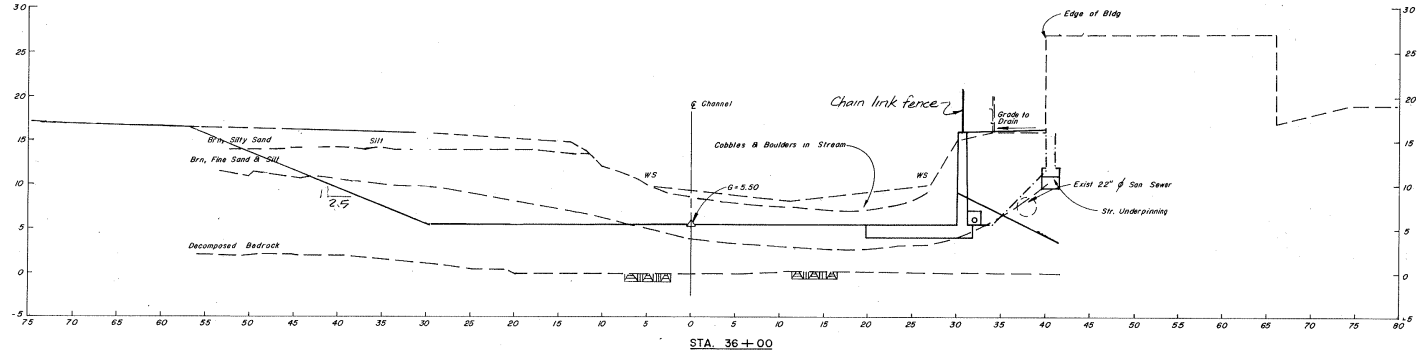
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

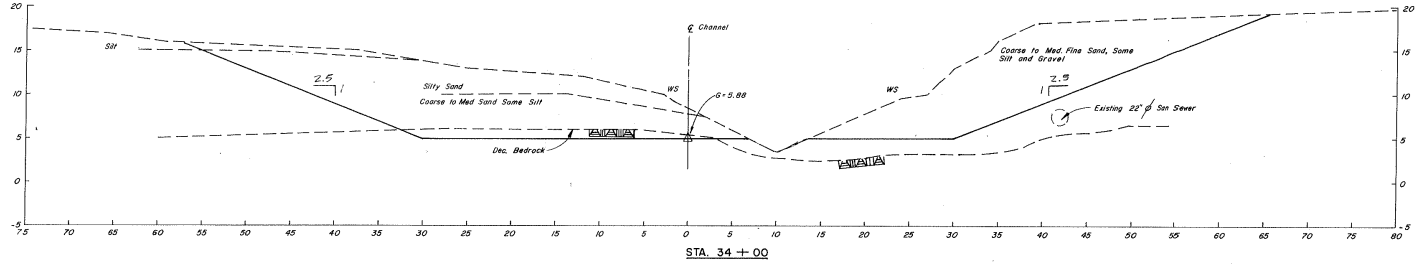
CROSS SECTIONS
STA. 30+00 and STA. 31+50

MAMARONECK NEW YORK

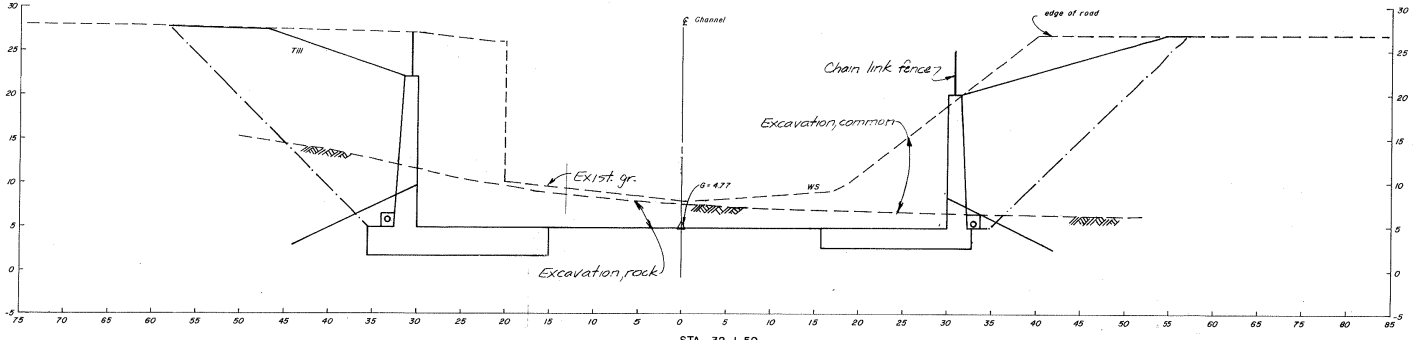
FIGURE 36



STA. 36 + 00



STA. 34 + 00



STA. 32 + 50

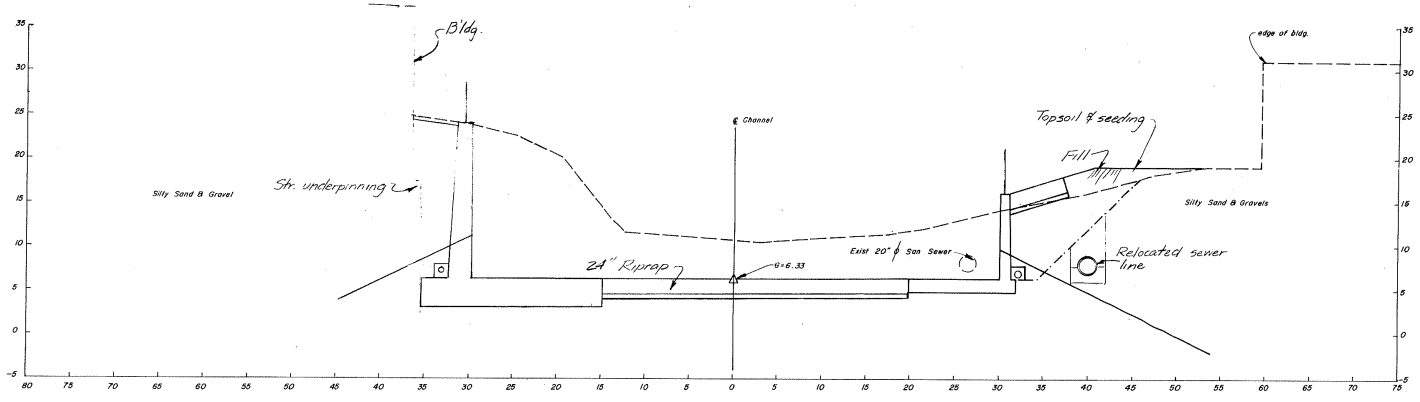
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

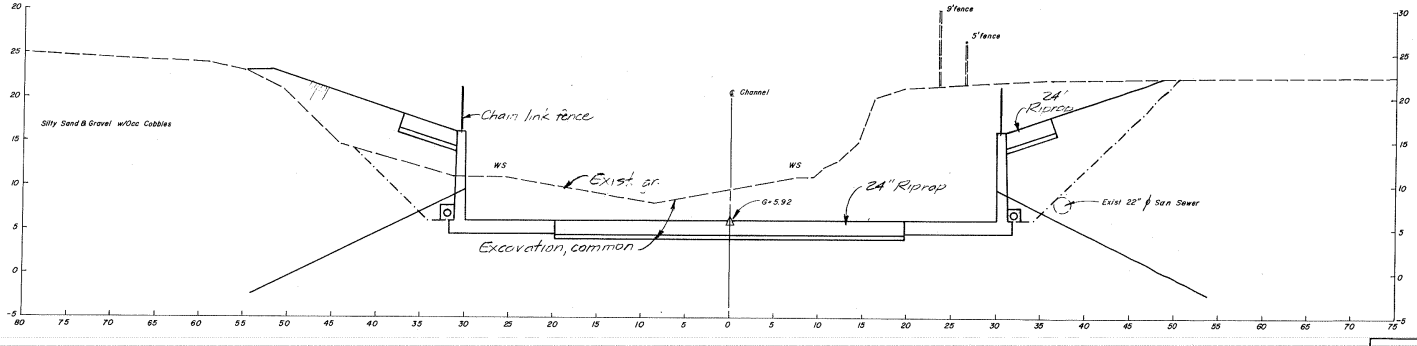
CROSS SECTIONS
STA. 32 + 50, STA. 34 + 00 and STA. 36 + 00

MAMARONECK NEW YORK

FIGURE 37



STA. 40+00



STA. 38+00

MAMARONECK AND SHELDRAKE RIVERS BASIN

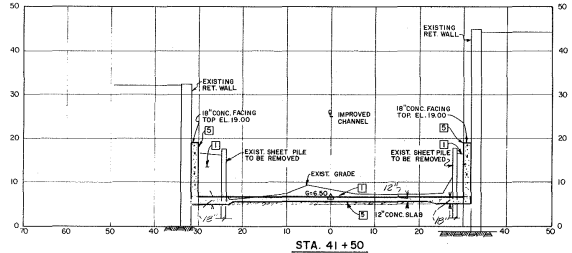
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

CROSS SECTIONS
STA. 38+00 and STA. 40+00

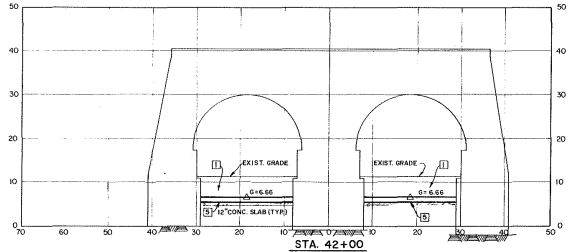
MAMARONECK NEW YORK

FIGURE 38

PH

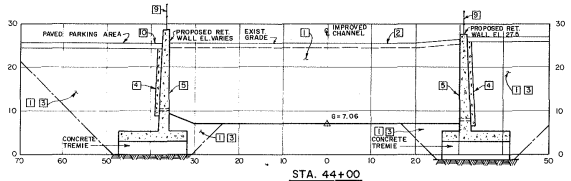


STA. 41+50

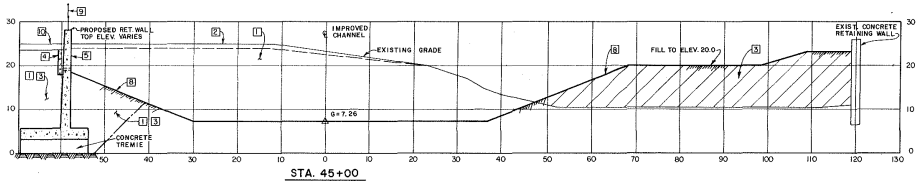


STA. 42+00

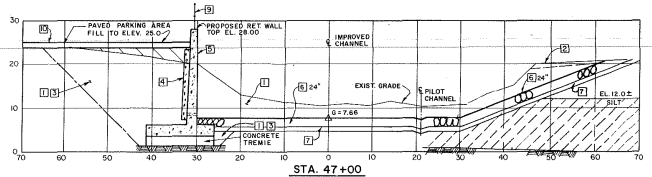
METRO NORTH R.R. BRIDGE



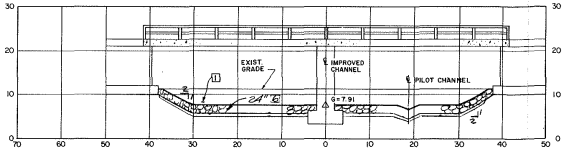
STA. 44+00



STA. 45+00

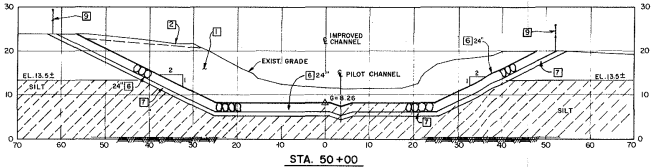


STA. 47+00

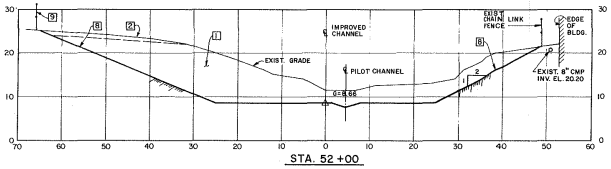


STA. 48+25

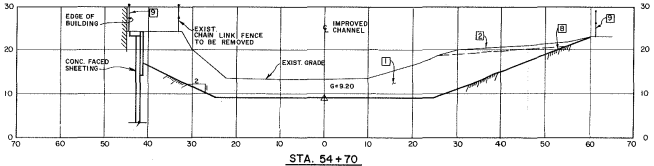
JEFFERSON AVE. BRIDGE



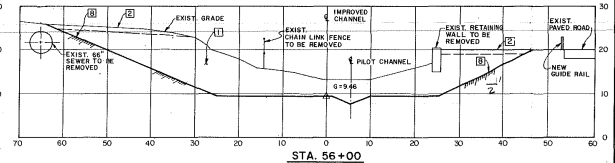
STA. 50+00



STA. 52+00



STA. 54+70



STA. 56+00

NOTES:

1. ALL SECTIONS TAKEN LOOKING DOWNSTREAM.
2. ALL SIDE SLOPES ARE 1 V ON 2.5 H UNLESS OTHERWISE NOTED.
3. LIMIT OF 5" TOPSOIL & SEEDING IS 3'-0" ABOVE IMPROVED CHANNEL.

LEGEND

1	EXCAVATION COMMON
2	EXCAVATION STRIPPING
3	COMPACTED FILL, COMMON
4	COMPACTED FILL, PERVIOUS
5	CONCRETE
6	RIPRAP
7	BEDDING MATERIAL
8	5" TOPSOIL & SEEDING
9	6' HIGH CHAIN LINK FENCE
10	BITUMINOUS PAVEMENT

SCALE: 1" = 10'

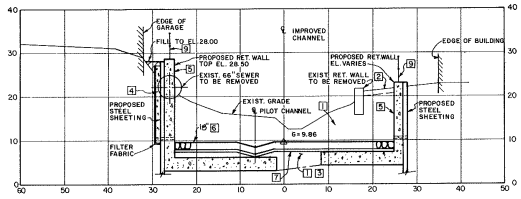
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

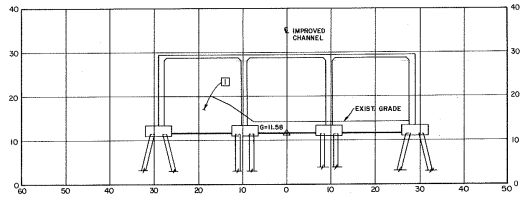
TYPICAL CROSS SECTIONS
IMPROVED MAMARONECK RIVER

MAMARONECK NEW YORK

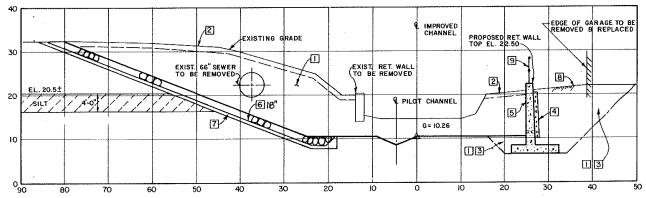
FIGURE 39



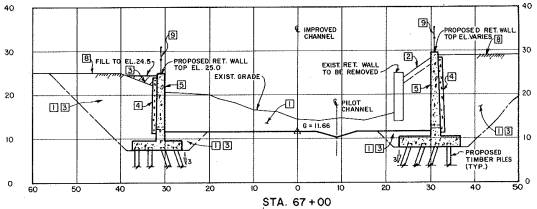
STA. 58+00



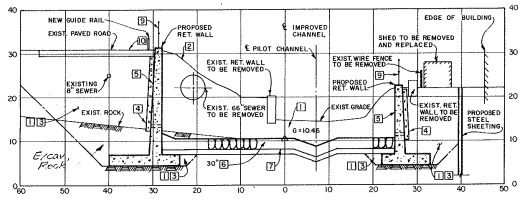
STA. 66+60
NEW BARRY ROAD BRIDGE



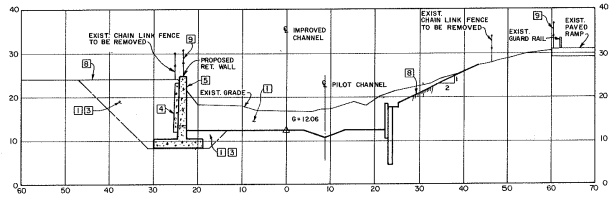
STA. 60+00



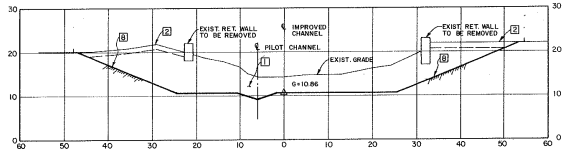
STA. 67+00



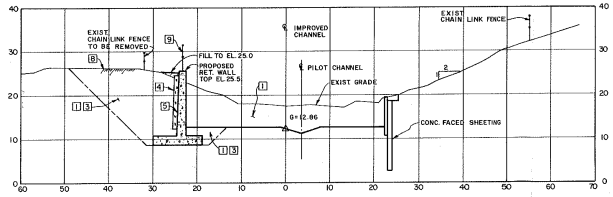
STA. 61+00



STA. 69+00



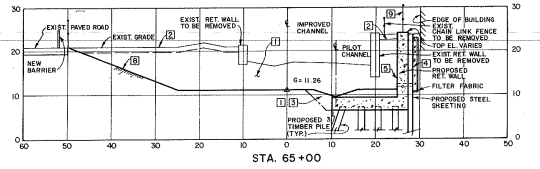
STA. 63+00



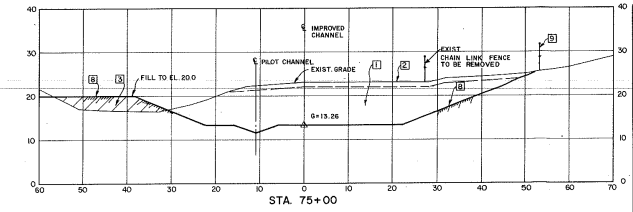
STA. 73+00

NOTE:

FOR LEGEND AND NOTES SEE FIGURE 39



STA. 65+00



STA. 75+00

SCALE: 1"=10'

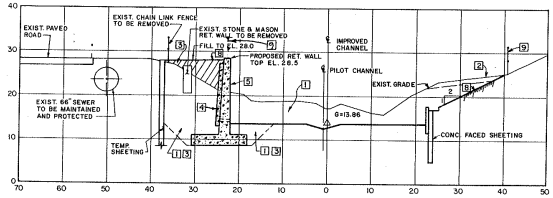
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

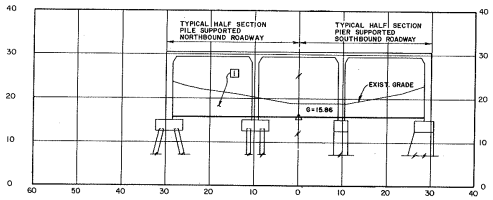
TYPICAL CROSS SECTIONS
IMPROVED MAMARONECK RIVER

MAMARONECK NEW YORK

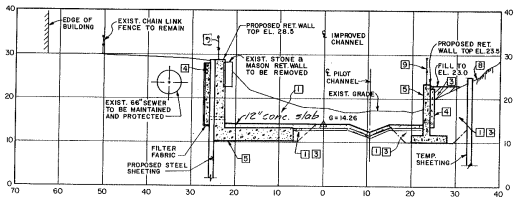
FIGURE 40



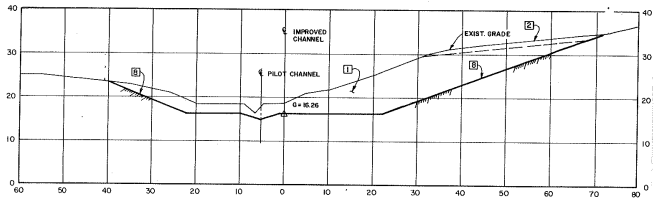
STA. 78+00



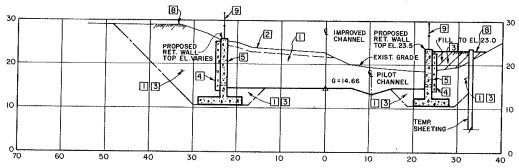
STA. 87+50 THRU 88+71
NEW ENGLAND THRUWAY BRIDGE



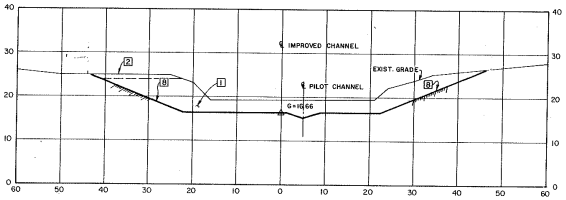
STA. 80+00



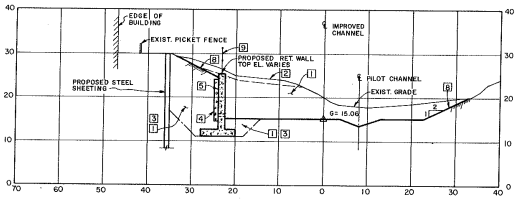
STA. 90+00



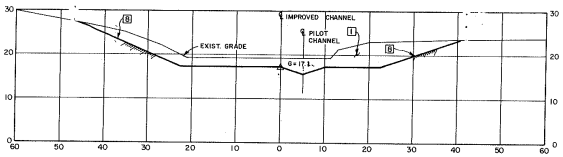
STA. 82+00



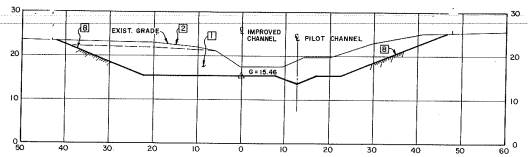
STA. 92+00



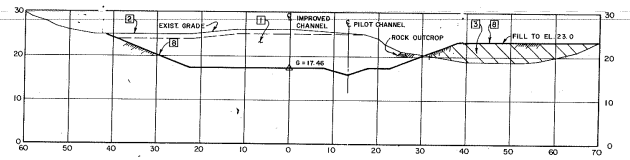
STA. 84+00



STA. 94+50



STA. 86+00



STA. 96+00

NOTE:
FOR LEGEND AND NOTES SEE FIGURE 39

SCALE: 1" = 10'

