Assessment of Sites
for an

Augmentation Reservoir for the Susquehanna Steam Electric Station

Prepared for
Pennsylvania Power & Light Company

August 1977

Tippetts-Abbett-McCarthy-Stratton
Engineers and Architects New York

SUMMARY AND CONCLUSIONS

Conclusions

Thirteen reservoir sites capable of developing augmentation water supply storage needed to meet Susquehanna River Basin Commission requirements for consumptive water use at the Susquehanna Steam Electric Station were appraised both technically and environmentally. The appraisal led to the identification of Pond Hills as being the site most suitable for development as a reservoir. The Graves Pond Creek site, which was almost as good but did require more relocations of people, roads and utilities, is recommended as the first alternative site. Little Meshoppen Creek is recommended as the second alternative site.

Summary

The 13 sites which were considered are:

Graves Pond Creek
Little Meshoppen Creek
Riley Creek
Butler Creek
Idlewild Creek
Fargo Creek
Laning Creek
Salem Creek
Tributary to Nescopeck Creek
Pond Creek
Little Wapwallopen Creek
Pond Hill
Tributary to South Branch Newport Creek

The Little Wapwallopen site would develop the needed water supply or yield by storing runoff from its drainage area. Supplemental pumping from a nearby source is required to develop the yield at the other sites.

The study consisted of establishing criteria for project requirements, developing a plan for each site and appraising the technical and environmental qualities of each site. The assessments were based primarily on office studies using existing maps and a literature search. Each site was, however, given a

cursory field inspection.

Based on the technical assessment, the Tributary to the South Branch, Newport Creek was eliminated because of geological uncertainties resulting from past surface and deep mining in the immediate vicinity. The other sites were judged to be technically acceptable and cost estimates prepared. Based on cost as being a measure of the relative technical suitability of a site for the development of a reservoir, the sites could be grouped as follows:

Estimated Project Cost less than $32.0 million	Estimated Project Cost between $32.0 and 39.0 million	Estimated Project Cost greater than $39.0 million
Little Meshoppen Creek	Graves Pond Creek	Laning Creek
Riley Creek	Butler Creek	Fargo Creek
Little Wapwallopen Creek	Pond Hill	Salem Creek
Idlewild Creek	Tributary to Nescopeck Cr.	Pond Creek

The environmental assessment indicated all sites to be good. Results are summarized on Plate 4-1, Reservoir Environmental Evaluation Matrix. From this matrix the sites were grouped as follows:

Relative Environmental Suitability for Development of a Reservoir

Relatively Good	Relatively Average	Relatively Poor
Pond Hill	Little Meshoppen Creek	Butler Creek
Graves Pond Creek	Riley Creek	Idlewild Creek
	Fargo Creek	Salem Creek
	Laning Creek	Trib. to Nescopeck Cr.
		Pond Creek
		Little Wapwallopen Cr.

CHAPTER 1

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Chapter 1

INTRODUCTION

This report summarizes the studies leading to the selection of a primary reservoir site and two alternative sites from a group of 13 sites for an augmentation of water supply storage needed to meet Susquehanna River Basin Commission requirements for consumptive water use at Susquehanna Steam Electric Station. The prime and two alternative sites were selected based on a technical and environmental assessment of 13 sites located on tributaries of the Susquehanna River between Berwick and Towanda, Pennsylvania. The 13 sites are:

Site	Number	County	U.S.G.S. Quad Map
Graves Pond Creek	P-OD-09-1	Wyoming	Jenningsville
Little Meshoppen Creek	T-10-10A	Wyoming/ Susquehanna	Auburn Center
Riley Creek	SCS 10-17A	Wyoming/ Susquehanna	Auburn Center & Springville
Butler Creek	T-38-100A	Susquehanna	Lenoxville
Idlewild Creek	SCS 38-10	Susquehanna	Clifford
Fargo Creek	P-OD-10-1	Bradford	Laceyville
Laning Creek	SCS-11-7	Bradford	Towanda
Salem Creek	T-OD 08-2A	Luzerne	Berwick
Tributary to Nescopeck Creek	P-35-1	Luzerne	Berwick
Pond Creek	P 07-2	Luzerne	Sybertsville
Little Wapwallopen Creek	SCS 07-8A	Luzerne	Sybertsville
Pond Hill	P-OD-07-1	Luzerne	Nanticoke & Shickshinny
Tributary to South Branch Newport Creek	P-OD-07-3	Luzerne	Nanticoke

The location of the sites are shown on Plate 1-1.

Purpose

The potential reservoir sites are being considered for development of a water supply source to augment the Susquehanna River during low flow periods by the amount of river flow used consumptively at the Susquehanna Steam Electric Station, now under construction near Berwick. The estimated average consumptive use is 50 cfs. The study was made for Pennsylvania Power & Light Company (PP&L), the owners of the Susquehanna Station, by Tippetts-Abbett-McCarthy-Stratton (TAMS).

The augmentation is required by the Susquehanna River Basin Commission (SRBC), during periods of critical low Susquehanna River flow. They have adopted as low flow criterion the average consecutive seven day low flow with a return frequency of ten years plus a project's total consumptive use. For SSES, the average consumptive use is 50 cfs; and, the SRBC indicates the seven day ten year low flow to be 790 cfs at the Wilkes-Barre gage. When flow in the river is below 840 cfs - the sum of 790 cfs and 50 cfs - there must be augmentation water released to equal the total consumptive use..

Scope

In this study each reservoir was sized to meet the SRBC low flow criteria during the most critical period of historic recorded flows at the Wilkes-Barre gage. Other possible incidental uses of the reservoir such as recreation and fishing were considered as possible reservoir functions. In future, more detailed studies of any of these reservoir sites, other local needs such a s municipal and industrial water supply and flood control would be considered when appropriate.

Only one of the alternatives (Little Wapwallopen Creek) is a conventional type reservoir where the total yield required can be obtained by storing runoff from the contributing drainage area. The remaining sites require supplemental pumping from a nearby runoff source to obtain the desired yield.

This assessment is based on a field reconnaissance of each site by engineering (TAMS and PP&L) and environmental (TAMS) personnel, map studies, and a literature search. Field work for this phase of the investigation was limited to one brief visit.

Previous Studies

Possible reservoir sites have been studied in the Susquehanna Basin by many investigators. The Susquehanna River Basin Coordinating Committee Report of June 1970, considered many reservoirs proposed by the U.S. Army Corps of Engineers, the Soil Conservation Service of the Department of Agriculture and others. Most of these previous studies considered only streams with drainage areas large enough to provide a relatively high yield.

TAMS has, since 1972, made studies in the basin of both conventional reservoirs and reservoirs supplemented by pumping from nearby streams. PP&L engineers have contributed to these studies as well as making their own investigations.

The 13 sites studied herein were selected by PP&L from combined inventories of all prior studies and from additional map review. These sites are considered to be the best suited to develop the required augmentation water supply for Susquehanna SES, based on a broad appraisal of engineering, environmental and relocation problems of many possible sites within the part of the Susquehanna Basin being considered.

It should be noted that in the site identifying number given above, SCS refers to sites previously identified by the Soil Conservation Service in the Susquehanna Report; T refers to sites identified by TAMS; and P refers to sites identified by PP&L. The first number refers to the sub-basins, and the second, a particular site.

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Chapter 2

TECHNICAL ASSESSMENTS

Each reservoir site was studied to determine its yield/storage capabilities, technical suitability, land and relocation requirements, and development costs. The appraisal was based on establishing a plan of development for each site, and assessing the various elements of each plan from a technical and cost standpoint.

Project Requirements

The criteria, assumptions and study procedures described below were developed and used to establish comparable project requirements and a layout for each potential site. Each site layout for this assessment was based primarily on a single purpose augmentation water supply function. Incidental uses such as limited recreation and fishing could possibly be accommodated by the projects.

Storage/Yield Criteria

Each reservoir was sized to augment the Susquehanna River during the historical low flow period by an amount equal to the consumptive use of the Susquehanna SES. Low flow as defined by the SRBC is the seven-day, ten-year low flow (Q7-10) plus the project's total consumptive use. The Q7-10 at the U.S.G.S. gaging station at Wilkes-Barre is estimated by SRBC to be 790 cfs, based on the historical record. The estimated average consumptive use at Susquehanna SES will be 50 cfs. Therefore, in this study it was assumed that when the natural Susquehanna River flow as measured at the Wilkes-Barre gage is less than 840 cfs, augmentation releases would be needed.

An analysis of past flow records (1905-1975) indicates the historical record low flow period when the river flow was below 840 cfs was 104 days in 1964. Plate 2-1 summarizes the number of days each year during the period of record that the Susquehanna River at Wilkes-Barre was below 840 cfs. It is these days when augmentation releases would have been made from the reservoir.

Each reservoir was designed to refill completely during the most critical refilling period. From an analysis of the historical records of appropriate gaging stations, the most critical refilling period extended from December 1964 through May 1965 following the historical record low flow period. At all sites except Little Wapwallopen, the inflow was insufficient to completely refill, and a pump station with a capacity to refill the remaining storage from a nearby source within a reasonable time was included as a part of the design. Results of mass curve analyses of nearby streams were used to estimate the portion of the required yield which could be developed from the natural runoff and the storage volume needed to do so. The remainder of the required yield must be developed by pumping, with storage volume provided accordingly. Losses for evaporation and seepage were assumed to equal 10% of the inflow and/or pumped volume. Based on these criteria the total volume required for water supply at each of the sites ranged from 11,500 acre-feet at the sites having the smallest drainage area to 12,300 acre-feet at the Little Wapwallopen site.

A minimum flow of 0.15 cfs per square mile of drainage area was assumed to be maintained downstream of the reservoirs and pumping sources. This represents the present (conservation) minimum flow criteria of the Department of Environmental Resources, Commonwealth of Pennsylvania. Streamflow downstream from the project would normally exceed this minimum because:

1. Most of the time the reservoir would be full, and all inflow will be passed downstream; and
2. During low flow periods, part of the augmentation release could be made downstream at those sites for which there is a demonstrable benefit to do so.

Minimum Storage

A minimum storage level with a capacity equivalent to either 2000 or 3000 acre-feet was assumed for each reservoir. Reservoirs near population centers were provided with the larger minimum pool. This pool would be large enough to store all sediments accumulating in the reservoir over the life of the project, and provide protection for aquatic life, reserve storage and for aesthetic reasons.

PLATE 2-1
1/2

DAYS DURING PERIOD OF RECORD (1905-1975) THAT AN AUGMENTATION RESERVOIR WOULD BE REQUIRED *

	July **	Aug.	Sept.	Oct.	Nov.	Total
1905	–	–	–	–	–	0
06	–	–	–	–	–	0
07	–	–	–	–	–	0
08	–	–	12	–	–	12
09	–	–	–	–	–	0
1910	–	–	–	–	–	0
11	–	3	–	–	–	3
12	–	–	–	–	–	0
13	–	–	13	–	–	13
14	–	–	–	–	–	0
15	–	–	–	–	–	0
16	–	–	–	–	–	0
17	–	–	–	–	–	0
18	–	–	–	–	–	0
19	–	–	–	–	–	0
1920	–	–	–	–	–	0
21	–	–	–	–	–	0
22	–	–	–	–	–	0
23	–	–	–	–	–	0
24	–	–	–	–	–	0
25	–	–	–	–	–	0
26	–	–	–	–	–	0
27	–	–	–	–	–	0
28	–	–	–	–	–	0
29	–	–	–	–	–	0
1930	–	–	–	–	–	0
31	–	–	–	–	–	0
32	–	–	–	–	–	0
33	–	–	–	–	–	0
34	–	–	–	–	–	0
35	–	–	–	–	–	0
36	–	–	–	–	–	0
37	–	–	–	–	–	0
38	–	–	–	–	–	0
39	–	8	27	–	–	35
1940	–	–	–	–	–	0
41	–	–	7	9	–	16
42	–	–	–	–	–	0
43	–	–	–	–	–	0
44	–	–	–	–	–	0
45	–	–	–	–	–	0
46	–	–	–	–	–	0
47	–	–	–	–	–	0
48	–	–	–	–	–	0
49	–	–	–	–	–	0

* Based on reservoir releases when flow was equal to or less than 840 cfs at the Susquehanna Gage at Wilkes-Barre.

** Based on historical record, augmentation releases would never be required in the months December through June.

DAYS DURING PERIOD OF RECORDI (1905-1975) THAT AN AUGMENTATION RESERVOIR WOULD BE REQUIRED * (Continued)

	July**	Aug.	Sept.	Oct.	Nov.	Total
1950	–	–	–	–	–	0
51	–	–	–	–	–	0
52	–	–	–	–	–	0
53	–	–	4	4	–	8
54	–	–	–	–	–	0
55	2	10	–	–	–	12
56	–	–	–	–	–	0
57	–	–	–	–	–	0
58	–	–	–	–	–	0
59	–	–	9	–	–	9
1960	–	–	–	–	–	0
61	–	–	–	–	–	0
62	–	9	23	–	–	32
63	–	–	–	19	6	25
64	–	19	29	31	25	104
65	2	1	–	–	–	3
66	–	–	–	–	–	0
67	–	–	–	–	–	0
68	–	–	–	–	–	0
69	–	–	–	–	–	0
1970	–	–	–	–	–	0
71	–	–	–	–	–	0
72	–	–	–	–	–	0
73	–	–	–	–	–	0
74	–	–	–	–	–	0
75	–	–	–	–	–	0
Total	4	50	124	63	31	272

* Based on reservoir releases when flow was equal to or less than 840 cfs at the Susquehanna Gage at Wilkes-Barre.

** Based on historical record, augmentation releases would never be required in the months December through June.

Spillway Requirements

A combination of flood surcharge storage and spillway capacity was provided to insure safety of the project, should the probable maximum flood occur. In general, the following depths of surcharge storage were provided:

- 15 feet for drainage areas greater than 15 square miles
- 10 feet for drainage areas greater than 5 square miles
- 5 feet minimum

Each spillway was sized to pass the peak outflow considering the applicable storage volumes.

Freeboard

A five foot freeboard over maximum flood level was used for all reservoirs. This is sufficient to prevent overtopping of the dam for maximum combination of flood, fetch, and wind conditions.

Other Project Features

Embankment dams and overflow spillways with hydraulic jump stilling basins for energy dissipation were specified for all sites. Studies leading to preliminary design would consider possible alternatives.

An outlet tower is indicated for each site and would connect to the pumping water conduit and/or to an energy dissipation basin on the downstream side of the dam. Augmentation releases would be made either back to the original pumping source or to the existing downstream channel. In no case would the downstream releases exceed the capacity of the downstream channel. The towers would be designed so releases can be made from various selected depths to assist in maintaining downstream water quality.

Pump stations were sized to refill the reservoir during the most critical historic refilling period which hydrologic records indicate to have occurred from December 1964 to May 1965 in the part of the Susquehanna River Basin containing the sites studied. At those sites which are refilled from the Susquehanna River or other large streams where ample water is available during this period, pumps were sized to refill the pumping storage volume within a three-month period.

Relocations are provided as needed to minimize disruptions to the present patterns of roads, transmission lines, pipelines and other utilities.

Land requirements were estimated from the existing U.S.G.S. maps. It was assumed that an adequate area above the maximum reservoir level would be acquired for recreation development and to preserve or enhance the existing aesthetic quality of the sites.

Plans of Development

A plan was developed for each site which would provide the water supply storage needed to meet the low flow augmentation requirements. These plans are described herein. Yield/storage requirements, water level and other pertinent information for each site are summarized on Plate 2-2. A plan for each reservoir and an area-storage curve are shown on Plate 2-3 through 2-28. Project cost and annual cost are summarized on Plate 2-29 for each site.

The plans considered storage only for low flow augmentation necessary for the Susquehanna SES. Other incidental uses such as recreation and fishing which require no additional storage can be accommodated within the plan. Some of the sites can be developed for more storage than is anticipated in this study. The additional storage could be used for flood control, municipal and industrial water supply, and low flow augmentation for other purposes. The need for this additional storage is unknown at this time. The possibility of providing additional storage is noted in the project descriptions herein.

It should be noted that no studies leading to optimization of the project features and costs have been made.

The plans were based on the above criteria and the topography shown on the U.S. Geological Survey maps with a scale of 1:24,000. Each reservoir site was visited in the field.

A description of each site, an area-storage curve and map showing the configuration of each reservoir follows.

Susquehanna Reservoir Study
Summary of Projects

Site Number	Units	Graves Pond Creek (P-OD-09-1)	Little Meshoppen Creek (T-10-10A)	Riley Creek (SCS-10-17A)	Butler Creek (T-38-100A)	Idlewild Creek (SCS-38-11)	Fargo Creek (P-OD-10-1)	Laning Creek (SCS-11-7)
Drainage Area	sq.mi	2.3	10	17.5	19.4	7.8	4.3	10.6
Yield from -								
Runoff	cfs	0	10	21	24	9	0	10
Pumping	cfs	50	40	29	26	41	50	40
Total	cfs	50	50	50	50	50	50	50
Storage for -								
Runoff	AF	0	2,700	5,200	5,700	2,300	0	2,900
Pumping	AF	11,500	9,300	6,700	6,100	9,400	11,500	9,200
Total Water Supply	AF	11,500	12,000	11,900	11,800	11,700	11,500	12,100
Inactive	AF	2,000	2,000	3,000	3,000	2,000	2,000	3,000
Elevations-								
Top of Dam	ft.MSL	1,090	945	940	1,100	1,225	1,020	1,040
Maximum Water Level	ft.MSL	1,085	940	935	1,095	1,220	1,015	1,035
Water Supply Level	ft.MSL	1,080	930	920	1,080	1,210	1,005	1,025
Minimum Water Level	ft.MSL	1,005	870	865	1,025	1,135	900	955
Reservoir Area -								
Top of Dam	Acres	300	370	465	450	330	330	420
Maximum Water Supply	Acres	255	310	355	350	275	280	340
Minimum Water Supply	Acres	75	100	130	125	90	60	90
Exposed Area, Maximum Drawdown	Acres	180	210	255	225	185	220	250
Pumping -								
Source		Susquehanna River	Meshoppen Creek	Meshoppen Creek	Tunkhannock Creek	South Branch Tunkhannock Creek	Susquehanna River	Susquehanna River
Drainage Area of Source	sq.mi	9,000	104	78	63	40	8,500	8,000
Capacity	cfs	64	64	100	50	50	64	50
Head	ft.	470	370	210	300	220	460	350
Pipeline Length	ft.	2,000 (Tunnel)	10,000	8,000	14,500	3,800	9,000	7,000 (Tunnel)

Plate 2-2
1 of 2

Susquehanna Reservoir Study

Summary of Projects

Site Number	Units	Salem Creek (T-00-08-2A)	Tributary to Nescopeck Creek (P-35-1)	Pond Creek (P-07-2)	Little Wap-wallopen Creek (SCS-07-8A)	Pond Hill (P-OD-07-1)	Tributary South Branch Newport Creek (P-OD-07-3)
Drainage Area	sq.mi	3.2	2.2	9.6	27	1.2	1.1
Yield from -							
Runoff	cfs	0	0	16	54	0	0
Pumping	cfs	50	50	34	0	50	50
Total	cfs	50	50	50	54	50	50
Storage for -							
Runoff	AF	0	0	4,000	12,300	0	0
Pumping	AF	11,500	11,500	7,600	0	11,500	11,500
Total Water Supply	AF	11,500	11,500	11,600	12,300	11,500	11,500
Inactive	AF	3,000	2,000	2,000	3,000	2,000	3,000
Elevations -							
Top of Dam	Ft.MSL	895	915	840	850	960	1,075
Maximum Water Level	Ft.MSL	890	910	835	845	955	1,070
Water Supply Level	Ft.MSL	885	905	825	830	950	1,065
Minimum Water Level	Ft.MSL	795	810	710	765	870	975
Reservoir Area -							
Top of Dam	Acres	275	255	270	410	240	220
Maximum Water Supply	Acres	235	215	200	300	230	200
Minimum Water Supply	Acres	55	45	45	100	80	70
Exposed Area, Maximum Drawdown	Acres	180	170	155	200	150	140
Pumping -							
Source		Susquehanna River	Nescopeck Creek	Little Wap-wallopen Creek	---	Susquehanna River	Susquehanna River
Drainage Area of Source	sq.mi	10,500	163	29	---	10,000	10,000
Capacity	cfs	64	64	50	---	64	64
Head	ft.	490	340	305	---	470	735
Pipeline Length	ft.	9,000	2,000	2,000	---	3,000	20,000

Graves Pond Creek (P-OD 09-1)

This project would be located on a small right bank tributary to the Susquehanna River in Windham Township of Wyoming County about 4.7 miles west of the Borough of Meshoppen. The location of the damsite and the outline of the maximum and minimum reservoir area is shown on Plate 2-3. An area-storage curve is shown on Plate 2-4.

The drainage area above the damsite is 2.3 square miles and is too small to develop any appreciable yield. This study assumes that all the yield would be developed by pumping from the Susquehanna River through a short tunnel (2200 feet) to the reservoir. Conservation releases will be made to the downstream channel. A part of the augmentation release could also be made to this channel as long as its capacity was not exceeded. The remainder of the augmentation release would be made through the tunnel back to the river.

The proposed project is based on providing 13,500 acre-feet of storage to obtain an augmentation yield of 50 cfs. It is estimate that the capability of the site as limited by topography is about 21,000 acre-feet which would yield about 80 cfs for augmentation purposes.

The reservoir is small and compact requiring a minimum of land. It was assumed that the existing secondary road falling within the reservoir would be relocated in order to maintain existing access. No other relocation requirements were apparent.

