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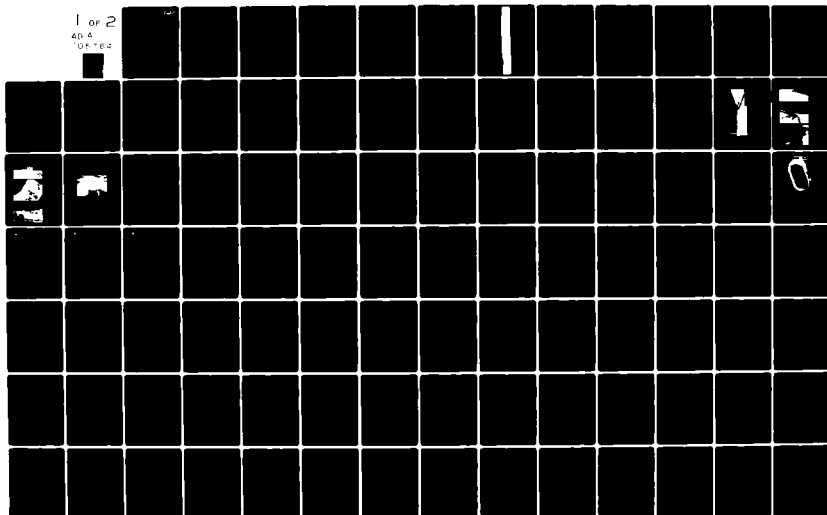
NATIONAL DAM SAFETY PROGRAM. WESTCOTT RESERVOIR (INVENTORY NUMB--ETC(U)

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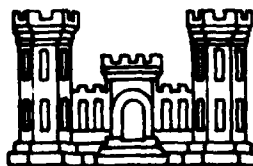
LEVEL II

WESTCOTT RESERVOIR
ONONDAGA COUNTY
NEW YORK

INVENTORY No. NY 1471

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NEW YORK DISTRICT CORPS OF ENGINEERS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. The Phase I Inspection of the Westcott Reservoir Dam did not indicate condi- tions which would constitute an immediate hazard to human life or property.		

There is no spillway at the Westcott Reservoir Dam. The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the PMP without overtopping the structure.

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Westcott Reservoir Dam I.D. No. NY 1471
State Located:	New York
County:	Oneida
Watershed:	Seneca River Basin
Stream:	Not Applicable
Date of Inspection:	November 21, 1980

ASSESSMENT OF GENERAL CONDITIONS

The Phase I Inspection of the Westcott Reservoir Dam did not indicate conditions which would constitute an immediate hazard to human life or property.

There is no spillway at the Westcott Reservoir Dam. The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the PMP without overtopping the structure.

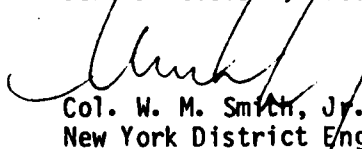
The following remedial work should be undertaken during normal maintenance operations within one year:

1. Seepage near the northwest toe of slope should continue to be monitored and data recorded to enable observers to detect changing conditions.
2. Tears in the hypalon liner should be repaired.
3. A flood warning and emergency evacuation system should be implemented to alert the public should conditions occur which could result in failure of the dam.
4. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility. Specifically data should be collected and recorded regarding flow from the sub-drain system of the facility.

Dale Engineering Company


John B. Stetson, President

Approved By:
Date:


Col. W. M. Smith, Jr.
New York District Engineer

30 JUN 1981

1. Overview of Westcott Reservoir.

PHASE I INSPECTION REPORT
WESTCOTT RESERVOIR DAM I.D. NO. NY 1471
SENECA RIVER BASIN
ONONDAGA COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and the U.S. Army Corps of Engineers.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the existing condition of the Westcott Reservoir Dam and appurtenant structures, owned by City of Syracuse, Division of Water, Syracuse, New York, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the U.S. Army Corp of Engineers.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Westcott Reservoir Dam is located in the City of Syracuse on a parcel of land which is surrounded by the Town of Geddes. The dam consists of an earthen embankment, approximately 2,826 feet in length, with a maximum height of 39.5 feet. The impoundment is perched on a prominent hilltop which is surrounded by a densely populated residential area. This facility provides local storage of potable water for use in the water distribution system of the City of Syracuse. The dam consists of an earthen embankment which was originally constructed with a gunite liner. Leakage through the gunite liner necessitated the installation of a nylon reinforced hypalon rubber liner over the gunite lining. Water is fed to this facility through a transmission line which is connected to the water source at Skaneateles Lake.

b. Location

The Westcott Reservoir Dam is located in the City of Syracuse, Onondaga County, New York.

c. Size Classification

The maximum height of the dam is approximately 39.5 feet. The volume of the impoundment is approximately 338 acre feet. Therefore, the dam is in the small size classification as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The impoundment is located immediately adjacent to a heavily developed residential section of the Town of Geddes. Therefore, the dam is in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the City of Syracuse, Division of Water, Syracuse, New York.

Contact: Richard F. Kunder P.E.
Division Engineer - Water
400 City Hall
Syracuse, New York, 13202
Telephone: (315) 473-5330.

f. Purpose of the Dam

The dam is used as a water supply reservoir for the water distribution of the City of Syracuse.

g. Design and Construction History

The reservoir was constructed in 1931 and was in continuous service for nearly 40 years until severe leakage occurred in January, 1970. The impoundment was drained and left out of service for a period of two years while plans were formulated for the sealing of the leakage. In 1973, a nylon reinforced hypalon rubber liner was installed over the original gunite lining. The facility was then placed back into operation and has provided continuous, satisfactory service until the present time.

h. Normal Operational Procedures

Water is supplied to the Westcott Reservoir from Skaneateles Lake by supply conduits under gravity flow. The reservoir has no spillway or overflow. The water level is continuously monitored by a recording gauge telemetered to an operations control center which is staffed 24 hours a day. An evaluation of reservoir level is made daily and more often if neces-

sary. Flow into the reservoir to control its elevation is accomplished by adjusting either a 42 inch hydraulic valve or a 30 inch pressure regulating valve located in the 42 inch inlet pipe to the reservoir. In addition, the flow from the lake can be reduced by throttling a 36 inch butterfly valve in the conduits supply lines by remote control from the operations center.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Westcott Reservoir Dam is 13.5 acres.

b. Discharge at Dam Site

The facility is a water supply reservoir. There are no facilities to accommodate discharge from the impoundment.

c. Elevation (Feet above MSL)

Top of Dam	627 ft.
Optimum Water	621.5 ft.
Toe of Slope within Impoundment	587.5 ft.

d. Reservoir

Length of Normal Pool	1072 ft.
-----------------------	----------

e. Storage

Normal Pool	338 acre feet 110,000,000 gallons
-------------	--------------------------------------

f. Reservoir Area

Normal Pool	11.8 acres
-------------	------------

g. Dam

Type - Earth Fill
 Length - 2826+ ft.
 Height - 39.5 ft.
 Freeboard between Normal Reservoir and Top of Dam - 5.5 feet
 Top Width - 15 ft.
 Side Slopes - interior and exterior: 2 horizontal:1 vertical
 Zoning - None
 Impervious core - None
 Grout curtain - None

h. Spillway

None

i. Regulating Outlets

Flow from the impoundment is through the water distribution system. A 12 inch diameter line allows for drainage of the reservoir bottom.

SECTION 2: ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

Geologically, Westcott Reservoir Dam is located in the Eastern Lake section of the Central Lowland Province which is part of the Interior Plains, the major physiographic division. The area is adjacent to the ice-beveled northern edge of the Catskill section of the Appalachian Plateau Province. Although the horizontally lying bedrock beneath the dam site is believed to be one of the upper units of the Salina Group of Upper Silurian age, the reservoir appears to be sited in the glacial debris of a drumlin, which unit of the Salina Group would be determined by the depth to bedrock beneath the reservoir. Several zones in some of these units may easily go into solution, due to a high concentration of gypsum, and thereby leave cavities. Several areas on the eastern side of Syracuse are known to have subsidence features due to the solution of gypsum and salt in the subsurface.

The drumlin is normally made up of medium to coarse textured, unsorted and unstratified glacial till that has low permeability. The soil surrounding the reservoir is designated as HTE according to the 1977 Onondaga County soils report of the U.S. Department of Agriculture. The Ontario soils of this designation is a very stony soil and is located mainly on the steep sides of drumlins. The soil is said to be slowly permeable near the surface and very slowly permeable below a depth of 28 inches (less than 0.2 inches per hour).

b. Subsurface Investigations

No detailed subsurface information was available concerning the foundation or the material of the original embankment. Data included in Appendix E includes a report on Knapp Reservoir embankments. "Knapp Reservoir" was the original name of the facility.

2.2 DESIGN RECORDS

No reports were available from the original design of the dam. Portions of the engineering report prepared by Konski Engineers of Syracuse, New York, regarding the restoration of the Wescott Reservoir are included in Appendix E. The specifications and plans for the restoration of the reservoir were available to the inspection team.

2.3 CONSTRUCTION RECORDS

Photographs showing the original construction of the facility are included in Appendix E.

2.4 OPERATIONAL RECORDS

There are no operational records available for this dam. The City of Syracuse, Division of Water, maintains records of water elevations for this facility.

2.5 EVALUATION OF DATA

The data presented in this report was obtained from the City of Syracuse, Division of Water. The information available appears to be reliable and adequate for a Phase I inspection report.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

The Westcott Reservoir Dam was inspected on November 21, 1980. The Dale Engineering Company inspection team was accompanied on the inspection by L. Fordock, Assistant Division Engineer of the City of Syracuse, Division of Water.

b. Dam

At the time of the inspection, water level in the impoundment was at elevation 619. Although there was a light snow cover at the time of the inspection, the slopes of the dike were noted to be uniform with no evidence of displacement or sloughing. The slopes were well maintained and no evidence of animal burrows was detected. The crest of the embankment was of uniform elevation with no evidence of subsidence or misalignment. The interior slope of the impoundment was covered by the hypalon lining. The hypalon lining is generally in good condition although a few tears caused by grass mowing equipment were found at the top of the bank. Numerous other locations were noted where tears had been repaired in the past. A small area of seepage was detected near the toe of the northwest slope. This area has existed for many years and is tested periodically for hardness and floride concentration. These characteristics of the seepage differ greatly from those of the reservoir water.

The subdrain system discharge was inspected. A moderate flow was being discharged at the time of the inspection. The Division of Water maintains periodic surveillance of the overflow discharge.

c. Appurtenant Structures

The gatehouse at the toe of the slope to the south of the impoundment was found to be in operating condition and generally in good repair.

d. Control Outlet

The outlet of the impoundment consists of the outlet line into the City water distribution system. This line was observed and found to be in good condition.

e. Reservoir Area

The reservoir covers approximately 11.8 acres. The hypalon lining near the water surface appears to be intact and no problem areas were detected.

f. Downstream Channel

There is no downstream channel on this facility.

3.2 EVALUATION

The visual inspection revealed that the embankment is in good condition.

The following specific items should be addressed by the Owner:

1. The seepage area near the toe of the northwest slope should continue to be monitored.
2. The inspection procedures should be formalized and data should be recorded to enable observers to detect any change which might occur.
3. Minor tearing of the hypalon lining near the top of the embankment exists and should be repaired.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

This reservoir is used to provide a local storage for the City of Syracuse water supply system. Flow from Skaneateles Lake is conveyed to Andrews gatehouse through two 30 inch and one 36 inch diameter parallel gravity transmission lines. From Andrews gatehouse, some of the flow is conducted to Westcott Reservoir through a 42 inch diameter cast iron gravity pipe. A 48 inch diameter pipe serves as the outlet line from Westcott Reservoir. Water level in the impoundment is controlled from an operations control center where 24 hour a day monitoring is provided. Valves in the system are manipulated to provide optimum water level consistent with water supply requirements.

4.2 MAINTENANCE OF THE DAM

Maintenance and operation of the dam is controlled by the City of Syracuse, Division of Water. Periodic visits are made to the site to check on conditions of the facility. No formal operating procedure is in effect at this site.

4.3 MAINTENANCE OF OPERATING FACILITIES

The valves controlling flow into the impoundment are in operating condition and show evidence of proper maintenance.

4.4 DESCRIPTION OF WARNING SYSTEM

No warning system is in effect at present.

4.5 EVALUATION

The dam and appurtenances are periodically inspected by representatives of the City of Syracuse, Division of Water. The facility is presently in good condition and adequately maintained. Since this dam is in the high hazard classification, a warning system should be implemented to alert the public should conditions occur which could result in failure of the dam.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Westcott Reservoir is located on the western fringe of the City of Syracuse. The reservoir serves as a water supply holding area and is perched above the surrounding terrain. The only contributing runoff areas consist of the reservoir and the interior embankment and a portion of the top of the berms, which constitute a relatively small area in comparison to the reservoir area.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the reservoir system's capacity to handle runoff from precipitation events. This has been assessed through the evaluation of the effects on the reservoir from the runoff produced by the Probable Maximum Precipitation (PMP).

The reservoir's capacity to handle the runoff produced by a precipitation event is a function of the available reservoir storage, the measures taken to regulate the reservoir's supply and outlet conduits, and the volume of runoff.

Water is supplied to Westcott Reservoir from Skaneateles Lake by supply conduits under gravity flow. This inflow can be regulated by a 42-inch hydraulic valve or a 30-inch pressure regulating valve in the 42-inch inlet pipe to the reservoir. Flow from Skaneateles Lake can also be controlled by regulating a 36-inch butterfly valve in the conduit supply lines by remote control from the operations control center.

The water level of the reservoir is continuously monitored by a recording elevation gauge. This information is telemetered to the operations control center which is staffed 24 hours a day. All reservoir levels are reviewed and evaluated on a daily basis or more often if necessary and the necessary adjustments made.

The strategy employed in normal operations incorporates filling the reservoir up to approximately elevation 621.5 at the beginning of the week (Monday morning) in the summer or 620.5 in the winter. This reservoir elevation normally decreases as the week progresses due to consumption and is replenished during the weekend. After the reservoir level rises above elevation 621.3, the reservoir level is usually monitored more frequently.

The Probable Maximum Precipitation (PMP) is 20.4 inches according to Hydrometeorological Report (HMR #33) for a 24-hour duration storm, 200 square mile basin. Adjusting the rainfall to the lower limit of the areal adjustment graph (the drainage area is less than 10 square miles, the lower limit of the areal adjustment graph) resulted in an index PMP of 27.1 inches. Nearly 100% of the precipitation will result in runoff as the drainage area consists primarily of the reservoir and the lined interior slopes of the reservoir. The reservoir, with a normal pool surface area of 11.8 acres, constitutes 88% of the 13.5 acre drainage area.

5.3 SPILLWAY CAPACITY

The reservoir does not have an overflow spillway. The major means of lowering the reservoir would be by decreasing the inflow from the supply conduit and/or increasing the flow through the outlet conduits.

5.4 RESERVOIR CAPACITY

The maximum reservoir elevation allowed under normal operations is approximately 621.5, leaving about 5-1/2 feet of freeboard to the top of embankment elevation of approximately 627+. The reservoir storage capacities, as estimated from the 1930 plans, for these two elevations are shown below:

Elevation 621.5	338 acre feet
Top of Embankment	405 acre feet

5.5 OVERTOPPING POTENTIAL

The surcharge storage of 67 acre feet between elevation 621.5 and the top of the embankment is equivalent to 60 inches of runoff from the drainage area. Therefore, if the reservoir elevation was 621.5 before the PMP event occurred and flow through the supply and outlet conduits were equal throughout this event, then the reservoir could store the PMP with about 3 feet of freeboard.

