Hudson River Basin

Tarrytown Waterworks Dam
Westchester County, New York
Inventory No. 54

Phase I Inspection Report
National Dam Safety Program

Approved for public release;
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Contract No. DACW-51-78-C-0024

Original contains color plates; all color reproductions will be in black and white.

New York District Corps of Engineers

September 1978
Honorable Hugh L. Carey  
Governor of New York  
Albany, New York 12224

Dear Governor Carey:

Reference is made to my letter of 2 October 1973 in which clarification of the guidelines used by this office in assessing dams with "seriously inadequate spillways" under the National Program of Inspection of Dams was outlined.

The following dams in your state have been assessed as having seriously inadequate spillways, with capability to pass safely only the percentage of the probable maximum flood as noted in each report. In accordance with revised criteria they are now to be assessed as unsafe:

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The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

Consequently, it is advisable to implement the recommendations previously furnished in the reports for the above-mentioned dams as soon as practicable.

Sincerely yours,

cc:
Barbero, Descenza  
Iarrobino (NAD), Exec Ofc  
Engrg File, George Koch, NYS DEC

CLARK H. DENN
Colonel, Corps of Engineers  
District Engineer
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. Tarrytown Waterworks Dam was judged to be unsafe-non-emergency due to a seriously inadequate spillway.
HUDSON RIVER BASIN
TARRYTOWN WATERWORKS DAM
INVENTORY NO. 54
PHASE I INSPECTION REPORT

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Tarrytown Waterworks Dam
           (I.D. No. 54)

State Located: New York State

County Located: Westchester County

Stream: Saw Mill River

Date of Inspection: 29 August 1978

ASSESSMENT

Examination of the available documents and visual inspection of the Tarrytown Reservoir Dam and appurtenant structures did not reveal any conditions which are considered to be unsafe.

Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 13 percent of the PMF, and 27 percent of the SPF. The spillway is, therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is, therefore, recommended that within three months from the date of notification to the Governor of the State of New York, owners engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the spillway. Within twelve months of the date of notification to the Governor, appropriate remedial mitigating measures should have been completed. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

No remedial measures are required to assure the safety of the dam at the present time; however, certain measures are recommended regarding:

- Repairs to gatehouse facilities and bridge

- Repair of riprap
- Removal of vegetation from the dam
- Preparation of an O & M manual and establishment of periodic inspections
- Monitoring of wet zone downstream of the toe of the dam

Eugene O'Brien, P.E.
New York No. 29823

Approved by: Col. Clark H. Benn
New York District Engineer

Date: 1976 Nov. 25
1) GENERAL OVERVIEW OF UPSTREAM SLOPE OF DAM AND GATE HOUSE
VICINITY MAP
TARRYTOWN RESERVOIR DAM
CONTOUR MAP
TARRYTOWN RESERVOIR DAM

SCALE 1:24,000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
TARRYTOWN RESERVOIR DAM, INVENTORY NO. 54  
HUDSON RIVER BASIN  
WESTCHESTER, NEW YORK  

SECTION 1 - PROJECT INFORMATION  

1.1 GENERAL  

a. Authority  
The Phase I Inspection reported herein was authorized by  
the DEPARTMENT OF THE ARMY, NEW YORK DISTRICT, CORPS OF ENGINEERS  
by letter dated 31 March 1978, in fulfillment of the requirements of the  

b. Purpose of Inspection  
The purpose of this inspection and report is to investigate  
and evaluate the existing conditions of subject dam in order to: identify  
deficiencies and hazardous conditions; determine if they constitute hazards  
to human life or property; and notify the State of New York of these results  
along with recommendations for remedial measures where necessary.  

1.2 DESCRIPTION OF THE PROJECT  

a. Description of Dam and Appurtenances  
Tarrytown Waterworks Dam is a 300-foot long earth embank- 
ment with a maximum height of about 18 feet above the downstream toe and  
a crest width varying from 15 to 22 feet. The horizontal alignment of the  
dam, which generally trends north-south, is "doglegged" at about 160° with  
the north leg being the spillway, and the south leg, the embankment. The  
dam contains a 26.5-foot high solid masonry core wall which is 4 feet and  
6 feet wide at the top and base respectively. The core wall ends 3.5 feet  
below the crest of the dam. The upstream and downstream slopes are 1 (V)  
on 3 (H) and 1 (V) on 2 (H), respectively.  

A stone masonry and concrete spillway is located at the  
north abutment. The spillway crest is 58 feet long and about 2 feet wide.  
The spillway is capped with two steps of concrete having a total height of  
about 2.5 feet. Below the concrete is a curved stone masonry chute about  
4.5 feet high. Flanking both sides of the spillway are masonry training  
walls about 32 feet long and having a height above the spillway crest of  
about 2.5 feet. The spillway crest is located 24 feet from the upstream end  
of the training walls. Two stone masonry walls are located in the approach  
channel upstream of the crest. The downstream ends of these walls serve  
as supports for a wood decked steel pedestrian bridge which crosses
the spillway. The downstream channel of gneiss bedrock is about 75 feet long, narrows to 7 feet at a measuring weir, and passes through an arch into an underground conduit. Water passing through this conduit flows into a small creek which empties into the Saw Mill River.

