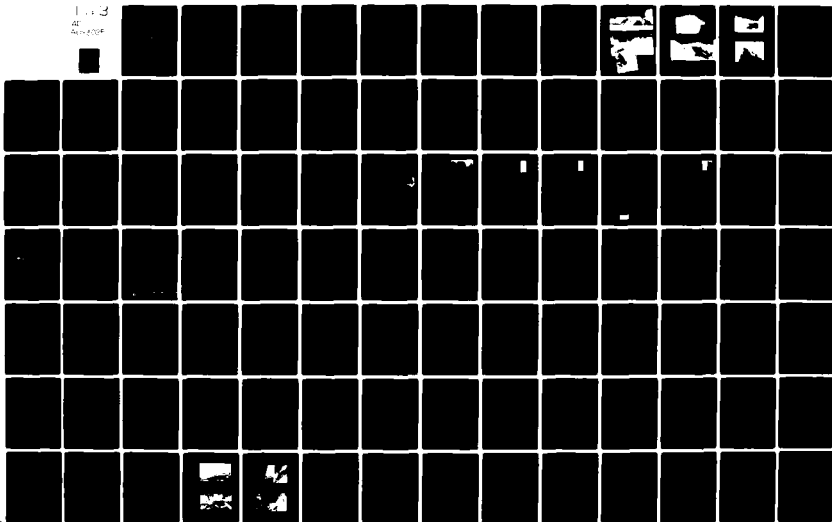


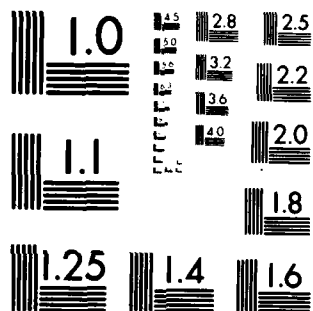
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the structural stability of the dam, the condition of the concrete and the extent of seepage through the concrete should		

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be investigated further.

The structural stability analysis indicates unsatisfactory stability against overturning for the cases where the dam is subjected to forces possible during winter operation (including ice loading), the Probable Maximum Flood (PMF), and 1/2 PMF conditions. Additional investigations should be undertaken immediately to fully evaluate the structural stability of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and leakage through construction joints. The walkway through the interior of the dam should be repaired so that the inspection of the interior of the dam can be performed. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include an investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. The recommended remedial measures should be completed within two years.

Hydrologic/hydraulic analysis performed in accordance with the Corps of Engineers Recommended Guidelines for Safety Inspection of Dams establishes the spillway capacity as 23% of the Probable Maximum Flood (PMF). The dam will be overtopped by 20.6 feet and 8.1 feet by the PMF and 1/2 PMF respectively. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure due to the small reservoir volume relative to the high flood flows. Therefore, the spillway is inadequate according to the Corps of Engineers screening criteria.

The following measures should be undertaken within one year:

1. A formalized inspection program should be initiated to develop data on conditions and maintenance operations at the facility.
2. A flood warning and emergency evacuation plan should be developed and implemented to alert the public in the event conditions occur which could result in failure of the dam.

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UPPER HUDSON RIVER BASIN

PALMER FALLS DAM
SARATOGA & WARREN COUNTIES
NEW YORK
INVENTORY NO NY 145

(15) DACW51-79-C-0001

(12) 241

(11) 23 Aug 80

PHASE I INSPECTION REPORT

(6) NATIONAL DAM SAFETY PROGRAM.

Palmer Falls Dam, (~~Inventory Number NY 145~~)
Upper Hudson River Basin, Saratoga and Warren
Counties, New York. Phase I Inspection Report,

APPROVED FOR RELEASE;

EXEMPT NO. 100-100000-1000

(14) NY-145

(11) John B. Stetson



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NEW YORK DISTRICT CORPS OF ENGINEERS

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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 aide 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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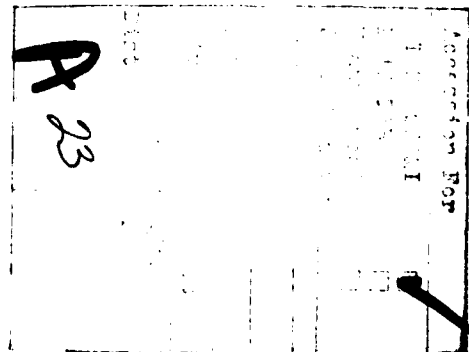
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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam Palmer Falls Dam, NY145

State Located	<u>New York</u>
County Located	<u>Saratoga and Warren</u>
Stream	<u>Hudson River</u>
Date of Inspection	<u>April 21, 1980, May 18, 1980</u>

ASSESSMENT OF
GENERAL CONDITIONS

The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the structural stability of the dam, the condition of the concrete and the extent of seepage through the concrete should be investigated further.

The structural stability analysis indicates unsatisfactory stability against overturning for the cases where the dam is subjected to forces possible during winter operation (including ice loading), the Probable Maximum Flood (PMF), and 1/2 PMF conditions. Additional investigations should be undertaken immediately to fully evaluate the structural stability of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and leakage through construction joints. The walkway through the interior of the dam should be repaired so that the inspection of the interior of the dam can be performed. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include an investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. The recommended remedial measures should be completed within two years.

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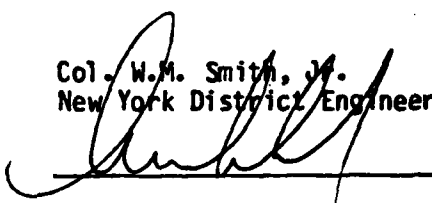
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1. A formalized inspection program should be initiated to develop data on conditions and maintenance operations at the facility.
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Dale Engineering Company

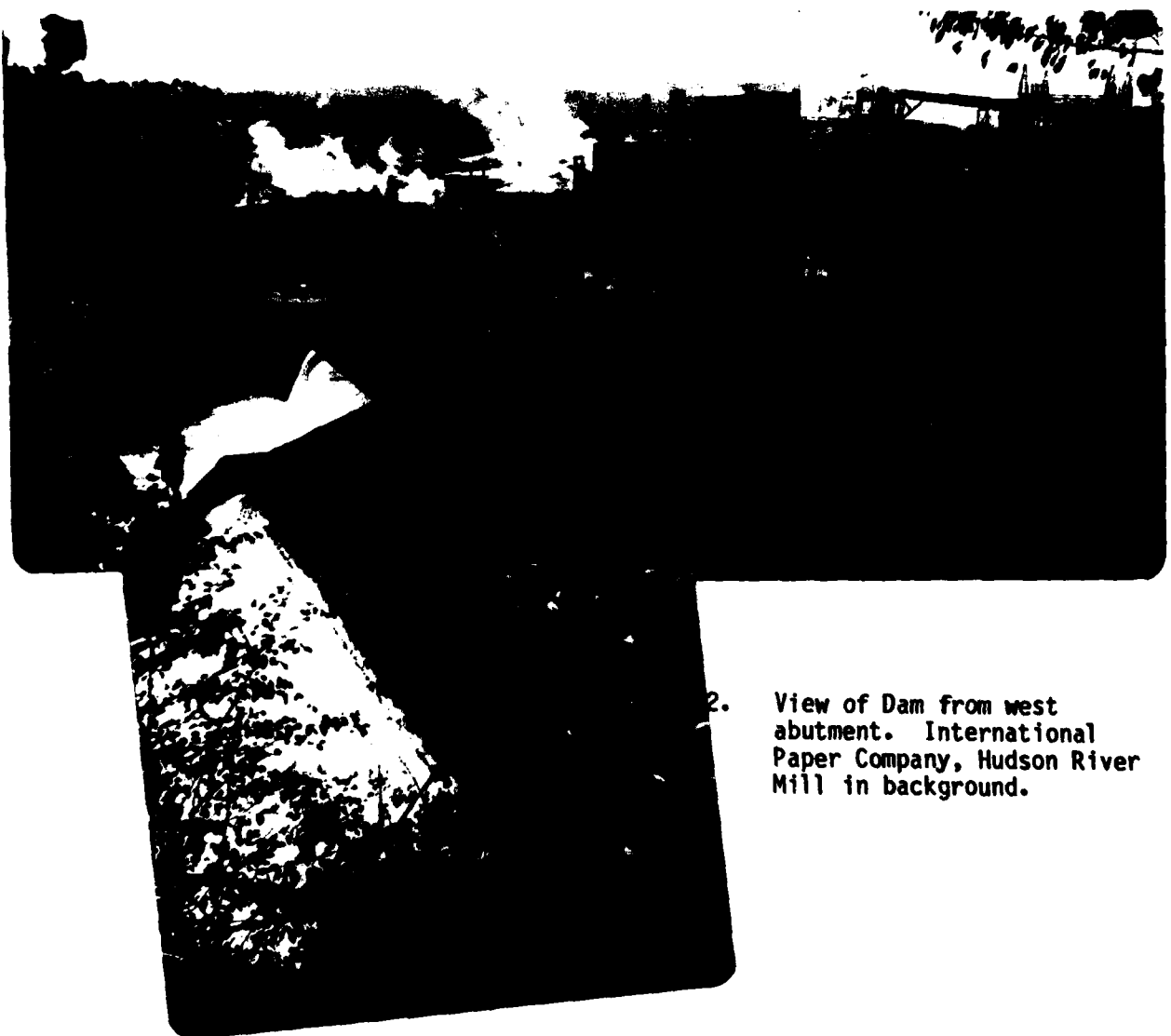

John B. Stetson, President

Approved By:
Date: 28 AUG 1980


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



1. View of Dam from downstream.



2. View of Dam from west abutment. International Paper Company, Hudson River Mill in background.



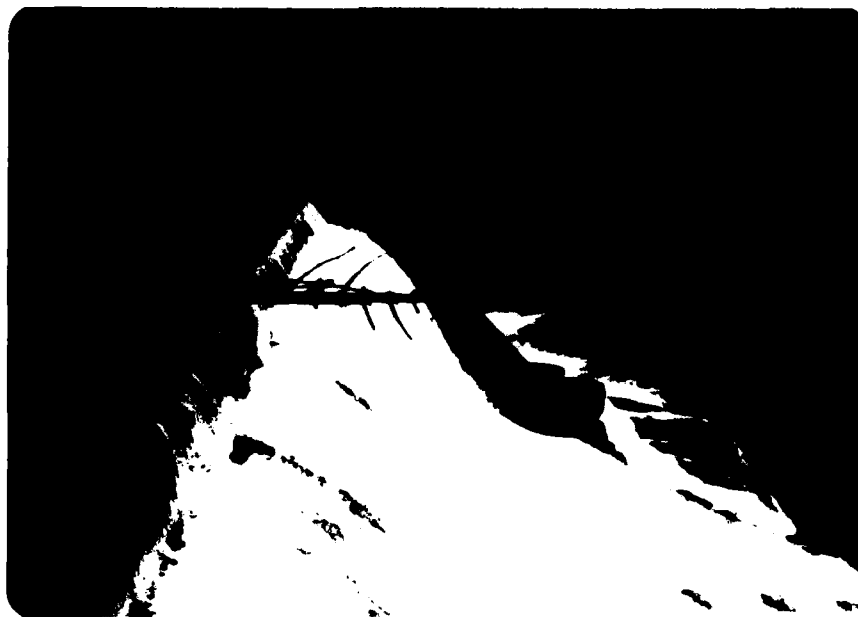
3. West abutment of Dam.



4. East abutment of Dam and spillway from single level forebay at upper left. Low level forebay in foreground.



5. View of impoundment from
east abutment.



6. View of receiving stream from east
abutment.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - PALMER FALLS DAM ID# - NY 145

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 New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the existing condition of the Palmer Falls Dam and appurtenant structures, owned by the International Paper Company, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

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 Palmer Falls Dam is situated on the Hudson River, in the Village of Corinth, New York. The dam is a V-shaped structure situated at the top of Palmer Falls, a natural waterfall in the river. The structure is approximately 557 feet long and 37 feet high. The spillway of the dam is an Ambursen type, concrete buttress structure. The easterly leg of the V-shaped spillway is constructed with an ogee shaped concrete spillway while the westerly portion is constructed with the buttresses exposed on the downstream face. The spillway section is normally equipped with flashboards 46 inches high. The International Paper Company, Hudson River Mill No. 3 is situated on the east abutment of the dam. A sluice gate structure approximately 196 feet long and accommodating 8 sluice gates controls flow into the

forebay of the power generating facility at the Paper Company Mill. The major spillway section of the dam forms a V at the crest of Palmer Falls and extends the full width of the river to the west abutment. The point of the V is in the downstream direction. The total length of the spillway section is approximately 346 feet. The dam is situated on rock.

The sluice gates control flow into the forebay of the power generating station of the Paper Mill. This generating station allows power to be generated either from the full head of the impoundment or by discharging flows from the upper level forebay into a lower level forebay which allows power to be generated at approximately 1/2 of the total head in the impoundment.

b. Location

The Palmer Falls Dam is located in the Village of Corinth, Town of Corinth, Saratoga County, New York and in the Town of Lake Luzerne, Warren County, New York.

c. Size Classification

The maximum height of the dam is approximately 37 feet. The storage volume of the impoundment is approximately 358 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 Hudson River, downstream from the impoundment, is used extensively for recreational purposes. The International Paper Company Hudson Mill is located on the east abutment of the dam. 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 International Paper Company.

Contact: International Paper Company
Pine Street
Corinth, New York 12822
Attention: Richard O'Brien, Plant Manager
Telephone: 518-654-9031

f. Purpose of Dam

The dam is used for power generating and as a source of process water by the International Paper Company.

g. Design and Construction History

The present dam was constructed in 1914 to replace a dam located a short distance upstream which was damaged during the floods of March, 1913. Correspondence included in Appendix B indicates that construction of the dam was started before the formal approval by the New York State Conservation Commission. In August of 1913, construction was halted by order of the Commissioner of the Conservation Commission until foundation problems on the easterly leg of the spillway section were resolved to the satisfaction of the Conservation Commission. The plans were subsequently revised to move the easterly leg of the spillway upstream and allow for construction of an ogee shaped spillway ramp which directed the water in a horizontal direction at the toe of the dam. This apparently eliminated to the satisfaction of the Conservation Commission the cause of probable erosion to the face of the natural waterfalls. The correspondence indicates that the dam was completed in late January of 1914.

h. Normal Operational Procedures

The facility is operated by the International Paper Company. The principal use of the facility is for power generation and as a source of process water. Normal operation of the facility consists of regulating the level of the impoundment for optimum power generation and process water availability. This is accomplished by the manipulation of the gates which control flow into the forebay of the mill.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Palmer Falls Dam, ID# NY145, is 2757 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed Discharges:

Ungated Spillway, Top of Dam (Without Flashboards)	66050	cfs
Ungated Spillway (With 46" Flashboards)	40200	cfs
Gated Drawdown (Through 2, 12'x12' Gated Outlets in Upper Forebay)	2090	cfs (@ elev. 517.17)

c. Elevation (Feet Above MSL)

Top of Dam	531.67
Spillway Crest	517.17
	520.92 with flashboards
Stream Bed at Centerline of Dam	479.7

d. Reservoir

Length of Normal Pool (With Flashboards)	2050 FT
--	---------

e. Storage

Top of Dam	561 Acre Feet
Normal Pool (With Flashboards)	358 Acre Feet
Normal Pool (Without Flashboards)	284 Acre Feet

f. Reservoir Area

Top of Dam	22 Acres
Spillway Pool	15 Acres

g. Dam

Type - Buttressed Concrete.
Length - 557 Feet.
Height - 37.5 Feet.
Freeboard Between Normal Reservoir and Top of Dam - 10.75 Feet.
Top Width - 12 Feet (Nominal).
Side Slopes - Upstream - 1 Horizontal, 0.75 Vertical; Downstream - 1 Horizontal, 1.75 Vertical.
Zoning - N/A.
Impervious Core - N/A.
Grout Curtain - N/A.

h. Spillway

Type - Ogee Crest.
Length - 346 Feet.
Crest Elevation - 517.17, with Flashboards - 520.92.
Gates - None.
U/S Channel - Natural.
D/S Channel - Natural - Rock.

i. Regulating Outlets

8 gates approximately 13 feet x 14 feet, controlling flow into upper forebay.

SECTION 2 - ENGINEERING DATA

2.1 GEOTECHNICAL DATA

The Palmer Falls Dam is situated entirely on bedrock. Appendix B has numerous references to the quality of the foundation material and also includes photographs of the site during construction.

2.2 DESIGN RECORDS

Appendix B also includes the original design calculations for the dam as well as design calculations developed by the Conservation Commission of the State of New York.

2.3 CONSTRUCTION RECORDS

Appendix B includes numerous inspection reports which took place during the construction of the dam.

2.4 OPERATION RECORDS

There are no Operation Records available for this dam.

2.5 EVALUATION OF DATA

The data presented in this report was obtained from the Department of Environmental Conservation files. The information available appears to be reliable and adequate for Phase I inspection purposes.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The Palmer Falls Dam was inspected on April 21, 1980. The Dale Engineering Company Inspection Team was accompanied on this inspection by Robert Talbot, Supervisor of Engineering Services for the International Paper Company. At the time of this inspection, flow in the river was approximately 20,000 cfs. This flow across the spillway section of the dam obscured much of the structure from view. A subsequent inspection was performed on May 18, 1980 during a period when flow was substantially less but still great enough to partially obscure the structure from view.

b. Dam

The second inspection of the Palmer Falls Dam was conducted when some flow was cresting the spillway, however, observation of the spillway surface was made through the water. The surface of the easterly wing of the V-shaped dam appears to be in good condition. Some slight surface spalling was noted through the water and horizontal joints in the concrete were also visible. The log chute in the center of the V of the dam shows some deterioration of the concrete but no structural cracking was detected when viewed from a distance. The westerly leg of the V-shaped spillway was viewed both from above the west abutment and from the receiving pool downstream from the dam. These vantage points did not offer a close enough view so that the condition of the concrete could be determined, however, the alignment of the structure does not indicate displacement of structural members. The interior of the structure was not inspected because of the hazardous condition of the walkway between the buttresses. Some leakage reputedly takes place through the concrete into the interior of the dam.

c. Appurtenant Structures

The easterly abutment wall shows some surface spalling of the concrete to the depth of approximately 3 to 4 inches in some places. Minor surface spalling was also noted on the walkways around the gates controlling flow into the forebay. Recent concrete repairs had taken place in this area.

d. Control Outlet

The sluice gates controlling flow into the forebay of the paper mill are in operating condition and were fully opened at the time of the inspection. These gates are pneumatically operated and the operating mechanism was in good condition.

e. Reservoir Area

The Palmer Falls Dam is a run-of-river structure and the impoundment is defined by the original banks of the Hudson River. This impoundment extends approximately 1/2 mile to an upstream dam also owned by International Paper Company. The banks of the Hudson River in this area are formed in rock and no evidence of bank instability was noted.

f. Downstream Channel

The downstream channel is also formed in bedrock and no evidence of recent erosion was noted.

3.2 EVALUATION

Although flow conditions at the dam precluded a close inspection of the spillway surface, there was no evidence that severe deterioration of the concrete has taken place. Flow over the ogee shaped spillway which comprises the easterly leg of the dam was generally smooth and no irregularities in flow were noted which would indicate severe surface deterioration. Field observations did not disclose evidence of displacement of the structure and no conditions were detected which would indicate structural instability.

Minor deterioration of concrete surfaces was detected on the east abutment wall, however, this deterioration was not severe and steps had been taken to repair spalled concrete on the walkways.

The walkway through the interior of the dam should be repaired so that inspections may be made of the structural elements of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The normal operating procedure for this structure is to control the water level in the impoundment for optimum use for power generation and process water for paper manufacturing.

4.2 MAINTENANCE OF THE DAM

Maintenance and operation of the dam is controlled by the International Paper Company. The dam is immediately adjacent to the facilities of International Paper Company and is in constant surveillance by their personnel. No formal reporting system is in effect regarding the condition of the dam. Inspection of the interior of the dam is presently prohibited due to the dangerous condition of the walkway between the buttresses.

4.3 MAINTENANCE OF OPERATING FACILITIES

The gates controlling the flow to the forebay of the power generating facilities are in operating condition and are checked periodically by personnel of the International Paper Company.

4.4 DESCRIPTION OF WARNING SYSTEM

No warning system is in effect at present.

4.5 EVALUATION

The dam and appurtenances are in constant surveillance by personnel from the International Paper Company. The facility is generally in satisfactory operating condition. Deterioration of the walkway through the dam prohibits access to the core for inspection purposes. There is no other evidence of deterioration caused by lack of maintenance. Because the 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 Palmer Falls Dam is located on the Warren and Saratoga County line in the Village of Corinth. The dam is situated on the Hudson River, which has a drainage area of approximately 2,757 square miles upstream of the site. The Upper Hudson River is a rather complex river system which includes such major tributaries as Schroon River, Cedar River and Sacandaga River. The major lakes in the river system upstream of the dam include Schroon Lake, Brant Lake, Indian Lake and Great Sacandaga Lake.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the dam and spillway with respect to their flood control potential and adequacy. This has been assessed through the evaluation of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the flood through the reservoir and the dam's spillway system. The PMF event is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration loss and concentration of run-off of a specific location that is considered reasonably possible for a particular drainage area.

The hydraulic analysis is performed to determine the capacity of the spillway and to determine the extent of the overtopping of the dam which could occur during the PMF. In establishing the spillway capacity, it was assumed that no flashboards were in place on the spillway. It should be noted that the placement of flashboards will further decrease the spillway capacity so that overtopping could occur at lesser flows than those indicated in this analysis if the flashboards do not fail before overtopping occurs.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Due to the limited scope of this Phase I investigation, certain assumptions, based on experience and existing data were used in this analysis and in the determination of the dam's spillway capacity to pass the PMF. In the event that the dam could not pass one-half the Probable Maximum Flood without overtopping, additional analyses are to be performed on potential dam failures if the dam is designated as a High Hazard Classification. This process was done with the concept that if the dam was unable to satisfy this criteria, further refined hydrologic investigations would be required.

An HEC-1 computer model for the basin was published by the New York District Corps of Engineers in a report entitled Upper Hudson and Mohawk River Basins Hydrologic Flood Routing Models, dated October 1976 (Ref. 19). The report was reviewed for the purpose of this investigation and the model which was used for the preparation of this report was obtained from the New York District. The model was re-coded and executed for analysis of the PMF. No changes were made to

the unit hydrograph, base flow, loss rate or routing parameters. A smaller sub-area was added to the model to determine flows at the Palmer Falls Dam. The unit hydrograph parameters and base flow for this new sub-area were estimated from equations presented in the aforementioned report.

The U.S. Army Corps of Engineers' Hydrologic Engineering Center's Computer Program HEC-1DB was utilized to evaluate the PMF hydrology. The Probable Maximum Precipitation (PMP) was 20.6 inches according to Hydrometeorological Report (HMR #51) for a 24-hour duration storm, 200 square mile basin. HMR #51 was used in lieu of HMR #33 because the drainage area exceeded the applicable limits of HMR #33. The loss rates used in the PMF analysis were those used in the Transposed Agnes Storm and SPF analysis published in the Upper Hudson and Mohawk River Basins report. These loss rates incorporated an initial abstraction of 1.0 to 2.0 inches and a continuous loss rate of 0.075 inches/hour. The loss rate function yielded 74 percent run-off from the PMF. The peak for the PMF inflow hydrograph was 282,570 cfs and the 1/2 PMF inflow peak was 140,770 cfs. The small storage capacity resulted in the peak outflows being essentially equal to the peak inflows. It should be noted that flows in the Upper Hudson River from any storm may be regulated appreciably by Great Sacandaga Lake and Indian Lake. Such time-varying operation was not simulated with the HEC-1 model.

5.3 SPILLWAY CAPACITY

The spillway is an Ambursen-type structure with a sloping upstream face and a rounded crest. Weir coefficients ranging from 3.1 to 3.65 over the heads encountered in routing the PMF were assigned for the spillway rating curve development. In the PMF evaluation, flow through the forebay gates and flow through the mill were not considered. The discharge capacity of the spillway at the top of dam elevation is 66,050 cfs with no flashboards in place. The spillway capacity with 46 inches of flashboards is 40,200 cfs.

SPILLWAY CAPACITY (WITHOUT FLASHBOARDS)

<u>Flood</u>	<u>Peak Discharge</u>	<u>Capacity as % of Flood Discharge</u>
PMF	282,567 cfs	23.4%
1/2 PMF	140,777 cfs	46.9%

5.4 RESERVOIR CAPACITY

The reservoir storage capacity was estimated from USGS mapping and available riverbed information at Palmer Falls and Curtis Falls dams.

The resulting estimates of the reservoir storage capacity are shown below:

Top of Dam	561 Acre-Feet
Spillway Crest	284 Acre-Feet

5.5 FLOODS OF RECORD

There are no accurate records of flood discharges at the site. A review of pertinent publications revealed the maximum discharges shown below for sites on the Hudson River near the dam site (Ref. 21).

<u>Hudson River Gage Location</u>	<u>Drainage Area (Sq. Mi.)</u>	<u>Period of Record</u>	<u>Date</u>	<u>Maximum Discharge(cfs)</u>
Corinth, NY	2755	1905-1912	4/16/09	41,400
Spier Falls, NY	2799	1900-1922	3/28/13	89,100
Ft. Edward, NY	2817	1896-1904	4/23/00	43,900

It should be noted that these flood discharges occurred before construction for the present structure and were not affected as much by the regulating capability of the Great Sacandaga Lake as present or future flood flows would be.

5.6 OVERTOPPING POTENTIAL

The HEC-1 DB analysis indicates that the dam will be overtopped as follows:

<u>Flood</u>	<u>Maximum Depth Over Dam</u>
PMF	20.6 Feet
1/2 PMF	8.1 Feet

5.7 EVALUATION

The spillway is inadequate to pass Probable Maximum Flood (PMF) without overtopping the dam, as the spillway capacity is 23% of the PMF. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure due to the small reservoir volume relative to the high flood flows. Therefore, the spillway is assessed as inadequate according to the Corps of Engineers screening criteria.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Palmer Falls Dam is situated at the crest of a natural rock ledge-waterfall in the Hudson River. The dam is "V-shaped" and comprised of two sections to generally follow the natural alignment of the rock ledge. A constructed abutment, of concrete, at the point of the dam's "V" serves to join the two sections. The westerly, or left abutment looking downstream, is sited into rock. The dam's right abutment, also founded in rock, adjoins the forebay structure for the International Paper Company hydropower facility-production plant situated on the east bank of the river.

The westerly dam section is an Ambursen design (downstream face unsurfaced). The easterly section represents a modification of the Ambursen design, being a buttressed structure with the downstream side concrete surfaced.

Both dam sections function as a spillway. Flashboards in place were being crested at the time two field inspections were performed. Spillway flow interfered with access to and observation of much of the dam surface. The interior of the dam could not be examined because of the unsafe condition of the walkway. Some leakage reputedly takes place through the concrete into the interior of the dam. However, observations indicate the dam retains structural stability and no sign of structural movement was evident. Some surface deterioration and spalling has occurred along the dam spillway sections and abutment structures. The spillway flow prevented examinations of the rock at the toe of the dam and investigation for erosion and underdam seepage.

b. Geology and Seismic Stability

Geologically, Palmer Falls is located in the eastern part of the Adirondack Province.

The dam foundation and both abutments are sited in bedrock of granitic to syenitic gneisses. This material is hard, dense, durable, resistant, and impermeable. Weathering is very minor.

At the east abutment the gneiss foliation strikes N80E and dips 10°-13° NW. The dip is, generally, in the downstream direction.

State reports of 1913 mention the dip as being anywhere from 10° to 20° downstream. Although the foliation is generally tight and closely spaced (1 to 3 mm), foliation open cracks exist and range in spacing from 2 to 8 inches.

Two prominent joint sets are present at the east abutment as follows:

<u>Set</u>	<u>Strike</u>	<u>Dip</u>	<u>Spacing</u>
1	N10E	90	2-1/2"-5"
2	N80-85E	80-85E	2-1/3"-8"

The rock structure therefore presents readily available blocks which are susceptible to movement by hydraulic action and frost wedging.

The included Geologic Map shows several faults which are located in the vicinity of the dam site. Several 1913 State reports which discuss construction of the present dam indicate a fault is at the dam and essentially parallel to the longitudinal axis. This fault was reported to be practically vertical with a trench eroded along that zone to a depth of 30 to 40 feet.

A fault about two miles west of the dam, known as Hoffman's fault, has a vertical displacement estimated as being from 1,000 to 1,600 feet. Another fault, situated about five miles east of the dam, has a vertical displacement of about 4,900 feet.

Information on some of the larger earthquakes recorded for the area appears below. Many earthquakes of less intensity are known to have occurred in this region, according to the New York State Geologic Survey, but none are in the immediate vicinity of the dam.

<u>Date</u>	<u>Intensity Modified Mercalli</u>	<u>Location Relative to Dam</u>
1847	III	7 mi. NE
1855	IV	14 mi. NNE
1916a	IV-V	26 mi. SW
1916b	V	7 mi. NE
1917	III	12 mi. ENE
1921a	IV	7 mi. NE
1921b	IV	7 mi. NE
1931	VII	13 mi. NNE
1955	V	20 mi. S
1974	IV-V	9 mi. N

The dam is located in an area having a Zone 2 Seismic Probability Designation. However, the area is considered to have the potential for a Zone 3 designation.

Concerning the fault existing at the dam site, if the trench (formed by erosion along the fault) was not properly filled or grouted, a significant potential zone of weakness will exist. Similarly, if the joints and foliation plane openings were not grouted, the potential for significant uplift is increased. It is also possible that the water falling on the bedrock at the toe may have accomplished some undermining.

The high (about 80 feet) steep walls above the impoundment area are considered subject to some rock fall (the result of frost wedging). The walls are not likely to experience a rock slide. A moderate to severe earthquake would increase the rock fall potential while movement along the fault underlying the dam would weaken the dam foundation and increase its susceptibility to sliding and uplift.

c. Stability Evaluation

Design drawings available for review show a plan alignment and cross-sections for the dam spillway sections but do not include information on the properties of the dam and foundation materials. Some previously performed stability computations are available (1913) for review but it is not certain that these analyses refer to the as-built conditions for the dam's actual location. As part of the present study, stability evaluations have been performed for the dam spillway sections. Actual properties of the dam's construction materials and foundations were not determined as part of this study; where information on properties were necessary for computations but lacking, assumptions felt to be practical were made. The stability computations assumed a structural cross-section based on dimensions indicated by the plans included in this report. It should be considered that in areas where deterioration has occurred, section dimensions would be less than indicated by the plans, with some adverse affect on the structural strength expected. The analysis also assumed dam sections to be monoliths possessing necessary internal resistance to shear and bending occurring as a result of loading.

The results of the stability computations are summarized in the table following this page. The stability analysis are presented in Appendix D.

The rock surface underlying the dam varies in elevation, a condition which effects the height of the dam's different sections. Cross-sections assumed for analysis are representative of the higher, and presumably more critical, dam areas.

The analysis indicates that both the easterly and westerly dam sections are stable against overturning and sliding effects under the normal summer operations condition which includes flashboards in place. Instability, but marginally so, is indicated for both dam sections subject to forces possible under winter operating conditions which include the effects of ice, according to the U.S. Corps of Engineers Recommended Guidelines for Safety Inspection of Dams (i.e., where the resultant of forces acting on the dam is located outside the middle third of the base or plan analyzed, tensile stress would develop in the dam section, a condition which is structurally undesirable because of the very low design tensile strength of concrete.)

Both dam sections show satisfactory stability for the condition where seismic effects are imposed onto the forces which occur from the normal summer operating condition.

RESULTS OF STABILITY COMPUTATIONS

Easterly Section	Loading Condition	Factor of Safety*		Location of Resultant Passing through Base***
		Overturning	Sliding**	
(1)	Normal operating condition of water level at top of flashboards, uplift on base (base considered equal to dam plan area)	1.37	6+ ₋	0.33b
(2)	Water level at top of flashboards, 7.5 kip per foot ice load acting, uplift on base	1.32	3+ ₋	0.30b
(3)	1/2 PMF conditions, with water level against upstream face and above dam based on 1/2 PMF elevation			
	(a) uplift on base as computed for normal operating condition	1.73	3.8+ ₋	0.41b
	(b) uplift based on full headwater hydrostatic pressure at heel	1.29	3.5+ ₋	0.31b
(4)	PMF conditions, with water level against upstream face and above dam based on PMF elevation			
	(a) uplift on base as computed for normal operating condition	1.93	3.1+ ₋	0.44b
	(b) uplift based on full headwater hydrostatic pressure at heel	1.25	2.7+ ₋	0.30b
(5)	Normal operating condition (water level at top of flashboards) plus seismic effects applicable to Zone 2	1.32	5+ ₋	0.31b

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

RESULTS OF STABILITY COMPUTATIONS - (CONTINUED)

<u>Loading Condition</u>		<u>Factor of Safety*</u> <u>Overturning</u> <u>Sliding**</u>		<u>Location of Resultant</u> <u>Passing through Base***</u>
<u>Westerly Section</u>				
(6)	Normal operating condition of water level at top of flashboards, uplift on base where			
	(a) base equals plan area of dam	1.41	14+ <u> </u>	0.35b
	(b) base equals foundation contact area only, area between buttresses excluded	1.78	7+ <u> </u>	0.38b
(7)	Water level at top of flashboards, 7.5 kip per lineal foot ice load acting, uplift on base			
	(a) base equals plan area of dam	1.27	more than 5.5	0.26b
	(b) base equals foundation contact area only	1.57	5.5+ <u> </u>	0.32b
(8)	1/2 PMF conditions, with water level against upstream face and above dam based on 1/2 PMF elevation, uplift on base as computed for normal operating condition			
	(a) base equals plan area of dam	1.47	greater than for (b)	0.28b
	(b) base equals foundation contact area only	greater than for (a)	3.3+ <u> </u>	---

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

RESULTS OF STABILITY COMPUTATIONS - (CONTINUED)

<u>Loading Condition</u>	<u>Factor of Safety* Overturning Sliding**</u>	<u>Location of Resultant Passing through Base***</u>
(9)		
PMF conditions, with water level against upstream face and above dam based on PMF elevation, uplift on base as computed for normal operating condition		
(a) base equals plan area of dam	1.59	0.31b
(b) base equals foundation contact area only	greater than for (a)	--
(10)		
Normal operating condition (water level at top of flashboards), seismic effects applicable to Zone 2, uplift on base		
(a) base equals plan area of dam	1.36	0.34b
(b) base equals foundation contact area only	greater than for (a)	--

* These factors of safety indicate the ratio of moments resisting overturning to those moments causing overturning, and the ratio of forces resisting sliding to those causing sliding.

** As determined applying the friction-shear method.

*** Indicated in terms of the dam's base dimension, b, measured from the toe of the dam.

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For the dam subject to the 1/2 PMF and PMF condition, a number of different possible uplift effects were studied. At this site, it is considered that the jointing, foliation cracks and bedding present in the foundation rock creates the possibility that uplift will act at the base of the dam. Accordingly, the easterly section of the dam was analyzed for the condition where the uplift force at a 1/2 PMF and PMF occurrence remained equal to the uplift possible under a normal operations condition (this would assume that the rock permeability and seepage was limited) and also for the more severe condition where the uplift related to pressures resulting from the actual upstream water level present during the 1/2 PMF or PMF. For each uplift condition, the hydrostatic pressure acting at the dam's upstream edge was based upon the appropriate headwater elevation, (the "normal operations" or flood level elevation), while a zero tailwater elevation and hydrostatic pressure was assumed at the dam's downstream edge. Uplift was assumed to vary linearly between a section's upstream and downstream faces, and act upon 100 percent of the dam base/section. For the easterly section, adequate stability is indicated with the "normal operations" uplift in effect but unsatisfactory stability results where the uplift is based upon the 1/2 PMF or PMF upstream level.

The westerly dam section exists with the downstream face open between buttress locations. The possibilities that uplift could act on a base equal to the dam's plan area or act only on the actual area in contact with the foundation rock (open area between buttresses is not considered as part of the base) were studied. For both these cases, an uplift developed from the normal operations condition was applied to the assumed base area. The resulting computations indicate unsatisfactory stability against overturning for the assumption of uplift acting upon a base with dimensions equal to the dam plan area, and unsatisfactory resistance to sliding (factors of safety less than four) for the assumption of uplift acting on only the foundation contact area. Lesser factors of safety (less stability) than shown in the tabulated summary would apply to the more severe condition where uplift pressures are based upon actual upstream flood water elevations. When evaluating the 1/2 PMF and PMF cases, the analysis assumed that lateral and vertical pressures acting against the back face of the dam related to the upstream flood level, with no water pressures acting against the dam's downstream side.

The discussed analysis applies to a dam in structurally good condition. The field observations indicate some materials attrition, including surface deterioration, is occurring. Although this analysis indicates generally satisfactory stability under normal operating conditions, there is a lack of information regarding the condition of many of the structural elements of the facility and the uplift forces acting on the base. Therefore, further investigations are recommended. Evaluation of existing structural conditions should be based upon inspection of the dam sections and abutment structures with the reservoir drawn down. Evaluation of the structure should include the dam's interior to determine the condition of the underside of the

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upstream face, the buttresses and the base. Because of the influence on the dam's stability under flood conditions, means to evaluate the presence and magnitude of uplift acting on the base should be undertaken. This study should also investigate and evaluate the structural condition of the rock underlying the dam and immediately downstream for determining the resistance to displacement. Dam stability studies based on actually existing conditions should be performed and if necessary, recommendations to improve the stability should be developed. Meanwhile, maintenance and repair should be provided for deteriorated areas to ensure that the presently existing stability is retained.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The Phase I inspection of the Palmer Falls Dam on the Hudson River did not indicate conditions which constitute an immediate hazard to human life or property.

The hydrologic/hydraulic analysis establishes the spillway capacity as 23% of the Probable Maximum Flood (PMF). The dam will be overtopped by 20.6 feet and 8.1 feet by the PMF and 1/2 PMF respectively. However, in the opinion of the inspection team, failure of the dam during the 1/2 PMF would not significantly increase the downstream hazard from that which would occur just prior to dam failure. Therefore, the spillway is inadequate according to the Corps of Engineers screening criteria.

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

1. The structural stability indicates unsatisfactory stability against overturning according to the Recommended Guidelines for Safety Inspection of Dams for cases of the dam subject to forces possible during winter operation (including ice loading), the 1/2 PMF and the PMF conditions. Under each of these conditions the resultant of the forces acting on the dam is located outside the middle third of the base indicating that tensile stresses would develop in the dam section.
2. The visual inspection revealed minor deterioration of horizontal joints in the spillway when viewed through the water cresting the spillway.
3. The walkway through the dam is unsafe, thereby prohibiting inspection of the interior.
4. Leakage reputedly takes place through the concrete into the core of the dams.

b. Adequacy of Information

The information available is adequate for this Phase I inspection report.

c. Urgency

During the inspections of the Palmer Falls Dam, water cresting the flashboards obscured the surface of the concrete spillway from view. The unsafe condition of the walkway through the center of the dam

prevented an inspection of the interior of the structure. Structural defects may exist that were undetected during the inspection. Therefore, the investigations recommended below should be undertaken within 6 months and remedial work should be completed within two years.

d. Need for Additional Investigation

Additional investigations should be undertaken to fully evaluate the structural condition of the dam. These investigations should consist of a physical examination of the structure with the impoundment drawn down so as to provide a view of the spillway concrete and a detailed inspection of the interior of the dam to determine the structural condition of the concrete and the extent of any leakage through construction joints. The walkway through the interior of the dam should be repaired to allow the inspection of the interior of the dam. Investigations should also be undertaken to evaluate the presence and magnitude of uplift forces acting on the dam. This study should also include the investigation and evaluation of the structural condition of the rock underlying the dam and immediately downstream. Dam stability studies based on actual existing conditions should then be performed. If necessary, recommendations to improve the stability should be developed. Meanwhile, maintenance and repair should be provided for deteriorated areas to ensure that the present existing stability is retained.

7.2 RECOMMENDED MEASURES

The following steps should be undertaken:

1. The walkway through the interior of the dam should be repaired within one year.
2. Complete the aforementioned structural inspections and structural stability investigations.
3. Undertake any repairs necessary as indicated by the detailed structural evaluations and stability computations.
4. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility.
5. A flood warning and emergency evacuation plan should be implemented to alert the public in the event conditions occur which could result in failure of the dam.