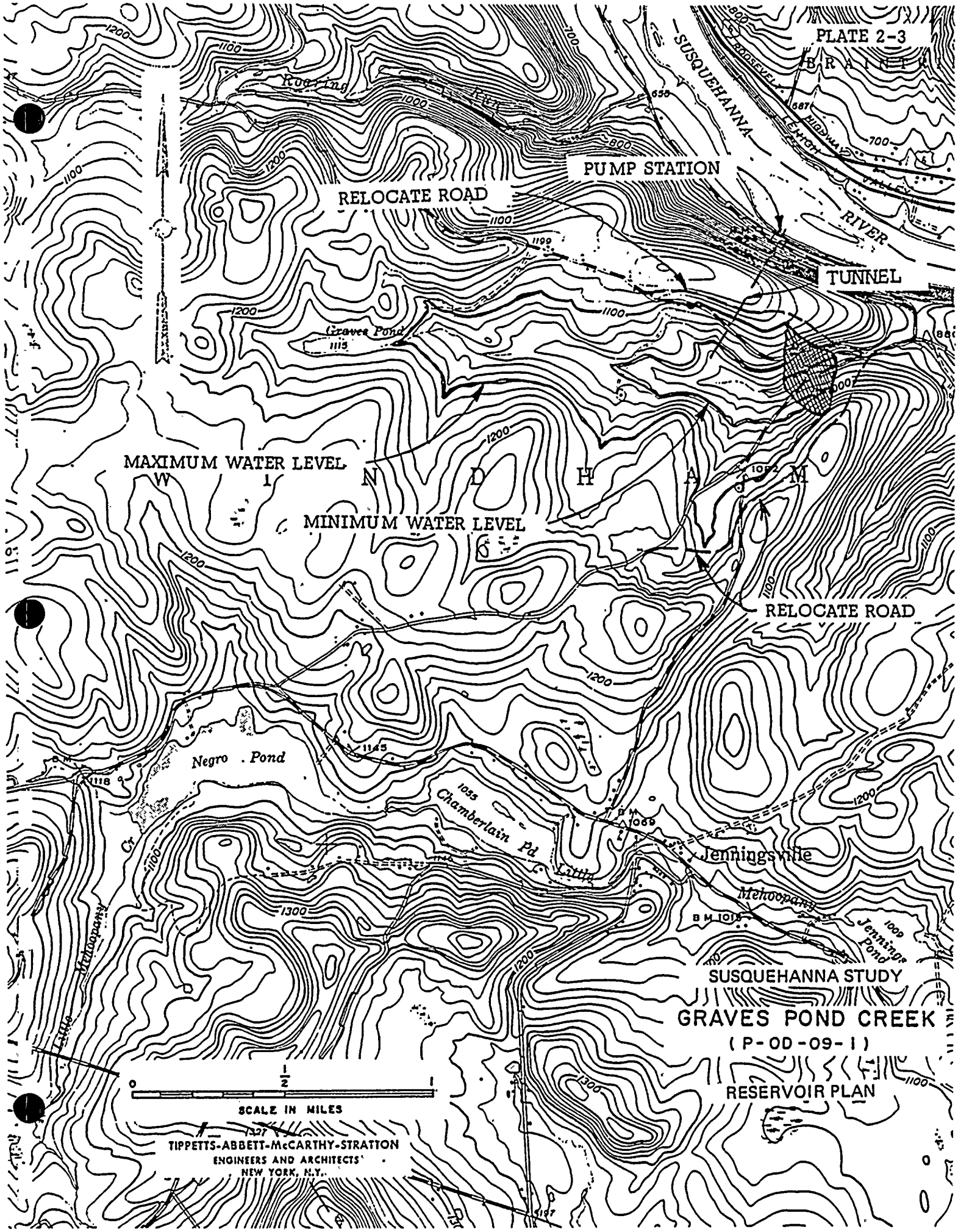


PLATE 2-3
PUMP STATION
RELOCATE ROAD
TUNNEL
MAXIMUM WATER LEVEL
MINIMUM WATER LEVEL
RELOCATE ROAD
Negro Pond
Graves Pond
Jenningsville
Mehoopany
Jennings Pond
SUSQUEHANNA STUDY
GRAVES POND CREEK
(P-OD-09-1)
RESERVOIR PLAN
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

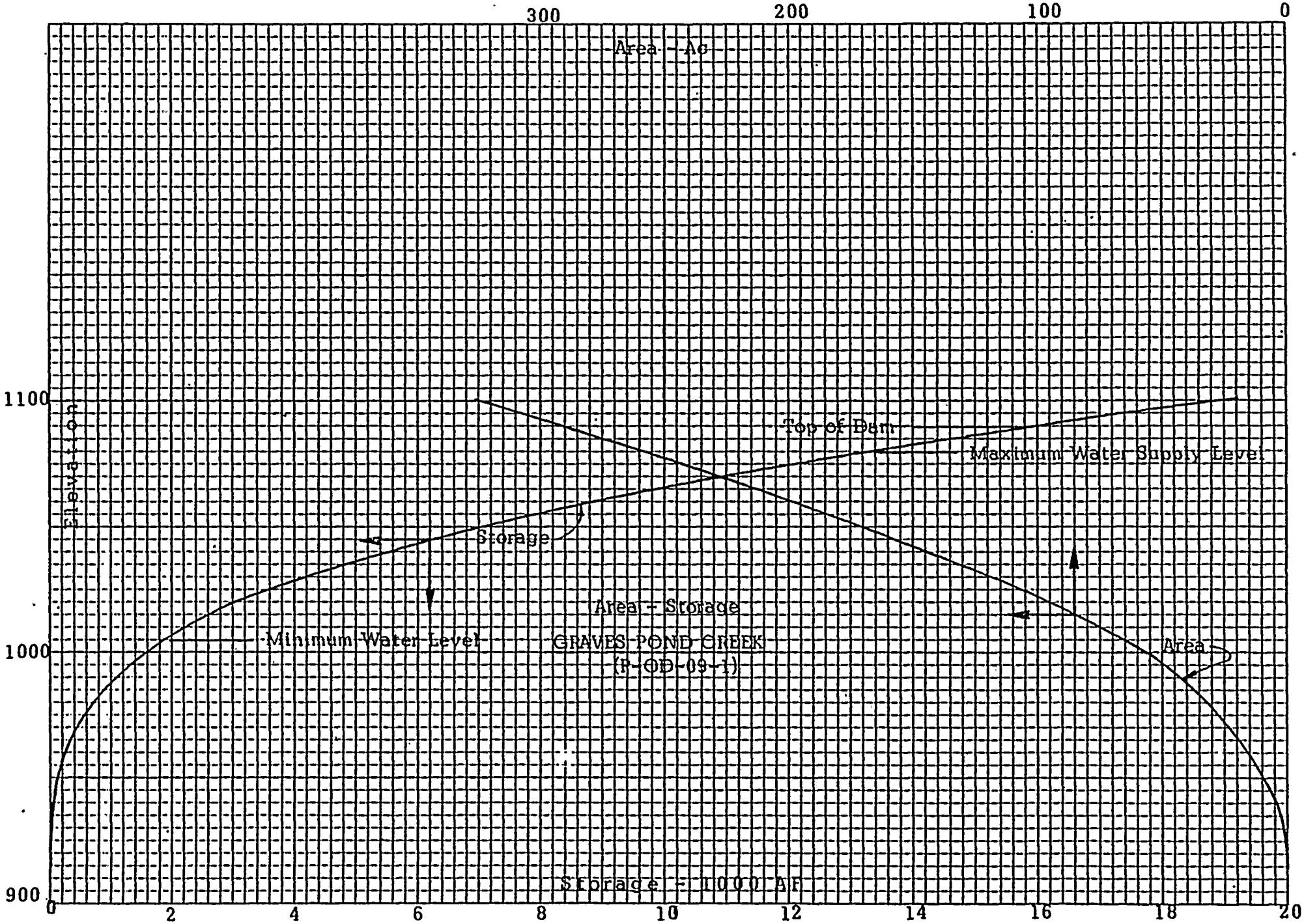


Plate 2-4

Little Meshoppen Creek (T 10-10A)

This project would be located on Little Meshoppen Creek, partly in Auburn Township, Susquehanna County, and partly in Meshoppen Township, Wyoming County. The damsite is approximately 1-1/2 miles north of the Borough of Meshoppen. The location of the damsite and the outline of the maximum and minimum reservoir area are shown on Plate 2-5. An area-storage curve is shown on Plate 2-6.

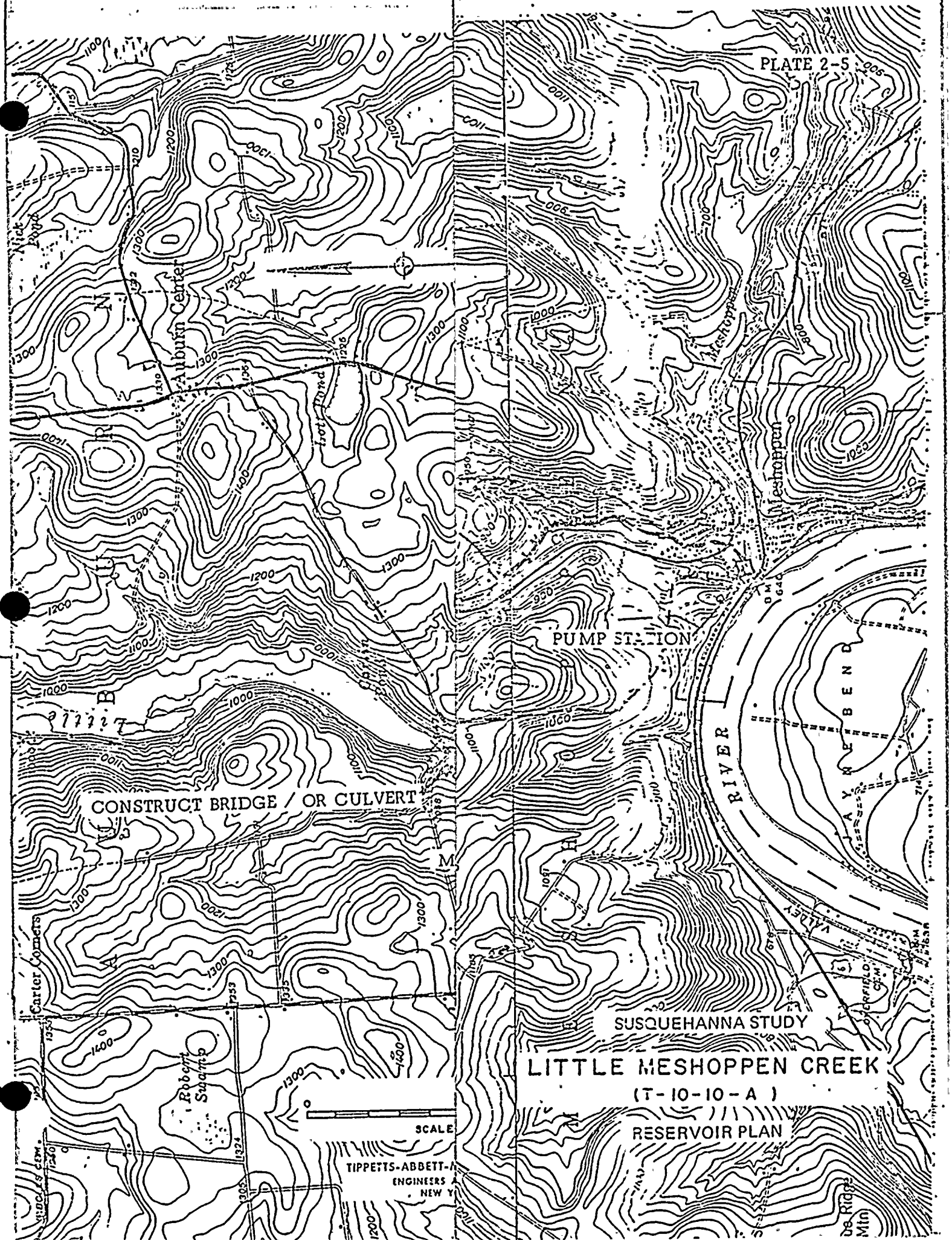
The proposed project is based on developing 14,000 acre-feet of storage to yield 50 cfs of augmentation flow. The maximum storage capability of the site as limited by the topography is about 35,000 acre-feet which would yield 140 cfs for augmentation purposes. There may be some benefits to the Borough of Meshoppen for flood control storage. This should be investigated in further studies of this site.

The drainage area of 10 square miles would provide an augmentation flow of 10 cfs. The remaining required augmentation yield of 40 cfs would be developed by pumping from Meshoppen Creek near its confluence with the Susquehanna River at the Borough of Meshoppen. A 1.9 mile pipeline would connect the pump station with the reservoir. Alternatively, pumping could be directly from the Susquehanna River. It is believed however, that a better quality water can be obtained from Meshoppen Creek. When pumping from the Meshoppen, the flow below the pump station during the critical refilling period would have been above the estimated long term median flow.

Conservation releases would be made to the downstream channel. Augmentation releases could be made to the channel also, or via the pipline to the river.

The reservoir is long and narrow and would back water up almost to Carlins Pond. Land requirements would not be extensive. The two transmission lines crossing the reservoir would be raised to provide not less than the minimum clearance required above the maximum water level. It was assumed that the secondary road at the upper end of the reservoir would be straightened and a new brdige constructed. Access in and around the project would be maintained by the existing roads outside the reservoir.

PLATE 2-5


Auburn Center
Nick Road
Lott Road
Meshoppen
Meshoppen Creek
PUMP STATION
RIVER
BEND
VALLEY
CONSTRUCT BRIDGE / OR CULVERT
Carter Corners
Robert Swamp
SUSQUEHANNA STUDY
LITTLE MESHOPPEN CREEK
(T-10-10-A)
RESERVOIR PLAN
SCALE
TIPPETTS-ABBETT-
ENGINEERS
NEW Y
Mt.

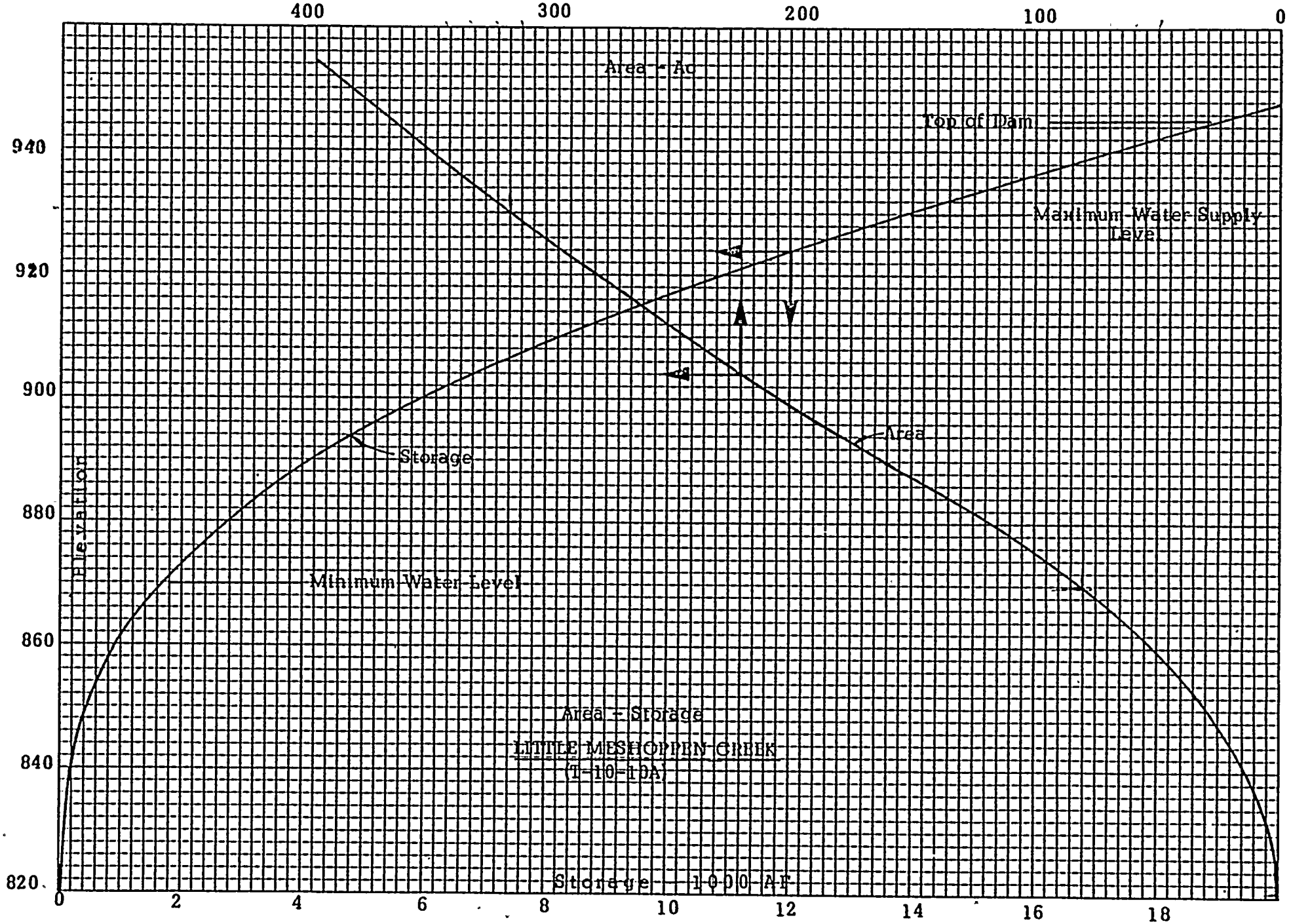


Plate 2-6

Riley Creek (SCS 10-17A)

This project is on a tributary of the West Branch of the Meshoppen Creek. It is located mostly in Auburn Township in Susquehanna County. A small portion is in Meshoppen Township in Wyoming County. The damsite is about 3-1/2 miles by road northeast of the Borough of Meshoppen. The location of the damsite and the extent of the maximum and minimum reservoir area is shown on Plate 2-7. An area-storage curve is shown on Plate 2-8.

The possibility of providing some flood control storage for the Borough of Meshoppen exists at this site also. Again it should be investigated if further studies of this site are considered.

The drainage area above the damsite is 17.5 square miles. Approximately 21 cfs of the 50 cfs augmentation flow would be developed from the drainage area. The remaining 29 cfs would be developed from pumping from Meshoppen Creek at the confluence with the West Branch through a pipeline 1.5 miles long. When pumping, the flows in the Meshoppen would not be reduced below the estimated long-term median flow at the pumping site. It is estimated that the downstream channel has sufficient capacity to convey all reservoir releases to the Susquehanna River.

Pumping from the West Branch of Meshoppen Creek is an alternative. However, during the critical refilling period, the flow past the pump station would have at times been reduced to the minimum required for conservation purposes.

The reservoir is long and narrow consisting of both farm land and second growth undeveloped areas. Land requirements are not extensive. Access throughout the area would be maintained by the existing road network and a small length of relocated secondary road on the right bank just north of the damsite. The two existing transmission lines would be raised to provide not less than the minimum clearance required above the maximum reservoir level.

LANING CREEK
SCS-11-7

LITTLE MESHOPPEN CREEK
T-10-10A

BUTLER CREEK
T-38-100A

FARGO CREEK
P-OD-10-1

IDLEWILD CREEK
SCS-38-10

GRAVES POND CREEK
P-OD-09-1

RILEY CREEK
SCS-10-17A

TRIBUTARY TO SOUTH BRANCH
NEWPORT CREEK
P-OD-07-3

POND HILL
P-OD-07-1

SALEM CREEK
T-OD 08-2A

LITTLE WAPWALLOPEN CREEK
SCS 07-8A

SUSQUEHANNA STEAM
ELECTRIC STATION

POND CREEK
P-07-2

TRIBUTARY TO NESCOPECK CREEK
P-35-1

5 0 5 10

SCALE: 1" = 5 MILES

SUSQUEHANNA STUDY
RESERVOIR LOCATION

TIPPETTS-ABBETT-McCARTHY-STRATTON

PLATE 2-7

MAXIMUM WATER LEVEL

RAISE EXISTING TRANSMISSION LINE

PIPELINE

MINIMUM WATER LEVEL

PUMP STATION

RELOCATE ROAD

LITTLE MESHOPPEN CREEK SITE

SCALE IN MILES

TIPPETTS-ABBETT-McCARTHY-STRATTON
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SUSQUEHANNA STUDY

RILEY CREEK
(SCS-10-17A)
RESERVOIR PLAN

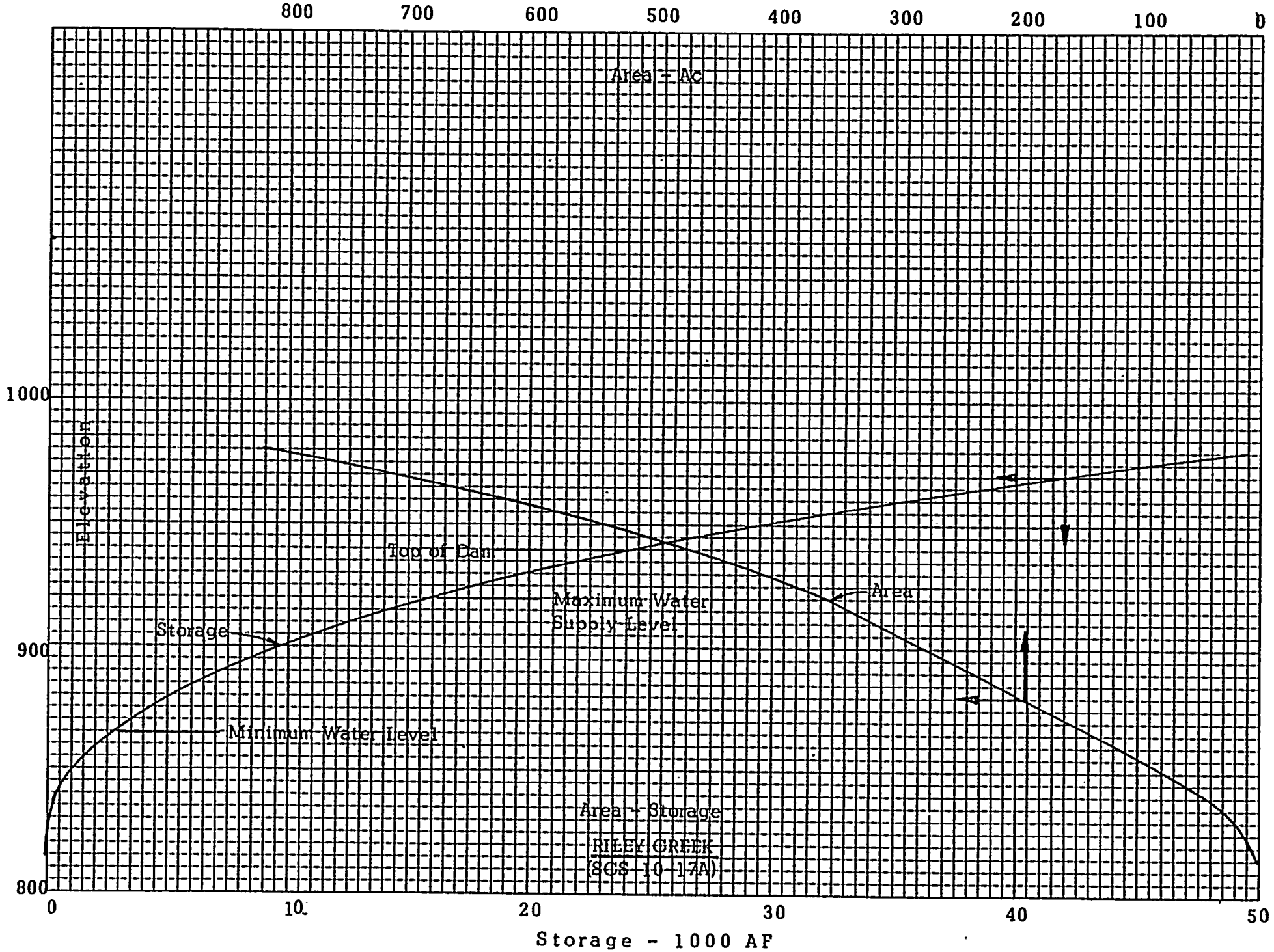


Plate 2-8

Butler Creek (T-38-100A)

This project is located in Harford Township in Susquehanna County about 2 miles directly west-northwest of the Village of South Gibson on a tributary to the Nine Partners Creek which is a tributary to Tunkhannock Creek. Plate 2-9 shows the location of the damsite and the extent of the reservoir and Plate 2-10 shows the area-storage curve.