An 18- by 16-foot stone masonry gatehouse and a 12-foot diameter brick-lined gate chamber are located on the upstream slope about 160 feet from the south abutment. The gatehouse contains manual floor stands at El 255.2 which regulate 6 gate valves in the gate chamber below at El 230. Four 12-inch gate valves regulate the low level intake into the gate chamber, one 24-inch diameter valve regulates the outflow into the underground conduit; and one 24-inch diameter valve regulates emergency low level flows into the main water supply line. An emergency low level intake pipe also enters the gate chamber; however, this pipe has been capped. The 24-inch diameter water supply line passes adjacent to the gate chamber and flows directly into the pumping station located at the toe of the dam. Intake into the water supply line is from the upper screened 12-foot section of a 24-inch diameter 55-foot high intake structure (well) located in the reservoir.

The Tarrytown Reservoir is divided by a road embankment. The upper lake is approximately five feet higher than the lower lake, which is formed by the Tarrytown Waterworks Dam. The top of the dividing dike is estimated to be at El 260+; it is reported that a small conduit, not visible from the dike, controls flow from the upper lake to the lower lake.

b. Location
The dam is located on an unnamed tributary of the Saw Mill River. It is approximately one quarter of a mile west of the Eastview exit of the Saw Mill River Parkway and about one mile north of the downtown section of the Village of Tarrytown.

c. Size Classification
The dam is less than 40 feet high and has a reservoir less than 1000 acre-feet and is therefore classified as a "small" dam.

d. Hazard Classification
The dam is in the "high" hazard potential category because a large corporate complex, a large utility complex and the main water supply pumping station for the Village of Tarrytown are located immediately downstream from the dam.

e. Ownership
Tarrytown Waterworks Dam is owned by the Village of Tarrytown. The day-to-day operation and maintenance is managed by the Water Department, Tarrytown.

f. Use of Dam
The impoundment provided by the dam is the main water
storage reservoir for the Village of Tarrytown.

g. **Design and Construction History**
The dam and appurtenances were designed by the Tarrytown Board of Water Commissioners. The construction was performed and completed by Van Vranken and Duell Inc. in 1897.

h. **Normal Operating Procedures**
Water releases from the Tarrytown Reservoir over the spillway. The released water flows through the spillway channel emptying into a stream and then into the Saw Mill River. The water supply is removed from the top level of the reservoir by means of the shaft type intake (well). The average water supply requirement is approximately 3 mgd.

### 1.3 PERTINENT DATA

| a. **Drainage Area**, square miles | 1.4 |
| b. **Discharge at Dam Site**, cfs |
| Maximum flood at site | unknown |
| Maximum regulating gate | inoperable |
| Ungated spillway, top of dam (El 254.3) | 590 |
| c. **Elevation** |
| Top of dam | 254.3 |
| Top of embankment separating reservoir | 260+ |
| Crest of spillway | 252 |
| Streambed at centerline of dam | 230+ |
| d. **Reservoir** |
| Length of pool, miles | .75+ |
| Surface area, acres | 81.2+ |
| e. **Storage**, acre-feet |
| Crest of spillway (El 252) | 890 |
| Top of dam (El 254.3) | 1100 |
| f. **Dam** |
| Type: Earth with masonry core wall |
| Length: 300 ft+ |
| Height: 18 ft+ |
| Top width: 15-22 ft |
| Side slopes: 1(V): 3(H) Upstream |
1(V): 2(H) Downstream
Impervious core: Masonry core wall

g. Spillway
Type: Broad crested, ungated
Length: 58 ft
Crest elevation: 252 ft
Upstream channel: masonry approach walls, 50 ft long
Downstream channel: 75 ft long channel in bedrock

h. Regulating Gates
Four 12-inch inlet pipelines with 12-inch gate valves control the flow of water into the gate chamber. A 24-inch pipeline from the gate chamber supplies water to the pumping station. Flow into and out of this line is controlled by a 24-inch gate valve and a 20-inch gate valve at the respective ends of the pipe. The gate chamber is drained by opening a second 24-inch gate valve which regulates flow into a 24-inch blowoff pipeline. The blowoff line empties into the underground conduit. All the above valves, except the 20-inch valve, which is located at the pumping station, are located at the bottom of the gate chamber at El 230.
SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The design of the dam was made by the Board of Water Commissions of Tarrytown in 1897. The available written design data and drawings consists of a report made in 1915 by the State of New York Conservation Commission.

2.2 CONSTRUCTION RECORDS

There are no construction records available for the project.

2.3 OPERATION RECORDS

There are no records of operation of the low level outlets, maintenance or repair work orders. There does not exist a formal operation and maintenance manual for the project.

A record of reservoir elevation and rainfall are kept daily.

2.4 EVALUATION OF DATA

Information was made readily available by personnel of the Water Department, Tarrytown.

The available data reviewed in conjunction with the visual inspection are considered adequate for this Phase I inspection and evaluation of safety.
3.1 FINDINGS

a. General
A visual inspection of Tarrytown Waterworks Dam was made on 29 August 1978. The weather was sunny to partly cloudy, temperature between 75° and 80°F. Last rainfall occurred the previous night. At the time of the inspection the reservoir level was at the spillway crest.

b. Dam
The earth embankment appears to be in generally good condition. The horizontal and vertical alignments of the crest are generally good except for some minor rutting and a few depressions about 3 feet in diameter and 4 inches deep. A shaft located on the crest about 10 feet south of the gatehouse was an access to an alum injection system which is no longer in use. The shaft is covered with a steel plate.

The upstream slope is in generally good condition with no signs of sloughing, erosion or trespassing. The riprap appears sound with stones missing at only a few locations. The upstream slope behind the gatehouse, however, does show signs of erosion with disrupted riprap. The entire slope and riprap are covered with bushes, saplings and trees.