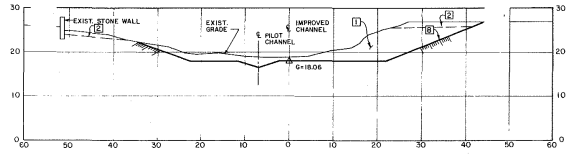
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

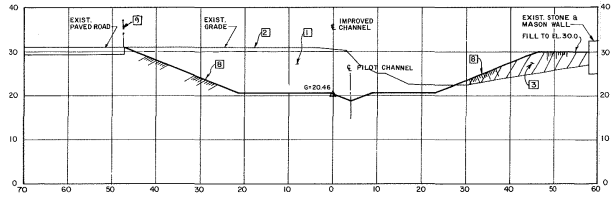
TYPICAL CROSS SECTIONS
IMPROVED MAMARONECK RIVER

MAMARONECK NEW YORK

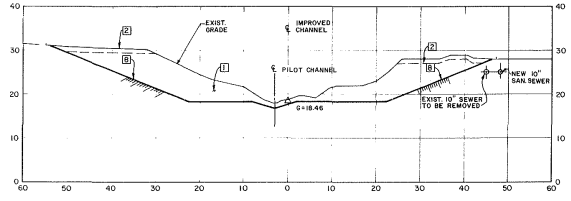
FIGURE 41



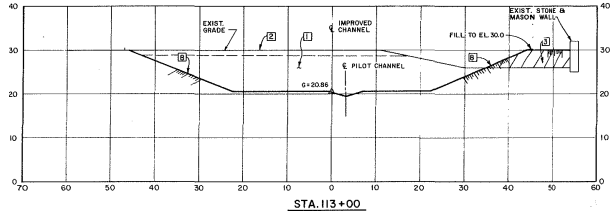
STA. 99 + 00



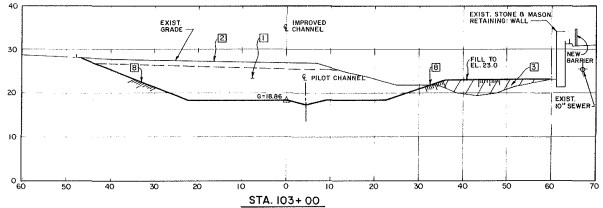
STA. 111 + 00



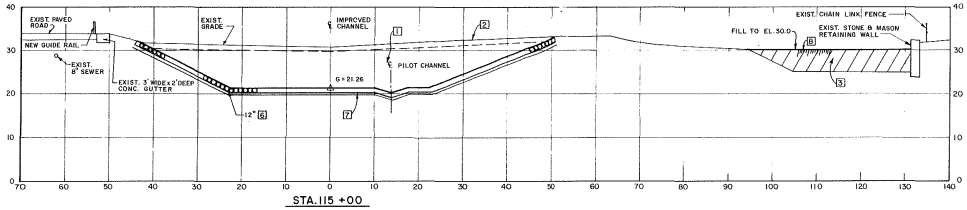
STA. 101 + 00



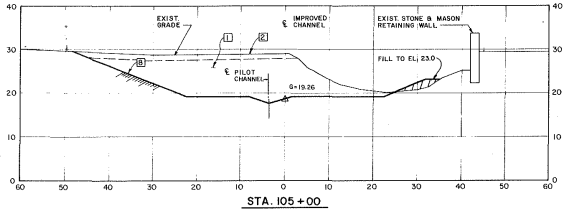
STA. 113 + 00



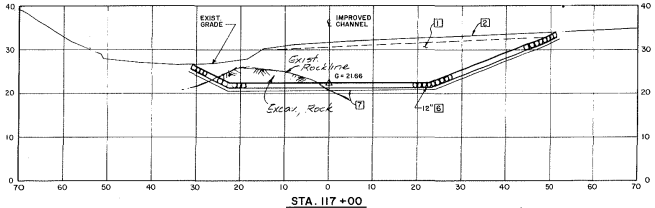
STA. 103 + 00



STA. 115 + 00



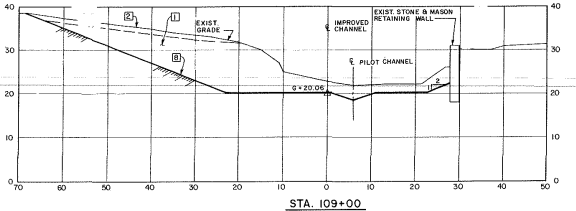
STA. 105 + 00



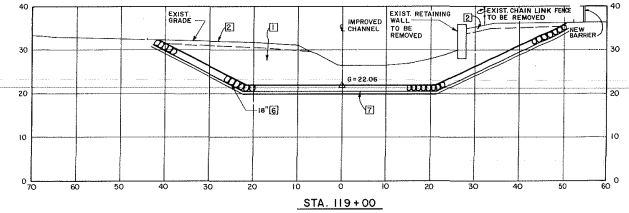
STA. 117 + 00

NOTE:

FOR LEGEND AND NOTES SEE FIGURE 3[illegible]



STA. 109 + 00



STA. 119 + 00

SCALE: 1" = 10'

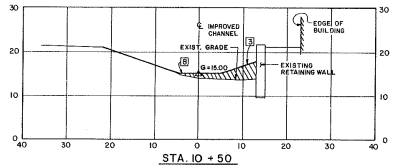
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

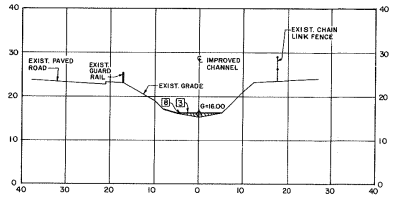
TYPICAL CROSS SECTIONS
IMPROVED MAMARONECK RIVER

MAMARONECK **NEW YORK**

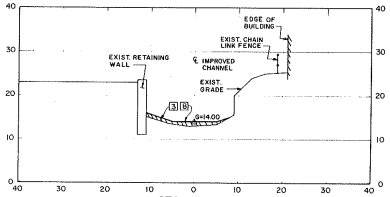
FIGURE 42



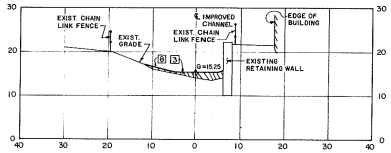
STA. 10 + 50



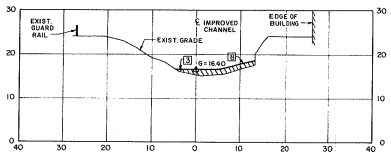
STA. 19 + 50



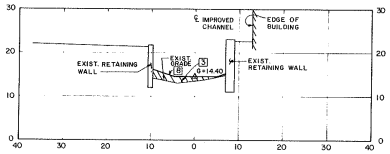
STA. 2 + 50



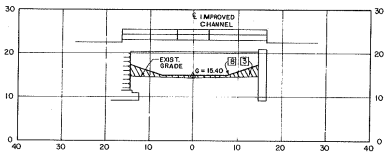
STA. 12 + 00



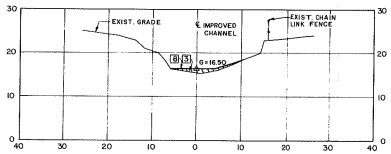
STA. 22 + 00



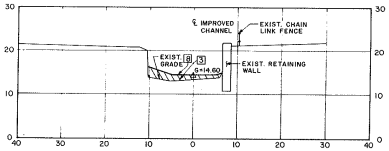
STA. 5 + 00



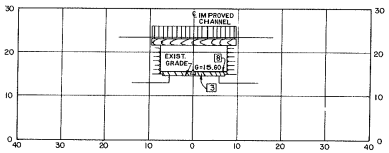
STA. 13 + 30
WAVERLY AVE. BRIDGE



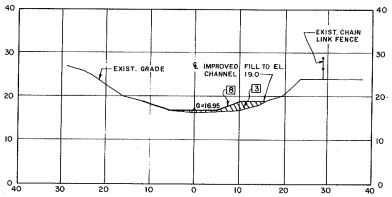
STA. 23 + 00



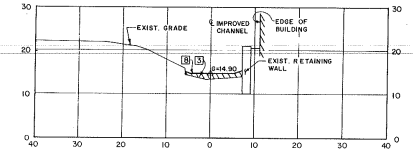
STA. 7 + 00



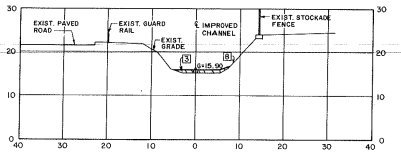
STA. 15 + 70
CENTER AVE. BRIDGE



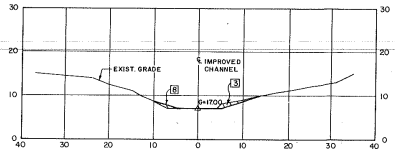
STA. 25 + 50



STA. 9 + 00



STA. 17 + 50



STA. 27 + 50

NOTES:

1. ALL SECTIONS TAKEN LOOKING DOWNSTREAM.
2. ALL SIDE SLOPES ARE 1 V ON 3 H.
3. WIDTH OF CHANNEL BTM. 10'-0" TYP EXCEPT AT BRIDGES
4. FOR LEGEND SEE FIGURE 50.

SCALE: 1" = 10'

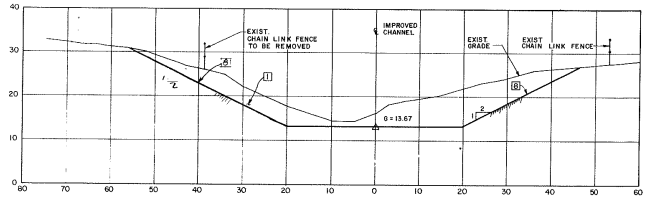
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

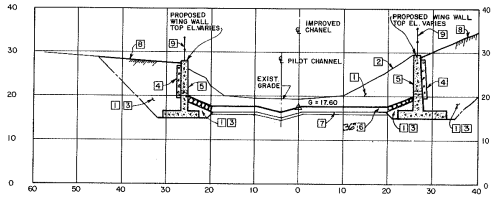
TYPICAL CROSS SECTIONS
IMPROVED SHELDRAKE RIVER

MAMARONECK **NEW YORK**

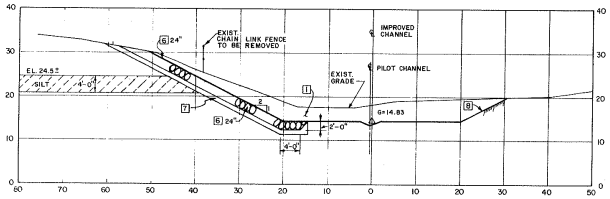
FIGURE 43



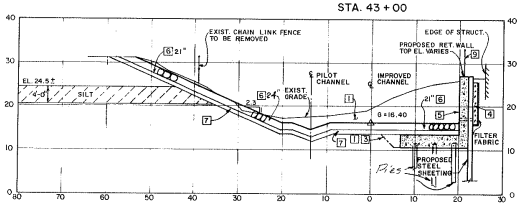
STA. 41+00



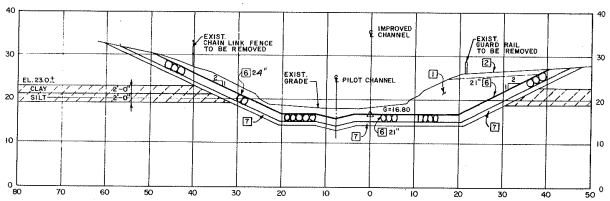
STA. 53+00



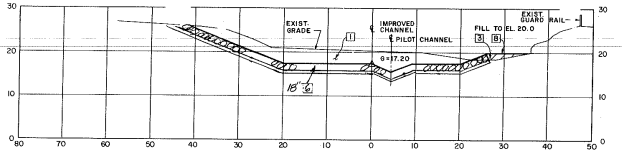
STA. 43+00



STA. 47+00



STA. 49+00



STA. 51+00

NOTE:

FOR LEGEND AND NOTES SEE FIGURE 2[illegible].

SCALE: 1" = 10'

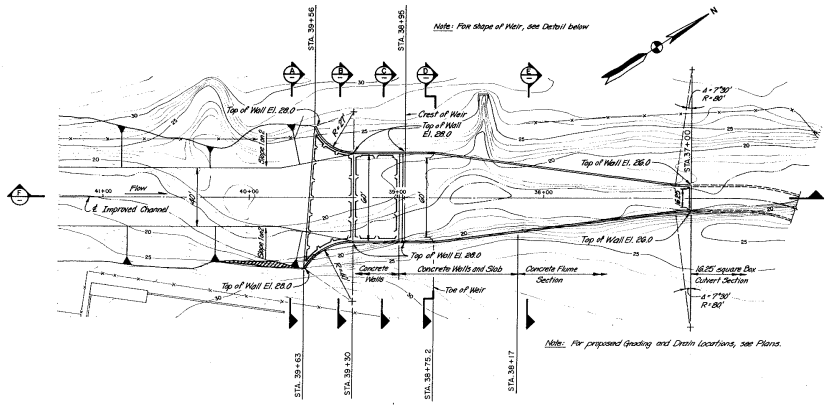
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

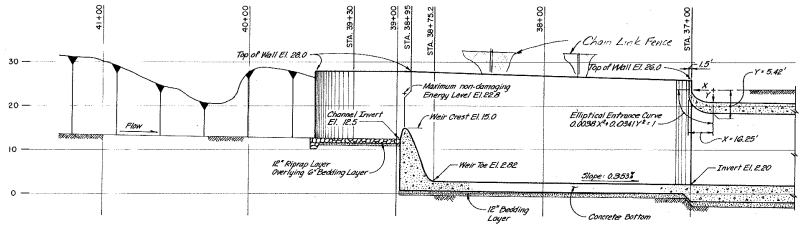
TYPICAL CROSS SECTIONS
IMPROVED SHELDRAKE RIVER

MAMARONECK NEW YORK

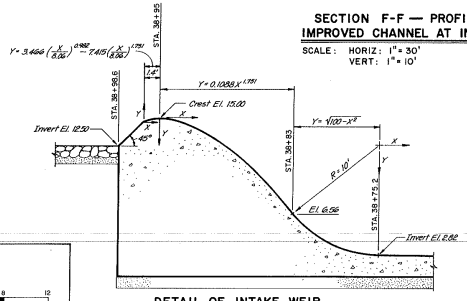
FIGURE 44



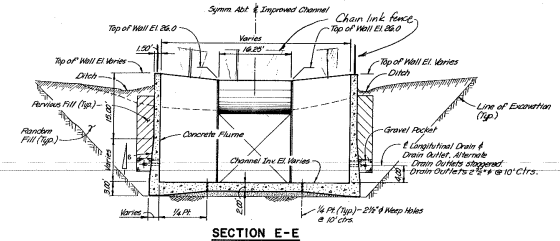
PLAN AT INTAKE STRUCTURE
SCALE: 1" = 30'



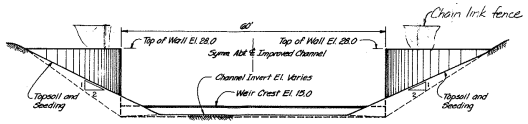
SECTION F-F — PROFILE ALONG ℄ OF IMPROVED CHANNEL AT INTAKE STRUCTURE
SCALE: HORIZ: 1" = 30'
VERT: 1" = 10'



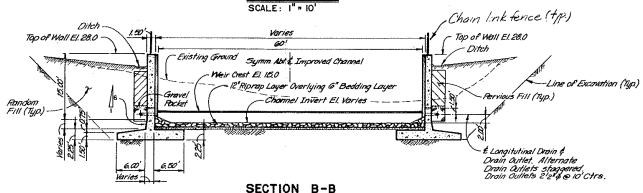
DETAIL OF INTAKE WEIR
SCALE: 1" = 4'



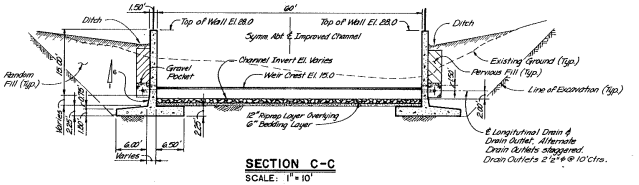
SECTION E-E
SCALE: 1" = 10'



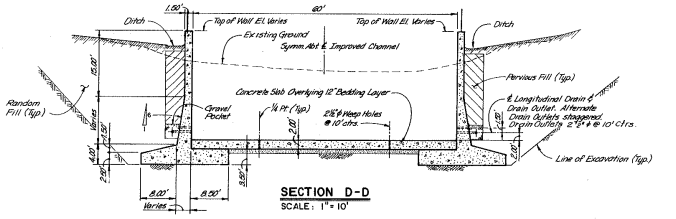
SECTION A-A
SCALE: 1" = 10'



SECTION B-B
SCALE: 1" = 10'



SECTION C-C
SCALE: 1" = 10'



SECTION D-D
SCALE: 1" = 10'

BAR SCALES

1" = 4'
1" = 10'
1" = 30'

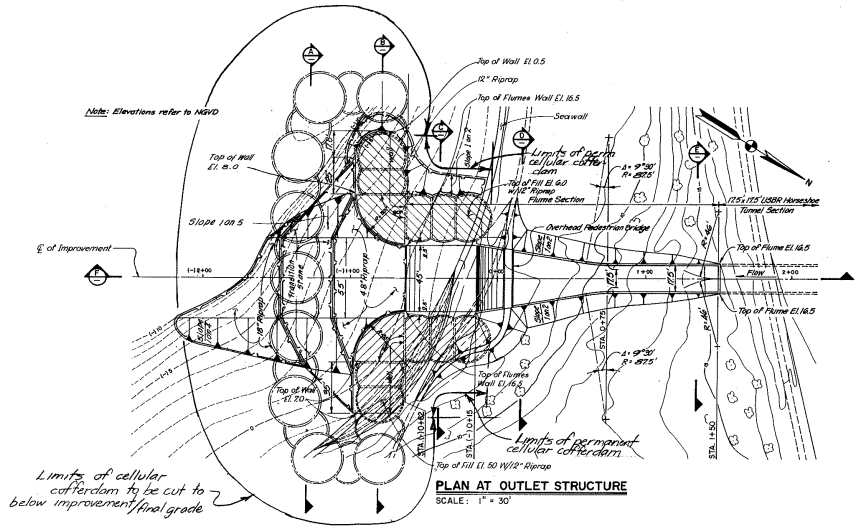
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

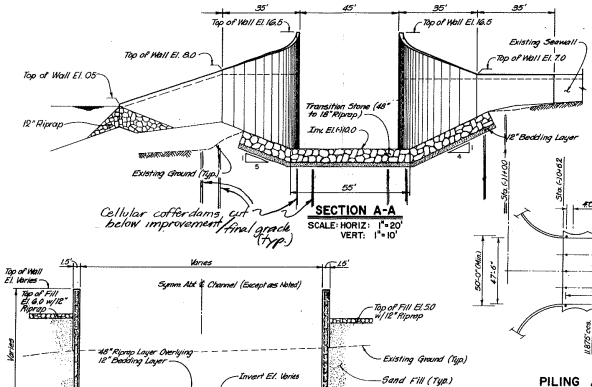
TYPICAL CROSS SECTIONS AND DETAILS
SHELDRAKE DIVERSION TUNNEL INTAKE STRUCTURE

MAMARONECK **NEW YORK**

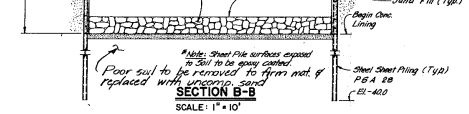
FIGURE 45



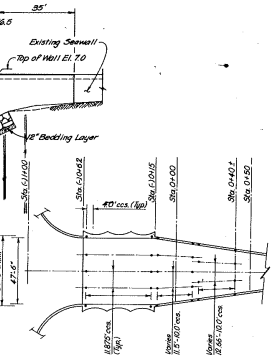
PLAN AT OUTLET STRUCTURE
SCALE: 1" = 30'



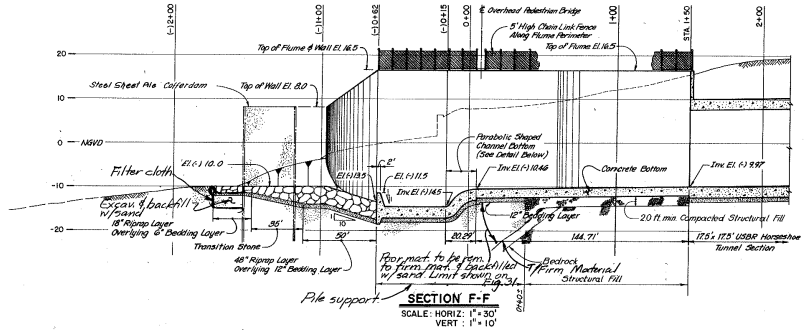
SECTION A-A
SCALE: HORIZ: 1" = 20'
VERT: 1" = 10'