The drainage area of 19.5 square miles upstream of the damsite can develop an augmentation yield of 20 cfs. The remaining required yield of 30 cfs would be developed by pumping from the confluence of Nine Partners and Tunkhannock Creeks through a pipeline 2.75 miles in length. The flow in the Tunkhannock Creek downstream of the pump station would be reduced at times during the critical refilling period to the minimum required for conservation purposes. It is estimated, however, that pumping would have caused this to occur in one year during the 70 years of record.

Conservation releases would be made to the downstream channel. Augmentation releases would be made to the downstream channel and back to the pumping source via the pipeline. In no case would the capacity of the existing channel be exceeded.

The reservoir area is long and narrow consisting of both farm and second growth undeveloped land. Land requirements would not be extensive. Access throughout the vicinity would be maintained by the existing road network. It was assumed that repaving the existing gravel road on the right bank near the damsite would be a part of the project. No other relocations are apparent.

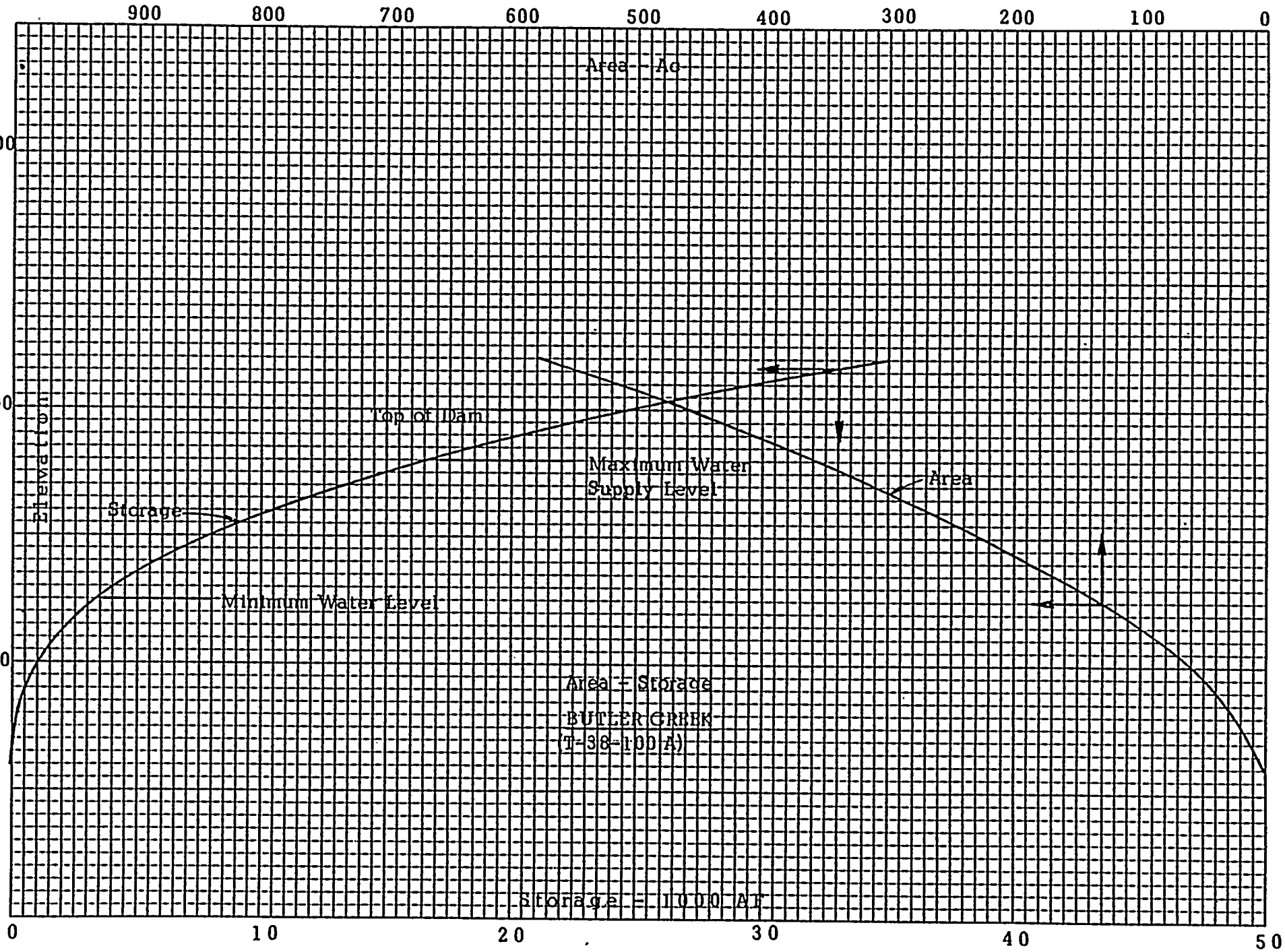
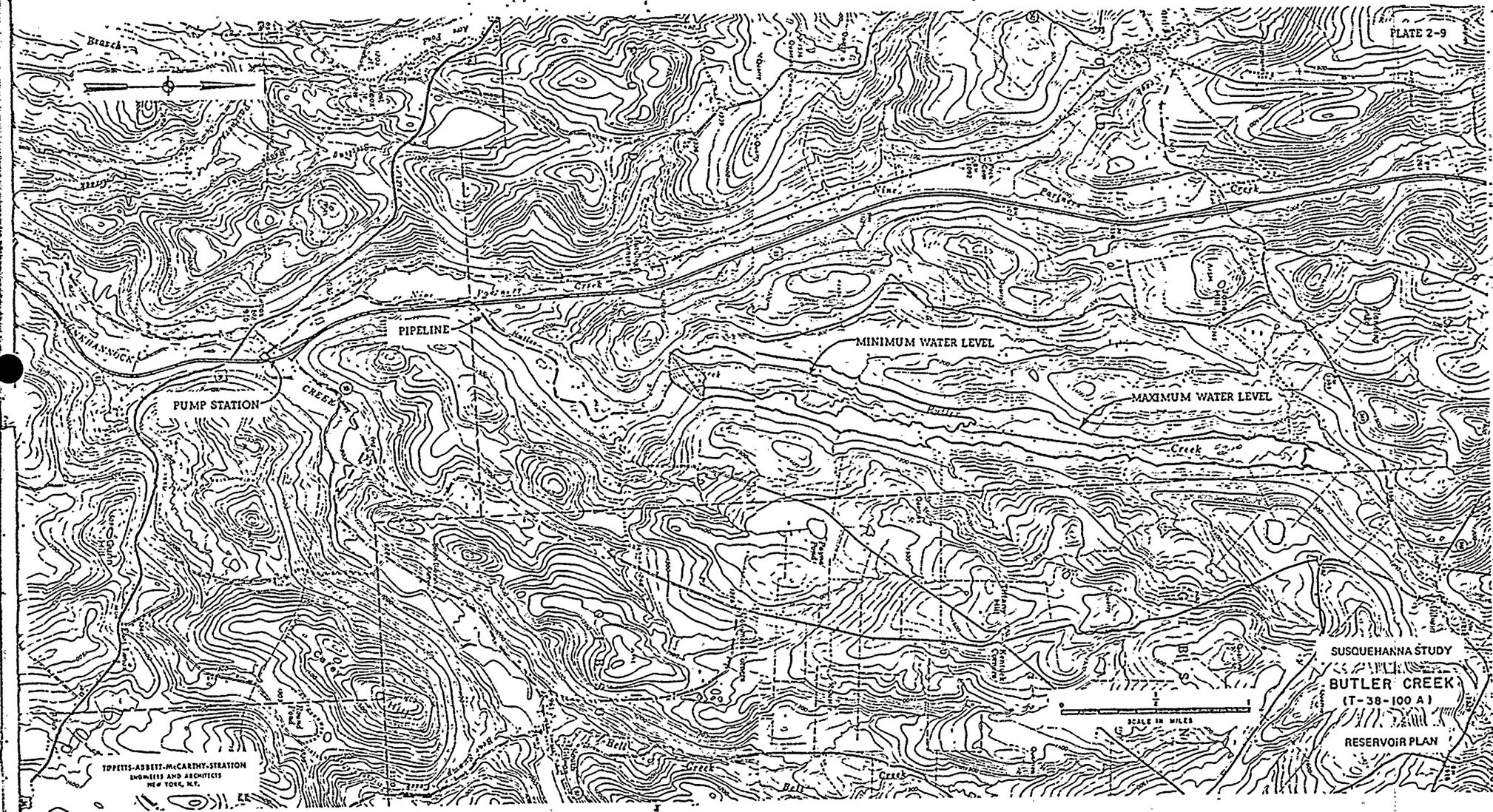


Plate 2-10

PLATE 2-9



TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

SUSQUEHANNA STUDY

BUTLER CREEK
(T-38-100 A)

RESERVOIR PLAN

Idlewild Creek (SCS 38-11)

This project would be in Clifford Township, Susquehanna County. The damsite would be about 4.4 miles directly south-southeast of the Village of South Gibson. The extent of the reservoir and the location of the damsite is shown on Plate 2-11. The area-storage curve is shown on Plate 2-12.

The drainage area of Idlewild Creek above the damsite is 7.8 square miles. About 9 cfs of augmentation yield can be developed from the drainage area. The remaining 41 cfs needed would be developed by pumping from the East Branch of Tunkhannock Creek. The flow in the East Branch past the pump station was, during the critical period, reduced at times to the minimum required for conservation purposes. It is estimated that pumping would have caused this to occur only in one year during the 70 years of record.

A pipeline 0.75 miles in length would connect the pump station and reservoir.

Conservation releases would be made to the downstream channel. Augmentation releases would be made via both the channel and the pipeline back to the pumping source. The existing channel capacity, however, would not be exceeded.

The reservoir is small and compact and will not require extensive land takings. Access in the area would be maintained mostly by the existing road system. A bridge is included as part of the project for the secondary road crossing near the upper end of the reservoir. A short relocation is provided in the vicinity of the left abutment of the dam. The bridge is now out of service on the existing secondary road upstream from the damsite. Because existing access can be maintained without this road, it is assumed to be abandoned. No other relocation requirements are apparent.

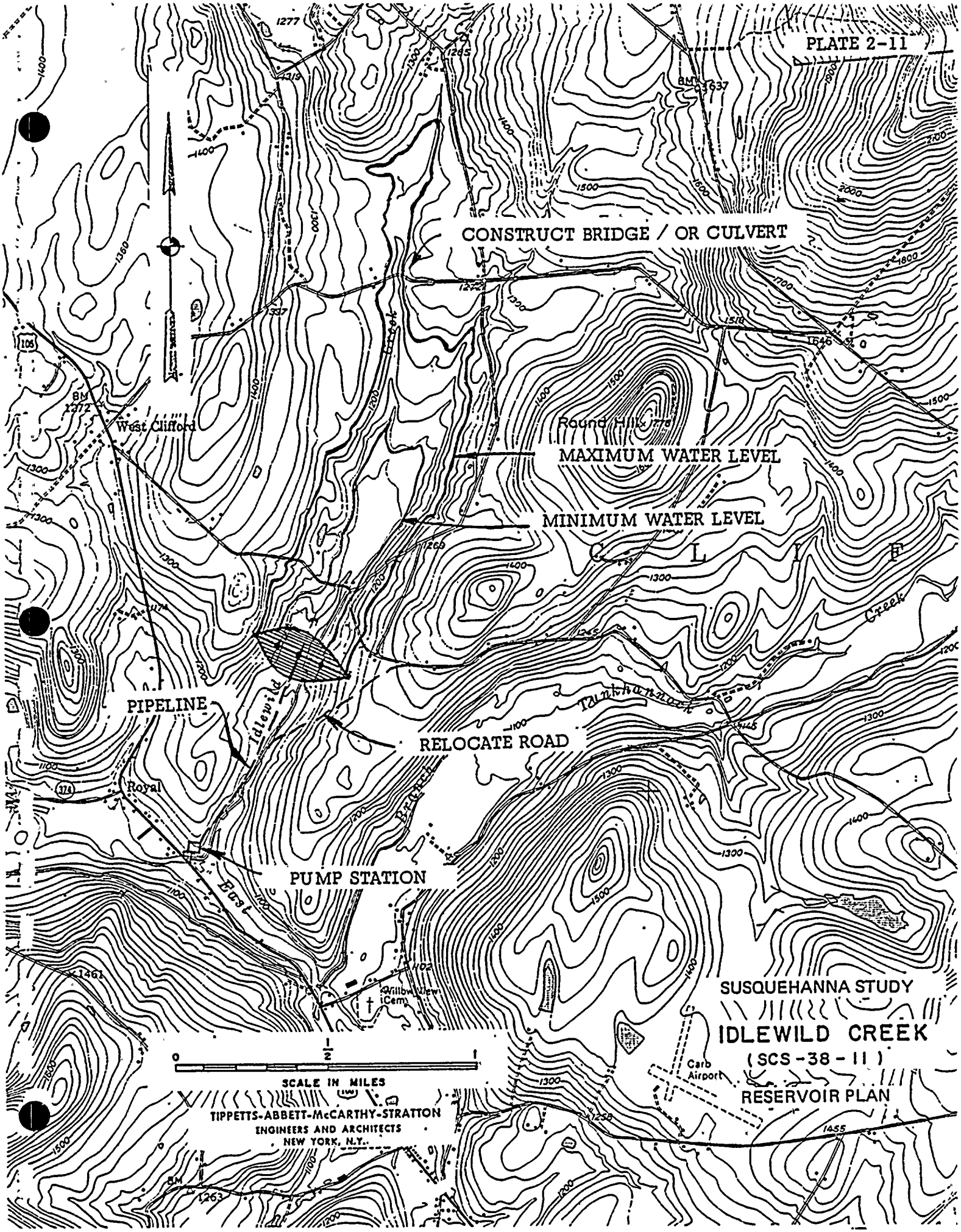


PLATE 2-11
CONSTRUCT BRIDGE / OR CULVERT
MAXIMUM WATER LEVEL
MINIMUM WATER LEVEL
CLIFF
PIPELINE
RELOCATE ROAD
PUMP STATION
West Clifford
Round Hill
Royal
Idlewild
Creek
Branch
East
Willow View Cem
Carb Airport
SUSQUEHANNA STUDY
IDLEWILD CREEK
(SCS - 38 - II)
RESERVOIR PLAN
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

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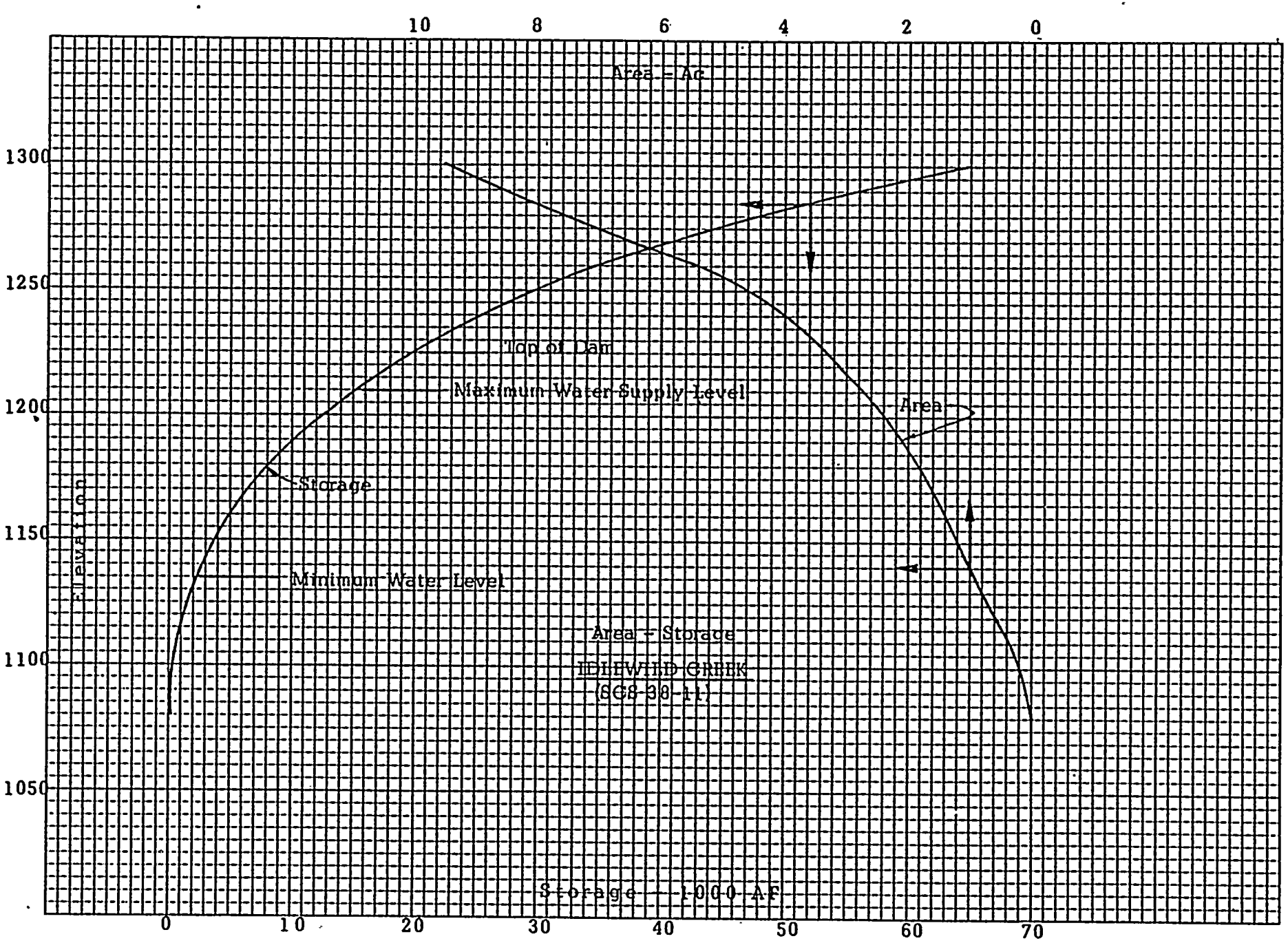

Plate 2-12

Fargo Creek (P-OD-10-1)

This project is located in Tuscarora Township in Bradford County. The damsite is about 1.6 miles directly northeast of the Borough of Laceyville. The extent of the reservoir and the location of the damsite is shown on Plate 2-13. An area-storage curve is shown on Plate 2-14.

The drainage area of Fargo Creek above the damsite is 4.3 square miles which is too small to develop a substantial natural yield. For this study it was assumed that the project yield was developed by pumping from the Susquehanna River near the confluence with Tuscarora Creek. A pipeline 1.7 miles long would connect the pump station with the reservoir. The conservation release and possibly part of the augmentation release would be made to the downstream channel. The capacity of this channel, however, would not be exceeded. The remainder of the augmentation release would be made via the pipeline to the river.

This site requires a larger than usual dam to develop the required storage.

The reservoir is long and narrow. Land requirements would not be extensive. The land appears to be part farm and part second growth undeveloped lands. Access is provided by the existing secondary road system. A bridge at the upper end of the reservoir is included as part of the project. Two existing transmission lines crossing the reservoirs would be raised to provide not less than the minimum clearance required above the maximum water level. No other relocations are apparent.