The downstream slope is in generally good condition with no signs of sloughing, erosion or trespassing. The slope is covered with low vegetation (not grass) which has reportedly not been cut since the fall of 1977. Normally the slopes are cut once a year.

A soft damp area, about 200 square feet, was observed at the toe of the dam, at the maximum section, in line with the gatehouse. Reportedly, in periods of dry weather, the area is not damp. During the inspection a small hole was dug in the damp area. After a short period of time had elapsed, no water was noted in the hole. In addition, upon digging the hole, numerous earthworms were observed. These factors tend to indicate that the dampness is due to runoff rather than seepage.

Based on a previous inspection report (1915) the dam is shown to be about 30 feet high at maximum section. Measurements made during the present inspection show a height of only 18 feet which indicates that the area in the vicinity of the toe at that time must have been filled.

c. Appurtenant Structures
The spillway appears to be in generally fair condition. The concrete capping is in good condition and there is relatively new pointing on the stone masonry chute. There are, however, several loose and missing stones at the bottom of the chute. Several leaks were observed at the contact
between the concrete and stone masonry. A small leak averages about 1 to 3 gpm. A slightly larger leak, located about 7 feet from the south end of the spillway averages about 5 to 10 gpm. In addition, there is vegetation at the contact and on the sill. The upstream approach to the spillway is clear with the exception of some aquatic weeds. These weeds are reportedly periodically destroyed by the use of copper sulphate, a herbicide and an algacide.

The stone masonry training walls are in generally good condition. The upstream walls, however, do have loose and missing pointing. The walls which support the pedestrian bridge have several loose and missing stones as well as missing mortar. The downstream walls are in good condition, with only minimal loose pointing. The wood decking of the bridge is in poor condition.

Reportedly, the valves located in the gate chamber have not been operated in at least 24 years. Water Department personnel do not operate these valves for fear they may break or that they may not be able to return the valves to the proper positions. The floor stands appear to be in good condition although the wooden floor of the gatehouse is in poor condition and is considered to be unsafe. The access ladder to the gate chamber is severely rusted. Because of these conditions, the inspection of the equipment in the chamber was limited to what could be seen through a hatchway in the gatehouse floor. The condition of the valves could not be assessed although the valve stem extensions show rusted surfaces with metal loss. The bottom of the chamber appears to be silted to a height equal to the bonnets of the gate valves. The gate chamber appears to be in relatively good condition with some dampness noted on the brick walls.

d. **Abutments**
There were no signs of seepage or other unusual conditions at the abutments.

e. **Downstream Channel**
The channel immediately downstream from the spillway is heavily overgrown with vegetation. There are blocks of concrete at the bottom of the spillway chute. However, the minor flows which were observed were not impeded by this condition. The channel, further downstream, is a natural creek with only minimal vegetation and no overhanging trees.

f. **Reservoir Area**
In the vicinity of the dam there is no evidence of sloughing, potentially unstable slopes or other unusual conditions which would adversely affect the dam.
3.2 EVALUATION OF OBSERVATIONS

Visual observations made during the course of the investigation revealed several deficiencies which at present do not adversely affect the adequacy of the dam. However, these deficiencies do require attention and should be corrected before further deterioration leads to a hazardous condition. Recommended measures to improve these conditions are given in Section 7.
SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The normal average water release to supply the village of Tarrytown is 3 mgd. The supply water enters at the shaft type intake and flows through a 24-inch pipeline to the pumping station where the water release is regulated. Water is always taken from the top 12 feet of the normal reservoir level.

4.2 MAINTENANCE OF THE DAM

There is no operation and maintenance manual for the project. The reservoir is visited daily by the pumping station personnel who examine the dam and other project features. There is no formally established program of inspection visits by other Village personnel.

The embankment dam is maintained only by periodic yearly mowing of the vegetated slope protection. Maintenance of the earth embankment appears to be adequate. Maintenance of the appurtenant structures is less than adequate.

4.3 MAINTENANCE OF OPERATING FACILITIES

It was reported that the low level gate valves have not been operated for at least 24 years. Operating personnel expressed concern that operating the valves might cause them to break or that the valves could not be brought back to their original position once rotated.

4.4 WARNING SYSTEMS IN EFFECT

There is no warning system in effect or in preparation.

4.5 EVALUATION

The operation and maintenance of the Tarrytown Reservoir Dam is considered less than adequate in the following areas:

a. Non-operation of low level outlet gates.

b. Control of vegetation growing on the embankment.

c. No formal operation and maintenance manuals for the project.
SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE BASIN CHARACTERISTICS

The Tarrytown Reservoir consists of two lakes. For this analysis it was found necessary to separate the basin into an upper and lower sub-basin. The sub-basin for the upper reservoir is approximately 50% urban development and 50% woods. It is rectangular in shape with a length to width ratio of about 0.3. The lower reservoir basin was considered 100% woods with fairly steep slopes and narrow winding valleys. The upper basin area is 261.2 acres and the upper reservoir is 21.6 acres or 8.3% of the basin area. The lower basin area is 567.1 acres with a reservoir area of 59.6 acres (10.5% basin area). Total drainage area is 1.3 square miles.

5.2 SPILLWAY CAPACITY

The reservoir spillway (see description Section 1.2) has a computed discharge capacity of 590 cfs with the water in the lake at El 254.3, which is equivalent to the top of the dam. The reservoir also has a 24-inch diameter, low level outlet pipe (which was reported inoperable) located in the gatehouse.