5.6 EVALUATION

Based on the information given by the operations staff, there will be more than sufficient operations freeboard within the reservoir to store the PMP without overtopping the embankment. The reservoir has never been known to have been overtopped and the only way it would be overtopped would be due to an operator error on the supply end of the system. Since an operator lives on the reservoir premises, and the reservoir levels are continuously monitored by a recording gauge that telemeters these levels to an operations control center which is staffed 24 hours a day, the possibility of the reservoir being overtopped seems quite remote.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The Westcott Reservoir is an oval shaped, self contained, earthen embankment, perched above the surrounding terrain. The interior slopes of the reservoir are lined with a rubberized fabric overlying a gunite and granite block layer. The crest and exterior slopes are grassed. About half-way down the slope a 10 feet wide bench and a security fence on the outside edge of the bench encircle the reservoir.

The embankments are well maintained, adequately mowed, and void of any brush or tree growth except for a single maple tree at the toe of the south slope. The slopes are generally uniform with no evidence of structural movement or cracking. A wet spot was detected near the toe of the exterior slope on the northwest curve, about 10 feet above the level of Orchard Road.

b. Design and Construction Data

No information regarding the structural stability of the structure was located. Drawings included in Appendix F substantially conform to the present configuration of the facility. The drawings indicate the interior slopes of the earthen embankment to be 2:1 (2 horizontal to 1 vertical). The exterior slopes are 2:1 down to the 10 feet wide bench and then 2:1 to natural ground, except for the west slope which is 2.5:1 below the bench. The interior slopes are lined with a 6 inch layer of crushed stone over the earthen embankment with a 3-1/2 inch reinforced gunite layer over the crushed stone. Over the upper 20 feet of the interior slopes, a 6 inch masonry layer (granite blocks with mortar pointing) overlays the gunite layer. The bottom of the reservoir is reportedly underlain with clay to retard seepage losses in that direction. The crushed stone layer underneath the gunite sidewalls was designed to pick up any losses through the sides and convey this seepage to the 6 inch open jointed clay tile drain at the toe of slope which is connected into the undrain system that carries collected seepage through the southern end of the embankment. Subsequent to problems experienced with reservoir leakage in the early 1970's, the interior slopes were lined with a synthetic rubber liner.

c. Operating Records

Formal records pertaining to reservoir water levels are on file with the City of Syracuse, Water Division. Other information dealing with problems and mitigative actions are contained in the reports and correspondence in Appendix E. When the reservoir was initially filled, a leak around the inlet pipe was evident. A clay patch made at this pipe/gunite joint by a diver apparently reduced this leakage significantly. Seepage has reportedly always discharged from the reservoir underdrain system when the reservoir had water in it. Prior to 1970, the underdrain discharged about 21,000 gallons per day. Water reportedly seeped out of the west side of

the reservoir embankment before 1970 but stopped after the reservoir was drained in 1970 (Ref. No. 14). A leak in the reservoir on January 10, 1970 caused a marked increase in the underdrain discharge from 25 gpm to 1000 gpm. Also water was reportedly bubbling up in the street on Fay Road. This led to the reservoir being drained. Cracks and deteriorated joints were repaired and the reservoir was filled with 8 feet of water in the winter of 1971-72. However, the underdrain discharge appeared greater than that experienced prior to 1970 so the reservoir was again drained. After the reservoir was lined with a hypalon liner in 1973, it was again returned to service.

d. Post Construction Changes

As a result of the excessive leakage experienced in January 1970 and the unsatisfactory results produced from repairing only the cracks and deteriorated gunite joints, the reservoir was lined. Voids underneath the gunite slab were pressure grouted. The joints were cleaned, rebuilt, and sealed. The granite block surface on the upper portion of the interior slope was covered with a gunite layer to produce a smooth surface for installation of the liner. The entire interior reservoir slope was covered with sheets of hypalon synthetic rubber liner and the liner seams were sealed.

e. Seismic Stability

No known faults exist in the vicinity of the reservoir, although faults are present in the region. The Preliminary Brittle Structures Map (1977) indicates several topographic linear features present in the immediate area. One with an east-northeasterly trend is located about one-half mile south of the reservoir. Two others, each about 2-1/2 miles distant, are located one to the northeast and trending northeast and another to the northwest and trending northwest.

The area is located within Zone 2 of the Seismic Probability Map. Only four earthquakes have been recorded in the area and are tabulated below:

<u>Date</u>	<u>Intensity Modified Mercalli</u>	<u>Location Relative to Dam</u>
1925	III	5 miles East
1927 (2)	III	5 miles East
1945	III	10 miles West

6.2 STRUCTURAL STABILITY ANALYSIS

The earthen embankment appears to be properly maintained with no signs of structural instability in evidence. The discharge of the underdrain system should be monitored and recorded with the corresponding reservoir level on a regular basis as part of a formalized inspection program. An unexplained decrease in the underdrain discharge might indicate a malfunction in the underdrain. The results of such a condition could lead to

seepage through the earthen embankment with a resulting decrease in stability of this embankment, as it is not designed to handle through the embankment seepage like an earthen dam. Conversely, large underdrain discharges would indicate liner leaks and could cause problems if greater than the safe capacity of the underdrain system. Also as part of the formalized inspection, the wet area near the northwest should be monitored. In addition, the entire embankment as well as areas beyond the toe of slope should be inspected under this program to detect deficiencies. Any deficiencies and the remedial measures undertaken to correct these deficiencies should be well documented to provide historical background on which future evaluations may be based.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The Phase I Inspection of the Westcott Reservoir Dam did not indicate conditions which would constitute an immediate hazard to human life or property.

The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the PMP without overtopping the structure.

The visual inspection did not reveal conditions which would indicate evidence of structural displacement or instability.

The following specific safety assessments are based on the Phase I visual examination and analysis of hydrology and hydraulics, and structural stability:

1. Seepage was detected near the toe of the slope of the northwest embankment.
2. Minor tears exist in the hypalon lining near the top of the embankment.
3. No warning system is presently in effect to alert the public should conditions occur which could result in failure of the dam.
4. No formalized inspection system is in effect at the facility.

b. Adequacy of Information

The information available is adequate for this Phase I investigation.

c. Urgency

Items 1 through 4 of the safety assessment should be addressed by the Owner and appropriate actions taken within one year of this notification.

d. Need for Additional Investigation

This Phase I inspection has not revealed the need for additional investigations regarding this structure.

7.2 RECOMMENDED MEASURES

The following is a list of recommended measures to be undertaken to insure safety of the facility:

1. Seepage near the northwest toe of slope should continue to be monitored and data recorded to enable observers to detect changing conditions.
2. Tears in the hypalon liner should be repaired.
3. A flood warning and emergency evacuation system should be implemented to alert the public should conditions occur which could result in failure of the dam.
4. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility. Specifically, data should be collected and recorded regarding flow from the sub-drain system of the facility.

APPENDIX A
PHOTOGRAPHS



2. Westerly slope of embankment.



3. Top of westerly embankment.



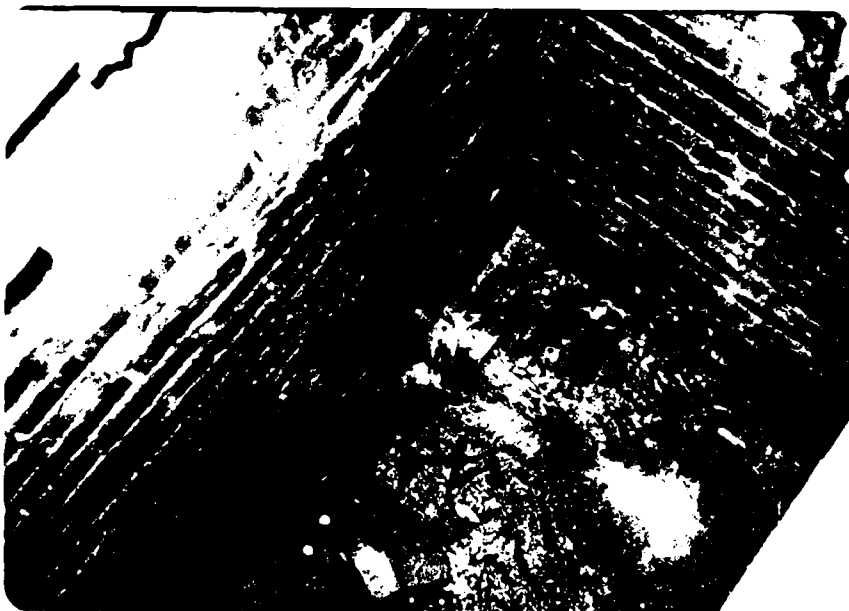
4. Easterly slope of embankment.



5. Closeup of hypalon lining.



6. Gatehouse at south end of reservoir.



7. Outlet from underdrain system.



8. View from toe of slope illustrating "downstream" hazard.



9. Wet area on northwest toe of slope.

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST1) Basic Data

a. General

Name of Dam WESTCOTT RESERVOIR DAM
 Fed. I.D. # NY 1471 DEC Dam No. _____
 River Basin SENECA RIVER
 Location: Town CITY OF SYRACUSE County ONONDAGA N.Y.
 Stream Name N/A
 Tributary of N/A
 Latitude (N) 43-02.6 Longitude (W) 76-12.1
 Type of Dam EARTH EMBANKMENT
 Hazard Category HIGH
 Date(s) of Inspection NOV 21, 1980
 Weather Conditions FAIR
 Reservoir Level at Time of Inspection 619

b. Inspection Personnel F.W. BYSZEWSKI, B. COLWELL, J. A. GOMEZ
H. MUSKATT - Dole Engineering L. FORDOCK - SYRACUSE WATERDEPT.

c. Persons Contacted (Including Address & Phone No.) _____
RICHARD F. KUNDER P.E.
DIVISION ENGINEER - WATER PHONE: 315-473-5330
400 CITY HALL
SYRACUSE, N.Y. 13207

d. History:

Date Constructed 1931 Date(s) Reconstructed HYDALON LINING
INSTALLED 1973
 Designer CITY OF SYRACUSE, DIVISION OF WATER, DEPT OF ENGINEERING
 Constructed By I.M. LUDINGTON'S SONS INC., ROCHESTER N.Y.
 Owner CITY OF SYRACUSE

93-15-3(9/80)

2) Embankment

a. Characteristics

- (1) Embankment Material LOCAL MATERIAL. SAND & GRAVEL
SOME CLAY (Reportedly)
- (2) Cutoff Type NONE
- (3) Impervious Core NONE
- (4) Internal Drainage System CRUSHED STONE DRAIN ON
INTERIOR SLOPE BENEATH GUNITE LINER, 6" TILE
DRAIN AT TOP OF INTERIOR SLOPE
- (5) Miscellaneous NYLON REINFORCED HYPALON RUBBER
LINER INSTALLED IN 1973.

b. Crest

- (1) Vertical Alignment NO MISALIGNMENT OBSERVED
- (2) Horizontal Alignment NO MISALIGNMENT OBSERVED
- (3) Surface Cracks NONE OBSERVED, LIGHT SNOW
COVER AT TIME OF INSPECTION.
- (4) Miscellaneous ---

c. Upstream Slope

- (1) Slope (Estimate) (V:H) 1 3 2
- (2) Undesirable Growth or Debris, Animal Burrows NONE
- (3) Sloughing, Subsidence or Depressions NONE OBSERVED

(4) Slope Protection HYPOLON LINER COVERS ENTIRE SLOPE

(5) Surface Cracks or Movement at Toe TOE OBSCURED BY DEPTH OF WATER IN IMPOUNDMENT

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:2

(2) Undesirable Growth or Debris, Animal Burrows NONE, Except lone maple tree at toe of south slope

(3) Sloughing, Subsidence or Depressions NONE OBSERVED

(4) Surface Cracks or Movement at Toe NONE OBSERVED

(5) Seepage SMALL AREA NEAR TOE OF NORTHWEST SLOPE, SEEPAGE HAS EXISTED FOR MANY YEARS.

CHEMICAL TESTS SHOW HARDNESS AND FLUORIDE CONCENTRATION SUBSTANTIALLY DIFFERENT FROM RESERVOIR WATER

(6) External Drainage System (Ditches, Trenches; Blanket) NONE

(7) Condition Around Outlet Structure NONE

(8) Seepage Beyond Toe NONE OBSERVED (SEE (5) ABOVE)

e. Abutments - Embankment Contact

NONE

93-15-3(9/80)

(1) Erosion at Contact N/A

(2) Seepage Along Contact N/A

3) Drainage System

a. Description of System SEE 2)a.(4.)

b. Condition of System OPERABLE

c. Discharge from Drainage System

NOV 4, 1980 , 439PM , RESERVOIR AT ELEV. 621.82
DEC. 5, 1980 , 259PM , RESERVOIR AT ELEV. 617.80

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) NONE

5) Reservoir

- a. Slopes SEE COMMENTS FOR DAM
- b. Sedimentation INSIGNIFICANT, POTABLE WATER
- c. Unusual Conditions Which Affect Dam NONE

6) Area Downstream of Dam

- a. Downstream Hazard (No. of Homes, Highways, etc.) DENSELY DEVELOPED
RESIDENTIAL AREA.
- b. Seepage, Unusual Growth SEE 2.) d.(5.)
- c. Evidence of Movement Beyond Toe of Dam NONE OBSERVED
- d. Condition of Downstream Channel N/A.

7) Spillway(s) (Including Discharge Conveyance Channel)

- NONE
- a. General
- b. Condition of Service Spillway

c. Condition of Auxiliary Spillway NONEd. Condition of Discharge Conveyance Channel —8) Reservoir Drain/OutletType: Pipe ☒ Conduit ☐ Other ☐Material: Concrete ☐ Metal CAST IRON Other ☐Size: 12" Length 250 FTInvert Elevations: Entrance 585.18 Exit ?Physical Condition (Describe): ☐ Unobservable ☒Material: —Joints: — Alignment —Structural Integrity: —

Hydraulic Capability: RESERVOIR IS DRAINED THROUGH CONSUMPTION WITHIN THE DISTRIBUTION SYSTEM. THE 12" DRAIN IS USED TO REMOVE WATER FROM THE BOTTOM OF THE RESERVOIR BELOW THE NORMAL OUTLET LINE.