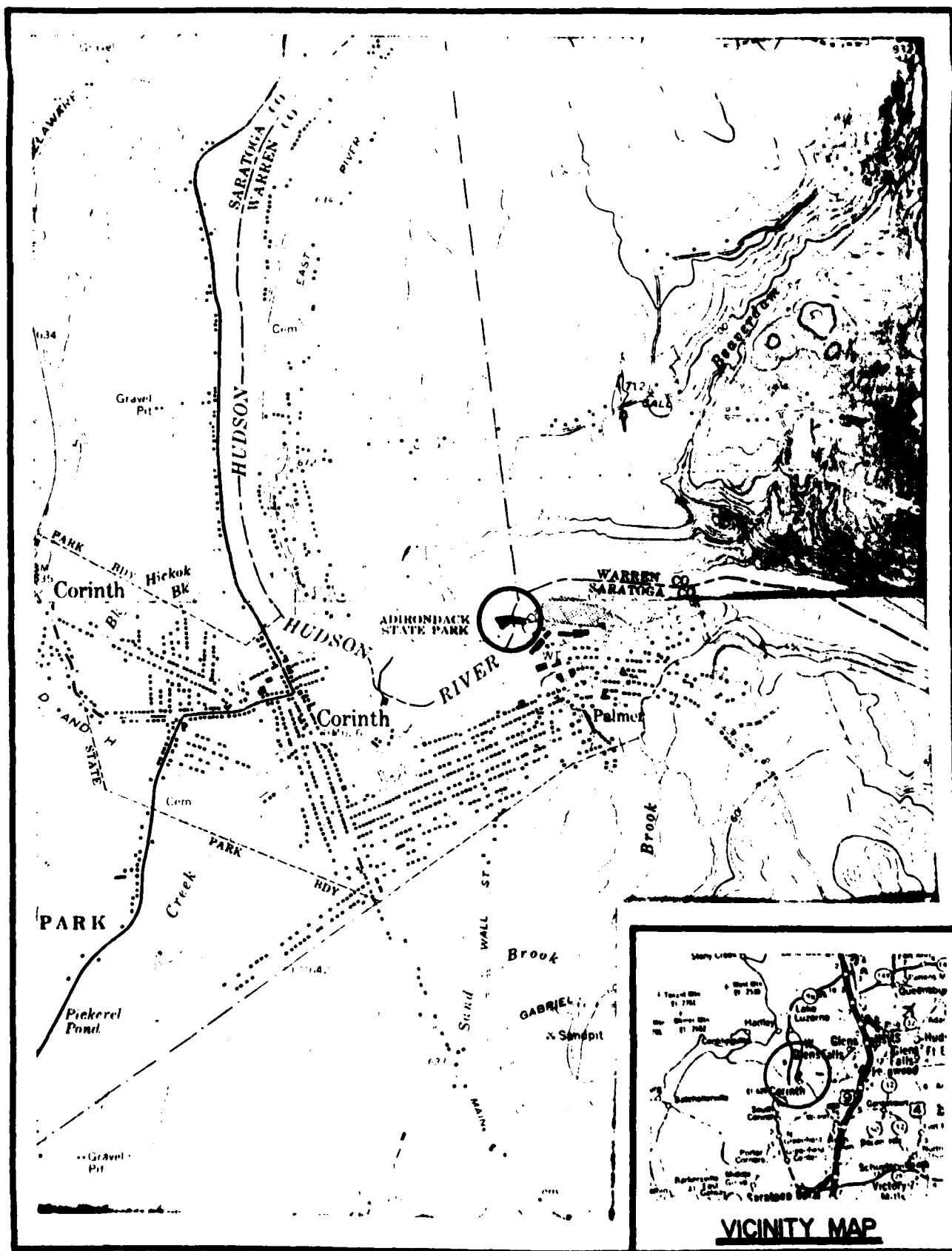


FIGURE 1

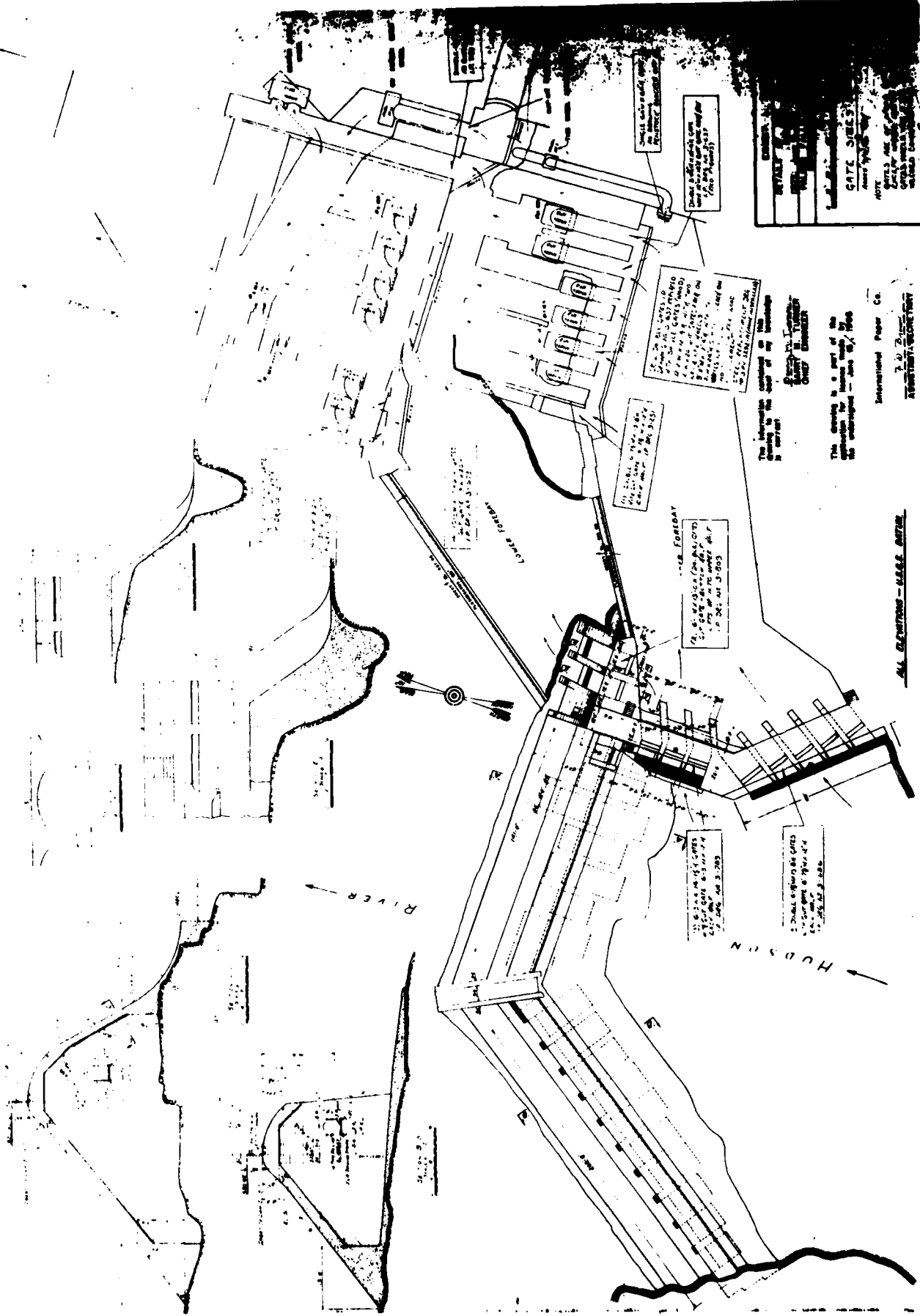
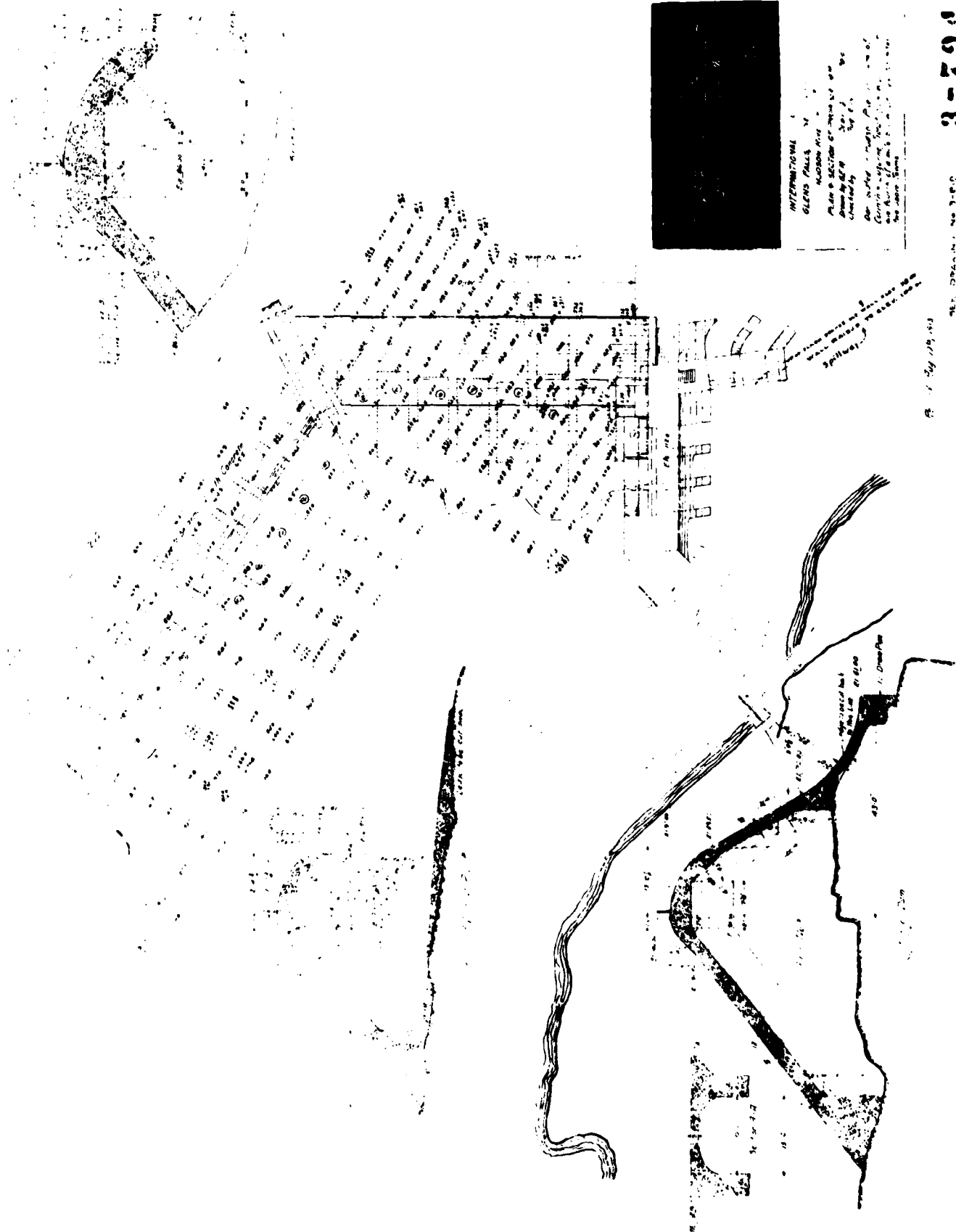
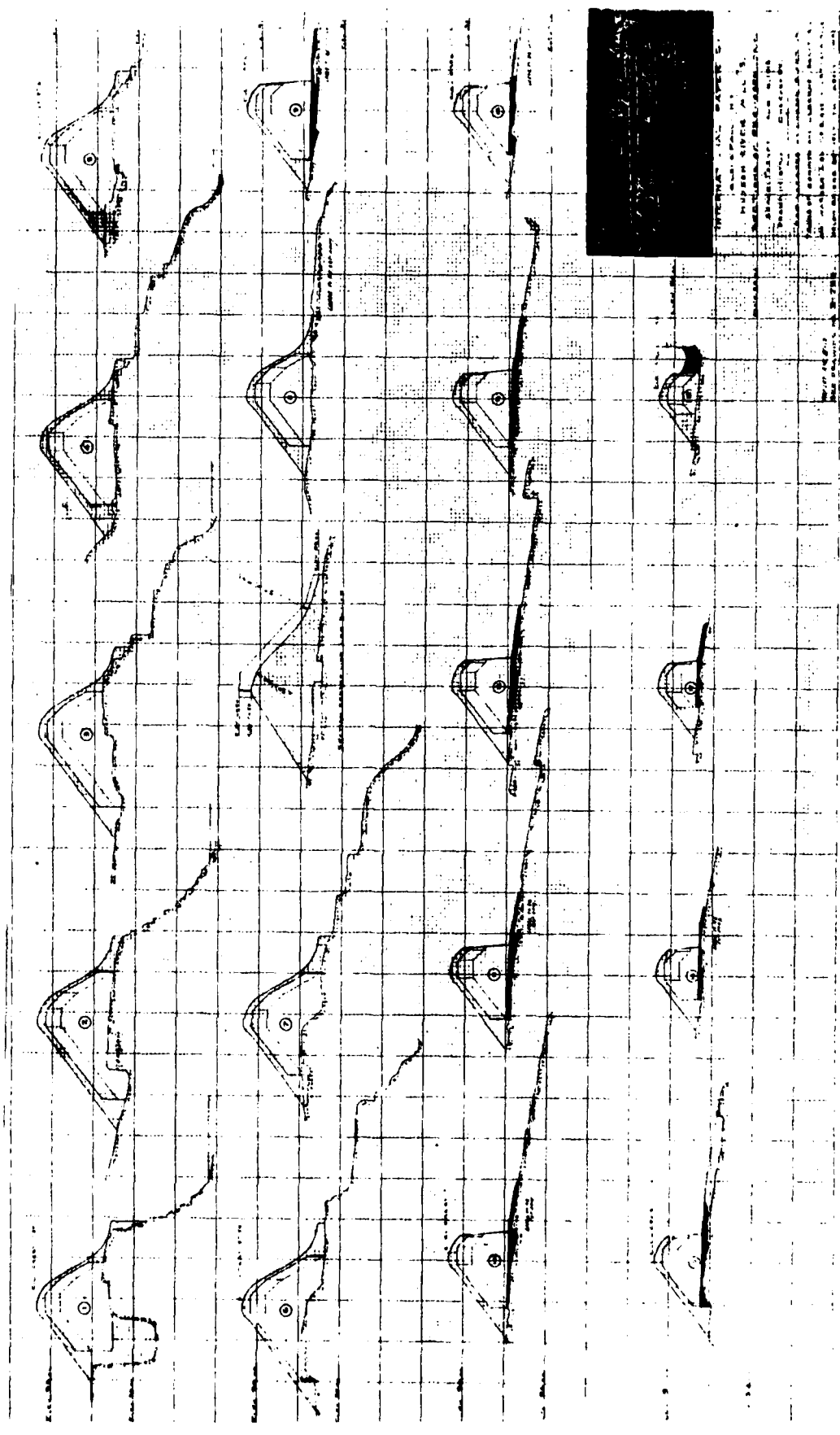


FIGURE 2



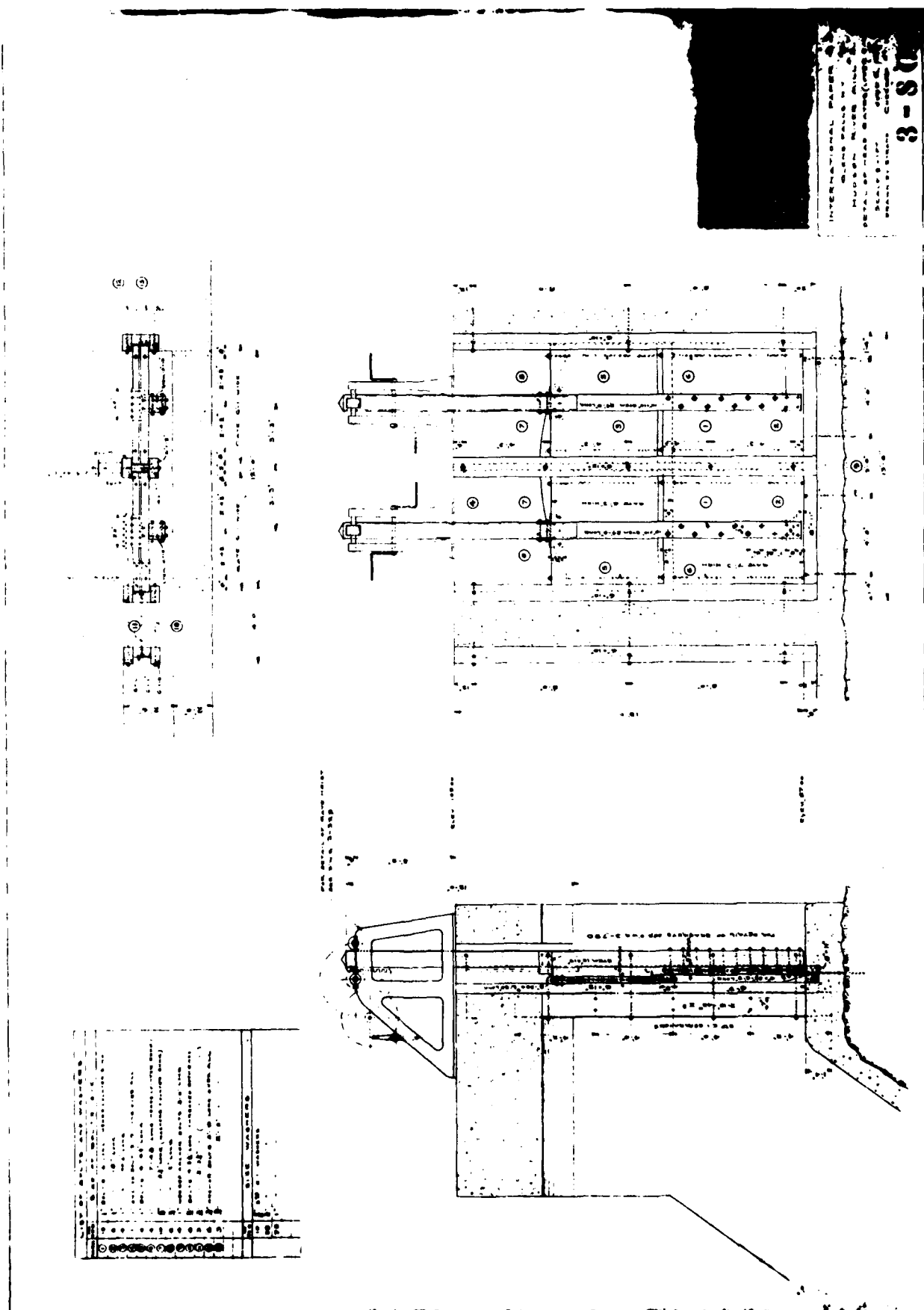


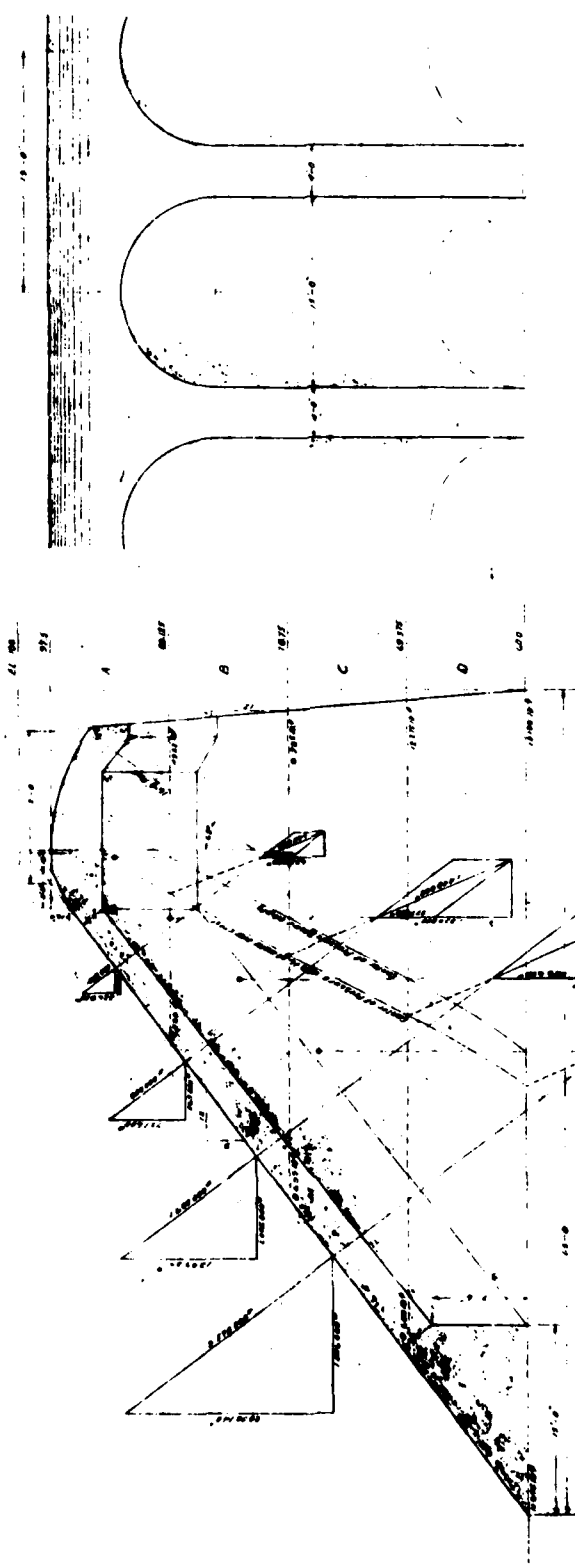
3-818

FIGURE 4

INTERNATIONAL PAPER C
COPPER FALLS NY
MUSON OVER ALL S
DETAILS WOULD BE
READY MAY 1953
BOARD OF DIRECTORS
3-785

FIGURE 5





SECTION OF PROPOSED BUTTRESS DAM
PALMER'S FALLS N.Y.
INTERNATIONAL PAPER CO.

Scale 1/4" = 1'-0" 000000
Date May 1917

PROJ. T. C.
Submitted to the
N.Y.S. Dept. of
Conservation
New York City
Consulting Engineer

Project A and B 1/4" = 1'-0" 000000
Project C 1/4" = 1'-0" 000000
Project D 1/4" = 1'-0" 000000

FIGURE 7

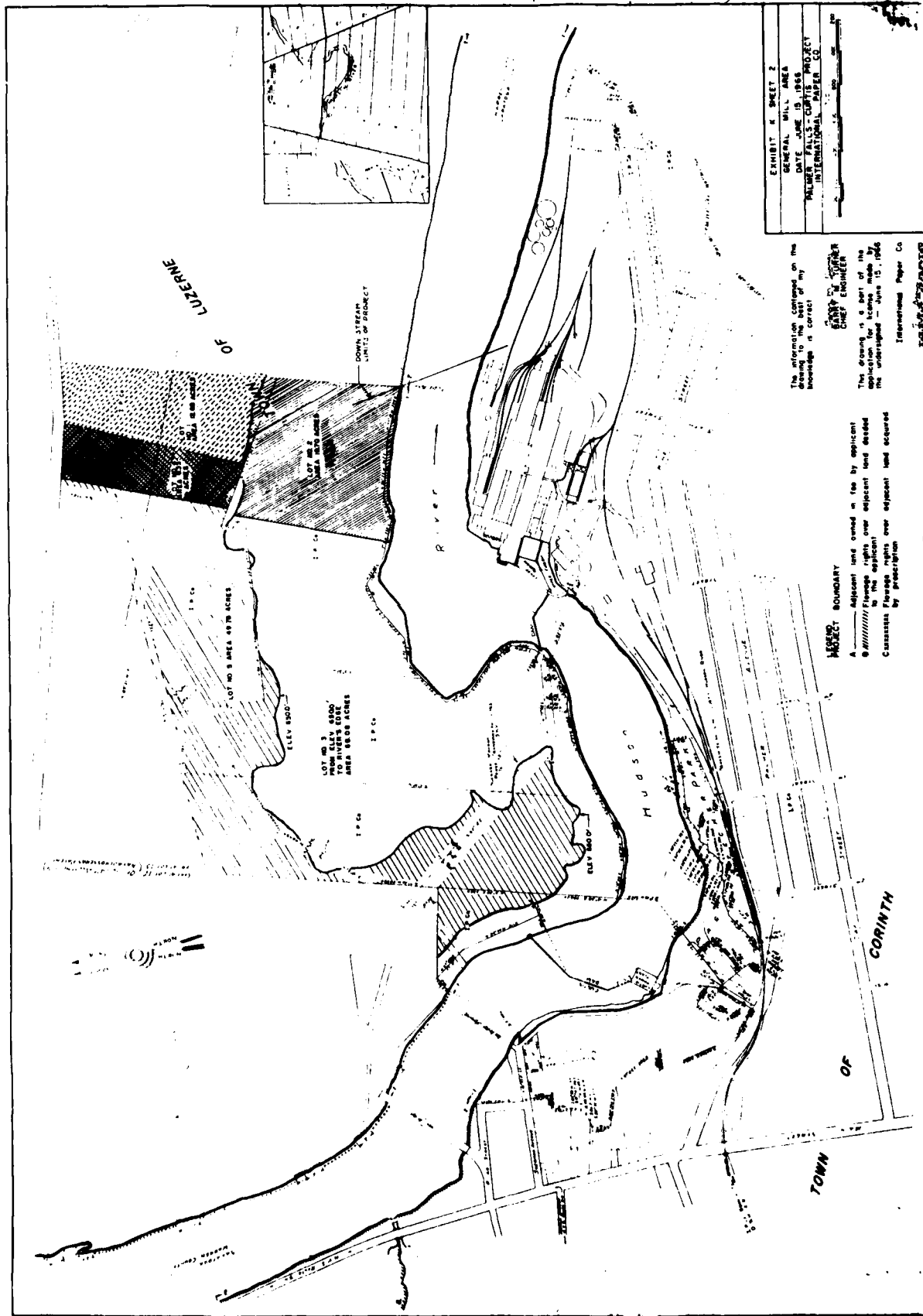


FIGURE 9

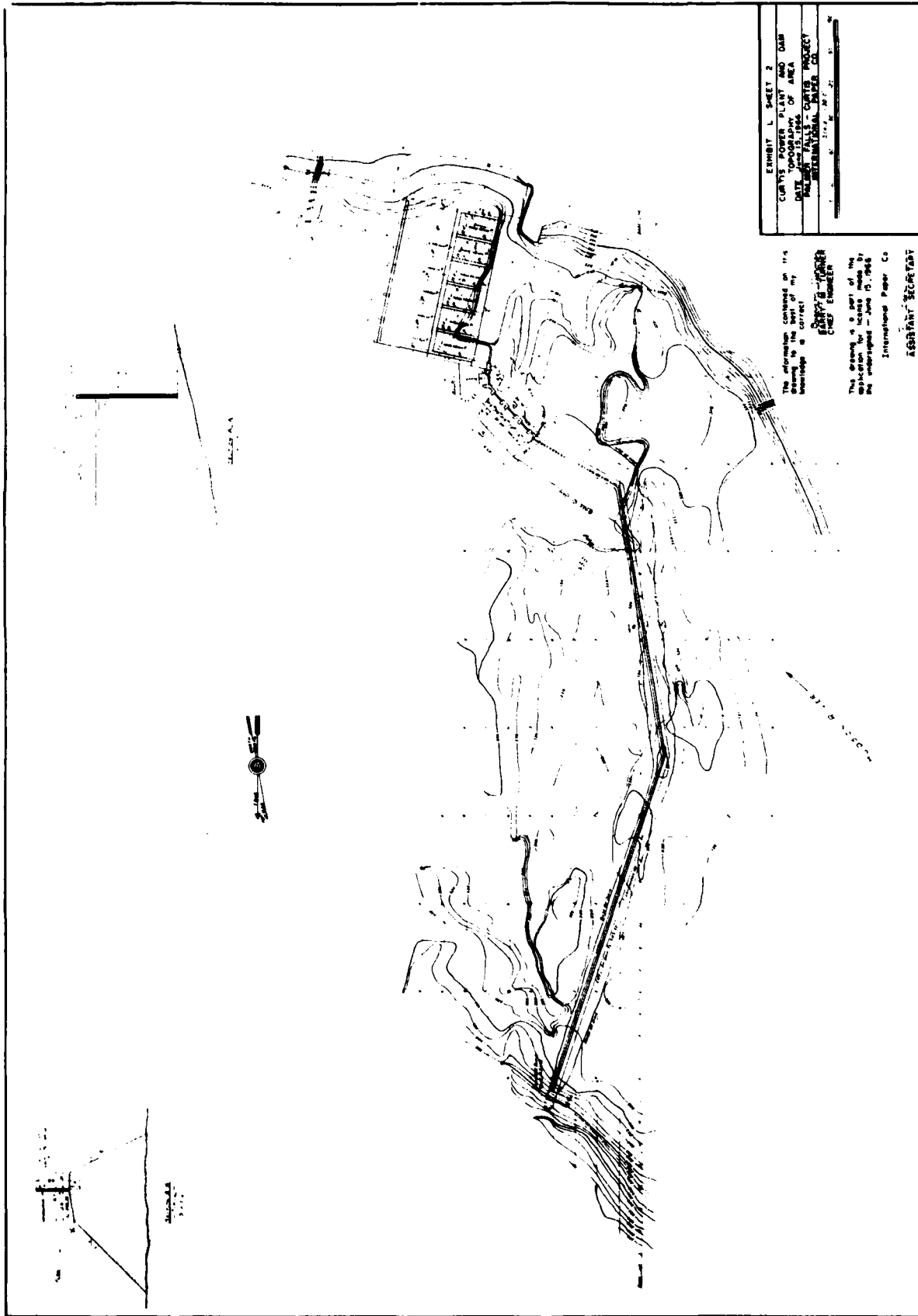
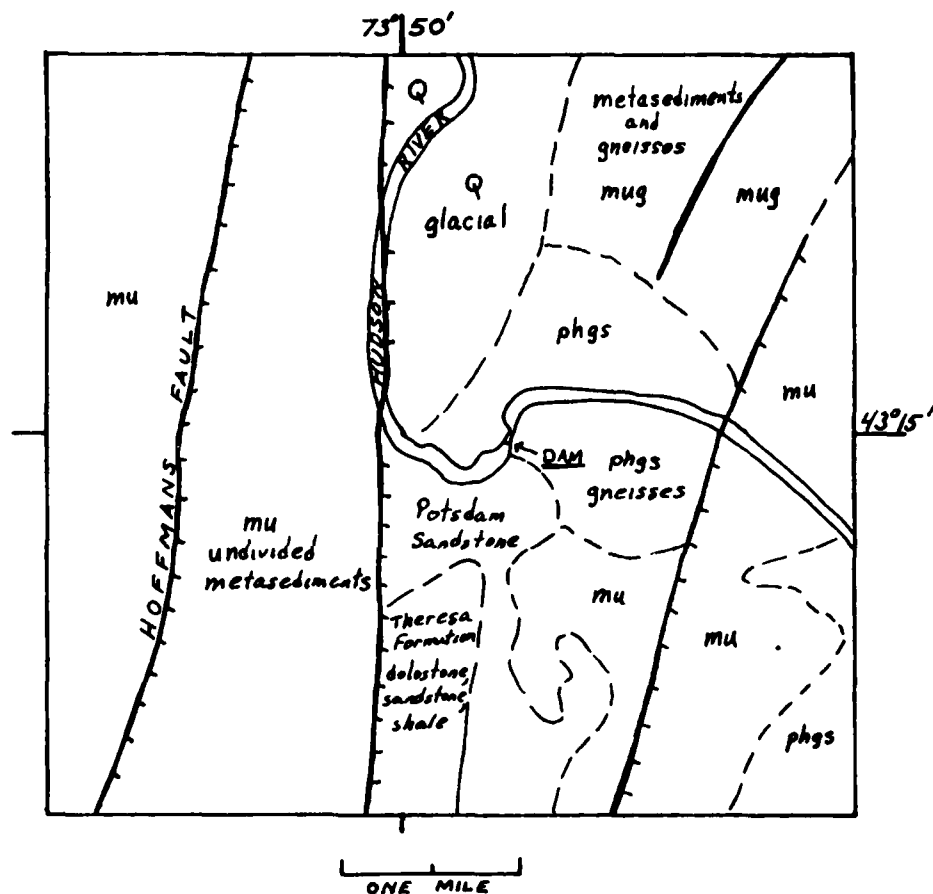


FIGURE 10



GEOLOGIC MAP

- Fault, if normal hachures on downthrown side
 Rock type contact



STETSON • DALE

DATE

6-2-80

ISS

2399

DRAWN

APP'D

FIGURE 11

APPENDIX A
FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam Palmer Falls County Saratoga-Warren State New York ID # NY145

Type of Dam Concrete Cellular Hazard Category High

Date(s) Inspection 1. April 21, 1980 Weather Sunny Temperature 60's
2. May 18, 1980

Pool Elevation at Time of Inspection 521.5+ M.S.L. Tailwater at Time of Inspection no measurement
taken

Inspection Personnel:

1 & 2 F.W. Byszewski	<u>Dale Engineering Company</u>
1 & 2 J.A. Gomez	<u>Dale Engineering Company</u>
1 D.F. McCarthy	<u>Dale Engineering Company</u>
1 H. Muskatt	<u>Dale Engineering Company</u>
1 W. Lynick	<u>New York State Department of Environmental Conservation, Dam Safety Sect</u>
1 R. Talbot	<u>Supervisor of Engineering Services - International Paper Company</u>

J. Gomez Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No seepage observed through concrete. Water flowing over spillway at time of inspection, obscuring face of spillway.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Abutments embedded in gneiss. No signs of distress observed at junctions.	
DRAINS	None observed.	
WATER PASSAGES	Conditions of flow did not permit close up inspection of water passages. Observations from a distance did not reveal defects.	
FOUNDATION	Dam sited on gneiss. Bedrock is very durable as evidenced by sharp edged geometry of rock just beyond toe.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some deterioration observed (as viewed through flowing water) at a number of areas just below spillway crest (on southern portion). Some surface spalling (to 3-4 inches deep) on south abutment wall and walkway. Some deterioration of log chute at point of "v", at one third height from top, etc.	Reportedly some surface restoration work performed to dam in summer of 1979.
STRUCTURAL CRACKING		Dam was not inspected from interior, due to walkway condition. Further investigations should include a thorough inspection of the interior of the dam.
VERTICAL & HORIZONTAL ALIGNMENT	No anomalies observed.	
MONOLITH JOINTS	No monolith joints observed in spillway section, possibly due to amount of overflow.	
CONSTRUCTION JOINTS	Location of horizontal joints observed through water flowing over spillway indicating some deterioration at joints.	
STAFF GAGE OF RECORDER	None observed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Not applicable.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Not applicable.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Not applicable.	
RIPRAP FAILURES	Not applicable.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Not applicable.	Dam extends to rock cliffs.
ANY NOTICEABLE SEEPAGE	Not applicable.	
STAFF GAGE AND RECORDER	Not applicable.	
DRAINS	Not applicable.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Some deterioration of concrete just below crest. Much of crest and downstream face was only observed from a distance.	Ambursen style dam. Sloping faces and rounded crest. North section - open D/S face, south section - closed downstream face.
APPROACH CHANNEL	Hudson River - side slopes - rock cliffs.	46 inch flashboards in use year round. Survived ice flows of past winter.
DISCHARGE CHANNEL	Hudson River - bedrock (gneiss), very durable.	
BRIDGE AND PIERS	Log chute at middle of "V" shows some deterioration.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		8 gut gates pass water into upper forebay. Upper forebay either discharges through mill or into lower forebay through 2 low level gut gates.
INTAKE STRUCTURE	Upper forebay walls show some surface deterioration.	outlets or flow over flashboards on upper forebay dam. Some of mill water discharges into lower forebay, while some mill operations utilize full head of dam & falls. Some of lower forebay water passes through mill, while excess is wasted over lower forebay dam.
OUTLET STRUCTURE		
OUTLET CHANNEL	Natural stream channel.	
EMERGENCY GATE	Impoundment can be drawn down by gut gates outletting from upper forebay.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Rock & boulder bottom. No observed obstructions downstream.	
SLOPES	Steep just below dam (dam built on top of natural falls), fairly shallow slopes downstream of falls.	
APPROXIMATE NO. OF HOMES AND POPULATION	Mill on riverbank, immediately downstream. Recreational use of river - fishermen observed just downstream of dam on both visits, even with high flows.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Not applicable.	
OBSERVATION WELLS	Not applicable.	
WEIRS	Not applicable.	
PIEZOMETERS	Not applicable.	
OTHER	Not applicable.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Side slopes - very steep; rock cliffs.	
SEDIMENTATION	Not observable.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Palmer Falls Dam

ID # NY 145

ITEM	REMARKS
AS-BUILT DRAWINGS	1966 drawings.
REGIONAL VICINITY MAP	U.S.G.S. map, 1966 plans.
CONSTRUCTION HISTORY	As derived from correspondence contained in N.Y.S. D.E.C Dam Safety files.
TYPICAL SECTIONS OF DAM	1913, 1966 plans.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	1966, 1980 plans, details.
RAINFALL/RESERVOIR RECORDS	None known.

ITEM	REMARKS
DESIGN REPORTS	1913 Report.
GEOLOGY REPORTS	Some information in 1913 Report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	1913 Report, although some calculations apply to original design not current configuration.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	1913 correspondence.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	None applicable.

ITEM	REMARKS
MONITORING SYSTEMS	None known.
MODIFICATIONS	Original design appears to have been modified during construction. Southern portion appears to have been moved upstream somewhat.
HIGH POOL RECORDS	Unknown. During spring high water, water level about to top of downstream training wall.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Correspondence.
MAINTENANCE OPERATION: RECORDS	None Known.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	1966 plans.
OPERATING EQUIPMENT PLANS & DETAILS	1966, 1980 plans & details.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Upper Hudson, 2757 sq. mi.
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 358 ac.-ft. @ elev. 5209
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 561 ac.-ft. @ elev. 531.7
ELEVATION MAXIMUM DESIGN POOL: 16 ft. above crest of spillway
ELEVATION TOP DAM: 531.7

CREST:

- a. Elevation 517.17 (spillway), 520.92 (Flashboards)
- b. Type Ambursen
- c. Width Ogee Shape
- d. Length 346 ft.
- e. Location Spillover nearly entire length of dam
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type Gut gates in upper forebay
- b. Location Right abutment
- c. Entrance Inverts Not shown on plans
- d. Exit Inverts Not shown on plans
- e. Emergency Draindown Facilities Gut gates

HYDROMETEOROLOGICAL GAGES:

- a. Type None
- b. Location --
- c. Records --

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

APPENDIX B

PREVIOUS INSPECTION REPORTS/RELEVANT CORRESPONDENCE

OFFICE E. VAN KENNEN,
CLERK

JOHN D. MOORE,
COMMISSIONER

ALBERT E. HOYT,
DEPUTY COMMISSIONER
JOHN J. FARRELL,
ASSY. SECRETARY

RECEIVED

July 23, 1913

DIVISION OF INLAND WATERS

Chief Engineer

FILE
STATE OF NEW YORK



DIVISION OF INLAND WATERS

JOHN D. MOORE, COMMISSIONER

JAMES J. FOX, DEPUTY COMMISSIONER

RICHARD W. SHERMAN, CHIEF ENGINEER

ALEX. RICE MCKIM, INSPECTOR OF DAMS AND BARS

IN REPLYING PLEASE REFER
TO FILE NUMBER

ANSWERED

CONSERVATION COMMISSION

ALBANY

July 23, 1913.

Mr. R. W. Sherman, Chief Engineer,

Conservation Commission,

Albany, N. Y.

Dear Sir:-

In accordance with your verbal instructions of the 16th inst., I visited Palmer Falls on July 19th and made an inspection of the dam now under construction by the International Paper Co.

Forms were being built for piers Nos. 3, 4, 5, 6 and 7 (as shown on plans submitted), and it was the intention of the Company to complete the concreting of these piers during the present week. Foundation trenches for piers 3 and 4 have been excavated from five to eight feet below the natural surface of the rock, and pairs of two inch round iron dowels extending five feet into the rock and from two to five feet into the masonry have been set, three feet center to center, the whole length of the piers. Shallower trenches set with dowels have been excavated for piers 5 and 6. In pier #7 (at the angle in the dam) about 30 dowels have been set, but no trench has been excavated. At this point the bedding plane of the rock ledge dips down stream about 10 degrees. From pier #7 to the west end of the dam, (piers 8 to 18), no trenches have been excavated, and only a single row of dowels, three feet center to

Address all communications to the Conservation Commission.

center, is being set in each pier.

Mr. Kellogg, engineer for the International Paper Company, to whom I was referred, was informed that they would be expected to conform to the "typical section" shown on their plans.

Attached hereto are six kodak pictures showing conditions on July 19th.

Respectfully yours,

E. A. Cullings

Assistant Civil Engineer.

ESC/F

INTERNATIONAL PAPER COMPANY.

REQUIREMENTS FOR CONCRETE WALLS.

GENERAL.

CEMENT. All cement will be furnished by the Company. It shall be delivered at the job site in a dry place. The cement shall be sampled by the International Paper Company before leaving the cement works and will be tested as soon as practical after its arrival. No cement from any one source shall be used in the walls.

SAND. Sand shall be clean, coarse and of grains varying in size and shape. It shall be free from all foreign matter. The sand from the beach will be used. The sand shall be screened through a 1/2 inch mesh and all material larger than 1/2 inch in diameter shall be excluded from the sand. The material which is excluded may be used in place of stone, if so desired.

STONE. Stone shall be run of crusher. Crushed and screened from all dust and very fine material. The stone shall be crushed to as to pass a 3-1/2 inch ring. Large stone may be included in the concrete provided that these stones are round, clean and thoroughly imbedded in concrete. No such stone shall be allowed within 6 inches of any corner or of any similar stone already placed. Stone shall be laid so as to break joints and so as to help bond the wall.

WATER. Water shall be clean and reasonably clear.

CONCRETE. Concrete shall be mixed in the following proportions; all quantities are expressed in parts by volume:

Cement	1 Part
Sand	3 Parts
Stone	5 Parts
Water	27 1/2 weight of cement

Concrete may be mixed by machine or by hand, but machine mixed concrete shall be used wherever possible. For hand mixing a tight platform shall be provided of at least sufficient size to accommodate men and materials for the mixing of mortar and concrete at the same time. Rather shall not exceed one cubic yard each. In mixing, a mortar shall first be prepared by spreading the sand for one hour evenly upon the platform, then the cement upon the sand. There shall be mixed thoroughly dry until of an even color. All the water necessary to make a thin mortar and of to a uniform consistency. The crushed stone for one batch is to be spread on the platform in a uniform layer not exceeding 4 inches in thickness. This is to be spread by the shovel and the mortar is to be mixed with the stone. The concrete shall be mixed thoroughly and the wall shall be built.

FILE

Duplicate

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July

REPORT ON

PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N.Y.

M. DE S. PARSONS,
22 WILLIAM STREET,
NEW YORK.

REPORT ON

PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N.Y.

H. DE B. PARSONS
CONSULTING ENGINEER
22 WILLIAM STREET, NEW YORK
LARGE ALL-ROUND EXPERIENCE

REPORT ON PROPOSED CONCRETE DAM,

HUDSON RIVER AT PALMER FALLS, N. Y.

19th May, 1913.

International Paper Company,
30 Broad Street,
New York.

Gentlemen:-

Complying with the request of your President, Mr. Philip T. Dodge, and with more detailed instructions from your Chief Engineer, Mr. A. H. White, I beg leave to submit my opinion on a concrete buttress dam which you propose to erect at Palmer's Falls, N.Y.

I have made studies and calculations for the proposed dam and have visited the site at Palmer's Falls, on 30th April, in company with Mr. White.

The specific questions which were asked and my replies thereto are as below:-

1. How to make temporary repairs ?

A section of the present wooden crib dam was washed out during the March flood, and lack of water in the head race has resulted in closing the mill down, except for such power as

could be obtained from the neighborhood by electric transmission. It is evident that the old dam must be permanently repaired or a new dam constructed. In the cost of either alternative the cost of having the mill closed must be considered.

In order to permanently repair the break in the present dam it would be necessary to divert the water from the river during the whole process of reconstruction.

The present dam could be temporarily repaired so that the water turned into the head race leaving the bed of the river dry below the present dam, for the construction of a new dam. In other words the present dam could be used as a coffer dam for the new dam and the mill could be kept running during the time of constructing the new dam.

After carefully studying the proposition, I am of the opinion that this latter arrangement would be the better for your interests and I have no objections to,--but on the contrary approve of the plan for diverting the water as arranged by Mr. White.

This plan consists of building a temporary crib dam with openings, below the upper portion of the present dam. Then, make a breach in the present dam, so that the water flows through the openings of the temporary construction. Then, close the breach in the present dam, the portion washed out by the flood. Then, close the openings of the temporary construction, thus permitting the river to pass the head race of the mill, which would take all the flow of the summer months.

2. Will the new dam pass as much water as the old dam ?

As judged by the gauging of the river over the crest of the Spiers Falls dam during the high water period of the March flood, the discharge of the river was about 89,000 to 90,000 cubic feet per second.

WATER PASSED BY PRESENT DAM. The length of crest of the present dam, according to surveys handed me by Mr. White, is 663.5 feet at an average elevation of 100.33 feet.

The present dam has 532 feet, which is practically parallel to the flow of the river.

Length of portion of dam nearly perpendicular to stream.	131.5 feet.
Length of dam parallel to stream 532 ft. Taking 0.8 of this portion as equivalent to a dam perpendicular to the stream.	425.6 "
Equivalent dam, perpendicular to stream	557.1 "

Owing to the peculiar shape of the crest of the present dam, the coefficient of discharge is probably not greater than 3.33. With this coefficient it would require a depth of water on the crest of 13.4 feet in order to pass 89,000 cubic feet per second.

WATER PASSED BY PROPOSED DAM. The elevation of the crest of the proposed dam is at 97.50, or 2.83 feet lower than the crest of the present dam.

The total length of the proposed dam is given on the surveys furnished me by Mr. White as 376 feet.

By suitably designing the crest in accordance with the Cornell experiments, it would be safe to assume that the coefficient would have a value of at least 4. If this value for the coefficient were used in the formula, the depth of water over the crest would be 15.4 feet in order to discharge 89,000 cubic feet per second:

Therefore,

The elevation of the water in the pond would be,

Above present dam $100.33 + 13.4 = 113.74$ ft.

Above new dam $97.50 + 15.4 = 112.90$ ft.

In other words, the river could be backed up by the new dam to a height of over 16 feet above its crest, without affecting the water rights at the Curtis dam any more than they would be affected by the present dam.

At time of severe flood, water could be passed into the lower level of the mill, and allowed to spill over its overfall section. Water so passed would be in addition to that discharged over the crest.

All my calculations have been based on a height of water of 16 feet above the crest, at which elevation the new dam will pass as much or more water as the present dam.

3. What is the strength of the proposed buttress dam?

During my visit to Palmer's Falls I carefully inspected the rock formation, as the stability of the new structure depends on its rock foundation and the power of the rock to resist the abrasive action of the water. This abrasive action will be very

severe, owing to the great depth of water which will pass the crest at times of flood and the height of the fall which has a maximum of about 37.5 feet.

The rock appears to be a gneiss, as found throughout the Adirondack regions. It is very hard and compact, although somewhat easily broken owing to its planes of cleavage.

The rock lies in layers or strata, on a slight dip to the westward. These layers are of variable thickness. The rock is cut by a double system of vertical seams, oblique to one another.

The rock near the surface on the high banks at the gorge is much softer than the rock found in the bed of the river. Where the water has poured over the present dam for some thirty years, the edges of the rock at the various seams are not badly worn, but in many cases are sharp and angular. The same is also true for other edges of the rock exposed to the full flow of the stream, which is very rapid at this point.

Palmer Falls is a natural fall or rapids, and the rock has withstood the abrasive action for many generations without showing material wear after the softer surface rock had been cut away.