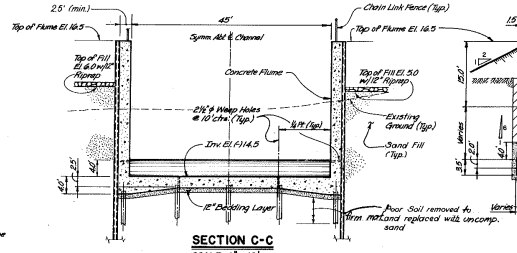
SECTION B-B
SCALE: 1" = 10'



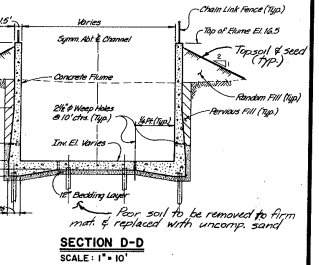
PILING ARRANGEMENT
SCALE: 1" = 30'



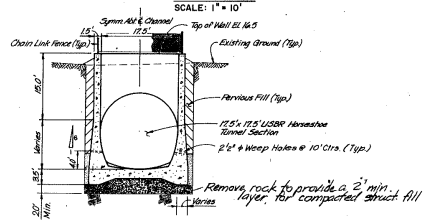
SECTION F-F
SCALE: HORIZ: 1" = 30'
VERT: 1" = 10'



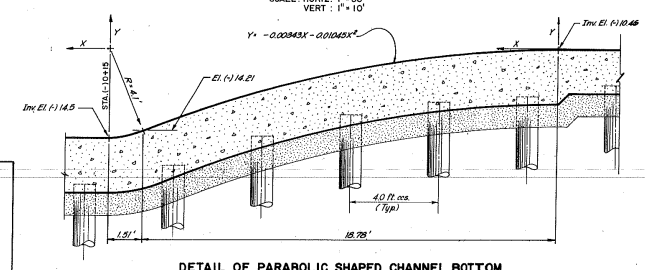
SECTION C-C
SCALE: 1" = 10'



SECTION D-D
SCALE: 1" = 10'



SECTION E-E
SCALE: 1" = 10'



DETAIL OF PARABOLIC SHAPED CHANNEL BOTTOM
SCALE: 1" = 2'

BAR SCALES

1" = 2'
1" = 10'
1" = 20'
1" = 30

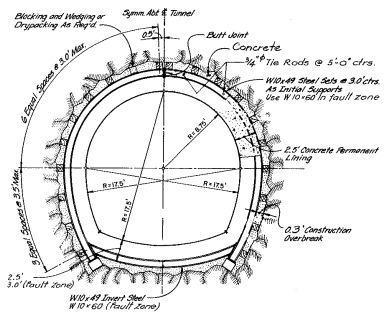
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

TYPICAL CROSS SECTIONS AND DETAILS
SHELDRAKE DIVERSION TUNNEL
OUTLET STRUCTURE

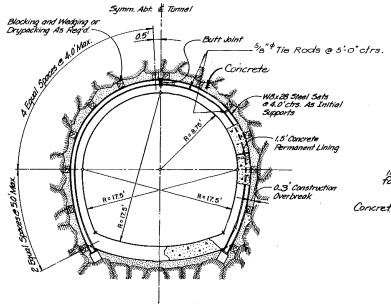
MAMARONECK NEW YORK

FIGURE 46



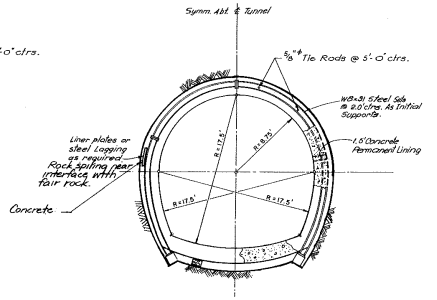
FAIR ROCK AND FAULT ZONE (AS NOTED)

FAIR ROCK - STA. 3+40 TO 4+25, 14+25 TO 16+25, 17+50 TO 18+30
FAULT ZONE - STA. 16+25 TO 17+50



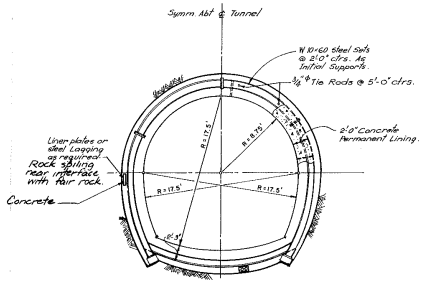
GOOD ROCK

STA. 4+25 TO 14+25



MIXED FACE TYPE 1 & ROCK SPILE ZONE

STA. 1+50 TO 3+40

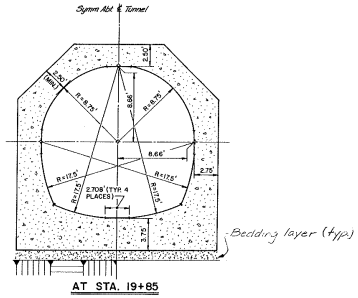


MIXED FACE TYPE 2 & ROCK SPILE ZONE

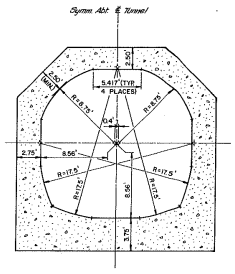
STA. 18+30 TO 19+67

HORSESHOE TUNNEL SECTION "B"

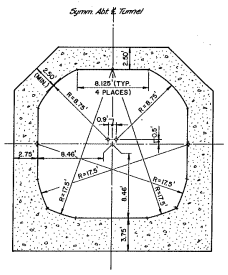
SCALE: 1" = 5'



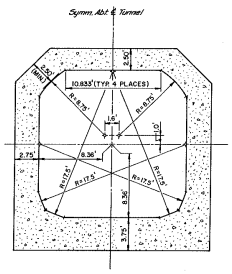
AT STA. 19+85



AT STA. 20+03



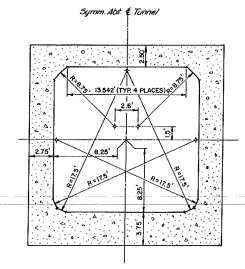
AT STA. 20+21



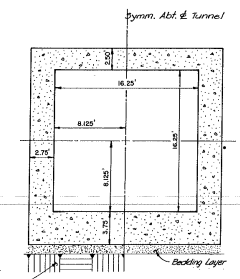
AT STA. 20+39

TRANSITION SECTION "A-B"

SCALE: 1" = 5'



AT STA. 20+57



FROM STA. 20+75 TO 37+00

CUT & COVER CULVERT SECTION "A"

SCALE: 1" = 5'

Note: For location of tunnel sections, refer to Figure Nos 17 & 21 thru 23

BAR SCALES

1" = 5' 0 1 2 3 4 5 10 15

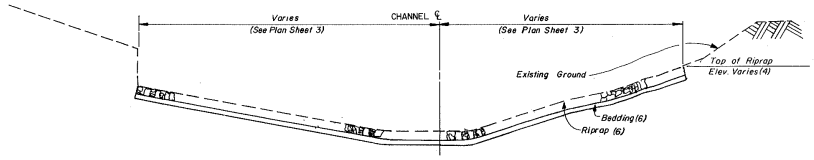
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

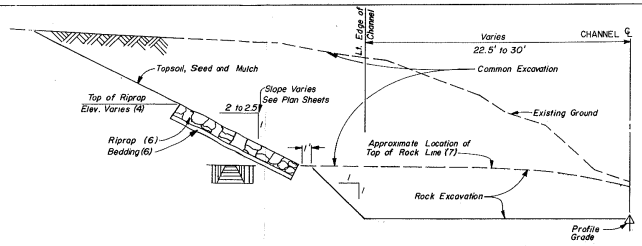
TYPICAL CROSS SECTIONS
SHELDRAKE DIVERSION TUNNEL

MAMARONECK NEW YORK

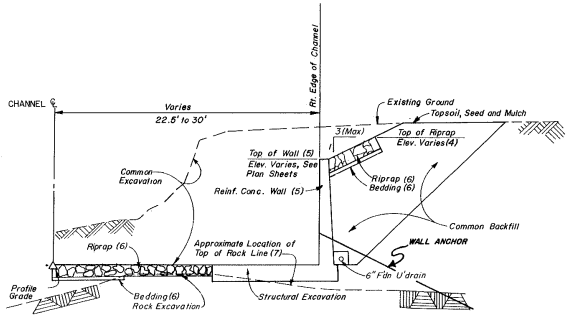
FIGURE 47



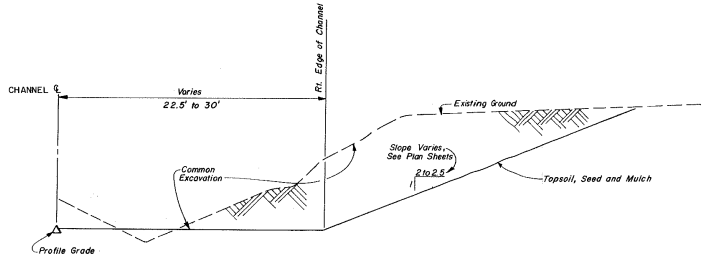
TYPICAL CHANNEL SECTION
N.T.S.
STA. 17 + 50 to STA. 19 + 00



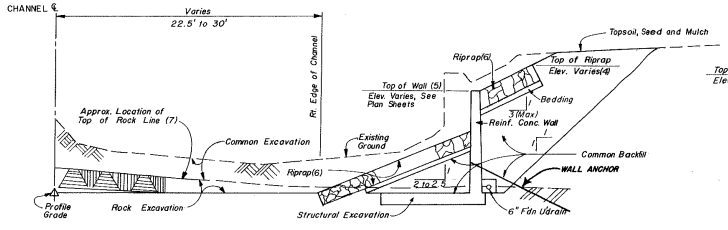
TYPICAL HALF CHANNEL SECTION(3)
N.T.S.
STA. 19 + 00LT to STA. 20 + 87LT
STA. 24 + 60LT to STA. 31 + 50LT
STA. 32 + 95LT to STA 33 + 45LT
STA. 33 + 90RT to STA. 33 + 20RT



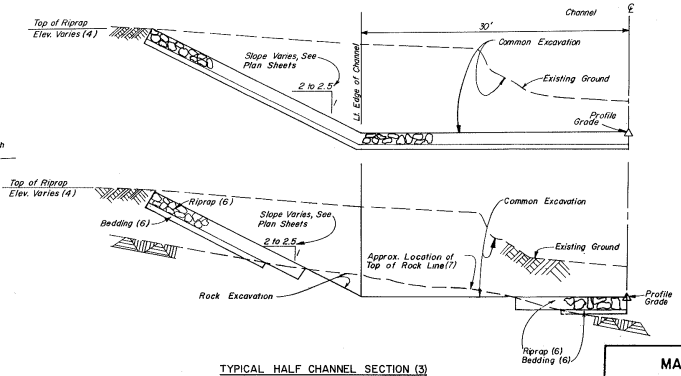
TYPICAL HALF CHANNEL SECTION (3)
N. T. S.
STA. 23 + 38RT to STA. 26 + 24RT
STA. 31 + 05RT to STA. 31 + 80RT
STA. 21 + 00LT to STA. 22 + 85LT
STA. 23 + 38LT to STA. 23 + 65LT
STA. 32 + 34LT to STA. 32 + 66LT
STA. 32 + 34RT to STA. 32 + 55RT
STA. 36 + 40LT to STA. 40 + 74LT
STA. 35 + 40RT to STA. 40 + 66RT
STA. 20 + 58RT to STA. 21 + 00RT



TYPICAL HALF CHANNEL SECTION (3)
N.T.S.
STA. 23 + 80LT to STA. 24 + 60LT
STA. 33 + 45LT to STA. 36 + 14 LT
STA. 26 + 60RT to STA. 28 + 60RT
STA. 32 + 90RT to STA. 35 + 15 RT



TYPICAL HALF CHANNEL TRANSITION SECTION (3)
N.T.S.
STA. 20 + 38RT to 20 + 58RT
STA. 21 + 00RT to 21 + 35RT
STA. 22 + 63RT to 22 + 85RT
STA. 26 + 24RT to 26 + 60RT
STA. 30 + 88RT to 31 + 05RT
STA. 32 + 55RT to 32 + 90RT
STA. 35 + 15 RT to 35 + 40RT
STA. 20 + 87LT to 21 + 00LT
STA. 23 + 65LT to 23 + 80LT
STA. 31 + 50LT to 31 + 80LT
STA. 32 + 66LT to 32 + 95LT
STA. 36 + 14 LT to 36 + 40LT



TYPICAL HALF CHANNEL SECTION (3)
N. T. S.
STA. 19 + 00RT to STA. 20 + 58RT
STA. 21 + 35RT to STA. 22 + 63RT
STA. 28 + 60RT to STA. 30 + 88RT

NOTES

1. For general notes, see Pl. 5.
2. All typical sections are drawn left to right looking downstream.
3. For all typical half sections, the opposite hand sections listed by station are the reflected mirror image of the one shown.
4. Top of riprap is set at the elevation of the 200 year flood event or top of slope, whichever is less.

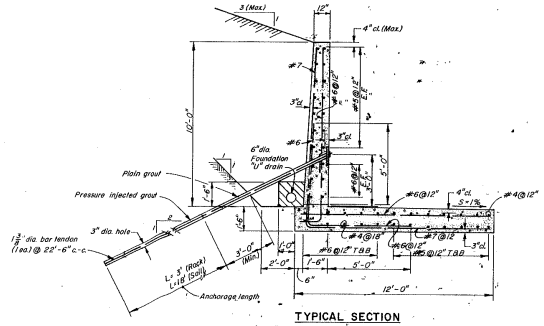
MAMARONECK AND SHELDRAKE
RIVERS BASIN

MAMARONECK AND SHELDRAKE
FLOOD CONTROL PROJECT

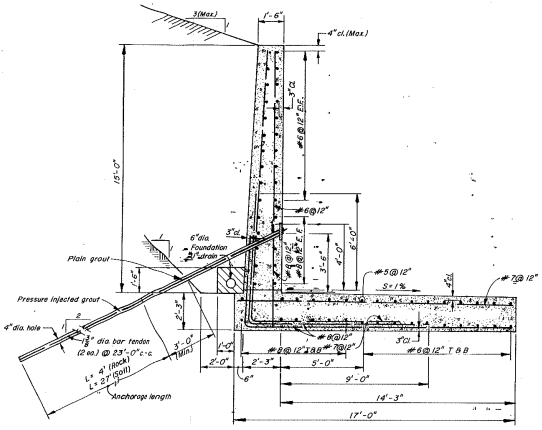
TYPICAL CHANNEL SECTIONS

MAMARONECK NEW YORK

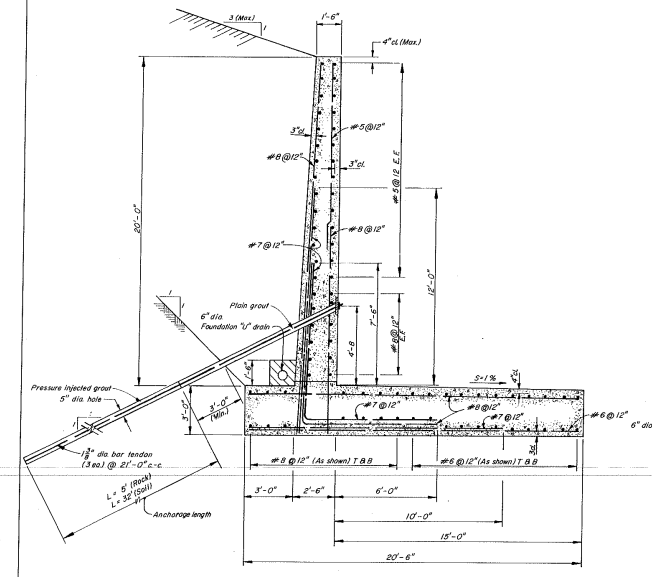
FIGURE 48



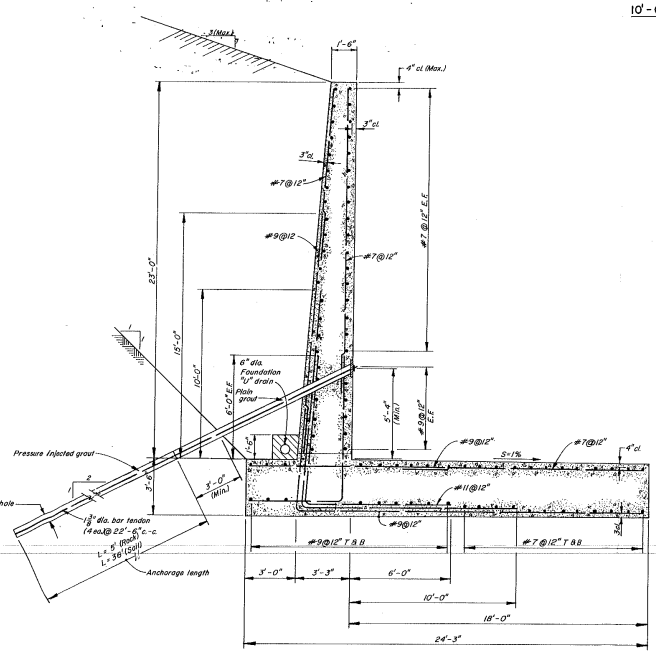
TYPICAL SECTION
7'-0" TO 10'-0" RETAINING WALL



TYPICAL SECTION
10'-0" TO 15'-0" RETAINING WALL



TYPICAL SECTION
15'-0" TO 20'-0" RETAINING WALL



TYPICAL SECTION
20'-0" TO 23'-0" RETAINING WALL

Notes:

1. *Wall excavation slope shall extend to temporary embankment retention structure between Sta. 24+00 and Sta. 26+58.*
2. *At each wall location, a 4' high chain link fence shall extend along the entire top of wall.*

SCALE IN FEET
0 1 2 3 4 5 6 7

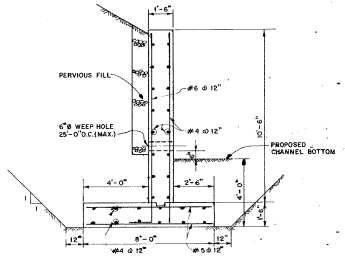
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

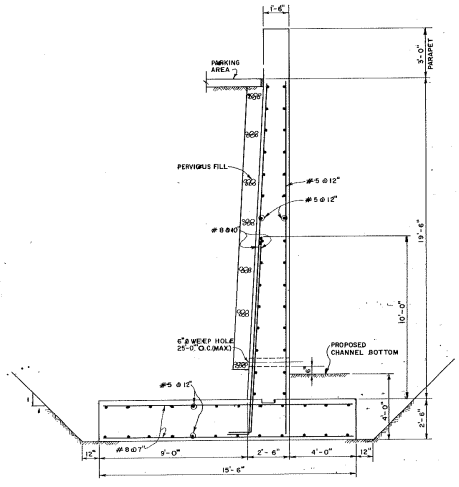
TYPICAL "L" WALL SECTIONS

MAMARONECK **NEW YORK**

FIGURE 49



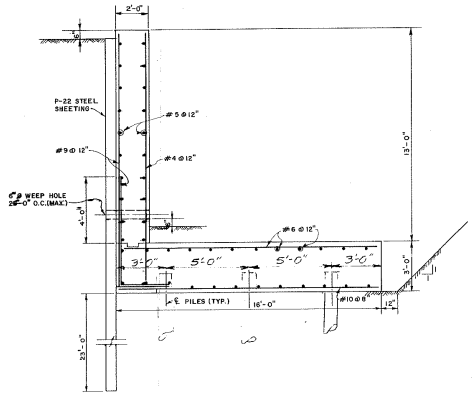
"T" TYPE AT STA. 81+00-MAMARONECK RIVER



"T" TYPE AT STA. 44+00-MAMARONECK RIVER

TYPICAL RETAINING WALL DETAILS

SCALE: $\frac{3}{8}$" = 1'-0"