Means of Control: Gate ☐ Valve ☒ Uncontrolled ☐Operation: Operable ☒ Inoperable ☐ Other ☐Present Condition (Describe): —

9) Structural

- a. Concrete Surfaces N/A
- b. Structural Cracking N/A
- c. Movement - Horizontal & Vertical Alignment (Settlement) N/A
- d. Junctions with Abutments or Embankments N/A
- e. Drains - Foundation, Joint, Face N/A
- f. Water Passages, Conduits, Sluices N/A
- g. Seepage or Leakage N/A

h. Joints - Construction, etc. N/A

i. Foundation N/A

j. Abutments N/A

k. Control Gates N/A

l. Approach & Outlet Channels N/A

m. Energy Dissipators (Plunge Pool, etc.) N/A

n. Intake Structures N/A

o. Stability N/A

p. Miscellaneous N/A

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

- a. Description and Condition LOCATED AT SOUTH END OF
RESERVOIR. CONTROLS FLOW INTO THE RESERVOIR
AND INTO THE DISTRIBUTION SYSTEM. THE FACILITY
IS IN GOOD OPERATING CONDITION AND WELL MAINTAINED

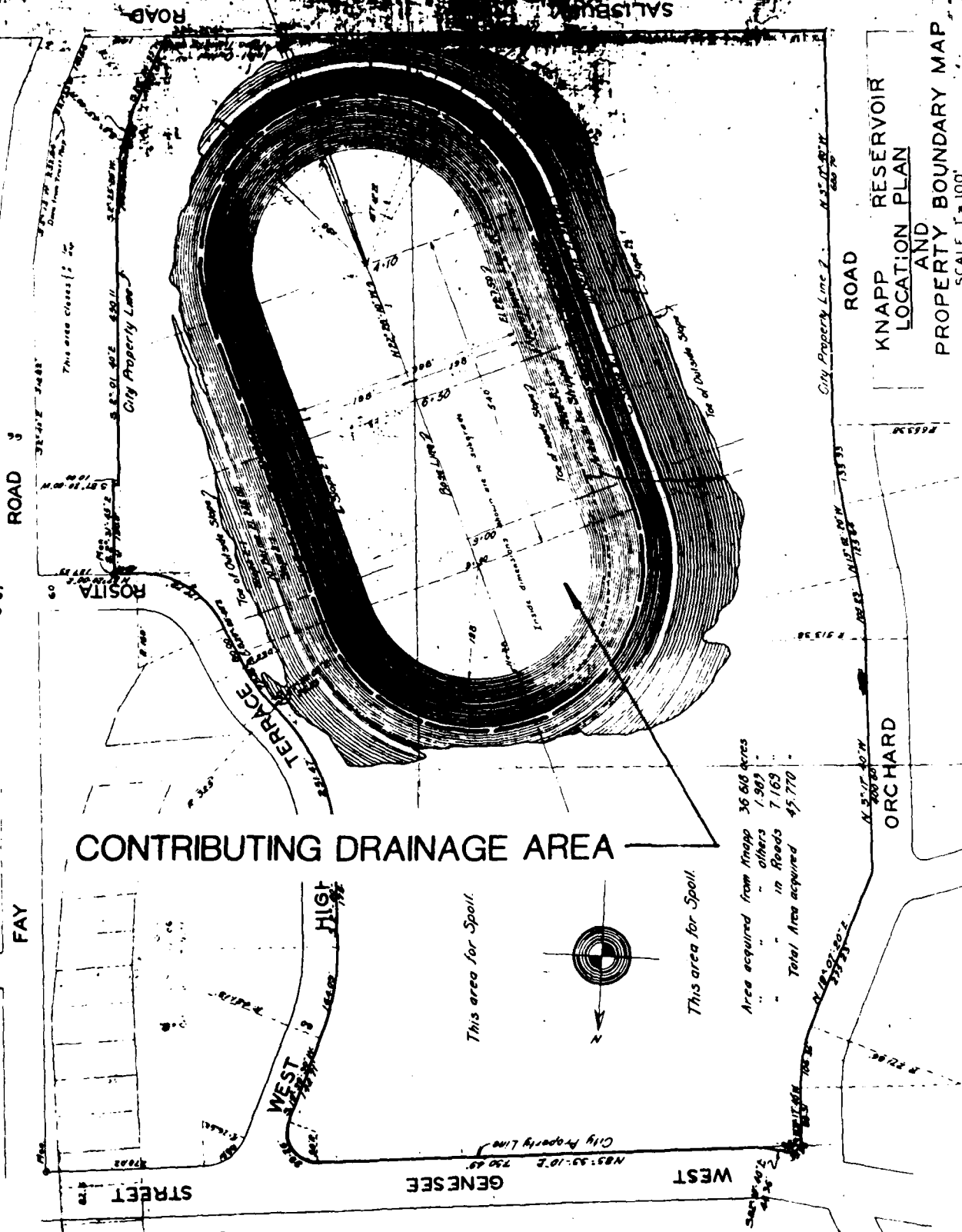
11) Operation Procedures (Lake Level Regulation):

WATER IS SUPPLIED TO THE RESERVOIR THROUGH A SUPPLY
CONDUIT FROM SKANEATELES LAKE. WATER LEVEL IS
CONTINUOUSLY MONITORED AND TELEMETERED TO AN OPERATIONS
CONTROL CENTER WHERE 24 HOUR SURVEILLANCE IS PROVIDED.
ELEVATION IS CONTROLLED BY ADJUSTING VALVES IN THE
42 INCH INLET LINE. A REMOTE CONTROLLED BUTTERFLY
VALVE IN THE TRANSMISSION MAIN MAY ALSO BE USED
TO REGULATE FLOW FROM THE OPERATIONS CENTER.

APPENDIX C

HYDROLOGIC/HYDRAULIC, ENGINEERING DATA AND COMPUTATIONS

KNAPP RESERVOIR
LOCATION PLAN
AND
PROPERTY BOUNDARY MAP
SCALE 1" = 100'



DRAINAGE BASIN



STETSON • DALE

BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501

TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME N.Y.S. Dam Inspections 1981 DATE 12-19-80
SUBJECT Westcott Reservoir Dam PROJECT NO. 2520
Depth-Area-Duration DRAWN BY JAG

PMP

FROM HMR #33

FOR Lat. ~ 43°03' Long. ~ 76°12'

Index Rainfall = 20.4" FOR 200 mi², 24 hr.
Zone 1

<u>Duration</u>	<u>% Index*</u>	<u>Depth</u>
6 hrs.	111	22.6"
12 hrs.	123	25.1
24 hrs	133	27.1
48 hrs	142	29.0

* Adjusted for site area (these are adjusted for 10 mi², the lower limit of the areal adjustment graph).

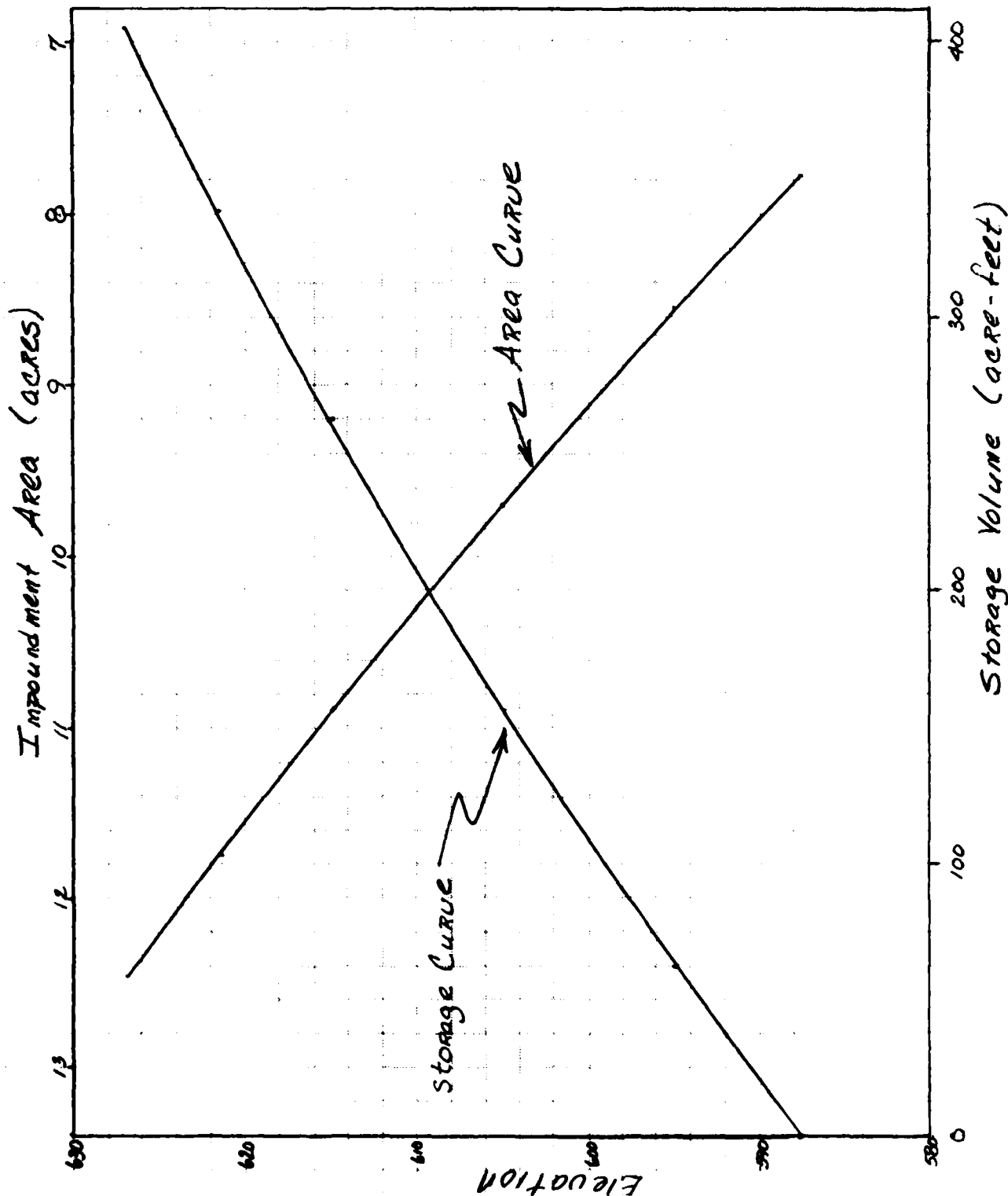


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TEL 315-797-5800

DESIGN BRIEF

OBJECT NAME N.Y.S. Dam Inspections 1981 DATE 1-15-81
SUBJECT Westcott Reservoir PROJECT NO. 2520
Area - Capacity Curve DRAWN BY JAG





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TEL 315-797-5800

DESIGN BRIEF

OBJECT NAME N.Y.S. Dam Inspections 1981 DATE 1-15-81
SUBJECT Westcott Reservoir PROJECT NO _____
DRAWN BY _____

High Pool Under Normal Operating
Conditions = 621.5 (Storage = 338 ac-ft)

Top of Dam @ Elevation 627 : Storage = 405 ac-ft

Surcharge Storage = 67 ac-ft

Drainage Area = 13,450 ac.

Surcharge Storage = $\frac{67 \text{ ac-ft}}{13,450 \text{ ac}} = 5'$ of Runoff over
Drainage Area

WESTCOTT RESERVOIR
NY #1471

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

1

AREA-CAPACITY DATA:

	<u>Elevation</u> (ft.)	<u>Surface Area</u> (acres)	<u>Storage Capacity</u> (acre-ft.)
1) Top of Dam	<u>627</u>	<u>12.5</u>	<u>405</u>
2) Design High Water (Max. Design Pool)	<u>N/A</u>	<u> </u>	<u> </u>
3) Auxiliary Spillway Crest	<u>N/A</u>	<u> </u>	<u> </u>
4) Pool Level with Flashboards	<u>N/A</u>	<u> </u>	<u> </u>
5)	<u> </u>	<u> </u>	<u> </u>
Normal Pool	<u>621.5</u>	<u>11.8</u>	<u>338</u>

DISCHARGES

	<u>Volume</u> (cfs)
1) Average Daily	<u> </u>
2) Spillway @ Maximum High Water	<u>N/A</u>
3) Spillway @ Design High Water	<u>N/A</u>
4) Spillway @ Auxiliary Spillway Crest Elevation	<u>N/A</u>
5) Low Level Outlet	<u>N/A</u>
6) Total (of all facilities) @ Maximum High Water	<u>N/A</u>
7) Maximum Known Flood	<u>N/A</u>
8) At Time of Inspection	<u>N/A</u>

K

* No spillway,
discharge through water transmission
lines only.

CREST:

ELEVATION: 627

Type: Earthen

Width: 15' Length: 2825'

Spillover N/A

Location _____

SPILLWAY: — None

PRINCIPAL

N/A

EMERGENCY

N/A

Elevation _____

Type _____

Width _____

Type of Control

Uncontrolled _____

Controlled: _____

Type _____

(Flashboards; gate)

Number _____

Size/Length _____

Invert Material _____

Anticipated Length
of operating service _____

Chute Length _____

Height Between Spillway Crest
& Approach Channel Invert
(Weir Flow) _____

HYDROMETEROLOGICAL GAGES:

Type : Water level Recording gage
Location: Stairwell to upper gate house
Records: Maintained at City of Syracuse, Div. of Water
Date - _____
Max. Reading - UNKNOWN

FLOOD WATER CONTROL SYSTEM:

Warning System: Water level is continuously monitored by a recording gauge telemetered to an operations control center which is staffed 24 hours a day.

Method of Controlled Releases (mechanisms):

Through water supply transmission lines

DRAINAGE AREA: 13.5 acres

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Reservoir Interior

Terrain - Relief: 2:1 (horiz. to vert.)

Surface - Soil: Rubber lining, grassed crest

Runoff Potential (existing or planned extensive alterations to existing
(surface or subsurface conditions)

High percentage of runoff

Potential Sedimentation problem areas (natural or man-made; present or future)

Unlikely

Potential Backwater problem areas for levels at maximum storage capacity
including surcharge storage:

N/A

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the
Reservoir perimeter:

Location: Dike completely encircles reservoir

Elevation: at approximately the same elev.

Reservoir:

Length @ Maximum Pool 0.2 (Miles)

Length of Shoreline (@ Spillway Crest) 0.5 (Miles)

APPENDIX D

REFERENCES

APPENDIX

REFERENCES

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5. Soil Conservation Service (Engineering Division): Urban Hydrology for Small Watersheds, Technical Release No. 55, U.S. Department of Agriculture, January 1975
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7. J.T. Riedel, J.F. Appleby and R.W. Schloemer: Hydrometeorological Report No. 33, U.S. Department of Commerce, U.S. Department of Army, Corps of Engineers, Washington, D.C., April 1956. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.
8. North Atlantic Regional Water Resources Study Coordinating Committee: Appendix C, Climate, Meteorology and Hydrology, February 1972
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10. The University of the State of New York - The State Education Department, State Museum and Science Service, Geological Survey: Geologic Map of New York, 1970
11. Y.W. Isachsen and W.G. McKendree, 1977, Preliminary Brittle Structures Map of New York, Hudson-Mohawk Sheet, New York State Museum Map and Chart Series No. 31B
12. T.C. Hopkins, 1914, The Geology of the Syracuse Quadrangle, New York State Museum Bulletin 171
13. Soil Survey of Onondaga County, New York, 1977, United States Department of Agriculture, Soil Conservation Service.
14. Konski Engineers, August 11, 1972, Westcott Reservoir Renovation, Syracuse, New York.

APPENDIX E

PREVIOUS INSPECTION REPORTS/AVAILABLE DOCUMENTS

REPORT ON
KNAPP RESERVOIR EMBANKMENTS

David R. Cooper
Consulting Hydraulic Engineer
June, 1929.

DAVID R. COOPER
CONSULTING HYDRAULIC ENGINEER
515 DILLAYE BUILDING
SYRACUSE, N. Y.

June 28, 1929.

Mr. Nelson F. Pitts
City Engineer
State Tower Bldg.,
Syracuse, N.Y.

SUBJECT: Knapp Reservoir Embankments

Dear Sir:

Several weeks ago you asked me to make such investigations as I deemed necessary or expedient and report to you as to whether certain portions of the Knapp reservoir embankments have been satisfactorily compacted. You also requested that I advise you as to the best method to be used in filling in the breach in the reservoir embankment at the northwest end. Having completed my investigations I am glad to submit to you my conclusions as follows:

Conclusions:

1. Concerning the degree to which the existing embankments have been compacted, I am glad to report as a result of a rather elaborate series of tests I conclude that they have been satisfactorily compacted. Whether this has been wholly the result of the contractor's operations or largely due to the very heavy rains of the early spring is aside from the question.