I am led to believe that the rock is amply strong for the foundation of the new dam, and owing to the vertical seams and joints which might be difficult to make tight, I favor the project, as proposed by Mr. White, of constructing a dam on the buttress principle. This type of dam has two advantages for a dam at Palmer Falls; First:- the weight of the water on the dam helps to increase

its stability, and Second:- if a leak should occur in the rock beneath the dam, there would be no tendency for uplift or overturning.

In order that the proposed dam shall have a reasonably long spillway, it seems necessary to give it the angular form, as proposed by Mr. White. I do not like this form, on account of the re-entrant angle where the two portions meet at midstream. I have given a great deal of study to try and avoid this apparent defect, but have not succeeded in securing a better general plan than that proposed, so long as the dam must be placed below the present dam.

I have made a number of calculations, which can be consolidated into three projects:

Project A. Buttresses 5 feet wide, spans 14 feet.

Project B. Buttresses 5 feet wide, spans 15 feet.

Project C. Buttresses 4 feet wide, spans 15 feet.

The object of using a span of 15 feet was suggested by Mr. White in order that the centers made for the dam at Cadyville could be used at Palmer Falls. In this I concur, as it would reduce the cost without impairing the strength of the dam.

I favor Project C and append to this report a design of the cross-section of the dam as proposed, and also a set of calculations showing the stability, masonry pressures, water pressures, etc.

GENERAL REMARKS.

Buttresses 4 feet wide would be amply strong and would permit a certain amount of loss through abrasion without endangering the strength of the dam.

I would recommend, however, that provision be made to protect the down-stream face of the dam on the portion from the re-entrant angle to the opposite bank from the mill, as owing to the rock formation the discharge water will have a tendency to flow somewhat parallel to the crest of the dam, especially at that portion near the bank.

Great care should be made at the re-entrant angle and at both ends of the dam, in order to secure sufficiently strong abutments to resist the horizontal pressures which will be transmitted.

I recommend having openings in the buttresses so as to aerate the spaces between and prevent the formation of a partial vacuum which would only add to the pressures.

I am in accord with the effort being made to widen the head race, as this will economize head of water, valuable at dry seasons.

If a water pressure should exist beneath the heel or upstream toe of the dam, the effect would be to change the point where the resultant cuts the base to a point further down stream. Even if maximum uplift pressures are considered beneath the heel,

-8-

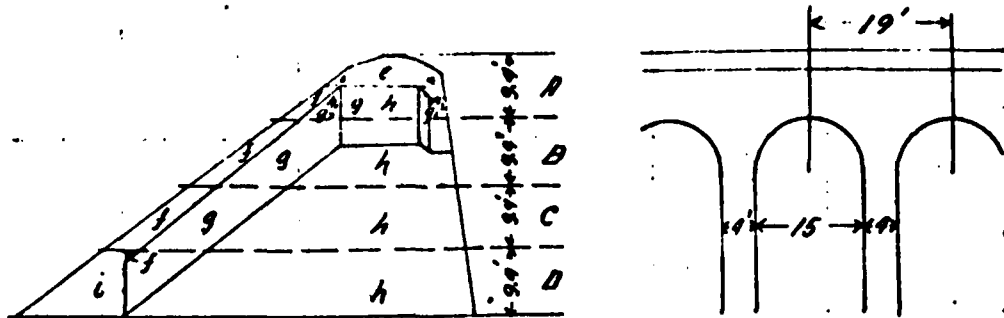
the resultant will still pass well within the middle third of the dam. Owing to the character of the rock it is not possible, in my opinion, for a complete uplift pressure to exist.

Yours respectfully,

DUPLICATE.

H. A. D. Parsons

International Paper Co.
Proposed Dam at Palmer's Falls N.Y.
Project C
Weight of 1st Section of dam



Concrete at 135# per Cu. ft.

		Cu. ft.	Weight	
Section "A"				
b	by Planimeter $3.12^{\circ} \therefore 3.12 \times 16 \times 19' =$	949	128 000	
b ₁	$\frac{3.5+1}{2} \times 2.1 \times 19'$	= 89.8	12 120	
f	$9^2 \times 19 \times 2.1$	= 359.0	48 500	
g	$24.1^{\frac{1}{2}} \times 10.6'$	= 255.0	34 400	
g ₁	$24.1^{\frac{1}{2}} \times 3.0'$	= 72.0	9 140	
g ₂	$20.16^{\frac{1}{2}} \times 5.5'$	= 118.0	15 930	
h ₁	$\frac{6.75}{2} \times 5.4 \times 4'$	= 72.9	10 000	
h ₂	$\frac{2+5.5}{2} \times 4 \times 4'$	= 60.0	8 108	
	$10.7^{\frac{1}{2}} \times 5.4 \times 4'$	= 232.0	<u>31 360</u>	298 156
Section "B"				
f	$15 \times 2.5 \times 19'$	= 713.0	96 300	
g	20.16×15	= 302.0	40 800	
h ₁	$\frac{12}{2} \times 9.4 \times 4'$	= 225.5	30 450	
h	$22 \times 9.4 \times 4'$	= 827.0	<u>111 700</u>	279 250
Section "C"				
f	$15 \times 2.9 \times 19'$	= 827.0	111 700	
g	20.16×15	= 302.0	40 800	
h ₁	$\frac{12}{2} \times 9.4 \times 4'$	= 225.5	30 450	
h	$34.75 \times 9.4 \times 4'$	= 1306.0	<u>176 300</u>	359 250
Section "D"				
f	$\frac{2.5}{2} \times 1.9 \times 19'$	= 45.1	6 095	
g	20.16×7	= 141.0	19 030	
h ₁	$\frac{2.5+9.5}{2} \times 2.5 \times 4'$	= 85.0	11 470	
h	$47.3 \times 9.4 \times 4'$	= 1778	240 000	
i	$\frac{2.5+11.5}{2} \times 9.4 \times 19'$	= 1563	<u>211 000</u>	487 595

1424 253

INTERNATIONAL PROJECT 44.
Proposed Dam at Palmar Falls N.Y.

Project C
Center of Gravity 19' Section

	Height	Length of Product		Length of Product	
		Horizontal Lever Arm	(1) and (2)	Vertical Lever Arm	(1) and (4)
		(1)	(2)	(3)	(4)
in "A"	e	128 000	11.2'	1 435 000	3 5.1'
	e ₁	12 120	4.0	48 480	3 2.6
	f	48 500	22.0	1 067 000	3 1.0
	g	34 400	11.9	409 500	3 1.8
	g ₁	9 740	4.6	44 750	3 0.0
	g ₂	15 930	19.5	310 600	3 0.0
	h ₁	10 000	19.4	194 000	2 9.8
	h ₂	8 108	4.5	36 500	3 0.0
	h	31 360	11.8	370 000	2 9.7
		298 158		3 916 830	9 729 440
Center of Gravity		Hor. = $\frac{3915830}{298158} = 13.15'$		Vert. = $\frac{9729440}{298158} = 32.65'$	
in "B"	f	96 300	31.3	3 013 000	2 3.8
	g	40 800	27.6	1 126 000	2 3.4
	h ₁	30 450	28.0	853 000	2 1.7
	h	111 700	12.8	1 430 000	2 3.5
		279 250		6 422 000	6 531 000
Center of Gravity A+B		Hor. = $\frac{10337830}{577408} = 17.90'$		Vert. = $\frac{16260490}{577408} = 28.2'$	
in "C"	f	111 700	43.7	4 880 000	1 4.4
	g	40 800	39.6	1 615 000	1 4.0
	h ₁	30 450	39.6	1 206 000	1 2.5
	h	176 300	18.5	3 262 000	1 4.1
		359 250		10 963 000	5 049 000
Center of Gravity A+B+C		Hor. = $\frac{21500830}{936658} = 22.73'$		Vert. = $\frac{21309490}{936658} = 22.78'$	
in "D"	f	6 095	49.1	299 200	8.8
	g	19 030	47.7	908 200	7.6
	h ₁	11 470	48.7	558 200	4.1
	h	240 000	24.0	5 760 000	4.6
	i	211 000	55.1	11 630 000	3.6
		487 595		191 55 600	2 108 210
Center of Gravity A+B+C+D		Hor. = $\frac{40456490}{1424253} = 28.4'$		Vert. = $\frac{23417650}{1424253} = 16.4'$	

INTERNATIONAL IMPERIAL
Proposed Dam at Palmer's Falls N.Y.
Project C
Water Pressure

Section "A"

$$P = \frac{1}{2} W H (H + 2h)$$

$$P = \frac{1}{2} \times 62.5 \times 9.38 (9.38 + 32)$$

$$P =$$

12120" horizontal

$$\text{For 19' section } P = 12120 \times 19 =$$

230300

Height above base where this pressure is applied is

$$x = \frac{H + 3h}{H + 2h} \cdot \frac{1}{3} H$$

$$x = \frac{9.38 + 48}{9.38 + 32} \cdot \frac{1}{3} \times 9.38$$

$$x = \frac{57.38}{41.38} \times \frac{1}{3} \times 9.38 = 4.34'$$

Section "B"

$$P = \frac{1}{2} \times 62.5 \times 18.75 (18.75 + 32)$$

$$P =$$

29720" horizontal

$$\text{For 19' section } P = 29720 \times 19 =$$

565000

$$x = \frac{18.75 + 48}{18.75 + 32} \cdot \frac{1}{3} \times 18.75$$

$$x = \frac{66.75}{50.75} \times \frac{1}{3} \times 18.75$$

$$x =$$

0.23'

Section "C"

$$P = \frac{1}{2} \times 62.5 \times 28.15 (28.15 + 32)$$

$$P =$$

52900" horizontal

$$\text{For 19' section } P = 52900 \times 19 =$$

1005000

$$x = \frac{28.15 + 48}{28.15 + 32} \times \frac{1}{3} \times 28.15$$

$$x = \frac{76.15}{60.15} \times \frac{1}{3} \times 28.15$$

$$x =$$

11.90'

Section "D"

$$P = \frac{1}{2} \times 62.5 \times 37.5 (37.5 + 32)$$

$$P =$$

81400" horizontal

$$\text{For 19' section } P = 81400 \times 19 =$$

1546000

$$x = \frac{37.5 + 48}{37.5 + 32} \times \frac{1}{3} \times 37.5$$

$$x = \frac{85.5}{69.5} \times \frac{1}{3} \times 37.5$$

$$x =$$

15.4'

Proposed Dam at Rainier Dam

Project C

Sliding and Shear for each section:

Taking .65 as coef. of friction (concrete on concrete) = f

Section A

Resistance to sliding will be fW W = Weight

$$\text{(Sliding)} R = fW = .65 \times 625\,000 = 422\,000$$

$$\text{Horizontal water pressure} = 230\,300$$

$$\text{Factor} = 1.8$$

$$\text{(Shearing)} \text{ Area of section } 25.2 \times 4 = 100.8 \text{ ft}^2$$

$$\text{Resistance to shearing } 100.8 \times 14\,000 = 1\,412\,000$$

$$\text{Horizontal water pressure} = 230\,300$$

$$\text{Factor} = 6.1$$

$$\text{Section B (Sliding)} R = fW = .65 \times 1\,350\,000 = 868\,000$$

$$\text{Horizontal water pressure} = 565\,000$$

$$\text{Factor} = 1.5$$

$$\text{(Shearing)} \text{ Area of section } 38.5 \times 4 = 154 \text{ ft}^2$$

$$\text{Resistance to shearing } 154 \times 14\,000 = 2\,155\,000$$

$$\text{Horizontal water pressure} = 565\,000$$

$$\text{Factor} = 3.8$$

$$\text{Section C (Sliding)} R = fW = .65 \times 2\,280\,000 = 1\,482\,000$$

$$\text{Horizontal water pressure} = 1\,005\,000$$

$$\text{Factor} = 1.5$$

$$\text{(Shearing)} \text{ Area of section } 51.7 \times 4 = 206.8 \text{ ft}^2$$

$$\text{Resistance to shearing } 206.8 \times 14\,000 = 2\,895\,000$$

$$\text{Horizontal water pressure} = 1\,005\,000$$

$$\text{Factor} = 2.9$$

$$\text{Section D (Sliding)} R = fW = .65 \times 3\,475\,000 = 2\,258\,000$$

$$\text{Horizontal water pressure} = 1\,546\,000$$

$$\text{Factor} = 1.5$$

$$\text{(Shearing)} \text{ Area of section } 65 \times 4 = 260 \text{ ft}^2$$

$$\text{Resistance to shearing } 260 \times 14\,000 = 3\,640\,000$$

$$\text{Horizontal water pressure} = 1\,546\,000$$

$$\text{Factor} = 2.4$$

Proposed Dam at Palmer's Falls N.Y.
 Project C
 Stability against Crushing
 (Masonry Construction Baker page 472.)

Max. Pressure per sq. ft. $H = P = \frac{W}{C} \left(1 \pm \frac{6ed}{C^2} \right)$
 $P = \frac{W}{C} \left(1 \pm \frac{6ed}{C^2} \right)$

d = departure of C.G.
 of base from point of
 pressure

Section "A" $P = \frac{625000}{25.3} \left(1 \pm \frac{6 \times 0.05}{25.3} \right)$

$P = 24700 \left(1 \pm 0.0015 \right) = 24700 \times \begin{cases} 1.0015 \\ 0.9985 \end{cases}$

$P =$ Up stream toe 29,680 or Down stream 19730 for 4' Buttress

$\therefore P =$ " " " 7420*4 " " 4932*4

Section "B" $P = \frac{1335000}{38.5} \left(1 \pm \frac{6 \times 0.05}{38.5} \right)$

$P = 34700 \left(1 \pm 0.0078 \right) = 34700 \times \begin{cases} 0.9922 \\ 1.0078 \end{cases}$

$P =$ Up stream toe 34,410 or Down stream 34,900 for 4' Buttress

$\therefore P =$ " " " 8603*4 " " 8725*4

Section "C" $P = \frac{2280000}{51.7} \left(1 \pm \frac{6 \times 1.05}{51.7} \right)$

$P = 44100 \left(1 \pm 0.122 \right) = 44100 \times \begin{cases} 0.878 \\ 1.122 \end{cases}$

$P =$ Up stream toe 38720 or Down stream 49100 for 4' Buttress

$\therefore P =$ " " " 9680*4 " " 12275*4

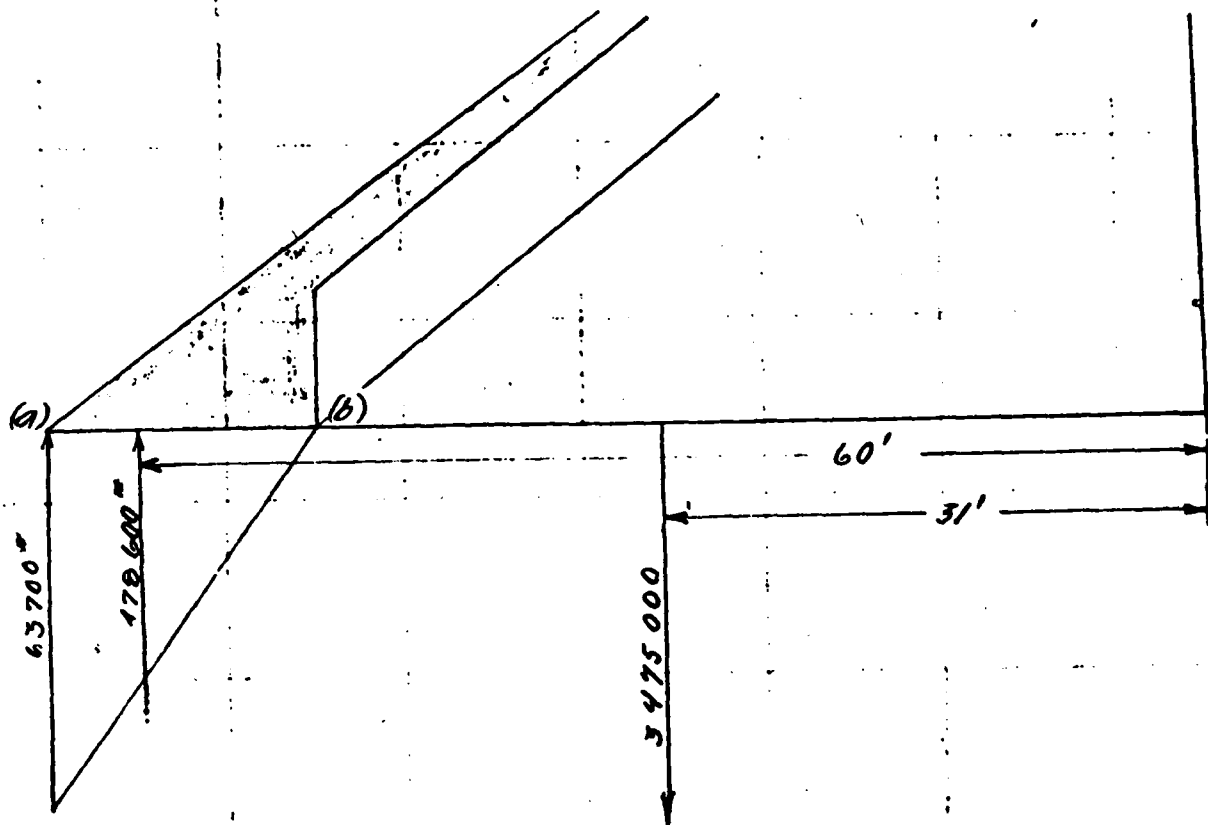
Section "D" $P = \frac{3475000}{66.0} \left(1 \pm \frac{6 \times 1.4}{66.0} \right)$

$P = 53500 \left(1 \pm 0.1292 \right) = 53500 \times \begin{cases} 0.8708 \\ 1.1292 \end{cases}$

$P =$ Up stream toe 46580 or Down stream 60400 for 4' Buttress

$\therefore P =$ " " " 11,645*4 " " 15100*4

Proposed National Railways Project
 Project C
 With allowance for water pressure under up stream toe



Hydrostatic pressure at up stream toe

$$(2.5 \times (37.5 + 16))$$

Pressure for 19' length at toe

Average pressure for 19' length (a) to (b)

Total upward pressure 31900×15

Taking moments about down stream toe

$$\text{Left moment} = 3475000 \times 31 = 107725000$$

$$\text{Right " } = \frac{478600 \times 60}{2996400} = \frac{28716000}{79009000}$$

The distance Resultant will be from down stream toe is

$$\frac{79009000}{2996400} = 26.38$$

$$\text{Max: Pressures per sq: ft} = p = \frac{W}{l} \left(1 \pm \frac{ed}{l} \right) = \frac{2996400}{65} \left(1 \pm \frac{6 \times 6.12}{65} \right)$$

$$= 46100 (1 \pm 0.565) = 46100 \times \begin{cases} 0.435 \\ 1.565 \end{cases}$$

$$P = \text{Up stream toe} = 20050 \text{ or Down stream toe } 72180 \text{ for 4' Buttress}$$

$$P = \text{" " " } 5610 \text{ " " " } 10045 \text{ per sq}$$

ORIGINAL

August 12th, 1913.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission.

Dear Sir:-

In accordance with your request, I submit the following report on the new dam under construction by the International Paper Company at Palmer Falls:-

This dam is being built to replace an old crib dam which was partially destroyed during the flood of March, 1913. As the paper mill is dependent almost entirely on water power, the Company decided to temporarily repair the crib dam, and to build a new masonry dam a short distance downstream, at the crest of the falls. In this way the crib dam could be used as a coffer dam, and the operation of the mill would not be interfered with during construction. The new dam is of the multiple arch type, built of concrete without reinforcement. It is V-shaped in plan and follows approximately the crest of falls.

The rock at this point is a granitic gneiss, hard and compact, but deeply cracked and fissured. The plane of chief fracture dips northerly from 10° to 15° , and a double system of cross fractures cuts the surface into blocks and plates of varying area and thickness. Light charges of dynamite exploded in shallow holes shattered this rock quite badly, and showed the existence of old cracks extending several feet into the apparently firm ledge. Immediately back of the heel of the proposed dam, a pocket or trench,

from 10 to 30 feet deep has been eroded along the line of a fault, nearly the whole length of the dam.

The stability of the proposed dam has been investigated, assuming a maximum surcharge of 18 feet on the crest. Following are the resulting stresses:-

Compression in deck masonry at center line	
of arch near base of dam - about	40# per sq.in.
Maximum compression in pier at toe	141" " " "
" " " " heel	58" " " "
" shear in pier near base	54" " " "
Factor of safety against overturning	2½

All these are well within the limits of good practice.

As to stability against sliding, however, the dam seems especially weak, the weakest point being pier #7, at the angle near the center of the dam. The rock surface at this point is smooth and waterworn, and has an average slope, downstream, of about 18 degrees. The forces acting on this pier have been calculated and the coefficient of friction between the masonry and rock surfaces is found to be 0.57. (See attached sheet, Acc. C-355). This is much too high for safety. The only precaution taken against sliding at this point is the placing of about 30 or 40 two inch iron rods set vertical and extending about five feet into the rock and from two to four feet into the masonry. These rods are probably of little value for this purpose.

Another element of danger is the possibility of the occurrence of a crack along the bedding plane of the rock at some distance below the base of the dam and extending from the trench back of the dam entirely through to the face of the falls. At the western end of the dam this distance would not be over 70 or 75 feet. Assuming

water pressure in such a joint equal to full static head at the back, decreasing uniformly to zero at the face, and acting over two-thirds the area, the coefficient of friction along this joint is found to be 0.69, as shown on attached sheet, Acc. No. C-356.

As no apron has been provided on this dam to divert the overfalling water away from the structure, there will be great danger of erosion at the bases of the piers. It would seem that some provision should be made to prevent this action.

I have inspected the site of this dam on three occasions. The first time, on July 19, 1913, I carried a letter of introduction addressed to "The International Paper Company," and on arriving at their office at Palmer Falls asked for the chief engineer. I was introduced to Mr. Kellogg, to whom I presented my letter of introduction, and stated the purpose of my visit. Mr. Kellogg introduced me to Mr. Ashworth, superintendent for the contractor building the dam, who showed me over a part of the work and then introduced me to Mr. Connor, (I believe that was his name), an inspector for the Company, who accompanied me during the rest of my stay on the work. At this time, forms had been built for piers Nos. 3, 4, 5, and 6, and work had been started on the forms for pier No. 7 (at the angle in the dam). No concrete had been placed in any of the piers at this time. Trenches five to eight feet deep had been excavated for piers Nos. 3 and 4, and somewhat shallower trenches for piers Nos. 5 and 6, but no excavation had been made for pier No. 7, and Mr. Connor stated that none was intended for this pier or for those to the west. Returning to the Company's office, I saw Mr. Kellogg and informed him that they would be expected to conform to the "typical section" shown

visit was on July 30, 1913, in company with Division Engineer Perkins. At this time the concreting of piers Nos. 3, 4, 5 and 6 had been completed, and about eight feet of concrete had been placed in pier No. 7. On August 8, I again visited the dam in company with Division Engineer Perkins and Assistant Engineers Cuter and Sargent. No concrete had been placed in pier No. 7 since July 30, and part of the concrete had been removed. Three or four piers to the east of this one had been completed, and forms had been built for two others near the westerly end of the dam. No work was in progress on August 8.

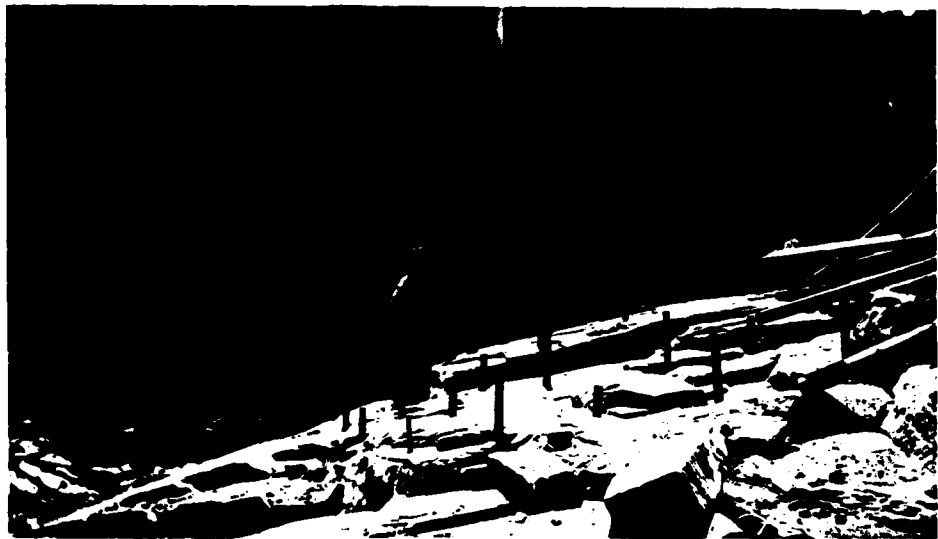
Attached hereto are photographs showing conditions on July 19 and August 8.

Respectfully submitted,

E. H. Cullings

Assistant Civil Engineer.

FSC/H.



Palmer Falls Dam - July 10, 1913 - Pier #7, showing slope of rock ledge



Palmer Falls Dam - July 10, 1913 - Showing Trench back of Dam



Palmer Falls Dam- Aug. 8, 1913- Trench back of Dam



Palmer Falls Dam- Aug. 8, 1913- Face of Piers.

Aug. 9, 1913.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

In answer to your verbal request, I hereto submit the following report on the site of the dam proposed to be built by the International Paper Company at Palmer Falls.

In company with Division Engineer Perkins and Assistant Civil Engineer Suter and Collings, I made an inspection of this dam site on August 8th. I made no technical examination of the plans, and it is assumed that the dam per se has been safely designed.

It is proposed by the International Paper Company to build a dam across the Hudson River, which is about 200 ft. wide at its narrowest point in this vicinity, immediately below their present dam, part of which was carried out by the floods of last spring. At the present time there is available a gross head of 83 ft. at the mill. The new dam is to be about 58 feet in height, and is to consist of eighteen concrete arches of 15 ft. span between concrete piers 4 ft. thick. Should a flood occur of the magnitude of that of last spring, there would be a total length of 273 feet.

The dam is situated on the crest of an abrupt fall approximately 20 feet high, giving a total fall of 60 ft. from the crest of the dam. About 40 ft. above the dam is a pocket 40 ft. long and 30 ft. deep at its deepest point; with 12 ft. of water on the crest of the dam it would give a total head of 88 feet, tending to uplift the foundation.

The foundation of the dam, which is a granite gneiss, is distinctly stratified and has a dip down-stream estimated at 10 degrees, and is covered in several places with vertically and horizontally, the vertical cracks being the wider.

It would seem, if a dam were to be constructed, the water with its clear fall of 60 ft. to 88 ft. would undermine the fissured rock at the base of the dam, thereby endangering the structure and making its eventual failure almost certain.

The pondage created by this dam would be small, and should the dam fail but little damage would probably result to the property below. It would not, however, seem advisable for the Conservation Commission to give its approval of the plans of a dam which seems liable to fail, even though the resulting damage might be slight.

In the writer's opinion, the best way to build a dam at this point would be to construct a concrete dam between the points where the new dam is being built, arching the dam upstream. A low secondary dam could be built a short distance below, creating a pool which would act as a water cushion for the flood flows over the dam.

Without doubt, the pier at this location also could be made safe by the construction of an apron, but probably at a prohibitive cost.

(Signed) Edward H. Sargent.

1966. 1967. 1968.

August 13, 1913.

Report on Proposed Dam of the Inter-
national Paper Co. at Palmer's Falls.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission.

Dear Sir:-

In accordance with your verbal directions I have examined the plans for the proposed dam of the International Paper Company at Palmer's Falls in the Village of Corinth, Saratoga County, and on August 8th I inspected the site of the proposed dam in company with Division Engineer Perkins and Assistant Engineers Sargent and Cullings.

The material on which the proposed dam is to be founded appears to be a hard gneiss. This rock is broken by cleavage and bedding planes into very distinct rectangular blocks of no great size and these planes of division appear to be continuous for long distances. The bedding planes are at an angle from 10 to 15 degrees with the horizontal, dipping down in the direction of the flow of the stream. A short distance back from the face of the falls there is a fault plane, practically vertical, which has been eroded to a depth of 30 to 40 feet and which is probably open to the entrance of water for a greater depth. The surface of the rock is not deeply water-worn, indicating erosion block by block rather than by surface abrasion of the rock mass. The natural fall at this point is between 37 and 60 feet.

The proposed dam is to be located practically on the crest of the existing fall. In plan it is to be L shaped with the angle pointing down stream, the shorter leg of the L crossing the line of the above mentioned fault at approximately right angles. The long side of the dam is to be placed upon the mass of rock lying between the fault plane and the face of the fall, which mass is structurally separated from the main rock body by the fault. The proposed dam is to be 44 feet high at the highest point. The maximum flood anticipated will give a depth of 18 feet upon the spillway crest.

The proposed type of dam has a deck inclined at an angle of 45 degrees. This is formed of plain concrete arches turned between buttresses placed normal to the axis of the dam; buttresses are triangular in side elevation. The crest is curved vertically with a wide radius. Details of the design of the dam proper have not been investigated by me, but consideration has been given to the possibility of sliding of the dam on its foundation, the sliding of the foundation itself and to the effect of erosion of the rock surface below the dam.

The dam, as shown by the plans and as partially constructed, rests upon a rock surface which slopes down in the direction of the water thrust. Some of the masonry has been laid upon undisturbed water-worn rock surface, which is very smooth. Where rock is excavated before placing masonry the surface of contact will be on natural bedding planes, which are as smooth as ordinary dressed masonry. Safe coefficients of friction on these surfaces would, in my opinion, be 35% and 45% respectively. I am informed by

Mr. Cullings that the stability of the proposed dam will not meet these requirements, at the salient angle, which is founded on a water-face. Owing to the open design of the structure, there is little chance for water pressure to develop in the masonry and rock. Where the open fault plane is back of the dam the effect of water pressure in joints beneath the dam cannot prudently be neglected in the stability of this structure. Computations for stability against sliding at the highest point were made it is upon the actual edge of the falls and the fault plane is practically at the heel of the apron. The proposed dam rests upon a detached prism of rock to carry it. Assuming water pressure over the area the bedding joints, varying from full at the fault to nothing at the face of the falls, it is estimated that the resistance to sliding on the upper part is less than I consider desirable. I have not seen the dam, but I concur in Mr. Cullings's theory. For the proposed dam to be stable as designed and to its foundation, there remains to be considered the effect of water on the structure as a whole. In the lower section, carrying water 18 feet deep and a total drop of as high as 44 feet on the face, hence this falling water will strike the base of the falls, where the rock is

~~structure~~ shattered and weather-worn. During times of flood this river will carry quantities of ice and logs. Under these conditions it seems inevitable that the rock immediately down stream from the dam will be shattered, broken off and carried away to an appreciable extent; that the lower extremities of the piers will be damaged and possibly undermined and this erosion will occur at the precise point where it will do the maximum amount of harm.

In my opinion a vertical drop on the down stream side of an overfall dam is always undesirable and should not be permitted in large structures. In general, such construction will not be safe unless the water falls clearly into a pool of considerable depth, or if the fall is so great as to break the falling water into spray before it reaches the bottom. That water will erode rock upon which it falls is a matter of common knowledge, and is clearly demonstrated at any water fall. That such erosion tends to extend horizontally at the point of impact is also well known. But for this undermining effect few actual cataracts or free falls would exist.

Such action at Palmer's Falls would undermine the buttresses, or cut out the lower corners of these structures. That such an action may be expected in this case is, to my mind, clearly demonstrated by comparison with the similar dam at Cadyville. There the loose upper strata of the rock on the north side of the dam were badly eroded by such action, while the drop and probably the volume of water passing were less than may be expected at Palmer's

Falls. This erosion endangered the stability of the structure. To make it safe much loose rock has been excavated from below the dam and the cavity being filled with concrete.

I respectfully recommend that: The plans for the proposed dam at Palmer's Falls, as submitted, be disapproved. That no modification or revision of these plans be approved, unless some form of reverse face for the dam is provided, which will carry the water gently down to the level of the base of the structure. It be required that no masonry be placed on the natural surface of the rock or on one that has been shattered by blasting. That where masonry is placed upon a properly excavated surface that the resistance to sliding come up to the specifications quoted above. The dam be so located as to be safe from the sliding of the dam on the foundation or of any portion of the foundation upon itself, on a natural joint, under the action of water pressure in that joint.

Respectfully submitted,

R. SUTER.

Assistant Civil Engineer.

RS/C.

Aug. 9, 1913.

Mr. E. W. Sherman, Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

Complying with your request for a report upon the proposed dam at Palmer Falls, I have visited the site four different times, and have examined the drawings and requested Mr. Cullings to figure out the stresses in the proposed structure.

I may state as a result of these investigations in general that the design of the dam appears to be well within good engineering practice, provided it were to be placed upon a suitable foundation. The question of the safety of this dam, therefore, reduces itself to one of judgment as to the safety of the foundations under the conditions that would exist with the dam erected.

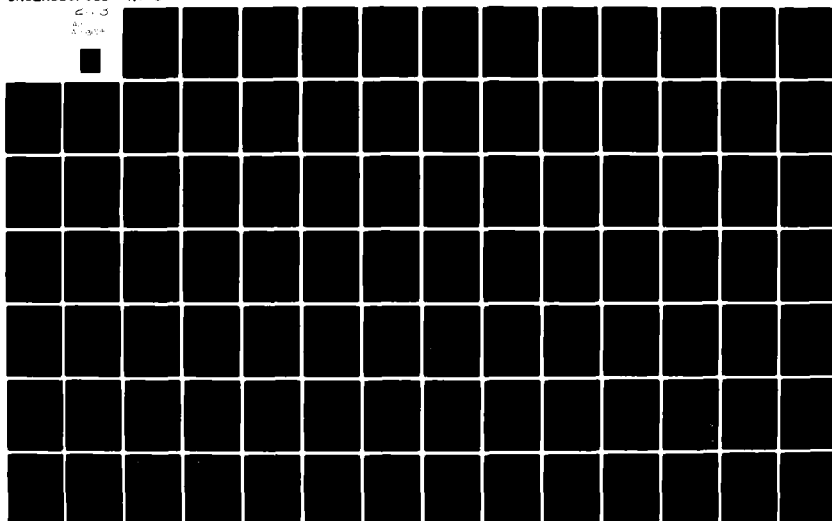
In the first place, it should be noted that the rock has well defined cleavage planes in two directions, at an angle of approximately 120 degrees. The cleavage planes most nearly horizontal dip at an angle of about 15 to 20 degrees down stream. Back of the proposed dam there is a fault in the rock, and the water has taken out the rock broken up by the faulting, leaving a deep hole along the edge of which the heel of the proposed dam

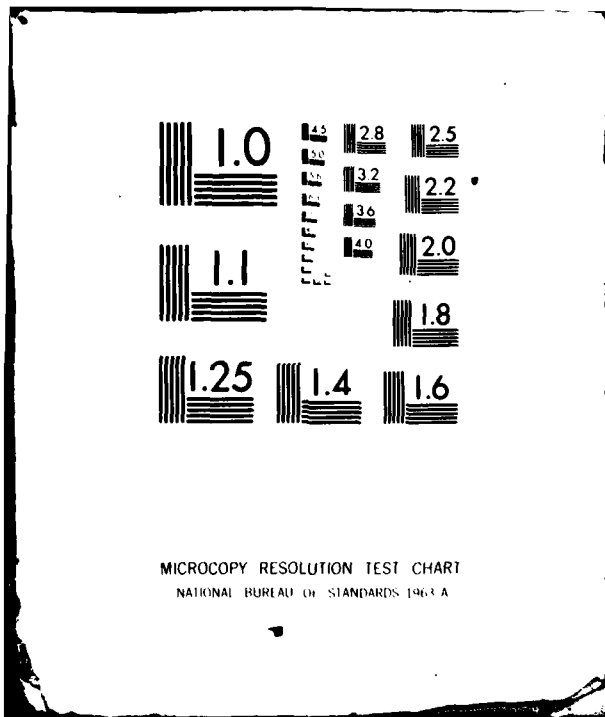
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NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. PALMER FALLS DAM. UPPER HUDSON RIV--ETC(U)
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would come over about three-fourths of the length of the dam. This line of faulting passes under the proposed location of the sluice gates and head gates. The dam is thus located upon a triangularly shaped mass of rock which, near its end near the sluice gates, is not over 30 ft. wide, and drops off to the lower pool of the river very steeply. These conditions might be described at greater length, and should be in case it is desired to call in the engineer to examine the dam with the proposed work.

The ~~run off~~ ^{run off} at the bottom at this point may be expected to reach at times of maximum flood over 100,000 sec. ft., the discharge at Spier Falls having been over 90,000 sec. ft. during the last spring, and the drainage areas at the two points are but slightly different. This discharge would require a depth on the spillway of about 15 ft. This mass of water plunging from the top of the dam onto the shattered rock beneath would very probably take out everything in front of it, stripping off the rock layer by layer. The undermining action of this sheet of water falling through the height from the top of the dam to the level of the lower pool, which is 85 ft., cannot but result in further undermining the shattered rock. There is, therefore, great danger that in flood the portion of the dam resting upon the narrower part of the rock tongue would be undermined and the dam would be destroyed.

In addition to the danger from undermining, there is the additional danger that water percolating through the cracks of the rock will exert an upward pressure upon the sloping sur-

face, and that one or more sections of the dam will slide bodily down the slope and clear the pool.

In view of the foregoing conditions, it is my opinion that this dam does not possess the degree of safety which the Commission has the right to demand. It should be noted, however, that the pondage above the dam is small, and that the failure of the dam would not cause any appreciable flood wave.

Two remedies appear to be open. The first would be to construct the dam in its present location, but add to it a roller-way extending from the top of the dam down below the surface to the bottom of the pool below, there giving the water a horizontal direction by an S. C. curve. The second remedy, and probably the best and cheapest solution of the problem, is to abandon the proposed site entirely and build a dam at a point further up stream. This is entirely feasible, but in any case it is believed that in view of the character of the rock at this locality a roller-way and surface protection of the rock below are essential.

Very respectfully yours,

(Signed) A. H. PERRINS,

Division Engineer.

FILE

International Paper Company's Dam
at Palmer Falls.

Conservation Commission, (Particular Attention of Commissioner Moore),
Albany, N. Y.

Gentlemen:-

In the matter of the application of the International Paper Company dated July 14th, 1913 for approval of its plans and specifications for a new dam in the Hudson River at Palmer Falls, known in our records as Serial No. 93, Upper Hudson Watershed No. 361, said plans and specifications being submitted herewith, I hereby report adversely upon the subject of the approval of said plans and specifications for the reasons hereinafter set forth.

The General Location.

The International Paper Company has a large plant at Palmer Falls with a dam across the Hudson River. The mill buildings are located on the west bank in the westerly part of the river channel. In this locality the river flows in a deep gorge, bottom and sides of which are of granite or gneiss rock formation. There is a natural water falls of about 45 feet in height. The mill buildings are at and near the westerly part of the natural water falls, while the surplus and flood water flow passes over the remainder of the natural falls in the easterly part of the channel. (For descriptive purposes herein, the river is assumed to flow in a southerly direction).

The Existing Old Timber Dam.

The International Paper Company's dam is of timber, extending from its mills and forebay in a diagonal direction upstream to the easterly wall of the gorge at a point several hundred feet upstream from the westerly end of the dam. A map of the location, show-

International Paper Company's Dam
at Palmer Falls. #2.

ing the relative positions and elevations of points of importance connected with this report is attached hereto and marked "Appendix A".

The flood of March 1913 carried out a section of the dam about 210 feet in length.

The location of the timber crib dam, as it existed before the flood of March 1913 and as reconstructed, is shown. A small part of the location was changed in reconstruction. The height of this dam ranges from 11 feet to 31 feet. The present length of the overflow weir is 550 feet, being about 115 feet shorter than before said flood and reconstruction.

As, at the time of rupture, the river was very high and as the quantity of water impounded by the dam is small, the partial failure of the dam made no appreciable impression on the flood height below the natural falls, and damage, so far as we know, was confined to the property of the International Paper Company.

The gap in the dam has been restored and the dam somewhat repaired, and it is now in service and seemingly as good and useful as before the said flood. The dam is old, and while due to decay etc., it cannot last for an indefinite period, still, with some not very extensive additional repairs, it can be made serviceable for several years to come.

Proposed New Dam.

As to plans, location and foundation submitted and proposed by the International Paper Company, I do not question that upon a location and foundation safe against undermining and sliding such a

International Paper Company's Dam
at Palmer Falls. #3.

general design of a dam would be safe. It has an objectionable feature, however, in that the water falling over the crest of the dam makes an unobstructed drop through the air to the elevation of the base below, in this case a drop of from 40 to 85 feet. The general design would be improved by extending the piers downstream with "O. G." fronts and constructing an apron thereon, thus supporting the water in its descent and discharging it in a horizontal current from the foot of the dam, thus avoiding all impact from the falling water.

To apply this principle on the location proposed, would require the concrete structure to extend to a rock foundation below the natural falls and would make this part of the structure nearly 100 feet high, extending over a considerable part of the length of the dam, and at a lesser height over the remainder, and would be so very expensive that some other design, with a location at greater distance upstream from the crest of the falls, would be, for a number of reasons, much safer as well as less costly.

The length of the proposed overflow weir is 376 feet compared with 550 feet on the existing timber dam and 665 feet as it was before this season's reconstruction.

The maximum flood flow, based upon the calculations made of the flow at Spier's Falls last March, is 100,000 second feet, which would cause a sheet of water 15 feet deep on the crest to flow over the proposed 376 feet long weir. This sheet of water 15 feet deep

International Paper Company's Dam
at Palmer Falls. #4.

by 376 feet long would drop from 40 to 85 feet through the air at different parts of the proposed dam, the 85 feet drop being where the proposed location of the dam is so close to the crest of the natural falls that the sheet of falling water would drop from the crest of the dam unobstructed or checked into the pool at the foot of the falls.

The terrific force of this mighty column of water as it collides with the rock below after an unobstructed fall of from 40 to 85 feet through the air, and its power to cut away even rock and to do so rapidly and in large quantities, are well known and easily appreciated by persons having to do with such subjects and to intelligent men generally.

The ordinary flow of Niagara River is 240,000 second feet (95% of which passes over the Canadian Falls), the whole being a little more than twice the maximum flood flow of the Hudson River at Palmer Falls. This affords a comparison easily appreciated by any person who has viewed Niagara Falls.

The length of the crest of Niagara Falls is - American channel, 950 feet, Canadian channel, 2400 feet - total, 3350 feet as scaled from maps.

For data as to Niagara Falls, made use of herein, refer to "62^d Congress, 1st Session, Senate Document 105." See Plate 10 therein. Quoting from page 32 thereof -

"During these thirty-one years the recession of the crest of
reaching a maximum of 170 feet

International Paper Company's Dam
at Palmer Falls. #5.

on the general trend of the central chute or apex." The thirty-one years are from 1875 to 1906.

The water has loosened and carried away such a vast quantity of rock in thirty-one years as to cause the apex of Horse-shoe Falls to move upstream 170 feet. When white men first saw this great falls, the crest was a long distance downstream from where it now is.

This is referred to here to show the astonishing effect of a heavy body of falling water in cutting and carrying away vast quantities of rock.

With the design of dam submitted by the International Paper Company constructed on the proposed site, I entertain no doubt that within a few years at most, due to undermining or sliding or both, the dam would fail.

The site of this proposed dam has been inspected by Commissioner Moore, the Chief Engineer, the Division Engineer, and Assistant Engineers Suter, Sargent and Cullings. The Division Engineer and each assistant engineer have made separate reports upon the dam site and local physical conditions. Said reports are submitted herewith, marked respectively as "Appendices B, C, D and E." The report of the Division Engineer clearly sets forth the physical conditions, and the opinions of its author are entitled to credit.

In the report of Assistant Civil Engineer Suter, the subject is ably treated, and particular attention is called to his statements and conclusions upon the subject of water falling vertically from dams and from natural water falls and the astonishing action resulting upon rock or other material at and near the base of the falls.

Assistant Civil Engineer Sargent in his report sets forth his views clearly as to the hazardous features of the proposed site and construction combined.

Assistant Civil Engineer Cullings has carefully calculated the stresses in the dam structure as designed and the forces tending to cause the dam to slide on or with the underlying rock. His mathematical conclusions are clearly set forth in the blue prints which he makes a part of his report. He shows that the design of the dam submitted would be safe per se if built upon a foundation free from undermining and sliding hazards.

