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LAKE KANASATKA DAM (N.. (U) CORPS OF ENGINEERS WALTHAM
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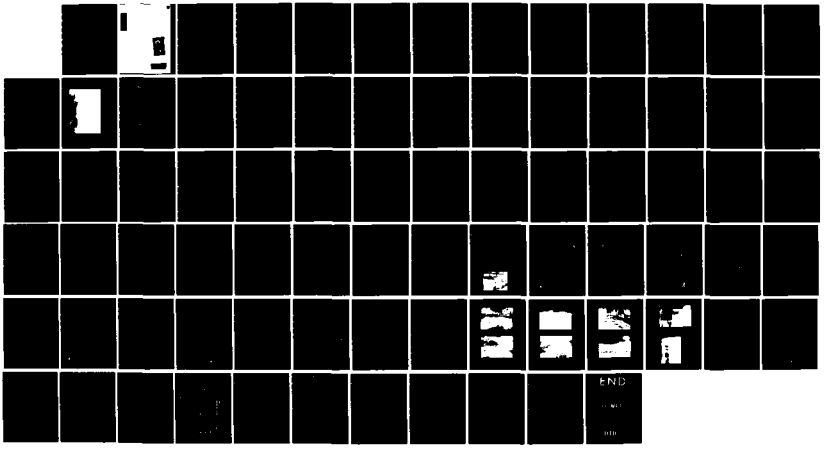

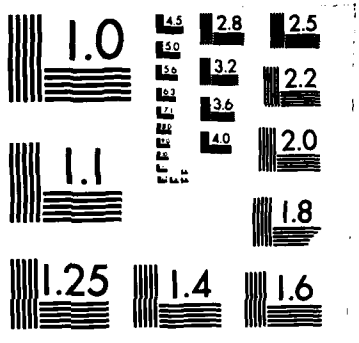

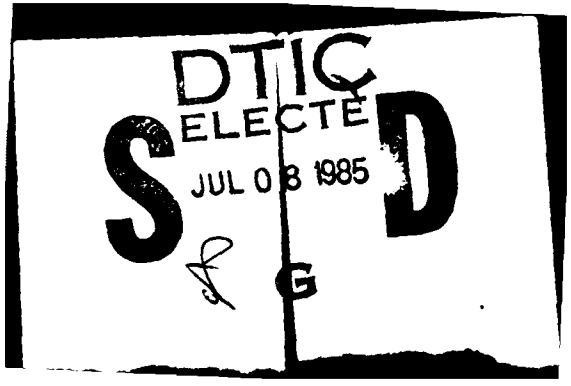
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Moultonboro, New Hampshire
Tributary to Lake Winnipesaukee

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam consist of an earth embankment with a stoplog controlled sluiceway type spillway. The dam is in good condition. It is intermediate in size with a significant hazard potential. There are various remedial measures which must be implemented immediately.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

JUL 2 3 1980

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Lake Kanasatka Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

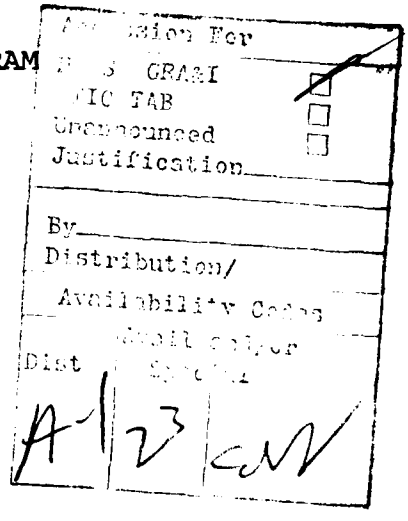
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK RIVER BASIN
MOULTONBORO, NEW HAMPSHIRE

LAKE KANASATKA DAM
NH 00125

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MARCH 1980

NATIONAL DAM INSPECTION PROGRAM
PHASE I INVESTIGATION REPORT

Identification No.:	NH 00125
Name of Dam:	Lake Kanasatka
Town:	Moultonboro
County and State:	Carroll, New Hampshire
Stream:	Tributary to Lake Winnipesaukee
Date of Site Visit:	1 November 1979

BRIEF ASSESSMENT

Lake Kanasatka Dam consists of an earth embankment with a stoplog controlled sluiceway type spillway. The box culvert of the sluiceway is about 104 ft. long. The embankment forms part of New Hampshire Route 25. The crest length of the dam is estimated to be 240 ft. with an associated height of 17 ft. The dam was constructed as part of a federally funded realignment of Route 25 in 1954. Lake Kanasatka serves primarily as a recreational reservoir though a measure of flood protection is obtained through seasonal operation of the sluiceway.

Due to the extent of downstream development that would be affected in the event the dam were to fail, Lake Kanasatka Dam has been determined to have a "significant" hazard potential classification in accordance with the Corps of Engineers guidelines.

The dam is in good condition, based on a visual examination of the structure. Although a few deficiencies were noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or conditions which would warrant urgent remedial action.

Based on the "intermediate" size and "significant" hazard potential classifications, in accordance with Corps of Engineers guidelines, the adopted test flood for this dam is 1/2 the Probable Maximum Flood (1/2 PMF). With the water level at the top of dam, the spillway capacity is approximately 740 cfs with all stoplogs removed. Hydraulic analyses indicate that the routed test flood outflow of 660 cfs (inflow 7,660 cfs or 1,050 csm) could be passed with a freeboard of about 1.5 ft. and an unused surcharge-storage of about 640 acre-ft. remaining.