2. After a series of tests to determine the extent to which the existing embankments have been compacted and a study of the various grades of material available for embankment construction, I recommend that the breach in the embankment be filled with material consisting mostly of gravel and sand (having very little if any clay) and that it be rolled with grooved rollers, the material being placed in 6" horizontal layers using plenty of water, particularly in dry weather, and that suitable trenches be cut in the bottom of the opening and up the end slopes of the old

embankment between the new and old work. My detailed recommendations on this subject have already been included in a letter addressed by your Department to the contractor under date of June 21, 1929.

Details of Investigation:

On May 18th, accompanied by Mr. Stewart of your Department, I visited the Knapp reservoir work and Mr. Stewart pointed out to me the portions of the embankment which you thought might not be satisfactorily compacted. I requested that test pits be dug at certain selected points in the questionable embankment and also in the portion that was thought to be all right. I also suggested a similar test pit in a shelf of original material on the east side of the reservoir. Subsequently I decided to excavate still another sample from the sand and gravel material showing in the face of the bank at the northeast side of the reservoir excavation.

Mr. Stewart and his men carried out my instructions with great care and I kept in intimate touch with them during the progress of the work, visiting the site at intervals.

Mr. Benjamin Rounds, Jr., was the foreman in charge of the excavation of the pits and the execution of the tests to determine the extent to which the material had been or could be compacted. Mr. Rounds has submitted a complete report in writing to Mr. Stewart under date of June 18, 1929.

Generally speaking the object of some of the tests was to determine whether it would be possible to take a cubic yard of material accurately measured and excavated from the existing embankment and compact it by some practical method

to a degree equal to or greater than it has already been compacted in the bank. With this object surface pits about 8 ft. square were sunk to a suitable depth and the bottom brought to a level plane. A 3 ft. square excavation was then carried on down in the center of the 8 ft. pit by using a box of ordinary caisson type, the edges of which were sharpened so that the box could be driven down as the excavation proceeded. By this method an exact cubic yard was excavated in each case, the material being weighed as fast as it was excavated. As soon as each batch of excavated material was weighed it was dumped into another strongbox 3 ft. square inside and tamped in place with a hand tamp weighing 18 lbs., in order to see if this method would produce a degree of compaction equal to or greater than that of the existing embankment from which the sample was taken. Although the excavated material was apparently of a favorable nature for tamping it was in no case found possible to compact any of the samples taken from the bank to the extent to which they had already been compacted in the existing embankment. This indicated in general that even though the contractor may not have compacted the material sufficiently by his own operations, nevertheless the results are now satisfactory, probably on account of the heavy rains of the past spring combined with the natural settling action over the long period of time over which he has been conducting his operations on this work.

The test that was made on a sample cubic yard taken from the natural ground on a shelf at the east side of the

reservoir excavation showed clearly that by the ordinary tamping method it was possible to compact a cubic yard of natural earth into a smaller volume than it occupied in its original position. The single test that we made of this nature showed that it was possible to reduce the volume of the original material by tamping to the extent of a little more than 2%.

In addition to our attempts to compact the material by tamping, we also tried puddling the material into the 3 ft. square boxes. In two instances it was found impossible to compact the material as much by this process as it could be compacted by tamping. These results pointed conclusively to the existence of so much clay in the mixture as to render puddling a questionable method for getting the most compact embankment. As you doubtless know clay has a tendency to bulk or swell with the application of water. It also has a tendency to clog the interstices in gravel or sand to such an extent that the draining away of surplus water from an embankment built with such material is greatly retarded. Therefore, the use of any considerable percentage of clay in an earth embankment to be formed by hydraulic methods is prohibited by most engineers experienced in hydraulically filled embankments or dams.

In order to satisfy myself whether the material available in the face of the principal remaining excavation at the northeast side of the reservoir which is composed mostly of gravel and sand could be compacted satisfactorily by puddling, I requested Mr. Stewart and his men to make a further test of

this particular material and they did so with the result that we found it possible by shoveling the material into a 3 ft. square box and turning an ordinary garden hose on the material as it was shoveled in, to compact the mass from an original depth of 36" to a depth of 34-7/8" measured immediately after the puddling process. After standing over the week-end the material of this test had settled to a net depth of about 34" so that it is apparent there is material on the ground which can be satisfactorily compacted by hydraulic methods and probably to an extent greater than would be possible by tamping. Nevertheless I have concluded that if the remaining embankment can be completed promptly this summer, it will be in the interest of the city to do so even though the subsequent settlement might be greater than if strictly hydraulic methods were used in making the remaining fill. Accordingly I have advised Mr. Stewart and have assisted him in drafting a letter to the contractor to carry out my suggestions to the effect that the method to be used shall consist primarily of rolling in a direction parallel with the water line of the reservoir and never at right angles to the same, the rolling to be done in accordance with the original specifications for use of grooved rollers and as much water to be used as may be without softening the fill so much as to hamper the contractor's operations.

It may clarify my idea somewhat to say that while the use of sluicing with selected sand and gravel would undoubtedly result in an embankment initially more compact than

could be secured by rolling and wetting, I am quite sure that with the clay available at the site, the length of time consumed in the operation would be a great deal longer than by resorting to wetting and rolling. I furthermore believe that a closely comparable result will be obtained by having the embankment finished at the earliest possible date by wetting and rolling and then the fall rains and the action of the winter frosts and spring thawing and the spring rains will all have an opportunity to supplement the contractor's work so that I should expect by the construction season of 1930 you will have an embankment fully as solid as could have been secured by the other method and meanwhile your Department will be doing nothing to interfere with the prompt completion of the Young Construction Company's contract which has already exceeded the original time limit by a full year and a half.

Following is a tabulation of the results of excavating a cubic yard of material from different locations and compacting it in heavy boxes of exact dimensions either by tamping or puddling with water.

COMPACTION TESTS - KNAPP RESERVOIR EMBANKMENTS

Tests made in May and June, 1929

Test Excavations Made to Include in Each Case an Exact Cu. Yd., i.e., 36" square and 36" deep, each sample being subsequently placed in a 36" square box and compacted to the depth given in the following table. When material was tamped in boxes an ordinary 18 lb. hand tamp was used. Where the term "Watered" is used it indicates that the material was moistened sufficiently to assist the tamping. Where the term "Puddled" is used it means that the water was sluiced with a practically constant stream from a hose, making the material too wet for tamping.

Hole No.	Station	Compacted Depth in Box	Compaction in Inches	Compaction Method
1	3 + 54.5	37"	Bulked 1"	Tamped
2	5 + 89	37-3/4"	" 1-3/4"	"
3*	3 + 61	35-1/4"	3/4"	"
3*	3 + 61	36"	Zero	Watered
4	7 + 17.5	36-1/2"	Bulked 1/2"	Tamped
4	7 + 17.5	37"	" 1"	Puddled
5	N.E. Bank Face	34"	2"	"

*Note: Hole #3 was excavated from a shelf of original undisturbed ground on the east side of the reservoir excavation.

The material taken from Holes #1-4 inclusive was weighed when excavated and was subsequently dried out (substantially dry) and again weighed in order to determine approximately the moisture content of each sample as an index of the amount of moisture still retained in the embankment at various points. The results of these tests are as follows:

Hole No.	Wt. per Cu.Yd. as Excavated	Wt. per Cu.Yd. Dry	Loss Lbs. by Weight	Percent Moisture
1	3605 Lbs.	3446 Lbs.	159 Lbs.	4.61%
2	3865 "	3589 "	276 "	7.69%
3	3577 "	3431 "	146 "	4.26%
4	3667 "	3425 "	242 "	7.1 %

Inspection of the foregoing table shows that in two instances the percent of moisture exceeded 7% by weight. The average moisture content of the four samples was 5.915% by weight. The average dry weight of the material excavated from Holes #1-4 inclusive was 3473 lbs. per cu. yd. or 128.5 lbs. per cu. ft. This is a very good unit weight to have for such an embankment as this. The moisture content as disclosed by the tests is somewhat high but will undoubtedly be materially reduced upon the completion of the grading and construction work so that storm water drains off the bank better than in the past.

On June 20, 1929 a line of levels was run around the top of the existing embankment, the elevations being taken at 33 points. At one of these points the elevations indicate that there has been no settlement. At three other points a raise of grade is indicated by the levels. This, of course, would be impossible unless some additional material may have been deposited accidentally or otherwise since the older levels were taken. At twenty-nine points the bank was found to have settled to an extent varying from a minimum of 1/10th of a foot to a maximum of 1.2 ft., the average settlement at these twenty-nine points being 5-5/8" or roughly one half a foot, between the dates of Oct. 10, 1923 and June 20, 1929. Expressed in percentage of the height of embankment, the shrinkage varied from less than 1% up to a maximum of 9.2%.

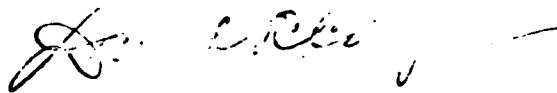
It is unfortunate that there were no permanent elevation plugs set in the top of the old embankment, otherwise

I am quite sure the results of these settlement measurements would have been more consistent and satisfactory. Nevertheless they show that considerable settlement has taken place and that it is, therefore, imperative to make the remaining embankment as compact as it possibly can be made without unduly delaying the completion of the embankment work. This I believe can be accomplished by the methods outlined in detail in the accompanying letter of June 21, 1929 to the Young Construction Company.

I strongly recommend that in the top of the remaining embankment your engineers place elevation plugs with bottom discs at least 3 ft. below the surface, the elevations to be taken on these plugs immediately after the embankment is finished and at fairly regular intervals of about one month thereafter so that your Department may have available next year some fairly exact data as to the amount of settlement that has taken place. I think it might be well to have a few such plugs placed now in the old embankment for purposes of general comparison.

In accordance with your request I shall arrange to make regular inspection of the progress of the remainder of the work on the reservoir embankments and shall report to you at intervals as to whether the contractor is in every case carrying out his obligations.

Respectfully submitted,



DRC:HN

June 21, 1929

Mr. John Young
Young Construction Company
Brighton & Hunt Avenues,
Syracuse, N. Y.

Dear Sir:

Referring again to the subject matter of my letter of January 7, 1929, to you, I wish at this time to supplement the instructions given you in that letter concerning the construction of the Knapp reservoir embankment.

You are aware of the fact that we have recently made some rather elaborate tests to determine the extent to which the material composing the existing banks has been compacted. We are glad to say that the results of these tests have shown clearly that the existing embankments have been satisfactorily compacted. You will probably realize, however, that the fact that these old banks are already so thoroughly compacted makes it all the more necessary to use every reasonable precaution to make the remaining section of the embankment as compacted as it can be made in order that the new part will not settle materially more than the old part. You will realize that if the new part of the bank should settle appreciably more than the old part, after the lining is in place, it might cause serious cracking of the lining, with resulting leakage.

It is exceedingly important that the embankment is absolutely finished at the earliest possible date so as to have as much time as possible for settlement before the lining is placed. I would, therefore, urge you to expedite the work as much as you possibly can without detriment to the quality of the workmanship.

As to the character of material to be used in filling in the gap in the embankment, you are hereby advised that this material should be composed mostly of gravel and sand, which can readily be compacted with water and rolling. We would have preferred to have some clay, particularly in the water side of the embankment, but after observing the hard, lumpy condition of the clay material which you were handling on the job this morning, we have decided to allow you to proceed with gravel and sand material, without any attempt to use any appreciable quantity of clay. Such large, hard lumps as you were placing in the bottom of the cut this morning are absolutely unsuitable for use in this class of work.

Mr. J. Y. #2

As to the question raised between yourself and Mr. Stewart this morning with reference to whether or not you should take all the material out of the reservoir before filling in the breach in the embankment, we shall be satisfied to have you use your own judgment in this matter, with the understanding that if you choose to attempt to take out everything except just the yardage, you will need to fill the breach, you will, of course, have to accept the responsibility for the remaining material being suitable for the embankment construction, or you may have to bring back from the outside such good material as would be necessary to complete the job. However, I would say that we did not anticipate any difficulty in finding plenty of suitable material. It is, of course, possible that the character of the material as it now appears on the surface might change after being entered by the shovel.

Referring now to the depression through which you have been hauling your material to spoil for some time past, the bottom of this depression has, of course, been very much compacted with the constant driving of your trucks over it. In order to discourage the formation of seepage lines through the embankment it will be necessary to cut drainage trenches two to three feet deep across the bottom of this depression and up the ends of the adjacent embankment. Before these trenches are cut, the entire hard surface should be thoroughly scarified; then the new material should be brought in and brought to a level and rolled with the grooved rollers called for in the specifications and thoroughly compacted to the satisfaction of the Engineer. On account of the congestion of the working area, it will undoubtedly be necessary to use tamps for the areas that are inaccessible to the rollers.

Referring to the provisions on page 11 of the specifications under the subject of "placing material", you will note that the specifications call for placing the material in layers not exceeding 12 inches in thickness. We realize that in asking you in our letter of January 7, 1929, to put this material in with layers not over 6 inches deep we may appear to be making the specifications a little more rigid than they originally were, but would say that the reason for doing so is because the concession that was made to you in permitting you for your convenience to haul all of the material through the depression instead of carrying the bank up at a uniform level has created a condition which requires these special precautions, and we trust you will proceed promptly to carry out the provision of 6 inch layers without questioning the advisability of our imposing this requirement.

Mr. J. Y. #3

Referring further to the same paragraphs of the specifications concerning the use of water to assist in compacting the material, I wish to advise that we shall insist that you be prepared to use all the water that may be required according to weather conditions to make the most compact bank without softening the material too much for you to haul over it.

In using your grooved rollers with whatever weights may be necessary to bring them to the specification requirements, you are advised that under no circumstances should the material be rolled crosswise of the embankment.

Yours very truly

City Engineer

NFA/CB

B. K. HOUGH, CONSULTING ENGINEER

Soils and Foundation Engineering

SAVING BANK OFFICE BLDG.
114-118 N. TIOGA ST.
ITHACA, N. Y. 14850

B. E. HOUGH, P.E., A.I.C.E., A.S.C.E., A.S.T.M.

July 27, 1970

TELEPHONE: AREA CODE 607
272-0770

Richard Kunder, Div. Engr.
Division of Water Supply
City Hall
Syracuse, New York 13202

Dear Mr. Kunder:

Reference is made to our inspection of the Westcott Reservoir and subsequent field conference on July 17, 1970. The reservoir had been emptied and was in the final stages of being cleaned at that time and we therefore had an opportunity to make a reasonably extensive examination of the gunite lining.

At one point on the floor of the reservoir, a break in the lining had been discovered by your assistant as the last of the water was being drained out. The lining at this point had been broken open and removed for the space of about one panel of wire mesh to permit examination of the stone drainage layer beneath. According to your report, this was the only place that an actual break had been found.

Elsewhere both on the floor and sides of the reservoir, what seemed to me like quite a number of cracks were found. At the time of our inspection, these cracks were pretty well closed, some resembling little more than hair cracks. However, the reservoir was then empty and the lining exposed directly to the sun and air at fairly elevated temperatures. It could be theorized, therefore, that when the reservoir was filled and the lining at a considerably lower temperature subjected to full water pressure, these cracks might open. The joints appeared to be in reasonably good condition.