The Division Engineer and the three assistant civil engineers have made their several reports as distinctly their own individually. None of them have been inspired or influenced by the Chief Engineer.

Respectfully submitted,

R. W. Shuman
Chief Engineer.

RWS/H.

June 17, 1913.

International Paper Co.,

30 Broad Street,

New York City, N. Y.

Gentlemen:-

Tentative plans for the proposed work at Corinth (dam #361 Upper Hudson) received. I cannot, however, see how the same provides for the maximum flow. Last March the flow was about 95,000 feet second and it could be more. The dam should provide for this flow with the flash boards in, unless they are so constructed that they will float off with their own buoyancy when overtopped. I presume, in cases where the rock is not rough, as shown on the drawings, so the dam can obtain a good hold thereon, that two inch iron anchors, going through two layers of the rock bed, would make up the deficiency.

When sending prints for approval, kindly have a slip of paper, 3 inches by 6 inches, placed on the tracing near the lower right hand corner for the stamp of approval, as stated in the requirements on the application blank.

International Paper Co. #2.
June 17, 1918.

In filling out the application blank, kindly show
how the maximum flow is to be taken care of.

Very truly yours,

Conservation Commission,

By

Inspector of Fisheries and Wildlife.

MoK/C.



International Paper Company
30 Broad Street
New York

June 23rd, 1913.

Re - HUDSON RIVER DAM

The Conversation Commission,
Mr. Alex. Rice McKim, Inspector of Docks & Dams,
Albany, N. Y.

Dear Sir:-

I have your letter of June 15th in reference to
dam #361 - Upper Hudson.

The best information we have shows the amount of
water passing Corinth during the March flood to have been 89,000
cubic feet per second.

We have designed a crest in accordance with the
Cornell experiments, to obtain the best possible coefficient of
discharge. The coefficient for the crest as we have designed it
will be, in accordance with our opinion and that of Mr. H. de B.
Parson's, at least 4; which would give a discharge of 89,000
cubic feet per second with a depth over the crest of 15.4 feet.

It is of course intended that the flash boards
shall go out if the water has risen six to eight feet over them.
The only damage which would be done if the flash boards would not
go out would be flooding back on Warren Curtis Mill, next above
us.

We will of course ask you to examine the foundation
bed before we start the dam, and if we cannot suitably prepare the
foundation otherwise we will put in the pins as you suggest.

In sending you prints for approval, we will as you
ask leave a white space on them for your approval stamp.

Yours very truly,

CHIEF ENGINEER.

AHW/A.

July 15, 1913.

Concerning the samples for Dam #361 Upper
Hudson at Palmer's Falls, sent to the
Laboratory for Testing.

International Paper Co.,

30 Broad St.,

New York City, N. Y.

Gentlemen:-

We found that the cement with five samples on a seven days test with standard quartz sand averaged 238 pounds per square inch. With the sand which you sent, the average of four samples on a seven days test was but 28 pounds per square inch and the average of five samples of the sand you sent washed averaged 112 pounds per square inch. The result of the tests on the sand, as you see, were very poor due to insoluble coating of loam, and sands of that nature always give a very low initial result. Often, however, these sands on a longer test give better results, but I think it unwise to use this sand for your dam.

The samples of crushed stone were composed of a good limestone and should give very good results. The foundation bed itself is composed of feldite and gneiss.

International Paper Co. #2
July 15, 1927.

I suggest that you submit another sample of sand,
for which I enclose a tag. ⁷¹³

Very truly yours,

Conservation Commission,

By

Inspector of Fish and Game.

HOK/C.

Encl.

FILE



International Paper Company

30 Broad Street

New York

July 30, 1913.

Chief Engineer
WATERS

Matter disposed of by phone
in interview. RMS.
no further reply.

Conservation Commission,
Albany, N. Y.

Mr. R. W. Sherman, Chief Engineer.

Dear Sir:

Your communication of July 29th addressed to this Company and delivered this day by hand of your division engineer, Mr. A. H. Perkins, has been repeated to the writer by telegraph.

Until my assistant, Mr. Hutchins, told me over the telephone to-day, I knew nothing of the visit of your Mr. Cullings to Corinth.

The last communication I have had from the Commission is a letter by Mr. McKim under date of July 15th, in which the receipt of plans, specifications, etc. were acknowledged. We are greatly surprised and somewhat disturbed by your letter of July 29th. We had discussed the type of dam with Mr. McKim. We are interested in a dam of the same type in Maine - 65 feet high, and impounding 8 billions of cubic feet of water. This type of dam was suggested by the writer for the reservoir in Maine, and was adopted by a Board of well known engineers.

Our design of dam for our Hudson River Mill was very carefully worked out, and carefully checked up by our consulting engineer, Mr. H. de Barclay Parsons.

I think if you will give me an interview I can show you the great advantages of this type of dam over the ordinary solid section.

As to the foundations at Hudson River Mill, I can only say, that Mr. McKim examined the foundations and expressed himself as highly satisfied

- 2 -

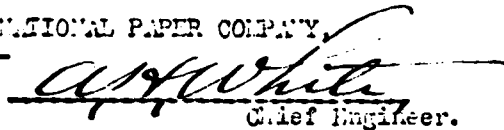
and told us to go right ahead, and that we would get the Commission's approval promptly after sending in the application. If, as I understand Mr. Perkins says, Mr. McKim exceeded his authority, we are unfortunate, and while we feel that we were about to build on a perfectly safe foundation, we of course stand ready to follow your instructions.

I am endeavoring to arrange with you to visit the site of the work with me, and trust that I may be successful.

Respectfully yours,

INTERNATIONAL PAPER COMPANY.

By-


Chief Engineer.

Chief Engineer Sherman.

Dear Chief:

Commissioner Moore directs me to let you know that that Mr. Perkins took up the matter of the new Palmer Falls dam of the International Paper Company just before he left Thursday, and gave him instructions to lay the whole thing before you by wire.

Now it appears that these people are proceeding in advance of the approval of the plans and are thereby in conflict with the law.

Please telephone Mr. White, Chief Engineer of the I. P. Co. and make it plain to him that construction work must cease until he notifies you. He ought to realize that he should should not proceed upon the verbal assurance of any employee of the Commission.

The Commissioner further says to "GET THIS DAM RIGHT."

Yours very truly,

J. M.

JDM/M

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Aug. 7, 1913.

Hon. John D. Moore, Commissioner,
Conservation Commission,

Oak Ridge, Tenn.

Dear Sir:-

Your telegram of yesterday in reply to mine of the same date reached me this morning.

Today morning in company with Division Engineer Perkins and Engineer White of the International Paper Company of Niagara, and with him in his auto we went to Palmer Falls and onto the site of the dam. I there read to Mr. White yours of the 4th inst. signed by J. Heirs, which reads as follows:

"Commissioner Moore directs me to let you know that Mr. Perkins took up the matter of the new Palmer Falls dam of the International Paper Company just before he left Thursday, and gave him instructions to lay the whole thing before you by wire.

Now it appears that these people are proceeding in advance of the approval of plans, and are thereby in conflict with the law.

Please telephone Mr. White, Chief Engineer of the I. P. Co., and make it plain to him that construction work must cease until he notified. He ought to realize that he should not proceed upon the verbal assurance of any employee of the Commission.

The Commissioner further says to "GET THIS DAM RIGHT".

I then took the above to Mr. White and he read it to me. He immediately ordered the

...
of all construction work upon the proposed dam, laying off a considerable number of men who were engaged in rock excavation, and the construction of the dam.

Mr. Perkins and I made a very careful inspection of the site, and as far as possible all features connected with the proposed dam, and as a result I became more than ever convinced that by reason of the possibility - almost probability - even bordering upon certainty - that the overflow of the immense volume of Hudson River water falling through the falls over the crest of the dam upon the rock at and near the brink of the falls upon which the site is located, would tear out the rock [&] underneath the dam to an extent that would cause the same to slide either upon or with the rock which has a decided dip down stream, and cause the dam to rupture and fall in part or as a whole over the precipice, ^{and that} the plans and specifications submitted by the owner should not be approved by the Conservation Commission.

After the inspection, I stated to Chief Engineer White that when Commissioner Moore and myself inspected the site and examined the plans some weeks ago we were impressed with the danger from undermining and sliding, and that upon my present inspection I was still more forcibly impressed in the same direction, and would not approve the plans upon the proposed site.

Mr. White asked numerous questions. He desired to know if the Commission would sustain my views, to which I replied that I thought so but it did not necessarily follow. He wished to know if you were of the same opinion as myself, and I said that I believed you were. He then asked if the Commission would not approve of the plan if it were shown in a different position, and I replied that I did not know.

would not create risk to life or property other than that of the United States Power Company. I declined to say that I could not say what action the Commission would take in any branch of the subject, but as I understood it it was the policy of the Commission to approve only such designs and locations for dams as would lead to the building of structures which the Commission believed could not fail.

Mr. White was anxious that you return from Idaho and again inspect the dam, and I said that I would ask you to do so but in my opinion you would not come. He wished me to telephone you, which I declined to do. He asked for your telephone address, which I gave him, in order that he might telephone you if he chose to do so.

Mr. White further asked if he could appeal to the Courts from the decision of the Commission. I said that I would not pass upon any law points, but personally I had no doubt of their right to do so.

Later in the day he (Mr. White) talked about abandoning the building of a new dam altogether for the time being at least, and continuing to use the existing timber dam by somewhat strengthening the repairs which they have lately made upon it.

Mr. White made numerous statements to which I made no reply. He threw out ideas as to construction, etc., as to which I was silent. He seemed to exhaust all the art and ingenuity which he possessed as to how to get the Commission to change its mind and dam location, in which efforts, I need scarcely say, he did not succeed.

From Glens Falls we continued with Mr. White in his car to Fort William Henry Hotel, where we dined (not at his expense), and from there we went to Glens Falls where, at his request, we inspected some site of their proposed dam and other work which you and I lately inspected. We left Mr. White at his Company's office in Glens Falls, and took the three o'clock (P. M.) train for Albany. Doubtless Mr. White is a great engineer, but he doesn't know much about law.

As you so clearly state in your telegram, the law makes approval of plans by Conservation Commission an indispensable preliminary to construction, and therefore responsibility is placed directly upon the Company. The Commission has taken no action and therefore there is nothing from which to appeal. The law does not require the Commission to take negative action. If plans and specifications submitted to the Commission by the owners for approval are not approved, the remedy of the owners is by Mandamus, and as I view it that is the only legal resort the International Paper Company has at the present time.

Mr. Perkins thinks that the International Paper Company will resort to some legal proceedings. Of course they may, but I do not feel confident that they will. By way of prediction, I think it more likely that they will drop the matter altogether for the present, patch up their old timber dam a little more so that it will answer a few years longer, and that they will finally resort to a safe design and location for their new dam in lieu of the present design and location combined. This sets forth the situation in the matter as I see it, and as I view it, is near as nothing but await such action as the International

...

Paper Company chooses to take, either by legal proceeding or by submitting some other plan. Possibly they may ask for a hearing plan and location.

I note that you are opposed to employing outside engineering experts. If Mandamus Proceedings against the Commission are instituted, it may then be advisable to employ such experts, but I concede that there is at least nothing urgent about doing so at this time, if at all.

Yours respectfully,

Chief Engineer,
Conservation Commission.

RMS/P

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from International Paper Co. for Antis Pt. Palmer, N. Y.
for use on Contract No. Contract Palmer on the Hudson River Division.
Contract Sample No. _____ taken _____; received at Laboratory _____; made up Aug. 11
Sand is composed of quartz, feldspar, and calcite with some hornblende and
trace of magnetite. Coarser grains are granite.
Percentage of Voids 38.2; Loam 1.0; Organic matter +
Parts of sand to cement by ^{weight} bulk 3 sand to 1 cement. Per cent water used 11.2
Temperature of water used in mixing 75 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests Standard Cement. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, { in 190 min. } hard, { in 570 min. }
Minim. requirement, 30 min. Requirement, 60 to 100 min.
Constancy of Volume Tests:—Normal air 1000; Normal water 1000; Accelerated 1000
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.8 (Requirement, 99%)
“ “ “ “ “ 10,000 “ “ “ “) 96.6 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
224	345	92		100		2	98.6
205	270	94		99		4	95.8
225	302	92		95		6 (1/8")	93.4
216	312	86		102		10	89.8
218	328	106		105		20	74.6
1088	1557	470		501		30	45.8
218 ^{1/2}	311 ^{1/2}	94		100 ^{1/2}		40	22.4
						60	9.0
						74	4.2
						100	0.8
						140	0.4
						200	0.3

Remarks:

I CERTIFY that this is a true abstract taken from the records of tests Aug. 8. & 12 1913

Russell L. Greenman
Resident Engineer in Charge of Tests

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from International Paper Co. taken at Palmer, N. Y.,
for use on Contract No. Blank, Res. No. at Palmer 11 1/2 Canal, Division.
Contract Sample No. _____ taken _____; received at Laboratory _____; made up Aug. 1
~~Sand is~~ Sample is "Iron Ore Tailings".

Percentage of Voids 32.7 ; Loam ; Organic matter
 Parts of sand to cement by weight bulk :— 3 sand to 1 cement. Per cent water used. ± 10 1/2
 Temperature of water used in mixing 75 Fahr. Briquettes kept in moist air 24 hours and then immersed.
 Cement used in tests, Standard "Cement". This cement tested as follows:—
 Sets (determined by Vicat needle):—Initial, { in 190 min. } ; hard, { in 370 min. }
 { Minim. requirement, 30 min. } { Requirement, 60 to 600 min. }
 Constancy of Volume Tests:—Normal air Good ; Normal water Good ; Accelerated Good
 Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.8 (Requirement, 99%)
 " " " " " " " " " ") 96.6 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND			
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
224	345	202				2	100.0
205	270	216				4	98.6
225	302	230				6(½)	87.4
216	312	231				10	66.8
218	328	242				20	42.2
108 ^g	155 ^g	112 ⁱ				30	28.2
218 ^v	311 ^v	224 ^w				40	20.8
						60	15.0
						74	12.2
						100	8.4
						140	6.4
						200	5.2

Remarks:

I CERTIFY that this is a true abstract taken from the records of tests..... Aug 8 + 12 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

RECEIVED

AUG 12 1913

DIVISION INLAND WATERS

Tests of Sand from Corinth N.Y. bank J. D. M.N. Y.
for use on Contract No. Res. No. Conservation Commission Canal Division.
Contract Sample No. taken ; received at Laboratory ; made up July 8
Sand is composed of quartz and calcite with some humblend and magnetite
- all somewhat coated
Percentage of Voids 32.0; Loam 1.6; Organic matter —
Parts of sand to cement by weight — 3 sand to 1 cement. Per cent water used 21.2
by bulk
Temperature of water used in mixing 72 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests, Cement received from Corinth This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, { in 140 min. } ; hard, { in 350 min. }
 { Minim. requirement, 30 min. } { Requirement, 60 to 600 min. }
Constancy of Volume Tests:—Normal air Good; Normal water Good; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.3 (Requirement, 99%)
" " " " " 10,000 " " " ") 92.3 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
242	307	—	75	106	79	2	98.2
254	300	25	77	109	92	4	91.6
234	300	26	69	117	99	6(1/8)	87.2
219	305	29	75	119	85	10	76.8
240	302	36	76	108	89	20	50.4
1189	1514	116	372	559	444	30	33.8
238"	303"	29	74"	112"	89"	40	18.0
						60	7.0
						74	3.0
						100	1.6
						140	1.0
						200	0.6

Remarks:

I CERTIFY that this is a true abstract taken from the records of tests Aug 5 1913

Russell S. Greenman
Resident Engineer in Charge of Tests

Chief Engineer
 GEORGE E. VAN KENNEN,
 JAMES W. FLEMING,
 JOHN D. MOORE,
 ALBERT E. HOYT,
 JOHN J. FARRELLY,
 ASST. SECRETARY

STATE OF NEW YORK



ORIGINAL

DIVISION OF INLAND WATERS
 JOHN D. MOORE, COMMISSIONER
 JAMES J. FOX, DEPUTY COMMISSIONER
 RICHARD W. SHERMAN, CHIEF ENGINEER
 ALEX. RICE, MCKIM, INSPECTOR OF DAMS AND DAMS

IN REPLYING PLEASE REFER
 TO FILE NUMBER

CONSERVATION COMMISSION

ALBANY

Aug. 9, 1913.

Mr. R. W. Sherman, Chief Engineer,
 Conservation Commission,
 Albany, N. Y.

Dear Sir:-

Complying with your request for a report upon the proposed dam at Palmer Falls, I have visited the site four different times, and have examined the drawings and requested Mr. Cullings to figure out the stresses in the proposed structure.

I may state as a result of these investigations in general that the design of the dam appears to be well within good engineering practice, provided it were to be placed upon a suitable foundation. The question of the safety of this dam, therefore, reduces itself to one of judgment as to the safety of the foundations under the conditions that would exist with the dam erected.

In the first place, it should be noted that the rock has well defined cleavage planes in two directions, at an angle of approximately 120 degrees. The cleavage planes most nearly horizontal dip at an angle of about 15 to 20 degrees down stream. Back of the proposed dam there is a fault in the rock, and the water has taken out the rock broken up by the faulting, leaving a deep hole along the edge of which the heel of the proposed dam

would come over about three-fourths of the length of the dam. This line of faulting passes under the proposed location of the sluice gates and head gates. The dam is thus located upon a triangularly shaped mass of rock which, near its end near the sluice gates, is not over 30 ft. wide, and drops off to the lower pool of the river very steeply. These conditions might be described at greater length, and should be in case it is desired to explain the conditions to one wholly unfamiliar with the proposed work.

The ~~runoff~~ ^{runoff} of the Hudson at this point may be expected to reach at times of maximum flood over 100,000 sec. ft., the discharge at Spier Falls having been over 90,000 sec. ft. during the last spring, and the drainage areas at the two points are but slightly different. This discharge would require a depth on the spillway of about 15 ft. This mass of water plunging from the top of the dam onto the shattered rock beneath would very probably take out everything in front of it, stripping off the rock layer by layer. The undermining action of this sheet of water falling through the height from the top of the dam to the level of the lower pool, which is 85 ft., cannot but result in further undermining the shattered rock. There is, therefore, great danger that in flood the portion of the dam resting upon the narrower part of the rock tongue would be undermined and the dam would be destroyed.

In addition to the danger from undermining, there is the additional danger that water percolating through the cracks of the rock will exert an upward pressure upon the sloping sur-

face, and that one or more sections of the dam will slide bodily down stream along some cleavage plane.

In view of the foregoing conditions, it is my opinion that this dam does not possess the degree of safety which the Commission has the right to demand. It should be noted, however, that the pondage above the dam is small, and that the failure of the dam would not cause any appreciable flood wave.

Two remedies appear to be open. The first would be to construct the dam in its present location, but add to it a roller-way extending from the top of the dam down below the surface to the bottom of the pool below, there giving the water a horizontal direction by an O. G. curve. The second remedy, and probably the best and cheapest solution of the problem, is to abandon the proposed site entirely and build a dam at a point further up stream. This is entirely feasible, but in any case it is believed that in view of the character of the rock at this locality a roller-way and surface protection of the rock below are essential.

Very respectfully yours,

A. H. Perkins

Division Engineer.

AHP/F
The above report is approved by,
R. D. Shuman,
Chief Engineer.

GEORGE E. VAN KENNEN,
CHAIRMAN

JAMES W. FLETCHER,
COMMISSIONER

JOHN D. MOORE,
COMMISSIONER

ALBERT E. HOYT,
SECRETARY

JOHN J. FARRELL,
SECRETARY

DIVISION OF INLAND WATERS

IN REPLYING PLEASE REFER
TO FILE NUMBER

STATE OF NEW YORK



ORIGINAL

DIVISION OF INLAND WATERS

JOHN D. MOORE, COMMISSIONER

JAMES J. FOX, DEPUTY COMMISSIONER

RICHARD W. SHERMAN, CHIEF ENGINEER

ALEX. RICE MCKIM, INSPECTOR OF DOCKS AND DAMS

CONSERVATION COMMISSION

ALBANY

Aug. 9, 1913.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

In answer to your verbal request, I beg to submit the following report on the site of the dam proposed to be built by the International Paper Company at Palmer Falls.

In company with Division Engineer Perkins and Assistant Civil Engineer Suter and Cullings, I made an inspection of this dam site on August 8th. I made no technical examination of the plans, and it is assumed that the dam per se has been safely designed.

It is proposed by the International Paper Company to build a dam across the Hudson River, which is about 200 ft. wide at its narrowest point in this vicinity, immediately below their present dam, part of which was carried out by the floods of last spring. At the present time there is available a gross head of 83 ft. at the mill. The new dam is to be about 38 feet in height, and is to consist of eighteen concrete arches of 15 ft. span between concrete piers 4 ft. thick. Should a flood occur of the magnitude of that of last spring, there would be a depth of water of 18 feet on the spillway, which is planned to have a total length of 383 feet.

Address all communications to the Conservation Commission.

The dam is situated on the crest of an abrupt falls approximately 20 feet high, giving a total fall of 60 ft. from the crest of the dam. About 40 ft. above the dam is a pocket 40 ft. long and 30 ft. deep at its deepest point; with 18 ft. of water on the crest of the dam it would give a total head of 88 feet, tending to uplift the foundation.

The foundation of the dam, which is a granite gneiss, is distinctly stratified and has a dip down-stream estimated at 15 degrees, and is fissured in several places both vertically and horizontally, the vertical cracks being the wider.

It would seem apparent that as no apron is proposed to be constructed, the water with its clear fall of 60 ft. to 80 ft. would undermine the fissured rock at the base of the dam, thereby endangering the structure and making its eventual failure almost certain.

The pondage created by this dam would be small, and should the dam fail but little damage would probably result to the property below. It would not, however, seem advisable for the Conservation Commission to give its approval of the plans of a dam which seems liable to fail, even though the resulting damage might be slight.

In the writer's opinion, the best way to build a dam at this point would be to construct a concrete dam between the points where the new dam is being built, arching the dam upstream. A low secondary dam could be built a short distance below, creating a pool which would act as a water cushion for the flood flows over the main dam.

...3

Without doubt, the proposed dam in its present location could be made safe by the construction of an apron, but probably at a prohibitive cost.

Respectfully submitted,

(Signed) Edward H. Sargent.

EHS/F

Asst. Civil Engr.

FILE

International Paper Company

30 Broad Street

New York

Aug. 11th. 1913.

RECEIVED
1913
LAND WATERS
YOUR FILE NO.

Chief Engineer

RECEIVED
(Sept 2-1913)
ANSWERED

erman. Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

We are sending you herewith duplicate copies of application
for construction of dam at Palmer.

Hoping this will answer your requirements, we are

Yours very truly,

A. J. White -
E.H.

CHIEF ENGINEER.

EH/B

x should read
construction

R. W. Sturges
Chief Engr

I
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Sept. 2, 1913.

Mr. O. H. White, Chief Engineer,
International Paper Co.,
30 Broad St., New York.

Dear Sir:-

Yours of the 29th ult. with enclosures as stated
was duly received.

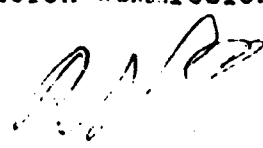
In your letter you use the word "reconstruction"
while in the application you use the word "construction".
The latter is correct.

At a meeting of the Conservation Commission held
this morning, plans covered by your application for both the
new dam and repairs to the existing crib dam at Palmer's
Falls, your new dam at Glens Falls, and repairs, reconstruc-
tion, etc., to your dam at your mill "C" on Black River
were all duly approved, as to all of which you will be fur-
ther formally advised through the Secretary.

Yours truly,

Conservation Commission,

By



RES/F

Chief Engineer

Memorandum . *OK* 9/2/13 *Gay X*

WHEREAS the International Paper Company, having an office at 30 Broad Street in the City of New York, did on the 18th day of August, 1913, submit plans and specifications for additional repairs and strengthening of a dam located in the Hudson River in the Towns of Corinth and Luzerne in Saratoga County, said dam being known in Conservation Commission records as dam No. 361, Upper Hudson Watershed, and did by Conservation Commission Serial No. 110 make application for the approval of said plans and specifications under the provisions of the Conservation Law, and

WHEREAS said plans and specifications have been approved by the Chief Engineer and the Inspector of Docks and Dams and said plans signed by them respectively.

NOW THEREFORE BE IT RESOLVED that said plans and specifications be and hereby are approved provided, however, that this resolution shall not be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of this resolution, nor to create any claim or demand against the State of New York.

GEORGE E. VAN KENNEN, CHAIRMAN

JAMES W. FLEMING,

JOHN D. MOORE, 1914
COMMISSIONERS

ALBERT E. HOYT, SECRETARY

JOHN J. FARRELL, ASST. SECRETARY
Chief Engineer

IN REPLYING PLEASE REFER
TO FILE NUMBER

STATE OF NEW YORK



CONSERVATION COMMISSION

ALBANY

DIVISION OF INLAND WATERS

JOHN D. MOORE, COMMISSIONER

JAMES J. FOX, DEPUTY COMMISSIONER

RICHARD W. SHERMAN, CHIEF ENGINEER

ALEX. RICE McKIM, INSPECTOR OF ROCKS
AND DAMS

Jan. 28, 1914.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission,
Albany, N. Y.

Dear Sir:-

In accordance with your verbal instructions of the 24th inst., I have today inspected Dam No. 361, Upper Hudson, recently constructed by the International Paper Company across the Hudson River at Palmer Falls. Owing to a sleet storm on Saturday, followed by a heavy snow storm which left all masonry and machinery covered with ice and snow, it was impossible to make a thorough inspection of the dam. So far as can be seen, however, the dam appears to have been constructed in a thorough and painstaking manner, and in accordance with the revised plans approved by the Conservation Commission August 19, 1913. The structure is practically complete, except for the placing of three or four gate-stands, and the closing of the sluice left open to take care of leakage through the old crib dam. The hand-rail has not yet been placed on the bridge through the dam, as shown on plans. Mr. Ashworth, superintendent for contractor, states that he will be ready to place the dam in service at the end of the present week. I see no engineering reason why formal permission to use this dam should not be granted.

Respectfully yours,

E. J. Cullings

Assistant Engineer.

ESC/F

Address all communications to the Conservation Commission.



PHILIP T. DODGE
PRESIDENT

FILE
International Paper Company
30 Broad Street
New York

January 22nd, 1914.

Jan 25 - 1914
RECEIVED

RECEIVED
JAN 23 1914
DIVISION INLAND WATERS
J. D. M.

The Conservation Commission,
Albany, N. Y.

Gentlemen:-

We beg to notify you that our dam on the Hudson River in the towns of Corinth and Luzerne, and known by you as Dam No. 361 Upper Hudson Watershed, Serial No. 93, is finished and ready to receive the water with the exception of filling a small sluice. We make this notification so that if you so desire you may have the dam inspected before it receives the water pressure.

As we desire to close the sluice within the next few days, we would like to hear from you immediately.

Yours very truly,

INTERNATIONAL PAPER COMPANY.

P. T. Dodge

PRESIDENT.

AHW/A.

Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners James H. Smith, Cornhill, N.Y.
2. Date of construction 1911
3. Uses of impounded water Power, irrigation
4. Character of foundation bed Granite
5. Material of waste spill Concrete
6. Length of waste and depth below dam 4 ft. long 10 feet deep, 10 ft. high
7. Total length of dam including waste About 75 ft. long 3 ft. high
8. Material of dam Concrete
9. Discharges, size and location

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.

Plan of the dam filed with
Conservation Commission Dam #360

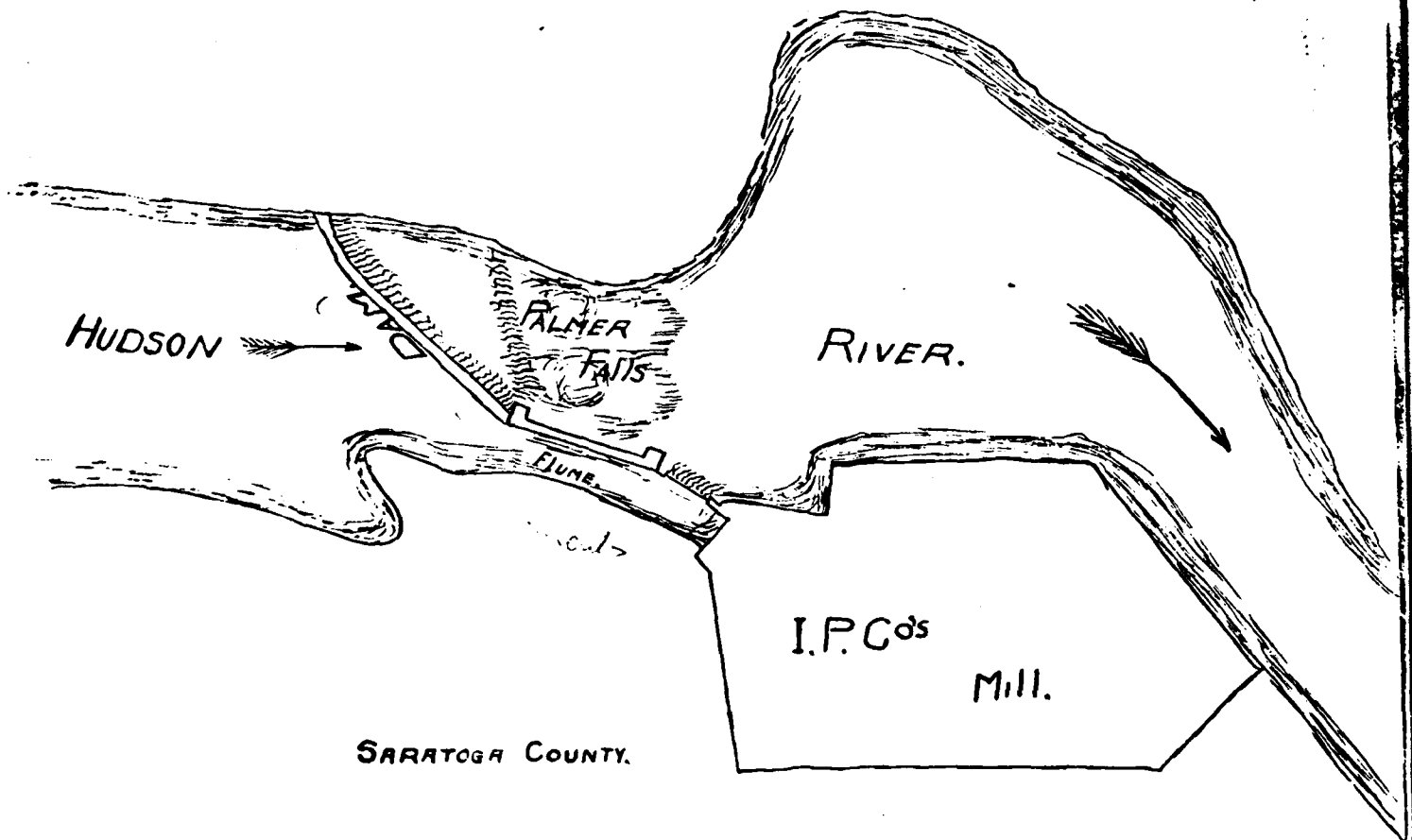
Nearest town

Cornhill N.Y.

Received Jan 25
Referred Com'n. home
W. H. Smith Secretary

(Signature, address and date.)

WARREN COUNTY.

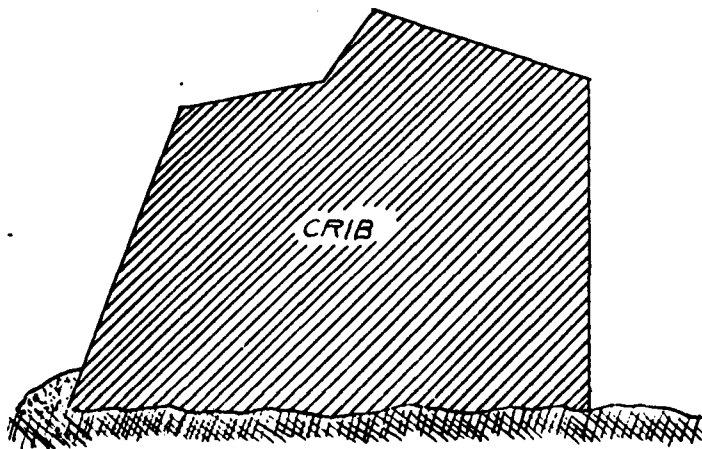
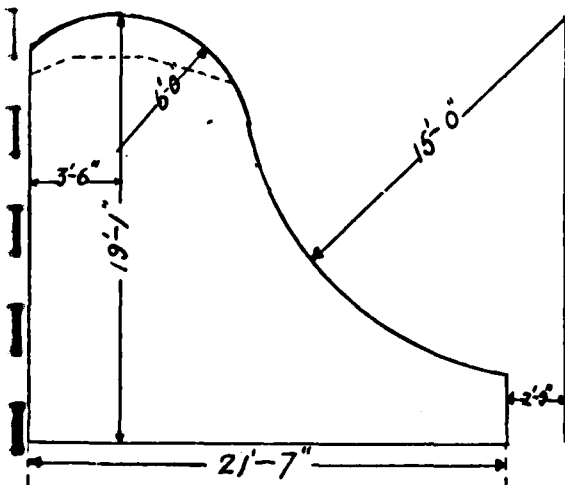


SARATOGA COUNTY.

Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners.....International Paper Company.....
2. Date of construction.....
3. Uses of impounded water.....Power for manufacturing pulp and paper.....
4. Character of foundation bed.....Ledge.....
5. Material of waste spill.....
6. Length of waste and depth below dam.....
7. Total length of dam including waste.....500 feet.....
8. Material of dam.....Limestone (97% best material).....
9. Discharges, size and location.....

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.



Nearest town, Huron

International Paper Company, Mr. Allen Curtis, Manager.

April 2nd, 1917.

(Signature, address and date.)

Nearest Bridge on Corinthian
about 1/4 mile up River.

Hudson River

Crib

Crib

Crib

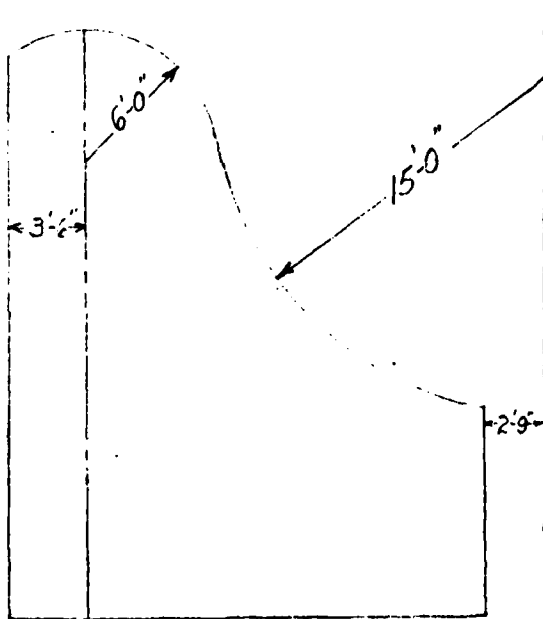
Masonry

Head Gate Wall.

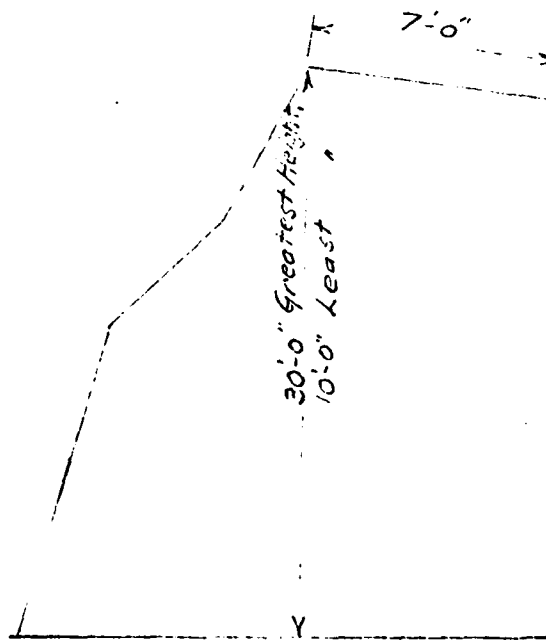
Fill out a form as complete as possible for each dam in your district and send to State Conservation Commission, Albany, N. Y.

1. Name and address of owners *International Paper Co., Elmira, N. Y.*
2. Date of construction *1881*
3. Uses of impounded water *Irrigation of crops, domestic use, etc.*
4. Character of foundation bed *Rock*
5. Material of waste spill
6. Length of waste and depth below dam
7. Total length of dam including waste *590 ft.*
8. Material of dam *Stone masonry & brick*
9. Discharges, size and location

Below sketch section of waste and section of dam, with greatest heights and top thickness and bottom thickness. On opposite side sketch general plan of dam and give distance from a bridge or from a tributary stream.



Section of Masonry Dam



Section of Crib Dam

Nearest town *Elmira, N. Y.*

(Signature, address and date)

L. J. Smith

Nov 11-1911

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

On.....I inspected the above work and found that it had been completed in a satisfactory manner.

Approved:

.....
Inspector of Docks and Dams.

.....
Chief Engineer.

INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space $2\frac{1}{2}$ inches high by $5\frac{1}{2}$ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory. On request tags will be sent for labelling the materials.

APPROVAL BY COMMISSION

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

On Sept 2 1913 the Conservation Commission, by resolution duly adopted, approved of the above application for the { construction } of dam 361 1/2 Hudson on Hudson River and hereby gives permission for the { reconstruction } of said dam within six months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

Robert E. Hall
Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

Work on the above dam was started....., contracts for the same having been awarded to.....

On

Approved:

Inspector of Docks and Dams.

Chief Engineer.

Sheeting or other cut-off.

Is fishway provided? None

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals, flashboards, gates, log chutes, etc.

Names of owners of property which will be submerged by construction of dam, with approximate submerged area owned by each.

It is intended to complete work covered by this application by Nov. 1, 1913
(Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany Aug 19 - 1913

I have carefully examined the plans of the above dam, and find that if the work is constructed in accordance with the plans, filed Aug 18 - 1913 with good workmanship and the specified materials that it will be safe.

Approved:

R. H. Sherman
Chief Engineer.

Alb. R. W. Kim
Inspector of Docks and Dams.

Masonry or timber portion: See drawing

Length on top.....feet.
Length in stream bed.....feet.
Maximum height above stream bed.....feet.
Maximum height above foundation bed.....feet.
Maximum width of base.....feet.
Maximum width of top.....feet.
Elevation of top above maximum water level in pond.....feet.
Elevation of top above spillway crest.....feet.
Nature of foundations Rock

Earth portion:

Embankment: None

Length on top.....feet.
Length in stream bed.....feet.
Maximum height above stream bed.....feet.
Maximum width of base.....feet.
Maximum width of top.....feet.
Elevation of top above maximum water level in pond.....feet.
Elevation of top above spillway crest.....feet.
Slope, upstream face.....
Slope, downstream face.....

Core wall: None

Material.....
Elevation of top above spillway crest.....feet.
Width of top.....feet.
Batter of faces.....
Maximum height above foundations.....feet.
Maximum width of base.....feet.

LOCATION AND GENERAL DATA

Site of dam is on Hudson River
(Name of stream)
a branch of , within the
(Name of stream)
limits of the town of Corinth and Luzerne , County of Saratoga and Warren
About 1/4 mile below the bridge between the towns of Corinth and Luzerne
(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)

Purpose of dam holding water to enable the Paper Mill to be operated during the
construction of new concrete dam

Reasons for making changes in existing structure part of present Coffey Dam was built
in connection with repairing the work in the original timber crib dam. This is to
be planked over and made safe to carry next spring's supply. Part of the present
structure will be braced on the down stream side in order to withstand next spring's
flood.

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Timber crib dam, filled with stone
and thoroughly ledge pinned

Area of watershed above dam 2760 square miles.

Area of water surface of pond at level of spillway crest 7 acres.

Capacity of reservoir (at above level) about 9,000,000 cubic feet.

Length of spillway crest about 525 feet.

Maximum depth of water on spillway crest feet.

Maximum discharging capacity of spillway cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area

..... cubic feet per second.

Dam No. 301

GEORGE E. VAN KENNEN
CHAIRMAN
JAMES W. FLEMING
JOHN D. MOORE
COMMISSIONERS
ALBERT E. HOYT
SECRETARY
JOHN J. FARRELL
ASST. SECRETARY

STATE OF NEW YORK



DIVISION OF INLAND WATERS
JOHN D. MOORE
COMMISSIONER
JAMES J. FOX
DEPUTY COMMISSIONER
RICHARD W. SHERMAN
CHIEF ENGINEER
ALEX. RICE MCKIM
INSPECTOR OF DOCKS
AND DAMS

CONSERVATION COMMISSION
ALBANY

Serial No. 110

Application filed Aug 18 - 1913

Approved by Commission Sept 2nd 1913

Material Tag No.

Foundations inspected

Final inspection

APPLICATION FOR ~~CONSTRUCTION~~ OR RECONSTRUCTION OF A DAM

No. 30 Broad Street, New York City
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked Sketch showing Cofferdam at Hudson River at Corinth, N. Y. - No. 3-814

herewith submitted, for the { ~~construction~~ } of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

Aug. 18th, 1913
(Date)

{ Signature of }
{ Applicant }

International Paper Co.

Per Geo H Park VP

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

On.....I inspected the above work and found that it had been completed in a satisfactory manner.

Approved:

.....
Inspector of Docks and Dams.

.....
Chief Engineer.

INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space $2\frac{3}{4}$ inches high by $5\frac{1}{4}$ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory.

On request tags will be sent for labeling the materials.

APPROVAL BY COMMISSION

STATE OF NEW YORK
CONSERVATION COMMISSION

ALBANY

On the Conservation Commission, by resolution duly adopted, approved of the above application for the { construction } of dam 361 Upper Hudson on Hudson River and hereby gives permission for the { reconstruction } of said dam within eighteen months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

Work on the above dam was started....., contracts for the same having been awarded to.....

On July 2^d 1913, I inspected the Foundations. Same were satisfactory and will be sufficient if instructions regarding pockets be carried out. North of angle in dam 3' deep shoulders to be cut for first two piers and pockets for the third.

Approved:

Allen Rice Wooten

Inspector of Docks and Dams.

Chief Engineer.

Sheeting or other cut-off.....

Is fishway provided?..... Yes

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals,
flashboards, gates, log chutes, etc.

See drawings

Names of owners of property which will be submerged by construction of dam, with approx-
imate submerged area owned by each.

It is intended to complete work covered by this application by Oct 1st 1913
(Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany July 14th 1913

I have carefully examined the plans of the above dam, and find that if the work
is constructed in accordance with the plans, filed July 14th 1913
with good workmanship and the specified materials that it will be safe.

Approved:

[Signature]
Chief Engineer.

[Signature]
Inspector of Docks and Dams.

Masonry or timber portion:

Length on top..... *Zero* feet.
Length in stream bed.....feet.
Maximum height above stream bed.....feet.
Maximum height above foundation bed.....feet.
Maximum width of base.....feet.
Maximum width of top.....feet.
Elevation of top above maximum water level in pond.....feet.
Elevation of top above spillway crest.....feet.
Nature of foundations

Earth portion:

Embankment:

Length on top.....feet.
Length in stream bed.....feet.
Maximum height above stream bed.....feet.
Maximum width of base.....feet.
Maximum width of top.....feet.
Elevation of top above maximum water level in pond.....feet.
Elevation of top above spillway crest.....feet.
Slope, upstream face.....
Slope, downstream face.....

Core wall:

Material..... *None*
Elevation of top above spillway crest.....feet.
Width of top.....feet.
Batter of faces.....
Maximum height above foundations.....feet.
Maximum width of base.....feet.

LOCATION AND GENERAL DATA

Site of dam is on Hudson River
(Name of stream)

a branch of _____, within the
(Name of stream)

limits of the town of Conituck and Luzerne, County of Lancaster
& Warren

(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)
Village of Conituck, Gibsonville

Purpose of dam Power

Reasons for making changes in existing structure Old wood crib dam
was partially destroyed during March 1913

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Concrete

Area of watershed above dam 260 ± square miles.

Area of water surface of pond at level of spillway crest 300000 Sq ft ± acres.