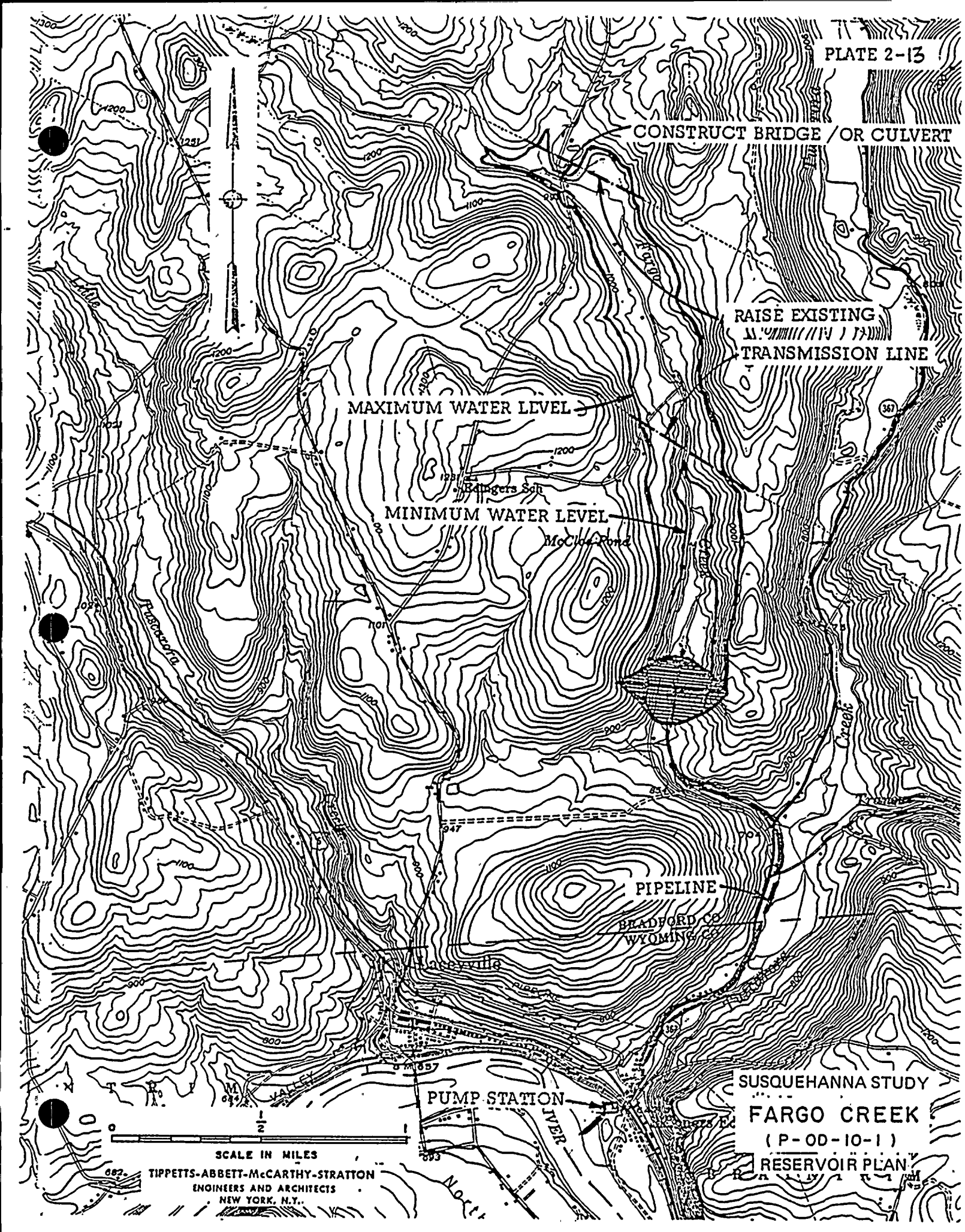
PLATE 2-13
CONSTRUCT BRIDGE /OR CULVERT
RAISE EXISTING
TRANSMISSION LINE
MAXIMUM WATER LEVEL
MINIMUM WATER LEVEL
Bolingers Sch
McCloe Pond
PIPELINE
BRADFORD CO
WYOMING CO
Wyalusing
PUMP STATION
SUSQUEHANNA STUDY
FARGO CREEK
(P-OD-10-1)
RESERVOIR PLAN
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
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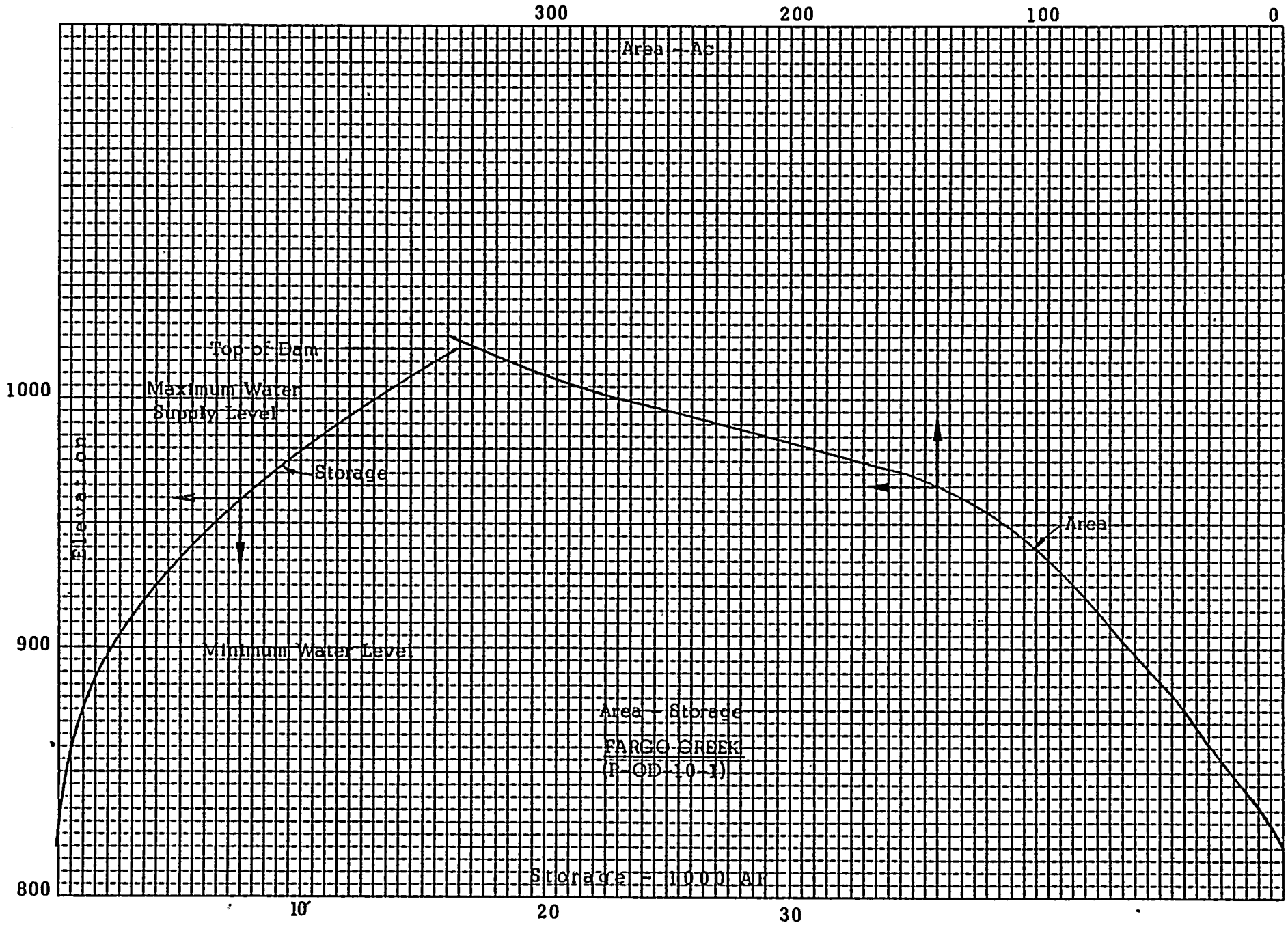

Plate 2-14

Laning Creek (SCS 11-7)

This project would be located in Sheshequin and Wysox Townships, Bradford County. The damsite is 2.6 miles northeast of the Borough of Towanda (west end of Highway 6 bridge). A plan of the reservoir and the location of the damsite is shown on Plate 2-15. An area-storage curve is shown on Plate 2-16.

The drainage area of Laning Creek above the damsite is 10.6 square miles and could develop an augmentation yield of 10 cfs. The remaining requirements (40 cfs) would be developed by pumping from the Susquehanna River. The pump station would be located on the bank opposite the Village of North Towanda. It would connect by tunnel (1.4 miles), to the reservoir.

It is estimated that the downstream channel can convey the releases back to the river. An alternative to the channel would be through the tunnel.

The reservoir is long and narrow. This site would require more land takings than the other sites. The access in the area would be maintained over the existing network of roads. No relocations of any kind are apparent.

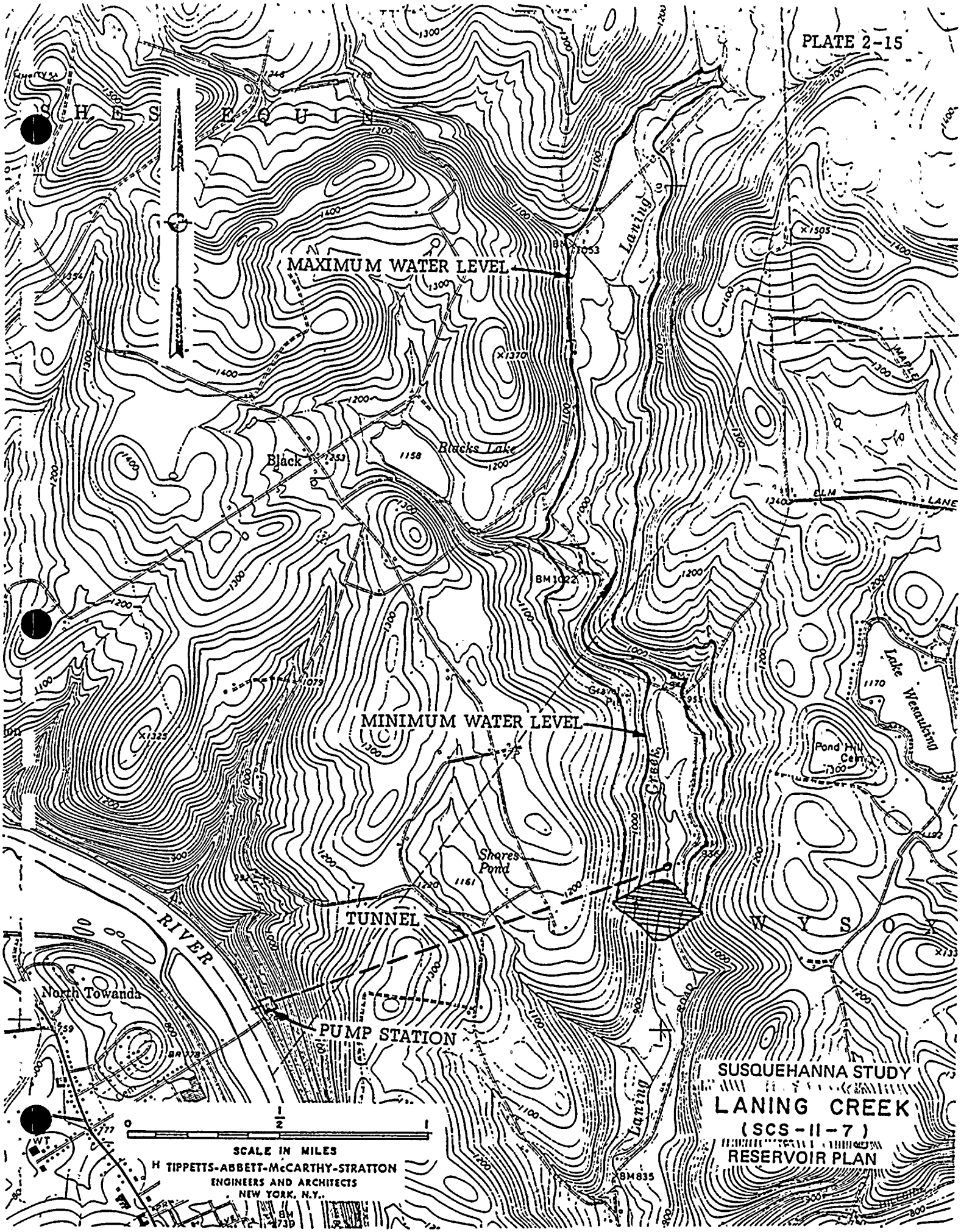
PLATE 2-15
MAXIMUM WATER LEVEL
MINIMUM WATER LEVEL
Laning Creek
Blacks Lake
Shores Pond
Lake Weaubing
TUNNEL
PUMP STATION
RIVER
North Towanda
SUSQUEHANNA STUDY
LANING CREEK
(SCS-11-7)
RESERVOIR PLAN
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

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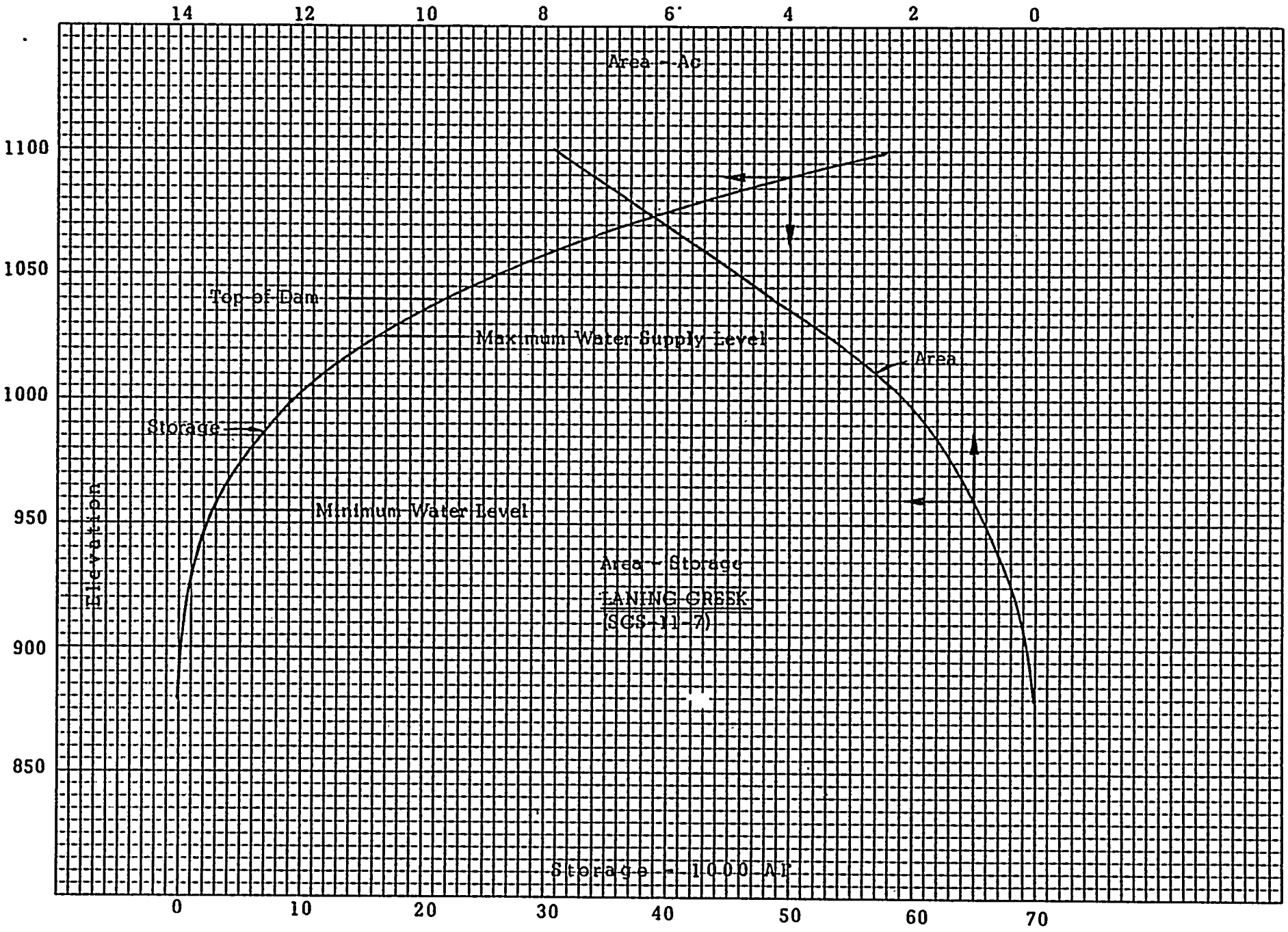

Plate 2-16

Salem Creek (T-OD 08-2A)

This site is located in Salem Township, Luzerne County, three miles east-northeast of the City of Berwick (north end of bridge). The extent of the reservoir and the location of the damsite is shown on Plate 2-17. An area-storage curve is shown on Plate 2-18.

The drainage area of Salem Creek above the damsite of 3.2 square miles, is too small to develop any substantial yield. This study assumes that the augmentation yield is developed by pumping from the Susquehanna River. The pump station would be located at the mouth of Salem Creek and would connect to the reservoir via a pipeline about 1.7 miles long.

Salem Creek below the dam has a limited capacity. It is assumed that most of the augmentation releases will be made through the pipeline to the river. Releases for conservation purposes and part of the augmentation needs not exceeding the existing capacity would be made to the downstream channel.

This site requires an extra large dam to provide the required storage.

The reservoir is long, narrow and deep. The area is mostly second growth undeveloped land and land takings would not be extensive. A bridge is provided for the secondary road which crosses the upper end of the reservoir area. The transmission line which crosses the upper end would be raised to provide not less than the minimum clearance required above the maximum reservoir level. No other relocations are apparent.

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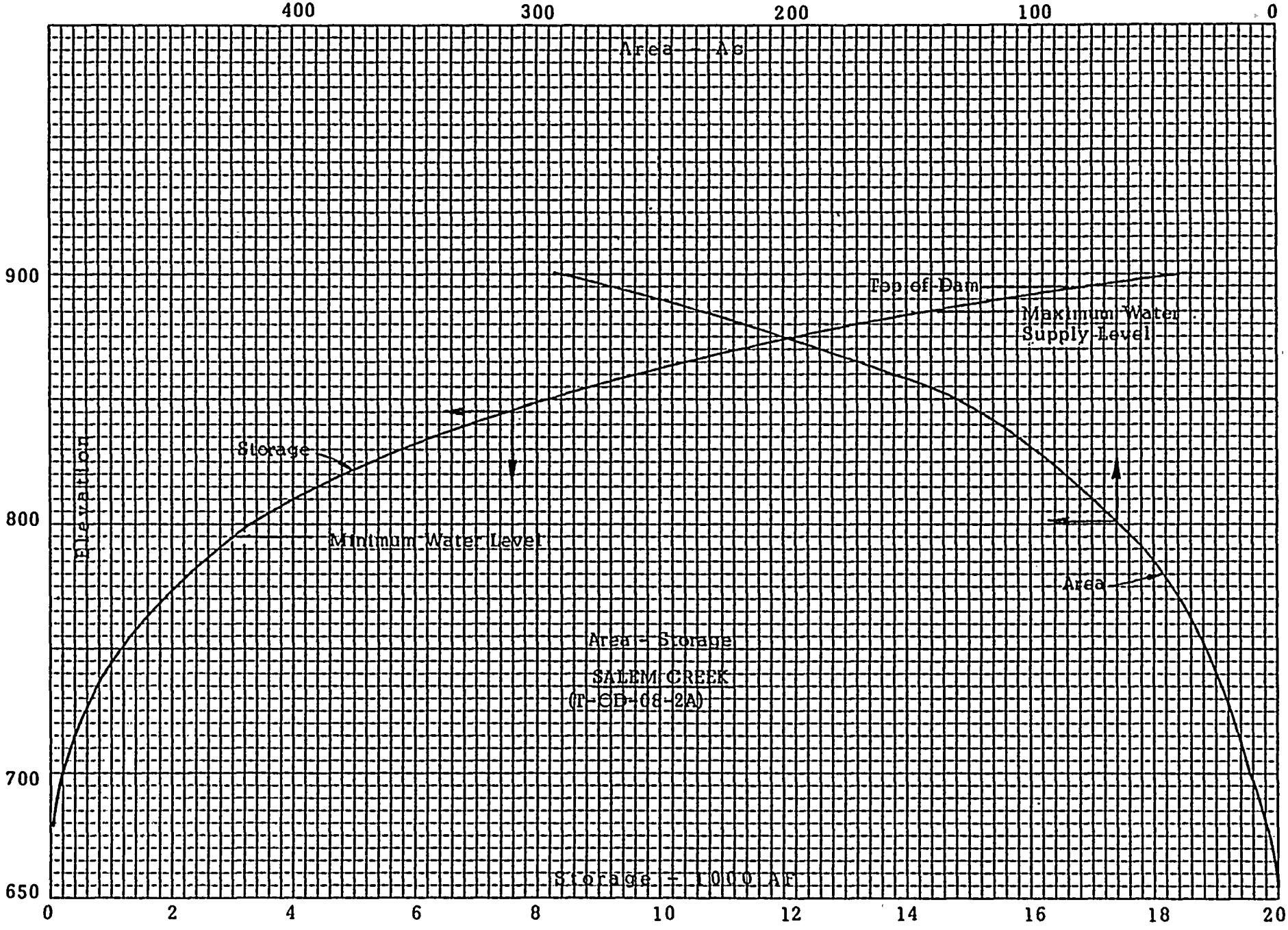


Plate 2-18

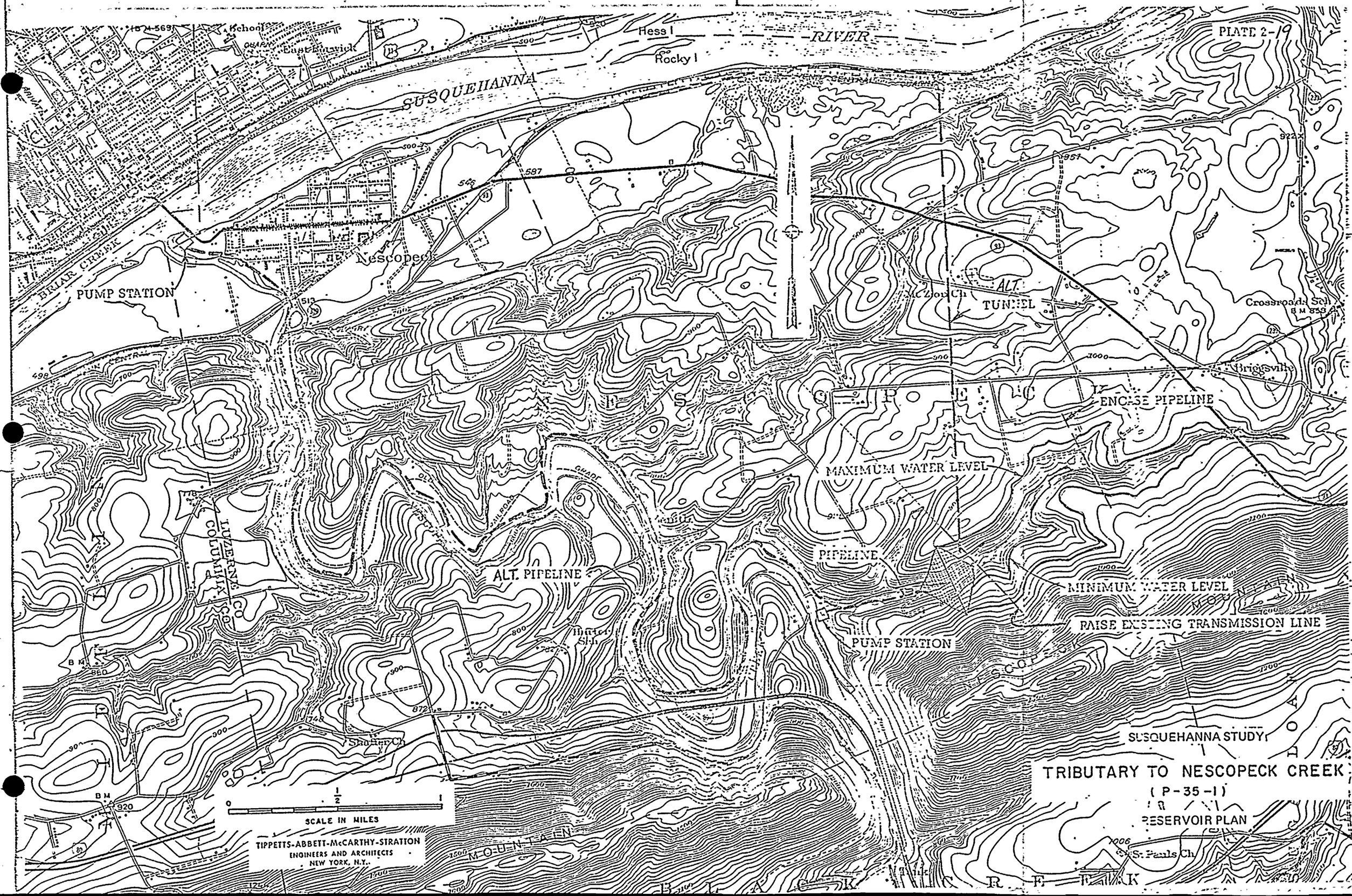
Tributary to Nescopeck Creek (P-35-1)

This site is Nescopeck Township, Luzerne County about 4 miles southeast of the Borough of Nescopeck (south end of bridge). The extent of the reservoir and the location of the damsite is shown on Plate 2-19. An area-storage curve is shown on Plate 2-20.