5.3 RESERVOIR CAPACITY

The normal capacity of the Tarrytown Reservoir is reported to be 2.9 x 10^8 gallons or 890 acre-feet. The estimated surcharge storage of the lower reservoir between the spillway crest (El 252) and the top of the dam (El 254.3) is about 143 acre-feet or about 3.4 inches of runoff over the lower drainage basin. The surcharge storage of the upper reservoir between normal lake level (El 257) and the estimated dike elevation of 260 is 71 acre-feet.

5.4 FLOODS OF RECORD

There are no records of flow from this drainage area.

5.5 OVERTOPPING POTENTIAL

Because there are no data on Probable Maximum Floods for an area of 1.26 square miles, it was necessary to synthesize a design flood hydrograph for the contributing area; both the Probable Maximum Flood (PMF) and the Standard Project Flood (SPF) were estimated and compared with the spillway capacity.

The Probable Maximum 6 hour rainfall over 10 square miles for the Tarrytown Reservoir area was taken from Weather Bureau sources and distributed in a probable storm sequence as indicated in a publication.
of the World Meteorological Organization. Based on the Soil Conservation Services' curve number method, the excess rainfall was determined for both sub-basins. Due to the unusual basin shape, a unit hydrograph for an area assumed to be representative of the entire basin was first developed. This representative unit hydrograph was transposed to each sub-basin and used to compute the PMF hydrograph. The flood inflow for the upper lake was derived by adding the runoff resulting from the excess rainfall on the lake surface to the computed PMF hydrograph. Inflow to the lower lake also included the outflow from the upper lake. The computed peak inflow to the lower lake was 4998 cfs for the PMF.

The potential of the water overtopping the dam was investigated on the basis of the available surcharge storage and spillway discharge capacity to meet a potential emergency inflow. It was assumed that the upper lake was at El 257 and the lower lake at El 252 (spillway crest) at the start of the flood inflow. Outflow from the upper lake was assumed to occur over the road as the conduit below the road was assumed blocked. Outflow from the lower lake is possible through the service spillway. Outflow through the water supply main is small relative to the storm flows and was not included in the analysis. Outflow through the pipes in the gatehouse is not possible as valves are inoperable.

The PMF routed through the reservoirs caused the water surface in the upper lake to rise to El 261.4, 1.4 feet above the dike. The flow over the dike corresponding to this critical situation is about 1572 cfs. The combined inflow to the lower reservoir from the upper lake and from the flood caused the water level to rise to El 256.6, 2.3 feet above the top of the dam. The peak outflow discharge was 4674 cfs, 7.9 times the computed spillway capacity.

The Standard Project Flood (1/2 PMF) resulted in the following:

- Maximum lower lake level, SPF............El 255.4
- Peak lower lake discharge, SPF............2195 cfs

The peak outflow discharge was 3.7 times the spillway capacity.

5.6 EVALUATION OF HYDROLOGY/HYDRAULICS

Using the Corps of Engineers screening criteria, it has been determined that the dam would be overtopped for all storms greater than 8.5 percent of the PMF and 19 percent of the SPF. The spillway capacity is therefore considered to be seriously inadequate from a hydrologic and hydraulic point of view.
SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations
Visual observations did not indicate any serious structural problems with the embankment or spillway. The deficiencies described in Section 3 require attention and measures to improve these deficiencies are given in Section 7.

b. Design and Construction Data
No design computations or other data pertaining to the structural stability of the dam have been located.

On the basis of the performance experience, the visual inspection, as well as engineering judgment, the dam and spillway appears to be structurally adequate at the present time.

c. Operating Records
There are no operating records available. It is reported that low level outlet valves have not been operated for at least 24 years.

d. Post Construction Changes
It is reported the dam was built in 1897. There are no records of any construction changes which have taken place since that time. It is reported, however, the spillway and the training walls were repaired in 1974. Loose and missing pointing was repaired and finished flush with the stone masonry. Wooden flashboards were removed and were replaced with a concrete crest.

e. Seismic Stability
The dam is located in Seismic Zone No. 1 and in accordance with recommended Phase I guidelines does not warrant seismic analyses.
7.1 DAM ASSESSMENT

a. Safety

Examination of the available documents and visual inspection of the Tarrytown Reservoir Dam and appurtenant structures did not reveal any conditions which are considered to be unsafe.

Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the embankment dam would be overtopped for all storms exceeding approximately 13 percent of the PMF, and 27 percent of the SPF. The spillway is, therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is, therefore, recommended that within three months from the date of notification to the Governor of the State of New York, owners engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the spillway. Within twelve months of the date of notification to the Governor, appropriate remedial mitigating measures should have been completed. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Adequacy of Information

The information and data available were adequate for performance of this investigation.

The information and data available with regards to operation and maintenance of the project is considered less than adequate in the following areas:

1) Record drawings of the project

2) Records of modifications and additions to the spillway
3) Operation and maintenance manuals
4) Records of inspections
c. Necessity for Additional Investigations
   Additional investigations are necessary to further evaluate
   the spillway adequacy and to determine remedial mitigating measures as
   recommended in Section 7.1a above.