Capacity of reservoir (at above level) _____ cubic feet.

Length of spillway crest 383 ± feet.

Maximum depth of water on spillway crest 16 ± feet.

Maximum discharging capacity of spillway 90000 ± cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area _____
 _____ cubic feet per second.

Dam No. 261 JH

GEORGE E. VAN KENNEN
CHAIRMAN
JAMES W. FLEMING
JOHN D. MOORE
COMMISSIONERS
ALBERT E. HOYT
SECRETARY
JOHN J. FARRELL
ASST. SECRETARY

STATE OF NEW YORK



DIVISION OF INLAND WATERS

JOHN D. MOORE
COMMISSIONER
JAMES J. FOX
DEPUTY COMMISSIONER
RICHARD W. SHERMAN
CHIEF ENGINEER
ALEX. RICE MCKIM
INSPECTOR OF DOCKS
AND DAMS

CONSERVATION COMMISSION
ALBANY

Serial No. 93
Application filed July 14th 1913
Approved by Commission
Material Tag No.
Foundations inspected July 2^d 1913
Final inspection

APPLICATION FOR CONSTRUCTION ~~OR RECONSTRUCTION~~ OF A DAM

30 Broad St. N.Y. City
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked 3-792 and 3-814

herewith submitted, for the { construction
~~reconstruction~~ } of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

July 14th 1913
(Date)

{ Signature of
Applicant }

International Paper Company

By R. A. Deane

President

THE WESTERN UNION TELEGRAPH COMPANY

Copy

25,000 OFFICES IN AMERICA.

INCORPORATED

CABLE SERVICE TO ALL THE WORLD

THEO. N. VAIL, PRESIDENT

BELVIDERE BROOKS, GENERAL MANAGER

RECEIVER'S No.

TIME FILED

CHECK

SEND the following message subject to the terms
on back hereof, which are hereby agreed to

Lake George, N. Y., Aug. 6/13.

Hon. John D. Moore,
C/o R. H. Burpee,
Rockland, Maine.

With Perkins and Chief Engineer White have just inspected
Palmer Falls dam site and plans. Still consider proposed con-
struction and site combined as hazardous, and cannot approve
thereof. I desire to employ three outside experts to examine
and report, and request that you inspect in person with them
and myself. Will be back in Albany this evening. Please
wire instructions.

RUSH

R. W. SHERMAN.

CRESCENT BEACH PHILLBROOK STAR ROUTE ROCKLAND MAINE THE LETTER WILL
REACH ME BY SIX THIRTY FRIDAY EVENING AND I WILL TELEGRAPH YOU OFFLY
IMMEDIATELY.

JOHN D MOORE

221AM

OF WIRE AND CABLES
ALL TELEGRAPH STATIONS
TERMS HEREON.

IF ANY RULES, REGULATIONS
LAID BY THE WESTERN UNION
OR WITH THE OFFICES OF
COMPETING COMPANIES

1913

ON INLAND WATERS

Chief Engineer

THEO. N. VAIL, PRESIDENT

RECEIVED AT NEW YORK CITY, N. Y. 1913

12 J. RECOLLECT ME VIA ROCKLAND

CRESCENT BEACH MAINE AUG 6

RICHARD W. SULLMAN

CHIEF ENGINEER CONSERVATION COMMITTEE

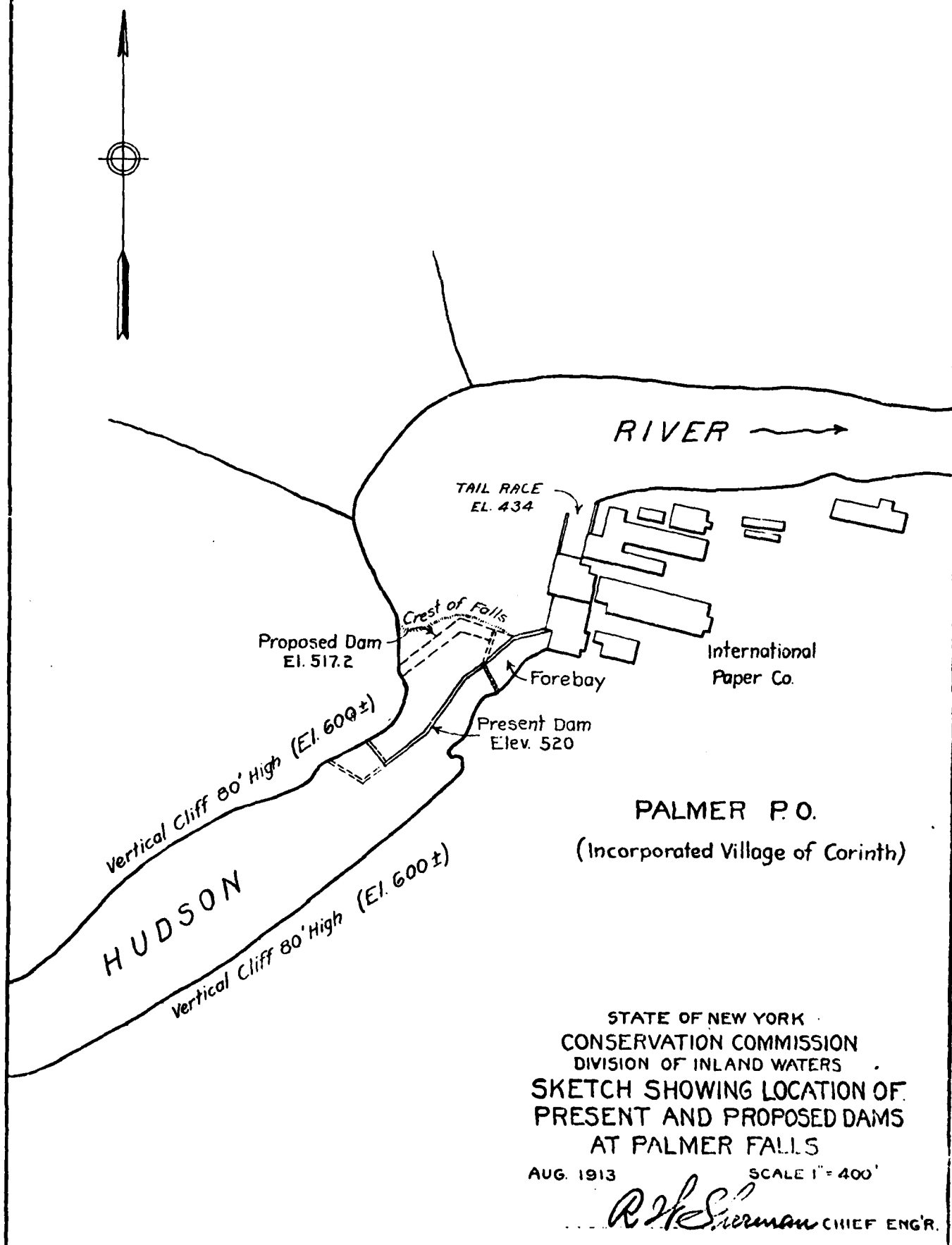
ALBANY

TELEGRAM RECEIVED SUBJECT, PALMERS FALLS AM OPPOSED TO SUGGESTED
PLAN TO BRING IN OUTSIDE ENGINEERS THE LAW MAKES APPROVAL OF PLANS BY
THE COMMITTEE AND THEREFORE RESPONSIBILITY IS PLACED DIRECTLY UPON THE COMMITTEE
AND THEREFORE RESPONSIBILITY IS PLACED DIRECTLY UPON THE COMMITTEE
ADVISORILY ADVISED TO SECURE THE OPINION OF PLANS WHICH ARE
SATISFACTORY IN EVERY RESPECT AND SEE TO IT THAT CONSTRUCTION WORK
IS INSTANTLY DISCONTINUED IF YOU WILL WRITE ME FULLY TOMORROW TO
CRESCENT BEACH PHILBROOK STAR ROUTE ROCKLAND MAINE THE LETTER WILL
REACH ME BY SIX THIRTY FRIDAY EVENING AND I WILL TELEGRAPH YOU REPLY
IMMEDIATELY.

JOHN D MOORE

221AM

File No D 5034 H
Acc 2056

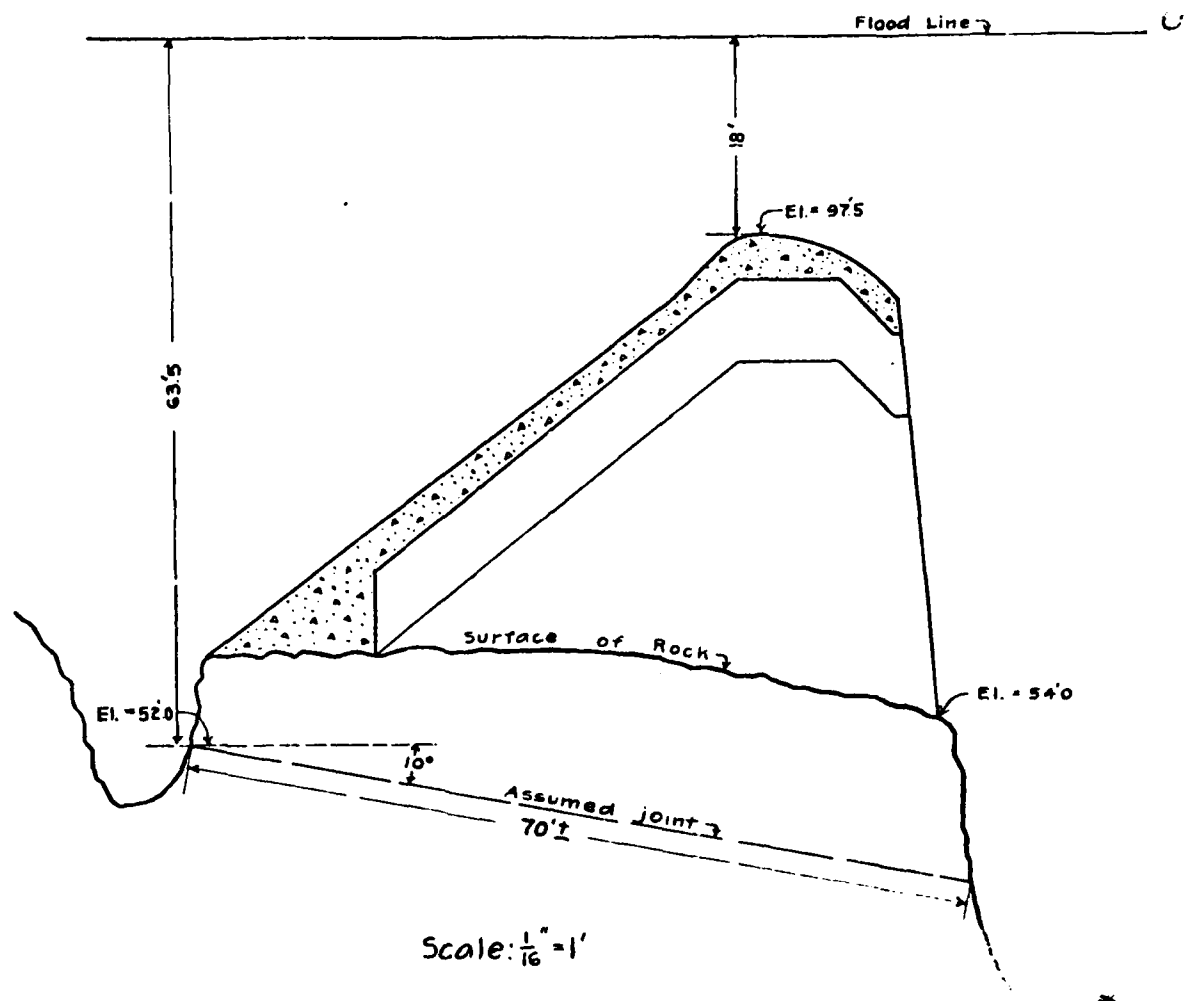


STATE OF NEW YORK
CONSERVATION COMMISSION
DIVISION OF INLAND WATERS
SKETCH SHOWING LOCATION OF
PRESENT AND PROPOSED DAMS
AT PALMER FALLS

AUG. 1913

SCALE 1" = 400'

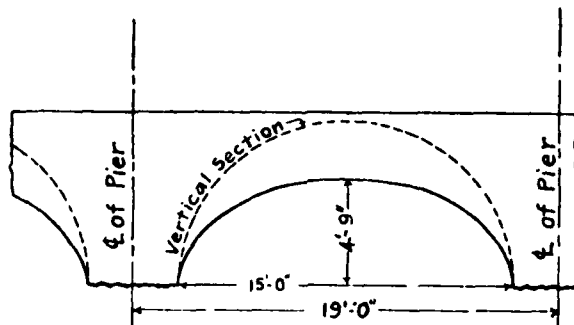
R. H. Sherman CHIEF ENGR.



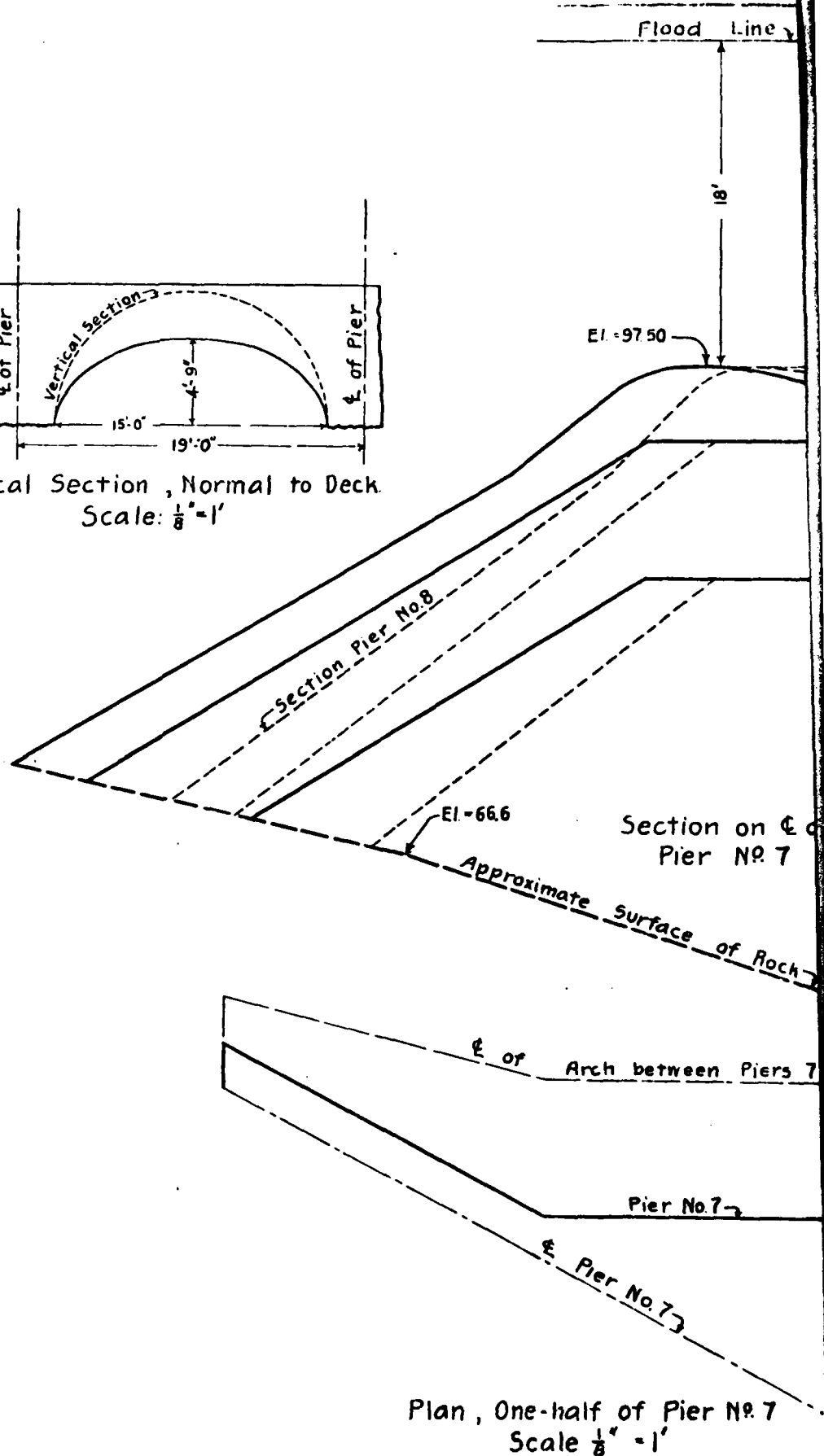
Total vertical load on assumed joint	= 4 378 000*
Upward pressure of water (assuming full static pressure at heel, decreasing uniformly to zero at toe, effective over two-thirds area of base)	= 1 760 000*
Net vertical load	= 4 830 000*
Horizontal component of water pressure	= 2 200 000*
Total pressure parallel to joint	= 3 005 000*
" " perpendicular to joint	= 4 378 000*
Coefficient of friction	= 0.69

STATE OF NEW YORK
 CONSERVATION COMMISSION
 DIVISION OF INLAND WATERS
 PALMER FALLS DAM
 SKETCH SHOWING EFFECT OF
 WATER PRESSURE IN JOINT UNDER DAM

Computed by: E. Cullings Checked by: H. P. Gallagher Aug 12, 1913.
 Acc. No. C-356 File No. D 502411



Typical Section, Normal to Deck.
Scale: $\frac{1}{8}" = 1'$



Plan, One-half of Pier No. 7
Scale: $\frac{1}{8}" = 1'$

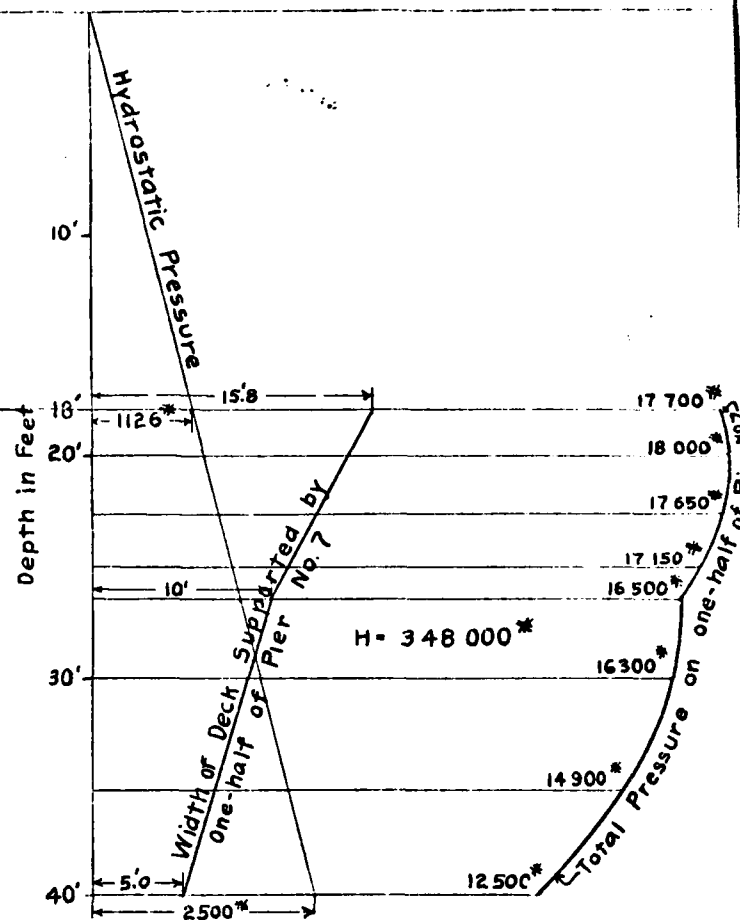
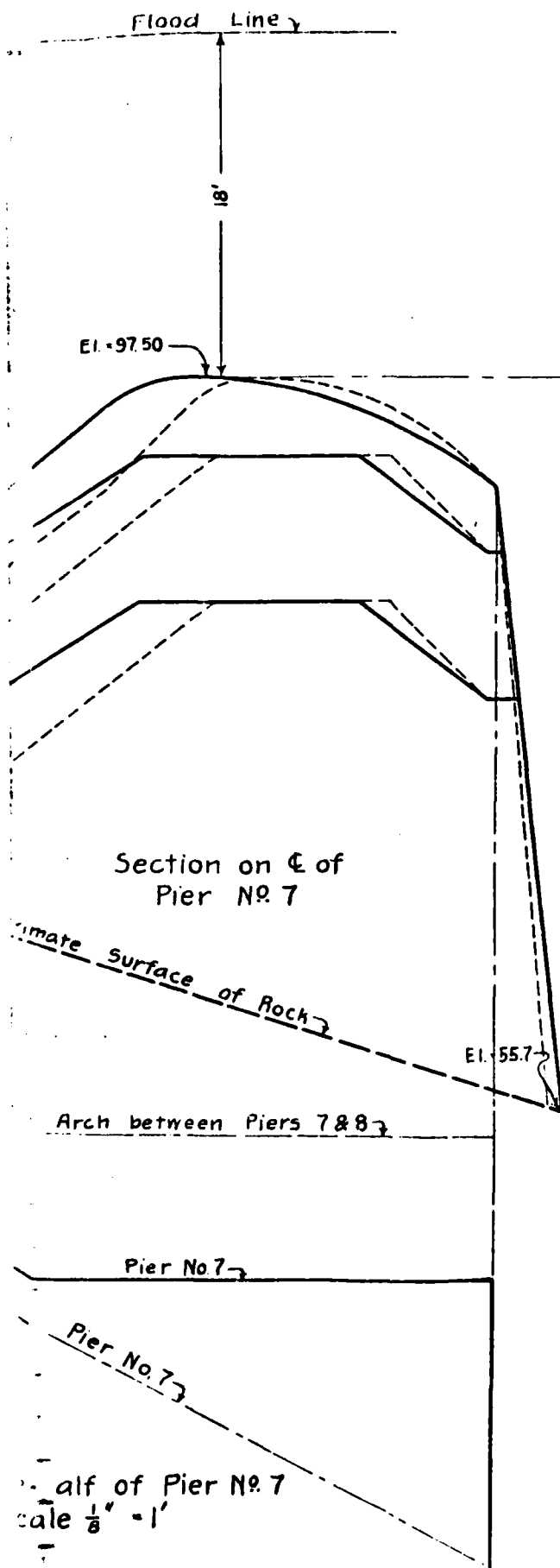


Diagram Showing Horizontal Load on One-half of Pier No. 7

STATE OF NEW YORK
 CONSERVATION COMMISSION
 DIVISION OF INLAND WATERS
 SKETCH SHOWING CONDITIONS AT PIER
 PALMER FALLS DAM

NOTE: Elevations shown are referred to I.P.C.

Computed by *E. J. Reings* Checked by *E. J. Reings*
 Acc. No. C-355 Aug. 12, 1913 File No. 1

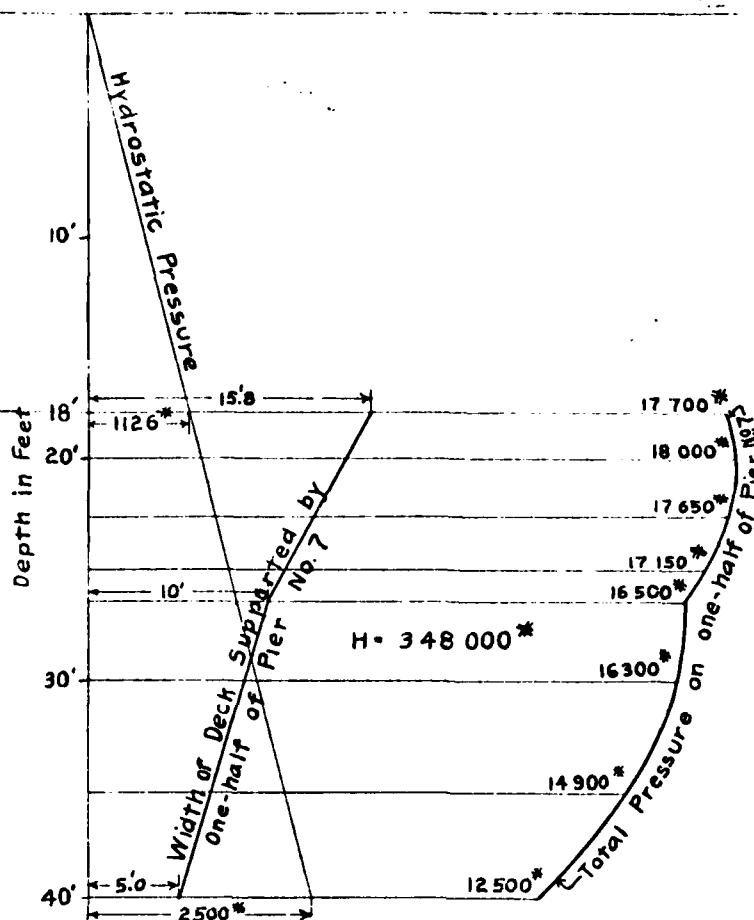


Diagram Showing Horizontal Load on One-half of Pier No. 7

STATE OF NEW YORK
 CONSERVATION COMMISSION
 DIVISION OF INLAND WATERS
 SKETCH SHOWING CONDITIONS AT PIER NO. 7
 PALMER FALLS DAM
 NOTE: Elevations shown are referred to I.P.Co's datum.

Computed by *[Signature]* Checked by *[Signature]*
 Acc No. C-355 Aug 12, 1913 File No. D 555 : H

DATE: _____

LOCATION: _____

NO. _____

James Hall's Dam.
Stability of proposed section

FILE NO. 237361

ACC. NO. 1

SHEET

COMPUTED BY R. L. Latta Aug. 1913 CHECKED BY _____ 1913

MADE IN CONNECTION WITH Jugal Aug 13, 1913

CONT'D FROM AC. 2710

Assuming dry stream bed.

W.L. Rock = $120 \times 10 \times 19 \times 105 = 3,360,000$

W.C. Dam. Water press. = $1,363,000$

$4,723,000$

Slope of dam 40 in $120 = 1$ in 3

Crops = Normal $\frac{3}{10} \times 4,723,000 = 1,416,900$ lbs.
Tang. $\frac{1}{10} \times 4,723,000 = 472,300$ lbs.

33.8%

Horiz. water pressure

Dam. = $1,650,000$ lbs.

Rock = $58 \times 62.5 \times 19 \times \frac{1}{2} \times \frac{1}{2} \times 40 = 580,000$

$2,230,000$ lbs.

Norm. $2,210,000$ lbs.

Tang. $738,000$ lbs.

$4,470,000$

$2,210,000$

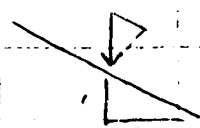
$2,260,000$

$1,495,000$

$738,000$

$2,233,000$

In which case dam will fail.



SUBJECT: Palmer's Falls Dam
Stability - 1) P. proposed section.

DESIGN 43

FILE NO. WAB 17
ACC. NO. R 971

SHEET 2

COMPUTER Op. Electr Aug 19 13 CHECKED BY 10

MADE IN CONNECTION WITH Report Aug. 13, 1913

CONT'D FROM ACC. 4973

Height concrete in 14' 3" bay

Pin $\frac{14}{65} \times 39.5 \times \frac{25}{36} \times 140 = 860 \text{ over lbs.}$

Triangular rest $15 \times \frac{1}{2} \times 15 \times \frac{2}{12} \times 140 = 255 \text{ over lbs.}$

Slab $\frac{5}{2} \times 41 \times 15 \times 140 = 215 \text{ over lbs.}$
 $18 \times 3 \times 15 \times 140 = 113 \text{ over lbs.}$
 $\frac{11}{10} \times \frac{172}{44} \times 20559110 = 156 \text{ over lbs.}$
 523 over lbs.

Nt. masonry in one pin = $\frac{523 \text{ over lbs.}}{1,363 \text{ over lbs.}} = 47 = 29 \text{ over lbs. per ft.}$

Vert. & Horiz. Water Press.

Vert. in slab. $= 14 \times 19 \times 62.5 \times \frac{1}{12} = 256 \text{ over lbs.}$

$18 \times 45 \times 62.5 \times \frac{1}{12} \times 35 \times 19 \times 62.5 = 1,310 \text{ over lbs.}$

Δ rest. $15 \times 12 = 101.1 \times 15 \times 19 \times 62.5 = 893 \text{ over lbs.}$

Hor. Slab. $1,310 \text{ over lbs.} \times \frac{11}{12} = 963 \text{ over lbs.}$

Δ rest. $893 \text{ over lbs.} \times \frac{11}{12} = 656 \text{ over lbs.}$

Vert. pressure Δ rest. $56 \times 62.5 \times \frac{7}{3} \times 15 \times \frac{1}{2} \times 15 = 262 \text{ over lbs.}$

Vert. pressure per $56 \times 62.5 \times \frac{7}{3} \times 62.5 \times \frac{1}{2} \times 15 = 75 \text{ over lbs.}$

$(15 \times 56) = 64 \times \frac{1}{2} \times 62.5 \times 34 \times 19 = 337 \text{ over lbs.}$

$\frac{256 \text{ over lbs.}}{1,310 \text{ over lbs.}}$
 893 over lbs.
 $1,363 \text{ over lbs.}$
 $3,822 \text{ over lbs.}$
 337 over lbs.
 $3,485 \text{ over lbs.}$

$\frac{963 \text{ over lbs.}}{656 \text{ over lbs.}}$
 $1,450 \text{ over lbs.}$

$\frac{3,485 \text{ over lbs.}}{1,450 \text{ over lbs.}} = 2.4$
 $P = 0.44 \text{ H. 6\%}$

$56 \times 62.5 = 35 \text{ over lbs. per 0 ft.} = 24 \text{ ft. with}$
pressure 6 ft. thickness of web 100 ft. long.

Vert. press. $= 100 \times 19 \times 56 \times 62.5 = 6,500 \text{ over lbs.}$

$- 100 \times 19 \times 62 \times 62.5 \times \frac{7}{3} = 2,060 \text{ over lbs.}$

$4,120 \text{ over lbs.}$

Rest $= 100 \times 19 \times 62 \times 101 = 1,800 \text{ over lbs.}$

Masonry $= 1,363 \text{ over lbs.}$

Total $7,353 \text{ over lbs.}$

Horiz. press.

Masonry $1,450 \text{ over lbs.}$

Rest $(56 \times 62) \times 114 \times \frac{1}{2} \times 19 \times 62.5 = 360 \text{ over lbs.}$

$1,998 \text{ over lbs.}$

24.6%

$\frac{1,450 \text{ over lbs.}}{1,450} = 1$

Area $= 62 \times 5 = 208 \text{ sq ft.}$ Shear $= 2000 \text{ lbs. per sq ft.} = 2000 \text{ lbs.} \times 20 = 40,000 \text{ lbs.}$

$40,000 \text{ lbs.}$

$40,000 \text{ lbs.}$

DATE: NEW YORK
 COMMUNICATION
 51

SUBJECT: *St. Lawrence Flood*
Computation of Sliding

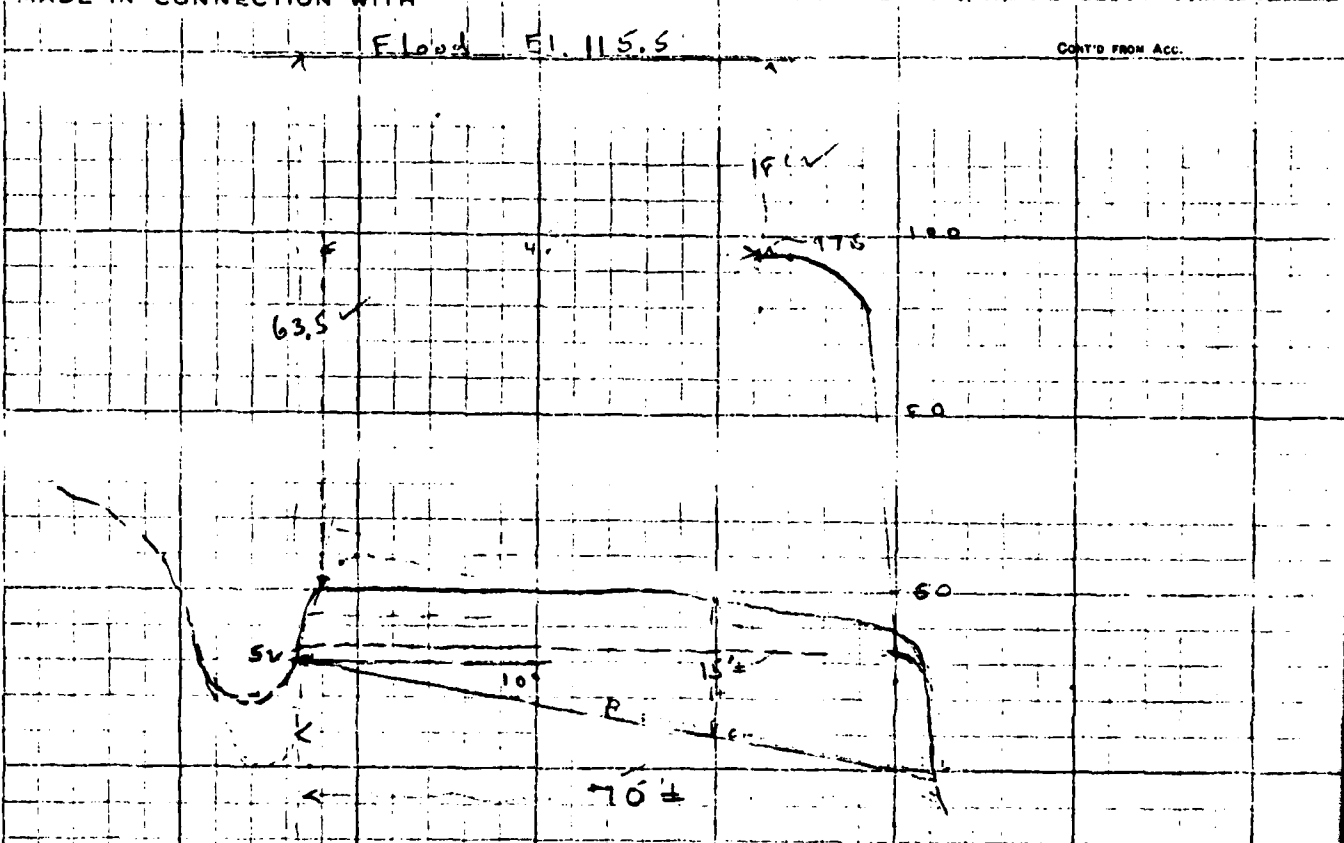
FILE NO. 43
 ACC. NO. C-12

COMPUTER: *E. E. Sullivan* Aug 11 1913 CHECKED BY: *W. H. ...* Dec 16 1913

MADE IN CONNECTION WITH

Flood 51.115.5

CONT'D FROM ACC.



Vertical load			
Water:	$V = \frac{\gamma}{2}(h+d)$	$= \frac{62.5 \times 47}{2}(17 + 34.5)$	$\times 19 = 2,070,000^*$
Masonry (c-300)	10467×145		$= 1,520,000$
Rock	$(\times 70 \times 15 - 35 \times \frac{1}{2}) \times 19 \times 170$		$= 2,000,000$
Total			$6,590,000^*$
Upward water pressure	$\gamma \times \frac{1}{3} \times \frac{1}{2} \times 70 \times 19$		$= -1,760,000$
Net Vertical Load			$4,830,000^*$
Horizontal Water Pressure			
$H = \frac{\gamma \times 45.5}{2}(17 + 63.5) \times 19$			$= 2,200,000$
	$H_{\text{resist}} = + 2,165,000^*$		
	Total H		
	$H_{\text{resist}} = - 2,200,000$		
	$V_{\text{resist}} = + 4,830,000$		
	Total V		$4,830,000$

SUBJECT Miller Falls Dam
Calculation of St. ...

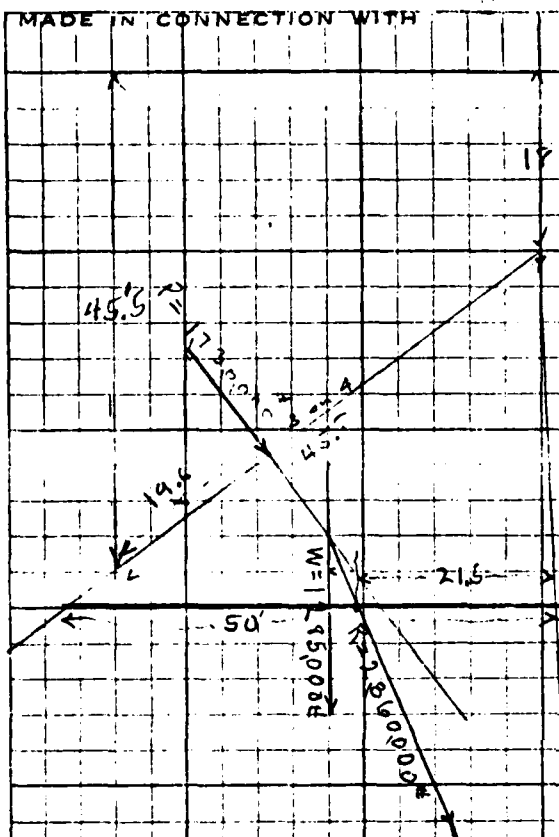
FILE NO. D-51
 ACC. NO. C-353

COMPUTER W. Collins Aug 11 1913

CHECKED BY _____

MADE IN CONNECTION WITH

CONT'D FROM ACC.



$$P = \frac{1}{2} (h+1)$$

$$= \frac{62.5 \times 45.5}{2} \left(\frac{45.5 + 19}{45.5 + 19} \right) \times 19 = 17,300.00 \checkmark$$

$$X = \frac{2}{3} \left(\frac{h+1}{h-1} \right) = \frac{45.5}{3} \left(\frac{81.5}{63.5} \right) = 19.6$$

From Plan, resultant cuts base
 21.5 from toe
 eccentricity = 3.5

$$S_t = \frac{R}{2} \left(1 + 6 \frac{e}{l} \right) = \frac{57,200}{50} \left(1 + \frac{6 \times 3.5}{50} \right) = 20,300 \text{ lb/sq. ft}$$

$$S_b = \frac{R}{2} \left(1 - 6 \frac{e}{l} \right) = 8,290 \text{ lb/sq. ft}$$

Stress at heel & toe using resultant = 2,760.00

$$S_t = \frac{1}{4} \times \frac{57,200}{50} \left(1 + 6 \times \frac{3.5}{50} \right) = 57,000 \times 1.42 = 36,500 \text{ lb/sq. ft}$$

$$S_b = \frac{1}{4} \times \frac{57,200}{50} \left(1 - 6 \times \frac{3.5}{50} \right) = 57,000 \times 0.58 = 37,300 \text{ lb/sq. ft}$$

Stress at heel & toe using resultant = 2,760.00

$$S_t = \frac{1}{4} \times \frac{57,200}{50} \left(1 + 6 \times \frac{3.5}{50} \right) = 14,300 \times 1.42 = 20,300 \text{ lb/sq. ft}$$

$$S_b = \frac{1}{4} \times \frac{57,200}{50} \left(1 - 6 \times \frac{3.5}{50} \right) = 14,300 \times 0.58 = 8,290 \text{ lb/sq. ft}$$

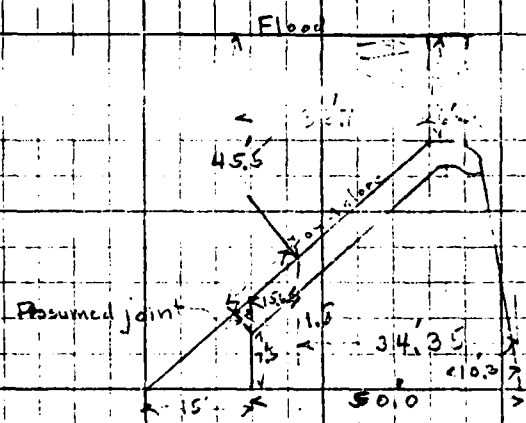
Lee Ann C-353

MADE IN CONNECTION WITH

CONT'D FROM ACC. 351

$$1. \dots 1.6 \dots 3.5 \dots 10.0 \dots 17.0 \dots$$

$$1. \dots 1.6 \dots 3.5 \dots 10.0 \dots 17.0 \dots$$



Compression on pier (assuming joint)

Vert. water pressure on deck

$$V = \frac{62.5 \times 19 \times 18 + 45.5 \times 19}{2} = 1,385,000$$

$$x = \frac{(h+2d)^2}{3(d+h)} = \frac{(45.5+36) \times 36.7}{3(19+45.5)} = 15.65$$

$$50 - 15.65 = 34.35 \text{ from toe}$$

Water pressure on crest - Assumed to exert full vert. pressure over 6 ft. hor.

$$18 \times 6 \times 19 \times 62.5 = 1,283,000$$

$$\text{Act.} - 50 - (36.7 + 3) = 10.3 \text{ ft. from toe}$$

Weight of masonry

10,467	42,704,400	Moment
1,604	12,800,000	
8,863	29,904,400	

$$29,904,400 = 23.3 \text{ ft. from toe}$$

Resultant Vertical Pressure			
Water on deck	1,385,000	x 34.35	= 47,600,000 ft-lb
Water on crest	1,283,000	x 10.3	= 13,200,000 "
Masonry	1,285,000	x 23.3	= 30,000,000 "
Total	2,798,300	28.2	78,920,000 "

$$2,798,300 \times (-1.33) = -3,732,000 \text{ ft-lb}$$

$$2,798,300 \times (1.33) = 3,732,000 \text{ ft-lb}$$

SUBJECT

FILE NO. 1

ACC. NO. C-350

SHEET

COMPUTER

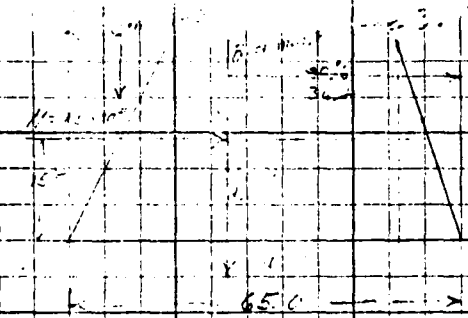
Aug 19 13

CHECKED BY

19

MADE IN CONNECTION WITH

CONT'D FROM ACC.