The drainage area of the stream above the damsite is 2.2 square miles and is too small to develop any substantial yield. This study assumes that the entire yield is developed by pumping from the Nescopeck Creek. The pump station is located at the confluence of the tributary to Nescopeck Creek and connects to the reservoir by a pipeline 0.75 miles long. When refilling the reservoir during the critical period, the flow in Nescopeck Creek would not be reduced below the estimated long term median flow. Because of the limited channel capacity, releases except for conservation purposes would be via the pipeline to Nescopeck Creek.

Two alternative water conductors were considered. One was a 2.25 mile long tunnel connecting the reservoir to the Susquehanna River. The second was a pipeline, 7.75 miles long, which follows the alignment of Nescopeck Creek to the Susquehanna River.

The reservoir is small, narrow and deep. The area appears to be farm and second growth undeveloped lands. Land requirements are not extensive. A medium size transmission line which crosses the reservoir would be raised to provide not less than the minimum clearance required above the maximum water level. A pipeline crossing the reservoir area would be rebuilt as an underwater pipeline. No other relocations are apparent.


SUSQUEHANNA RIVER
Hess I
Rocky I
East Berwick
School
BM 569
Nescopeck
BRIAR CREEK
PUMP STATION
ALT. TUNNEL
Crossroads Sch
BM 853
Briggsville
ENCASE PIPELINE
MAXIMUM WATER LEVEL
PIPELINE
ALT. PIPELINE
LUZERNE CO
COLUMBIA CO
Shafer Ch
Shafer Sch
MINIMUM WATER LEVEL
RAISE EXISTING TRANSMISSION LINE
PUMP STATION
SUSQUEHANNA STUDY
TRIBUTARY TO NESCOPECK CREEK
(P-35-1)
RESERVOIR PLAN
St. Pauls Ch
M-O-U-N-T-A-I-N
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

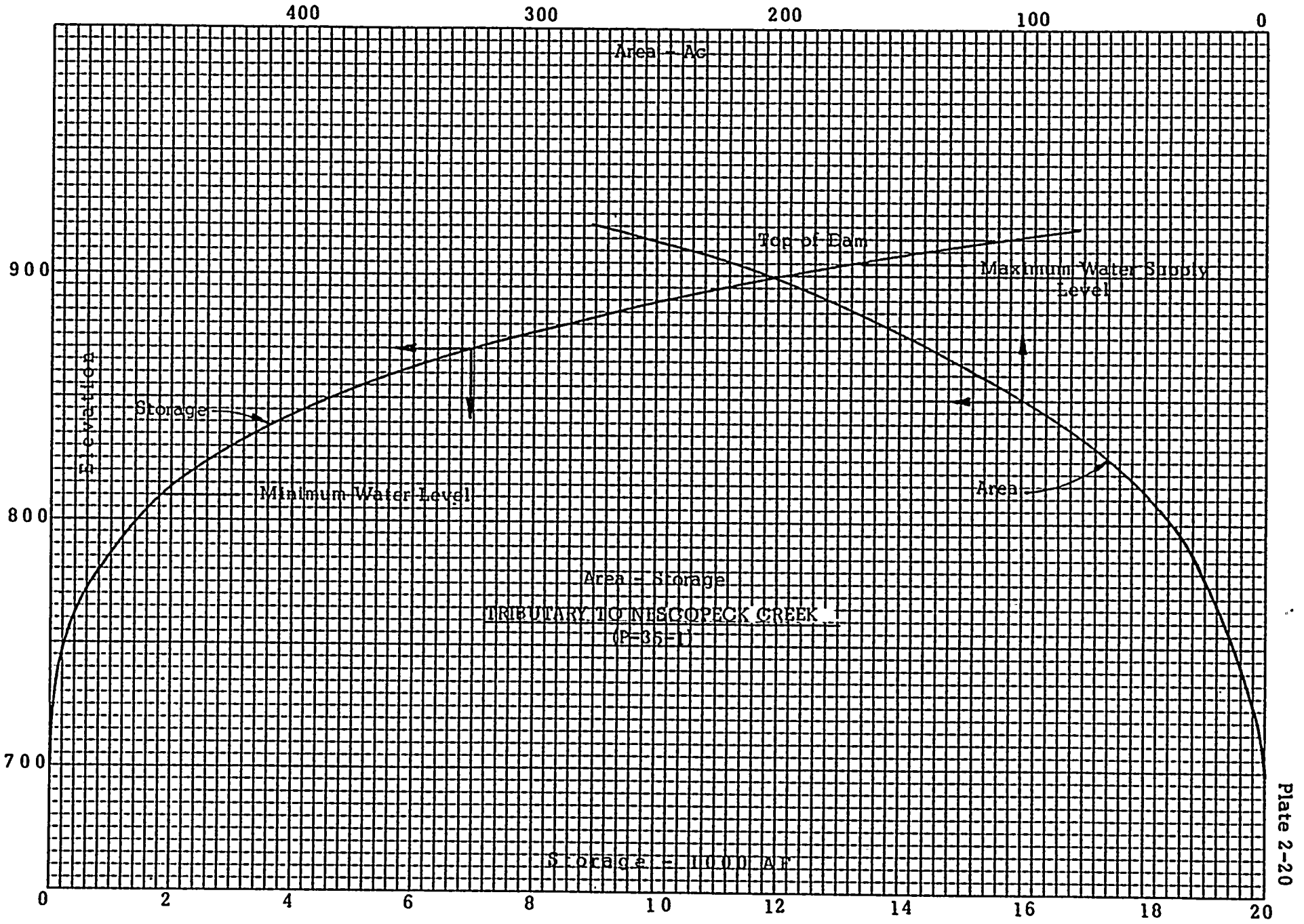


Plate 2-20

Pond Creek (P-07-02)

This site would be located in Conyngham Township, Luzerne County, on Pond Creek, a tributary to Little Wapwallopen Creek. The damsite is about 7.5 miles east-northeast from the City of Berwick. Plate 2-21 shows the location of the damsite and the extent of the reservoir. Plate 2-22 is an area-storage curve for the reservoir.

The drainage area of Pond Creek above the damsite is 9.6 square miles. About 16 cfs of augmentation flow can be developed from the drainage area. The remaining requirement of 34 cfs would be developed by pumping from Little Wapwallopen Creek at its confluence with Pond Creek. A pipeline about 1/2-mile long would connect the pump station to the reservoir. Conservation releases would be made to the downstream channel. Augmentation releases would be made through this pipeline to Little Wapwallopen Creek.

Pumping from Little Wapwallopen Creek would have reduced its flow during the critical refilling period at times to the minimum required for conservation purposes. It is estimated that pumping would have caused this to occur only in one year during the period of record. An alternative would be to locate the pump station at the Susquehanna River.

The reservoir would be small, compact and deep. The area appears to consist almost entirely of second growth undeveloped land. The amount of land needed for the reservoir would not be large. The secondary road which crosses the upper end of the reservoir would be relocated in order to maintain the existing access in the general vicinity. The transmission lines near the damsite would be raised to provide not less then the minimum clearance required above the maximum water level. The pipeline through the reservoir area would be rebuilt as an underwater crossing.

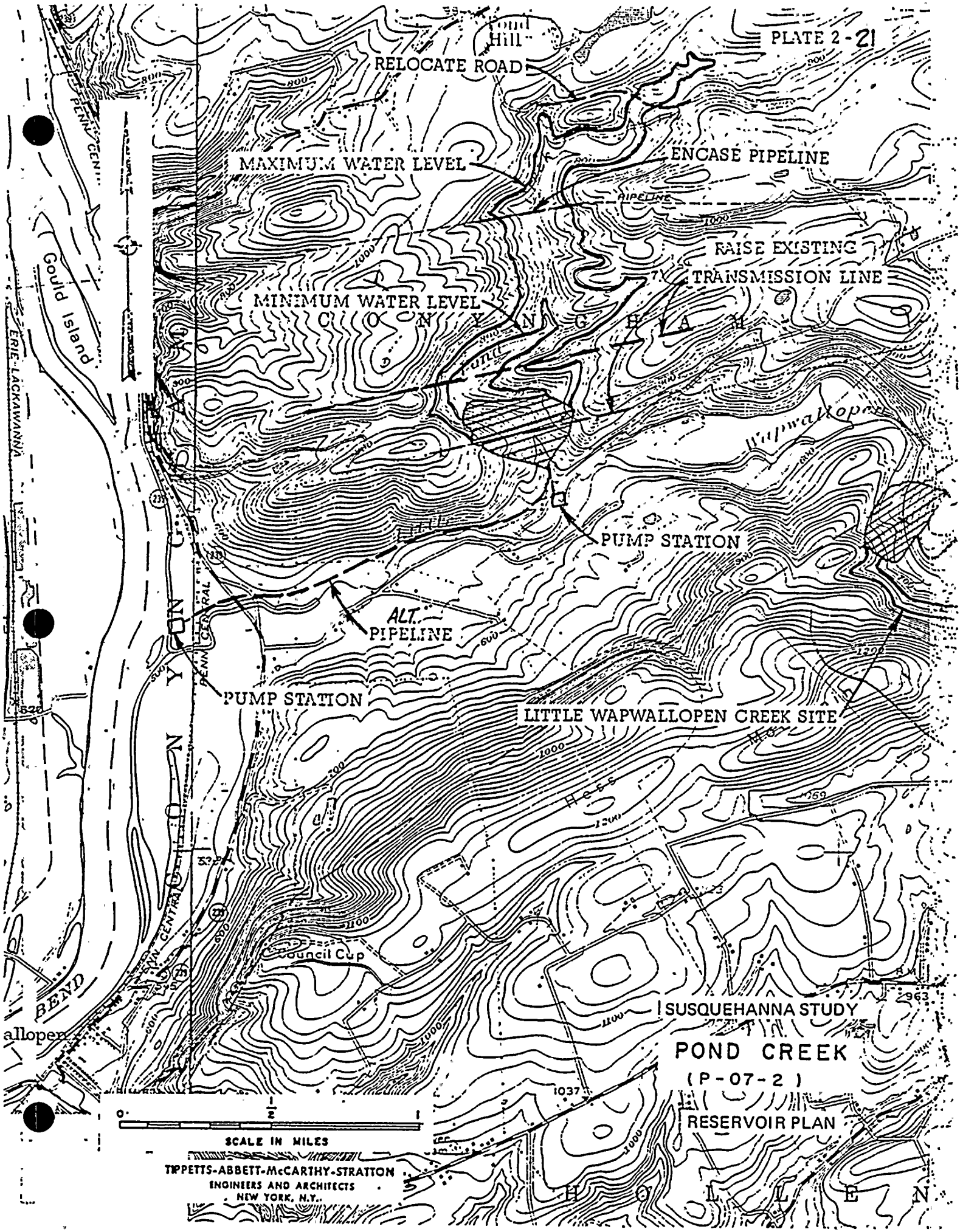


PLATE 2-21
RELOCATE ROAD
MAXIMUM WATER LEVEL
ENCASE PIPELINE
PIPELINE
RAISE EXISTING
TRANSMISSION LINE
MINIMUM WATER LEVEL
CONYNGHAM
Gould Island
ERIE-LACKAWANNA
PENN CEN
Wapwallopen
PUMP STATION
ALT.
PIPELINE
PENN CENTRAL
PUMP STATION
LITTLE WAPWALLOPEN CREEK SITE
Council Cup
SUSQUEHANNA STUDY
POND CREEK
(P-07-2)
RESERVOIR PLAN
BEND
allopen
SCALE IN MILES
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
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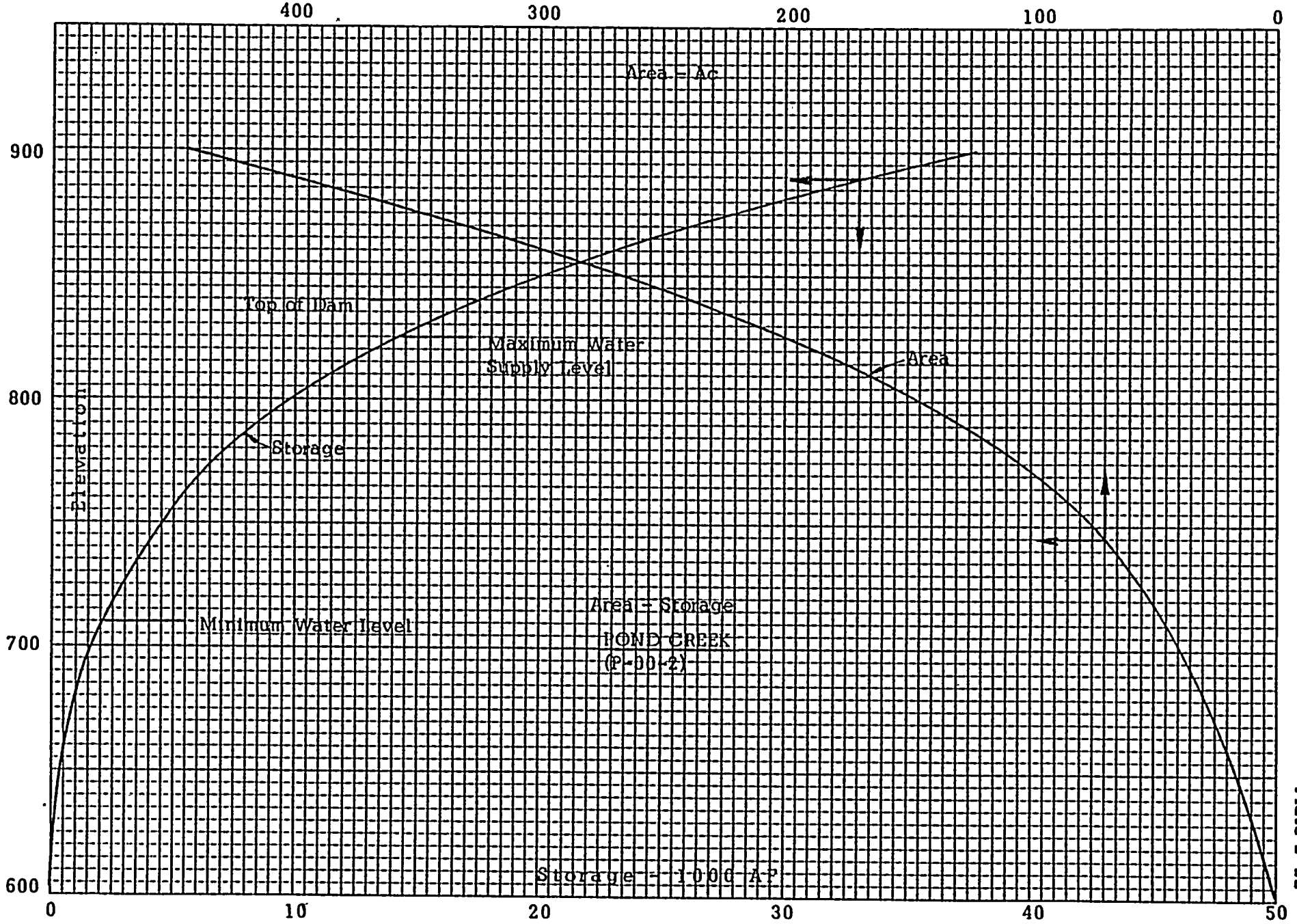

Plate 2-22

Little Wapwallopen Creek (SCS-07-8A)

This site would be partly in Conyngham, Dorance and Hollenback Townships, Luzerne County. The damsite is about 8 miles east-northeast of the City of Berwick. Plate 2-23 shows the location of the damsite and the extent of the reservoir. An area-storage curve is shown on Plate 2-24.

The drainage area of Little Wapwallopen Creek at the damsite is 27 square miles. Approximately 54 cfs can be developed from the natural flow for augmentation releases. No pumping would be required.

Little Wapwallopen Creek is classified by the Pennsylvania Fish Commission as a good trout stream. The release-refill pattern estimated for the design drought would reduce the downstream flow at times to the minimum required for conservation purposes. However, under normal hydrologic conditions an operating schedule could be established which would complement fish stocking. It would consist of the following:

1. When the reservoir is full, release all inflows. This would normally cover the period March through June.

2. In July and August make conservation and augmentation releases as required.

3. After August when it is apparent that hydrologic conditions are normal, make all required releases and maintain a minimum downstream flow equal to the reservoir inflow or the median flow which ever is least. Store all inflows in excess of the median until the reservoir has completely refilled.

This site requires an extra large dam to provide the required storage. The reservoir area appears to consist mostly of second growth undeveloped land. Real estate needs would not be extensive. It is assumed that the secondary road which crosses the reservoir can be abandoned without affecting existing traffic patterns in the area. The transmission line along the left rim of the reservoir will be raised to provide not less than the required minimum clearance above the maximum water level. No other relocation needs are apparent.

PLATE 23

SLOCUM

RAISE EXISTING TRANSMISSION LINE

POND CREEK SITE

PIPELINE

CONYNGHAM

MAXIMUM WATER LEVEL

MINIMUM WATER LEVEL

Wapwallopen

Little

Hunt

Hess

Good Sch

Council Cup

Hobb

Penn Central

Erie-Lackawanna

Gould Island

Blvd

Grave Cem

HOLLENBACK

SCALE IN MILES

0 1/2 1

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ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

SUSQUEHANNA STUDY

LITTLE WAPWALLOPEN CREEK

(SCS-07-8A)

RESERVOIR PLAN

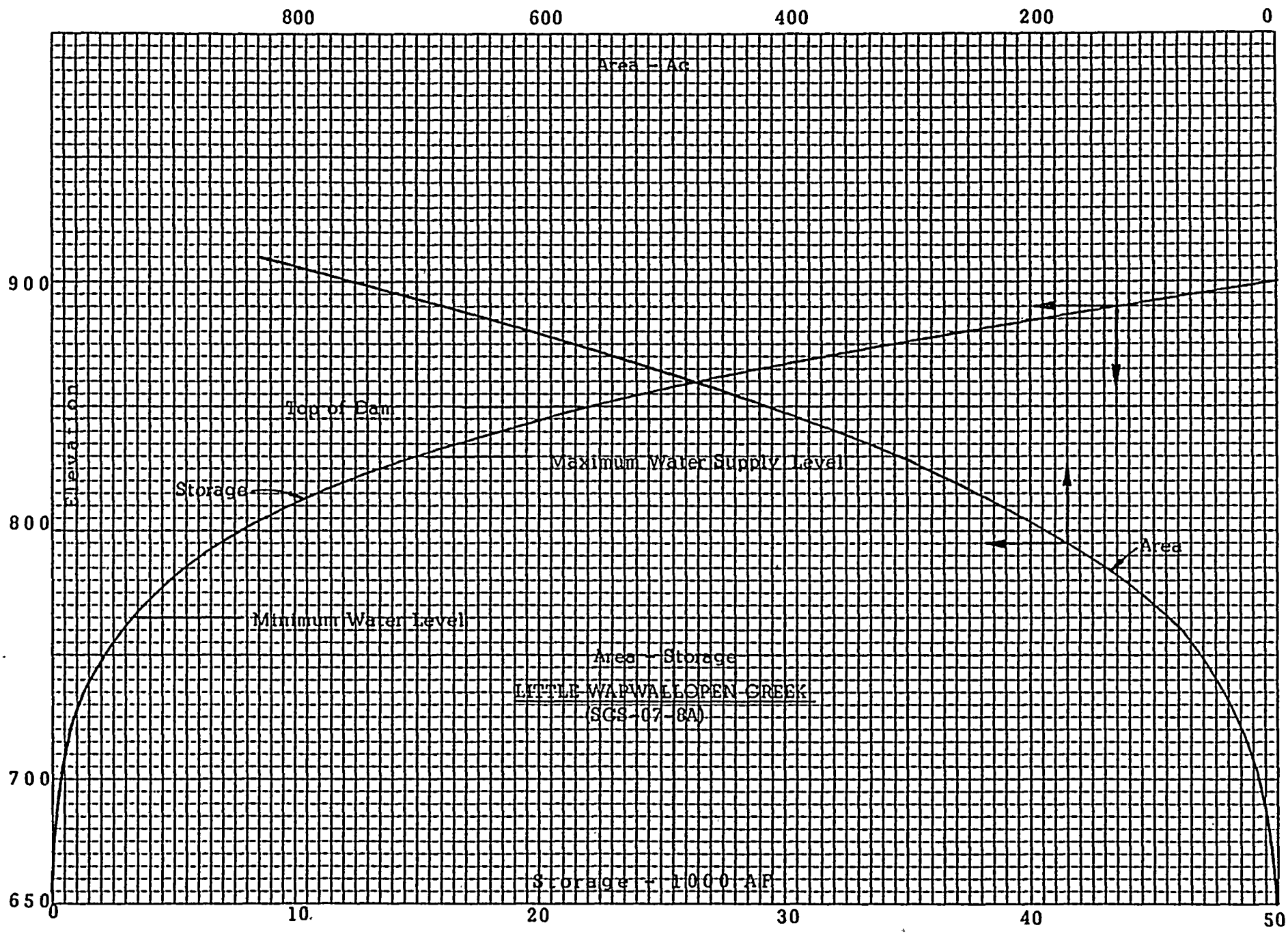

Plate 2-24

Pond Hill (POD-07-1)

This project would be located in Conyngham Township, Luzerne County, on a small tributary to the Susquehanna River near the Village of Pond Hill. The damsite would be about one mile southeast of the Village of Mocanaqua. The location of the damsite and the extent of the reservoir is shown on Plate 2-25. An area-storage curve is shown on Plate 2-26.