You reported that ever since the reservoir was built, there has been what might be termed moderate leakage. This evidenced itself as flow from the underdrainage system which could be observed at a point in the gate house and from reports of moisture due to seepage to nearby properties. The reservoir has been in service something like 40 years.

BR

B. K. HOUGH, CONSULTING ENGINEER

Mr. Kunder
July 27, 1970
Page 2

In my opinion, relatively steady, moderate leakage might very well be due to the more or less random system of fine cracks in the liner mentioned above. I am unable to account for the very heavy flow which developed suddenly (while the operator was away for lunch) and which led to taking the reservoir out of service. It does not seem possible to me that so much water could pass through one small break in the lining and then through the underdrainage system. There is a suggestion of a channelling of the flow due to underscour, but where the water broke through the liner is not apparent.

Reservoirs like Westcott place great dependence on the integrity of the liner. The embankments around the sides do not function primarily as earth dams to retain the water. Their purpose is to provide support for the liner and the underdrain. They cannot very well function as earth dams, in fact, as long as the underdrainage system remains open. In the writer's opinion, a brittle, inelastic liner such as gunite on what must be assumed to be a relatively yielding support cannot be considered as a good combination. Furthermore, the placement of a crushed stone drainage course directly on a soil surface without one or more filter courses between would probably not be proposed in modern practice. In view of these considerations, the writer is doubtful that efforts which are limited to sealing existing cracks in the liner will be of lasting benefit. There is therefore a possible need for completely relining the reservoir, this time with a material having considerably more ductility. One example would be the asphalt linings installed in the Terminal and Eastern reservoirs when they were built a few years ago.

Since it has proved possible to take the Westcott reservoir completely out of service for a number of months and to plan on keeping it out for a somewhat indefinite additional period, one wonders whether the reservoir could not be permanently retired if repairs prove to be too costly. The many changes which have been made in the City and County's supply and distribution systems in the last few years might conceivably make this possible. It is, at least, an alternative solution which may deserve consideration. There would actually be a number of advantages to taking a large, open reservoir out of service if adequate distribution could be maintained by other means.

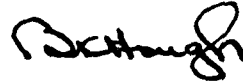
B. K. HOUGH, CONSULTING ENGINEER

Mr. Kunder
July 27, 1970
Page 3

The above comments are those which have occurred to the writer since our inspection. If other possible solutions are seen later, you will be advised.

Very truly yours,

B. K. HOUGH, CONSULTING ENGINEER


B. K. Hough

BKH/sch



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COPY
PROJECT NO. 7207
WESTCOTT RESERVOIR RENOVATION
SYRACUSE, NEW YORK

ENGINEER'S REPORT OF
INSPECTION, ANALYSIS, AND
METHOD OF RENOVATION

Submitted by:

KONSKI ENGINEERS, P. C.
McCarthy Building
113 East Onondaga Street
Syracuse, New York 13202

August 11, 1972

MCCARTHY BUILDING
113 E. ONONDAGA STREET
SYRACUSE, NEW YORK 13202
(315) 471-2101
CABLE ADDRESS KONENGRS

JAMES L. KONSKI, P.E.
WILLIAM H. HUGHES, P.E.
CHARLES W. WOOD, P.E.
ASSOCIATES

KONSKI ENGINEERS

DESIGN AND SUPERVISION
OF CONSTRUCTION
BRIDGES AND HIGHWAYS
EXPRESSWAYS
INDUSTRIAL CONSTRUCTION
PARKING STRUCTURES
DAMS, FOUNDATIONS, MAPPING
AIRPORTS AND PUBLIC WORKS
WATER AND SEWAGE SYSTEMS
INVESTIGATIONS AND REPORTS

August 11, 1972

City Engineer
City of Syracuse
City Hall
Syracuse, New York

Attention: Mr. Harry Rook

PROJECT NO. 7207
WESTCOTT RESERVOIR RENOVATION
SYRACUSE, NEW YORK

Dear Sir:

In accordance to your request, we have investigated the cause of leakage, evaluated our findings, and submit herewith our report and recommendations relative to the above project.

Investigating Engineer:

Charles W. Wood, P. E.

Respectfully Submitted,
KONSKI ENGINEERS

James L. Konski

JLK:ph

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DRAWINGS AND TABLES

Field Inspection, July 1972, Drawing No. 7207-1

Location of Core Borings, Drawing No. 7207-2

Pittsburgh Testing Laboratory Report

Article by E. P. Stewart (Existing Construction Details)

Inspection Report by E. P. Stewart, August 18, 1970

Description of Photographs

Photographs

PROJECT NO. 7207
WESTCOTT RESERVOIR RENOVATION
SYRACUSE, NEW YORK

RECOMMENDATIONS

Three basic methods of renovation for the reservoir have been considered. Certain repairs such as reconstructing joints, and patching cracks are in general required in all methods.

With Method No. 1, there is the possibility that small cracks not visible at the time of inspection or repair would remain unsealed resulting in continuing leakage when the reservoir is filled. If additional cracking developed after repairs, when the reservoir is filled, no protection would be provided against leakage. Depending on the seriousness of these extending defects, the reservoir would have to be drained and inspected, and the cracks repaired. Further damage to the reservoir could result when drained. While this is initially the least costly method at about \$160,000, it is more of a temporary repair and a 5-year life might be a reasonable assumption of the magnitude of its life. When increase in cost of construction is considered, this method could become appreciably more expensive than Method 3.

With Method No. 2, all the work required for Method No. 1 would have to be performed, and the existing reservoir lining paved with

RECOMMENDATIONS (Continued)

asphalt. Although the asphalt pavement could be designed with adequate thickness and density to provide protection against leakage there would be the possibility of cracking in the asphalt over the existing expansion joints, smaller cracks, and the granite blocks on the side slopes. Difficult access to the work area and the necessity of operating paving equipment on the relatively steep slopes of 1 on 2 would increase the cost of paving appreciably. Because of the possibility of cracks developing in the asphalt paving, the added cost of this method does not, in our opinion, justify its cost.

With Method No. 3, a fabric lining is utilized. Initially most of the work under Method No. 1 would be necessary. The expansion joints and areas of broken and spalled lining would require repair and the granite block portion of the side slopes covered with gunite to provide a smooth surface for the installation of a prefabricated lining. The repair of small cracks would not be necessary. The special linings can then be placed. This will provide a positive seal for construction joints between the existing gunite lining and pipes, piers, gate house foundation, and aerator foundation. The estimated magnitude of construction cost would be about \$680,000.

RECOMMENDATIONS (Continued)

Various linings suitable for installation at the Westcott Reservoir are available. Particular reference is made to a prefabricated, reinforced, asphalt panel Butyl EPDM. Data from three manufacturers of such material were reviewed.

From an evaluation of manufacturers' data examined by us and other reports available to us, it is our opinion that the estimated life of a properly installed prefabricated lining of the type considered might be in the magnitude of about fifty years; but it should be noted that the manufacturer's guarantee may be about twenty years.

As leakage has become appreciable, it is extremely desirable that the reservoir be repaired and filled with water prior to the onset of winter weather 1972. Based on its life and dependability it is recommended that the reservoir be renovated using Method No. 3, the performing of the necessary repairs and installation of a prefabricated lining.

WESTCOTT RESERVOIR RENOVATION
ECONOMIC ANALYSIS OF ANNUAL COSTS
(FOR GUIDANCE ONLY)

Method No.	1	3		
Type Construction	Renovate joints, cracks & granite block	Repair joints & install prefabricated lining		
Estimated Cost	\$160,000	\$680,000		
Assumed "Life" Years	5	50		
Period of Payment (Years)	<u>5</u>	<u>50</u>	<u>20</u>	Avg. for <u>50 yrs.</u>
Annual Cost (Capital Recovery)				
4% Bonds	\$ 35,941	\$ 31,654	\$ 50,100	\$ 20,040
5% Bonds	\$ 36,955	\$ 37,250	\$ 54,500	\$ 21,800
6% Bonds	\$ 37,984	\$ 43,139	\$ 59,400	\$ 23,760

Example: \$160,000 at 4% for 5 years

Capital Recovery Factor: 0.22463

\$160,000 (.22463) equals \$35,941

NOTE: Method assumes no increase in construction cost with time. Actual increase in construction cost would increase differential cost of Method No. 1 appreciably greater than Method No. 3.

DESCRIPTION OF RESERVOIR

The Westcott Reservoir, located just south of West Genesee Street between Fay Road and Orchard Street, was constructed in 1930-31 by the City of Syracuse. It is a gunite lined earth distributing reservoir with a capacity of 107,000,000 gallons, approximately 1100 feet long, 565 feet wide and 40 feet deep. The inside bank, which slopes at 1 on 2, measures 86 feet along the slope. The gunite lining extends 66 feet up the side slope, the remaining 20 feet being mortared granite block on gunite base topped by a stone curb.

Intake is by a 42 inch cast iron pipe extending approximately 630 feet into the reservoir from the south end, and terminating in a 38 foot high aerator. The pipe is supported on short concrete piers.

Outlet is by a 48 by 48 inch concrete tunnel and 12 inch cast iron drain pipe located at the south end of the reservoir.

Original construction details are described in the attached article by Mr. E. P. Stewart, Division Engineer of Water Supply for the City of Syracuse at the time of construction.

HISTORY OF LEAKAGE

During a conference with Mr. E. P. Stewart, retired Division Engineer of the City Water Department, the following information was obtained relative to the history of leakage in the reservoir:

1. At south gate house the gunite side panels had been directly tied to the gate house walls, but that due to displacement and separation at the time of original construction this was rebuilt as a construction joint. Embankment for the side slopes adjacent to the gate house was placed after the gate house was constructed.
2. At the time of initial construction as soon as the reservoir was full of water, leakage was encountered in the area of the inlet pipe passing through the gunite side slopes. This was repaired by a diver placing clay in the joint around the pipe between the pipe and gunite. Leakage was considerably reduced.
3. Measurements taken on the amount of leakage after construction stabilized at about 21,000 gallons per day. This remained fairly constant.
4. Prior to 1970 it was reported that water seeped out on the west side of reservoir embankment and that this seepage stopped after draining the reservoir in 1970.

HISTORY OF LEAKAGE (Continued)

5. Leakage from the reservoir in 1971-72 after filling with 8 feet of water was at a rate considerably greater than the 21,000 gallons per day previously experienced.
6. From the time the reservoir was initially filled after construction, it was not drained until 1970.
7. The eastern side of the reservoir was constructed on sandy material in contrast to the south and west sides, which were constructed on very dense glacial fill.

During a conference with Mr. William Hughes of Konski Engineers, Mr. Richard Kunder, Division Engineer of Water Supply for the City of Syracuse, the following information was obtained relative to recent leakage in the reservoir:

1. Leak apparently started Saturday afternoon, January 10, 1970.
2. Water bubbling up in the street in front of 427 Fay Road.
3. Water supply to reservoir was cut off and reservoir lowered by consumption from January 12, 1970, to January 16, 1970.
4. Reservoir lowered by leakage January 16, 1970, to April 17, 1970.

1

HISTORY OF LEAKAGE (Continued)

5. Reservoir was then drained from April 17, 1970, to May 7, 1970, when it was empty.
6. Puddles swept out, reservoir was cleaned, repaired some joints.
7. Void was found after dewatering in the bottom (southeast quadrant) in the 1970 inspection. The void was grouted, rich mortar mix and mesh placed on top.
8. Wet fall in 1970 slowed clean up and joint repair, some joints were repaired but sealant over repaired joints not placed, apparently due to advent of cold weather.
9. The reservoir was left dewatered over the winter of 1970-71.
10. The reservoir was filled with about 8 feet of water over the winter of 1971-72.

On August 18, 1970, Mr. E. P. Stewart inspected the drained reservoir. Repairs and clean-up of the reservoir were in progress at this time. In general, he noted that the lining appeared to be in excellent condition but that there were several areas where cracks and spalled joints should be examined in detail. His observations were included with this report.

FIELD INSPECTIONS

On April 14, 1972, a cursory inspection was made of the Westcott Reservoir. Present during the inspection were Mr. Tony Baldino and two associates from the Division of Water, City of Syracuse and Mr. William H. Hughes and Mr. Timothy R. Mee of Konski Engineers.

At the time of this inspection there was an estimated 8 feet of water in the reservoir. The inspection covered the upper portion of the gunite slopes.

There were numerous small or hairline cracks in the gunite lining. There was a long horizontal crack in the gunite in many of the gunite panels at about the same elevation. No measurements were taken at this time of its location but it appeared to be at or near the location of the anchor wall. These cracks had been repaired in most cases.

Some of the joint material in the transverse joints between the gunite panels on the slope had squeezed out of the joint.

There were some areas of cracked gunite around these transverse joints. One particularly bad area between panels S-15 and S-16 on the east side.

FIELD INSPECTIONS (Continued)

There were a few minor areas of spalling in the gunite lining.

At the top of the gunite lining where it joins the stone there were some moist areas. It appeared that some moisture may be coming from the joint between the top of the gunite and the bottom of the stone.

Signs of previous joint repairs were observed around the upper gate house. It was also mentioned that there was a possibility of voids under some of the panels in the bottom of the reservoir.

Photographs labeled "A", included with this report, were taken showing typical conditions of the gunite lining.

It was recommended that the reservoir be drained at a time and at a rate to insure no further damage to the gunite lining and that the lining be cleaned of debris to enable a thorough inspection.

On May 26, 1972, Konski Engineers made an inspection at the Westcott Reservoir. Present during the inspection were Mr. William H. Hughes and Mr. Charles W. Wood of Konski Engineers and Mr. John Murphy of the Water Division, City of Syracuse.

FIELD INSPECTIONS (Continued)

Mr. Kunder had stated that some complaints had been received from two homeowners on the west side of Fay Road, that there was seepage through the embankment of the reservoir.

With Mr. Murphy, Mr. Hughes and Mr. Wood inspected the backyards of DeMario and Jones. These homes are on Fay Road and are east of the reservoir. The backyards were found to be damp, but no standing water was found. It was observed that both backyards are shaded by trees. Mrs. DeMario stated they had had some water in the cellar, but that this year was the worst; no water was in the cellar at the time of inspection.

Mrs. Jones was not home. Mr. Murphy said he would check that evening to see if Mrs. Jones had any water in her cellar; and, if so, he would take a sample for testing purposes.

It appeared from an inspection of the area that the natural surface drainage would drain off in the direction of these homes. Mr. Murphy stated that there was quite a snow drift on this side of the reservoir. The spring of 1972 had been a wet spring. All of these factors could have contributed to the water in these backyards.

At the time of this inspection the reservoir was being drained and had approximately $4\frac{1}{2}$ feet of water in it.

FIELD INSPECTIONS (Continued)

On June 20, 1972, Mr. Kunder contacted Konski Engineers to report that the reservoir was nearly drained. Some water still remained in the area adjacent to the intake pipe. The silt in the bottom of the reservoir was still very wet, and would have to dry before it could be brushed up and removed.

On July 5, 1972, a general inspection of the drained reservoir was conducted by Mr. Kunder. The purpose of the inspection was so that City Water Department personnel could point out to Konski Engineers areas of previous repair, typical deteriorated joints, areas of vertically displaced slabs, and areas of possible voids.

On July 6, 7 and 10, 1972, Mr. Wood and Mr. Boyce of Konski Engineers inspected the drained reservoir.

Drawing No. 7207-1, included with this report, indicates location of observed major cracking in the lining and deteriorated expansion joints. Drawing No. 7207-2 indicates locations at which 3 inch core borings were taken in the lining.