MADE IN CONNECTION WITH 100 = 42' 11" 1/2
To the right 1,520

$$x_0 = \frac{42' 10" \times 100}{1,520 \times 100} = 28.1' - 1' 10.72"$$

Total Mass = 139,000 + 400 = 139,400
3655

$$\text{Capacity of Mass} = \frac{139}{3.70} = 37.5 - 91.9 = 5.4$$

$$\frac{100}{3655} = 0.02732 \quad \alpha = 1^\circ 20'$$

$$100 \times \tan \alpha = 0.36 \quad \therefore C = 5.1 - 0.4 = 4.7$$

$$S_{\text{net}} (\text{kg}) = \frac{W}{g} \left(1 + \frac{C}{g} \right) = \frac{3695 \times 100}{9.8} \left(1 + \frac{4.7}{9.8} \right) = \frac{3695 \times 100}{9.8} \times 1.483 = 81,400$$

$$S_f (\text{per foot}) = \frac{81,400}{19} = 4,250"$$

Vertical Pressure on 9' width of foot 62.5 x 15 x 9 x 19 = 192,500"

$$\text{Mass} = 15 \times 12.5 = 241.25 \times 100 = 24,125$$

$$\text{Total Mass} = 139,400 + 24,125 = 163,525$$

$$\text{Capacity} = \frac{163,525}{3.70} = 44,200$$

Reviewed by C-353

SUBJECT Palmer Falls Dam

FILE NO. D-533-11

CONSTRUCTION OF Palmer Falls Dam

ACC. NO. C-345

SHEET 5

COMPUTER Offillings Aug 5 1913

CHECKED BY H. J. Allen Aug 19 13

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-344

Resulting Moment = 121,000,000 ✓
 Overturning " = 55,000,000 ✓
 Factor of Safety = 2.5 ✓

Sliding on Hor. Plane

Vertical comp. of water, $114300 \times 19 = 2,175,000$ ✓
 Wt. of Masonry $10467 \times 145 = 1,520,000$ ✓
 Total $3,695,000$ ✓
 Buoyancy $495,000$ ✓
 Net total $3,200,000$ ✓

Hor. comp. of water, $85700 \times 19 = 1,630,000$ ✓

Coefficient of Friction = 0.68 ✓
 Allowable " " = 0.34 (Factor of safety of two)

$\frac{1,630,000}{3,200,000} = 0.51$ ✓ Too high

$\frac{.68}{.51} = 1.33$ ✓ Actual Factor of Safety

Not considering buoyancy:-

$\frac{1,630,000}{3,695,000} = 0.43$ ✓ Too high

$\frac{.68}{.43} = 1.58$

Shear- At top of "heel"

$\frac{18 + 44.5 \times .245 \times 19}{4 \times 49 \times 144} = 35$ ✓ $\frac{\text{lb}}{\text{sq. in.}}$

Assuming joint in arch at top of "heel" normal to deck

$\frac{18 + 51.5 \times .335 \times 19}{4 \times 44.5 \times 144} = 54$ ✓ $\frac{\text{lb}}{\text{sq. in.}}$

SUBJECT Palmer Falls Dam
Computation of Stresses

FILE NO. 1-1111
ACC. NO. C-344

SHEET 1

COMPUTED BY D. S. Collins Aug 5 1913

CHECKED BY H. H. H. Aug 5 1913

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-343

13' section.		145' p. r. 20.7'	
Heel		$\frac{15 \times 11.25}{2} \times 19 = 1604$ <u>ft</u>	lever arm = 55.0
Deck		$\frac{11.25 + 19.0}{2} \times 19 - \frac{176.7}{2} \times 33 = 3750$ <u>ft</u>	= 33.5
Crest		$(11.5 \times 19 - 88.3) \times 90 = 1170$ <u>ft</u>	= 12.5
Apron		$(10.8 \times 19 - 88.3) \times 5.5 = 643$ <u>ft</u>	= 5.25
Pier		Sec A $33 \times \frac{26}{2} \times 4 = 1715$	= 28.0
		B $26 \times 9 \times 4 = 936$	= 12.5
		C $21 \times 25 \times 4 = 525$	= 4.77
		D $21 \times \frac{17.5}{2} \times 4 = 74$	= 1.17
		E $5 \times 5 \times 4 = 50$	= 6.33
		$\frac{10467}{2} = 5233.5$	
Resistance to Overturning			
Heel	1604	x 145 x 55.0 =	128000000
Deck	3750	x 145 x 33.5 =	182000000
Crest	1170	x 145 x 12.5 =	21250000
Apron	643	x 145 x 5.25 =	4900000
Pier - A	1715	x 145 x 28.0 =	69600000
B	936	x 145 x 12.5 =	17000000
C	525	x 145 x 4.77 =	3710000
D	74	x 145 x 1.17 =	126000
E	50	x 145 x 6.33 =	458000
Total	10467	x 145 x	427040000
Vertical Water	11430	x 145 x 44.0 =	163000000
			139004000

SUBJECT: Lower Falls Dam

FILE NO.

ACC. NO. C-343

SHEET

COMPUTED BY: J. H. ... Aug. 1, 1912

CHECKED BY: H. ... Aug. 5, 1912

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-342

Max. Flood, 10,000 cfs.

Length of spillway 376 ft.

$$Q = CLH^{3/2} \quad C = 3.75; \quad L = 376, \quad Q = 100,000$$

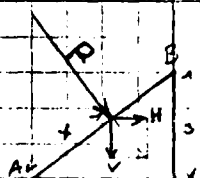
$$H = \left(\frac{100,000}{3.75 \times 376} \right)^{2/3} = (71.0)^{2/3}$$

$$\log 71.0 = 1.851258$$

$$3 \overline{) 5.702516} = 1.900838 \quad \text{L. m. 17 ft.}$$

18' flood on crest; base of e. 6.000 or 37.5 below crest.

$$P = \frac{\gamma L}{2} (h+d) = \frac{62.5 \times 12.5}{2} (73.5) = 143,000 \text{ lb/lin. ft.} \quad (\text{Acc. M-253})$$



$$H = \frac{3}{8} P = 85,800 \text{ lb per lin. ft.}$$

$$V = \frac{5}{8} P = 114,300 \text{ lb per lin. ft.}$$

Point of application of resultant, (P)

Let x = dist. along deck from heel.

$$\text{From Acc. M-253, } R_a x = R_o (L-x) = R_o L - R_o x$$

$$x(R_a + R_o) = R_o L \quad \text{or} \quad x = \frac{R_o L}{R_a + R_o} = \frac{39.5}{91.5} \times 73.5 = 31.5$$

$$x = \frac{\frac{3}{8} (h+2d)L}{\frac{5}{8} (d+2h+2d+h)} = \frac{(h+2d)L}{3(d+h)} = \frac{(55.5 + 2 \times 18) 62.5}{3(55.5 + 18)} = 25.9$$

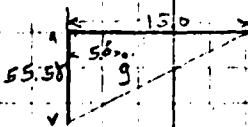
Overturning Moment, 19 ft. section.

Hor. comp. of water: -

$$85,800 \times 19 \times 15.5 = 25,300,000 \text{ ft.-lb.}$$

Uplift at heel. That heel o.o. at toe; effective over whole surface.

$$\text{Upward pressure} = \frac{55.5 \times 62.5}{2} \times 15 \times 19 = 495,000 \text{ lb}$$



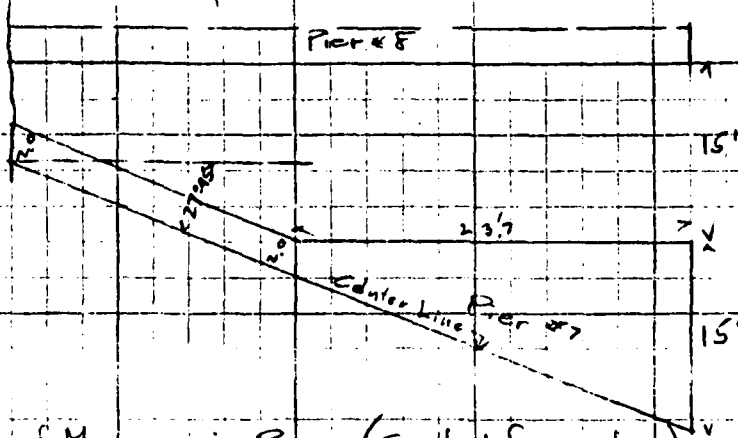
$$\text{Lever arm} = 60 \text{ ft.; moment about toe} = 60 \times 495,000 = 29,700,000$$

$$\text{Total Overturning Moment} = 55,000,000 \text{ ft.-lb.}$$

MADE IN CONNECTION WITH

CONT'D FROM ACC.

Half of pier considered



$$H = 348,000 \text{ lb}$$

Slope of deck = 3 on 4

$$\frac{H_v}{V_v} = \frac{3}{4}$$

$$V_v = \frac{4}{3} H_v$$

$$= \frac{4}{3} \times 348,000 = 464,000 \text{ lb}$$

Wt. of Masonry in Pier (Sedged from plan)

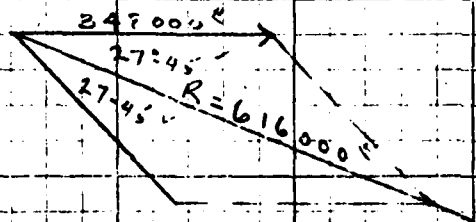
9.0 x 24.5 x 2.0	= 441.0 cu ft.
2 x 20.0 x 1.0	40.0
9.0 x 25.0 x $\frac{8}{3}$	150
2.5 x 20.0 x 7.5	375
2.5 x 9.0 x 12.5	281
2.5 x 12.0 x 18.0	540
11.0 x 36.5	390

$$7146 \times \frac{145}{150} = 1,036,000 \text{ lb}$$

$$V (\frac{1}{2} \text{ pier}) = 1,500,000 \text{ lb}$$

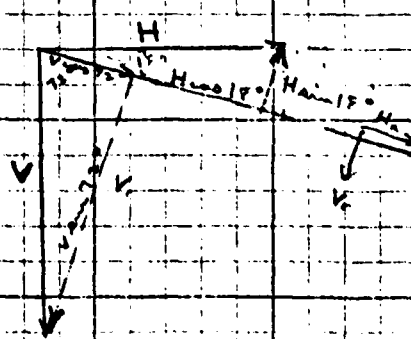
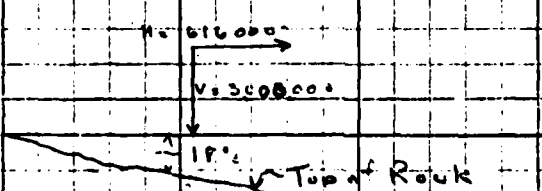
$$7146 \text{ cu ft. } (\frac{1}{2} \text{ pier})$$

Resultant H in direction of θ of pier



$$H_R = 2 \times 348,000 \times \cos 27.45^\circ = 616,000 \text{ lb}$$

$$V = 3,000,000 \text{ lb}$$



$$616,000 \times \sin 18^\circ = 190,000$$

$$3,000,000 \times \sin 72^\circ = 2,810,000$$

$$\text{Force parallel with base} = 2,660,000$$

$$616,000 \times \sin 18^\circ = 190,000$$

$$3,000,000 \times \sin 72^\circ = 2,810,000$$

$$\text{Force normal to base} = 2,660,000$$

$$\text{Coeff. of Friction} = \frac{1514}{2660} = 0.57 \text{ - Too High}$$

$$\text{Allowable Coef. of Fric.} = 0.33 \text{ (Failure prob. of 2)}$$

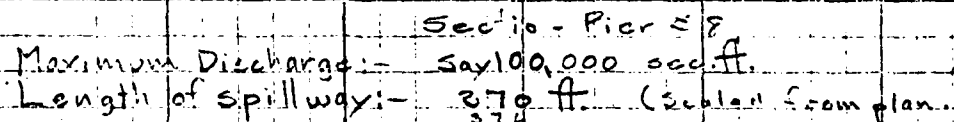
COMPUTER.....

12

CHECKED BY

.18

MADE IN CONNECTION WITH



$\text{In } 2000 = 270 \text{ feet per foot of crest.}$

$$Q = 3.33 \text{ L H}^{3/2}, \quad L = 1, \quad Q = 270$$

$$H = \left(\frac{270}{3.33} \right)^{\frac{2}{3}} = (81)^{\frac{2}{3}} \quad \text{log } 81 = 1.908485$$

Assume $H = 18 \text{ ft.}$

$$P = \frac{\pi^2}{2} (h+d) = \frac{62.5 \times 4^2}{2} (47+18) = 97500 \text{ N per lin ft (Acc. Mod)}$$

$$H: \text{Pain 2} = 97500 \times 0.600 = 58500 \times 15 = 877.000$$

$$V = P_{\text{in}} \alpha = 97500 \times 0.900 = 78000 \times 1.5 = 1,155,000 \text{ €}$$

$$\text{Along surface} = \text{Perimeter} = 0.650 \times 97500 \times 15 = 995000$$

$$\left\{ \begin{array}{l} 15 \times 12 + (4 \times 2) \times 27 + 3 \times 10 + 2 \times 6 \end{array} \right\} \times 15 + \left\{ \begin{array}{l} 9 + 2 \times 3 \end{array} \right\} \times 21 + \left\{ \begin{array}{l} 30 + 2 \times 15 \end{array} \right\} \times 4 \Big\} 150 = 956000$$

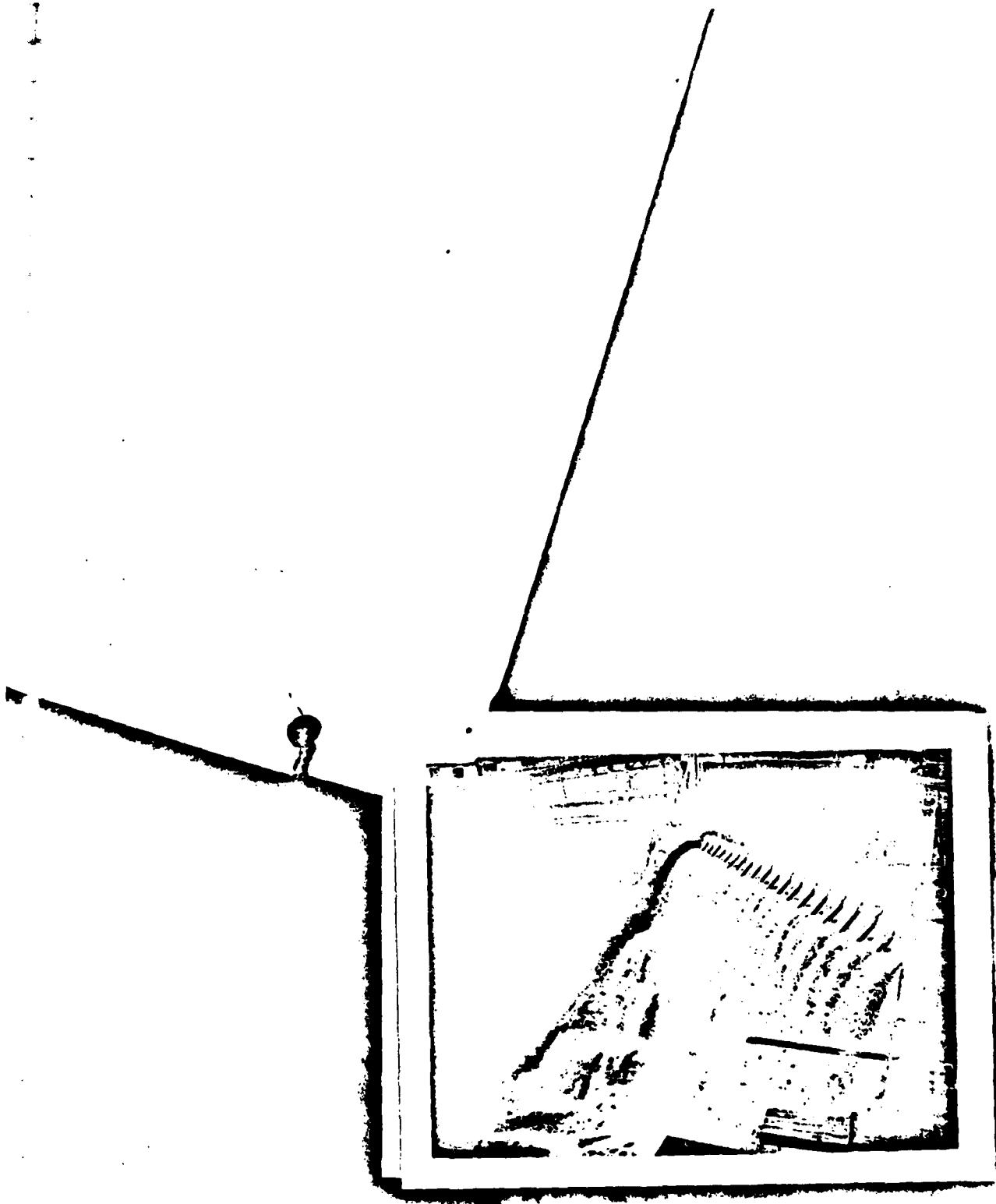
$$T \cdot \ln V = 1155,000 + 956000 = 2,111,500 \times 33 = 703,800$$

Shear = (50% σ_{yin}) Area, $37 \times 4 \times 144 \times 50 = 1,060,000 \text{ lb}$

4361 U-H.
8-26-71

0135041





☒ 2 RB
 ☒ 46 CTY
 ☐ YR AP.
 00036/ DAM NO.
 082671 INS. DATE
 039 USE
 4 TYPE

AS PERMIT INSPECTION

☒ Location of Sp'way and outlet
 ☐ Elevations
☐ Size of Sp'way and Outlet
 ☐ Geometry of Non-overflow section

GENERAL CONDITION OF NON-OVERFLOW SECTION

☐ Settlement
 ☒ Cracks
 ☒ Deflections
☒ Joints
 ☒ Surface of Concrete
 ☐ Leakage
☐ Undermining
 ☐ Settlement of Embankment
 ☐ Crest of Dam
☐ Downstream Slope
 ☐ Upstream Slope
 ☐ Toe of Slope

GENERAL COND. OF SP'WAY AND OUTLET WORKS

☐ Auxiliary Spillway
 ☒ Service or Concrete Sp'way
 ☐ Stilling Basin
☒ Joints
 ☒ Surface of Concrete
 ☐ Spillway Toe
☒ Mechanical Equipment
 ☐ Plunge Pool
 ☐ Drain

☐ Maintenance
 ☒ Hazard Class
☒ Evaluation
 ☒ Inspector

COMMENTS:

GATES # 19 & 20 LEAKING SLIGHTLY

1. River Basin - Nos. 1-23 on Compilation Sheets
2. County - Nos. 1-62 Alphabetically
3. Year Approved -
4. Inspection Date - Month, Day, Year
5. Apparent use -

1. Fish & Wildlife Management	4. Power
2. Recreation	5. Farm
3. Water Supply	6. No Apparent Use
6. Type -
 1. Earth with Aux. Service Spillway
 2. Earth with Single Conc. Spillway
 3. Earth with Single non-conc. Spillway
 4. Concrete
 5. Other
7. As-Built Inspection - Built substantially according to approved plans and specifications

Location of Spillway and Outlet Works

1. Appears to meet originally approved plans and specifications.
2. Not built according to plans and specifications and location appears to be detrimental to structure.
3. Not built according to plans and specifications but location does not appear to be detrimental to structure.

Elevations

1. Generally in accordance to approved plans and specifications as determined from visual inspection and use of hand level.
2. Not built according to plans and specifications and elevation changes appear to be detrimental to structure.
3. Not built according to plans and specifications but elevation changes do not appear to be detrimental to structure.

Size of Spillway and Outlet Works

1. Appears to meet originally approved plans and specifications as determined by field measurements using tape measure.
2. Not built according to plans and specifications and changes appear detrimental to structure.
3. Not built according to plans and specifications but changes do not appear detrimental to structure.

Geometry of Non-overflow Structures

1. Generally in accordance to originally approved plans and specifications as determined from visual inspection and use of hand level and tape measure.
2. Not built according to plans and specifications and changes appear detrimental to structure.
3. Not built according to plans and specifications but changes do not appear detrimental to structure.

General Conditions of Non-Overflow Section

1. Adequate - No apparent repairs needed or minor repairs which can be covered by periodic maintenance.
2. Inadequate - Items in need of major repair.

ITEMS For boxes listed on condition under non-overflow section.

1. Satisfactory.
2. Can be covered by periodic maintenance.
3. Unsatisfactory - Above and beyond normal maintenance.

General Condition of Spillway and Outlet Works

1. Adequate - No apparent repairs needed or minor repairs which can be covered by periodic maintenance.
2. Inadequate - Items in need of major repair.

Items) For boxes listed conditions listed under spillway and outlet works.

1. Satisfactory.
2. Can be covered by periodic maintenance.
3. Unsatisfactory - Above and beyond normal maintenance.
4. Dam does not contain this feature.

Maintenance

1. Evidence of periodic maintenance being performed.
2. No evidence of periodic maintenance.
3. No longer a dam or dam no longer in use.

(S.C.S.) Hazard Classification Downstream

1. (A) Damage to agriculture and county roads.
2. (B) Damage to private and/or public property.
3. (C) Loss of life and/or property.

Evaluation - Based on Judgment and Classification in Box Nos.

Evaluation for Unsafe Dam

1. Unsafe - Repairable.
2. Unsafe - Not Repairable.
3. Insufficient evidence to declare unsafe.

RIVER BASINS

- (1) LOWER HUDSON
- (2) UPPER HUDSON
- (3) MOHAWK
- (4) LAKE CHAMPLAIN
- (5) DELAWARE
- (6) SUSQUEHANNA
- (7) CHEMUNG
- (8) OSWEGO
- (9) GENESEE
- (10) ALLEGHENY
- (11) LAKE ERIE
- (12) WESTERN LAKE ONTARIO
- (13) CENTRAL LAKE ONTARIO
- (14) EASTERN LAKE ONTARIO
- (15) SALMON RIVER
- (16) BLACK RIVER
- (17) WEST ST. LAWRENCE
- (18) EAST ST. LAWRENCE
- (19) RACQUETTE RIVER
- (20) ST. REGIS RIVER
- (21) HOUSATONIC
- (22) LONG ISLAND
- (23) OSWEGATCHIE
- (24) GRASSE

COUNTIES

STATE NAME: NEW YORK

STATE ABBREVIATION: NY

STATE CODE: 36

CODE COUNTY NAME

1 ALBANY
2 ALLEGANY
3 BROOK
4 BROOME
5 CATTARAUGUS

6 CAYUGA
7 CHAUTAUGUA
8 CHEMUNG
9 CHENANGO
10 CLINTON

11 COLUMBIA
12 CORTLAND
13 DELAWARE
14 DUTCHESS
15 FRIE

16 ESSEX
17 FRANKLIN
18 FULTON
19 GENESEE
20 GREENE

21 HAMMILTON
22 HERKIMER
23 JEFFERSON
24 KINGS
25 LEWIS

26 LIVINGSTON
27 MADISON
28 MONROE
29 MONTGOMERY
30 NASSAU

31 NEW YORK
32 NIAGARA
33 ONEIDA
34 ONONDAGA
35 ONTARIO

36 ORANGE
37 ORLEANS
38 OSWEGO
39 OTSEGO
40 PUTNAM

41 QUEENS
42 RENSSELAER
43 RICHMOND
44 ROCKLAND
45 ST LAWRENCE

46 SARATOGA
47 SCHENECTADY
48 SCHUYLER
49 SCHUTLER
50 SENECA

51 STEUBEN
52 SUFFOLK
53 SULLIVAN
54 TIOGA
55 TOMPKINS

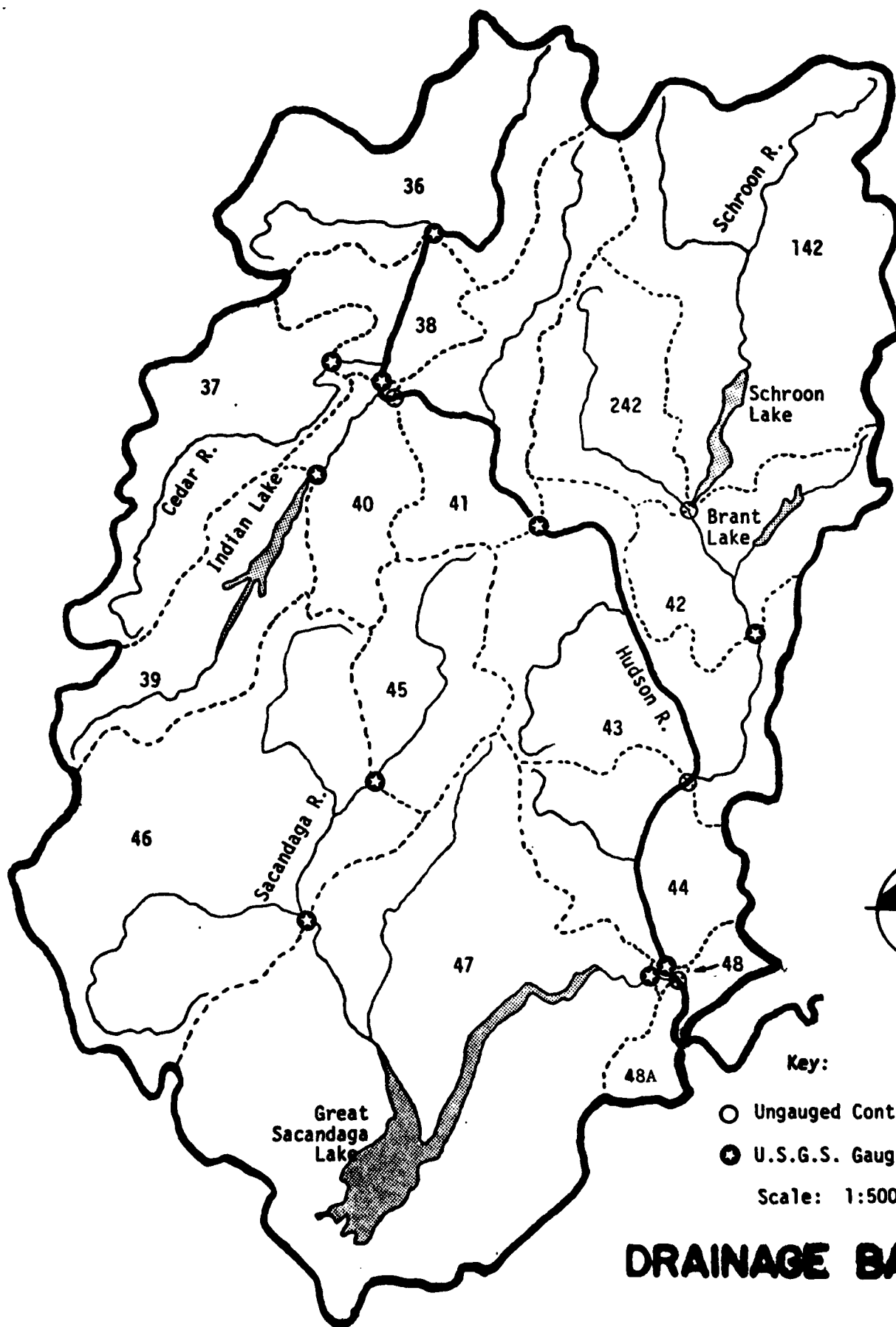
56 ULSTER
57 WARREN
58 WASHINGTON
59 WAYNE
60 WESTCHESTER

61 WYOMING
62 YATES

CLASSIFICATION
CORPS. ENG
(II)
(I)
(I)

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



Key:

- Ungauged Control Point
- ⊙ U.S.G.S. Gauge

Scale: 1:500,000

DRAINAGE BASIN



STETSON • DALE

BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501
TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME New York State Dam Inspection DATE 5.20.80
SUBJECT Upper Hudson - Falmer Falls PROJECT NO. 2399
DRAWN BY JPG

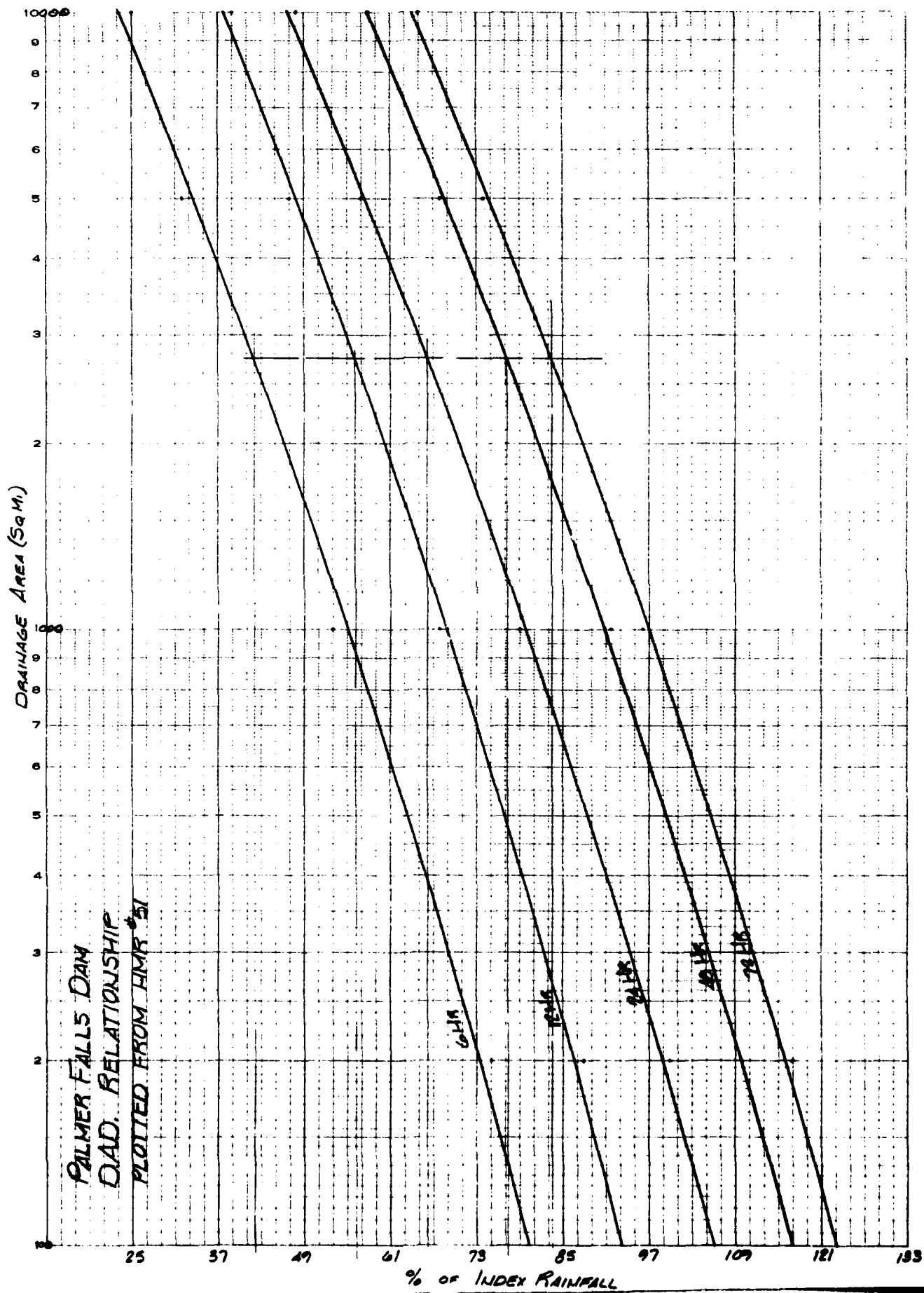
FROM HMR #51

Area	Duration	DEPTH	% INDEX
200 mi ²	6 hr	15.5"	75
	12	18.2	88
	24	20.6	100
	48	22.7	110
	72	24.2	117
1000 mi ²	6	10.9	53
	12	14.0	68
	24	16.2	79
	48	19.0	92
	72	19.8	96
5000 mi ²	6	6.6	32
	12	9.7	47
	24	11.8	57
	48	14.0	68
	72	15.3	74
10,000 mi ²	6	5.1	25
	12	8.0	39
	24	9.9	48
	48	12.0	58
	72	13.3	65

PMF
INDEX RAINFALL

DRAINAGE AREA 2750 SQ MI

PMF RATIO	% INDEX	DEPTH
DURATION		
6 HR	42	8.7
12 HR	56	11.5
24 HR	66	13.6
48 HR	77	15.9
72 HR	84	17.2





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UTICA • NEW YORK • 13501
TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME 1980 N.Y.S. Dam Inspections DATE _____
 SUBJECT Palmer Falls PROJECT NO. _____
 DRAWN BY _____

Sub-Area 48A

Hydrograph Parameters based on "Upper
 Hudson & Mohawk River Basins Hydrologic
 Flood Routing Models" - Corps of Engineers

$$(T_c + R) = 7.52 A^{0.215} * St^{0.425} \quad \text{Eqn. 5.3a}$$

$$R = 3.30 A^{0.155} * St^{0.775} \quad \text{Eqn. 5.3b}$$

Good for $15 \leq A \leq 1000 \text{ mi}^2$
 $1.05 \leq St \leq 4.10$

A = drainage area, mi^2

St = Surface area of lakes and reservoirs as
 percent of total drainage area, % + 1.0

T_c, R = Clark Unit hydrograph parameters, hrs.

$$A = 35.2 \text{ mi}^2$$

$$St = 1.45$$

$$R = 3.3 (35.2)^{0.155} * (1.45)^{0.775} = 7.64$$

$$(T_c + R) = 7.52 (35.2)^{0.215} * (1.45)^{0.425} = 18.94$$

$$T_c = 11.3$$

Initial Flow, $STRTQ$ = 45 cfs for $A = 35 \text{ mi}^2$ Fig. 5.1

Peak Flow, $QRCSN$ = 350 cfs for $A = 35$ Fig. 5.3

**STETSON • DALE**BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501
TEL 315-797-5800**DESIGN BRIEF**

PROJECT NAME _____

DATE _____

SUBJECT _____

Palmer Falls

PROJECT NO. _____

Spillway Stage-Discharge Curve

DRAWN BY _____

$$Q = CLH^{3/2}$$

C From King & Brater - "Handbook of Hydraulics" for
a similar section

Total Length of 2 sections = 205 + 141' = 346'

Elev.	H	C	Q (cfs)
517.17	0	—	0
518	0.83	3.1	811
519	1.83	3.2	2740
520	2.83	3.25	5354
521	3.83	3.3	8560
522	4.83	3.3	12120
523	5.83	3.3	16070
524	6.83	3.3	20380
525	7.83	3.3	25015
526	8.83	3.3	29960
528	10.83	3.35	41310
530	12.83	3.4	54060
532	14.83	3.45	68170
534	16.83	3.5	83610
536	18.83	3.55	100,360
538	20.83	3.6	118,420
543	25.83	3.65	165,800
548	30.83	3.65	216,200
553	35.83	3.65	270,850
558	40.83	3.65	329,500

**STETSON • DALE**BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501
TEL 315-797-5800**DESIGN BRIEF**

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 5.12.80
SUBJECT PALMER FALLS DAM PROJECT NO. 2399
STAGE STORAGE DRAWN BY JAG

IMPOUNDMENT APPROX 350' WIDTH X 2750' LENGTH

CHAN SLOPE = 2% , SIDE SLOPES = 1:1.5

STAGE	AREA	VOL	Σ VOL
480.0	0	.696	.696
482.0	303x100	2.101	2.796
484.0	304x200	3.533	6.329
486.0	305x300	4.993	11.322
488.0	312x400	6.481	17.803
490.0	315x500	7.996	25.799
492.0	318x600	9.539	35.338
494.0	321x700	11.109	46.447
496.0	324x800	12.807	59.254
498.0	327x900	14.532	73.786
500.0	330x1000	15.983	89.771
502.0	333x1100	17.643	107.414
504.0	336x1200	19.373	126.787
506.0	339x1300	21.109	147.896
508.0	342x1400	22.872	170.768
510.0	345x1500	24.643	195.411
512.0	348x1600	26.500	221.911
514.0	351x1700	28.326	250.237
516.0	354x1800	29.243	279.480
CREST 517.0	355.5x1850	30.200	309.680
518.0	357x1900	32.101	341.781
520.0	360x2000	34.029	375.810
522.0	363x2100	35.985	411.795
524.0	366x2200	37.968	449.763
526.0	369x2300	39.979	489.742
528.0	372x2400	42.018	521.760
530.0	375x2500		
540	390x2750	230.7	752.2
560	420x2750	511.4	1263.6

**STETSON • DALE**BANKERS TRUST BUILDING
UTICA • NEW YORK • 13501

TEL 315-797-5800

DESIGN BRIEFPROJECT NAME N.Y.S. Dam Inspections - 1980

DATE _____

SUBJECT Palmer Falls

PROJECT NO. _____

Discharge Rating - Upper Forebay Outlets

DRAWN BY _____

Assumptions: No flow through plant and
sufficient number of gates open into upper
forebay to fully utilize outflow capacity of
2 outflow gates

2 gates openings 12'x12'
Invert @ elev. 506.67
Top of Spillway @ 512.17
Top of Flashboards @ ~ 521

Flows from Fig. B-12 "Design of Small Dams"

<u>Elev.</u>	<u>H</u>	<u>Q</u>
512.17	10.5'	1045 cfs ; 2090 for 2 openings
521	14.33'	1630 cfs ; 3260 for 2

PALMER FALLS DAM

		PALMER FALLS DAM									
		PMF OVERTOPPING ANALYSIS									
		MODEL DERIVED FROM UPPER HUDSON C OF E MODEL									
		1	2	3	4	5	6	7	8	9	10
(0001)	A1	150	0.2	0.3	0.4	0.5	0.6	0.8	1.0		
(0002)	A2										
(0003)	A3										
(0004)	B										
(0005)	B1										
(0006)	J										
(0007)	J1										
(0008)	K										
(0009)	M										
(0010)	P										
(0011)	T										
(0012)	V										
(0013)	X										
(0014)	K										
(0015)	Y										
(0016)	Y1										
(0017)	K										
(0018)	F										
(0019)	F										
(0020)	T										
(0021)	V										
(0022)	X										
(0023)	K										
(0024)	M										
(0025)	F										
(0026)	T										
(0027)	V										
(0028)	X										
(0029)	K										
(0030)	Y										
(0031)	Y1										
(0032)	K										
(0033)	K										
(0034)	M										
(0035)	F										
(0036)	T										
(0037)	V										
(0038)	X										

CC39	K1	1	39	C	C	C	C	1
(0040)	K1	ROUTE THRU INDIAN LAKE						
(0041)	V1	C	C	1				
(0042)	V1	C	C	C				
(0043)	Y2	Q. 36210.	5268C.	10656C.	11435C.	118250.	123060.	128100. 138460.
(0044)	Y3	C.	C.	C.	70C.	1440.	2340.	3370. 4525. 5785.
(0045)	K1	394C						
(0046)	V1	C	C	1.0C	.3			
(0047)	V1	C	C	1.0C	.3			
(0048)	K1	C	C					
(0049)	M1	C	22	C	274C			
(0050)	M1	C	20.6	56	C			
(0051)	T1	C	C	C	C			
(0052)	V1	15.27	17.66					
(0053)	X1	110	400	1.3				
(0054)	K1	3	4C					
(0055)	K1	1	4041	C	C			
(0056)	K1	ROUTE TO 1041						
(0057)	V1	C						
(0058)	V1	2	C	0	2.12	.2		
(0059)	K1	C	41					
(0060)	M1	C	C	165	C	274C		
(0061)	P1	C	20.6	42	56	66		
(0062)	T1	C	C	C	C	C		
(0063)	V1	18.04	13.0C					
(0064)	X1	25C	230C	1.5				
(0065)	K1	2	41					
(0066)	K1	1	4143	C	0	C	C	1
(0067)	K1	ROUTE TO CONFLUENCE WITH SCROON RIVER						
(0068)	V1	C	C	C	2.08	.2		
(0069)	K1	C	142					
(0070)	K1	C	C					
(0071)	M1	C	C	313	C	274C		
(0072)	F1	C	20.6	42	56	66		
(0073)	T1	C	C	C	C	C		
(0074)	V1	22.15	17.72					
(0075)	X1	60C	430C	1.3				
(0076)	K1	1	144	C	C	C		

PALMER FALLS DAM

A1

		ROUTE THRU SCHROON LAKE			
(0077)	K1				
(0078)	V	C			
(0079)	V1	1	55.		
(0080)	K	1	242		
(0081)	M	1	49	2740	
(0082)	F	0	42	56	24
(0083)	T	0	20.6	C	2.0
(0084)	V	15.56	11.43		C.075
(0085)	X	152	1100	1.3	
(0086)	K	2	142		
(0087)	K	1	14242		
(0088)	V	0			
(0089)	V1	3	C	1.51	.1
(0090)	K	0	42		
(0091)	M	1	C	115	2740
(0092)	P	0	20.6	42	56
(0093)	T	0	C	C	84
(0094)	V	15.13	8.99		2.0
(0095)	X	163	1350	1.3	C.075
(0096)	K	1	44		
(0097)	V	0			
(0098)	V1	1	C	C	
(0099)	K	2	42	45.	
(0100)	K	1	4243		
(0101)	V	0			
(0102)	V1	5	C	1.63	.3
(0103)	K	7	43		
(0104)	M	1	C	227	C
(0105)	F	0	20.6	56	2740
(0106)	T	0	C	C	66
(0107)	V	18.54	11.07		C
(0108)	X	4.0	3100		
(0109)	K	3	43		
(0110)	K	1	4344	C	0
(0111)	K1	ROUTE TC 1.44			1
(0112)	V	0			
(0113)	V1	6	C	1.59	.2
(0114)	K	C	44		

FALMER FALLS DAM

A1

(0115)	M	1	0	118	0	2740	0	84	
(0116)	F	0	20.8	42	56	66	77	1.0	0.075
(0117)	T	0	0	0	0	0	0		
(0118)	V	15.25	9.86						
(0119)	X	105	1500	1.3					
(0120)	K	2	44	0	0	0	0	1	
(0121)	K1	COMPLETE 2 HYDROGRAPHS AT FALLEY, NY							
(0122)	K	0	45						
(0123)	K	1	0	114	0	2740	77	1.0	0.075
(0124)	F	0	20.8	42	56	66			
(0125)	T	0	0	0	0	0			
(0126)	V	10.1	11.77						
(0127)	X	100	1350	1.3					
(0128)	K	1	456						
(0129)	K1	ROUTE TO 146							
(0130)	V	0	0	1.29	0	0			
(0131)	V1	2	0						
(0132)	K	0	46						
(0133)	F	1	0	377	0	2740	77	1.0	0.075
(0134)	F	0	20.8	42	56	66			
(0135)	T	0	0	0	0	0			
(0136)	V	24.41	26.10						
(0137)	X	745	5300	1.3					
(0138)	K	2	45						
(0139)	K	1	4647	0	0	0	0	1	
(0140)	K1	ROUTE TO 1147							
(0141)	V	0	0						
(0142)	V1	2	0	0	1.47	0			
(0143)	K	0	47						
(0144)	K	1	0	564	0	2740	77	1.0	0.075
(0145)	F	0	20.8	42	56	66			
(0146)	T	0	0	0	0	0			
(0147)	V	24.15	14.73						
(0148)	X	120	7600	1.3					
(0149)	K	2	47						
(0150)	K	1	47						
(0151)	K1	ROUTE TO 1047 THRU GREAT SECONDARY LK.							
(0152)	V	0	0						

FA02 0005

(0153)	Y1	1	7	0730	133700	705011	814270	11971	765302																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</
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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	36
ROUTE HYDROGRAPH TO	3638
RUNOFF HYDROGRAPH AT	38
RUNOFF HYDROGRAPH AT	37
ROUTE HYDROGRAPH TO	3738
COMBINE 3 HYDROGRAPHS AT	38
RUNOFF HYDROGRAPH AT	39
ROUTE HYDROGRAPH TO	3940
RUNOFF HYDROGRAPH AT	40
COMBINE 3 HYDROGRAPHS AT	40
ROUTE HYDROGRAPH TO	4041
RUNOFF HYDROGRAPH AT	41
COMBINE 2 HYDROGRAPHS AT	41
ROUTE HYDROGRAPH TO	4143
RUNOFF HYDROGRAPH AT	142
ROUTE HYDROGRAPH TO	142
RUNOFF HYDROGRAPH AT	242
COMBINE 2 HYDROGRAPHS AT	142
ROUTE HYDROGRAPH TO	14242
RUNOFF HYDROGRAPH AT	42
ROUTE HYDROGRAPH TO	42
COMBINE 2 HYDROGRAPHS AT	42
ROUTE HYDROGRAPH TO	4243
RUNOFF HYDROGRAPH AT	43
COMBINE 3 HYDROGRAPHS AT	43
ROUTE HYDROGRAPH TO	4344
RUNOFF HYDROGRAPH AT	44
COMBINE 2 HYDROGRAPHS AT	44
RUNOFF HYDROGRAPH AT	45
ROUTE HYDROGRAPH TO	4546
RUNOFF HYDROGRAPH AT	46
COMBINE 2 HYDROGRAPHS AT	46
ROUTE HYDROGRAPH TO	4647
RUNOFF HYDROGRAPH AT	47
COMBINE 2 HYDROGRAPHS AT	47
ROUTE HYDROGRAPH TO	47
RUNOFF HYDROGRAPH AT	48
COMBINE 3 HYDROGRAPHS AT	48
ROUTE HYDROGRAPH TO	48257
RUNOFF HYDROGRAPH AT	257.5
COMBINE 2 HYDROGRAPHS AT	257.5
ROUTE HYDROGRAPH TO	1257.5
END OF NETWORK	

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE?TUE, MAY 27 1980
 TIME?15:43:40

PALMER FALLS DAM
 PMF OVERTCIPPING ANALYSIS
 MODEL DERIVED FROM UPPER HUDSON C OF E MODEL

JOB SPECIFICATION									
NO	NHR	NMIN	IDAY	IHR	IPIN	METRC	JPLT	JFRT	NSTAN
150	1	0	0	0	0	0	0	4	0
		JCFER	NWT	LROPT	TRACE				
		5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 RTIO= 7 LRTO= 1

RTIO= 0.20 0.30 0.40 0.50 0.60 0.80 1.00

SUB-AREA RUNOFF COMPLETION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JFRT	INAME	ISTAGE	IAUTO
36	0	0	0	0	0	0	0	0

HYDROGRAPH DATA									
INVDG	IUNG	TAREA	SMAF	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	192.00	0.00	2740.00	0.00	0.000	0	0	0

PRECIP DATA									
SPFE	PMS	R6	R12	R24	R48	R72	R96		
0.00	20.60	42.00	56.00	66.00	77.00	84.00	0.00		

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA										
LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STATL	CNSTL	ALSMX	RTIOP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.07	0.00	0.00

UNIT HYDROGRAPH DATA
 TC= 20.13 R= 22.01 NTA= C

RECESSION DATA
 STRIO= 340.00 ORCSN= 2550.00 RTIOR= 1.30

UNIT HYDROGRAPH END-OF-PERIOD ORDINATES, LAG= 14.94 HOURS, CP= 0.55 VOL= 0.58

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	PC.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP C
43.	163.	336.	544.	778.	1032.	1302.	1586.	1881.	2185.				
2487.	2767.	3012.	3223.	3399.	3541.	3645.	3711.	3733.	3699.				
3506.	3429.	3277.	3131.	2992.	2859.	2732.	2611.	2495.	2384.				
2272.	2177.	2080.	1988.	1859.	1815.	1734.	1657.	1544.	1513.				
1440.	1382.	1320.	1262.	1206.	1152.	1101.	1052.	1005.	961.				
918.	877.	836.	801.	765.	731.	699.	668.	638.	610.				
583.	557.	532.	509.	486.	464.	444.	424.	405.	387.				
373.	354.	338.	323.	308.	295.	282.	269.	257.	246.				
235.	224.	214.	205.	196.	187.	179.	171.	163.	156.				
145.	142.	136.	130.	124.	119.	114.	108.	104.	99.				