The drainage area of the stream upstream of the damsite is 1.2 square miles. As the flow from this drainage area is negligible, the yield for the project would be developed by pumping from the Susquehanna River. The pump station would be located about 0.8 miles south of the Village of Mocanaqua. A pipeline 0.50 mile long would connect the pump station with the Reservoir. An alternative to the pipeline would be a tunnel approximately the same length.

The proposed project is based on developing 13,500 acre-feet of storage which would yield 50 cfs of augmentation flow. The maximum storage capacity of the site as limited by topography is about 25,000 acre-feet which could yield about 100 cfs for augmentation purposes.

The reservoir would be small and compact. The area appears to be second growth undeveloped wood lands. Right-of-ways needs are not extensive. There are apparently no roads or utilities within the reservoir requiring relocations.

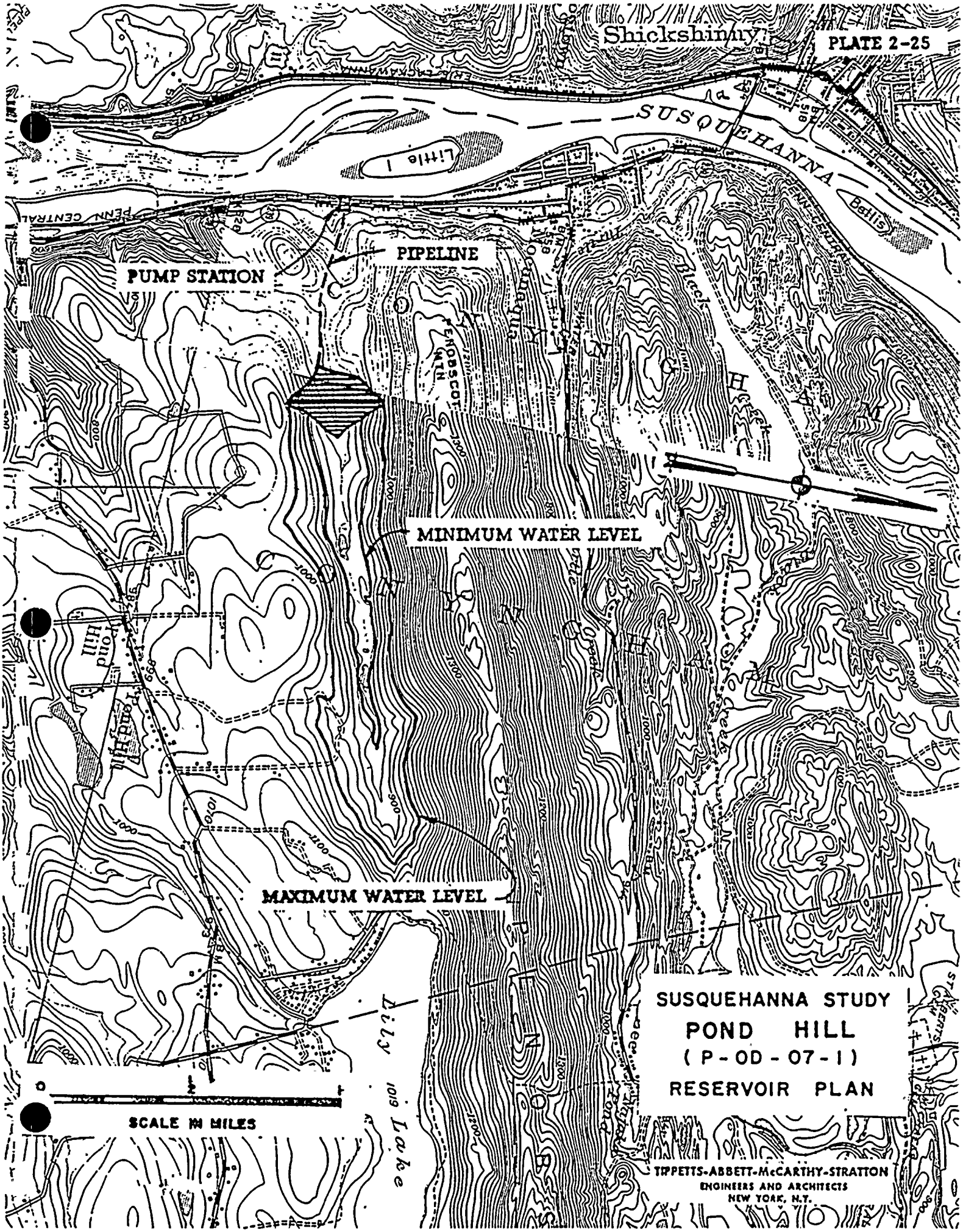
PLATE 2-25
Shickshinny
SUSQUEHANNA
PENN CENTRAL
PIPELINE
PUMP STATION
MINIMUM WATER LEVEL
MAXIMUM WATER LEVEL
Pond Hill
Lily Lake
SCALE IN MILES
SUSQUEHANNA STUDY
POND HILL
(P-OD-07-1)
RESERVOIR PLAN
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.

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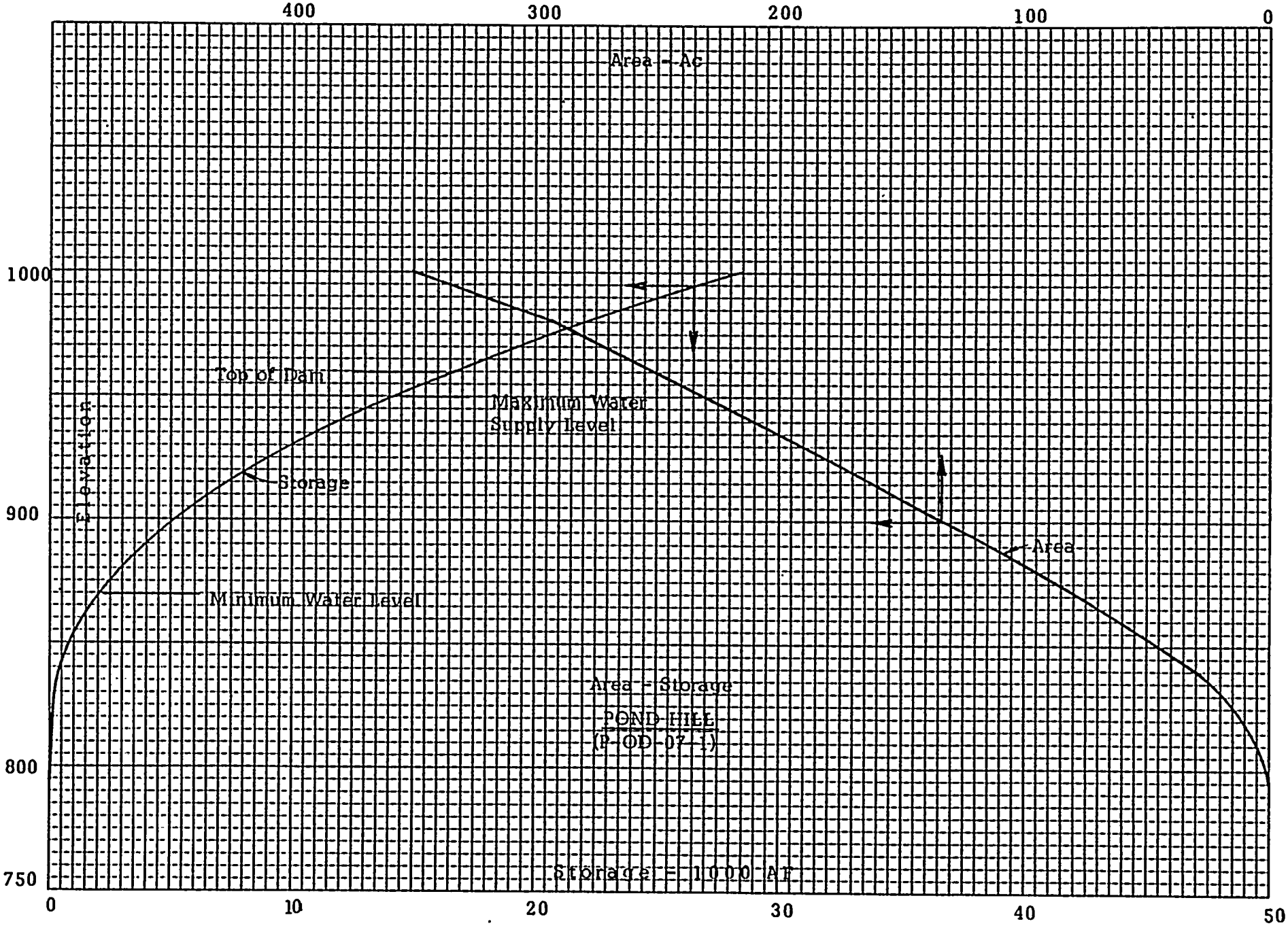


Plate 2-26

Tributary to South Branch, Newport Creek (POD-07-3)

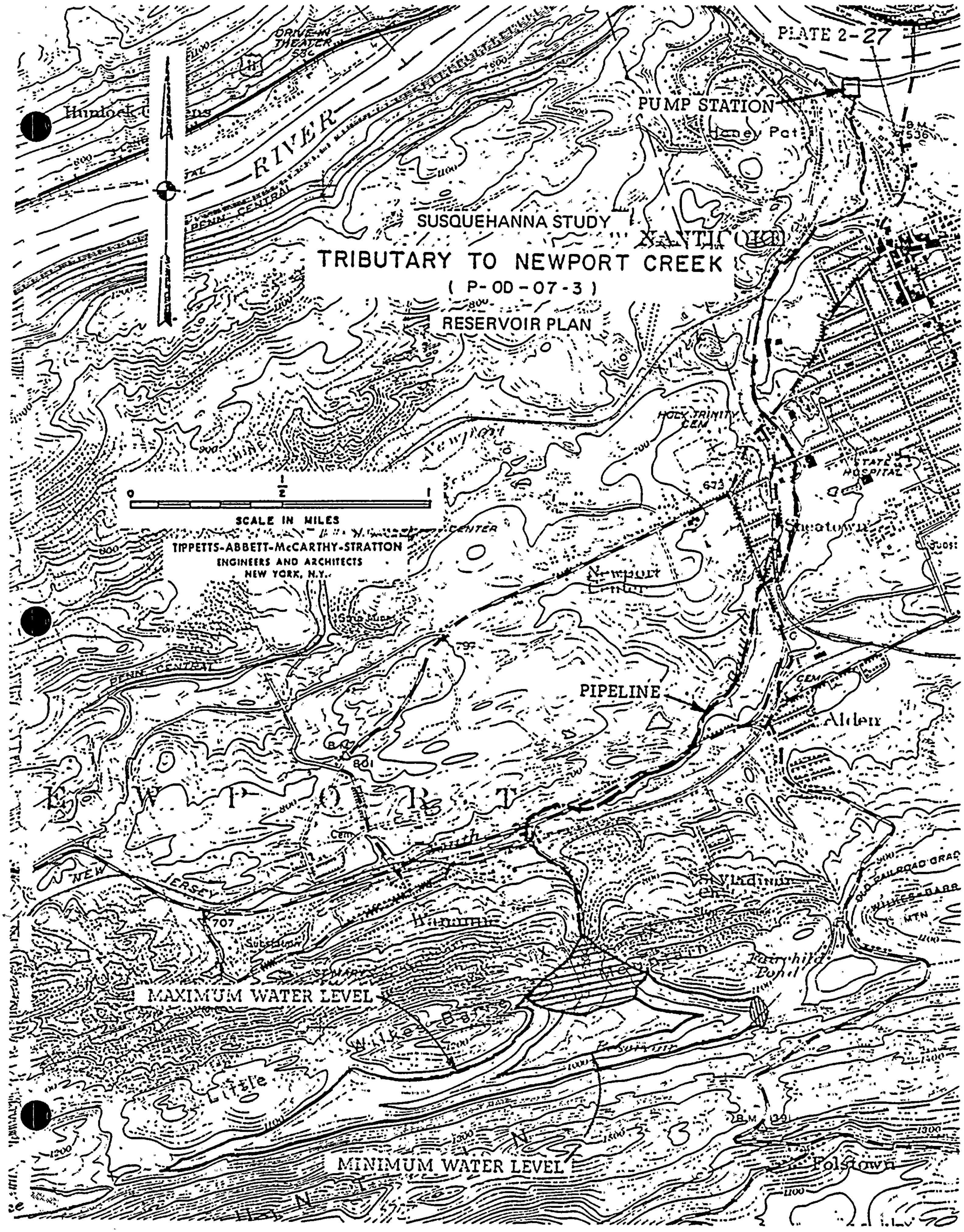
This project would be located in Newport Township, Luzerne County, about 2.7 miles south-southwest of the City of Nanticoke. The location of the damsite and the extent of the reservoir is shown on Plate 2-27. An area-storage curve is shown on Plate 2-28.

The drainage area of the stream above the dam is 1.1 square miles. The runoff from this area is negligible. Pumping from the Susquehanna River would be necessary to develop the required yield. The pump station would be located on the Susquehanna River near the mouth of Newport Creek. A pipeline four miles long, following the stream alignment would connect the reservoir with the pump station. Normally releases, except for conservation needs, would be made through the pipeline to the river.

The proposed site now contains a small water supply reservoir. It is adjacent to an area where both surface and deep coal mining has taken place. The surface mining extends right up to the damsite. The extent of the underground mining is not known. The damsite is located over an existing waterfall approximately 25 feet high.

An extra large dam is required at this site to develop the needed storage. Also there are two low areas near the maximum water level where weathering of the existing ridge might have taken place. Further investigation of the geology of this area is needed to establish the technical suitability of this site. A boring program will be needed to establish the extent of the deep mining, water highness of the reservoir, the depth of weathering in the low ridges and the degree of foundation treatment which might be required.

The reservoir area is completely undeveloped except for the small water supply reservoir. Land requirements are small. No relocation needs are apparent.


SUSQUEHANNA STUDY
TRIBUTARY TO NEWPORT CREEK
(P-OD-07-3)
RESERVOIR PLAN
SCALE IN MILES
0
1/2
1
TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS AND ARCHITECTS
NEW YORK, N.Y.
PUMP STATION
PIPELINE
MAXIMUM WATER LEVEL
MINIMUM WATER LEVEL
RIVER
PENN CENTRAL
NANTICOKE
Newport Center
Alden
Sheatown
STATE HOSPITAL
HOLY TRINITY CEM
DRIVE-IN THEATER
NEW JERSEY
Wilkes-Barre
Little
Folstown

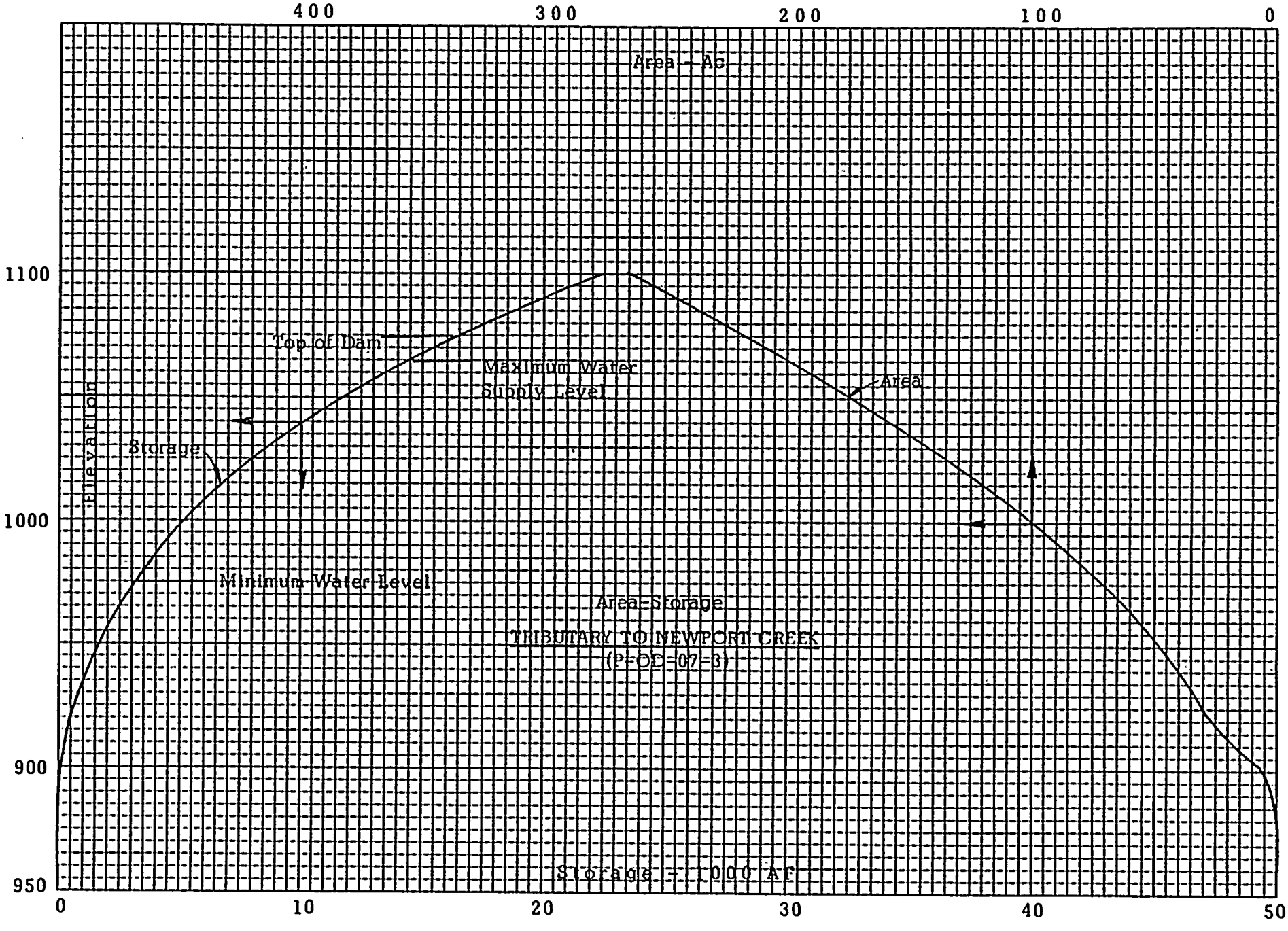


Plate 2-28

Cost

Construction Cost

An estimate of the project cost was prepared for each of the reservoirs. The cost for each site are compared on Plate 2-29. The estimates are based on the project layouts described above. In general, quantity take-offs were made for the large construction items (including lands and relocations) and extended with appropriate unit prices. The cost for the smaller items which could not be readily estimated was included in the unit prices. The unit prices reflect recent experience with similar types of projects within the northeastern region of the United States.

The following allowances were added to obtain project cost:

Contingencies	25%
Engineering, legal and other costs incurred by the owner	10%
Interest during construction	5%

Annual Cost

The annual cost of operation, maintenance and amortization of the project cost were computed for each reservoir. These costs are compared in Plate 2-29. The factors used in estimating these costs are outlined in Figure 1. The method used for the estimate is similar to that given in the Federal Power Commission's publication "Hydroelectric Power Evaluation, Supplement No. 1."

Variable operation and maintenance costs for pumping stations were based on the following data which is similar to data for hydroelectric plants given in the FPC publication (Table 37). That data has been increased by 50% to reflect price increases.

FIGURE 1

ANNUAL COST FACTORS

Item	Annual Rate as a Percent of Initial Cost
Land and Relocations	
Cost of Money, Depreciation, Operation, Maintenance, Insurance, Taxes (Local and Federal)	17.5%
Civil Works	
Cost of Money, Depreciation, Insurance and Interim Replacements, Operation and Maintenance, Taxes (Local and Federal)	17.5%
Pump Station	
Cost of Money, Depreciation, Insurance and Interim Replacement, Taxes (Local and Federal)	17.5%
Operation and Maintenance	Variable
Power Cost	Vairable

Installed Capacity (kilowatts)	Annual Expenses Excluding Energy Costs for Operation (Dollars per kilowatt of installed capacity)
2500	14.70
5000	11.80
7500	7.20
10000	5.50
15000	4.20
20000	3.80

The annual power cost for each pump-in reservoir was based on operating the pump station, on the average, one month each year. Included in this average is the pumping necessary to refill the reservoir each year, and an allowance for scheduled operation for maintenance purposes. An average energy cost of $0.025 per kilowatt hour was assumed.

Susquehanna Reservoir Study
Summary of Costs

Project Cost	Graves Pond Creek (P-OD-09-1)	Little Meshoppen Creek (T-10-10A)	Riley Creek (SCS-10-17A)	Butler Creek (T-38-100A)	Idlewild Creek (SCS-38-11)	Fargo Creek (P-OD-10-1)	Laning Creek (SCS-11-7)
Land and Land Rights	$ 1,060,000	$ 1,240,000	$ 1,680,000	$ 2,300,000	$ 840,000	$ 970,000	$ 1,350,000
Relocations	800,000	990,000	1,220,000	430,000	250,000	920,000	100,000
Dam	8,422,000	4,375,000	4,138,000	6,240,000	8,440,000	14,175,000	8,111,000
Spillway	2,054,000	4,042,000	4,183,000	4,440,000	4,240,000	3,640,000	4,798,000
Service Outlet	2,600,000	1,800,000	1,950,000	2,030,000	2,030,000	1,800,000	2,500,000
Pumpstation	3,200,000	2,700,000	2,800,000	2,000,000	2,000,000	3,100,000	2,200,000
Tunnel and/or Pipeline	1,650,000	2,350,000	2,430,000	3,070,000	1,360,000	2,190,000	5,250,000
Miscellaneous	1,800,000	1,600,000	1,800,000	1,600,000	1,710,000	2,300,000	2,330,000
Subtotal	21,586,000	19,097,000	20,200,000	22,110,000	20,870,000	29,095,000	26,639,000
Contingencies, etc.	10,514,000	9,503,000	10,100,000	11,090,000	10,430,000	14,605,000	13,261,000
Total	$32,100,000	$28,600,000	$30,300,000	$32,200,000	$31,300,000	$43,700,000	$39,900,000
Annual Cost							
Total	$ 5,750,000	$ 4,960,000	$ 5,390,000	$ 5,870,000	$ 5,560,000	$ 7,770,000	$ 7,080,000
Pumping	$ 72,000	$ 57,000	$ 40,000	$ 36,000	$ 32,000	$ 70,000	$ 36,000

Susquehanna Reservoir Study

Summary of Cost

Project Cost	Salem Creek (T-OD-08-2A)	Tributary to Nescopeck Creek (P-35-1)	Pond Creek (P-07-2)	Little Wapwallopen Creek (SCS-07-8A)	Pond Hill (P-OD-07-1)	Tributary to South Branch Newport Creek (P-OD-07-3)
Land and Land Rights	$1,060,000	$ 850,000	$ 670,000	$ 1,030,000	$1,160,000	$ 680,000
Relocations	750,000	560,000	1,600,000	500,000	50,000	50,000
Dam	16,350,000	11,860,000	14,820,000	10,427,000	8,955,000	14,417,000
Spillway	2,650,000	2,460,000	5,339,000	5,631,000	2,920,000	3,146,000
Service Outlet	2,250,000	3,150,000	3,250,000	1,500,000	2,700,000	2,250,000
Pumpstation	3,200,000	2,700,000	2,000,000	---	3,200,000	4,000,000
Tunnel and/or Pipeline	2,190,000	1,310,000	910,000	---	1,130,000	3,950,000
Miscellaneous	2,640,000	2,000,000	2,400,000	1,940,000	1,900,000	2,600,000
Subtotal	31,090,000	24,890,000	30,989,000	21,028,000	22,015,000	31,093,000
Contingencies, etc.	15,510,000	12,410,000	15,111,000	10,072,000	10,985,000	15,607,000
Total	$45,600,000	$37,300,000	$46,100,000	$31,100,000	$33,000,000	$46,700,000
Annual Cost						
Total	$ 8,280,000	$ 6,590,000	$ 8,180,000	$ 5,450,000	$ 5,920,000	$ 8,210,000
Pumping	$ 76,000	$ 52,000	$ 46,000	$ ---	$ 72,000	$ 112,000

CHAPTER 3

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CHAPTER 3

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Chapter 3

ENVIRONMENTAL ASSESSMENT

Introduction

This environmental assessment of thirteen potential reservoir sites in the Susquehanna River Basin is part of a screening process to identify a primary site which will be studied in detail prior to the final selection of a site for development. As such, this assessment is necessarily limited in its scope, and does not attempt to treat any particular environmental factor in detail. Rather, only those areas associated with reservoir development which were felt to be of particular importance or to have potentially significant impacts were identified and briefly analyzed.