"L" TYPE AT STA. 47+00-SHELDRAKE RIVER

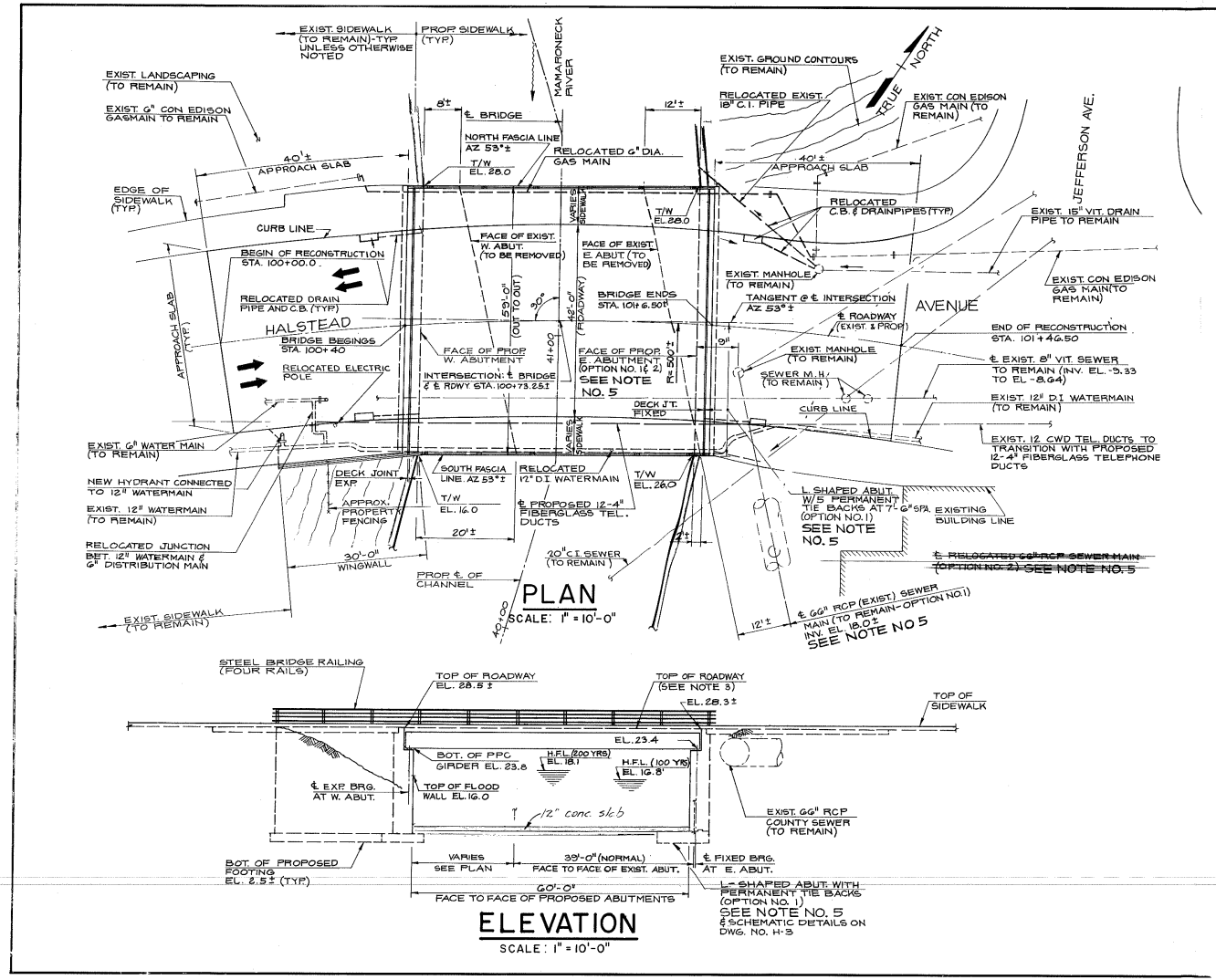
MAMARONECK AND SHELDRAKE
RIVERS BASIN

MAMARONECK AND SHELDRAKE
FLOOD CONTROL PROJECT

TYPICAL RETAINING WALL SECTIONS

MAMARONECK NEW YORK

FIGURE 50



NOTES:

1. ~~SEE GENERAL NOTES ON DWG. NO. G-1~~
2. ~~SEE UTILITY NOTES ON 8½" x 11" SHEETS.~~
3. THE TOP OF PROPOSED ROADWAY SHALL MATCH THE TOP OF EXIST. ROADWAY
4. THE DIMENSIONS INDICATING TIES BETWEEN THE EXISTING AND PROPOSED BRIDGE MAY VARY FROM THE ACTUAL DIMENSIONS THAT MAY EXIST IN THE FIELD. AT THIS STAGE, IT IS NOT POSSIBLE TO DETERMINE THESE DIMENSIONS EXACTLY FROM THE EXISTING BRIDGE 'AS BUILT' PLANS AND THE 'PHOTOGRAPHIC SURVEY' MAPS FURNISHED BY THE CORPS OF ENGINEERS. A DETAILED SURVEY IS DEEMED NECESSARY TO INVESTIGATE THIS ANTICIPATED DISCRIPENCY.
5. OPTION NO. 1 INVOLVES THE SUBSTRUCTURE RECONSTRUCTION (L-SHAPED ABUT. WITH PERMANENT TIE BACKS IN THE AFFECTED AREA) WITHOUT RELOCATING THE 66" RCP SEWER ~~MAIN. OPTION NO. 2 INVOLVES THE SUBSTRUCTURE RECONSTRUCTION (CANTILEVER TYPE ABUT.) WITH RELOCATING THE 66" RCP SEWER MAIN PRIOR TO RECONSTRUCTION. SEE "PRELIMINARY STUDY-IMPACT OF 66" RCP SEWER MAIN ON THE SUBSTRUCTURE RECONSTRUCTION" ON 8½" x 11" SHEETS.~~

LEGEND:

T/W	TOP OF FLOODWALL
N.I.C.	NOT IN THIS CONTRACT
C.B.	CATCH BASIN
P.P.C.	PRECAST PRESTRESSED CONCRETE
H.F.L.	HIGH FLOOD LEVEL
◐	BORING LOCATION (SEE SHEET N° H-4 FOR LOCATION AND ESTIMATED ROCK LINE.)

MAMARONECK AND SHELDRAKE RIVERS BASIN

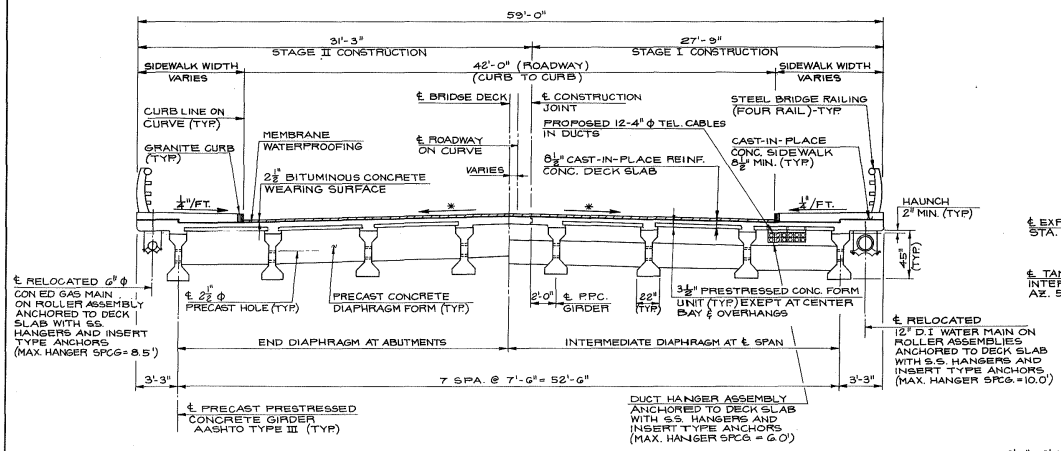
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HALSTEAD AVENUE BRIDGE OVER MAMARONECK RIVER

PLAN AND ELEVATION

MAMARONECK NEW YORK

FIGURE 51

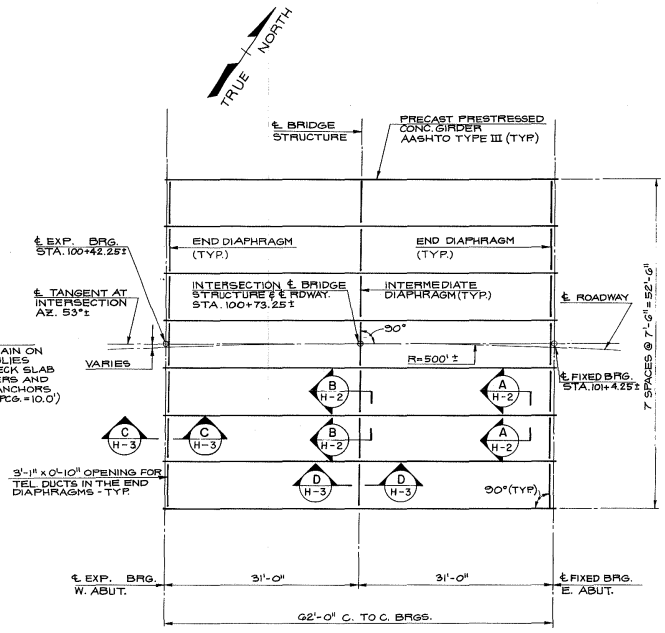


TYPICAL BRIDGE CROSS SECTION

(LOOKING EAST)

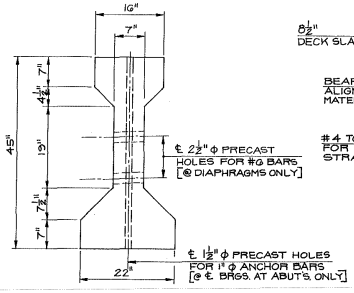
SCALE: $\frac{1}{4}$" = 1'-0"

* THE PROP. ROADWAY CROSS-SLOPE SHALL MATCH THE EXISTING ROADWAY CROSS-SLOPE



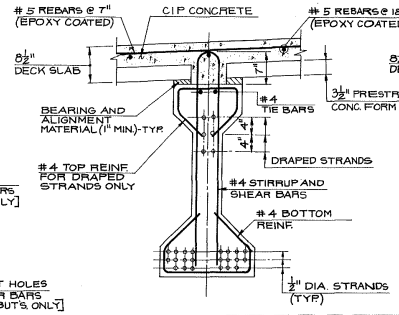
FRAMING PLAN

SCALE: $\frac{1}{8}$" = 1'-0"



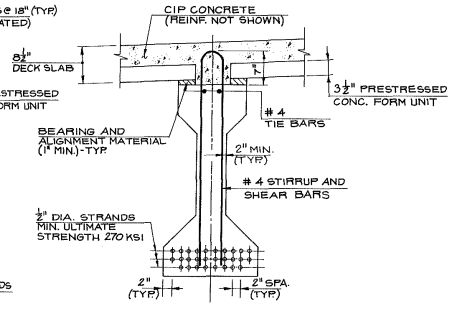
TYPICAL GIRDER SECTION

SCALE: 1" = 1'-0"



(A) SECTION

H-2 SCALE: 1" = 1'-0"



(B) SECTION

H-2 SCALE: 1" = 1'-0"

MAMARONECK AND SHELDRAKE RIVERS BASIN

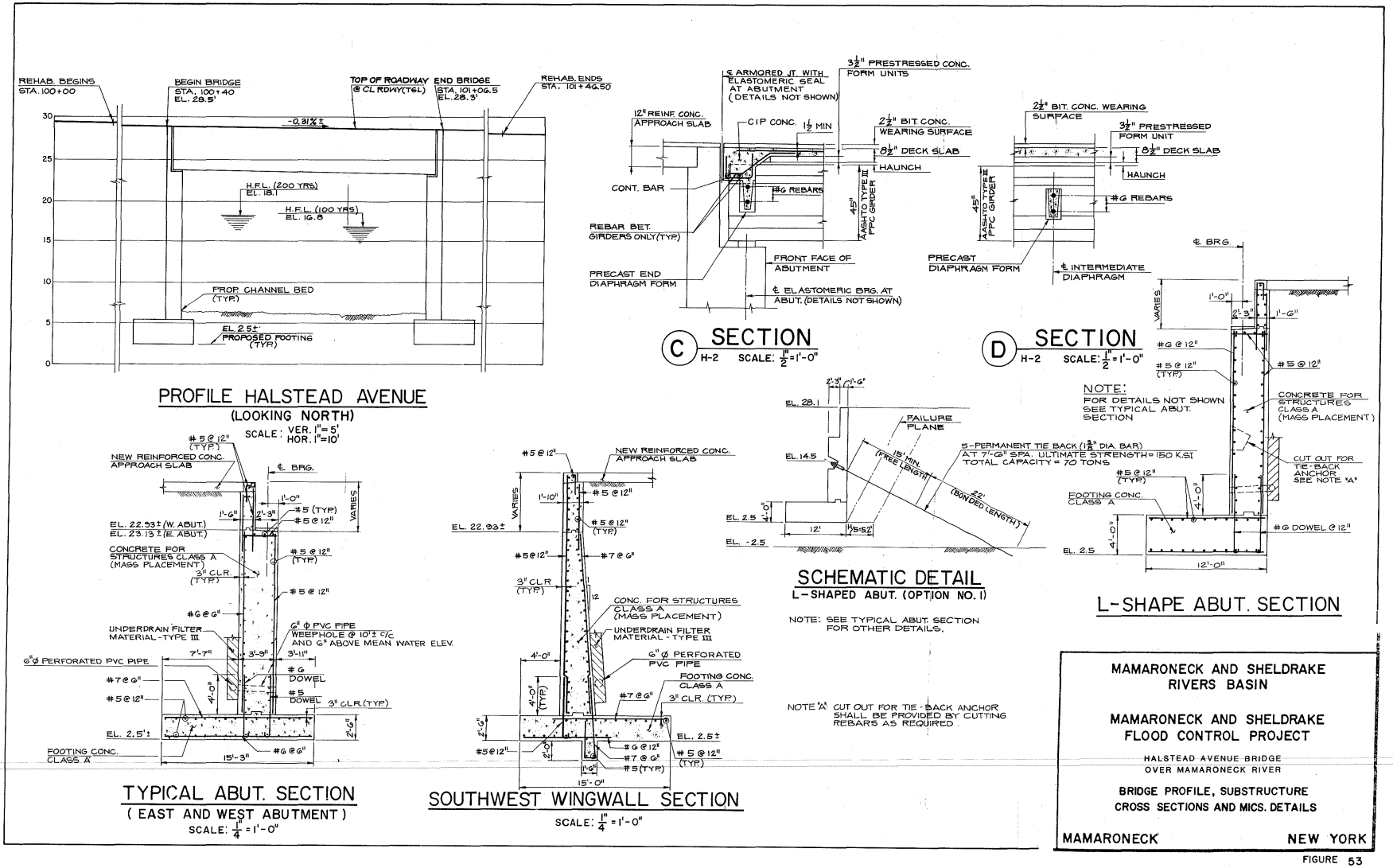
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HALSTEAD AVENUE BRIDGE OVER MAMARONECK RIVER

TYPICAL BRIDGE CROSS SECTION FRAMING PLAN AND DETAILS

MAMARONECK NEW YORK

FIGURE 52



MAMARONECK AND SHELDRAKE RIVERS BASIN

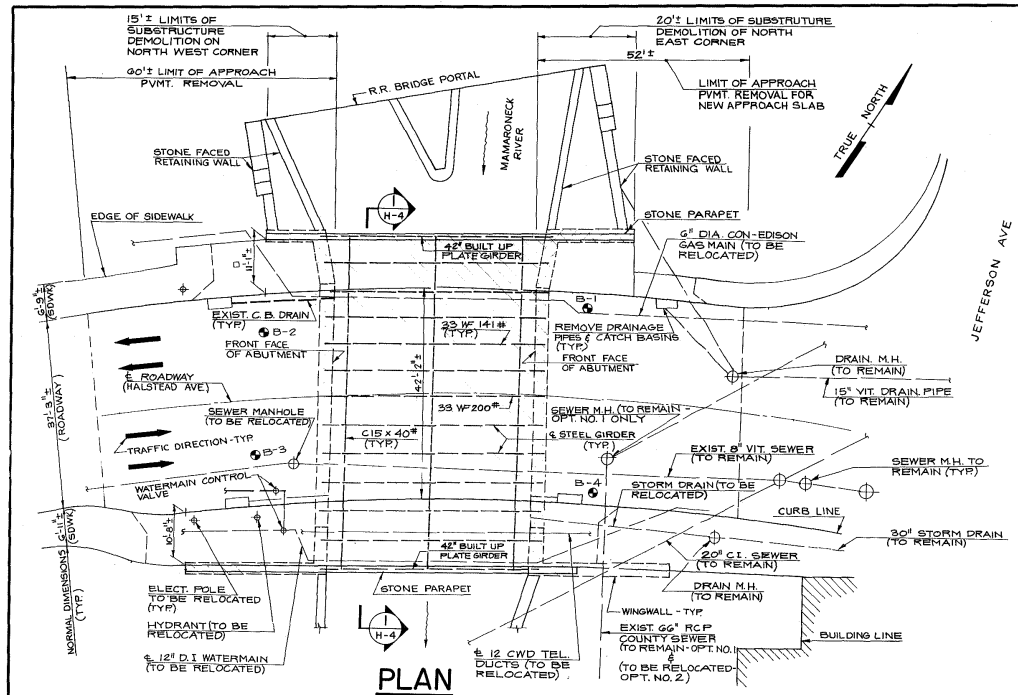
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HALSTEAD AVENUE BRIDGE OVER MAMARONECK RIVER

BRIDGE PROFILE, SUBSTRUCTURE CROSS SECTIONS AND MICS. DETAILS

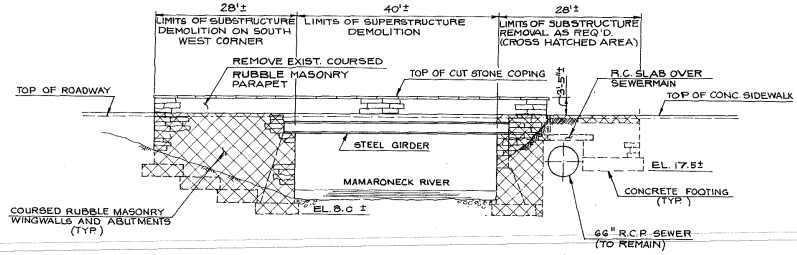
MAMARONECK NEW YORK

FIGURE 53



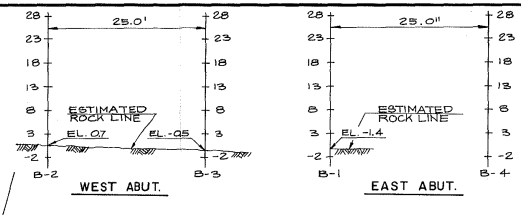
PLAN

SCALE: 1" = 10'



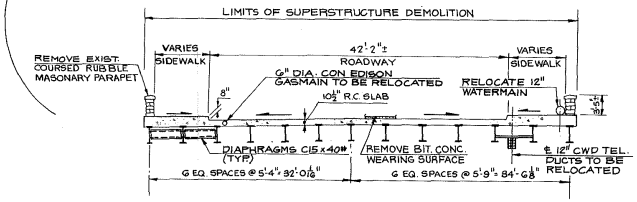
ELEVATION

SCALE: 1" = 10'



ESTIMATED ROCK LINE

N.T.S.



(1) SECTION

SCALE: $\frac{1}{8}$" = 1'-0"

DEMOLITION NOTES:

1. EXISTING SUPERSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
2. EXISTING SUBSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
3. ALL DIMENSIONS ARE APPROXIMATE, AND SUBJECT TO VERIFICATION IN THE FIELD.