7.2 REMEDIAL MEASURES

   No remedial measures are required to assure the safety of the
dam at the present time; however, certain measures are recommended as
follows:

   a) Repair and/or replace the rotted gatehouse flooring and
      access ladder to the gate chamber.
   b) Inspect all surfaces and equipment in the gate chamber
      and make any necessary repairs.
   c) All valves should be made operable and maintained.
   d) Repair the missing and displaced riprap along the upstream
      slope.
   e) Repair the rotted and broken planks on the pedestrian
      bridge.
   f) Repair the loose masonry along the training walls and
      spillway chute, adding new pointing where necessary.
   g) Remove the loose concrete blocks from spillway channel.
   h) Remove heavy brush, shrubs and saplings from all locations
      on the embankment, spillway and spillway channel. Aquatic
      weeds should be removed from the spillway approach channel.
   i) Prepare an operation and maintenance manual and establish
      a program of periodic inspections for the project features.
   j) Establish a monitoring program to determine whether the
      zone of dampness described in Section 3 is caused by
      runoff or seepage. If seepage is the case, a systematic
      program of observation and monitoring of changes in the
      pattern and quantity of the seepage should be initiated.

- 14 -
APPENDIX A

DRAWINGS AND INSPECTION REPORTS
SECTION A-A

SECTION B-B

SECTION C-C

Reservoir
Area: 64 acres
Max Elevation: 252 ft
Storage (Max): 290,1.0 x 10^4 cu ft

Bridge

Top of Training Wall

Note: Drawing based on rough field measurements made during visual inspection.
TARRYTOWN WATERWORKS DAM

GATEHOUSE AND PIPING LAYOUT

FROM WELL

24" Ø SUCTION PIPELINE FROM WELL

INTAKE BASIN

4-12" Ø INTAKE PIPELINES

24" Ø INTAKE PIPELINE (CAPPED 1932)

GATE HOUSE 16'x18'
FLOOR EL 255.2

GATE CHAMBER
12' DIAMETER
FLOOR EL 230.6

12" GATE VALVES (CLOSED)
INVERT 229.7

24" GATE VALVES
INVERT 229.4

24" BLOWOFF PIPELINE

TO UNDERGROUND CONDUIT

20 INCH GATE VALVE (CLOSED)

INFORMATION SOURCES
1) WATERLINE LAYOUTS ON VARIOUS STATIONS
   FIELD BOOK No. 1 - TARRYTOWN WATER DEPT.

2) GENERAL ARRANGEMENT MAP AT PUMPING STATION
NOTICE: After filling out one of these forms as completely as possible for each dam in your district, return it at once to the Conservation Commission, Albany.

STATE OF NEW YORK
CONSERVATION COMMISSION
ALBANY

DAM REPORT

JULY 16TH, 1915

CONSERVATION COMMISSION
DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known as the

Tarrytown Waterworks Dam.

This dam is situated upon the West Branch of Sawmill River
in the Town of Tarrytown, Westchester County, about 1½ miles from the Village of Tarrytown.

The distance down stream from the dam to the Sawmill River is about 2500 feet.

The dam is now owned by the Village of Tarrytown and was built in or about the year 1894, and was extensively repaired or reconstructed during the year.

As it now stands, the spillway portion of this dam is built of masonry and the other portions are built of masonry, over B. F. froth asphalt.

As nearly as I can learn, the character of the foundation bed under the spillway portion of the dam is rock and under the remaining portions such foundation bed is rock and clay.

Map 219 E

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(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings or other conspicuous objects in the vicinity.)
(In the space below, make one sketch showing the form and dimensions of a cross section through the spillway or waste-weir of this dam, and a second sketch showing the same information for a cross section through the other portion of the dam. Show particularly the greatest height of the dam above the stream bed, its thickness at the top, and thickness at the bottom, as nearly as you can learn.)
The total length of this dam is 600 feet. The spillway or waste-weir portion is about 60 feet long, and the crest of the spillway is about 4 feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used for drawing off the water from behind the dam, are as follows: 2 3/4" 3/4" weir, and 4-12" pipes also a 34" feed to pump station.

At the time of this inspection the water level above the dam was 0 ft 8 in. below the crest of the spillway.

(State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly any leaks or cracks which you may have observed.)

This dam is in good condition showing no sign of weakening. Should a rupture occur several buildings in the valley below would probably suffer severe damages as well as the roadway which runs just below the dam.

Reported by ____________

Waldott W. Y.
PHOTOGRAPHS

APPENDIX B
2) CREST OF DAM LOOKING NORTH, NOTE RUT ALONG CENTER OF CREST

3) DOWNSTREAM SLOPE OF DAM LOOKING NORTH
4) VALVE OPERATING STANDS IN GATE HOUSE
7) APPROACH CHANNELS TO SPILLWAY

8) SPILLWAY CHUTE, NOTE DISPLACED MASONRY AT CHUTE TOE
9) SPILLWAY CHANNEL LOOKING DOWNSTREAM, NOTE ENTRANCE OF CONDUIT AND HEAVY VEGETATION

10) SPILLWAY CHANNEL LOOKING UPSTREAM
11) ENTRANCE OF CONDUIT, NOTE MEASURING WIER

12) ROADWAY (NEPERAN ROAD) NORTH AND UPSTREAM OF SPILLWAY, NOTE DEPRESSED AREA BETWEEN ROAD AND TARRYTOWN WATER SUPPLY SIGN
ENGINEERING DATA CHECKLIST