Each site was analyzed according to eleven factors: number of residential units within the site; amount of residential development below the proposed dam site; amount and type of agricultural activity affected; agricultural capability classification of soils within site; length of stream inundated; quality of the affected stream's fishery; water quality of the reservoir's water source (this will directly affect the reservoir's potential water quality); potential impact on pumping source (with particular emphasis on proportion of total flow to be pumped and fishery quality); a qualitative judgment of the wildlife habitat within the site relative to the other sites studied; length and type of water conduit (i.e. pipeline or tunnel) and character of area which would be traversed by a pipeline; and area exposed by maximum drawdown (this is directly related to the size and shape of the reservoir).

In order to preserve confidentiality, the data on which this analysis was based was limited to that contained in easily obtainable public documents. A list of documents consulted is presented in the list of references following this chapter. In addition to a literature review, a two-day reconnaissance was made of the 13 sites in late November, 1976 to assess the general character of each site.

Two major assumptions were made to facilitate the evaluation of the sites considered:

a) Because of the difficulties involved in accurately estimating total land requirements for each site at this stage of study, a site was defined

as that area bounded by the topographic contour at the elevation of the top of the dam. In all cases this elevation is five feet above maximum water level. The elevations used are shown on Table 2-2.. It is within this area that the analysis of such things as residential relocations and land use is focused. A plan of each reservoir showing the extent of the maximum water level is given in Chapter 2.

b) Construction impacts were assumed to be essentially similar for each site, with the exception of the water conduit route which is treated separately for each site.

The following descriptive site analyses present a brief discussion of each site's suitability for reservoir development.

GRAVES POND

Land Use and Development.

The Graves Pond site is located in the extreme northwest corner of Wyoming County. The site is similar in its land use mix to the county as a whole, with approximately 30% of the site area devoted to agricultural use and the remainder wooded. The agricultural activity is located in the upper portion of the site, and is mainly cropland. The generalized agricultural capability classification for the cultivated area is Class III, which is the predominant classification for this section of the county. The project will directly affect a total of approximately 300 acres, with 90 acres of agricultural land and 210 acres of forest area impacted. Graves Pond would affect the greatest amount of active agricultural land of any site studied.

The only residential development in the site is located along a local road which skirts the northern edge of the site. Three or four residential relocations may be required.

There are approximately 5-8 residences located below the proposed dam site. Most of these homes are over a mile away and the dam will probably not be visible to their inhabitants.

Natural Resources

Graves Pond Creek is a very small stream which probably flows intermittently during dry periods. The stream is not stocked or listed as a fishery by the Pennsylvania Fish Commission Approximately 1.5 miles, or 50% of the total length of the stream will be inundated. In that there are no obvious pollution sources in the drainage basin, it is assumed that the existing water quality of the stream is good, with the exception of some possible pollution from farm runoff.

All of the water for this site will be pumped from the Susquehanna River. According to the Pennsylvania Department of Environmental Resources, water samples taken from this section of the River consistently

contain excesses of total dissolved solids and iron, and the one observation available shows a very high total coliform level. Based on this information the water quality of the river in this area could be termed fair to good (see Table 3-1).

Pumping at this site will never exceed 7% of the flow in the Susquehanna, and at most times it will be much less than this.

Wildlife habitat at this site is of about average quality when compared with the other sites surveyed.

Other Factors

The water will be pumped from the river through a tunnel; thus, the impacts of constructing the water conduit will be relatively minor.

Drawdown at Graves Pond is about average for the sites studied, with 180 acres of the total inundated area exposed in a maximum year.

LITTLE MESHOPPEN CREEK

Land Use and Development

Little Meshoppen Creek is located in northwestern Wyoming County and extends into southwestern Susquehanna County. The site is in a mixed agricultural and wooded area similar to Graves Pond, with approximately 40-50% of the watershed devoted to active agricultural use. The site itself, however, is much more wooded in character, with only about 5% of the site under cultivation. The site is in a long and narrow valley, which follows the creek for approximately 2.5 miles. The valley floor is mixed woodland and old fields with valley walls mainly wooded.

Approximately 370 acres of land would be directly affected by this project and, of this, only an estimated 20 acres is under active cultivation.

The land within the site is predominantly (80%) Class IV-VIII agricultural capability, which is considered land of poor productivity. There is, however, a small section (20%) of the upper end of the site which is rated Class II and III.

Residential activity within the site is limited, with approximately 4-5 homes scattered through the site. Most of these homes appear to be former farm houses which are now used as rural non-farm residences. There is a significant amount of residential development below the dam, with 3-4 homes within sight of the structure and the Borough of Meshoppen about 1.5 miles downstream.

Natural Resources

Little Meshoppen Creek is a medium to small stream which is approximately nine miles long and includes three small ponds in the upper half of its reach. Approximately 2.75 miles of the stream would be inundated, but none of the three ponds would be affected by the project. The stream was stocked with brook and brown trout during the middle fifties, but was last stocked in 1958. During the period in which it was stocked, 17,550 fingerling trout were placed in the stream. Several beaver ponds were observed along the stream during the site reconnaissance.

The quality of the water in Little Meshoppen Creek is assumed to be good due to the lack of pollution sources other than agriculture in its watershed. Approximately 80% of the water in this reservoir would be pumped in from Meshoppen Creek near its confluence with the Susquehanna River. Although stocking takes place approximately one mile upstream from the confluence of the Creek and the River, this section of Meshoppen Creek is not stocked, and the Creek's flow would not normally be reduced below the long-term median flow.* Water quality in Meshoppen Creek at this point is assumed to be good, due to the fact that trout are stocked in the area directly above the pumping point.

The mixed character of this site's wildlife habitat, including the presence of beaver, results in its being classed as having somewhat above average wildlife habitat relative to the sites reviewed.

Other Factors

The pump-in water conduit for this project runs to the confluence of Meshoppen Creek and the Susquehanna, and is approximately 1.8 miles long. It would go through the Borough of Meshoppen, and may cause some disruption to the area during construction.

Drawdown at this site would expose a greater than average area in comparison to the other sites studied. Approximately 210 acres would be exposed in a maximum year.

* Conversations between PP&L and the Pennsylvania Fish Commission indicate that the Fish Commission believes it desirable not to reduce flows in designated trout fishing streams below the natural long-term median flow.

RILEY CREEK

Land Use and Development

Riley Creek is long and narrow, surrounded by mixed agriculture and wooded areas, with most of the site itself either wooded or abandoned agricultural land. Approximately five percent or 25 acres of the site's 465-acre, direct-impact area is currently under cultivation. The soils in the site area are about ten percent Agricultural Capability Class II and III, and ninety percent Class IV-VIII.

Residential development in the site is limited, with three to four homes which may be directly affected. Development below the dam is also limited, with only scattered residences between the reservoir site and the Borough of Meshoppen approximately five miles downstream.

Natural Resources

Riley Creek is a small stream, approximately eight miles in length, which joins with the West Branch of the Meshoppen Creek about 1.5 miles below the proposed dam site. Approximately 2.5 miles of Riley Creek would be inundated by this project. Riley Creek was an approved trout stream and was stocked from 1932 to 1954, when it was removed from the approved list after public access became difficult because of posting. There is every reason to believe, however, that the stream remains of good quality and may support some trout. This is particularly true given the continued stocking of the West Branch of Meshoppen Creek.

The water quality of both Riley Creek and Meshoppen Creek (which would serve as the pumping source), is probably good. Although no recent data on the water quality of Riley Creek is available, there is no reason to believe it has changed for the worse since the years when it was stocked.

Meshoppen Creek is currently stocked with trout in the stretch from which water would be pumped. It is rated as a medium quality, cold water fishery by the Pennsylvania Fish Commission. Approximately, 65 percent of the water required for filling the reservoir will be pumped from

Meshoppen Creek; however, pumping would not lower the creek below its long-term median flow.

Wildlife habitat at Riley Creek is rated as above average quality for the sites under consideration due to the fact that much of the site is uncultivated bottom land which provides a very diverse habitat when associated with the wooded hills. A related factor is the inclusion of approximately 50 percent of the land within and surrounding the site in the Pennsylvania Game Commission Farm-Game Cooperative Program.

The pump-in water conduit for this project will be a pipeline running approximately two miles to Meshoppen Creek just below the mouth of the West Branch of Meshoppen Creek. The area traversed is largely wooded with scattered residential development. It may be possible to follow the right-of-way of a local road for most of this distance.

Drawdown at Riley Creek would expose approximately 225 acres in a maximum year. This is an above average amount of drawdown exposure as compared to the other sites investigated.

BUTLER CREEK

Land Use and Development

Butler Creek is located in the southeastern quadrant of Susquehanna County. This section of the county is predominantly wooded, with some agricultural land scattered throughout the area. Susquehanna County as a whole is approximately 53% forest and 39% agricultural land.

This site contains approximately 20 % active agricultural land with the remainder uncultivated bottom land or wooded hills. Development of this site would directly affect approximately 450 acres of land, including about 90 acres of active agricultural land. The agricultural capability rating of the land in the site is estimated to be about 50% Class IV - VIII land, with the remaining land approximately 25% Class III and 25% Class II.

Approximately four residences in the site would be affected by this project. Downstream development is limited with only a few homes scattered along the valley below the dam.

Natural Resources

Butler Creek is a tributary to Nine Partners Creek, which in turn feeds into Tunkhannock Creek. Butler Creek is classed as a medium quality, cold water fishery, and until last year was stocked with brown and brook trout. It was deleted from the approved trout stocking list in 1976 due to posting. Approximately two miles or 20% of the total length of Butler Creek would be lost by the development of this site.

Approximately 46% of the total water required for filling this site would come from natural runoff, and the remainder would be pumped from Tunkhannock Creek near the mouth of Nine Partners Creek. Water quality in Tunkhannock Creek (see Table 3-1) is good. Pumping from Tunkhannock Creek would, at certain times, withdraw all of the flow in the creek except for a conservation flow of 0.15 cfs per square mile of the creek's drainage area. Tunkhannock Creek is rated as a high quality trout stream and is stocked by the Pennsylvania Fish Commission.

The wildlife habitat was rated as being of average quality and abundance at the Butler Creek site relative to other sites studied.

Other Factors

Water would be pumped to the site through a 2.75-mile pipeline from Tunkhannock Creek. This pipeline could follow existing road rights-of-way for most of its length, but it may be required to pass through an area of wetlands which have been identified as suitable for preservation by the Comprehensive Water Quality Management Plan for this area (Buchart-Horn, Inc.).

Drawdown in the Butler Creek site would expose a larger than average area for the sites studied with approximately 225 acres exposed in a maximum year.

IDLEWILD CREEK

Land Use and Development

Idlewild Creek is located approximately five miles southeast of Butler Creek in Susquehanna County. The site is surrounded by a mixture of agricultural and forested areas, but the site itself is approximately 90-95% forest or old fields. This project would directly affect a total of approximately 330 acres, with less than 30 acres of active agricultural land impacted. The generalized agricultural capability classification for the site area is about 20% Class II, 40% Class III, and 40% Class IV-VII.

There are only two to three houses within the site, and there is no development along the three-quarter mile of stream between the dam and the East Branch of Tunkhannock Creek. There is, however, scattered development along this section of the East Branch.

Natural Resources

Idlewild Creek is a small stream which is not currently stocked due to its small size (Pa. Fish Commission, 1977). It was, however, stocked with fingerling trout on at least two occasions; once in 1938 with 1750 brown trout, and once in 1952 with 600 brook trout.

Development of this project would result in the loss of approximately 2 miles or 50% of Idlewild Creek. Idlewild Lake, which feeds Idlewild Creek, would not be affected by this site's development.

Water for this site will be pumped from the East Branch of Tunkhannock Creek. The East Branch is a medium quality cold water trout stream which is currently stocked, (Pa. Fish Commission, 1977). Approximately 82% of the required water would be pumped from the East Branch, and and in a worst case condition this would result in the withdrawal of all the stream's flow, except a conservation flow of 0.15 cfs per square mile of drainage area of the East Branch. The water quality in Idlewild Creek is not known; however, there may be some pollution problems caused by development around Lake Idlewild. Available literature mentions a pollution problem in the East Branch, but the location, severity or cause of this problem is not known at this time (Buchart-Horn, Inc.).

Wildlife habitat along Idlewild Creek is about average for the sites considered.

Other Factors

The water conduit for this site is a pipeline which is very short (0.75 mile), and could follow the right-of-way of the eixsting local road in the valley.

Drawdown at Idlewild Creek would be about average for the sites studied with approximately 185 acres of the inundated area exposed in a maximum year.

FARGO CREEK

Fargo Creek is located in southeastern Bradford County and is long and narrow, with a mixture of agricultural land and woodlands surrounding the site. Land use in the site itself is about 15% active agriculture, which is concentrated at the upper end of the site, and the remainder either old fields or forest. The upper end of the site is rated as Class III Agricultural Capability, and the lower portion is rated as Class IV-VIII.

A total of approximately 330 acres would be directly affected by this project, including about 35 acres of active agricultural land, and 295 acres of non-agricultural land.

Residential development in the site is fairly active, with approximately seven homes now present, and several lots for sale. Downstream of the dam, there are several scattered residences with the village of Skinners Eddy approximately 1.5 miles below the site. In all, there are probably no more than 20 homes below the reservoir, with only two or three within sight of the dam.

Natural Resources

Fargo Creek, a tributary to Tuscarora Creek, is approximately seven miles long, and is currently considered too small for stocking by the Pennsylvania Fish Commission, (Pa. Fish Commission, 1977). The stream was stocked with fingerling brook trout in the years 1953-1956, and it is possible that trout continue to inhabit the creek. Approximately 2.0 miles of Fargo Creek would be inundated by this project.

All of the water for this project would be obtained from the Susquehanna; the water quality of the river in this area is considered fair to good, with high iron and total dissolved solids levels during certain periods, and the one observation available showing a high total coliform count (see Table 3-1). Pumping at this site will never exceed seven percent of the flow in the Susquehanna, and at most times it will be much less.

Other Factors

The water conduit for Fargo Creek would be a pipeline to the Susquehanna. This pipeline could follow the existing road right-of-way for approximately two miles to the river.

Drawdown at Fargo Creek would be above average for the sites studied with approximately 220 acres exposed in a maximum year.

LANING CREEK

Land Use and Development

Laning Creek is located in central Bradford County, in an area of mixed farming and woodlands. Bradford County is divided almost equally between woodland and agricultural land, with 48% of the land area devoted to forest and 47% to agriculture. This site is located in a long, narrow valley, and as such is predominantly woodlands and old fields, with only 10% of its surface area used for active agricultural cultivation.

The soils in the site are predominantly rated Class IV-VIII with the area surrounding the site rated as Class III land. The site would directly affect approximately 330 acres, or about 35 acres of active agricultural land.

Residential development in the site is somewhat more extensive than most sites, with approximately 8-10 homes which may be directly affected by the project. Several of the homes are new, and there is fairly extensive development below the dam.

Natural Resources

Laning Creek, which is also known as Little Wysox Creek, is a small, unstocked stream of approximately 10 miles length. The project would inundate 2.5 miles of the stream. Because there are no apparent pollution sources, the water quality of the stream is assumed to be good, with some agricultural runoff possible. Approximately 80% of the water required for this site would be pumped from the Susquehanna River. The Susquehanna at Towanda has water quality problems similar to those found downstream near Graves Pond and Fargo Creek. Iron and total dissolved solids levels are consistently high, and the one observation available shows a high total coliform count (see Table 3-1).

Pumping at this site would never exceed 50 cfs, or approximately seven percent of the total flow in the river.

Wildlife habitat at Laning Creek was rated as somewhat better than average for the sites studied with abundant deer habitat and several beaver dams observed.

Other Factors

Water would be pumped to this project through a tunnel, and thus water conduit construction impacts would be limited.

A greater than average area for the sites studied (250 acres) would be exposed during maximum drawdown at this site.

SALEM CREEK

Land Use and Development

Salem Creek is located near the Luzerne-Columbia County line, in an area that is a mixture of heavy forests, scattered agriculture and relatively extensive urban development. The west side of the site is an active agricultural area, with peach and apple orchards extending down into the site.

The site itself is less than 10% agricultural land, however, with the remainder heavily wooded. The land in the site is predominantly Class IV-VIII agricultural land, with Class II and III land on the site perimeter. Approximately 275 acres would be affected by this project, or about 250 acres of woodland and less than 30 acres of active agricultural land. Six to eight residences in the site would be directly affected by this project. There is also extensive new residential development in an area approximately one mile downstream from the dam.

The only significant public recreation resource in the site vicinity is the State Game Land immediately northeast of the site.

Natural Resources

Salem Creek is a small stream of about four miles length which runs from Lee Mountain to the Susquehanna. Because there are no apparent pollution sources, it is probably of good quality. It was stocked in the late 1950's with fingerling brook trout, but was deleted from the approved list in 1961 due to its small size. Approximately two miles, or 50% of the stream would be inundated by this action.

All of the water required for this project would be obtained from the Susquehanna. According to the Pennsylvania Department of Environmental Resources, the Susquehanna River at this point suffers from depressed water quality, with several parameters showing unacceptable levels during certain periods (see Table 3-2). The volume of water pumped for sites in this area would have little effect on the flow of the river, as less than seven percent of the flow would be removed in a worst-case situation.

Wildlife habitat at Salem Creek is rated as average relative to the sites studied.

Other Factors

Water would be pumped to the reservoir through a 1.7-mile pipeline which would run parallel to Salem Creek to the Susquehanna. Construction impacts of the pipeline would be low if it follows the presently existing road right-of-way from the dam to the river.

Drawdown at Salem Creek would be about average for the sites studied with 180 acres exposed in a maximum year.

TRIBUTARY, NESCOPECK CREEK

Land Use and Development

This site is located on an unnamed tributary to Nescopeck Creek, and is directly north of the heavily wooded Nescopeck Mountain. Active agricultural land lines the north side of the site, and the valley itself is approximately 20% active agricultural land and 80% wooded.

The development of this reservoir would affect approximately 255 acres of which at least 50 acres are actively farmed. The land at this site presents an interesting contrast between the high quality Class I and II agricultural land on the north side of the creek and the heavily wooded Class IV - VIII land to the south.

Residential development in and around the site is relatively heavy, with approximately five to seven homes which may be directly affected by the reservoir. There are also two to three homes below the dam in the 0.75 mile stretch above the confluence of the creek with the Nescopeck.

There is a small recreational area in the site which is known as Roinicks Grove Picnic Area and Swimming Hole.

Natural Resources

This unnamed tributary to the Nescopeck is not stocked and probably never has been, in that it has a very small drainage area (2.2 square miles) and is less than two miles long. This project would inundate about 75% of the creek and in fact would cover an area which extends above the creek's normal headwaters.

All of the water for this project would be pumped from Nescopeck Creek. Although the upper reaches of Nescopeck Creek are considered to be of excellent quality and are stocked with trout, this portion of the creek below its confluence with the Little Nescopeck suffers from water quality problems resulting from acid mine drainage and inadequately treated domestic wastewater. A water quality sampling station in Nescopeck Township shows consistently high iron and ammonia nitrogen levels, and a low pH (see Table 3-2).

Pumping from the Nescopeck would result in the creek being reduced to its long-term median flow during certain periods.

Wildlife habitat at this site is about average for the sites surveyed. However, much of the area is posted as being owned or leased by an organization called Whitetail Enterprises. Other sections of the site are posted by the Tri-Township Rod and Gun Club. This would indicate that although the actual site itself may not have wildlife habitat of special significance, its proximity to the heavily wooded Nescopeck Mountain offers good access for deer hunting.

Other Factors

The pump-in pipeline could run along the existing road right-of-way from the Nescopeck for approximately 0.75 miles, and would have very little construction impact.

Drawdown at this site would be slightly less than average for the sites studied with approximately 170 acres exposed in a maximum year.

square mile of drainage area.

Wildlife habitat at Pond Creek was rated as somewhat better than average for the sites studied.

Other Factors

Water would be pumped to the reservoir through a short (1/2-mile) pipeline whose construction would have limited impacts beyond those associated with constructing the dam.

Drawdown at Pond Creek would expose about 155 acres in a maximum year; this is less than average for the sites studied due to the compact nature of the site.

LITTLE WAPWALLOPEN CREEK

Land Use and Development

The Little Wapwallopen Creek site is located on Little Wapwallopen Creek in Luzerne County approximately three miles above the Creek's confluence with the Susquehanna River.