LEGEND:

- SUPERSTRUCTURE DEMOLITION LIMITS
- SUBSTRUCTURE DEMOLITION LIMITS
- BORING LOCATION

MAMARONECK AND SHELDRAKE RIVERS BASIN

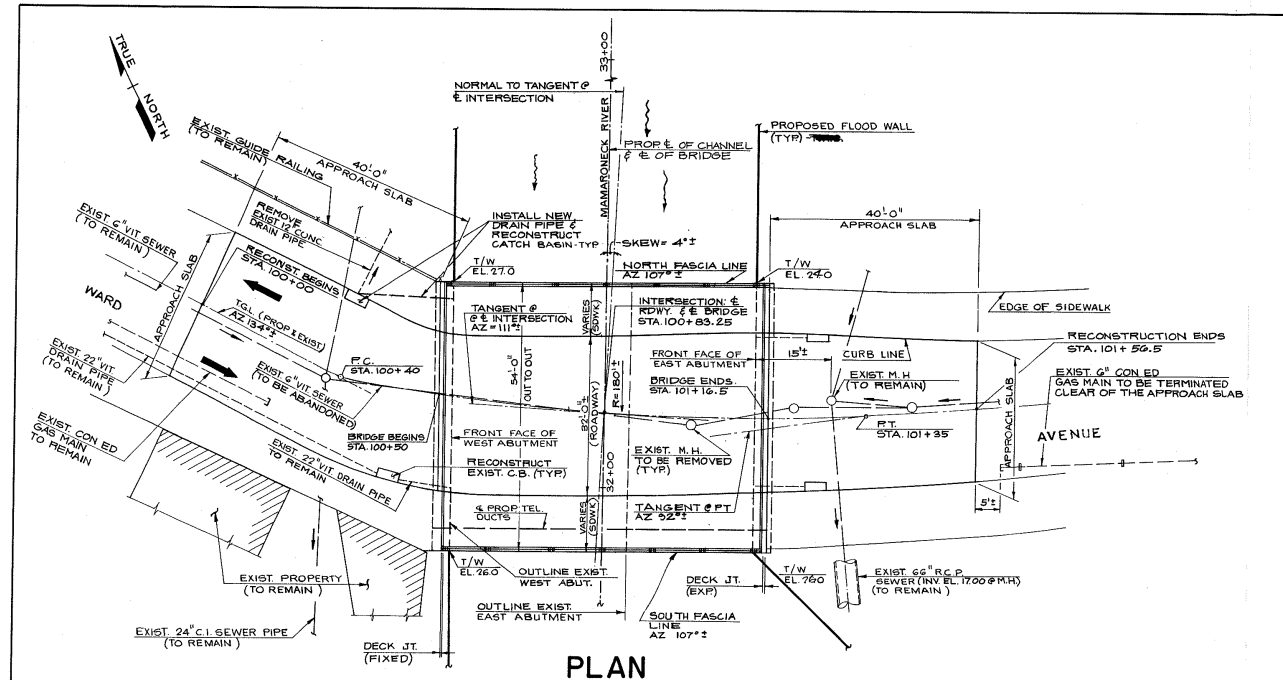
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HALSTEAD AVENUE BRIDGE OVER MAMARONECK RIVER

EXISTING BRIDGE PLAN, ELEVATION AND DEMOLITION LIMITS

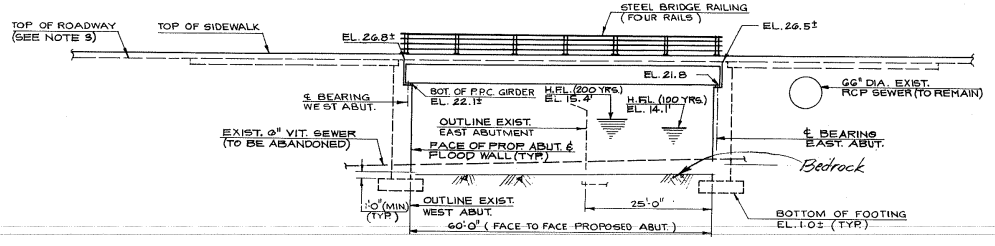
MAMARONECK NEW YORK

FIGURE 54



PLAN

SCALE: 1" = 10'-0"



ELEVATION

SCALE: 1" = 10'-0"

NOTES:

1. ~~SEE GENERAL NOTES ON DWG. NO. G-1.~~
2. ~~SEE UTILITY NOTES ON 8½" x 11" SHEETS.~~
3. ~~THE TOP OF PROPOSED ROADWAY SHALL MATCH THE TOP OF EXIST. ROADWAY.~~

LEGEND:

T/W	TOP OF FLOODWALL
~~N.I.C.~~	~~NOT IN THIS CONTRACT~~
C.B.	CATCH BASIN
P.P.C.	PRECAST PRESTRESSED CONCRETE
H.F.L.	HIGH FLOOD LEVEL
T.G.L.	THEORETICAL GRADE LINE
⊕	BORING LOCATION (SEE SHEET Nº W-4 FOR LOCATION)

MAMARONECK AND SHELDRAKE RIVERS BASIN

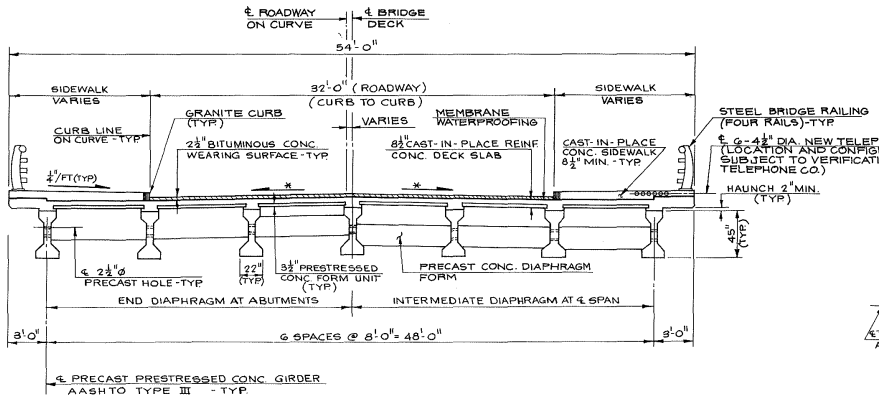
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

WARD AVENUE BRIDGE OVER MAMARONECK RIVER

PLAN AND ELEVATION

MAMARONECK NEW YORK

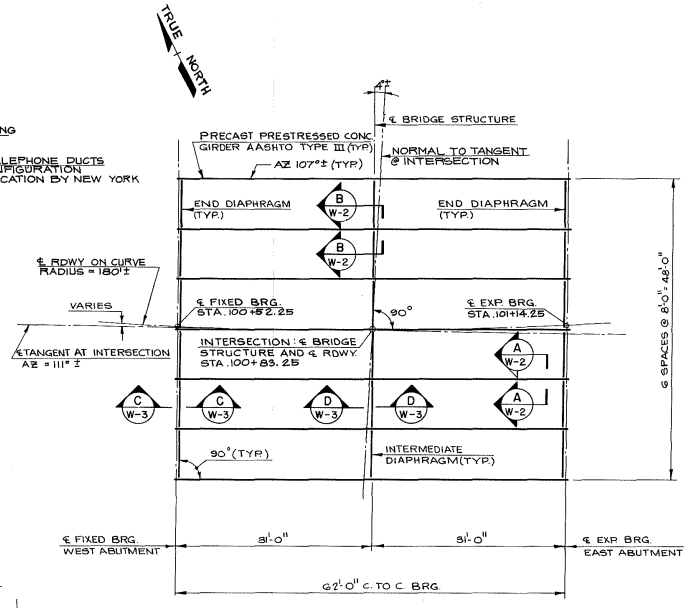
FIGURE 55



TYPICAL BRIDGE CROSS SECTION

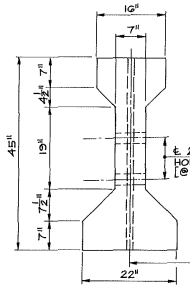
SCALE: $\frac{1}{4}$" = 1'-0"

* THE ROADWAY CROSS-SLOPE SHALL MATCH THE EXISTING ROADWAY CROSS-SLOPE.



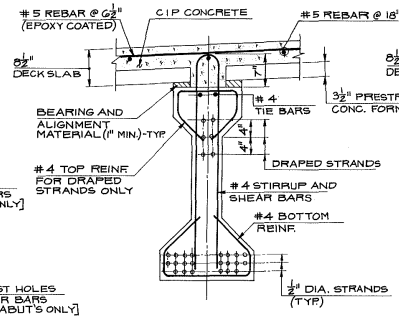
FRAMING PLAN

SCALE: $\frac{1}{8}$" = 1'-0"



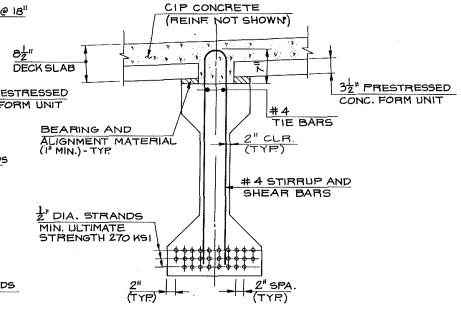
TYPICAL GIRDER SECTION

SCALE: 1" = 1'-0"



A SECTION

W-2 SCALE: 1" = 1'-0"



B SECTION

W-2 SCALE: 1" = 1'-0"

MAMARONECK AND SHELDRAKE RIVERS BASIN

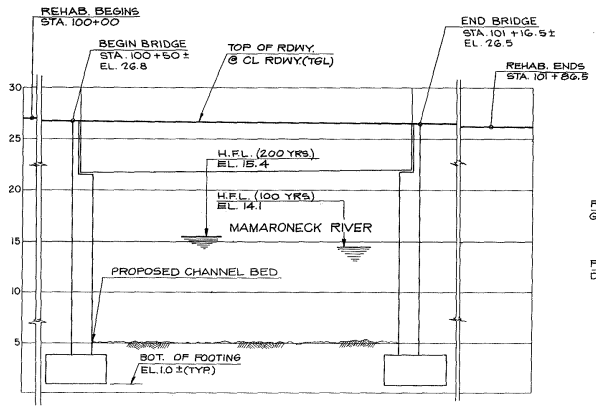
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

WARD AVENUE BRIDGE OVER MAMARONECK RIVER

TYPICAL BRIDGE CROSS SECTION FRAMING PLAN AND DETAILS

MAMARONECK NEW YORK

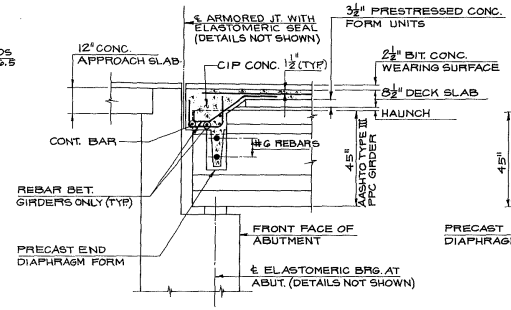
FIGURE 56



PROFILE WARD AVENUE

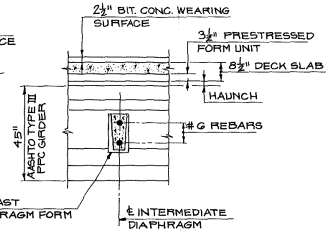
(LOOKING NORTH)

SCALE: VER. 1" = 5'
HOR. 1" = 10'



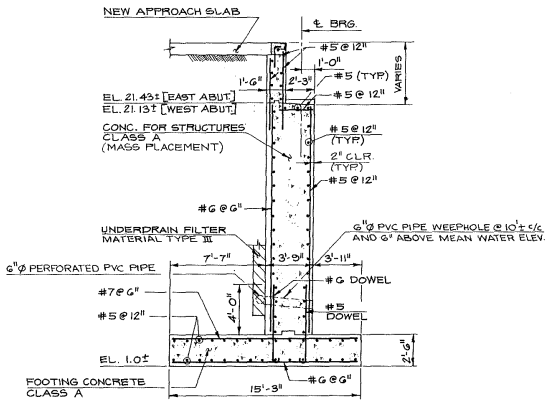
(C) SECTION

W-2 SCALE: ½" = 1'-0"



(D) SECTION

W-2 SCALE: ½" = 1'-0"



TYPICAL ABUT. SECTION

(EAST AND WEST ABUTMENT)

SCALE: ¼" = 1'-0"

MAMARONECK AND SHELDRAKE
RIVERS BASIN

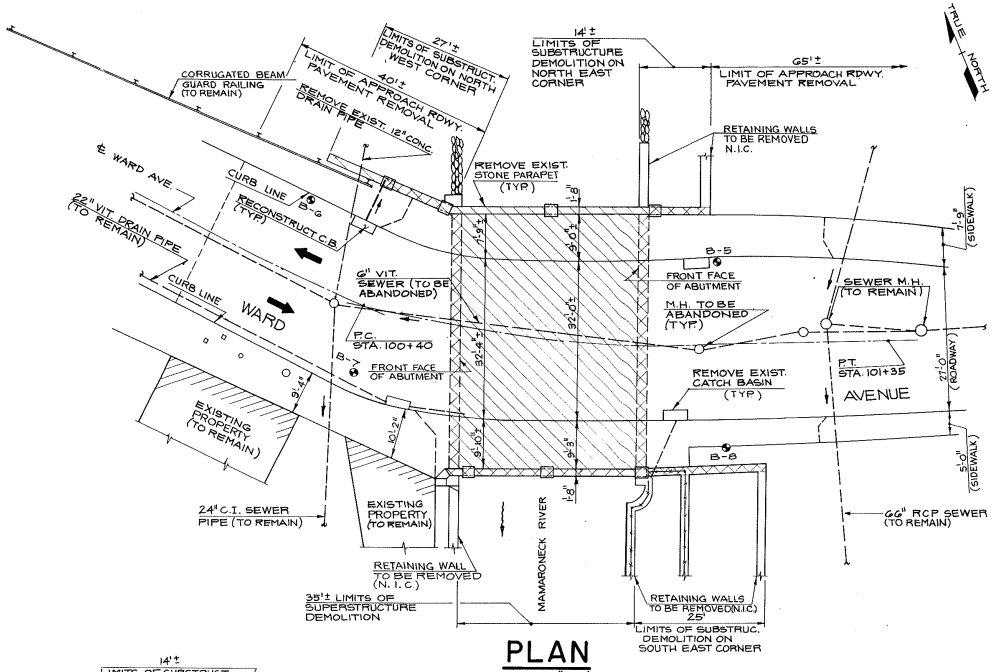
MAMARONECK AND SHELDRAKE
FLOOD CONTROL PROJECT

WARD AVENUE BRIDGE
OVER MAMARONECK RIVER

BRIDGE PROFILE, SUBSTRUCTURE
CROSS SECTIONS AND MICS. DETAILS

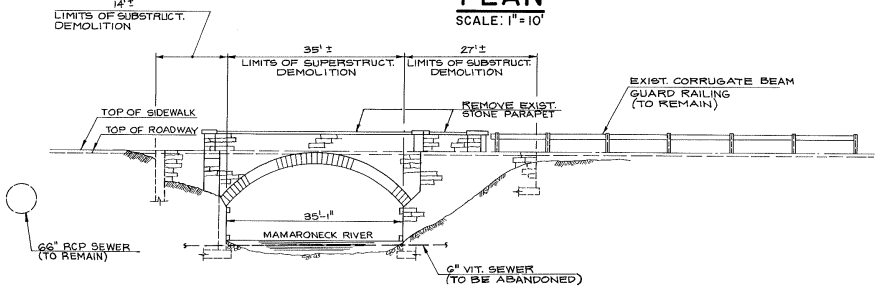
MAMARONECK NEW YORK

FIGURE 57



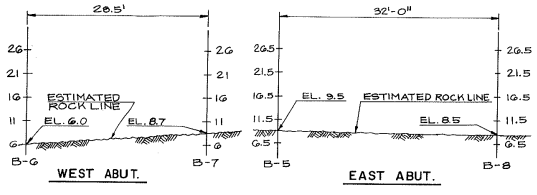
PLAN

SCALE: 1" = 10'



NORTH ELEVATION

SCALE: 1" = 10'



ESTIMATED ROCK LINE

N.T.S.

DEMOLITION NOTES:

1. EXISTING SUPERSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
2. EXISTING SUBSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
3. ALL DIMENSIONS ARE APPROXIMATE, AND SUBJECT TO VERIFICATION IN THE FIELD

LEGEND:

- SUPERSTRUCTURE DEMOLITION LIMITS
- SUBSTRUCTURE DEMOLITION LIMITS
- BORING LOCATION

MAMARONECK AND SHELDRAKE RIVERS BASIN

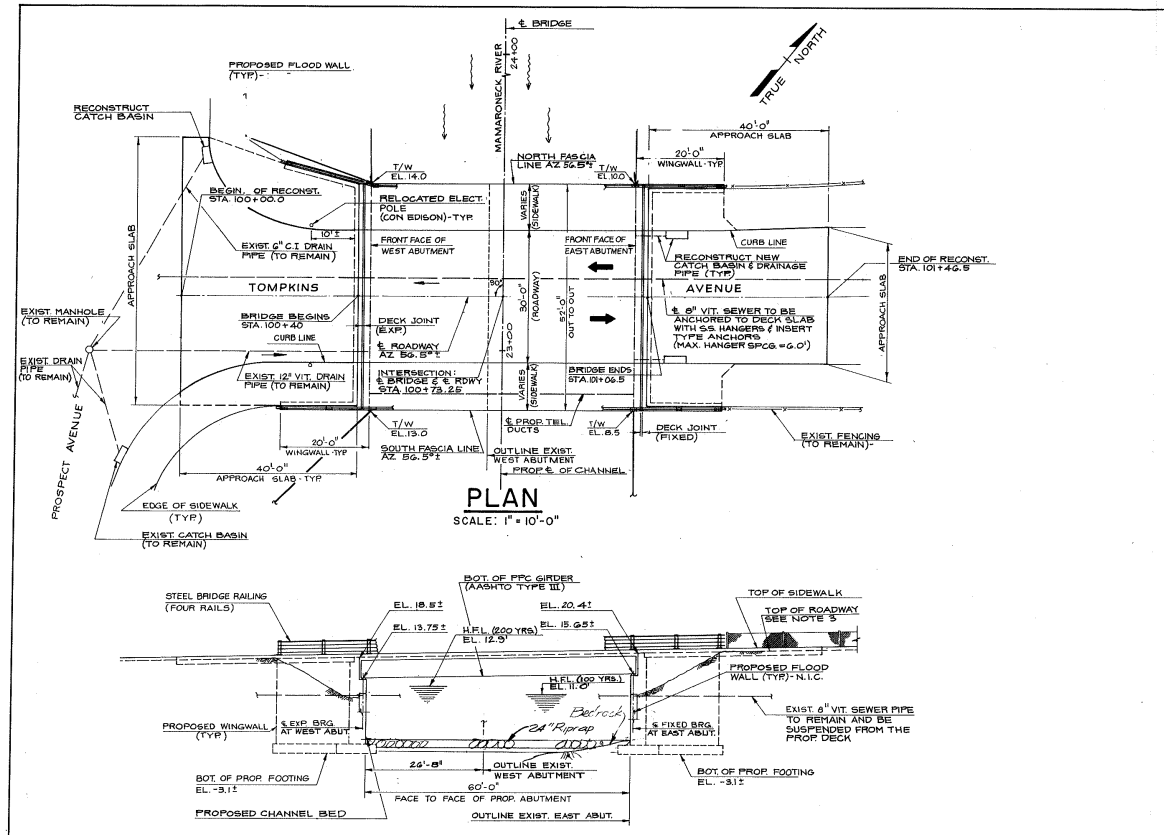
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

WARD AVENUE BRIDGE OVER MAMARONECK RIVER

EXISTING BRIDGE PLAN, ELEVATION AND DEMOLITION LIMITS

MAMARONECK NEW YORK

FIGURE 58



PLAN

SCALE: 1" = 10'-0"

ELEVATION

SCALE: 1" = 10'-0"

NOTES:

1. ~~SEE GENERAL NOTES ON DWG. NO. G-1.~~
2. ~~SEE UTILITY NOTES ON 8½" x 11" SHEET.~~
3. THE TOP OF PROPOSED ROADWAY SHALL MATCH THE TOP OF EXISTING ROADWAY.

LEGEND:

T/W TOP OF FLOOD WALL

~~N.I.C. NOT IN THIS CONTRACT.~~

P.P.C. PRECAST PRESTRESSED CONC.

H.F.L. HIGH FLOOD LEVEL

BORING LOCATION (SEE SHEET Nº T-4 FOR LOCATION AND ESTIMATED ROCK LINE)

MAMARONECK AND SHELDRAKE RIVERS BASIN

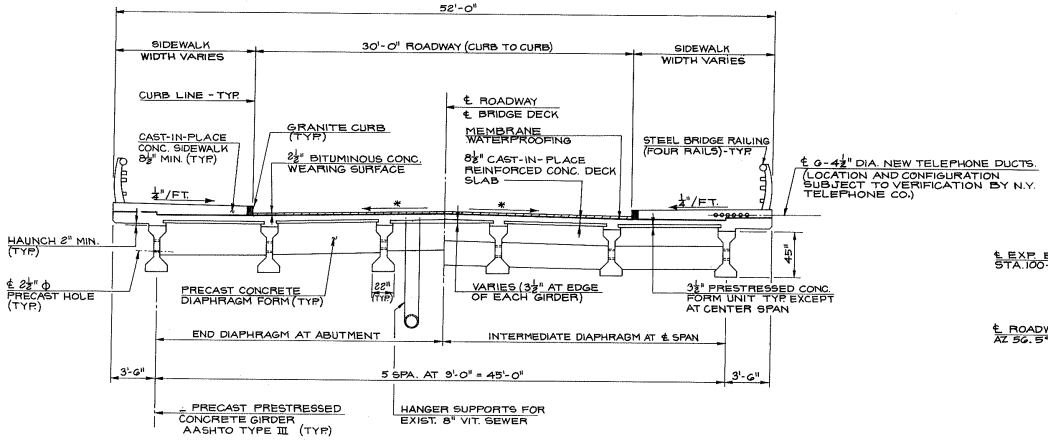
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

TOMPKINS AVENUE BRIDGE OVER MAMARONECK RIVER

PLAN AND ELEVATION

MAMARONECK **NEW YORK**

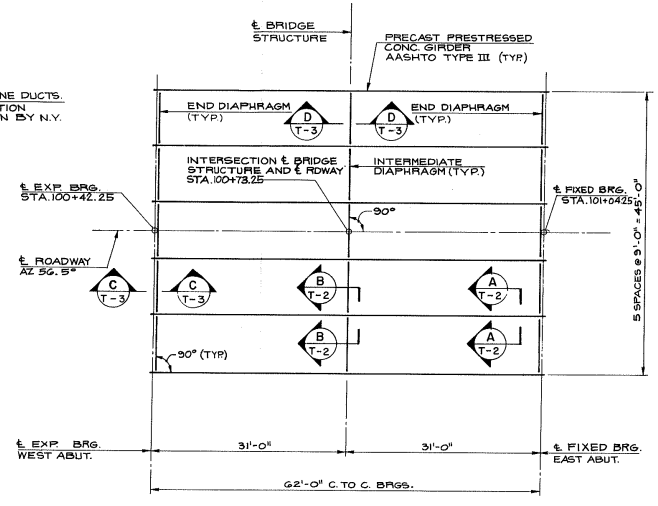
FIGURE 59



TYPICAL BRIDGE CROSS SECTION

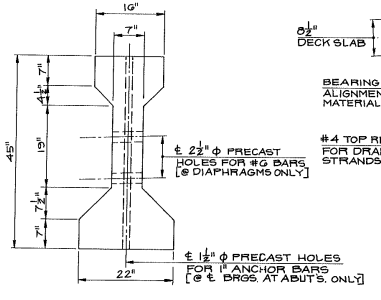
SCALE: $\frac{1}{4}$" = 1'-0"