APPENDIX C
**CHECKLIST**

**ENGINEERING DATA**

**DESIGN, CONSTRUCTION, OPERATION**

**PHASE I**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAME OF DAM</strong></td>
<td>Tarrytown Waterworks</td>
</tr>
<tr>
<td><strong>ID #</strong></td>
<td>54</td>
</tr>
<tr>
<td><strong>AS-BUILT DRAWINGS</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>REGIONAL VICINITY MAP</strong></td>
<td>USGS Quadrangle - White Plains, NY</td>
</tr>
<tr>
<td><strong>CONSTRUCTION HISTORY</strong></td>
<td>Built in 1897 by Van Winkle &amp; Drill Inc.</td>
</tr>
<tr>
<td><strong>TYPICAL SECTIONS OF DAM</strong></td>
<td>Spillway and embankment sections (Conservation Commission - Dam Report, 1915)</td>
</tr>
<tr>
<td><strong>OUTLETS-PLAN</strong></td>
<td>Plan of low level outlets copied from Tarrytown Water Dept., Field Book and general arrangement map at pumping station.</td>
</tr>
<tr>
<td><strong>-DETAILS</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>-CONSTRAINTS</strong></td>
<td>None</td>
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<tr>
<td><strong>-DISCHARGE RATINGS</strong></td>
<td>At measuring weir (March, 1950)</td>
</tr>
<tr>
<td><strong>RAINFALL/RESERVOIR RECORDS</strong></td>
<td>Kept daily - Records at Pumping Station and Water Department Office</td>
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</table>

*THIS PAGE IS BEST QUALITY PRACTICABLY FROM COPY FURNISHED TO DDC*
<table>
<thead>
<tr>
<th>ITEM</th>
<th>REMARKS</th>
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<td>GEOLOGY REPORTS</td>
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<td>DESIGN COMPUTATIONS</td>
<td>None</td>
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<td>HYDROLOGY &amp; HYDRAULICS</td>
<td>None</td>
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<td>DAM STABILITY</td>
<td>None</td>
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<td>SEEPAGE STUDIES</td>
<td>None</td>
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<td>MATERIALS INVESTIGATIONS</td>
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<td>BORING RECORDS</td>
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<td>LABORATORY</td>
<td>None</td>
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<td>FIELD</td>
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<td>POST-CONSTRUCTION SURVEYS OF DAM</td>
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<tr>
<td>BORROW SOURCES</td>
<td>Unknown</td>
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<td>ITEM</td>
<td>REMARKS</td>
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<tr>
<td>-------------------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>MONITORING SYSTEMS</td>
<td>None</td>
</tr>
<tr>
<td>MODIFICATIONS</td>
<td>Repairs to Spillway</td>
</tr>
<tr>
<td>HIGH POOL RECORDS</td>
<td>As part of daily pool records</td>
</tr>
<tr>
<td>POST CONSTRUCTION ENGINEERING</td>
<td>None</td>
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<tr>
<td>STUDIES AND REPORTS</td>
<td>Conservation Commission - Dam Report (1915)</td>
</tr>
<tr>
<td>PRIOR ACCIDENTS OR FAILURE OF DAM</td>
<td>None Reported</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>Reportedly in 1955 flood, dam came within 1 foot of overtopping</td>
</tr>
<tr>
<td>REPORTS</td>
<td></td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>None except for cutting of vegetation</td>
</tr>
<tr>
<td>OPERATION</td>
<td>No operation of low level outlets for at least 24 yrs.</td>
</tr>
<tr>
<td>RECORDS</td>
<td>None</td>
</tr>
<tr>
<td>ITEM</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>SPILLWAY PLAN</td>
<td>None</td>
</tr>
<tr>
<td>SECTIONS</td>
<td>None</td>
</tr>
<tr>
<td>DETAILS</td>
<td>None</td>
</tr>
<tr>
<td>OPERATING EQUIPMENT</td>
<td>Water Supply Lines, low level gate valves, emergency water supply siphon</td>
</tr>
<tr>
<td>PLANS &amp; DETAILS</td>
<td>None</td>
</tr>
</tbody>
</table>
VISUAL INSPECTION CHECKLIST

APPENDIX D
VISUAL INSPECTION CHECKLIST

1. Basic Data
   a. General
      Name of Dam: Tarrytown Waterworks
      Hazard Category: High
      County: Westchester
      ID#: 54
      Stream Name: Unnamed
      Tributary of: Saw Mill River
      Location: Westchester County
      Nearest Town (P.O.): Eastchester
      Longitude: 73° 49' 55" W
      Latitude: 41° 5' N
      Other Directions:
      Date of Inspection: [Date]
      Weather Condition: [Condition]
      Temperature: [Temperature]
   b. Inspection Personnel
      Glenn Goudry - Mechanical Engineer
      Harvey Feldman - Geotechnical Engineer
      Team Captain: Bethof Jams, New York
   c. Persons Contacted
      Mr. R Piccirelli - Tarrytown Dept.
      of Public Works, Pumping Station
   d. History:
      Date Constructed: 1997
      Present Owner: Village of Tarrytown
      Designed by: Board of Water Commissioners
      Constructed by: Van Vranken & Pauell Inc.
      Recent History: Replaced warning flashboards w/concrete

2. Technical Data
   Type of Dam: Earth
   Drainage Area: 896± Acres
   Height: 18 ft±
   Length: 300 ft±
   Upstream Slope: 1V on 3H
   Downstream Slope: 1V on 2H
   Crest Width: 15 to 22 ft
   Freeboard at Spillway Crest: 2± ft±

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Low Level Control: (Type and Size) 4-10" x 6" Feed into 24" outlet
Valve Condition: Unknown, last operation 24 years ago

Emergency Spillway Type (Material) Concrete Steel, Width 5.9 ft
Side Slopes: Vertical Slope
Height (Crest to Top): 2.5 ft
Exit Slope: 1V on 1H (approx.)
Exit Length: 75 ft

Ponded Surface Area: 81.2 ft² Acres
Capacity (Normal Level): 890 ft³ Acre Feet
Capacity Emergency Spillway Level: 1100 ft³ Acre Feet