On the south and west side slope panels the interior gunite lining appeared to be holding up very well and generally in a good condition. Small cracks were evidenced in some of the panels. In all the expansion joints the bituminous material had been

FIELD INSPECTIONS (Continued)

extruded out of the joint. Scaling adjacent to the expansion joints existed at some of the joints. At the top of the gunite side slopes particularly at the expansion joints some heaving of the mortared granite blocks had taken place. The expansion joint at the toe of slope was generally in good condition. Bituminous material had also been extruded from this joint.

Beginning at the north end of the reservoir in the side slope Panel S-11, there was observed a repaired crack about half way up the gunite side slope and extending through Panel 12 and a portion of 13. A small unrepaired crack appeared at the same location in Panel S-14, skipped Panel S-15 and reappeared as a repaired crack in Panels, 16, 17, 18 and 19. Based on the construction drawings and on field measurements, this crack would be located over the key wall constructed vertically into the side slope and extending below the gunite lining to prevent lateral displacement in the crushed stone lining. The joint between Panels 14 and 15 was badly cracked and spalled. Between Panels 16 and 17 the joint was badly cracked, with no room for expansion remaining in some places along the joint. The granite blocks at the top of the slope expansion joints as the eastern side of the reservoir were also heaved to varying degrees. Between Panels 22 and 23 the top half of the joint had been repaired. Separation was noted in the sealing compound along and above the joint.

FIELD INSPECTIONS (Continued)

In the area around the gate house between the gunite side slopes and the gate house foundation walls separation had occurred. These had been filled with bituminous material. Diagonal cracking existed in the gunite side slopes beginning at the gate house foundation and running across a portion of the side slope. No cracks or holes were observed in the bituminous material. Bituminous material had also been placed around the 42 inch intake pipe between the pipe and the gunite side slopes. No puncture or separation was observed.

Patched cracking was noted in the side slopes and the concrete outlet tunnel where it intersects the gunite side slopes. The outlet sump in the floor of the reservoir was completely filled with silt and debris.

On the bottom panels of the reservoir, although the gunite lining appeared to be in generally sound condition, there was a considerable amount of small cracks within the panels. The more serious of these formed a pattern across several panels. On the west side of the reservoir this pattern ran from Panel E diagonally northwesterly through to the north edge of Panel G. On the east side of the reservoir the pattern ran from a repaired section of the lining northerly through Panels V and U. Almost all of the bottom panels on both sides of the reservoir indicated small cracks of varying amounts.

FIELD INSPECTIONS (Continued)

The expansion joints between the panels on the bottom of the reservoir were in various states of deterioration ranging from little or none except for extruded bituminous material to considerable vertical displacement, exposed copper water stop, exposed steel mesh, separated gunite, and voids beneath the gunite lining.

The most serious of these appeared to be along the joint between Panels C, D, E, F, G, H and K, L, M, N, O, P. Vertical displacement between Panels D and L was in the magnitude of $1\frac{1}{2}$ inches.

A hollow sound effect was noted when the slab was tapped with a hammer along the easterly side of the joint. The slab adjacent to the easterly side of the joint was vertically displaced above the westerly slab. Between Panels C and K the gunite lining was badly deteriorated exposing the exposed steel mesh and copper water stop. In Panel F the series of alligator type cracking would appear to have been caused by lack of bonding between overlaps in placing the gunite lining at time of initial construction. The joints between Panels FG, GH, HI, RS, ST, OS, TU, XY were badly cracked with the steel mesh and copper water stop exposed at several areas.

FIELD INSPECTIONS (Continued)

At the south end of the reservoir in the area of the depression in the floor under and adjacent to the 42 inch intake pipe a small crack was observed running parallel to the pipe and along the top of the rounding on both sides of the depressed portion.

The joints around the bottom of the short concrete piers supporting the intake pipe had been sealed with bituminous material. No separations or cracks in this material were visible.

The area around the bottom of the aerator at the gunite lining appeared to be in good condition.

CORE BORINGS

Core borings at locations shown on Drawing 7207-2 were taken by Pittsburgh Testing Laboratory on July 20 and 21, 1972.

Borings were taken to support and supplement visual inspection relative to voids under lining, depth of small cracks, and general condition of the gunite lining.

The depth of gunite cores removed ranged from $3\frac{1}{2}$ inches to 4- $\frac{3}{4}$ inches. Borings 1 through 5 indicated a void area underneath the lining along the west edge of Panels K, L, M, N, O. Boring No. 18 taken 5 feet easterly of the west edge of Panel M indicated no void under the lining. The greatest depth of void in this area measured approximately $1\frac{1}{4}$ inches. Boring No. 3 indicated approximately an inch separation between the bottom of gunite and top of footing.

In Panel F, Boring No. 6 indicated a horizontal separation in the slab down about 3 inches. Boring No. 7 in the same panel had a solid core. There were no voids under either Boring No. 6 or 7.

Between Panels H and I, Cores 13 and 4 taken along the westerly edge of Panel I indicated that the gunite lining was horizontally split about 3 inches down. Indications of bituminous joint sealer appeared on the bottom of Core No. 13.

CORE BORINGS (Continued)

On the easterly side of the reservoir cores taken in the badly cracked areas of Panels V and U showed no voids under the slab.

Cores taken in cracks indicate the slab to be cracked all the way through. Core No. 9 also showed an indication of severe horizontal cracking about 3 inches down.

Compressive strength tests made on representative solid cores by Pittsburgh Testing Lab indicated:

Core No.	PSI
3	4,040
10	8,500
18	9,190

ANALYSIS

The inspection has shown deterioration and spalling at the expansion joints, vertical displacement of some of the slabs adjacent to joints, extensive small cracks in the panels, voids under certain slabs adjacent to joints, and some heaving in the granite block portion of the side slopes.

Horizontal expansion of the panels and closing of the expansion joints has caused extrusion of the bituminous material in the joints. Once extruded the material does not go back into the joint leaving the joint open. In areas of vertically displaced slabs, damage to the copper water stop embedded within the slab quite probably has occurred. This might not be apparent to visual inspection right at the joint, and would take place particularly in areas of severe vertical displacement. With the loss of sealant in the joint, a damaged water stop and vertical displacement of the slabs, the joint has lost its effectiveness to prevent leakage.

Core borings have indicated that the small cracks observed within the bottom panels, and those running diagonally across several panels, go through the entire depth of gunite lining, with no apparent void between the bottom of the lining and the subbase. These cracks could be temperature and shrinkage cracks and due to settlement in the subbase underlying the panels. Frost

ANALYSIS (Continued)

action during exposure of the empty reservoir to the weather in 1970-71 could also have caused displaced joints and cracking in the panels. Under normal operating conditions with a head of 34 feet of water, these small cracks could significantly contribute to the leakage.

Although the granite block portion of the side slopes appear to be generally in good condition, some heaving of the block with consequently loosening of the mortar joint was observed. It was most evident at the top of the side slope expansion joints where they meet the granite block.

Since this area is near the normal operating level of water in the reservoir, ice action could cause a loosening of the mortar. Subsequent leakage through the loosened mortar in the joint would have been trapped by the gunite lining under the block. Also, if the gunite lining under the block has cracked, this would allow seepage into the crushed stone under the gunite lining. On the easterly side of the reservoir, this condition could cause the washing of fine sand into the under drain.

Although the joint around the outlet pipe at the gunite side slope appears to be sealed with bituminous material, some leakage could be occurring at this joint.

ANALYSIS (Continued)

In summary, damage to the reservoir exists primarily in the following areas:

Deteriorated expansion joints.

Vertically displaced slabs at expansion joints.

Cracks through lining within and across lining panels.

Separated joints between gate house foundation walls and
gunite side slope panels.

Cracking at intersection of 48 inch concrete outlet tunnel and
gunite side slopes.

Heaved granite block and cracked mortar joints.

METHODS OF RENOVATION & COMPARATIVE COSTS

Three basic approaches to the renovation of the reservoir were considered:

Method No. 1. Grout the void areas under existing lining panels, repair and seal deteriorated expansion joints, repair and seal all cracks, repair sections of heaved granite block, repair joints between gate house and side slope lining, repair and seal joints around inlet pipe and outlet pipe.

Method No. 2. Initial work as indicated in Method 1 plus the addition of a paving with asphalt.

Method No. 3. Grout the voids under lining panels, clean reservoir and expansion joints, repair spalled and broken areas adjacent to joints to provide a smooth surface. Then install a complete prefabricated liner.

Under Method No. 1 it would be necessary to remove the extruded bituminous material at expansion joints, clean the joint, widen closed joints by saw cutting, and seal a flexible compound. The smaller cracks should be widened at the top by notching and filled with flexible sealing compound.

METHODS OF RENOVATION & COMPARATIVE COSTS (Continued)

Under Method No. 2, the work required would be the same as for Method No. 1. The interior of the reservoir would then be paved with asphalt. Based on the height of water, three inches of asphalt is recommended. Three inches would also be required to cover the granite block portion of the side slopes from the top of the gunite lining to stone curb. Difficult access to the work area and the placing of paving on steep slopes would increase the cost appreciably above the average for most asphalt paving work.

Under Method No. 3, the extruded bituminous material at the joints should be removed and the joint cleaned. At the edges of vertically displaced panels, it would be necessary to construct a wedge of concrete to provide a smooth surface for the prefabricated lining. Broken and spalled areas should be repaired for the same reason. To avoid punctures to the prefabricated lining it is recommended by manufacturers of lining that the surface of the granite blocks in the area to be covered be smoothed out by an application of concrete. Embedment of the top of the prefabricated lining on side slopes is required if the lining is placed 1 or 2 feet above the normal operating level of the reservoir, this joint would occur in the granite block portion of the side slopes. Removal and replacement of one or two rows of granite block to allow for embedment of the liner would be required depending on the type of liner used. The liner could also be placed to cover the entire granite block portion of the slope with embedment of the

METHODS OF RENOVATION & COMPARATIVE COSTS (Continued)

liner back of the stone curbing at the top. Manufacturers of linings have stated that after the reservoir is filled no problem should be anticipated in the area where the liner would cover expansion joints. Linings can be formed to provide a tight seal around the bottom of the piers supporting the intake pipe, the bottom of the concrete base for the aerator, the joint between the gate house foundation and the side slopes, and the joint between the inlet and outlet pipes and tunnel.

CWW:ph

The American City

Editor: WLF

Section: Water Feature

Issue:

Article No.

Line Count

Illustrations

TITLE: Rubber lining helps leaking reservoir 'bounce' back

Blurb: Syracuse, N.Y., lines 40-year old reservoir with chemically inactive, flexible fabric to shut the valve on water losses

By-Line: By HARRY E. ROOK, City Engineer, Syracuse, N.Y.

1 When the flow from our Westcott Reservoir underdrain system
2 suddenly jumped from 25 gpm to 1000 gpm, our water division engineers
3 knew they had a problem. And when the 110 million gallon reservoir
4 was drained, our worst suspicions were confirmed.--cracks around the
5 gatehouse structure and in several sections of the bottom.

6 Today, the reservoir is back in operation with a bottom that won't
7 crack. Lined with a rubberized fabric that can be repaired underwater,
8 the reservoir stands ready for another 40 years of use.

9 Built during the early thirties, the reservoir was an oval, gunite-
10 and granite block-lined structure 1090 feet long and 550 feet wide.
11 Water stood 34 feet deep between its steeply sloped 2:1 embankments.

12 The reservoir had been built with a 3½-inch thick gunite lining.
13 Its underlying clay bottom was designed to prevent seepage losses in
14 that direction while a six-inch crushed stone subcourse on the slopes
15 was used to channel sidewall losses to an open-joint tile drain at the

The American City

Continuation of: Rubber lining helps leaking reservoir 'bounce' back Page 2

1 toe of the slope. The cast iron drain which carried this water away
2 through the embankment gave us the first warning of reservoir failure.
3 ~~Initial attempts at spot repairs were unsuccessful as tests showed~~
4 ~~water leakage was still excessive. After an extensive survey, Kensi~~
5 ~~Engineers of Syracuse recommended three alternatives.~~ ^{Three alternatives [} ~~The water division~~
6 ~~was faced with the choice of:~~ ^{found} ^{would be feasible.}

- 7 . Grouting void areas and general repairs without additional
- 8 lining.
- 9 . Repairs plus an asphalt concrete lining
- 10 . Repairs plus an elastomeric lining. (This option included a
- 11 requirement for additional guniteing.)

12 Although initially more expensive, a life cycle analysis showed
13 ~~that~~ that the third alternate would be most economical. And, experience
14 with a rubberized lining in a 10.5 million gallon reservoir belonging
15 to the nearby town of Solvay had been good. Although the three ply,
16 30 mil sheeting used in Solvay had withstood our severe climatic changes
17 without difficulty for two years, we decided to use a five ply, 45
18 mil fabric. ^{It was the 45-mil fabric} ~~we felt it~~ would be more resistant to tearing and would
19 hold up better in ^{the} ~~our~~ larger reservoir.

20 The first step in repairing the reservoir was to drill holes in
21 the concrete slabs and pressure grout the voids underneath. Then about
22 9000 lineal feet of joint were cleaned, recut and rebuilt to eliminate
23 sharp edges which could damage the rubberized fabric lining. The joints
24 were closed with Sika I-Gas sealant.

25 The final step of this preliminary repair phase, performed by

The American City

Continuation of: Rubber lining helps leaking reservoir 'bounce' back

Page 3

1 Northern Gunito of Oakland, Me., included covering the upper section of
2 the embankment with gunito. We were concerned that the roughness of the
3 granite facing in that above-water area might damage the lining. The
4 gunito assured that the entire reservoir had a smooth surface.
5 The ~~Hydrolin~~ liner, ^{made from nylon-reinforced Hydrolin synthetic rubber,} arrived from the Burke Rubber Co. of San Jose,
6 Calif., already precut and folded on pallets ready for installation.
7 The contractor for the job, Globe Linings Inc. of Long Beach, Calif.,
8 only had to position the pallets at the top of the slope, unroll the
9 folded material to the bottom, and unfold it across the sides. Each
10 separate sheet covered about 10,000 sq ft.

11 Seams were lapped from 4½ to 10 inches. The faces of the overlapped
12 sheets were first wiped with a solvent. After ^{a Hydrolin-based} ~~another~~ adhesive
13 was applied, the seams were closed up and rolled with a hand-pulled
14 roller. The cured seams have the strength to resist separation in
15 either a peel or shear attitude.

16 Seams on the sloped sides were kept vertical to prevent damage
17 by wave action.

18 ^{Special Waterproof "Boots"}
19 Special "boots" were used to keep water from getting under the
20 liner around the more than 100 concrete supports for the reservoir's
21 water intake pipe. The 42-in cast iron pipe ^{leads to an overflow} structure in
22 the middle of the impoundment. Most of these boots were made at the
23 factory, but some had to be cut on the site.

24 The tops of the boots were first cemented to the vertical face
25 of the pipe support. A stainless steel strap was then laid over the
fabric and fastened to the concrete support with a stud gun. The

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STETSON-DALE UTICA NY

F/G 13/13

NATIONAL DAM SAFETY PROGRAM. WESTCOTT RESERVOIR (INVENTORY NUMB--ETC(U))

DACW51-81-C-0009

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^{THE} American City

Continuation of: Rubber lining helps leaking reservoir 'bounce' back

Page 4

1 for the reservoir bottom was seamed to the lower part of the boat during
2 installation.