MO.DA HR.MN PERIOD RAIN EXCS LOSS
 SUM 16.02 11.85 4.18 1474420.
 (407.)(301.)(106.)(41750.88)

HYDROGRAPH ROUTING
 IECON ITAPE JPLT JFRT INAME ISTAGE IAUTO
 0 0 0 0 0 0
 ROUTING DATA
 IRES ISAME IOPT IFMP LSTR
 0 0 0 0 0
 LAG AMSKK X TSK STORA ISFRAT
 0 1.310 0.300 0.000 0

SUE-AREA RUNOFF COMPUTATION
 ISTAQ ICCPP IECON ITAPE JPLT JFRT INAME ISTAGE IAUTO
 38 0 0 0 0 0 0 0
 HYDROGRAPH DATA
 INYDG IUNG TAREA SNAF TRSDA TRSPC RATIO ISNOW ISAME LOCAL
 1 0 67.00 0.00 2740.00 0.00 0.00 0 0 0

PRECIP DATA
 SPFE PMS R6 R12 R24 R48 R72 R96
 0.00 20.60 42.00 56.00 66.00 77.00 84.00 0.00

LOSS DATA
 LROPT STRKR DLTGR RTIOL ERRAIN STRKS RTIOK STRTL CNSTL ALSMX RTIFF
 0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 0.07 0.00 0.00

UNIT HYDROGRAPH DATA

TRSPC COMPUTED BY THE PROGRAM IS 0.926

IL= 14.00 N= 10.00 NIA= L

RECESSION DATA
STRIG= 55.00 QRCSN= 700.00 RTIOR= 1.30

UNIT	HYDROGRAPH	91	END-OF-PERIOD	ORDINATES	LAG=	13.72	HOURS	CP=	0.56	VOL=	1.00
33.	126.	250.	415.	569.	776.	973.	1174.	1317.	1517.	1717.	1917.
1642.	1735.	1794.	1816.	1785.	1698.	1592.	1493.	1312.	1132.	952.	772.
1231.	1154.	1082.	1014.	951.	892.	836.	784.	735.	689.	643.	597.
646.	606.	568.	533.	499.	468.	439.	412.	386.	362.	338.	314.
339.	318.	298.	280.	262.	246.	231.	216.	203.	190.	177.	164.
178.	167.	157.	147.	138.	129.	121.	114.	106.	98.	90.	82.
94.	88.	82.	77.	72.	68.	64.	60.	56.	52.	48.	44.
49.	46.	43.	40.	38.	36.	33.	31.	29.	28.	26.	24.
26.	24.	23.	21.	20.	19.	18.	16.	15.	14.	13.	12.

MO.DA HR.MN PERIOD RAIN EXCS LOSS CUM Q MO.DA HR.MN PERIOD RAIN EXCS LOSS CUM Q
0 16.02 11.05 4.18 522339.
SUM (407.) (311.) (106.) (14796.64)

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAFE	JPLT	JFRT	INAP	ISTAGE	IAUTO
37	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IMYD	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	160.00	0.00	2740.00	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.60	42.00	56.00	66.00	77.00	84.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA

LROPT	STKR	DLTKR	RTIOL	ERAIN	STKRS	RTIOK	STRTL	CNSTL	ALSPX	RTIIF
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.07	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 19.11 R= 21.23 NTA= C

RECESSION DATA

STRIG= 270.00 QRCSN= 2100.00 RTIOR= 1.30

UNIT	HYDROGRAPH	100	END-OF-PERIOD	ORDINATES	LAG=	18.04	HOURS	CP=	0.55	VOL=	0.55
40.	152.	314.	507.	724.	960.	1211.	1474.	1747.	2026.	2306.	2586.
2244.	2532.	2736.	2906.	3047.	3150.	3217.	3242.	3215.	3114.	2926.	2736.

2972.	2835.	2705.	2500.	2462.	2340.	2240.	2137.	2034.	1945.
1856.	1770.	1689.	1611.	1537.	1466.	1399.	1334.	1273.	1214.
1158.	1105.	1034.	1006.	959.	915.	873.	833.	795.	758.
723.	690.	658.	628.	599.	571.	545.	520.	496.	473.
452.	431.	411.	392.	374.	357.	340.	325.	310.	295.
262.	269.	257.	245.	233.	223.	212.	203.	193.	184.
176.	168.	160.	153.	146.	139.	133.	127.	121.	115.
110.	105.	100.	95.	91.	87.	83.	79.	75.	72.

MO.DA HR.MN PERIOD RAIN EXCS LCSS END-OF-PERIOD FLOW MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP 6

SUM 16.02 11.85 4.18 1231513.

(407.) (301.) (106.) (34883.86)

HYDROGRAPH ROUTING

IECON 0 ITAPE 0 JFLT 0 JPRT 0 INAME 0 ISTAGE 0 IAUTO 0

ROUTING DATA

IFMP 0 LSTR 0

IFMP 0

TSK STORA ISPRAT 0

LAG AMSKK X 0.500 0.500 0.500

LAG AMSKK 0 1.000 0.500

COMBINE HYDROGRAPHS

IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 0 ISTAGE 0 IAUTO 0

SUB-AREA RUNOFF COMPUTATION

IECON 0 ITAPE 0 JFLT 0 JPRT 0 INAME 0 ISTAGE 0 IAUTO 0

HYDROGRAPH DATA

SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL

0.00 2740.00 0.00 C.00C

PRECIP DATA

R12 R24 R48 R72 R96

56.00 66.00 77.00 84.00 C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

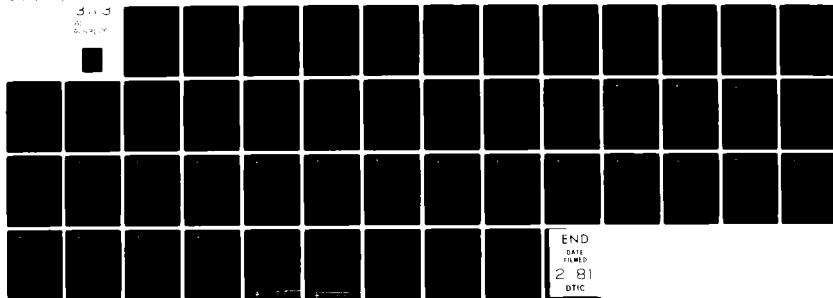
LOSS DATA

AD-A093 025

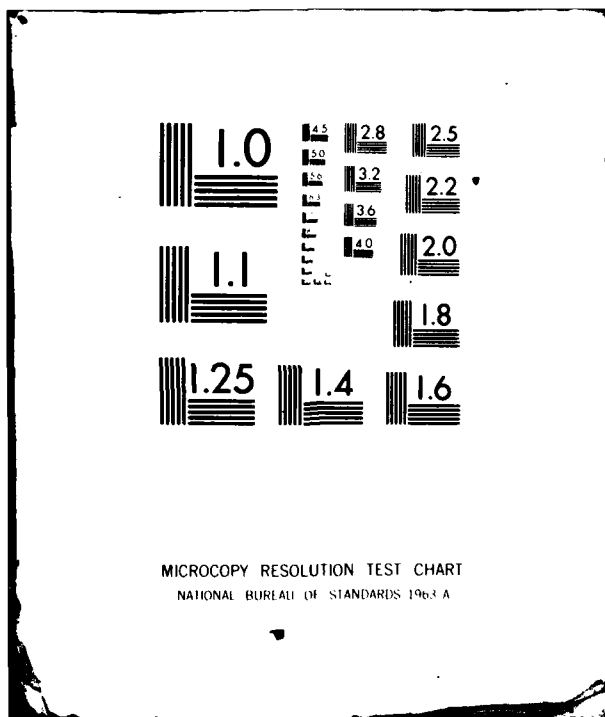
NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/6 13/13
NATIONAL DAM SAFETY PROGRAM, PALMER FALLS DAM, UPPER HUDSON RIV--ETC(U)
AUG 80 J B STETSON
NY-145 DACW51-79-C-0001
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END
DATE
FILMED
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DTIC



LROPT STRKR DLTKR RTIOL ERRAIN STRKS RTIOL STRTL CNSTL ALSPX RTIMP
C 0.00 0.00 1.00 0.00 0.00 0.00 1.00 0.07 0.00 0.00

UNIT HYDROGRAPH DATA
TC= 16.09 R= 10.13 NTA= C

RECESSION DATA
STRTQ= 240.00 QRCN= 1750.00 RTIOR= 1.30

UNIT HYDROGRAPH 63 END-OF-PERIOD ORIGINATES, LAG= 14.02 HOURS, CP= C.71 VOL= 1.1C
328. 665. 1056. 1482. 1530. 2393. 2864. 3317. 3705.
4006. 4222. 4356. 4407. 4221. 3923. 3557. 3222. 2919.
2644. 2170. 1966. 1781. 1614. 1462. 1324. 1200. 1087.
985. 892. 808. 732. 663. 601. 544. 493. 447.
367. 332. 301. 273. 247. 224. 203. 184. 166.
136. 124. 112. 101. 92. 83. 75. 62. 56.
51. 46. 42.

MO.DA HR.MN PERIOD RAIN EXCS LOSS END-OF-PERIOD FLOW PO.DA HR.MN PERIOD RAIN EXCS LOSS COMP C
SUM 16.02 11.85 4.18 1051720.
(407.)(301.)(106.)(29781.37)

HYDROGRAPH ROUTING

ROUTE THRU INDIAN LAKE

ISTAQ ICCPP 1
39 0 0 0 0 0 0 0 0
ROUTING DATA
QLOSS CLOSS AVG IRES ISAME IOFT IFMP LSTR
0.0 0.000 0.00 1 0 0 0 0 0
NSTPS NSTOL LAG ANSKK X TSK STORA ISFRAT
1 0 0 0.000 0.000 0.000 10656C. 0

STORAGE 0.00 36210.00 92880.00 106560.00 11435C.00 118250.00 12306C.00 128100.00 134100.00
OUTFLOW C.00 C.00 0.00 C.00 700.00 144C.00 234C.00 3370.00 4525.00

HYDROGRAPH ROUTING

ISTAQ ICCPP 1
3940 0 0 0 0 0 0 0 0
ROUTING DATA
QLOSS CLOSS AVG IRES ISAME IOFT IFPP LSTR
C.0 0.000 0.00 0 0 0 0 0 0

NSTPS NSTDL LAG AMSKK X TSK STORA ISFRAT
1 0 0 1.600 0.300 0.000 C. 0

SUB-AREA RUNOFF COMPUTATION

ISTAQ ICOMP IECON ITAFE JPLT JPRT INAPE ISTAGE IAUTO
40 0 0 0 0 0 0 0 0 0

HYDROGRAPH DATA

IMYDG IUNG IAREA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL
1 0 72.00 0.00 2740.00 0.00 0.000 C C C

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96
C.00 20.60 42.00 56.00 66.00 77.00 84.00 C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA

LROPT STRKR DLTKR RTIOL ERAIN STRKS RTIOK STRTL CNSTL ALSM FTIME
J 0.00 C.00 1.00 C.00 C.00 1.00 1.00 C.07 C.00 0.00

UNIT HYDROGRAPH DATA

TC= 15.27 R= 17.66 NTA= C

RECESSION DATA

STRTQ= 110.00 QRCSN= 800.00 RTIOR= 1.30

UNIT HYDROGRAPHIC END-OF-PERIOD ORDINATES, LAG= 14.43 HOURS, CP= 0.53 VOL= 0.59

30.	114.	235.	379.	539.	713.	896.	1086.	1268.	1425.
1555.	1657.	1729.	1770.	1772.	1718.	1627.	1538.	1453.	1373.
1297.	1226.	1159.	1095.	1034.	977.	924.	873.	825.	779.
736.	696.	658.	621.	587.	555.	524.	495.	468.	442.
418.	395.	373.	353.	333.	315.	298.	281.	266.	251.
237.	224.	212.	200.	189.	179.	169.	160.	151.	142.
135.	127.	120.	114.	107.	101.	96.	91.	86.	81.
76.	72.	68.	64.	61.	58.	54.	51.	49.	46.
43.	41.	39.	37.	35.	33.	31.	29.	28.	26.
25.	23.	22.	21.	20.	19.	18.	17.	16.	15.

END-OF-PERIOD FLOW

MO-DA HR-MN PERIOD RAIN EXCS LOSS COMP Q MO-DA HR-MN PERIOD RAIN EXCS LOSS COMP Q

SUM 16.02 11-85 4-18 559398.
(407.)(311.)(106.)(15840.37)

 LUMBINE HYDROGRAPHS
 ISTAQ 40 ICCPP 3 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 0 ISTAGE 0 IAUTO 0

 HYDROGRAPH ROUTING

ROUTE TO 1041
 ISTAQ 4041 ICCPP 1 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IAUTO 0
 QLOSS 0.0 CLOSS 0.000 AVG 0.00 IRES 0 ISAME 0 IOFT 0 IPWP 0 LSTR 0
 NSTPS 2 NSTDL 0 LAG 0 AMSKK 0 X 0.200 ISK STORA ISPRAT 0

 SUB-AREA RUNOFF COMPUTATION

ISTAQ 41 ICCPP 0 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 0 ISTAGE 0 IAUTO 0
 INYDG 1 IUNG 0 TAREA 0.00 SNAP 0.00 TRSDA 0.00 TRSFC 0.00 RATIO 0 ISNOW 0 ISAME 0 LOCAL 0

PRECIP DATA
 SPFE 0.00 PMS 20.60 R6 42.00 R12 56.00 R24 66.00 R48 77.00 R72 84.00 R96 96.00
 TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA
 LROPT 0 STKR 0.00 DLTKR 0.00 RTIOL 1.00 ERAIN 0.00 STRKS 0.00 RTIOK 1.00 STRTL 1.00 CNSTL 0.07 ALSPX 0.00 RTIIV 0.00

UNIT HYDROGRAPH DATA
 TC= 18.04 R= 13.00 NTA= C

RECESSION DATA
 STARTQ= 290.00 ORCSN= 2300.00 RTIOR= 1.30

UNIT HYDROGRAPH 79 END-OF-PERIOD ORIGINATES, LAG= 16.12 HOURS, CP= 0.67 VOL= 1.00
 75. 280. 572. 915. 1293. 1696. 2117. 2552. 2954. 3425.
 3805. 4359. 4538. 4650. 4693. 4661. 4533. 4276. 3960.
 3666. 3395. 3143. 2911. 2695. 2495. 2310. 2139. 1921. 1834.
 1698. 1572. 1456. 1348. 1246. 1156. 1070. 991. 916. 850.
 787. 674. 624. 578. 535. 459. 425. 394. 364.
 337. 312. 289. 268. 248. 230. 213. 197. 182.

NO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW	MO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	COMP	Q
107.	78.	150.	72.	145.	67.	134.	62.	124.	57.	115.	53.	116.	49.	98.	46.	97.	42.	64.
SUM 16.02 11.85 4.18 1336531. (407.)(301.)(106.)(37846.30)																		

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	IAUTO
41	2	0	0	0	0	0	0	0

HYDROGRAPH ROUTING

ROUTE TO CONFLUENCE WITH SCHROON RIVER									
ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	IAUTO	
4143	1	0	0	0	0	1	0	0	
ROUTING DATA									
QLOSS	CLOSS	AVG	IRIS	ISAME	IOFT	IFMP	LSTR		
C.G	0.000	0.00	0	0	0	0	C		
ROUTING DATA									
MSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT		
3	0	0	2.080	0.200	0.000	C.	0		

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	IAUTO
142	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

INTD6	IUNG	TAREA	SWAF	TRSDA	TRSPC	RATIC	ISNOW	ISAME	LOCAL
1	0	313.00	0.00	2740.00	0.00	C.00C	0	C	C

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.60	42.00	56.00	66.00	77.00	84.00	C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA

LROPT	STKR	DLTKR	RTIOL	ERAIN	STKRS	RTIOK	STRTL	CNSTL	ALSMR	RTIPE
0.00	0.00	0.00	1.00	C.00	C.00	1.00	2.00	C.07	C.00	0.0

UNIT HYDROGRAPH DATA

TC= 22.15 R= 17.72 NTA= C

UNIT	HYDROGRAPHIC	END-OF-PERIOD	ORDINATES	LAC=	20.09	HCURS,	CP=	0.64	VOL=
75.	284.	563.	940.	1336.	1766.	2223.	2697.	3186.	
4196.	4700.	5160.	5559.	5897.	6176.	6395.	6555.	6654.	
6667.	6515.	6250.	5912.	5587.	5280.	4991.	4717.	4458.	
3962.	3763.	3557.	3362.	3177.	3003.	2838.	2682.	2535.	
2264.	2140.	2023.	1912.	1807.	1708.	1614.	1525.	1442.	
1217.	1288.	1150.	1037.	971.	918.	867.	820.	780.	
732.	692.	654.	618.	584.	552.	522.	493.	466.	
416.	394.	372.	352.	332.	314.	297.	280.	265.	
237.	224.	211.	200.	189.	179.	169.	159.	151.	
335.	327.	320.	314.	307.	302.	296.	291.	286.	

END-OF-PERIOD FLOW					
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS
		CUMP Q			
SUM			16.02	11.19	4.83
(407.)			(284.)	(123.)	(5372.75)

[illegible]

HYDROGRAPH ROUTING

ROUTE THRU SCHROON LAKE

	ISTAB	ICORP	IECON	ITAFE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	142	1	0	0	0	0	1	0	0
			ROUTING DATA						
	CLOSS	AVG	IRES	ISAME	IOFT	IPMP		LSTR	
0.0	0.000	0.00	0	0	0	0			
	MSTPS	MSTOL	LAG	AMSKK	X	TSK	STORA	ISPRT	
	1	0	0	55.000	0.000	0.000	0.	0	



























SUB-AREA RUNOFF COMPUTATION

ISTAG	ICOMP	IJECON	ITAFE	JPLY	JFRT	INAME	ISTAGE	IAUTO
242	0	0	0	0	0	0	C	0

HYDROGRAPH DATA

INDVIG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	99.00	0.00	2740.00	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.60	42.00	56.00	66.00	77.00	84.00	C.00

TRSPC COMPUTED BY THE PROGRAM IS C.926

SUB-AREA RUNOFF COMPUTATION									
ISIAQ	ICCPP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO	
42	C	0	0	0	0	C	0	0	

HYDROGRAPH DATA
INVDG IUNG TAREA SNAF TRSDA TRSPC RATIO ISNOW ISAME LOCAL
1 C 115.00 0.00 2740.00 0.00 C.000 0 0 0

PRECIP DATA
SPFE PMS R2 R12 R24 R4E R72 R96
C.00 20.60 42.00 56.00 66.00 77.00 84.00 C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA
LROPT STRKR DLTKR RTIOL ERAIN STRKS RTIOK STRTL CNSTL ALSMA RTIMP
C 0.00 C.00 1.00 C.00 0.00 1.00 2.00 C.00 C.00 C.00

UNIT HYDROGRAPH DATA
TC= 15.13 R= 8.99 NTA= C

RECESSION DATA
STRITQ= 180.00 QRCSN= 1350.00 RTIOR= 1.30

UNIT HYDROGRAPH 56 END-OF-PERIOD ORDINATES, LAG= 13.05 HOURS, CP= 0.72 VOL= 1.00
94. 350. 707. 1118. 1562. 2027. 2502. 2979. 3468. 3746.
3988. 4139. 4164. 4013. 3703. 3317. 2967. 2655. 2375.
2125. 1901. 1701. 1521. 1361. 1218. 1069. 975. 872. 780.
698. 624. 558. 500. 447. 400. 358. 320. 286. 256.
229. 205. 183. 164. 147. 131. 117. 105. 94. 84.
75. 67. 60. 54. 48. 43.

END-OF-PERIOD FLOW
MO.DA HR.MN PERIOD RAIN EXCS LCSS COMP Q PO.DA HR.MN PERIOD RAIN EXCS LOSS COMP G
0 SUP 16.02 11.19 4.83 865CC4.
(407.)(244.)(123.)(24494.16)

HYDROGRAPH ROUTING
ISTAQ ICGPF 42 1
IECON ITAFE JFLT JFRT INAME ISTAGE IAUTO
0 0 0 0 0 0
ROUTING DATA
IRES ISAME IOFT IFMP LSTR
0 0 0 0 C
QLOSS CLOSS AVG C.CU
C.0 0.000 C.CU
NSTPS NSTDL 1 0
LAG AMSKK X TSK STORA ISPRAT
0 45.000 0.000 0.000 C. 0

COMBINE HYDROGRAPHS
ISTAQ ICCPP 42 2
IECON ITAFE JPLT JFRT INAME ISTAGE IAUTO
0 0 0 0 0 0

ISTAQ ICOPP 1
4243
GROSS CLOSS AVG
C.C 0.000 0.00
NSTPS NSTDL 5
LAG AMSKK X
0 1.630 0.300
TSK STORA ISPRAT
0.000 C.
C.

ISTAQ ICOPP 1
43
ROUTING DATA
JPLT 0
JPR7 0
INAME 0
ISTAGE 0
IAUTO 0

HYDROGRAPH DATA
RATIO ISNOW ISAME LOCAL
C.000 C C 0

PRECIP DATA
R12 R24 R48 R72 R96
56.00 66.00 77.00 84.00 C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA
LROPT STRKR DLTKR RTIOL ERRAIN STRKS RTIOK STRTL CNSTL ALSPX RTIMP
0 0.00 C.00 1.00 C.00 0.00 1.00 1.00 0.07 0.00 C.00

UNIT HYDROGRAPH DATA
TC= 18.54 R= 11.07 NTA= C

RECESSION DATA
STARTO= 400.00 ORCSN= 3100.00 RTIOR= 1.30

UNIT HYDROGRAPH 69 END-OF-PERIOD ORDINATES, LAG= 15.98 HOURS, CP= 0.71 VOL= 1.00
112. 419. 854. 1359. 1913. 2496. 3105. 3725. 4354. 4971.
5522. 5967. 6311. 6556. 6704. 6755. 6704. 6534. 6183. 5693.
5201. 4752. 4341. 3966. 3623. 3310. 3024. 2762. 2524. 2306.
2106. 1924. 1758. 1606. 1467. 1340. 1224. 1119. 1022. 934.
853. 779. 712. 650. 594. 543. 496. 414. 378. 338.
345. 316. 288. 263. 241. 220. 201. 183. 168. 153.
140. 128. 117. 107. 97. 89. 81. 74. 68. 61.

MU.DA HR.MN PERIOD RAIN EXCS LOSS END-OF-PERIOD FLOW MU.DA HR.MN PERIOD RAIN EXCS LOSS CONF C

COMBINE HYDROGRAPHS									
ISTAQ	ICPP	IECON	ITAFE	JFLT	JFRT	INAME	ISTAGE	J-UTO	
43	3	0	0	0	0	0	C	0	

ROUTE TO 1044

[illegible]

JOB	AREA	CURRENT	SUBSCRIPTION
ISTAG	IComp	IECON	ITAPE JPLT JFRT INAME ISTAGE ILTCO
44	0	0	0 0 0 0 0 0

ISNAME	ISNOW	RATIO	TRSDA	TRSPC	TAREA	SNAP	JUNG	INVDG
C	Q	C.00C	2740.00	0.0C	118.00	0.00	0	1

SPFE	PMS	R6	R12	R24	R48	R72	R96
C-0C	20.60	42.00	56.00	66.00	77.00	84.00	C.00

PROPT	STRKA	DLTKR	RTIOL	ERAIN	STRSK	RTIOK	STRTL	CNSTL	ALSMX	RTIYF
C	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.07	0.00	0.00

TC= 15.80 R= 9.86 NTA= C

```
STRG= 185.CC  QRC SN= 150C.00  RTTOR= 1.30
```

UNIT HYDROGRAPH 61 END-OF-PERIOD ORDINATES, LAG= 13.55 HOURS, CP= 0.70 VOL= 1.00

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LCSS	END-OF-PERIOD FLOW				MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP G
						COMP Q	1592.	1872.	2244.	2603.	3049.	3446.				
03.	3711.	3895.	4001.	4028.	4033.	3960.	3784.	3478.	3143.	2839.	2565.					
2318.	2094.	1892.	1709.	1544.	1395.	1260.	1139.	1029.	930.							
84C.	759.	686.	619.	560.	506.	457.	413.	373.	337.							
304.	275.	248.	224.	203.	183.	166.	150.	135.	122.							
11C.	100.	90.	81.	73.	66.											
4C.																
MO.DA HR.MN PERIOD RAIN EXCS LCSS COMP Q 1592. 1872. 2244. 2603. 3049. 3446. SUM 16.02 11.85 4.18 538363. (407.)(301.)(106.)(26571.46)																

COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT MADLEY, NY

ISTAQ	ICOMP	IECON	ITAPE	JFLT	JFRT	INAME	ISTAGE	1-UTO
44	2	0	0	0	0	1	C	0

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JFLT	JFRT	INAME	ISTAGE	IAUTO
45	C	0	0	0	0	C	C	0

HYDROGRAPH DATA

INVDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIC	ISNOW	ISAME	LOCAL
1	0	114.00	0.00	2740.00	0.00	C.000	C	C	C

PRECIP DATA

SPEE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.60	42.00	56.00	66.00	77.00	84.00	C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA

LROPT	STNKR	DLTKR	RTIOL	GRAIN	STKS	RTIOL	STRTL	CNSTL	ALSPX	RTIME
C	C.CC	C.00	1.00	C.00	C.00	1.00	1.00	0.07	C.CC	C.00

UNIT HYDROGRAPH DATA

TC= 16.16 R= 11.77 NTA= C

RECESSION DATA

STARTG= 1.000 ORCSN= 1350.00 RTIUR= 1.30

UNIT HYDROGRAPH 72 END-OF-PERIOD ORIGINATES, LAG= 14.40 HOURS, CP= C.67 VOL= 1.00

65.	244.	498.	795.	1120.	1466.	1825.	2194.	2554.	2865.
3120.	3309.	3438.	3504.	3503.	3421.	3224.	2965.	2723.	2501.

SIRINE 742.00 WKLSNE 3300.00 MIUNE 1.30

UNIT HYDROGRAPH 100		END-OF-PERIOD ORDINATES, LAG= 23.01 HOURS, CP= 0.56		VOL= 0.56	
54.	203.	420.	977.	1299.	1644.
3182.	3596.	4010.	4755.	5069.	5345.
6048.	6117.	6134.	5951.	5741.	5526.
4740.	4562.	4391.	4067.	3914.	3767.
3231.	3110.	2993.	2880.	2772.	2668.
2203.	2120.	2040.	1964.	1890.	1819.
1502.	1445.	1391.	1339.	1288.	1240.
1024.	985.	948.	912.	878.	845.
698.	672.	646.	599.	576.	554.
576.	458.	441.	424.	393.	378.
					364.
					350.
					337.
					325.
					314.
					304.
					294.
					284.
					274.
					264.
					254.
					244.
					234.
					224.
					214.
					204.
					194.
					184.
					174.
					164.
					154.
					144.
					134.
					124.
					114.
					104.
					94.
					84.
					74.
					64.
					54.
					44.
					34.
					24.
					14.
					4.

MO.DA HR.MN PERIOD RAIN EXCS LOSS END-OF-PERIOD FLOW MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP G

SUM 16.02 11.85 4.18 2846094.
(407.)(301.)(106.)(80592.33)

COMBINE HYDROGRAPHS	
ISTAQ	ICOPP
46	2
IECON	ITAFE
0	0
JPLT	JPT
0	0
INAME	ISTAGE
0	0
IAUTO	
0	

HYDROGRAPH ROUTING

ROUTE TO 1147

ISTAQ	ICOMP	IECON	ITAFE	JPLT	JPT	INAME	ISTAGE	IAUTO
4647	1	0	0	0	0	1	0	0
ROUTING DATA								
CLOSS	AVG	IRCS	ISAME	IOPT	IPMP		LSTR	
0.00	0.00	0	0	0	0		0	
MSTPS								
2	0	LAG	AMSKK	X	TSK	STORA	ISFRAT	
		0	1.470	0.300	C.000	C.	0	

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAFE	JPLT	JPT	INAME	ISTAGE	IAUTO
47	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

INVDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	564.00	0.00	2740.00	0.00	0.000	0	0	0

	PMS	R6	PRECIP DATA			K48	R72	R96
SPT#			R12	R24				
C.0C	20.6C	42.0C	56.00	66.00		77.00	£4.00	C.00

LOSS DATA										
LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSPX	RTIPE
C	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.07	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 24.16 R= 14.73 NTA= C

RECESSION DATA
STRTO= 1200.CC QRCSN= 7600.00 RTIOR= 1.30

UNIT HYDROGRAPH 92 END-OF-PERIOD ORIGINATES, LAG= 20.91 HOURS, CP= 0.71 VOL= 1.00									
142.	535.	1097.	1760.	2496.	3284.	4113.	4571.	5850.	6746.
7651.	9453.	9453.	10237.	10943.	11515.	11977.	12332.	12580.	12721.
12672.	12672.	12672.	12672.	12672.	12672.	12672.	12672.	12672.	12672.
7637.	7136.	6667.	6230.	5821.	5438.	5081.	4748.	4436.	4145.
3873.	3618.	3381.	3159.	2951.	2758.	2576.	2407.	2249.	2102.
1964.	1835.	1714.	1602.	1496.	1398.	1306.	1221.	1140.	1066.
996.	930.	869.	812.	759.	709.	662.	619.	578.	540.
505.	472.	441.	412.	385.	359.	336.	314.	293.	274.
256.	239.	223.	209.	195.	182.	170.	159.	149.	139.
130.	121.								

D				END-OF-PERIOD FLOW				END-OF-PERIOD FLOW					
MO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	16.02	12.18	3.84	4558318.
										(407.)	(309.)	(98.)	(\$129077.)

Question	Answer
1. What is the main purpose of the study?	To investigate the effect of the new curriculum on the learning outcomes of the students.
2. What are the research objectives?	To compare the learning outcomes of the students who were taught using the new curriculum with those who were taught using the old curriculum.
3. What is the research hypothesis?	The students who were taught using the new curriculum will have higher learning outcomes than those who were taught using the old curriculum.
4. What is the significance of the study?	The study is significant because it will help to determine whether the new curriculum is more effective than the old curriculum.
5. What are the limitations of the study?	The study is limited to the students who were taught using the new curriculum and the old curriculum.
6. What are the conclusions of the study?	The study concludes that the new curriculum is more effective than the old curriculum.
7. What are the recommendations of the study?	The study recommends that the new curriculum should be implemented in all schools.

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	LAUTO
47	2	0	0	0	0	0	0	0

[illegible]

HYDROGRAPH ROUTING

ROUTE TO 1047 THRU GREAT SACANDAGA LAKE									
	ISTAQ	IComp	IECON	ROUTINE DATA	JPLT	JPERT	INAME	ISTAGE	IAUTO
	47	1	Q	Q	Q	Q	1	Q	0
QCLOSS	C.C	0.C00	Avg	IRIS	ISAME	IOPT	IMP	LSTR	Q
			0.C0	1	Q	Q	Q		

STORAGE 435941.0C 655418.0C 707300.0C 733700.00 765611.00 814279.00 841598.00 941230.00 1003213.00
 OUTFLOW 7275.00 7848.00 7970.00 8029.00 8220.00 11971.00 23187.00 41164.00 52464.00

 SUB-AREA RUNOFF COMPUTATION
 ISTAT ICOMP IECON ITAPE JPLT JPRF INAPE ISTAGE IAUTO
 48 0 0 0 0 0 0 0 0

HYDROGRAPH DATA
 INYD6 IUNG TAREA SNAF TRSDA TRSPC RATIO ISNOW ISAME LOCAL
 1 C 3.00 C.CC 2740.00 0.00 C.000 0 0 0

PRECIP DATA
 SPFE PMS R6 R12 R24 R48 R72 R96
 0.00 20.60 42.00 56.00 66.00 77.00 84.00 C.00

TRSPC COMPUTED BY THE PROGRAM IS 0.926

LOSS DATA
 LROPT STRKR DLTKR RTIOL ERAIN STRKS RTIOL STRTL CNSTL ALSMX RTIIF
 C C.00 C.00 1.00 C.00 0.00 1.00 1.00 0.07 C.CC 0.00

UNIT HYDROGRAPH DATA
 TC= 5.60 R= 3.92 NTA= C

RECESSION DATA
 STRIQ= 5.00 QRCSM= 5.00 RTIOR= 1.30

UNIT HYDROGRAPH 24 END-OF-PERIOD ORIGINATES, LAG= 4.78 HOURS, CP= 0.66 VOL= 1.00
 23. 84. 163. 231. 266. 253. 207. 160. 124. 96.
 74. 57. 44. 34. 27. 21. 16. 12. 10. 7.
 6. 3. 3.

END-OF-PERIOD FLOW
 MO.DA NR.MN PERIOD RAIN EXCS LOSS COMP Q MO.DA NR.MN PERIOD RAIN EXCS LOSS COMP Q
 0 16.02 11.85 4.18 23123.
 (407.) (301.) (106.) (654.77)

COMBINE HYDROGRAPHS

COMBINE 3 HYDROGRAPHS AT 1048 - HUDSON R. BELOW SACANDAGA R.

Category	Item	Score
Mathematics	1. Addition	85
	2. Subtraction	78
	3. Multiplication	92
	4. Division	88
	5. Fractions	75
	6. Decimals	82
	7. Geometry	70
	8. Algebra	80
	9. Statistics	72
	10. Calculus	85
Science	11. Biology	78
	12. Chemistry	82
	13. Physics	75
	14. Earth Science	80
	15. Space Science	72
	16. Environmental Science	78
	17. Botany	70
	18. Zoology	85
	19. Microbiology	75
	20. Astronomy	82
History	21. Ancient History	75
	22. Medieval History	80
	23. Modern History	78
	24. World History	82
	25. US History	70
	26. European History	75
	27. Asian History	80
	28. African History	72
	29. Latin American History	78
	30. Oceanic History	75
Literature	31. English Literature	85
	32. American Literature	78
	33. British Literature	82
	34. World Literature	75
	35. Classic Literature	80
	36. Modern Literature	72
	37. Postmodern Literature	78
	38. Contemporary Literature	70
	39. Children's Literature	85
	40. Young Adult Literature	75

COMBINE 2 HYDROGRAPHS AT PALMER FALLS DAM									
ISTAQ	ICOPP	IECON	IYAPE	JPLT	JFRT	INAPE	ISTAGE	IAUTO	
257.5	2	0	0	0	0	1	0	0	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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ROUTE OVER PALMER FALLS DAM															
		ISTAQ	IComp	IECON	ITAPE	JPLY	JFRT	INAME	ISTAGE	IAUTO					
1257-5		1		0	0	0	0	1	0	0					
ROUTING DATA															
		Avg		IRCS	ISAME	IOPT	IPMP		LSTR						
QLOSS		CLOSS	0.00	1	0	0	0		C						
0.0		0.000													
		NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRT						
		1	0	0	0.000	0.000	0.000	-517-	-1						

STAGE	517.17	518.00	519.00	520.00	521.00	522.00	523.00	524.00	525.00
	526.00	530.00	532.00	534.00	536.00	538.00	543.00	548.00	553.00

FLOW	0.00	811.00	2740.00	5355.00	8560.00	12120.00	16070.00	20380.00	25015.00
41310.00	54060.00	68170.00	83610.00	100360.00	118420.00	165800.00	216200.00	270850.00	

CAPACITY=	0.	3.	11.	26.	46.	74.	107.	148.	195.	250.
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ELEVATION=	480.	484.	488.	492.	496.	500.	504.	508.	512.	516.
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CREL	SPM10	COBM	EXPM	ELEV	COBL	CAREA	EXPL
517.2	C.0	C.0	0.0	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COOD	EXFD	DAM#ID
531.7	2.6	1.5	80.

PEAK OUTFLOW IS 52661. AT TIME 85.00 HOURS

PEAK OUTFLOW IS 84965. AT TIME 86.00 HOURS
PEAK OUTFLOW IS 113023. AT TIME 86.00 HOURS
PEAK OUTFLOW IS 140777. AT TIME 86.00 HOURS
PEAK OUTFLOW IS 168640. AT TIME 86.00 HOURS
PEAK OUTFLOW IS 225123. AT TIME 86.00 HOURS
PEAK OUTFLOW IS 282567. AT TIME 86.00 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS						
				RATIO 1 0.20	RATIO 2 0.30	RATIO 3 C.40	RATIO 4 0.50	RATIO 5 C.60	RATIO 6 0.80	RATIO 7 1.00
HYDROGRAPH AT	36	192.00 (497.27)	1	7661. (216.93)	11491. (325.39)	15321. (433.85)	19152. (542.31)	22982. (650.78)	30643. (867.70)	38303. (1084.63)
	ROUTED TO	192.00 (497.27)	1	7585. (214.79)	11378. (322.18)	15170. (429.57)	18963. (536.97)	22755. (644.36)	30341. (859.15)	37926. (1073.93)
HYDROGRAPH AT	38	67.00 (173.53)	1	3541. (100.28)	5312. (150.42)	7083. (200.56)	8854. (250.70)	10624. (300.64)	14166. (401.13)	17707. (501.41)
	HYDROGRAPH AT	160.00 (414.40)	1	6614. (187.28)	9920. (280.92)	13227. (374.55)	16534. (468.19)	19841. (561.83)	26455. (749.11)	33068. (936.39)
ROUTED TO	3738	160.00 (414.40)	1	6600. (186.89)	9900. (280.34)	13200. (373.78)	16500. (467.23)	19800. (560.67)	26400. (747.56)	33000. (934.45)
	3 COMBINED	419.00 (1085.20)	1	16712. (473.24)	25069. (709.86)	33425. (946.49)	41781. (1183.11)	50337. (1419.73)	66850. (1892.57)	83562. (2366.21)
HYDROGRAPH AT	39	132.00 (341.88)	1	8436. (238.88)	12654. (358.32)	16872. (477.76)	21090. (597.20)	25308. (716.63)	33744. (955.51)	42180. (1196.39)
	ROUTED TO	132.00 (341.88)	1	1595. (45.18)	2684. (75.99)	3796. (107.48)	5022. (142.21)	6513. (184.42)	9441. (267.35)	12343. (349.52)
ROUTED TO	3940	132.00 (341.88)	1	1595. (45.16)	2682. (75.94)	3793. (107.41)	5017. (142.07)	6506. (184.22)	9430. (267.02)	12331. (349.17)
	HYDROGRAPH AT	72.00 (186.48)	1	3509. (99.35)	5263. (149.03)	7017. (198.70)	8771. (248.38)	10526. (298.05)	14034. (397.41)	17543. (496.76)
3 COMBINED	40	623.00 (1613.55)	1	20687. (585.80)	31387. (888.79)	42091. (1191.87)	52833. (1496.07)	63537. (1799.17)	85536. (2422.10)	107645. (3048.15)
	ROUTED TO	623.00 (1613.55)	1	20278. (574.20)	30747. (870.65)	41247. (1167.97)	51756. (1465.56)	62322. (1764.78)	83919. (2376.33)	105592. (2990.04)
HYDROGRAPH AT	41	169.00 (437.71)	1	9255. (262.08)	13883. (393.13)	18511. (524.17)	23139. (655.21)	27766. (786.25)	37022. (1048.34)	46277. (1310.42)
	2 COMBINED	792.00 (2051.26)	1	27553. (780.23)	41580. (1177.41)	55664. (1576.23)	69781. (1975.96)	83892. (2375.55)	112377. (3182.15)	141108. (3995.74)

ROUTED TO	4143	792.00 (2051.26)	1	26750. (757.49)	40369. (1143.13)	54039. (1530.22)	67735. (1918.03)	81447. (2306.31)	109143. (3090.58)	137040. (3880.54)
HYDROGRAPH AT	142	313.00 (810.66)	1	13413. (379.82)	20120. (569.73)	26827. (759.64)	33533. (949.56)	40240. (1139.47)	53653. (1519.29)	67066. (1899.11)
ROUTED TO	142	313.00 (810.66)	1	4659. (131.94)	6989. (197.91)	9319. (263.88)	11648. (329.85)	13978. (395.82)	18637. (527.75)	23297. (659.69)
HYDROGRAPH AT	242	99.00 (256.41)	1	5989. (165.58)	8983. (254.37)	11977. (339.16)	14972. (423.95)	17966. (508.73)	23954. (678.31)	29943. (847.89)
2 COMBINED	142	412.00 (1067.07)	1	7641. (216.38)	11462. (324.57)	15283. (432.76)	19103. (540.95)	22924. (649.13)	30565. (865.51)	38207. (1081.85)
ROUTED TO	14242	412.00 (1067.07)	1	7405. (205.70)	11108. (314.55)	14811. (419.40)	18514. (524.25)	22216. (629.10)	29622. (838.80)	37027. (1048.50)
HYDROGRAPH AT	42	115.00 (297.85)	1	7849. (222.26)	11774. (333.39)	15698. (444.52)	19623. (555.65)	23547. (666.78)	31356. (889.64)	39245. (1111.31)
ROUTED TO	42	115.00 (297.85)	1	2322. (65.76)	3483. (98.63)	4644. (131.51)	5805. (164.39)	6966. (197.27)	9289. (263.62)	11611. (328.78)
2 COMBINED	42	527.00 (1364.91)	1	9580. (271.29)	14371. (406.93)	19161. (542.57)	23951. (678.22)	28741. (813.86)	38322. (1085.15)	47902. (1356.43)
ROUTED TO	4243	527.00 (1364.91)	1	9414. (266.57)	14121. (399.85)	18828. (533.14)	23535. (666.42)	28241. (799.71)	37655. (1066.28)	47069. (1332.85)
HYDROGRAPH AT	43	227.00 (587.92)	1	13243. (375.00)	19864. (562.50)	26486. (750.00)	33107. (937.50)	39729. (1125.00)	52972. (1500.00)	66215. (1874.99)
3 COMBINED	43	1546.00 (4004.09)	1	42654. (1207.82)	64193. (1817.74)	85790. (2429.31)	107417. (3041.70)	129053. (3654.38)	172531. (4885.52)	216194. (6121.93)
ROUTED TO	4344	1546.00 (4004.09)	1	41624. (1178.66)	62635. (1773.62)	83711. (2370.43)	104809. (2967.85)	125945. (3566.37)	168440. (4769.67)	211073. (5976.91)
HYDROGRAPH AT	44	118.00 (305.62)	1	7672. (217.26)	11509. (325.88)	15345. (434.51)	19161. (543.14)	23017. (651.77)	30689. (869.62)	38362. (1086.28)
2 COMBINED	44	1664.00 (4309.71)	1	43137. (1221.49)	64892. (1837.54)	86706. (2455.23)	108545. (3073.64)	130411. (3692.82)	174331. (4936.51)	218396. (6184.28)
HYDROGRAPH AT	45	114.00 (295.26)	1	6783. (192.07)	10175. (288.11)	13566. (384.15)	16958. (480.18)	20349. (576.22)	27132. (768.30)	33915. (960.37)
ROUTED TO	4546	114.00 (295.26)	1	6722. (190.35)	10083. (285.53)	13444. (380.70)	16806. (475.68)	20167. (571.06)	26889. (761.41)	33611. (951.76)

HYDROGRAPH AT	46	377.00 (976.42)	1	12874. (364.54)	19310. (546.81)	25747. (729.08)	32184. (911.35)	38621. (1093.62)	51454. (1458.16)	64368. (1822.76)
2 COMBINED	46	491.00 (1271.68)	1	18901. (535.22)	28352. (802.83)	37802. (1070.44)	47253. (1338.05)	56703. (1605.66)	75604. (2140.87)	94505. (2676.09)
ROUTED TO	4647	491.00 (1271.68)	1	18749. (530.90)	28123. (796.35)	37497. (1061.80)	46871. (1327.24)	56245. (1592.69)	74954. (2123.59)	93742. (2654.49)
HYDROGRAPH AT	47	564.00 (1460.74)	1	26541. (751.56)	39812. (1127.34)	53082. (1503.12)	66353. (1878.90)	79624. (2254.68)	106165. (3006.25)	132706. (3757.81)
2 COMBINED	47	1055.00 (2732.42)	1	45047. (1275.60)	67571. (1913.40)	90095. (2551.20)	112618. (3189.00)	135142. (3826.79)	180189. (5102.39)	225237. (6377.99)
ROUTED TO	47	1055.00 (2732.42)	1	11681. (330.76)	24027. (680.36)	30988. (877.49)	38128. (1079.68)	45336. (1283.76)	60531. (1714.05)	76263. (2159.52)
HYDROGRAPH AT	48	3.00 (7.77)	1	385. (10.91)	578. (16.37)	771. (21.82)	963. (27.28)	1156. (32.73)	1541. (43.64)	1926. (54.55)
3 COMBINED	48	2722.00 (7049.90)	1	54127. (1532.70)	87817. (2486.69)	116176. (3289.75)	144686. (4097.05)	173285. (4906.89)	231285. (6549.26)	290341. (8221.54)
ROUTED TO	48257	2722.00 (7049.90)	1	52616. (1485.91)	84870. (2403.25)	112692. (3196.73)	140605. (3981.47)	168433. (4765.49)	224856. (6367.20)	282238. (7992.08)
HYDROGRAPH AT	257.5	35.20 (91.17)	1	2845. (80.57)	4268. (120.86)	5691. (161.14)	7113. (201.43)	8536. (241.71)	11381. (322.28)	14227. (402.85)
2 COMBINED	257.5	2757.20 (7141.07)	1	52684. (1491.84)	84970. (2406.07)	113024. (3200.49)	140770. (3986.17)	168632. (4775.13)	225121. (6374.71)	282570. (8001.47)
ROUTED TO	1257.5	2757.20 (7141.07)	1	52681. (1491.76)	84965. (2405.95)	113023. (3200.45)	140777. (3986.35)	168640. (4775.35)	225123. (6374.77)	282567. (8001.41)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 517.17 284. 0.	SPILLWAY CREST 517.17 284. C.	TOP OF DAM 531.70 561. 66053.	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF	
									MAX OUTFLOW	FAILURE HOURS
0.20	529.78					518.	52681.	0.00	85.00	0.00
0.30	534.07					615.	84965.	26.00	86.00	0.00
0.40	537.11					685.	113023.	45.00	86.00	0.00
0.50	539.84					748.	140777.	59.00	86.00	0.00
0.60	542.51					816.	168640.	71.00	86.00	0.00
0.80	547.56					946.	225123.	91.00	86.00	0.00
1.00	552.27					1066.	282567.	94.00	86.00	0.00

APPENDIX D
STABILITY ANALYSIS



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PROJECT NAME PALMER FALLS DAM

DATE 5/27/80

SUBJECT STABILITY ANALYSIS

PROJECT NO. _____

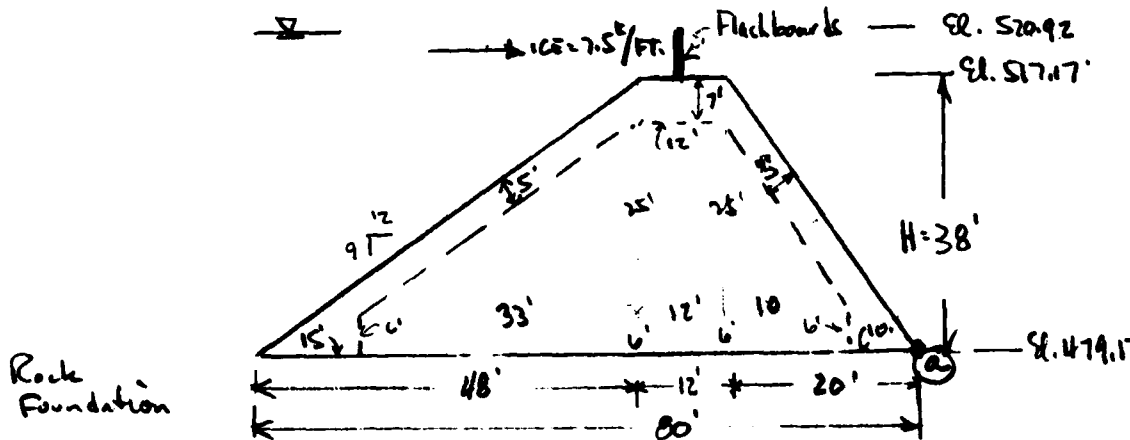
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Assumed Cross-Section and Loading Conditions - Easterly Section

$\frac{4}{8}$
El. 552.3
 $\frac{4}{8}$
El. 539.9

Normal
Operating
Condition

Note: Dam section selected at location near to maximum height (Pier 6). Upstream and downstream thickness represents weighted avg between buttresses.