3. Embankment

a. Crest

(1) Vertical Alignment: Good except for cutting and one 3 ft diameter depression

(2) Horizontal Alignment: Good

(3) Longitudinal Surface Cracks: None

(4) Transverse Surface Cracks: None

(5) General Condition of Surface: Good except as noted above

(6) Miscellaneous: Alignment access shaft, 30° C; no longer used. Covered with ¾ steel plate

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### b. Upstream Slope

<table>
<thead>
<tr>
<th>(1) Undesirable Growth or Debris</th>
<th>Shrubs, Sedges &amp; Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Sloughing, Subsidence, or Depressions</td>
<td>None except for erosion behind gatehouse</td>
</tr>
<tr>
<td>(3) Slope Protection</td>
<td>Riprap</td>
</tr>
<tr>
<td>(a) Condition of Riprap</td>
<td>Good except for several locations where stones are missing</td>
</tr>
<tr>
<td>(b) Durability of Individual Stones</td>
<td>Excellent</td>
</tr>
<tr>
<td>(c) Adequacy of Slope Protection Against Waves and Runoff</td>
<td>Good</td>
</tr>
<tr>
<td>(d) Gradation of Slope Protection - Localized Areas of Fine Material</td>
<td>Uniform - no bedding layer</td>
</tr>
<tr>
<td>(4) Surface Cracks</td>
<td>None</td>
</tr>
</tbody>
</table>

### c. Downstream Slope

<table>
<thead>
<tr>
<th>(1) Undesirable Growth or Debris</th>
<th>Completely overgrown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Cutting</td>
<td>Fall of 1977</td>
</tr>
</tbody>
</table>

**Note:**

This page is best quality practicable.

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(2) Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity

(3) Surface Cracks on Face of Slope

(4) Surface Cracks or Evidence of Heaving at Embankment Toe

(5) Wet of Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils"

(6) Fill Contact with Outlet Structure

(7) Condition of Grass Slope Protection

(d) Abutments

(1) Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream

(2) Springs or Indications of Seepage Along Contact of Embankment with the Abutments
(3) Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

(4) Unusual Muddy Water in Downstream Channel

(5) Sloughing or Erosion

(6) Surface Cracks or Evidence of Heaving Beyond Embankment, Toe
(7) Stability of Tailrace Channel Sideslopes  ____________

(8) Condition of Tailrace Channel Riprap  ____________

(9) Adequacy of Slope Protection Against Waves, Currents and Surface Runoff
   Waves almost nonexistent. Too small fetch.

(10) Miscellaneous

f. Drainage System  ____________

1. Condition of Relief Wells, Drains and Appurtenances

(2) Unusual Increase or Decrease in Discharge from Relief Wells

4. Instrumentation

(1) Monumentation/Surveys

__________________________
(2) Observation Wells


(3) Weirs


(4) Piezometers


(Other)


5. Reservoir


a. Slopes
b. Sedimentation  Indeterminate

6. Spillways

a. Principal Spillway: Inlet Condition __________
   Pipe Condition __________
   General Remarks (include information such as recently repaired, potential for debris accumulation, special items of note, etc.)

b. Emergency Spillway: General Condition
   Tree Growth
   Sapling & other vegetation
   Erosion
   Other Observations

7. Structural (if required) See Attached Appendix
   Not Required
8. Downstream Channel

a. Condition (obstructions, debris, etc.) Heavy vegetation, some silting, little to no debris other than old concrete from floodboard sill which was removed from sill

b. Slopes NA

c. Approximate No. Homes and Population The main water supply pumping station for the Village of Terrytown, a large corporate complex and a large utility complex are located immediately downstream

d. General
HYDROLOGIC DATA AND COMPUTATIONS

APPENDIX E
March 1, 1950

LOWER LAKE RECTANGULAR WEIR (5' WIDE) DISCHARGE
APPROXIMATE GALLONS PER 24 HRS.

<table>
<thead>
<tr>
<th>Head in Inches</th>
<th>Gallons per 24 Hours</th>
<th>Head in Inches</th>
<th>Gallons per 24 Hours</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>1/4</td>
<td>4,662,000</td>
</tr>
<tr>
<td>1/4</td>
<td>32,220</td>
<td>1/2</td>
<td>4,896,000</td>
</tr>
<tr>
<td>1/2</td>
<td>91,620</td>
<td>3/4</td>
<td>5,148,000</td>
</tr>
<tr>
<td>3/4</td>
<td>165,120</td>
<td>1/4</td>
<td>5,400,000</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1/2</td>
<td>5,670,000</td>
</tr>
<tr>
<td>1/2</td>
<td>473,400</td>
<td>3/4</td>
<td>5,922,000</td>
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<tr>
<td>3/4</td>
<td>595,800</td>
<td>1/4</td>
<td>6,192,000</td>
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<tr>
<td>1/4</td>
<td>257,400</td>
<td>1/2</td>
<td>6,462,000</td>
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<tr>
<td>1/2</td>
<td>360,000</td>
<td>3/4</td>
<td>6,670,000</td>
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<tr>
<td>3/4</td>
<td>595,800</td>
<td>1/4</td>
<td>7,002,000</td>
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<td>1/4</td>
<td>725,400</td>
<td>1/2</td>
<td>7,272,000</td>
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<tr>
<td>1/2</td>
<td>865,800</td>
<td>3/4</td>
<td>7,560,000</td>
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<td>1,670,400</td>
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</tbody>
</table>
A = 0.12 mi²  \quad C_t = 1.5