* THE PROP. ROADWAY CROSS SLOPE SHALL MATCH THE EXISTING ROADWAY CROSS SLOPE



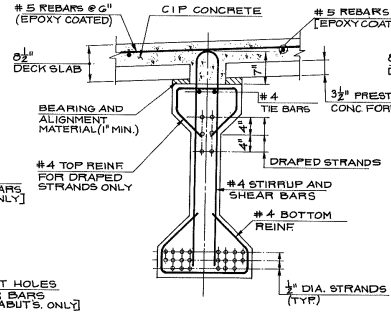
FRAMING PLAN

SCALE: $\frac{1}{8}$" = 1'-0"



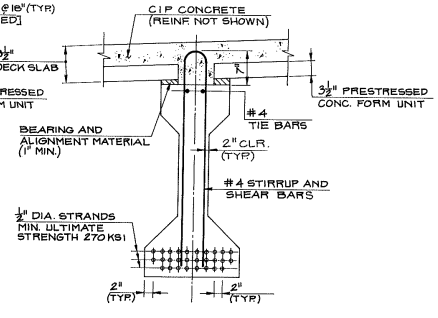
TYPICAL GIRDER SECTION

SCALE: 1" = 1'-0"



(A) SECTION

T-2 SCALE: 1" = 1'-0"



(B) SECTION

T-2 SCALE: 1" = 1'-0"

MAMARONECK AND SHELDRAKE RIVERS BASIN

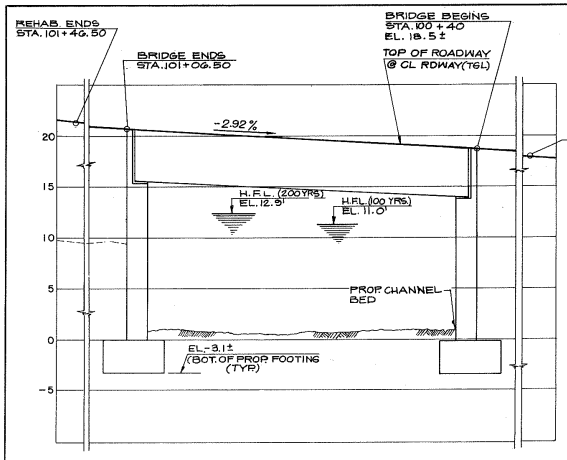
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

TOMPKINS AVENUE BRIDGE OVER MAMARONECK RIVER

TYPICAL BRIDGE CROSS SECTION FRAMING PLAN AND DETAILS

MAMARONECK NEW YORK

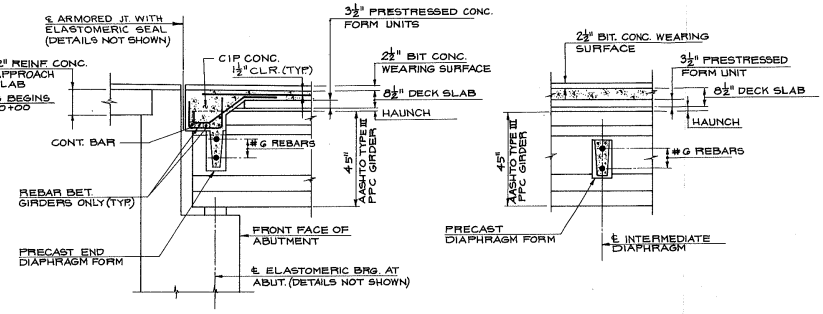
FIGURE 60



PROFILE TOMPKINS AVENUE

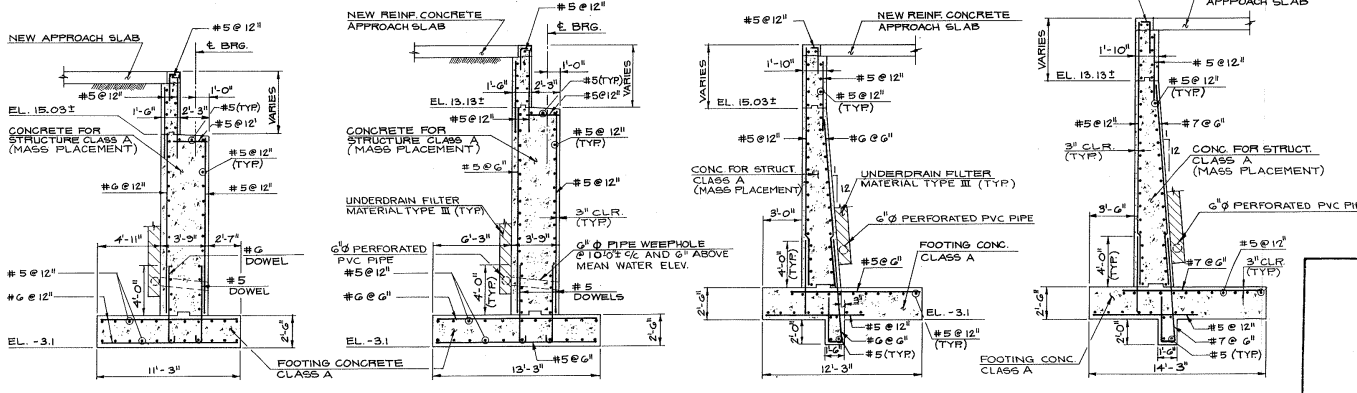
(LOOKING SOUTH)

SCALE: VER. 1" = 5'
HOR. 1" = 10'



(C) SECTION
T-2 SCALE: ½" = 1'-0"

(D) SECTION
T-2 SCALE: ½" = 1'-0"



WEST ABUTMENT | EAST ABUTMENT | N.W. AND S.W. WINGWALL | N.E. AND S.E. WINGWALL

TYPICAL ABUT. SECTION

SCALE: ¼" = 1'-0"

TYPICAL WINGWALL SECTION

SCALE: ¼" = 1'-0"

MAMARONECK AND SHELDRAKE RIVERS BASIN

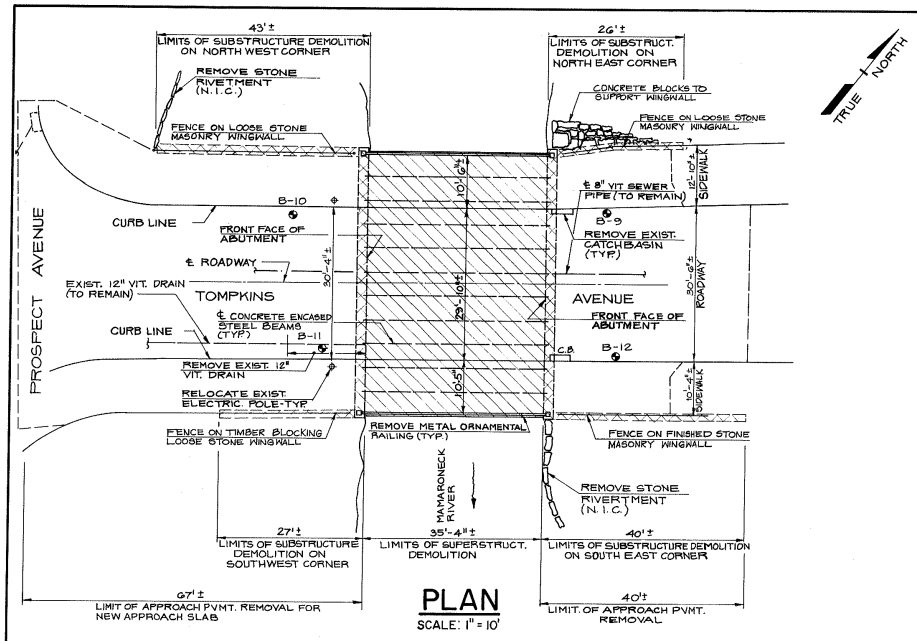
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

TOMPKINS AVENUE BRIDGE OVER MAMARONECK RIVER

BRIDGE PROFILE, SUBSTRUCTURE, CROSS SECTIONS AND MICS. DETAILS

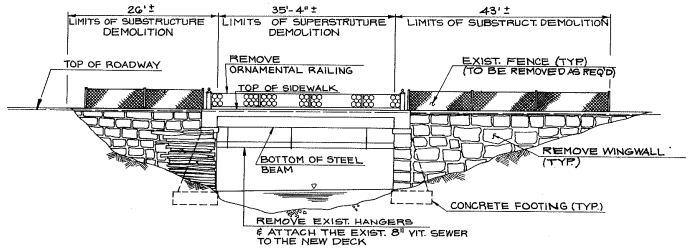
MAMARONECK NEW YORK

FIGURE 61



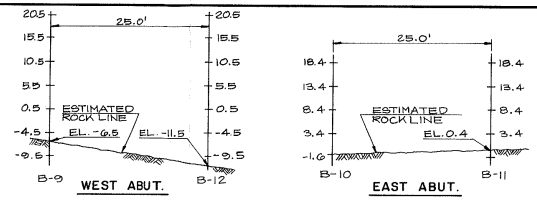
PLAN

SCALE: 1" = 10'



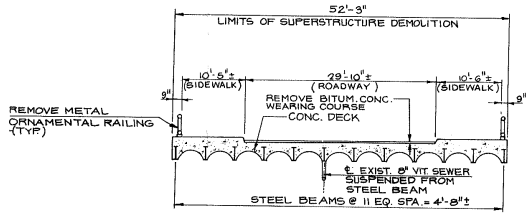
NORTH ELEVATION

SCALE: 1" = 10'-0"



ESTIMATED ROCK LINE

N.T.S.



TYP. BRIDGE CROSS SECTION

SCALE: $\frac{1}{8}$" = 1'-0"

DEMOLITION NOTES:

1. EXISTING SUPERSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
2. EXISTING SUBSTRUCTURE SHALL BE REMOVED WITHIN THE LIMITS SHOWN ON THIS DRAWING.
3. ALL DIMENSIONS ARE APPROXIMATE, AND SUBJECT TO VERIFICATION IN THE FIELD.

LEGEND:

- SUBSTRUCTURE DEMOLITION LIMITS
- SUBSTRUCTURE DEMOLITION LIMITS
- BORING LOCATION

MAMARONECK AND SHELDRAKE RIVERS BASIN

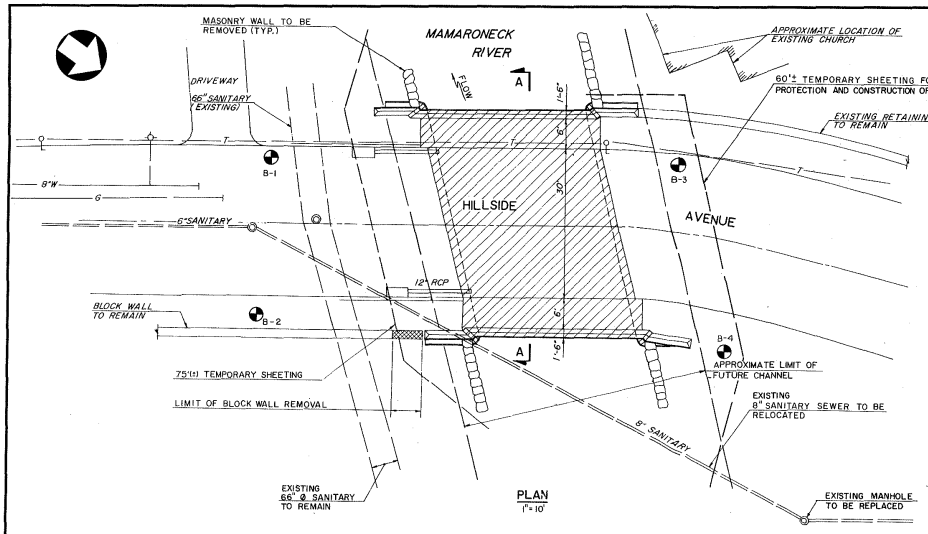
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

TOMPKINS AVENUE BRIDGE OVER MAMARONECK RIVER

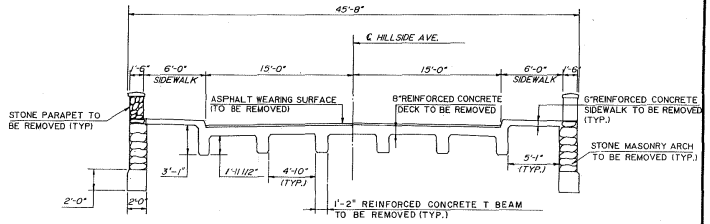
EXISTING BRIDGE PLAN, ELEVATION AND DEMOLITION LIMITS

MAMARONECK NEW YORK

FIGURE 62



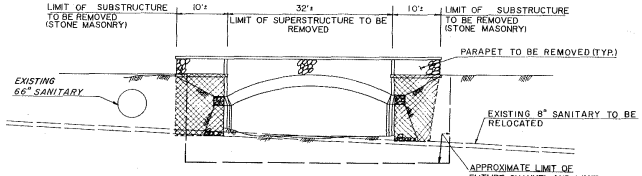
PLAN
1" = 10'



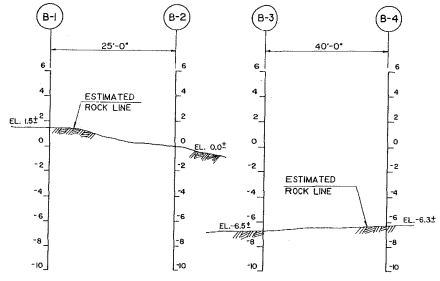
SECTION A-A
3/16" = 1'-0"

NOTES:

1. THE SUBSTRUCTURE SHALL BE REMOVED ENTIRELY OR TO A MINIMUM 2' BELOW THE FINAL GRADE.
2. PLANS OF EXISTING STRUCTURE BUILT 1936 ARE AVAILABLE.



ELEVATION
1" = 10'



ESTIMATED ROCK LINE
N.T.S.

LEGEND:

SUBSTRUCTURE TO BE REMOVED

SUPERSTRUCTURE TO BE REMOVED

DESIGNED BY:
DRAWN BY:
CHECKED BY:
IN CHARGE OF:

JOB NO. 615

MAMARONECK AND SHELDRAKE RIVERS BASIN

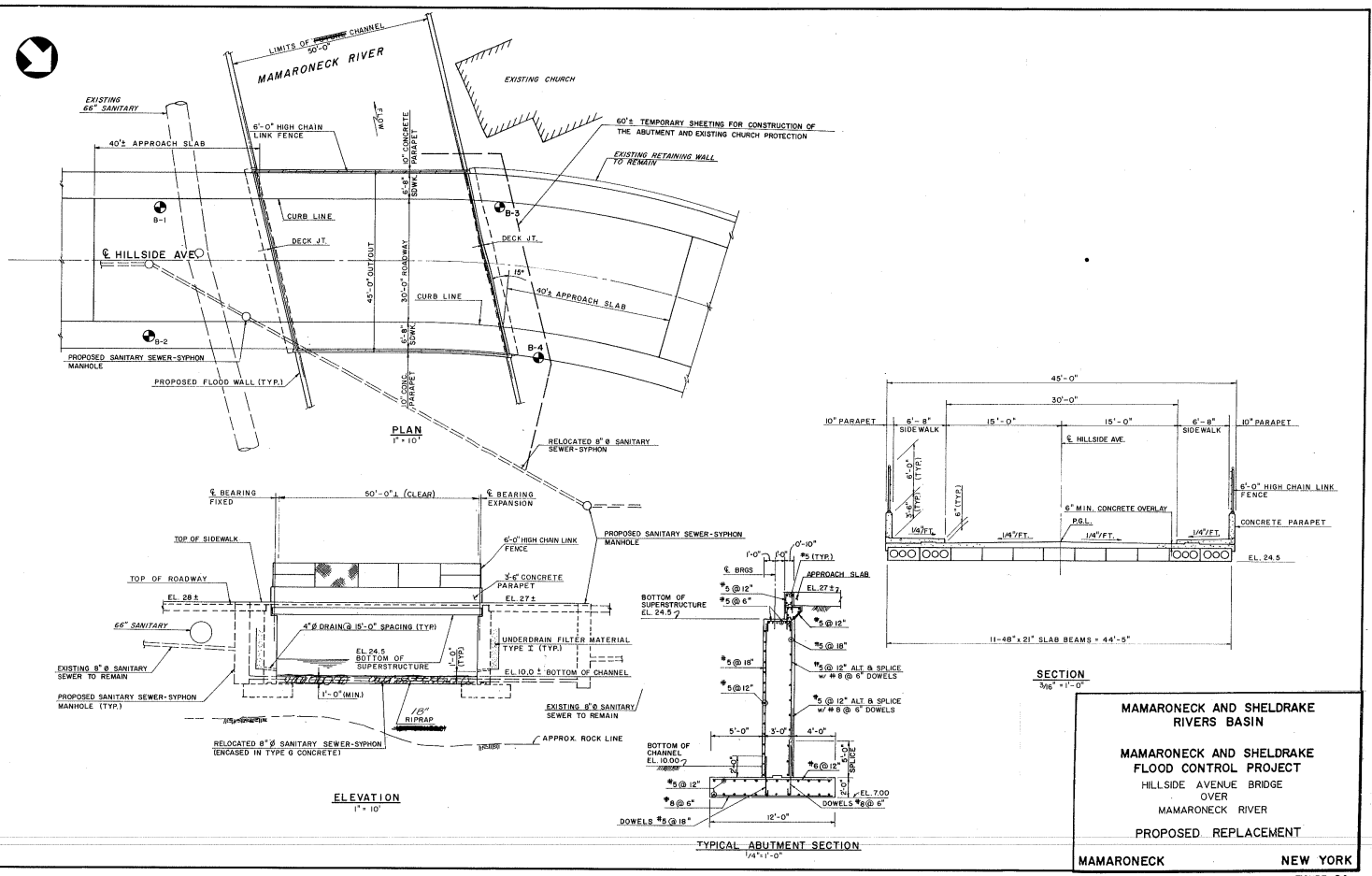
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HILLSIDE AVENUE BRIDGE
OVER
MAMARONECK RIVER

LIMITS OF REMOVAL

MAMARONECK NEW YORK

FIGURE 63



MAMARONECK AND SHELDRAKE RIVERS BASIN

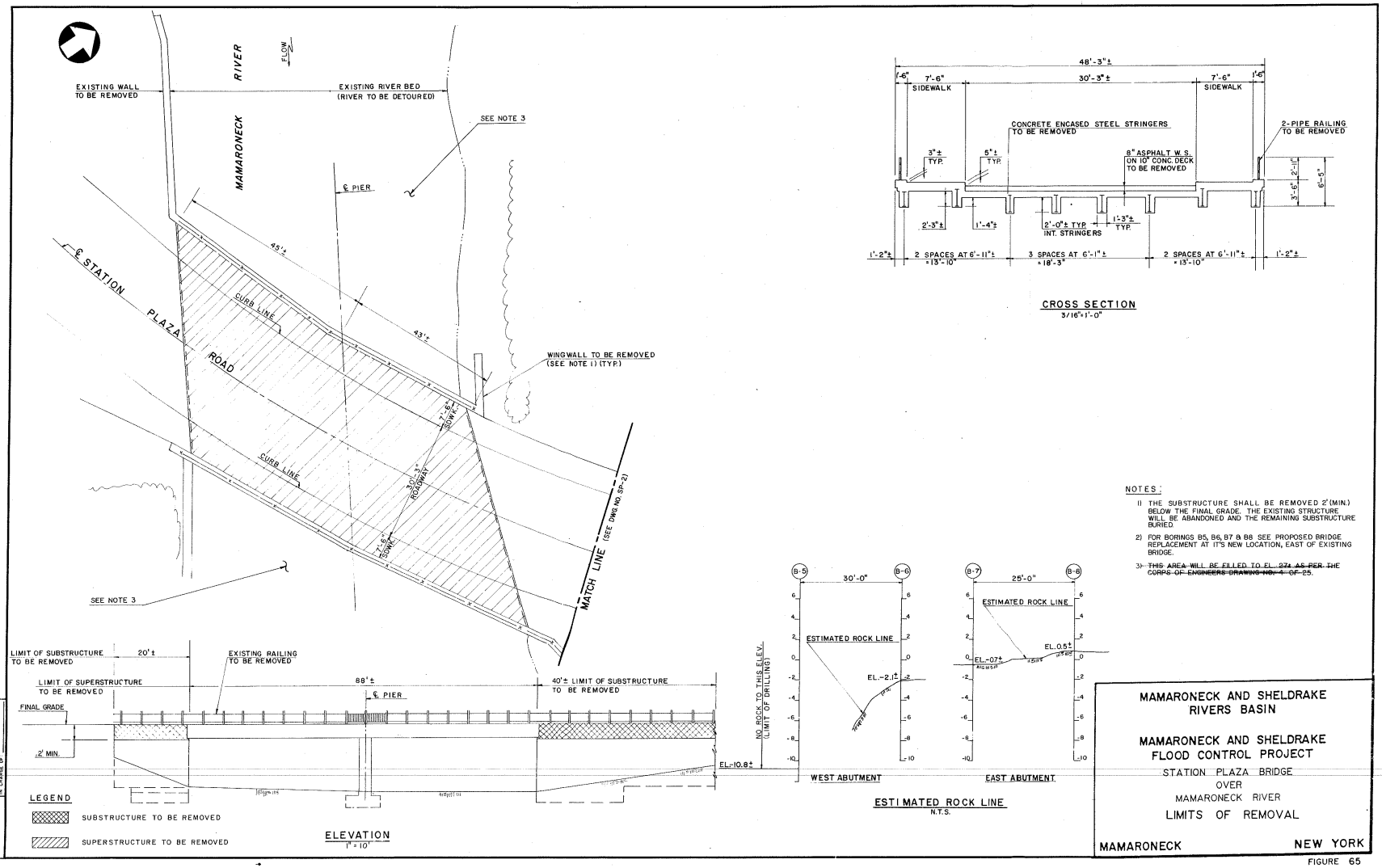
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

HILLSIDE AVENUE BRIDGE OVER MAMARONECK RIVER

PROPOSED REPLACEMENT

MAMARONECK NEW YORK

FIGURE 64



NOTES:

1) THE SUBSTRUCTURE SHALL BE REMOVED 2' (MIN.) BELOW THE FINAL GRADE. THE EXISTING STRUCTURE WILL BE ABANDONED AND THE REMAINING SUBSTRUCTURE BURIED.