3 Similar seals were used around the base of the upper gatehouse
4 and where the 42-in pipe entered the reservoir.

5 The liner was anchored at the top of the reservoir sideslopes by
6 carrying it over the lip of the gunite and granite block base into a
7 trench. The trench was then backfilled on top of the lining material
8 to hold it in place. This also serves as a barrier to prevent water
9 from finding its way under the reservoir sides.

10 Before the Westcott Reservoir was placed back in service, the
11 lining was washed with a water and chlorine solution to disinfect it.
12 The cost for repairing and lining the 600,000 sq ft reservoir was
13 \$411,500--about \$0.69/sq ft.

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THE American City

Continuation of: PIX CAPS

Page 1

1. 1 Granite blocks used to face the above-water section of the reservoir
2 slopes had to be gunite-ed to prevent damage to the liner.
2. 3 The 45-mil liner was supplied in 80'x120' sheets for easy handling.
3. 4 ^{Hyp: A/n} Special boots were made for underwater pipe supports. Cement and a
5 stud gun were used to keep them watertight.
4. 6 Burying the upper end on the liner keeps it in place and provides
7 a water barrier ~~xxxxx~~ to protect sideslopes.

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City of Syracuse

NEW YORK
LEE ALEXANDER, MAYOR
DEPARTMENT OF ENGINEERING
400 CITY HALL
SYRACUSE, N. Y. 13202

RECEIVED

DEC 8 1980

STETSON-DALE

December 5, 1980

Stetson-Dale
185 Genesee Street
Utica, New York 13501

Attention: Mr. F. W. Byszewski, P.E.

Re: Westcott Reservoir
Federal Dam Inspection Program 1981

Gentlemen:

When representatives from your organization inspected Westcott Reservoir recently they requested the information detailed below.

Westcott Reservoir has no surface or sub-surface inflow into it. It is supplied with water from Skaneateles Lake by the supply conduits under gravity flow. The reservoir has no spillway or overflow. The water level is continuously monitored by a recording elevation gauge telemetered into an operations control center which is staffed 24 hours a day. An evaluation of all reservoir levels is made daily and more often if necessary. Flow into Westcott Reservoir to control its elevation is accomplished by adjusting either a 42-inch hydraulic valve or 30-inch pressure regulating valve located in the 42-inch inlet pipe to the reservoir. In addition, the flow from the lake can be reduced by throttling a 36-inch butterfly valve in the conduit supply lines by remote control from the operations control center.

The 12-inch vertical pipe in the stairwell leading to the upper gatehouse is not an overflow pipe but a well for the float for the elevation gauge. The gauge is located in the protective wooden enclosure against the far wall over the well opening in the upper gatehouse floor.

Page 2
December 5, 1980

Stetson-Dale

Attention: Mr. F. W. Byszewski, P.E.

As my assistant, Mr. Fordock explained, the wet spot on the northwest side of the reservoir always existed and was attributed to ground water. A check sample was taken again on December 1, 1980 with the following results.

<u>Sample Location</u>	<u>Hardness Grains/Gallon</u>	<u>Fluoride Ion P.P.M.</u>
Wet Spot	25	0.26 and falling
Reservoir Water	7	1.00

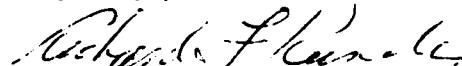
To differentiate between ground water and potable water, we test for hardness and fluoride content when checking for leakage throughout the system.

Water has always flowed from the reservoir underdrain outlet pipe. The rate of flow does vary with the water level. Listed below are flow rates for two different reservoir elevations.

<u>Date</u>	<u>Timing for 5 Gallon Container</u>	<u>Equivalent Flow G.P.M.</u>	<u>Reservoir Elevation U.S.G.S.</u>
November 4, 1980	7 Secs.	43 g.p.m.	621.82'
December 5, 1980	12 Secs.	25 g.p.m.	617.80'

If you require additional information, please contact this office.

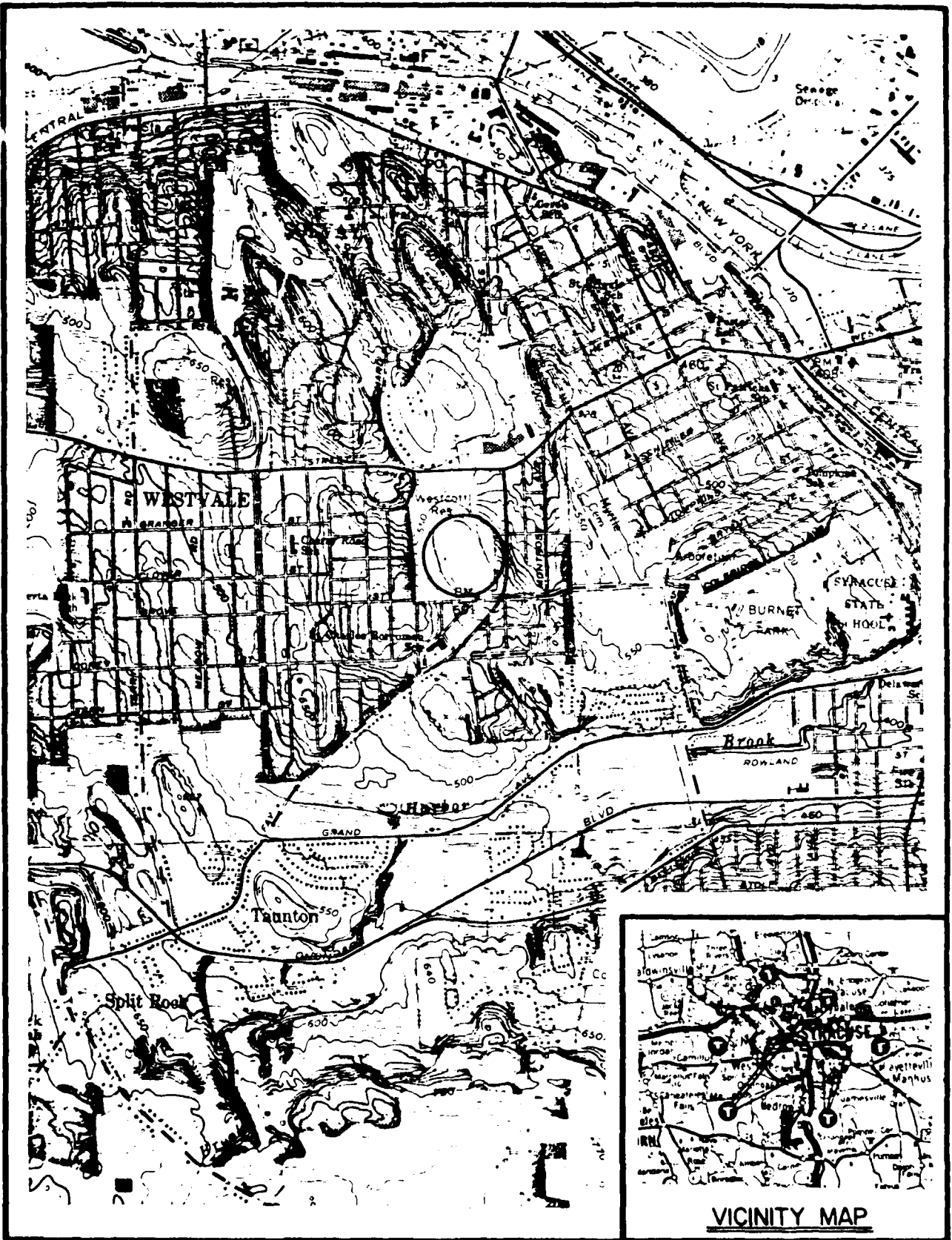
Very truly yours,


Richard F. Kunder, P.E.
Division Engineer - Water

RFK:dk

APPENDIX F

DRAWINGS



LOCATION PLAN

FIGURE I

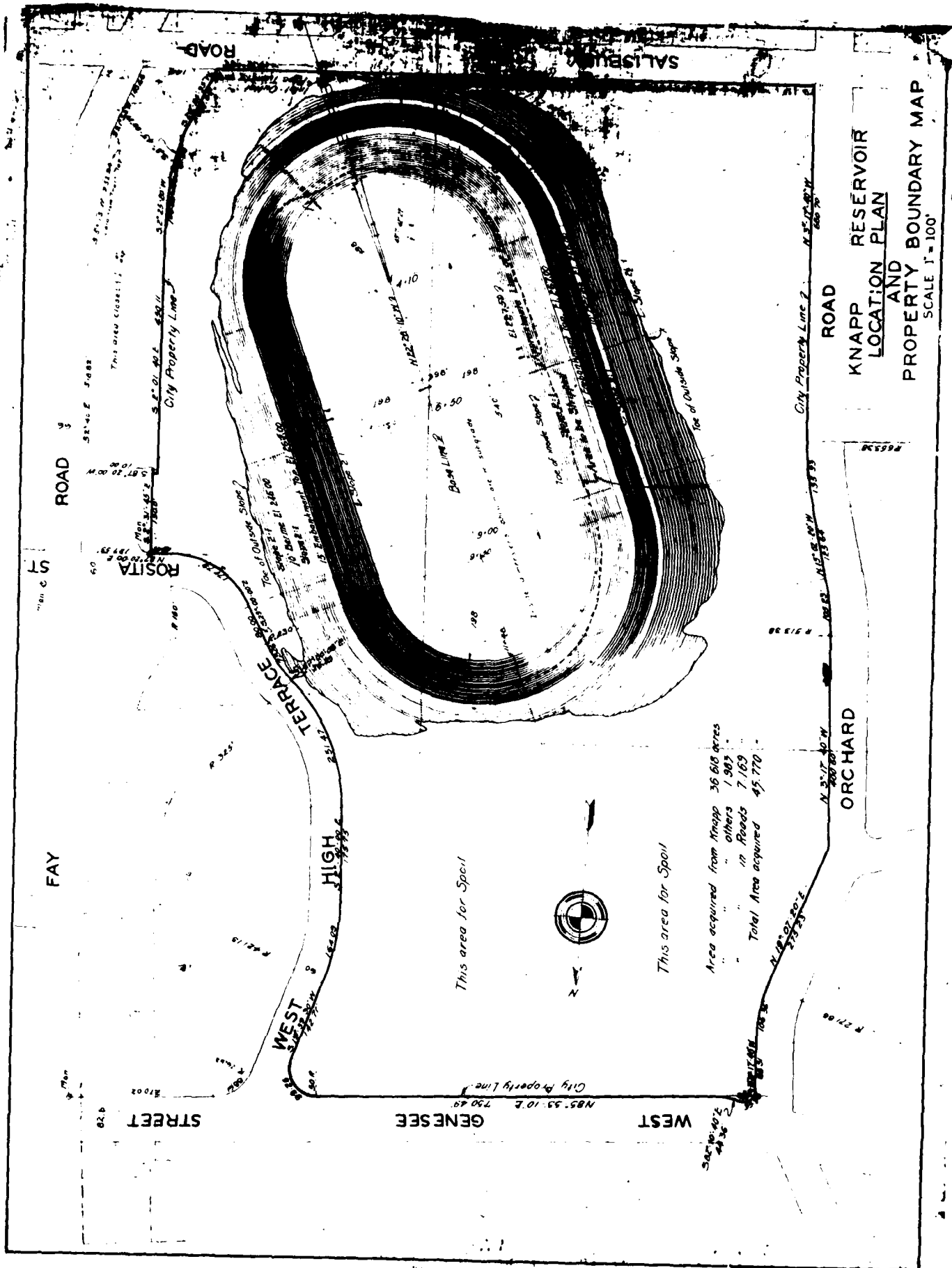
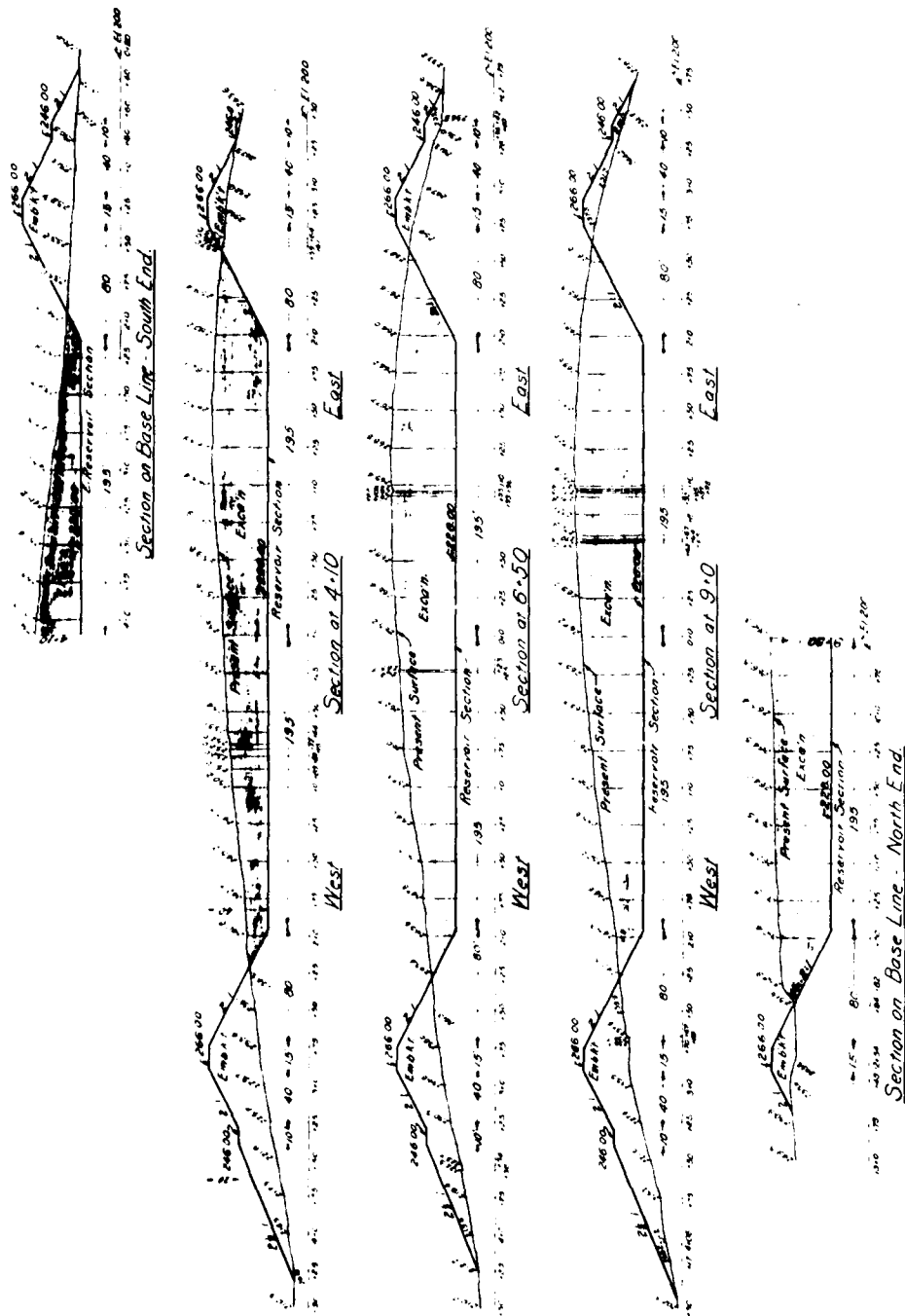


FIGURE 2



TYPICAL SECTIONS

SCALE 1"=50'