L_{ca} = 1150 ft / 0.22 mi
\quad 1 = 3,700 ft / 0.70 mi

\[ t_p = C_t \left(L_{ca}\right)^{0.3} \cdot 1.5 \left(0.7 \times 0.22\right)^{0.3} \]
\[ = 0.86 \text{ hours} / 52 \text{ min} \]

\[ t = \frac{t_p}{5.5} = 0.16 \text{ hrs} / 9.4 \text{ min} \]

\[ Q_p = \frac{C_p 640}{t_p} = \frac{400}{0.86} = 465.1 \text{ cfs} / \text{sq mi} \]

Lower Sub-basin area = 507.5 acres / 0.79 mi²  Lower Lake Area
77.8 acres

\[ Q_p = q \cdot A = (465.1)(0.79) = 367.5 \text{ cfs} \]

Upper Sub-basin Area = 239.6 acres / 0.37 sq mi  Upper Lake Area
21.6 acres

\[ Q_p = q \cdot A = (465.1)(0.37) = 172 \text{ cfs} \]
<table>
<thead>
<tr>
<th>El.</th>
<th>Area</th>
<th>Lower Lake</th>
<th>Δ Vol</th>
<th>S.S.</th>
<th>Area</th>
<th>Mean</th>
<th>Upper Lake</th>
<th>Δ Vol</th>
<th>S.S.</th>
<th>Total S.S.</th>
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<td>59.6</td>
<td>60.75</td>
<td>0</td>
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<tr>
<td>253</td>
<td>61.9</td>
<td>63.05</td>
<td>60.75</td>
<td></td>
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<tr>
<td>254</td>
<td>64.2</td>
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**Note:** This page is best quality practicable, from copy furnished to D.I.C.
Location: 73°50' 41°05'

Probable Maximum 6 hour Rainfall over 10.5 sq miles
is 26 inches.

Reduced 20% ~ 20.8 inches.

Discharge capacity of dike & roadway between lakes
width of road 80 ft
length of dike 300 ft.

Assume flow over road is critical

\[ Q = 3.087 \times 10^{\frac{1}{4}} - 926.1 \times 10^{\frac{3}{4}} \]

\[
\begin{align*}
H & | Q \\
10 & | 026.1 \\
20 & | 2619. \\
30 & | 4812 \\
40 & | 7409 \\
\end{align*}
\]

Discharge capacity of conduit below road unknown, assumed blocked during test flood.
**TAMS**

**Job No.** 1487-13  
**Project** Inspection Tarrytown Reservoir  
**Subject** Upper Lake Routing input  
**Date** 09-23-78  
**By** DLC  

---

P.M. P = 20.8 inches in 6 hours  
D = 3.4 mins  
Lake area = 21.6 acres  
Hydrologic Soil Group C A MC II  
Drainage Basin 50% urban development CN 88  
80% Woods CN 73  
Recharge CN 81  

\[ S = \frac{1000}{CN} - 10 = 23.5 \]

\[ Q = \frac{(P - 0.25)^2}{P + 0.85} = \frac{(P - 0.47)^2}{P + 1.85} \]

---

**Unit Hydrograph**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Peak</th>
<th>End</th>
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<td>0</td>
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<tr>
<td>258</td>
<td>22.35</td>
<td>0</td>
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<td>159</td>
<td>44.15</td>
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<td>0</td>
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<td>926</td>
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<td>262</td>
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<tr>
<td>264</td>
<td>187.26</td>
<td>7409</td>
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</tbody>
</table>

---

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*From copy furnished to DCC*
Spillway length: 54.0'  Dam length: 210'  
Spillway width: 22"  Dam width: 
Maximum depth to top of dam: 28"

<table>
<thead>
<tr>
<th>Elev</th>
<th>Head</th>
<th>C</th>
<th>Q = CH^{1/2}</th>
<th>Total</th>
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<td>1.6 2.96</td>
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<td>254</td>
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<td>2.91 444</td>
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<td>254.3</td>
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<tr>
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Assume weir acts as 'sharp crested' weir above 2.75' head.  
Assume flow over dam critical C = 3.067
### TAMS

**Job No.** 1487-13  
**Project** Inspection Tarrytown Reservoir  
**Subject** Lower Lake Routing Input  
**Date** Sep 23, 78  
**Ch’k. by** DLC

<table>
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<th>P.M.P.</th>
<th>20.8 inches</th>
<th>in 6 hours</th>
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<td>Duration</td>
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<td>0.16 hrs</td>
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<tr>
<td>Lake Area</td>
<td>77.8 acres</td>
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<tr>
<td>Hydrologic Soil Group</td>
<td>C AMC II</td>
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<tr>
<td>Drainage Basin</td>
<td>100% Wood</td>
<td>CN 78</td>
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</table>

\[ S = \frac{1000}{CN} - 10 = 3.70 \]

\[ Q = \frac{(P - 0.25)^2}{P + 0.85} \cdot \frac{(P - 0.74)^2}{P + 2.96} \]

#### Unit Hydrograph

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<th>Flow (cfs)</th>
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<tr>
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<td>2.60</td>
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*This page is best quality practicable from copy published to doc.*
### DAM INSPECTION
### TARRYTOWN RESERVOIR
### UPPER LAKE ROUTING
### FULL PMF

#### INPUT PARAMETERS

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<th>ENDING TIME (HOURS)</th>
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<th>PLOT GATE OPTION</th>
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### DAM INSPECTION
TARRYTOWN RESERVOIR
LOWER LAKES ROUTING
FULL FMI

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