2) FOR BORINGS B5, B6, B7 & B8 SEE PROPOSED BRIDGE REPLACEMENT AT IT'S NEW LOCATION, EAST OF EXISTING BRIDGE.

3) ~~THIS AREA WILL BE FILLED TO EL. 2.7± AS PER THE CORPS OF ENGINEERS DRAWING NO. 4 OF 25.~~

MAMARONECK AND SHELDRAKE RIVERS BASIN

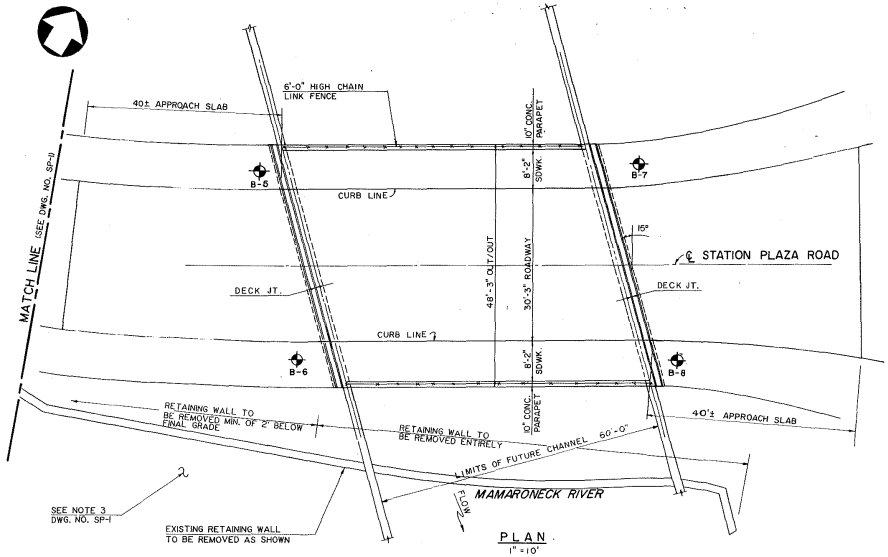
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

STATION PLAZA BRIDGE
OVER
MAMARONECK RIVER
LIMITS OF REMOVAL

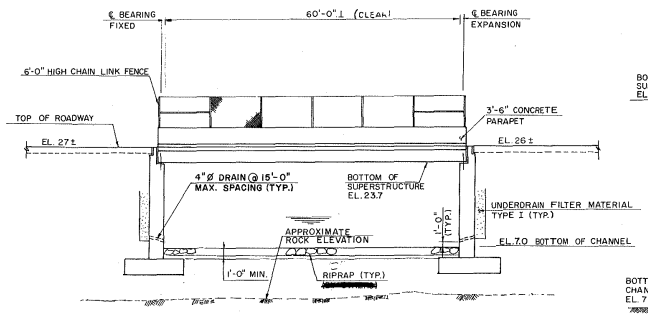
MAMARONECK NEW YORK

JOB NO. 19-
DESIGNED BY:
DRAWN BY:
CHECKED BY:
W. CHIEF ENG.

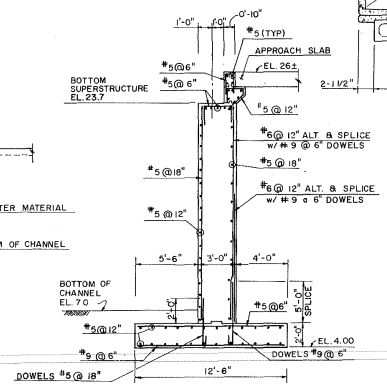
FIGURE 65



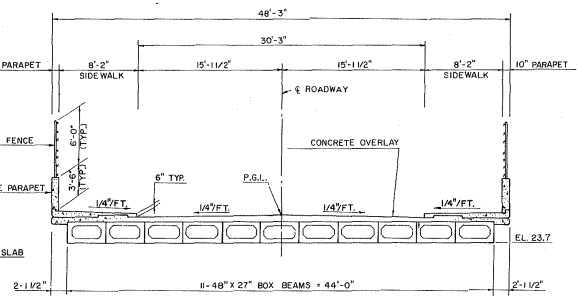
PLAN
1" = 10'



ELEVATION
1" = 10'



TYPICAL ABUTMENT SECTION
1/4" = 1'-0"



SECTION
3/16" = 1'-0"

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

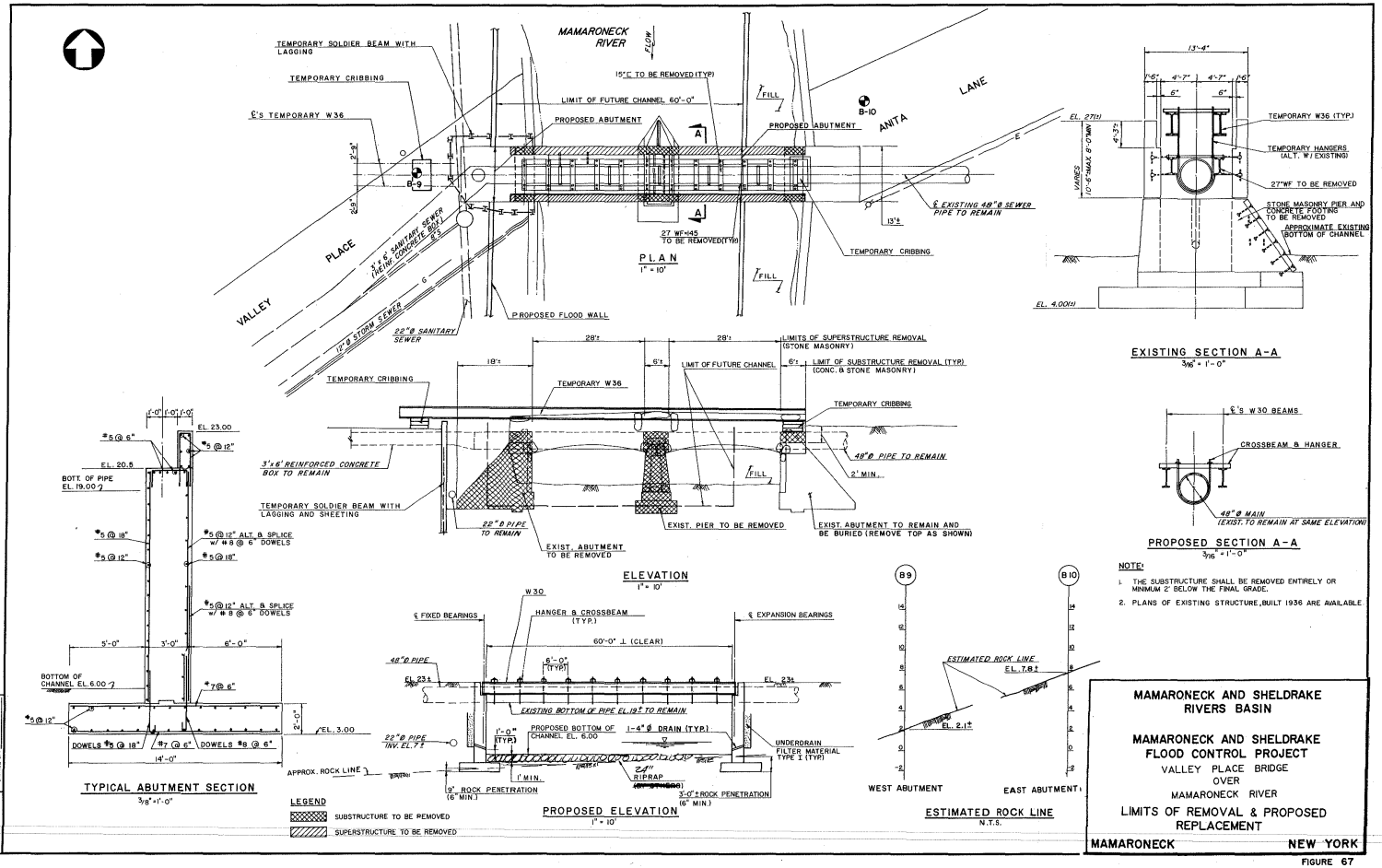
STATION PLAZA BRIDGE
OVER
MAMARONECK RIVER

PROPOSED REPLACEMENT

MAMARONECK NEW YORK

FIGURE 66

JOB NO. 1073
DESIGNED BY:
DRAWN BY:
CHECKED BY:
IN CHARGE OF:



NOTE:

1. THE SUBSTRUCTURE SHALL BE REMOVED ENTIRELY OR MINIMUM 2' BELOW THE FINAL GRADE.
2. PLANS OF EXISTING STRUCTURE, BUILT 1936 ARE AVAILABLE.

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

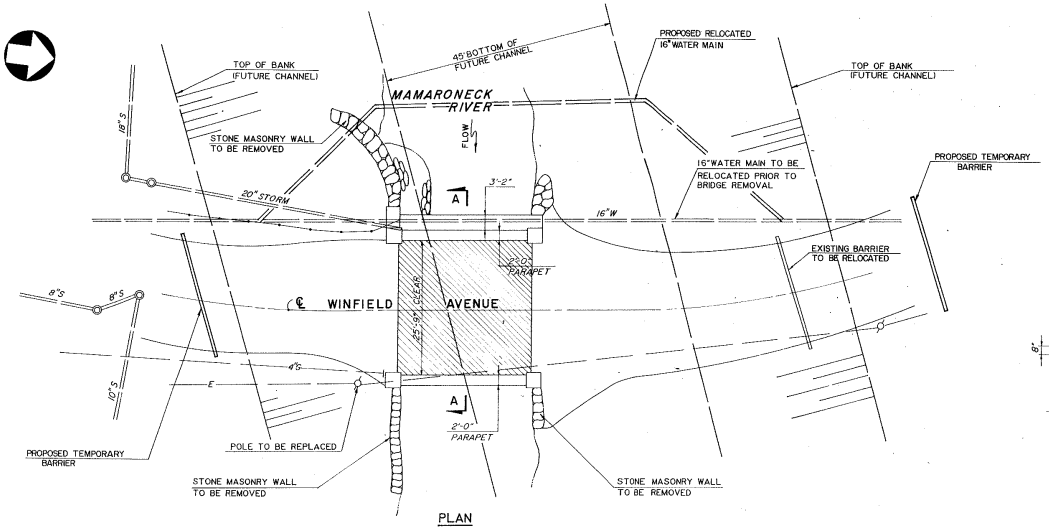
VALLEY PLACE BRIDGE
OVER
MAMARONECK RIVER

LIMITS OF REMOVAL & PROPOSED REPLACEMENT

MAMARONECK **NEW YORK**

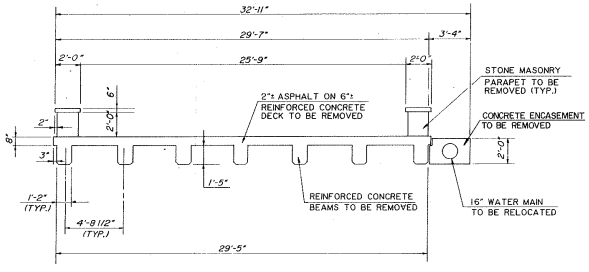
DESIGNED BY: RJD
DRAWN BY:
CHECKED BY:
IN CHARGE OF:
JOB NO. 1073

FIGURE 67



PLAN

1"=10'

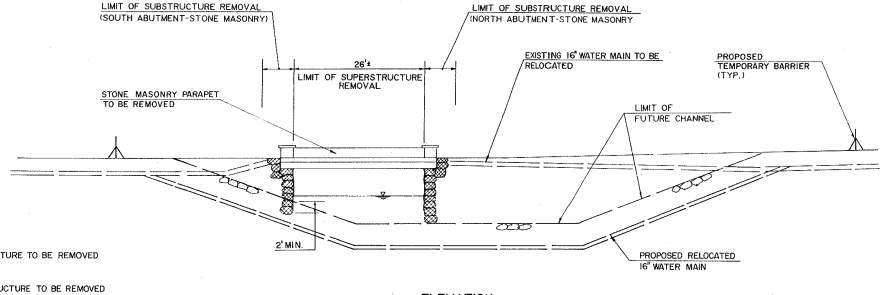


SECTION A-A

1/4"=1'-0"

NOTES:

1. THE EXISTING STRUCTURE, AS SHOWN, SHALL BE REMOVED IN ITS ENTIRETY, AND THE 16" WATER MAIN SHALL BE RELOCATED.
2. THE SUBSTRUCTURE SHALL BE REMOVED ENTIRELY OR 2' MIN. BELOW THE PROPOSED FINAL GRADE



ELEVATION

1"=10'

LEGEND:

SUBSTRUCTURE TO BE REMOVED

SUPERSTRUCTURE TO BE REMOVED

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE OF

JOB NO.

MAMARONECK AND SHELDRAKE RIVERS BASIN

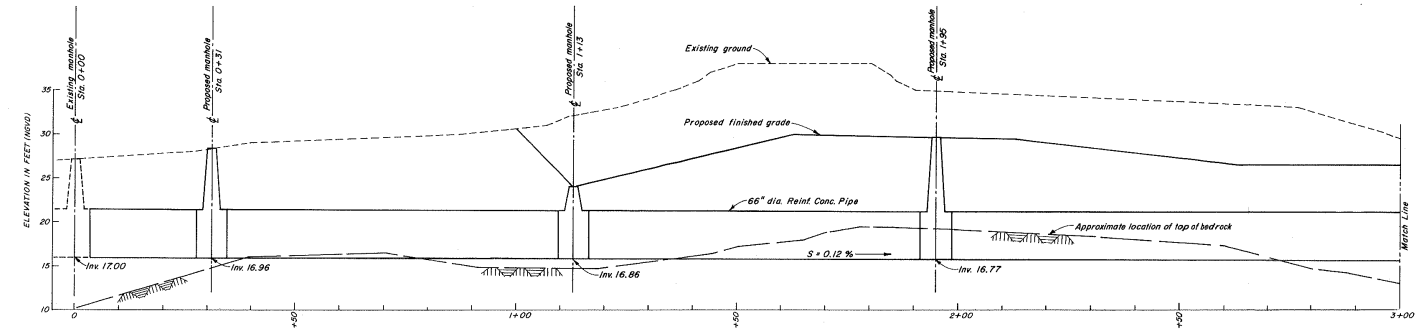
MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

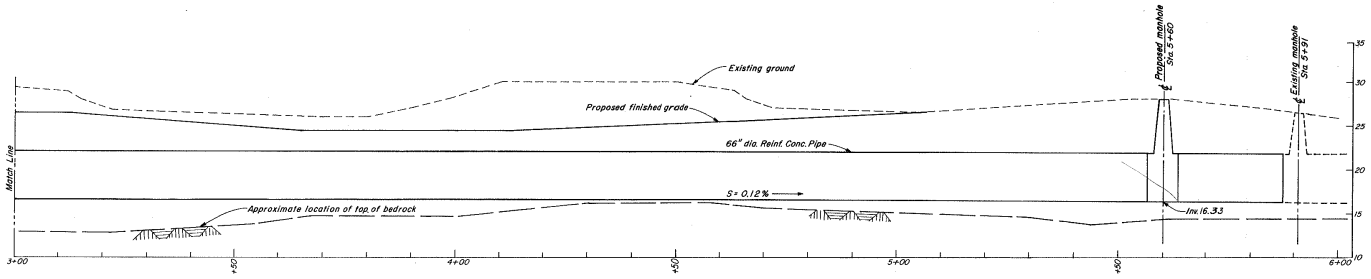
WINFIELD AVENUE BRIDGE
OVER
MAMARONECK RIVER

LIMITS OF REMOVAL

MAMARONECK **NEW YORK**

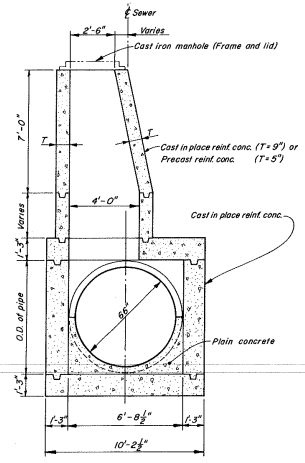
FIGURE 68



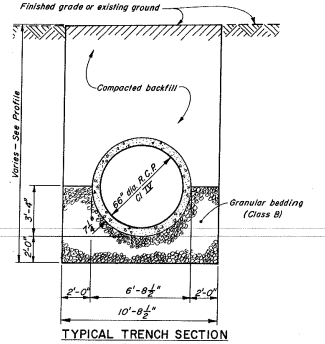


PROFILE - RELOCATED 66" DIA. SANITARY SEWER
(℄ MAMARONECK RIVER STA. 25+65± TO STA. 32+10 ± RT.)

SCALE IN FEET
5 0 5 10 VERT
10 0 10 20 HOR



TYPICAL MANHOLE SECTION
(RELOCATED 66" DIA. SANITARY SEWER)
NOT TO SCALE



TYPICAL TRENCH SECTION
(RELOCATED 66" DIA. SANITARY SEWER)
NOT TO SCALE

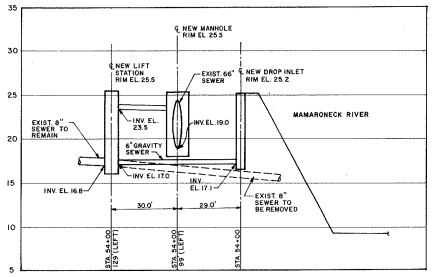
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE AND TYPICAL SECTIONS - RELOCATED 66" DIA. SANITARY SEWER

MAMARONECK NEW YORK

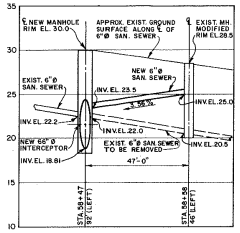
FIGURE 69



LIFT STATION & FORCE MAIN CONNECTION - WILLOW ST

≈ STA. 54+00

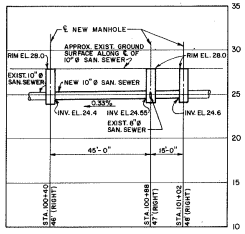
SCALE: Horiz. 1" = 20'
Vert. 1" = 5'



6" SANITARY DRAIN

≈ STA. 58+50

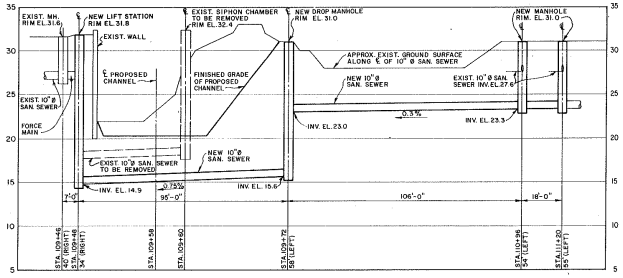
SCALE: Horiz. 1" = 20'
Vert. 1" = 5'



10" SANITARY DRAIN

≈ STA. 100+50

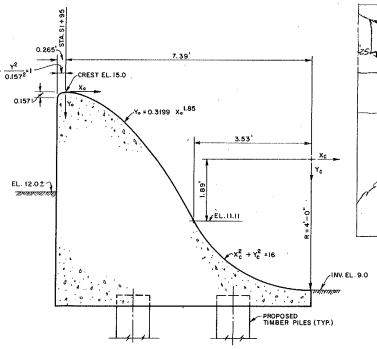
SCALE: Horiz. 1" = 20'
Vert. 1" = 5'



10" SANITARY DRAIN

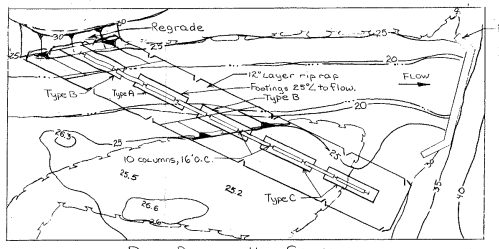
≈ STA. 110+00

SCALE: Horiz. 1" = 20'
Vert. 1" = 5'



DETAIL OF INTAKE WEIR AT LOWER SHELDRAKE

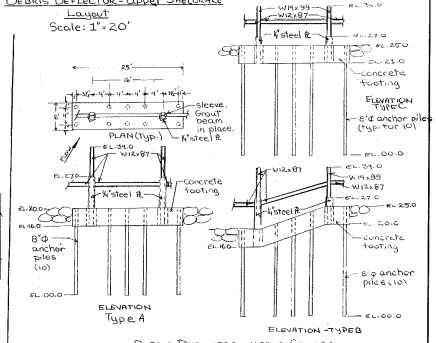
SCALE: $\frac{3}{4}$" = 1'-0"



DEBRIS DEFLECTOR - UPPER SHELDRAKE

Layout

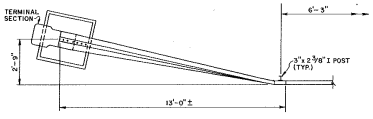
Scale: 1" = 20'