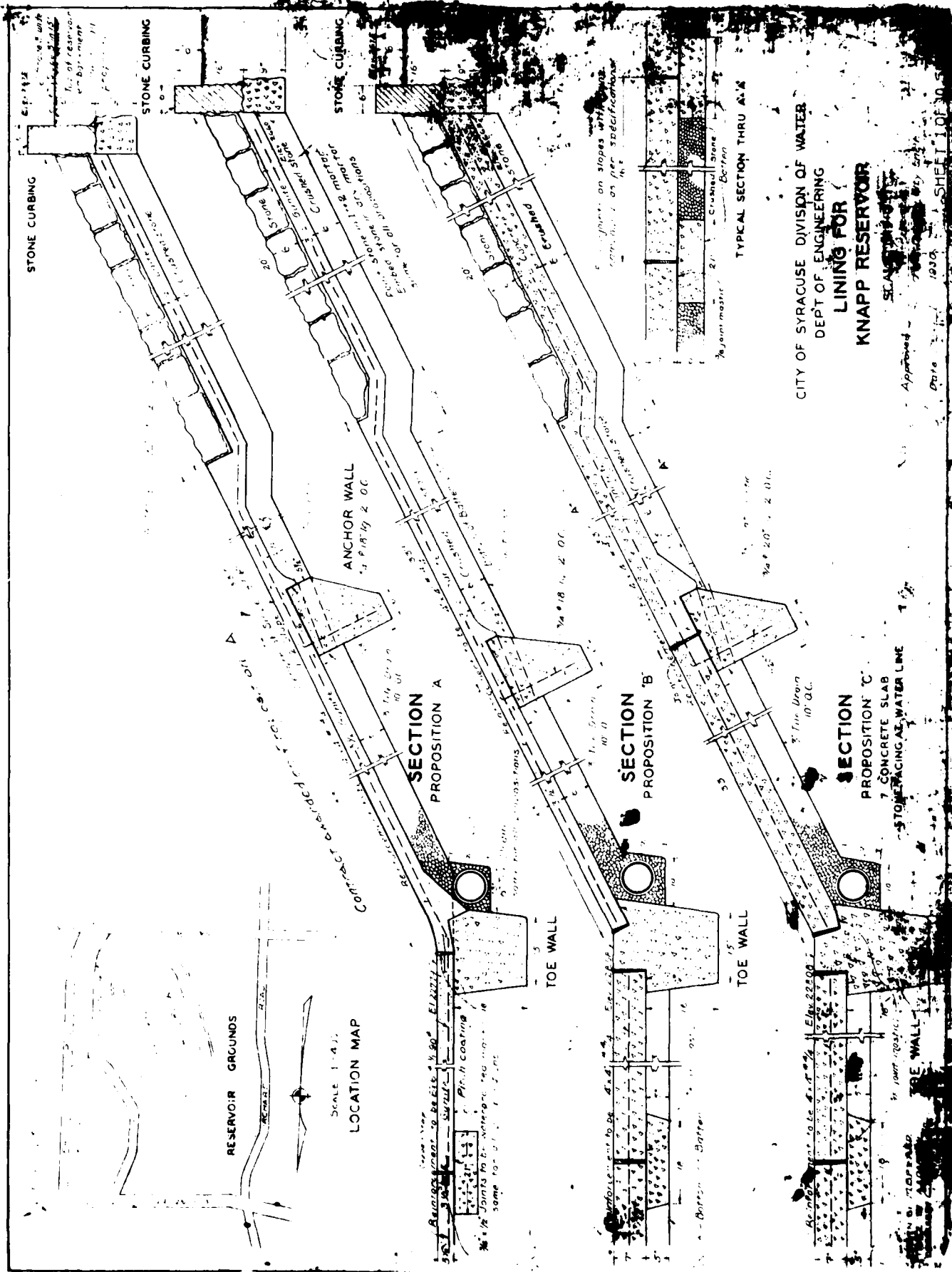
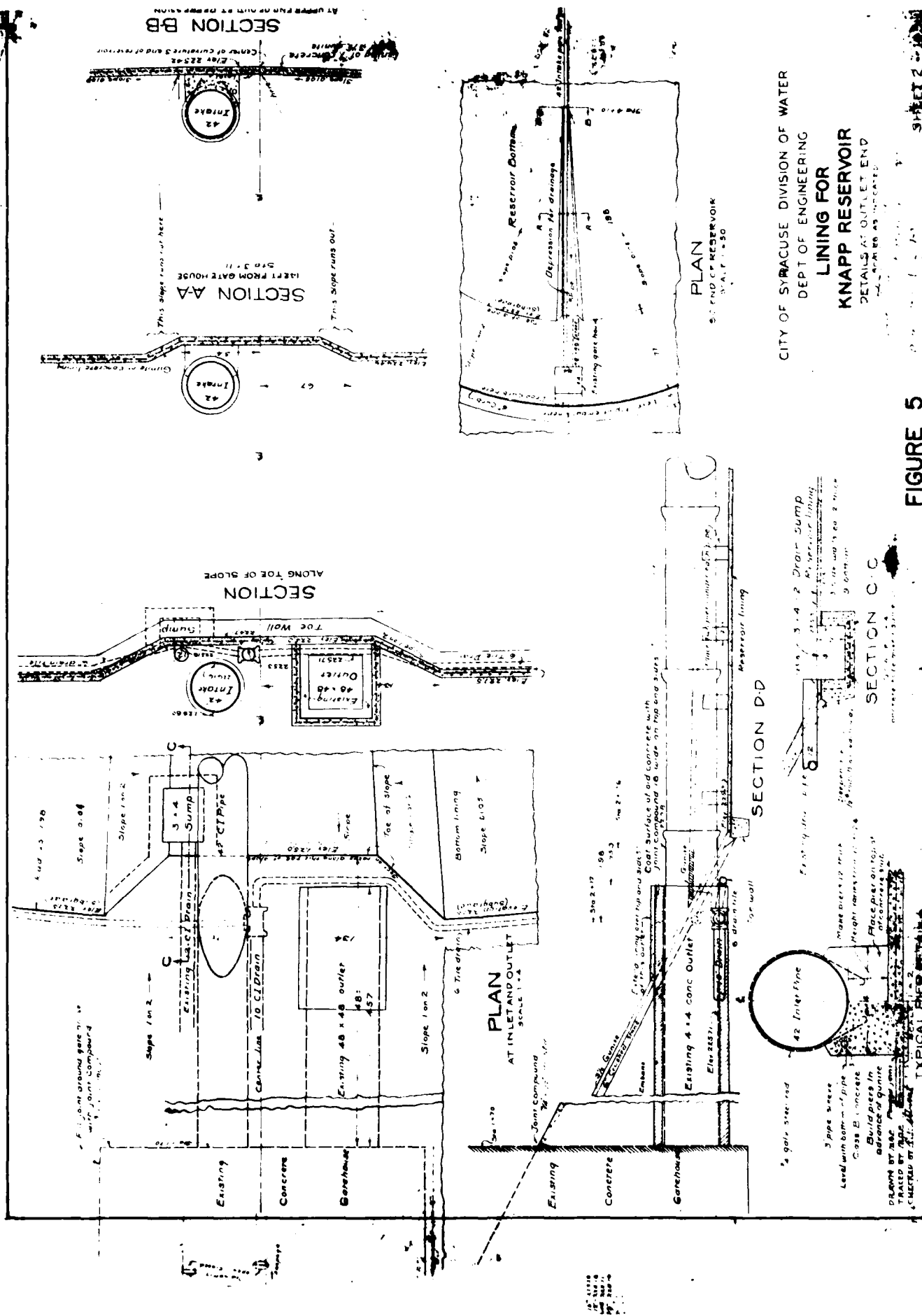
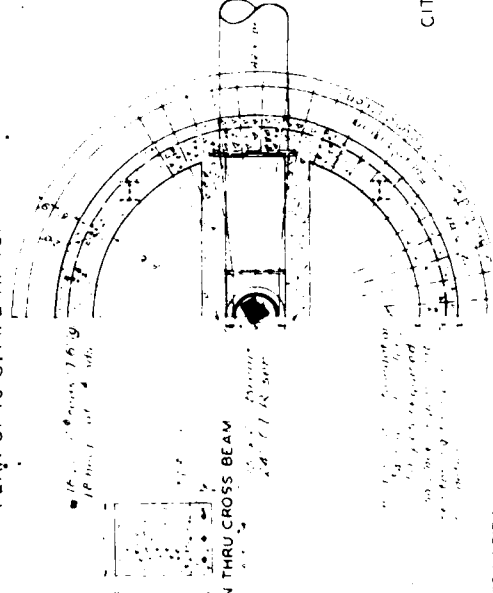
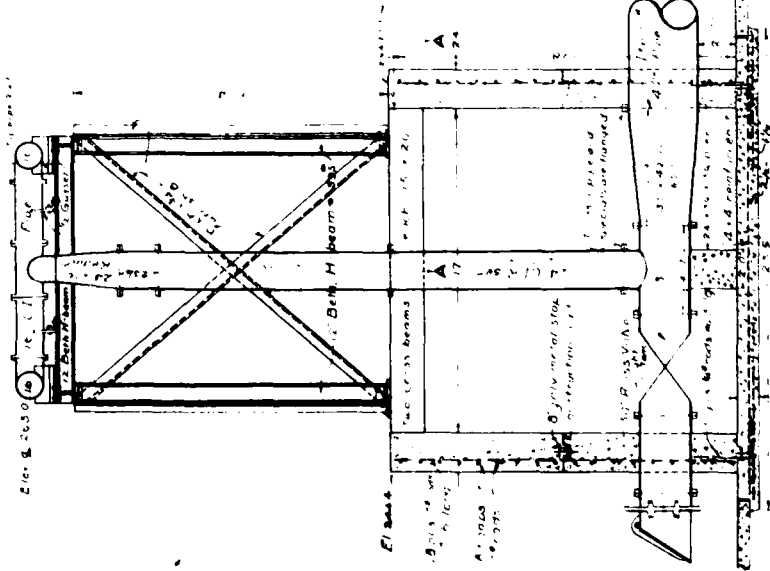
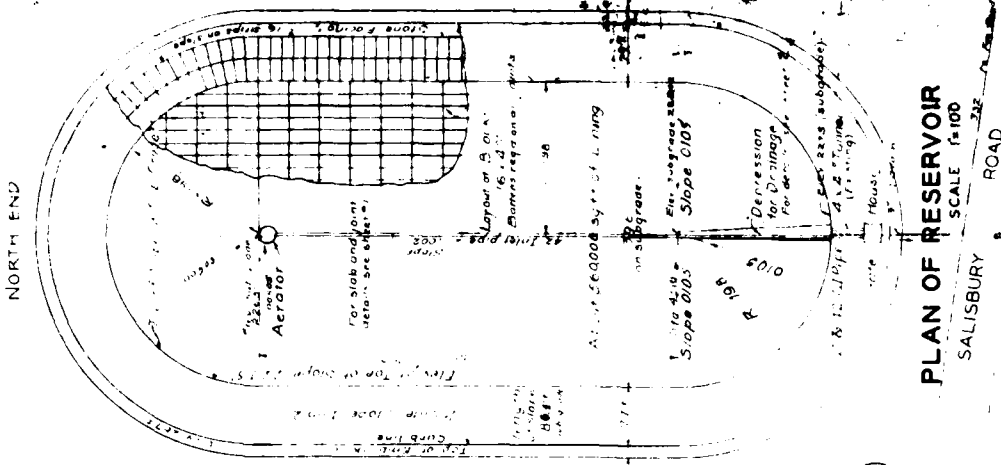
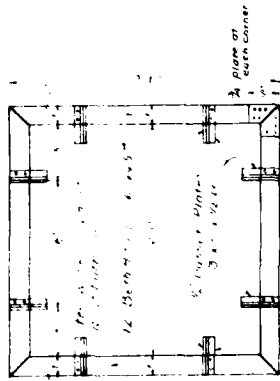
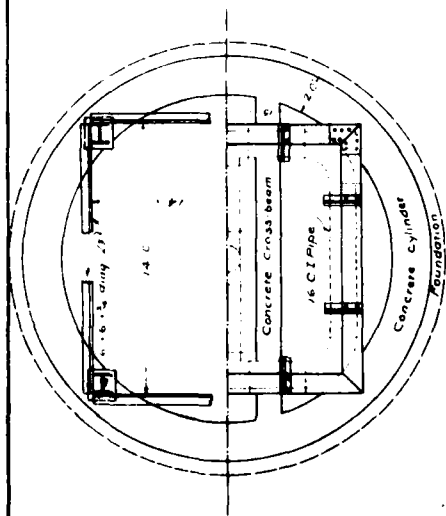


FIGURE 4





PLAN OF 16 C I PIPE AT TOP

HORIZONTAL SECTION A-A

PLAN OF RESERVOIR

SCALE 1"=100'

SALISBURY ROAD

CITY OF SYRACUSE DIVISION OF WATER

DEPT OF ENGINEERING

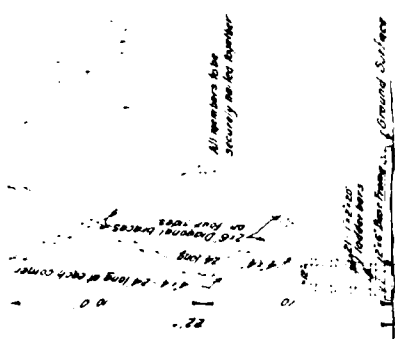
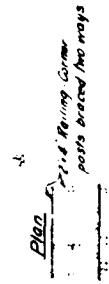
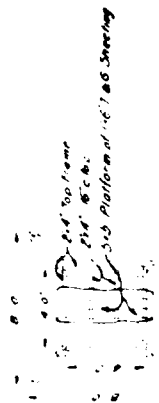
AERATOR FOR

KNAPP RESERVOIR

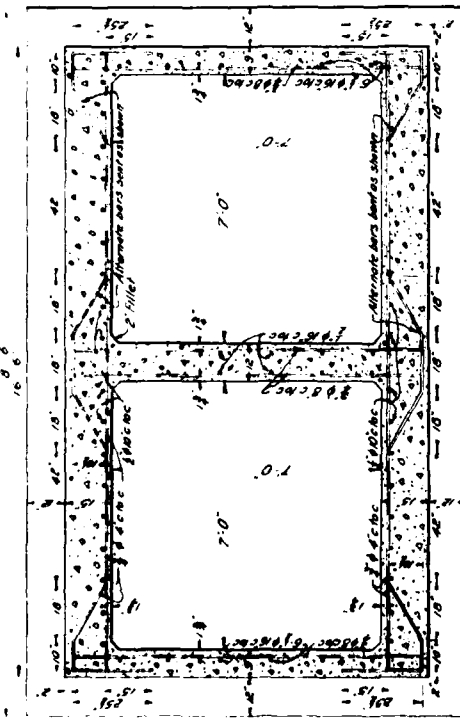
SCALES AS INDICATED

FIGURE 7

SHEET 1 OF 1



OBSERVATION TOWER
Scale 1/4"



Cut all walls all 12" thick
Frame dimensions thickness of center and side walls and reinforcing in center
and base walls will be the same for all types

Type A

Type B

Type C

Top and bottom slab thickness 12" transverse bars 1/4" 6" c.c. alternate
bars bent as shown longitudinal bars 1/4" 12" c.c.

Top and bottom slab thickness 9" transverse bars 1/4" 6" c.c. alternate
bars bent as shown longitudinal bars 1/4" 12" c.c.

INLET-OUTLET TUNNELS
SCALE 1/4"



PROFILE OF TUNNELS
SCALE 1/4" HORIZONTAL
AS CONSTRUCTED

FIGURE 8

MED
-8