There is no active agricultural land in the site. The land in the area is approximately 30% Class I and 70% Class IV-VIII agricultural capability. Approximately 410 acres of land would be affected by this project, of which about 380 acres is forest and the remainder is devoted to a small road which crosses the site, a small recreational lake on the site, and an electrical transmission line.

There are approximately two to three residences in or near the site that may be directly affected. The nearest downstream residences are scattered homes approximately two miles downstream.

There is a small lake and picnic area in the center of the site.

Natural Resources

Little Wapwallopen Creek is a medium quality cold water fishery, which is stocked with brown and rainbow trout in the section of the stream which will be inundated. Approximately 2.25 miles of the stream's total 17.5 miles will be lost. This includes about 1.25 miles of the total four-mile stockable length of the stream. In addition, because this would be a conventional reservoir which would not require pumping, the flow downstream of the dam would be reduced to a conservation release of 0.15 cfs per square mile of the Creek's drainage area in a maximum drought year. The proposed operating scheme for this project is described in Chapter 2, Page 2-15. The water quality of Little Wapwallopen Creek is considered to be good, with only minor agricultural runoff problems (Buchart-Horne, Inc.).

The wildlife habitat at this site was rated somewhat better than average for the sites studied.

POND HILL

Land Use and Development

The Pond Hill site is primarily woodland, with scattered cultivated fields along its south side. Penobscot Mountain runs parallel to the site on the north.

Approximately 240 acres of land would be directly affected by this project and all of the land within the site is rated as agricultural capability Class IV- VIII. The land directly south of the site is rated as Class III land.

There is no residential activity within or below the site.

Natural Resources

The Pond Hill site is located in a valley formed by a small unnamed tributary to the Susquehanna River. The stream is about two miles long, and has two small ponds along its course. About one mile of the stream would be inundated by the impoundment.

The stream is probably intermittent in its flow and is not classed as a fishery by the Pennsylvania Fish Commission.

All of the water for this project will be pumped from the Susquehanna River just below the village of Mocanaqua. According to the Pennsylvania Department of Environmental Resources, the Susquehanna River in this area suffers from depressed water quality with several water quality parameters showing unacceptable levels during certain periods (see Table 3-2). Pumping would never reduce the river's flow more than seven percent.

Wildlife habitat at the Pond Hill site was rated as somewhat better than average for the sites studied, but it is very similar to much of the land in the area and does not appear unique.

Other Factors

A pipeline running from the river to the site would be required to run through a heavily wooded area and down a steep bluff to the river for approximately 0.5 miles.

Drawdown at Pond Hill would be less than average for the sites studied, with 155 acres exposed in a maximum year out of the total 225-acre inundated area.

TRIBUTARY TO SOUTH BRANCH, NEWPORT CREEK

Land Use and Development

This site is located in a wooded and swampy area along the north side of the heavily wooded Penobscot Mountain. The land within the site is devoted entirely to wetlands, forest and a small water supply reservoir owned by the Pennsylvania Gas & Water Company. The site is immediately south of an extensive strip mining area and the soils are not considered suitable for cultivation or other agricultural use.

Approximately 220 acres of land (the smallest of any site) would be affected by this project.

There is no residential development in or around the site, but there is extensive development about 2 miles downstream in the city of Nanticoke. There is a small settlement known as Wanamie, which was built by the coal company for its employees, about 1/2 mile north of the reservoir. This village is currently listed as a State Historic District.

Natural Resources

The stream on which this site is located is very small and is not listed as a fishery by the Pennsylvania Fish Commission. It is a tributary to the south branch of Newport Creek, which is reported to be severely polluted. Approximately one mile of the 1.5 mile length of this stream would be lost.

All of the water for this project would be pumped from the Susquehanna near Nanticoke. According to the Pennsylvania Department of Environmental Resources the Susquehanna River in this area suffers from depressed water quality with several water quality parameters showing unacceptable levels during certain periods (see Table 3-2).

The location of this site next to Penobscot Mountain, and the mixed wetland/woodland character of the site causes its wildlife habitat to be rated as better than average for the sites studied.

Other Factors

The water for this site would be pumped through a pipeline which would run for about three miles through a strip-mined area and along Newport Creek to the Susquehanna.

Drawdown at this site would expose the least amount of land of any site studied, with about 125 acres exposed in a maximum year.

TABLE 3-1

WATER QUALITY OF PUMPING SOURCE

UPPER SUSQUEHANNA SITES

	Tunkhannock Creek - Rt. 6 Bridge PA. DER - Quarterly, 1971-1974			S. Branch - Tunkhannock Ck/ (mouth) PA. DER - Quarterly, 1971-1974			Towanda Creek - Rt. 220 Bridge PA. DER - Quarterly, 1971-1974		
PARAMETER	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Temperature (C^{o})	0.5	26.0	15.0	1.0	20.0	11.1	0.5	22.0	10.8
Dissolved Oxygen (mg/l)	9.5	14.0	11.56	10.0	15.0	11.7	9.0	13.1	10.7
pH	6.80	8.60	7.57	6.8	8.0	7.40	6.30	7.30	6.98
Ammonia Nitrogen (mg/l)	0.030	0.400	0.146	0.030	0.330	0.132	0.030	1.399	0.261
Iron (mg/l)	90	1,100	318	100	52.0	228.2	10	9,300	1,375.3
Total Coliform (col./100 mg/l)	---	---	---	---	---	---	(one observation)		5,695
	Susquehanna River - Rt. 309 Bridge PA. DER - Quarterly, 1971-1974			Susquehanna River - Rt. 92 Bridge PA. DER - Quarterly, 1971-1974			Susquehanna River - Rt. 6 Bridge PA. DER - Quarterly, 1971-1974		
Temperature (C^{o})	0.5	26.0	7.5	1.0	22.0	9.72	3.5	23.0	15.28
Dissolved Oxygen (mg/l)	11.0	15.0	12.4	8.0	12.2	10.6	11.0	17.0	12.6
pH	6.60	7.50	7.01	6.80	8.00	7.48	6.60	8.40	7.42
Total Dissolved Sol. (mg/l)	(one observation)		130	(one observation)		72	204	238	216
Ammonia Nitrogen (mg/l)	0.100	0.300	0.190	0.090	0.200	0.153	0.150	1.399	0.798
Iron (mg/l)	140	4,100	1,167.1	280	1,780	1,095.7	100	2,300	957.5
Total Coliform (col./100 mg/l)	(one observation		23,940	(one observation)		3,700	(one observation)		8,985

*Sources: US EPA Quality Criteria for Water, 1976; Penna. DER Water Quality Criteria eff. Oct. 1976; Std. Methods, 14th Edition 1976.

TABLE 3-2

WATER QUALITY OF PUMPING SOURCE

LOWER SUSQUEHANNA SITES

PARAMETER	Susquehanna River (Bi-Weekly)						Nescopeck Creek (Quarterly)			Standards*, Comments
	PP&L Data, 4/11/68-8/30/72 1/			USGS Data, 10/3/74-9/23/75 2/			PA-DER Data, 1971-1974 3/			
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	
Hardness (mg/l)	42.0	279.0	125.0	---	---	---	---	---	---	Mod. Hard
Alkalinity (mg/l)	21.0	67.0	---	34.0	59.0	46.0	---	---	---	Min., 20 mg/l
Iron (mg/l)	0.02	3.0	0.4	0.23	17.0	3.376	0.100	3.0	1.415	0.3 mg/l - drinking water (EPA) not to exceed 1.5 mg/l (DER)
Aluminum (mg/l)	0.0	0.56	0.10	0.02	8.8	0.686	---	---	---	< 0.2 mg/l desirable; > 1.5 mg/l dangerous to aquatic life.
Suspended Solids (mg/l)	3.2	912.6	---	5.0	501.0	52.1	---	---	---	< 80 mg/l drinking water
pH	6.5	7.4	---	6.2	8.1	7.0	4.2	7.6	5.66	6.0 to 8.5 acceptable range
Fecal Coliform (col./100 ml.)	---	---	---	390.0	21,000.0	3,068.0	(one observation)		60.0 (ttL)	< 200 for water contact
Sulfide (S)	0.0	0.25	---	---	---	---	---	---	---	< .002 mg/l for aquatic org.
Sulfate (SO_4)	12.8	222.5	60.0	---	---	---	---	---	---	< 250 mg/l for drinking water
C.O.D. (mg/l)	4.8	70.8	---	8.0	37.0	16.8	---	---	---	< 12 mg/l typical of good quality
B.O.D. (mg/l)	0.55	6.6	2.9	0.8	4.4	2.42	---	---	---	> 5.0 mg/l undesirable
Lead (mg/l)	---	---	---	0.000	0.033	0.0073	---	---	---	< 0.05 mg/l for drinking water
Zinc (mg/l)	---	---	---	0.010	0.120	0.027	---	---	---	< 5 mg/l for drinking water
Chlorophyll A	---	---	---	0.000	0.057	0.0167	---	---	---	eutrophic at > 0.010 mg/l
Temperature (C°)	0.0	29.4	17.2	1.0	27.0	13.25	4.5	21.0	11.8	30.5° or no more than 3° increase over ambient.
Dissolved Oxygen (mg/l)	5.8	14.20	10.6	7.6	14.0	10.55	8.0	15.0	10.59	Min., 4-5 mg/l
Dissolved Solids (mg/l)	79.6	388.8	206.8	54.0	298.0	167.2	---	---	---	Max., 750 mg/l absolute; 500 mg/l monthly range.

*Sources: U.S. EPA Quality Criteria for Water, 1976; Penna. DER Water Quality Criteria, effective Oct. 1976; Standard Methods, 14th Ed., 1976.

1/ Samples taken at Susquehanna Steem Electric Station.
2/ Samples taken near Hunlock Creek (U.S.G.S. Station #5377).
3/ Samples taken at Bridge on L.R. 40017 in Nescopeck Township, Luzerne County.

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Chapter 4

EVALUATION OF SITES

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CHAPTER 4
EVALUATION OF SITES

INTRODUCTION

Based on the results of the technical and environmental assessments of the sites developed in the previous chapters, the sites were compared and ranked considering physical suitability and environmental factors. From this comparison, the sites best suited for development of a reservoir were selected.

TECHNICAL EVALUATION

The technical assessment indicated that except for the Tributary to South Branch Newport Creek there were no apparent reasons why reservoirs could not be constructed at any of the sites. This part of the Newport Creek area may have geologic problems resulting from surface and deep mining which make it questionable as a reservoir site. It is recommended that this area be eliminated from further consideration.

Some of the other sites are, however, better suited for reservoir development than others. Among the many factors influencing suitability of a site for developing a reservoir are topography, hydrology, geology and existing facilities. These usually are factors affecting project cost also. Accepting project costs as an important indicator of the physical suitability of a site for development of a reservoir, the following is a ranking of the sites from this standpoint.

Good Sites (Project Cost less than $32.0 million)	Average Sites (Project Cost $32.0 to $39.0 million)	Poor Sites (Project Cost greater than $39.0 million)
Little Meshoppen Creek	Graves Pond Creek	Fargo Creek
Riley Creek	Butler Creek	Salem Creek
Idlewild Creek	Trib. to Nescopeck Cr.	Pond Creek
Little Wapwallopen Creek	Pond Hill Creek	Laning Creek

ENVIRONMENTAL EVALUATION

Each site was evaluated on eleven environmental factors which are summarized on an accompanying Reservoir Environmental Evaluation Matrix (Plate 4-1).

The matrix rates sites as potential reservoirs relative to each other, and is not a summary of environmental impacts at each site. It is, rather, an assessment of a site's relative suitability for reservoir development. The sites are rated relatively good, fair or poor on each factor. Although the ratings are based on a subjective judgment as to what constitutes the dividing line between a relatively good, fair or poor reservoir site under each factor, an attempt was made to ensure comparability between sites by establishing criteria for rating the sites on each factor prior to the analysis. The criteria used are shown on Plate 4-1.

An important point to remember in using this matrix is that the environmental factors must be examined individually to compare sites, and cannot be added to develop a score for a site. Although a decision on selecting a site should be based on all the factors, one or two factors may outweigh several others in selecting or rejecting a site. This is a judgment which must be made by the decision maker based on the ratings in this matrix as well as the facts and analyses presented in the foregoing individual site analyses.

Each of the thirteen potential reservoir sites was evaluated and placed in one of three categories: Category I sites should definitely be given further consideration for development; Category II sites are possibilities for further consideration, but do not appear as favorable as Category I sites; and Category III sites should be dropped from further consideration.

The sites were classified as follows based on the environmental evaluation:

Category I - <u>Recommended for Further Study</u>:

- Pond Hill
- Graves Pond Creek

Category II - Further Study Should Be Considered:

- Little Meshoppen Creek
- Riley Creek
- Fargo Creek
- Laning Creek
- Unnamed Tributary to South Branch Newport Creek

Category III - Not Recommended for Further Study:

- Butler Creek
- Idlewild Creek
- Salem Creek
- Unnamed Tributary to Nescopeck Creek
- Pond Creek
- Little Wapwallopen Creek

The sites were placed in their respective categories for the following reasons:

Category I

Pond Hill

From the perspective of the environmental evaluation, Pond Hill is the best reservoir site of the thirteen sites evaluated in this study. The Pond Hill site is rated as a good reservoir site on eight of the eleven factors considered. Development of this site would have minimal direct negative impact on people, existing or potential agriculture, existing stream fishery, river flow and aesthetics. This site was rated fair in one area, character of pipeline route, because the pipeline would extend through a wooded area which is clearly visible from the Susquehanna River. The poor rating on wildlife habitat resulted from the site's relatively undisturbed character relative to the other sites studied. It should be emphasized, however, that the wildlife habitat within the site is very similar to much of this part of Pennsylvania, and as such it does not appear to be unique in any way.

The significance of the site's poor rating on the quality of its water source is not known at this time; however, the generally poor quality of the Susquehanna in this area could affect the quality of the water in the reservoir, and thus its potential as a fishery and a recreation area. This subject will require further study prior to this site's final selection for development.

Graves Pond Creek

This site was rated as a good reservoir site on four factors, including stream fishery quality, length of stream inundated, impact on water source, and impact of the water conduit. It was rated as a fair site in six areas, and poor in only one--the amount of active agricultural land affected. None of the fair ratings are the result of serious problems, and although the site takes the most agricultural land of any site studied, its development would result in the loss of less than 100 acres of actively farmed, Class III, agricultural land. Overall, the Graves Pond Creek site is only slightly less attractive than the Pond Hill site, and is rated as a Category I site.

Category II

Little Meshoppen Creek

The Little Meshoppen Creek site was rated as the best of the Category II sites. It was rated as a good site in the areas of impact on agriculture, quality of reservoir water source and impact on the water source. It was rated fair on residential activity within the site, stream fishery quality and the character and length of the water conduit route. Poor ratings in the areas of development below the dam, length of stream inundated, wildlife habitat and area exposed by drawdown kept from it from being rated as a Category I site.

Riley Creek

Riley Creek is very similar to Little Meshoppen Creek in many respects, not the least of which is their close proximity to each other.

There are also several differences between the two sites. These include Riley Creek's less intense downstream development, its higher quality fishery and the possible negative impact on Meshoppen Creek's flow. Although it is difficult to assess the relative importance of these factors, it appears that Riley Creek is somewhat less attractive as a reservoir site than Little Meshoppen Creek, but should be retained for further study as a Category II site.

Fargo Creek

Fargo Creek is an average site, with a poor suitability rating in only three factors: residential activity, wildlife habitat and drawdown. Of these factors, residential activity is probably the most important; however, this site has only a few more residential units than others rated "fair" in residential activity. The other factors on which this site is rated "poor" are also important but not major. Therefore, although Fargo Creek is slightly less attractive than Little Meshoppen Creek or Riley Creek, it is rated as Category II.

Laning Creek

Laning Creek is similar to Fargo Creek in that it is rated as "fair" on a number of factors, but is not rated "poor" on any factor which would, in itself, knock the site out of consideration. Therefore, although residential activity is somewhat more intense at Laning Creek than at Riley or Little Meshoppen, Laning Creek is also classed as a Category II site.

Unnamed Tributary to South Branch Newport Creek

This site is rated good on seven factors, and poor on four factors. The poor ratings on water quality of pumping source, development below dam, wildlife habitat, and character and length of water conduit route are important enough to reduce the site to Category II, but not sufficient in themselves to put the site into the "not recommended for further study" category.

Category III

Butler Creek

Butler Creek has several serious problems, not the least of which is the severe impact that pumping to fill it would have on Tunkhannock Creek. The additional impacts of this site on agricultural lands and wetlands indicates that this site should be classed as Category III and dropped from further consideration.

Idlewild Creek

Idlewild Creek is somewhat more suitable than Butler Creek, but the problem of depletion of the pumping source remains as a serious drawback to this site. It is felt that although Idlewild Creek is similar to a site such as Riley Creek in many ways, a more important factor is the potential problem in pumping from the East Branch of Tunkhannock Creek. These difficulties are even more severe than those at Butler Creek due to the smaller drainage areas involved. Therefore, Idlewild Creek should also be rated Category III and dropped from further consideration.

Salem Creek

Salem Creek is rated "fair" on several factors and "poor" on three: water quality, residential activity within the site and development below the site. These negative factors plus the paucity of good ratings are strong enough to knock it out of consideration. It is, therefore, ranked as Category III.

Unnamed Tributary to Nescopeck Creek

This site appears to be a fair site overall, but is suffers from a problem which is not shown on the selection matrix. That is, much of the site is apparently owned or leased by a hunt club. An organization such as this could pose serious problems to acquisition, and it is felt that the overall fair suitability rating of the site plus the possible ownership problem makes a Category III rating appropriate.

Pond Creek

The Pond Creek site is rated highly in several areas, but has a poor rating on three important factors. One of these poor ratings (i.e., impact on pumping source) could be changed to good if water were pumped from the Susquehanna instead of Little Wapwallopen Creek. This would result in other trade-offs, however, as pumping source water quality would then be rated poor and character/length of water conduit would rate fair. Thus, three important areas would remain rated "poor" including residential activity, water quality and wildlife habitat. In addition, there is a strong possibility that part of this site is a state game or recreation area of some sort. This conflict, plus the other factors, brings the site a Category III rating.

Little Wapwallopen Creek

This site has one very serious problem: Little Wapwallopen Creek, at this point, is considered one of the best stocked trout streams in the region. This project would inundate part of the stocked reach and seriously reduce the flow at certain times to the remaining stocked area. Mainly because of this fact, Little Wapwallopen Creek is rated Category III.

SELECTION OF SITES

The technical and environmental evaluations and the resulting site rankings were used to select a preferred site and two alternative sites. All sites other than the Unnamed Tributary to South Branch Newport Creek were found to be feasible for reservoir development from an engineering and geotechnical standpoint, and no site was so costly as to be dropped automatically from further consideration. The four sites rated as technically poor sites were, however, significantly less desirable than the other eight sites.

The environmental evaluation rated Pond Hill as clearly the most suitable site of the thirteen sites evaluated. Graves Pond Creek was rated second, and Little Meshoppen Creek was rated third. Based on the environmental evaluation, and given the relatively small differences in cost between the three environmentally top rated sites, these sites were recommended for further evaluation with Pond Hill as the preferred site.

RESERVOIR ENVIRONMENTAL EVALUATION MATRIX

PLATE

Key: Rating as a Potential Reservoir Relative to Other Sites Studied
- ◐ — Good Reservoir Site
- ◐ — Fair Reservoir Site
- ○ — Poor Reservoir Site

	SITES												
	GRAVES POND CREEK	LITTLE MESHOPPEN CREEK	RILEY CREEK	BUTLER CREEK	IDLEWILD CREEK	FARGO CREEK	LANING CREEK	SALEM CREEK	UNNAMED TRIBUTARY TO NESCOPECK CREEK	POND CREEK	LITTLE WAPWALLOPEN CREEK	POND HILL	UNNAMED TRIBUTARY TO SOUTH BRANCH OF
RESIDENTIAL ACTIVITY 0-2 Residences — Good 3-6 Residences — Fair > 6 Residences — Poor	◐	◐	◐	◐	◐	○	○	○	○	○	◐	◐	◐
DEVELOPMENT BELOW DAM 0-5 Residences — Good 6-15 Residences — Fair > 15 Residences — Poor	◐	○	◐	◐	◐	◐	○	○	◐	◐	◐	◐	○
ACTIVE AGRICULTURAL LAND AFFECTED 0-25 Acres — Good 26-75 Acres — Fair >75 Acres — Poor	○	◐	◐	○	◐	◐	◐	◐	◐	◐	◐	◐	◐
AGRICULTURAL CAPABILITY OF SOILS WITHIN SITE Predominantly Class IV — VIII — Good Significant Amount of Class III —Fair Significant Amount of Class I and II — Poor	◐	◐	◐	○	○	◐	◐	◐	○	◐	○	◐	◐
LENGTH OF STREAM INUNDATED ≤ 1.5 mile — Good 1.6-2.9 mile — Fair ≥ 3.0 mile — Poor	◐	○	○	◐	◐	◐	◐	◐	◐	◐	○	◐	◐
STREAM FISHERY QUALITY Small (Intermittent Flow) Unstocked — Good Other Unstocked Streams — Fair Stocked Streams — Poor	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	○	◐	◐
QUALITY OF RESERVOIR WATER SOURCE Good to Excellent Quality — Good Fair to Good Quality — Fair Poor to Fair Quality — Poor	◐	◐	◐	◐	◐	◐	◐	○	○	◐	◐	○	○
POTENTIAL IMPACT ON WATER SOURCE Never Withdraw More Than 10% of Flow — Good Normally, Flows Not Reduced Below Long-term Median — Fair Flows Sometimes Reduced to Conservation Flow — Poor	◐	◐	◐	○	○	◐	◐	◐	◐	○	○	◐	◐
WILDLIFE HABITAT Worse Than Average (For Sites Studied) — Good Average Quality (For Sites Studied) — Fair Better Than Average (For Sites Studied) — Poor	◐	○	○	◐	◐	○	○	◐	◐	○	○	○	○
CHARACTER/LENGTH OF WATER CONDUIT ROUTE Tunnel, or Pipeline Less Than 1.0 Mile Long — Good Pipeline 1.0-3.0 Miles Long — Fair Pipeline More Than 3.0 Miles Long or Pipeline of Any Length Which Traverses Sensitive Area — Poor	◐	◐	◐	○	◐	◐	◐	◐	◐	◐	NA	◐	○
AREA EXPOSED BY DRAWDOWN <150 Acres — Good 150-200 Acres — Fair >200 Acres — Poor	◐	○	○	○	◐	○	○	◐	◐	◐	◐	◐	◐