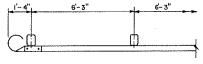
DEBRIS DEFLECTOR - UPPER SHELDRAKE

PLAN & ELEVATIONS

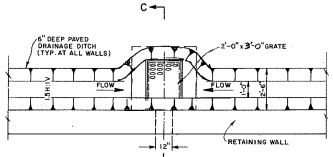
Scale: 1" = 10'



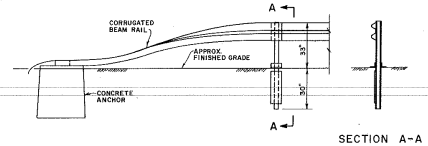
PLAN



PLAN

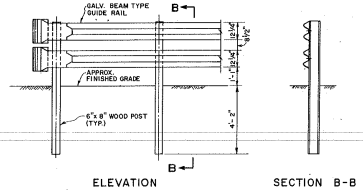


PLAN



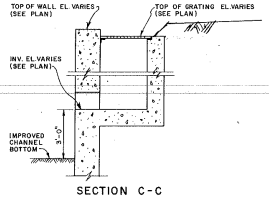
ELEVATION

SECTION A-A



ELEVATION

SECTION B-B



SECTION C-C

DROP INLET DETAIL

N. T. S.

GUIDE RAILING DETAIL

SCALE: $\frac{3}{8}$" = 1'-0"

BARRIER DETAIL

SCALE: $\frac{3}{8}$" = 1'-0"

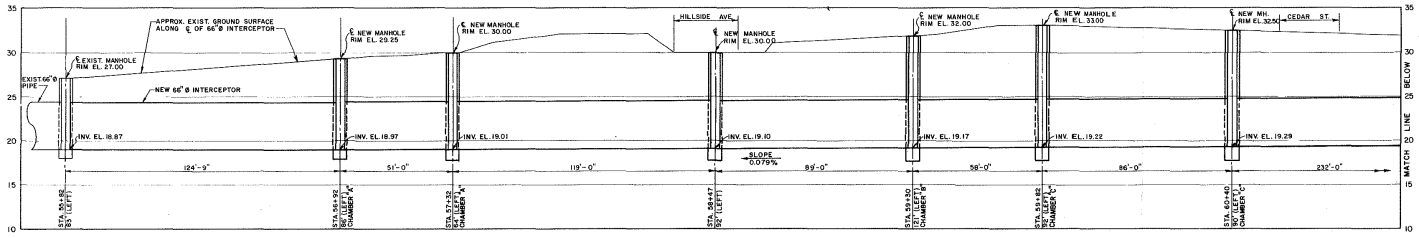
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE AND DETAILS OF
RELOCATED SANITARY DRAINS
IMPROVED MAMARONECK RIVER

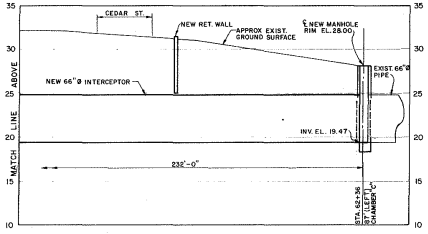
MAMARONECK **NEW YORK**

FIGURE 70



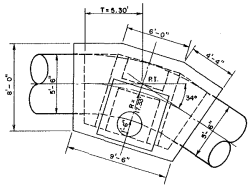
PROFILE 66" SANITARY INTERCEPTOR

SCALE: Horiz. 1"=20' Vert. 1"=5'



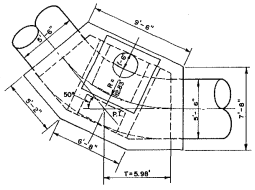
PROFILE 66" SANITARY INTERCEPTOR

SCALE - Horiz. 1"=20' Vert. 1"=5'



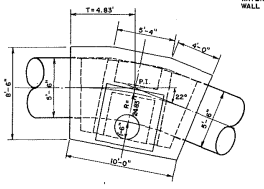
TURN CHAMBER "A" PLAN

SCALE: $\frac{1}{4}$"=1'-0"



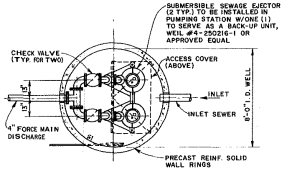
TURN CHAMBER "B" PLAN

SCALE: $\frac{1}{4}$"=1'-0"

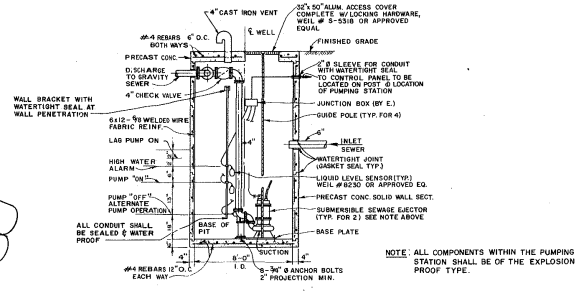


TURN CHAMBER "C" PLAN

SCALE: $\frac{1}{4}$"=1'-0"



PLAN



NOTE: ALL COMPONENTS WITHIN THE PUMPING STATION SHALL BE OF THE EXPLOSION PROOF TYPE.

SECTION

PROPOSED PUMPING STATION DETAIL

SCALE: NONE

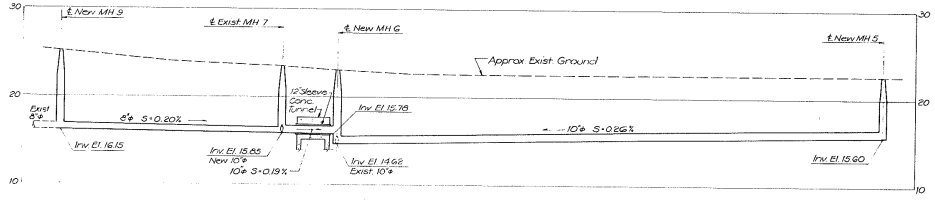
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILE AND DETAILS
RELOCATED 66" SANITARY INTERCEPTOR
IMPROVED MAMARONECK RIVER

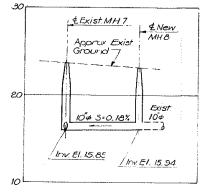
MAMARONECK NEW YORK

FIGURE 71



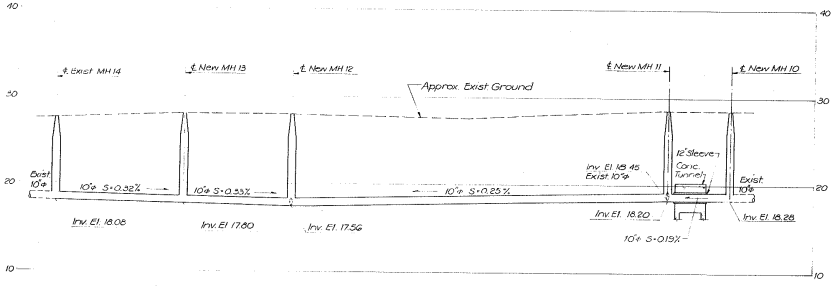
PROFILE - MANHOLE 5 TO MANHOLE 9

Scale: Hor. 1"=30' Vert. 1"=5'



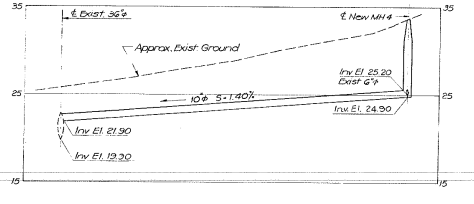
PROFILE - MANHOLE 8 TO MANHOLE 7

Scale: Hor. 1"=30' Vert. 1"=5'



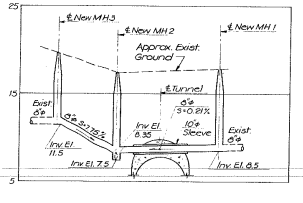
PROFILE - MANHOLE 10 TO MANHOLE 14

Scale: Hor. 1"=30' Vert. 1"=5'



PROFILE - MANHOLE 4 TO 36" SEWER

Scale: Hor. 1"=30' Vert. 1"=5'



PROFILE - MANHOLE 1 TO MANHOLE 3

Scale: Hor. 1"=30' Vert. 1"=5'

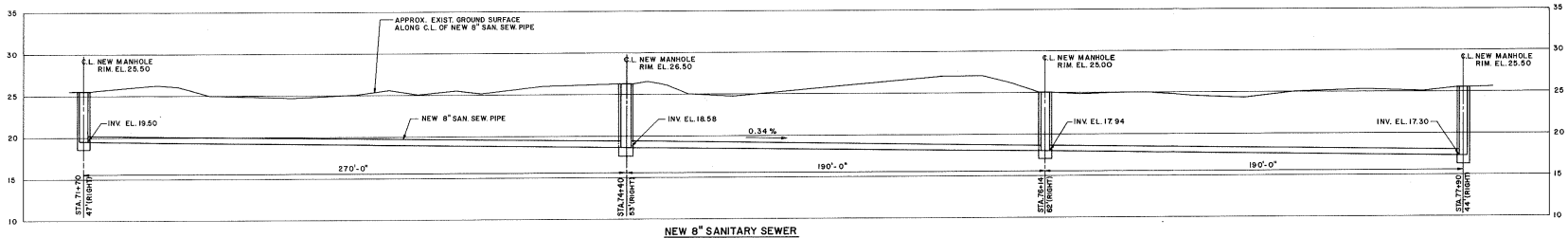
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

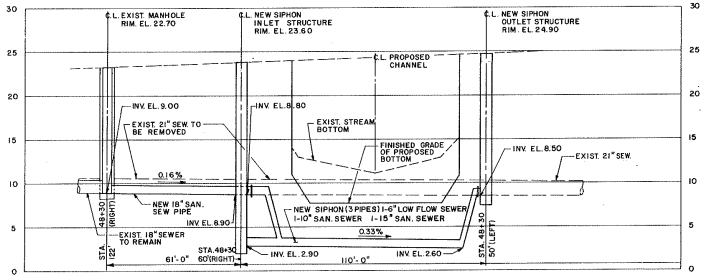
RELOCATED SANITARY SEWER PROFILES
SHELDRAKE DIVERSION TUNNEL

MAMARONECK **NEW YORK**

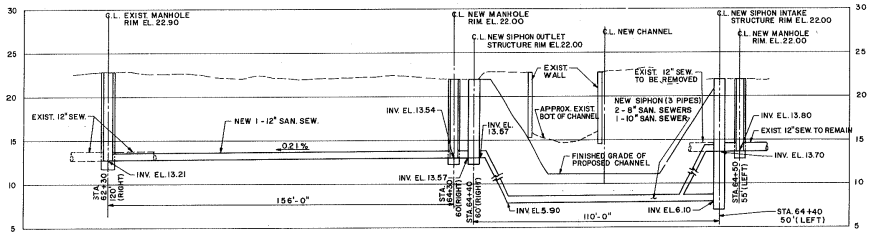
FIGURE 72



NEW 8" SANITARY SEWER
(N. BARRY AVE. TO RIVER ST.)
SCALE: H: 1" = 20' V: 1" = 5'



NEW 18" SANITARY SEWER
(JEFFERSON AVE.)
≈ STA. 48+30
SCALE: H: 1" = 20' V: 1" = 5'



NEW 10" SANITARY SEWER
(HOWARD AVENUE EXTENSION)
≈ STA. 63+95
SCALE: H: 1" = 20' V: 1" = 5'

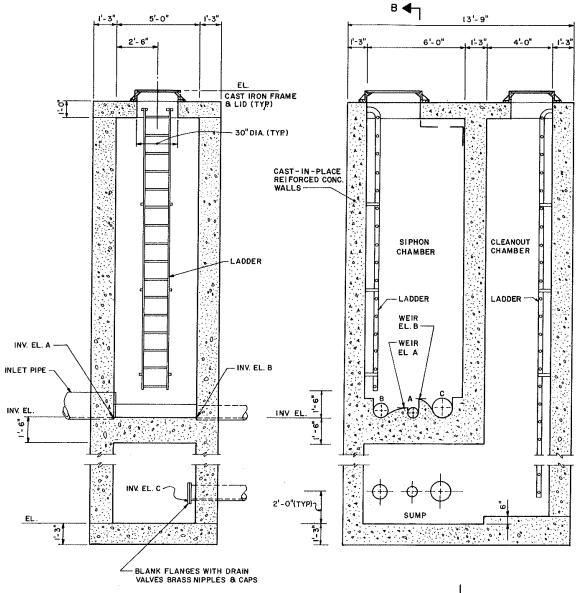
MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

PROFILES
RELOCATED SANITARY DRAINS
IMPROVED MAMARONECK RIVER

MAMARONECK NEW YORK

FIGURE 73

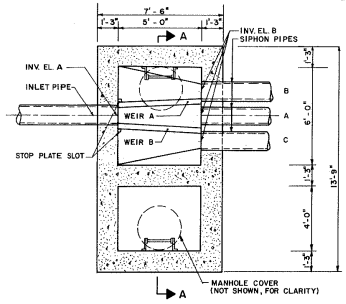


SECTION B-B

SCALE: 3/8" = 1'

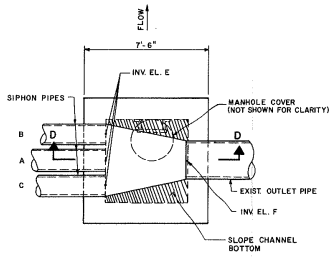
SECTION A-A

SCALE: 3/8" = 1'



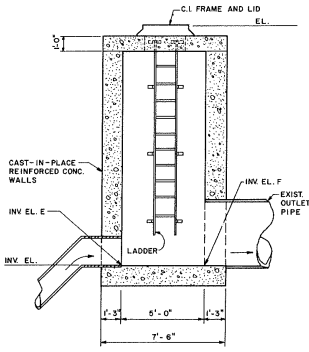
PLAN - INTAKE STRUCTURE

SCALE: 3/8" = 1'



PLAN - OUTLET STRUCTURE

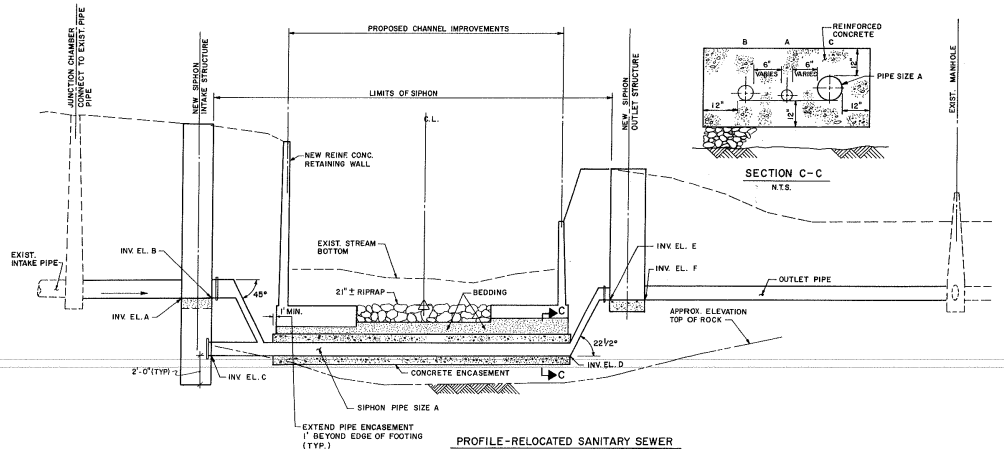
SCALE: 3/8" = 1'



SECTION D-D

SCALE: 3/8" = 1'

LOCATION	INVERT ELEVATIONS						SIPHON PIPE SIZES			WEIR ELEVATIONS		ADJACENT PIPE		STRUCTURE RIM. EL.		SIPHON LENGTH (A)	CHANNEL INFORMATION	
	A	B	C	D	E	F	A LOW FLOW	B PK. DIURNAL	C EXT. PK. DIURNAL	A	B	INLET	OUTLET	IN	OUT		INV.	TOP ± WIDTH
JEFFERSON STA. 48 + 38 ±	8.9	8.8	2.9	2.6	8.5	8.5	1.250 1-6"	2.290 1-10"	4.580 1-15"	9.42	9.64	18"	21"	22.9	23.9	110'±	7.8±	75'±
HOWARD AVE. EXTENSION STA. 64 + 48 ±	13.7	13.7	6.1	5.9	13.57	13.57	0.535 1-8"	1.128 1-8"	2.250 1-10"	14.46	15.23	12"	12"	22.0	22.0	110'±	10.8±	105'±
RIVER ST. STA. 77 + 90 ±	17.3	17.3	6.5	6.3	16.92	16.92	0.194 1-8"	1.045 1-8"	2.090 1-10"	17.77	18.44	12"	12"	26.0±	28.0±	80'±	14.0±	65'±
NORTH OF LOUIS AVE. STA. 84 + 78 ±	21.1	21.0	9.0	8.7	20.3	20.2	0.250 1-6"	0.600 1-6"	1.200 1-10"	21.40	21.60	10"	10"	29.0±	26.0±	85'±	15.0±	75'±



PROFILE-RELOCATED SANITARY SEWER

N.T.S.

SECTION C-C

N.T.S.

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

DETAILS-RELOCATED SANITARY SEWER (INVERTED SIPHON) VARIOUS LOCATIONS IMPROVED UPPER MAMARONECK RIVER

MAMARONECK NEW YORK

FIGURE 74

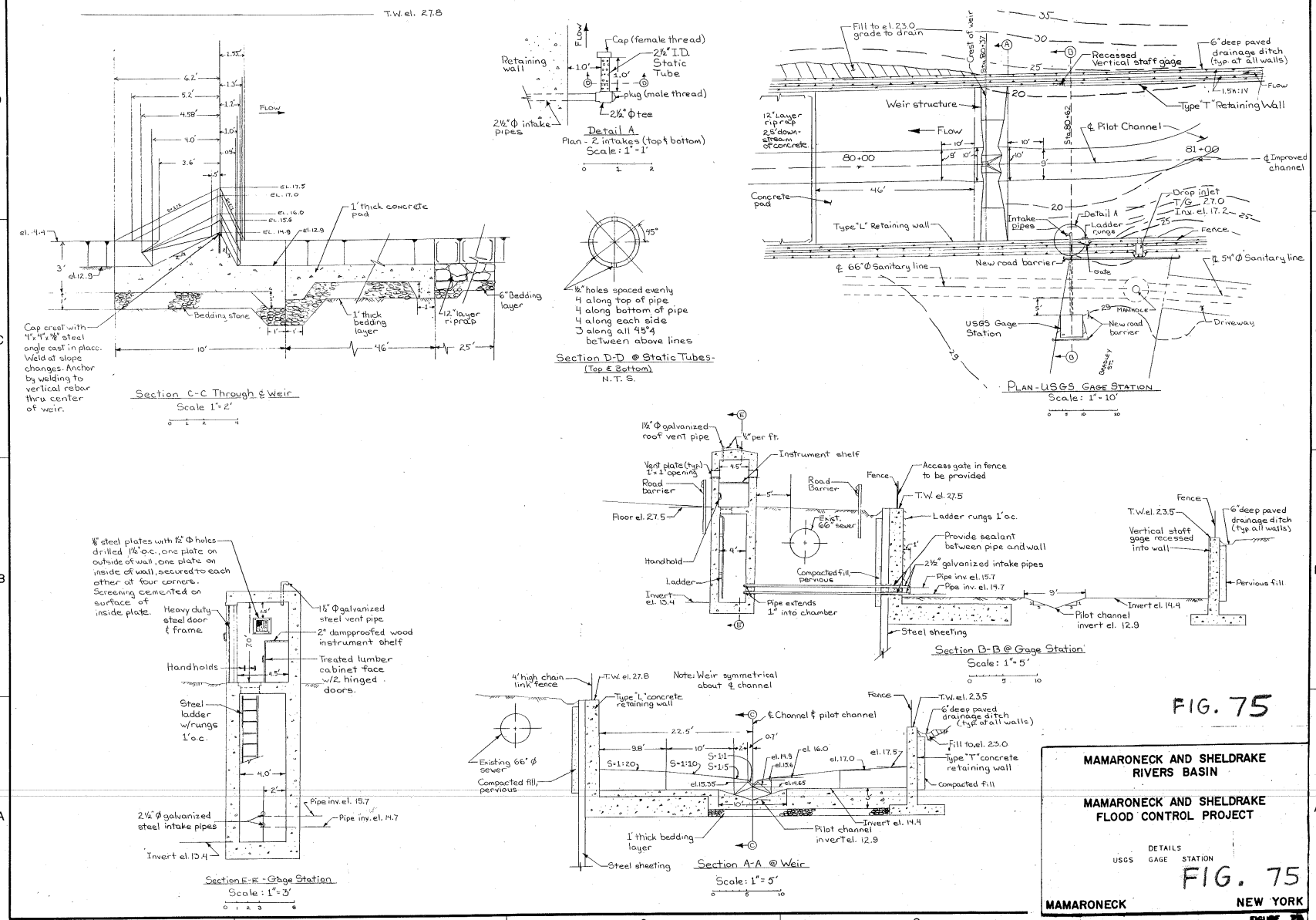


FIG. 75

MAMARONECK AND SHELDRAKE RIVERS BASIN

MAMARONECK AND SHELDRAKE FLOOD CONTROL PROJECT

DETAILS
USGS GAGE STATION

FIG. 75

MAMARONECK NEW YORK

FIGURE 75