Note 19' cc between buttresses, buttresses 4' wide the section of dam 19' long

$$\begin{aligned} \text{Wt. of 19' long section} &= (19') \left[\left(\frac{1}{2} \times 48 \times 38 \right) + (12 \times 38) + \left(\frac{1}{2} \times 20 \times 38 \right) \right] (0.150 \text{ k/ft}^3) - \\ &\quad - (15' \times 15' \text{ ft}^2) \left[\left(\frac{1}{2} \times 33 \times 25 \right) + (12 \times 25) + \left(\frac{1}{2} \times 10 \times 25 \right) + (5 \times 6) \right] = \\ &= 4982 - 2626 = \underline{2354 \text{ k}} \end{aligned}$$

$$\begin{aligned} M_a \text{ due to mass of 19' long section} &= (19 \times 15) \left[(4376 \times \frac{48}{3} + 32) + (456 \times \frac{12}{2} + 20) + (380 \times \frac{20}{3} + 10) \right] - \\ &\quad - (15 \times 15) \left[(1754 \times \frac{33}{3} + 32) + (7800 \times \frac{12}{2} + 20) + (2083 \times \frac{20}{3} + 10) + (11375 \times \frac{5}{2} + 10) \right] \\ &= 172,991 \text{ k} - 90,038 \text{ k} = \underline{82,953 \text{ k}} \end{aligned}$$



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DATE

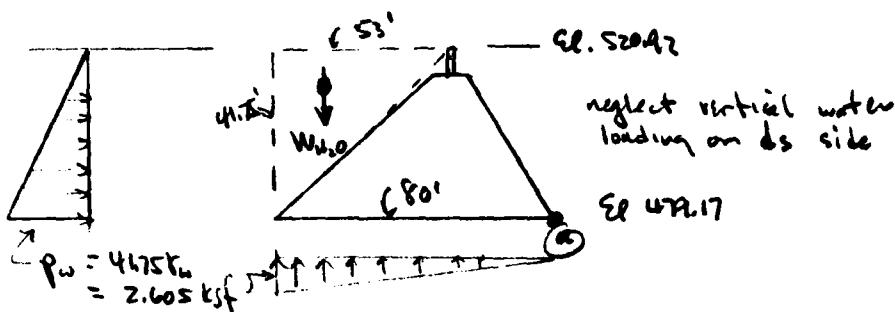
SUBJECT

PROJECT NO.

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Easterly Section

Case I: WL @ Normal Operating Level (Top of Flashboards)



overturning
(a) M_a causing overturning due to lateral H_2O pressure = $(H) \left(2.605 \times \frac{41.75}{2} \times \frac{41.75}{3} \right)$
no uplift
(19) (757 ^{k}) = 14,383 ^{k} /per 19'

$$\text{FS against overturning} = \frac{82,953 \text{ } ^k + (19) \left(\frac{1}{2} \times 41.75 \times 53 \times 0.0624 \right) \left(\frac{106}{3} + 27 \right)}{14,383 \text{ } ^k} = \frac{164,717}{14,383} = 11.4$$

(b) M_a causing overturning, assuming uplift on entire base area
(assume base slab of rock/concrete acts as raft)

$$= 14,383 \text{ } ^k + (19) \left(2.605 \times \frac{80}{2} \times \frac{160}{3} \right) = 119,972 \text{ } ^k \text{ /per 19'}$$

$$\text{FS against overturning} = \frac{164,717}{119,972} = 1.37$$

Position of Resultant, R: $d = \frac{\sum M_u}{\sum V}$

$$d = \frac{(164,717 - 119,972)}{(2354) + (19 \times \frac{1}{2} \times 41.75 \times 53 \times 0.0624) - \left(\frac{1}{2} \times 80 \times 2.605 \times 19 \right)} = \frac{44,745}{1686} = 26.54' = 0.3$$

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Sliding - friction/shear method, use 50 psi bond conc/rock

$$FS = \frac{\mu V + (\text{contact area} \times \text{bond})}{\text{force causing sliding (wt. H}_2\text{O only)}}$$

$$\underline{FS} = \frac{(0.65 \times 1686) + [4 \times 80] + (25 \times 15) \left(0.50 \times 144 \frac{\text{psi}}{\text{ft}^2} \right)}{(19') \left(\frac{1}{2} \times 41.75 \times 2.605 \right)} = \frac{1046 + 5504}{1034} = \underline{\underline{6.4 \pm}}$$



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Case II. WL @ Top of Flashboards, Ice Acting

assume ice loading of $7.5^k/\text{linear ft} \times 19'$ @ height of $37'$

Overturning
 (1) FS against overturning = $\frac{164,717}{(119,472^k) + (7.5^k/\text{ft} \times 19' \times 37')}$ = $\frac{164,717}{125,445} = \underline{1.32}$

Position of Resultant, R: $d = \frac{(164,717 - 125,445)}{(1686)} = 23.4' = \underline{0.30 b}$

(b) Sliding - friction/shear method

$$FS = \frac{\mu V + (\text{contact area} \times \text{bond})}{\text{forces causing sliding}}$$

$$= \frac{(0.65 \times 1686) + (4' \times 80' \times 0.050 \times 144 \frac{\text{psi} \times \text{bond}}{\text{ft}^2})}{19' \left[\left(\frac{1}{2} \times 4175 \times 2.605 \right) + 7.5 \right]}$$

$$= \frac{1096 + 2304}{1176^k} = 3 \pm (\text{factor})$$

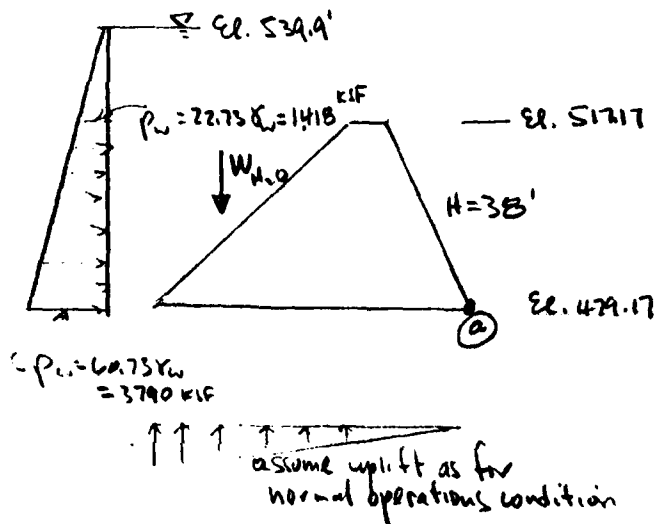
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Case III. WL @ $\frac{1}{2}$ PMF Elevation, Flashboards Failed

- a) assume weight water on upstream face as for normal operations case, uplift as for normal operations case, lateral H_2O pressure increases

$$M_a \text{ causing overturning} = (19)(1.418 \times 38 \times \frac{38}{2}) + 119.972'' = 139,424''$$

$$FS \text{ against overturning} = \frac{164,717''}{139,424''} = 1.18$$

$$\text{Position of Resultant, } R : d = \frac{\sum M_a}{\sum V}$$

$$d = \frac{(164,717 - 139,424)''}{(1686)''} = 15.1'' = 1.196$$



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b) assume weight on upstream face due to full height of water, normal uplift
 additional M_a due to upstream weight water = $(52' \times 22.73 \times 0.0624) \times (27 + \frac{52}{2})$
 $= 76,413 \text{ } ^\text{ft-k}$

total M_a resisting overturning = $164,717 + 76,413 = 241,130 \text{ } ^\text{ft-k}$

FS against overturning = $\frac{241,130}{139,424} = \underline{1.73}$

Position of Resultant, R : $d = \frac{\Sigma M_a}{\Sigma V}$

$$\underline{d} = \frac{(241,130 - 139,424)}{1686 + (19)(53 \times 22.73 \times 0.0624)} = \frac{101,706}{3,114} = 32.7' = \underline{0.41 \text{ } b}$$

c) assume uplift results from full height of upstream water level

$\therefore M_a$ due to uplift = $(19) \left(3.790 \times \frac{80}{2} \right) \left(\frac{2 \times 80}{3} \right) = 153,621 \text{ } ^\text{ft-k}$

extra M_a due to increased uplift = $153,621 - 105,590 = 48,031 \text{ } ^\text{ft-k}$

Total M_a causing overturning = $139,424 + 48,031 = 187,455 \text{ } ^\text{ft-k}$

FS against overturning = $\frac{241,130}{187,455} = \underline{1.29}$

Position of Resultant, R : $d = \frac{\Sigma M_a}{\Sigma V}$

$$\underline{d} = \frac{(241,130 - 187,455)}{2354 + (1312 + 1428) - (\frac{1}{2} \times 3.79 \times 80 \times 19)} = \frac{53,675}{(5044 - 2880)} = 24.2' = \underline{0.31 \text{ } b}$$

$\begin{matrix} \text{dam} & \text{H}_2\text{O} & \text{uplift} & \text{7880} \\ & \text{in top} & & \end{matrix}$



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Sliding - for conditions of case (c)

$$FS = \frac{\mu V + \text{bond/shear}}{\text{forces causing sliding}} =$$

$$= \frac{(0.65) \left[2354 + 1312 + \overset{1470}{(22.73 \times 53 \times 0.0624 \times 19)} - \overset{2800}{(19)(3.79 \times \frac{80}{2})} \right] + \overset{32 \text{ lb/ft}^2}{(4 \times 80)} + \overset{3.5 \text{ ton + bond between substrates}}{(25 \times 15)(0.5 \times 144)} }{(19) \left(\frac{1.418 + 3.790}{2} \right) (38)}$$

$$\underline{FS} = \frac{(0.65) \left[2354 + 1312 + \overset{1440}{1428} - 2000 \right] + 5004}{(1880)} = \underline{3.5} \text{ (slightly low)}$$

for conditions of case (b)

$$\underline{FS} = \frac{(0.65) \left[\overset{\text{down at 4 ft, 2 at 4 ft up lift}}{2354 + 2740} - 1980 \right] + 5004}{(1880)} = \frac{2024 + 5004}{1880} = \underline{3.75 \pm}$$



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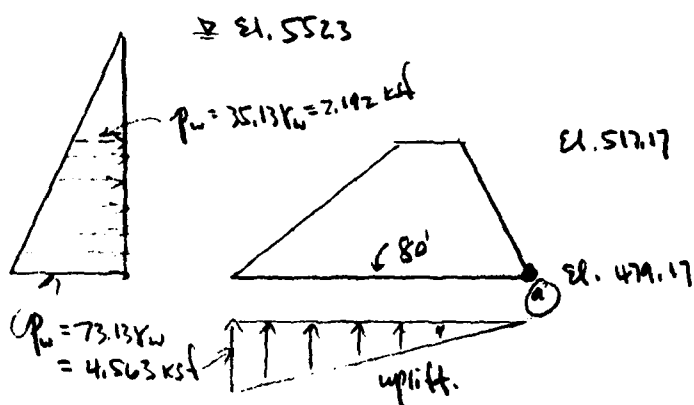
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Case IV. WL @ PMF Elevation, Flashboards Failed



1. assume weight of water on upstream face due to full height of water, assume uplift results from full height of upstream water level

M_a causing overturning due to lateral H_2O , uplift

$$= (19) \left[(2.192 \times 38 \times \frac{38}{2}) + (4.563 - 2.192) \left(\frac{38}{2} \times \frac{38}{3} \right) \right] + (19) \left[(4.563 \times \frac{80}{2} \times \frac{160}{3}) \right] =$$

$$= 40,919 + 184,954 = 225,873 \text{ K}$$

M_a resisting overturning due to mass of dam, H_2O vertical on upstream face

$$= 82,953 \text{ K} + 81,764 \text{ K} + (35.13 \times 53 \times 0.0624) \left(\frac{53}{2} + 27 \right) (19) = 282,817 \text{ K}$$

$$\text{FS against overturning} = \frac{282,817 \text{ K}}{225,873 \text{ K}} = 1.25$$

Position of Resultant R : $d = \frac{\sum M_a}{\sum V}$

$$d = \frac{2354 + \left[1312 + (35.13 \times 53 \times 0.0624) \right] - (19 \times 4.563 \times \frac{80}{2})}{2707} = \frac{56,944 \text{ K}}{2405 \text{ K}} = 237' = 0.306$$



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(b) conditions as for case (a) except uplift as for normal operating level

M_a causing overturning due to lateral water pressure, normal uplift

$$= 40,919'' + 105,590'' = 146,509''$$

$$M_a \text{ resulting overturning} = 282,817''$$

$$\text{FS against overturning} = \frac{282,817''}{146,509''} = \underline{1.93}$$

Position of Resultant, R : $d = \frac{\sum M_a}{\sum V}$

$$\underline{d} = \frac{(282,817 - 146,509)}{2354 + 1312 + 2207 - 1980} = \frac{136,308}{3893} = 35' = \underline{0.446}$$



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Sliding - case (a)

$$FS = \frac{\mu V + \text{bond/shear}}{\text{forces causing sliding}} =$$

$$= \frac{(0.65) \left[2354 + 1312 + (19 \times 35.13 \times 53 \times 0.0624) - (19 \times 4.563 \times \frac{80}{2}) \right] + 5004}{(19) \left(\frac{2.192 + 4.563}{2} \right) (38)}$$

$$FS = \frac{(0.65) \left(\overset{1563}{2405} \right) + 5004}{2439} = \frac{6567}{2439} = \underline{2.7} \quad (\text{low})$$

case b

$$FS = \frac{(0.65) \left[\overset{2572}{3893} \right] + 5004}{2439} = \frac{7534}{2439} = \underline{3.1} \quad (\text{low})$$



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Case II - Normal Operating Level, No Ice, Seismic Applicable to Zone 2 Added
Overtopping

Additional M_a due to inertial effects on mass of dam and water

(i) M_a due to horiz. acceleration effects of 0.05 G on mass of dam

$$= (19 \times 0.05) \left[\left(\frac{1}{2} \times 48 \times 38 \times 1.15 \times \frac{38}{3} \right) + (12 \times 38 \times 1.15 \times \frac{38}{2}) + \left(\frac{1}{2} \times 20 \times 38 \times 1.15 \times \frac{38}{3} \right) \right] -$$

$$- (15 \times 0.05 \times 1.15) \left[\left(\frac{1}{2} \times 33 \times 25 \times (\frac{25}{3} + 6) \right) + (12 \times 25 \times (\frac{25}{2} + 6)) + \left(\frac{1}{2} \times 25 \times 10 \times (\frac{25}{3} + 6) \right) + (55 \times 6 \times 3) \right]$$

$$= 3755 - 1612 = 2143 \text{ }^{\text{K}}$$

(ii) M_a due to vertical acceleration effects of 0.025 G on dam mass

$$= (19 \times 0.025 \times 1.15) \left[\left(\frac{1}{2} \times 48 \times 38 \times (\frac{48}{3} + 32) \right) + (12 \times 38 \times 76) + \left(\frac{1}{2} \times 20 \times 38 \times \frac{40}{3} \right) \right] -$$

$$- (15 \times 0.025 \times 1.15) \left[\left(\frac{1}{2} \times 33 \times 33 \times (\frac{33}{3} + 32) \right) + (12 \times 25 \times 26) + \left(\frac{1}{2} \times 25 \times 10 \times (10 + \frac{20}{3}) \right) + (55 \times 6 \times 3) \right]$$

$$= 4325 \text{ }^{\text{K}} - 2250 \text{ }^{\text{K}} = 2075 \text{ }^{\text{K}}$$

(iii) M_a due to horiz. acceleration/wave action of water (face @ 55° to water)

$$M_a = (0.37)(1.05)(0.024 \times 41.75)(41.75 \times 41.75)(0.30)(19') = 479 \text{ }^{\text{K}}$$

$$\text{Extra } M_a \text{ total} = 2143 + 2075 + 479 = 4697 \text{ }^{\text{K}}$$

$$\text{FS against overturning} = \frac{(164,717)}{(119,472 + 4697)} = \frac{1.32}{124,669}$$

Position of Resultant R: $d = \frac{\Sigma M_a}{\Sigma V}$

$$d = \frac{164,717 - 124,669}{119,472 + 4697} = \frac{40,048}{124,669} = 25.1' = 0.31 b$$



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Sliding

Additional horizontal force due to inertial effects on dam and water

$$A H_{\text{dam}} = .05 W_{\text{dam}} = .05 (2354) = 118 \text{ k}$$

$$A H_{\text{H}_2\text{O}} = (0.73)(0.37)(.05 \times .0624 \times 41.75)(41.75)(19') = 28 \text{ k}$$

$$FS_{\text{against sliding}} = \frac{(1034 + 118 + 28) + 5004}{(1034 + 118 + 28)} = \frac{6041}{1180} = \underline{5.1 \pm}$$



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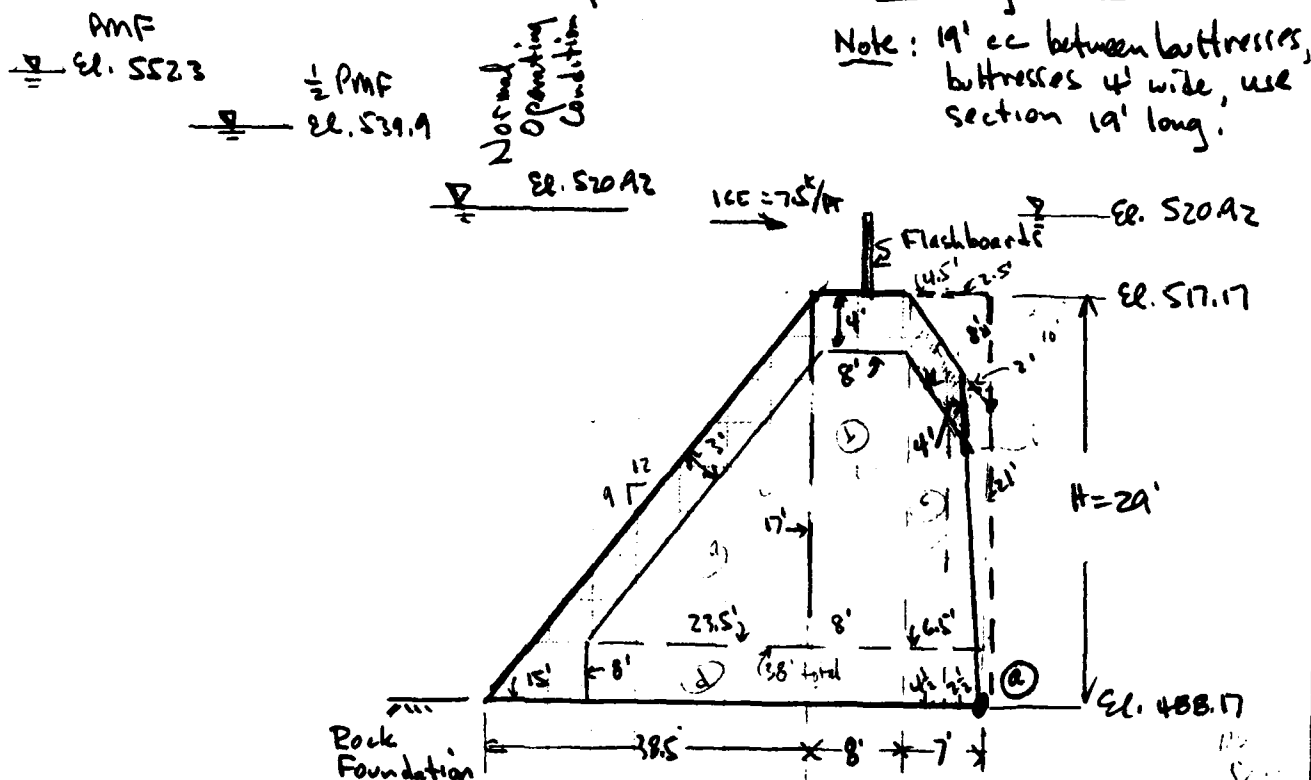
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Assumed Cross-Section and Loading Conditions - Westerly Section



$$\begin{aligned} \text{Wt. of 19' long section} &= (19 \times 15) \left[\left(\frac{1}{2} \times 38.5 \times 29 \right) + (15 \times 29) - \left(\frac{1}{2} \times 7 \times 8 \right) - \left(\frac{1}{2} \times 2 \times 24 \right) \right] - \\ &\quad - (15 \times 15) \left[\left(\frac{1}{2} \times 17 \times 23.5 \right) + (8 \times 17) + \left(\frac{6.5 \times 5}{2} \times \frac{17+13}{2} \right) + (37.5 \times 8) \right] = \\ &= (19 \times 15 \times 944.3) - (15 \times 15 \times 722) = 1065 \text{ K} \end{aligned}$$

$$\begin{aligned} M_a \text{ due to mass of 19' long section} &= (19 \times 15) \left[(558.3) \left(\frac{38.5}{3} + 15 \right) + (435 \times \frac{15}{2}) - (28 \times \frac{7}{3}) - (24 \times \frac{2}{3}) \right] - \\ &\quad - (15 \times 15) \left[(448) \left(\frac{23.5}{3} + 15 \right) + (136) (4+7) + (186) \left(\frac{4.5}{2} + 2.5 \right) + (300 \times 14) \right] = \\ &= (19 \times 15) (18723) - (15 \times 15) (12167) = 25985 \text{ K} \end{aligned}$$



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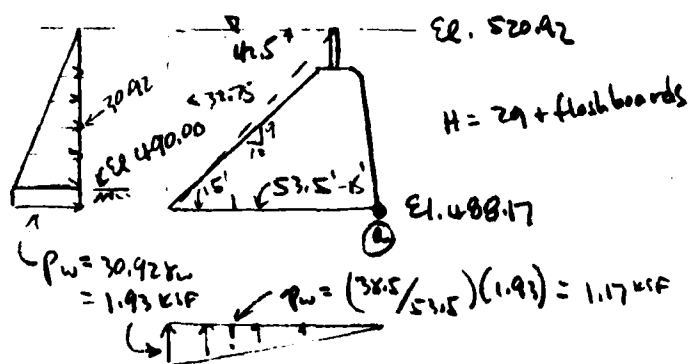
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Westerly Section

Case I • WL @ Normal Operating Condition (Top of Flashboards), No Ice



Overturning - case (a), uplift acting on entire plan area of dam

M_a causing overturning due to lateral H_2O pressure, uplift (assume base slab of rock/concrete acts as raft)

$$= (19) \left[(1.93 \times \frac{32.75}{2} \times \frac{32.75}{3}) + (-1.93 \times \frac{53.5}{2} \times \frac{28.5 \times 35}{3}) \right] = 41,483 \text{ k}$$

M_a resisting overturning due to mass of dam, wt. H_2O on upstream face

$$= 25,985 \text{ k} + (\frac{1}{2} \times 42.5 \times 32.75 \times 0.0624) (\frac{2}{3} \times 42.5 + 11)(19) = 58,442 \text{ k}$$

$$\text{FS against overturning} = \frac{58,442}{41,483} = 1.41$$

Position of Resultant, R: $d = \frac{\Sigma M_a}{\Sigma V}$

$$d = \frac{(58,442 - 41,483)}{1065 - (\frac{1}{2} \times 1.93 \times 53.5)(19) + (\frac{1}{2} \times 42.5 \times 32.75 \times 0.0624)(19)} = \frac{16,959 \text{ k}}{910 \text{ k}} = 18.6' = 35'$$



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Overturning - case (b), uplift acting on foundation contact area only

$$M_a \text{ due to uplift} = 34,986'' - (15) \left(1.17 \times 38.5 \times \frac{1}{2} \right) \left(\frac{2}{3} \times 38.5 \right) = 26,315''$$

732 A 8671

$$\text{total } M_a \text{ causing overturning} = \overset{\text{uplt. H}_2\text{O}}{6497} + 26,315 = 32,812''$$

$$\text{FS against overturning} = \frac{58,442}{32,812} = 1.78$$

Position of Resultant, R : $d = \frac{\sum M_a}{\sum V}$

$$d = \frac{(58,442 - 32,812)}{1065 + 825 - \left[980 - (1.17 \times \frac{38.5}{2} \times 15) \right]} = \frac{25,630}{1248''} = 20.5' = 0.38'$$

785 - 138 = 642

Sliding - case (b) (least foundation contact area)

FS against sliding = $\frac{\mu V + \text{shear/bond at fdtn}}{\text{forces causing sliding}}$

$$\text{FS} = \frac{(0.65)(1065 + 825 - 642) + \left[(19 \times 15) + (4 \times 38.5) \right] (0.05 \times 144 \frac{\text{lb}}{\text{ft}^2})}{(19 \times 1.93 \times \frac{30.42}{2})} = \frac{3912}{567} = 7$$

785 contact area 3151 x 51

$$\text{FS} = \frac{(0.65)(910) + (19 \times 53.5) (0.05 \times 144 \frac{\text{lb}}{\text{ft}^2})}{567} = \frac{7911}{567} = 14 \pm \quad \text{uplift on exterior}$$

case (a) 7312 7317



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Case II. WL @ Top of Flashboards, Ice Load Acting
assume ice loading of $7.5 \text{ k/ft.} \times 19' \text{ @ height of } 31.75'$

Overturning (case a)

$$\text{FS against overturning} = \frac{58,442}{41,483 + (7.5 \times 19 \times 31.75)} = \frac{58,442}{46,007} = \underline{1.27}$$

$$\text{Position of Resultant, } R: \underline{d} = \frac{\sum M_h}{\sum V} = \frac{(58,442 \cdot 46,007)}{910} = 13.7' = \underline{0.26 b}$$

Overturning (case b)

$$\text{FS against overturning} = \frac{58,442}{(32,812 + 4524)} = \frac{58,442}{37,336} = \underline{1.57}$$

$$\text{Position of Resultant, } R: \underline{d} = \frac{\sum M_h}{\sum V} = \frac{(58,442 - 37,336)}{1248} = 16.9' = \underline{.32 b}$$

Sliding (case b)

$$\text{FS against sliding} = \frac{3914}{567 + (7.5 \times 19)} = \frac{3914}{79.5} = \underline{5.5 \pm}$$



PROJECT NAME PALMER FALLS

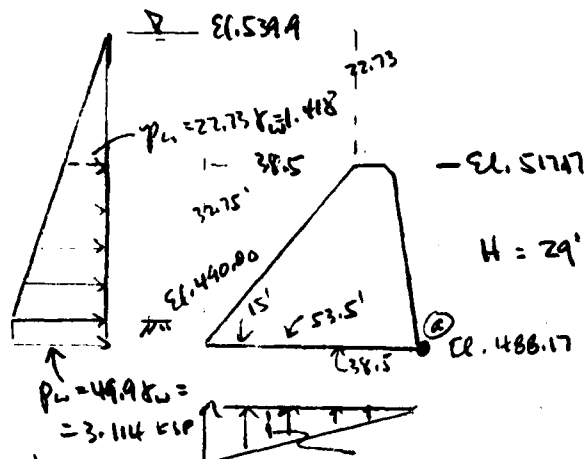
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Case III. WL @ $\frac{1}{2}$ PMF Elevation, Flash boards failed



water condition

causing overturning due to horiz. H_2O pressure, normal uplift on entire plan area

$$= (19) \left[\left(1.418 \times 32.75 \times \frac{32.75}{2} \right) + \left(1.93 \times \frac{32.75}{2} \times \frac{32.75}{3} \right) \right] + 34,986 = 55,990 \text{ ft-k}$$

Resisting overturning due to mass of dam, wt. H_2O on top dam

$$= 25,985 + 19 \left[\left(\frac{1}{2} \times 32.75 \times 38.5 \times 0.0624 \right) \left(\frac{38.5}{3} + 15 \right) + \left(22.75 \times 38.5 \times 0.0624 \right) \left(\frac{38.5}{2} + 15 \right) \right] = 82,491 \text{ ft-k}$$

FS against overturning = $\frac{82,491 \text{ ft-k}}{55,990 \text{ ft-k}} = 1.47$

Position of Resultant, R : $d = \frac{\sum M_a}{\sum V}$

$$d = \frac{(82,491 - 55,990)}{1065 + (38.5) \left(\frac{77.73 + 81.73}{2} \right) (0.0624) (19) - (1.93 \times \frac{53.5}{2} (19))} = \frac{26,501}{1784} = 14.9' = 0.28$$



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Sliding - case a

$$FS = \frac{\mu V + \text{shear/bond at filter contact}}{\text{forces causing sliding}}$$

$$FS = \frac{(0.65)(2201^k) + 3161^k}{(19)(\frac{1.418 + 3.114}{2})(32.75)}$$

$$= \frac{4592}{1410} = \underline{3.3 \pm} \quad (\text{low})$$

where $V =$ ^{at base} $1065 - 642 +$ ^{up to 11} $+(\frac{1}{2} \times 32.75 \times 38.5 \times 0.624) +$ ^{at H₂O} $+(32.75 \times 38.5 \times 0.624) =$
 $= 1065 - 642 + (39 + 55)(4) = 220$



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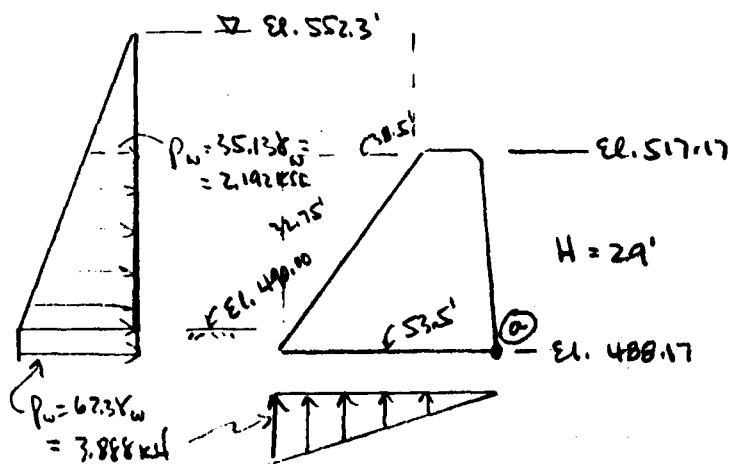
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Case IV • WL @ PMF Elevation, Flashboards Failed



Overturning

M_a causing overturning due to horiz. H_2O pressure, normal uplift on entire plan area

$$= (19) \left[(2.142 \times 32.75 \times \frac{32.75}{2}) + (1.43 \times \frac{32.75}{2} \times \frac{32.75}{2}) \right] + 34,986 \text{ k} = 63,876 \text{ k}$$

M_a resisting overturning due to mass of dam, wt. H_2O on top dam

$$= 25,985 + 19 \left[\left(\frac{1}{2} \times 32.75 \times 38.5 \times 0.0624 \right) \left(\frac{38.5}{2} + 15 \right) + \left(35.13 \times 38.5 \times 0.0624 \right) \left(\frac{38.5}{2} + 15 \right) \right] = 101,616 \text{ k}$$

FS against overturning = $\frac{101,616}{63,876} = 1.59$

Position of Resultant, R : $d = \frac{\sum M_a}{\sum U}$

$d = \frac{(101,616 - 63,876)}{1065 + (38.5) \left(\frac{67.3 + 35.13}{2} \right) (0.0624) (19) - 981} = \frac{37,740}{2308} = 16.4' = 0.31 b$



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Sliding

$$F_s = \frac{\mu V + \text{shear/bond at filter contact}}{\text{forces causing sliding}}$$

where $V = 1065 - 642 +$
 $+ 19[39 + (35.13 \times 8.5 \times 2.24)] =$
 $= 1065 - 642 + 2345 = 2768^k$

$$F_s = \frac{(0.65)(2768) + 3161^k}{(19)(\frac{2.192 + 3.89}{2})(32.75)} = \frac{4960}{1736} = \underline{2.9 \pm}$$



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Case II. Normal Operating Level, No Ice, Seismic Applicable to Zone 2 Added

Overturning

Additional M_a due to inertial effects on mass of dam and water(i) M_a due to horiz acceleration effects of $0.05 G$ on mass of dam

$$\begin{aligned}
 &= (19 \times 0.05 \times 15) \left[\left(\frac{1}{2} \times 38.5 \times 29 \times \frac{29}{3} \right) + (15 \times 29 \times \frac{29}{2}) - \left(\frac{1}{2} \times 7 \times 8 \times \left(21 + \frac{16}{3} \right) \right) - \left(\frac{1}{2} \times 2 \times 21 \times \left(\frac{44}{3} \right) \right) \right] \\
 &\quad - (15 \times 0.05 \times 15) \left[\left(\frac{1}{2} \times 17 \times 23.5 \times \left(8 + \frac{17}{3} \right) \right) + (8 \times 17) \left(\frac{17}{2} + 8 \right) + \left(\frac{6.5 \times 5}{2} \right) \left(\frac{17+13}{2} \right) \times (8+15) + (37.5 \times 8) \right] \\
 &= (19 \times 0.05 \times 15) [10672] - (15 \times 0.05 \times 15) [8155] = 1521 - 917 = 604^{\text{K}}
 \end{aligned}$$

(ii) M_a due to vertical acceleration effects of $0.025 G$ on mass of dam

$$= 0.025 (25,985) = 650^{\text{K}}$$

(iii) M_a due to horiz. acceleration/wave action of water (dam face @ 53° to vertical)

$$M_a = (0.37)(0.05)(0.0624 \times 30.92)(30.92 \times 30.92)(.30)(14) = 195^{\text{K}}$$

Extra M_a total due to seismic effects = $604 + 650 + 195 = 1449^{\text{K}}$

$$\text{FS against overturning} = \frac{58,442}{41,483 + 1,449} = \frac{58,442}{42,932} = 1.36$$

$$\begin{aligned}
 \text{Position of Resultant, } R : \underline{d} &= \frac{(58,442 - 42,932)}{910 - (1065 + 825)(0.025)} = \frac{15510}{863} = 18' = 0.34b \\
 &\quad \text{1248} \quad \text{wt. dam} \quad \text{11.0} \quad \text{47} \quad \text{1200} \quad \text{2500}
 \end{aligned}$$



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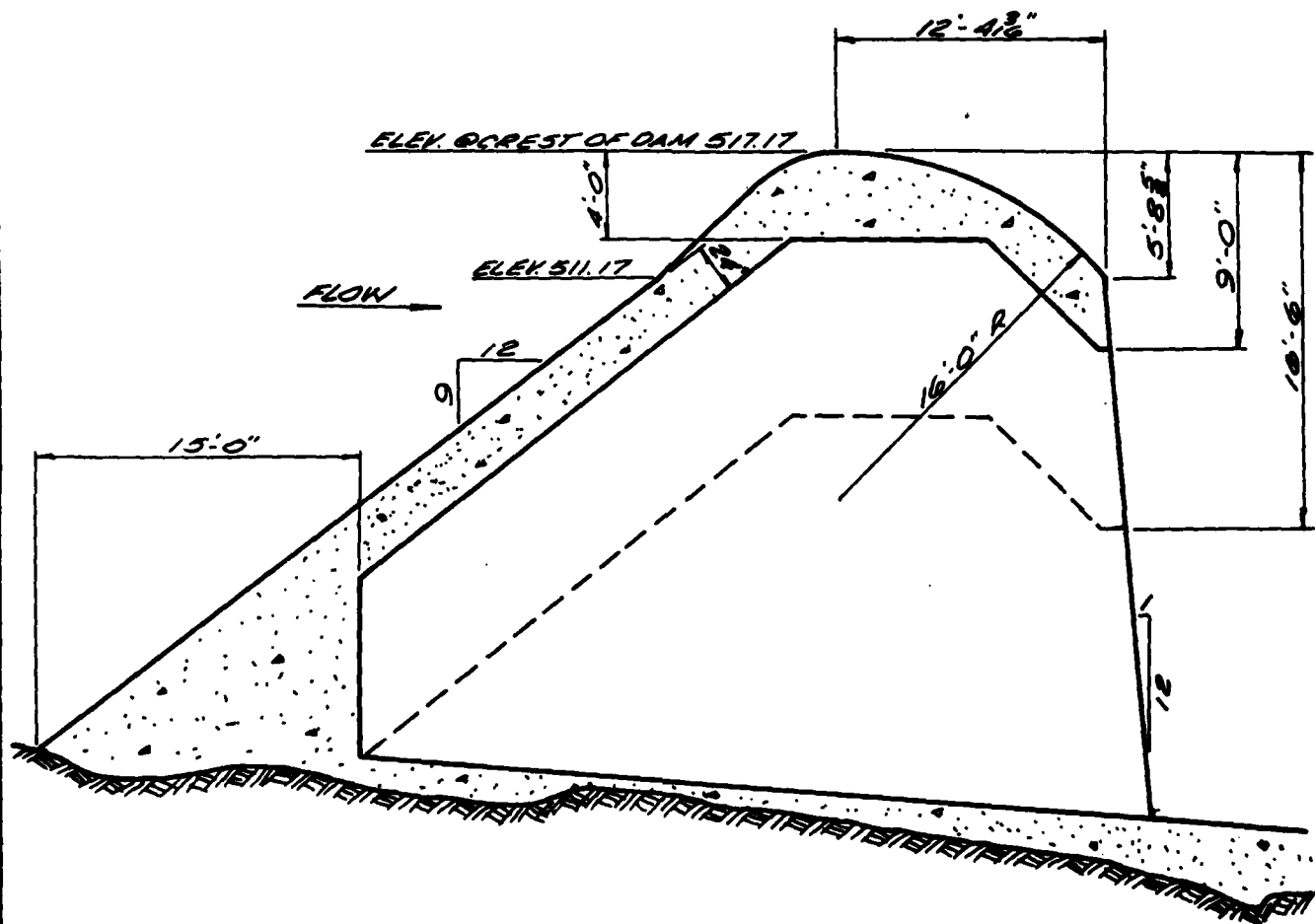
Sliding

Additional horiz. force due to inertial effects on dam and water

$$\Delta H_{\text{dam}} = .05 W_{\text{dam}} = .05(1065^k) = 53^k$$

$$\Delta H_{\text{H}_2\text{O}} = (0.73)(0.37)(.05 \times .0624 \times 30.92)(30.92)(19') = 11^k$$

$$\text{FS}_{\text{against sliding}} = \frac{\overset{794}{(0.65)(1248.27)} + \overset{.05 W_{\text{dam}}}{3161}}{(567 + 53 + 11)} = \frac{3955}{631} = \underline{6.3}$$



PALMER FALLS DAM
 1/8" = 1'-0"

NOTE: - 19' ON CENTER BETWEEN
 ARCHWAYS
 - BUTTRESSES ARE 4' THICK

APPENDIX E

REFERENCES

APPENDIX

REFERENCES

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