The New Hampshire Water Resources Board, owner of the

dam, should conduct an investigation of the need for trash racks at the upstream end of the sluiceway, as outlined in Section 7.2. This investigation should be performed under the direction of a registered professional engineer qualified in the design and construction of dams. Any necessary modifications resulting from the investigation, and remedial measures, including clearing the discharge channel, fixing the leak in the box culvert and providing a means of access to the sluiceway stop-logs during high reservoir stages, as outlined in Section 7.3. This work should be implemented by the Owner within two years after receipt of this report. The Owner should also prepare a formal operations and maintenance manual for the dam and establish an emergency preparedness plan and downstream warning system that would compliment the State's existing disaster operations plan, "Link-Up".

HALEY & ALDRICH, INC.
by:

Harl Aldrich
President

This Phase I Inspection Report on Lake Kanasatka Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

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, DC 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 continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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ntly sloping wooded terrain. The shoreline is generally veloped with summer cottages. There is no significant obability of landslides into the reservoir affecting the fety of the dam. No conditions were noted that could re-lt in a sudden increase in sediment load into the reservoir.

e. Downstream Channel. An unnamed brook conveys discharge from the dam approximately 1,800 ft. to the Blackey ve portion of Lake Winnipesaukee. The elevation difference tween the normal water surfaces of Lake Kanasatka and ke Winnipesaukee is approximately 11 ft. Existing development along the downstream channel is presently limited to e shoreline of Blackey Cove to the west of the mouth of e downstream channel.

The downstream channel contains some loose stones mediately downstream of the sluiceway outlet. There was lso minor debris in the form of tree branches noted in e channel at the same location.

.2 Evaluation

Based on the visual examination conducted on 1 November 979, Lake Kanasatka Dam is considered to be in good condition. However, the remedial measures outlined in Section .3 should be implemented to correct the noted deficiencies n the sluiceway culvert and downstream channel.

the right wingwall of the outlet and dry-laid stone wall immediately downstream of the right wingwall.

The masonry portion of Lake Kanasatka Dam (the sluiceway) is in good condition. However, it was found during the site inspection that the dimensions of the sluiceway inlet structure, Photo No. 2, are not as shown on the design plans furnished by the New Hampshire Water Resources Board. In particular, the maximum height available for stoplogs is 8 ft. and not 10 ft. as shown on the design plans.

It was also found that the sluiceway culvert consists of two distinct parts with different cross-sections, Photo No. 9. From the inlet, 62 ft. of the culvert length is of old construction and measures approximately 7.5 ft. by 7.5 ft. in section. The old construction meets an 8 ft. by 8 ft. section that extends to the outlet. Instead of rebuilding the entire length of the culvert during the 1954 reconstruction of the facility, the then existing culvert was apparently extended with the enlarged section.

Clear seepage into the culvert was detected at the junction of its two sections, about 6 in. above the base slab on the right side. The taped length of the culvert, from the downstream end of the stilling pool at the inlet to the outlet, is 103 ft.

Minor erosion of concrete along the base slab of the older portion of the culvert and minor distress at the junction of the old and new portions were apparent. The concrete, especially at the newer portions of the facility, appeared to be sound and without deficiencies. The alignment of the structural elements, with the exception of the first monolith of the discharge conduit from the upstream end, was good with no indication of settlement. The first monolith did not indicate any recent movement and its slightly tilted condition is probably due to an original construction error.

Conditions at the sluiceway outlet, including wingwalls, are excellent, Photo No. 8. Rehabilitation work performed by the New Hampshire Department of Public Works and Highways in 1976 is evident. The stone masonry walls at either side of the outlet are in satisfactory condition.

c. Appurtenant Structures. There are no separate appurtenant structures for the facility.

d. Reservoir Area. Lake Kanasatka is bordered by

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of Lake Kanasatka Dam was conducted on 1 November 1979. The upstream water surface elevation was about 4.1 ft. below the top of the sluiceway inlet structure that day or at about full pond elevation. The top two stoplogs had been removed from the sluiceway the day before the site examination.

In general, the project was found to be in good condition. A few deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. The upstream slope of the earth embankment is covered partly by mown grass and some areas are bare with exposed sandy gravelly fill material, Photos Nos. 2 and 7. Weeds, tall grass and small brush cover portions of the slope in areas away from the sluiceway inlet, Photo No. 4. Minor erosion of the upstream slope is occurring to the right of the sluiceway inlet, Photo No. 3. This erosion is caused by local runoff and extends about 30 ft. up the slope, Photo No. 2.

The bare sandy gravelly areas were part of a prior alignment of New Hampshire Route 25, and presently form a small parking area. Remnants of the old pavement are locally visible. Erosion from vehicles traveling on the embankment is evident, Photo No. 5, but not considered serious.

The horizontal alignment of the crest is straight. The crest elevation varies along the vertical curve for the highway, Photo No. 6. The roadway pavement covering the crest of the dam is in generally good condition. There are several transverse cracks in the pavement, the largest of which is about 1/8 in. in width.

On the downstream side, the embankment is covered with tall grass as shown on Photo No. 1. There is some erosion, less than 3 in. deep and 1 ft. wide, to the left of the sluiceway outlet. Also, there are minor bare areas behind

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the dam and mill that occupied the site prior to 1937 were located and none are believed to exist. New Hampshire Route 25 was rehabilitated in 1937 and again in 1954. Plans for both reconstructions were located and in general show the enlargement and lengthening of the sluiceway culvert and changes in the roadway alignment. The above plans comprise all the available design data known to exist.

2.2 Construction Data

No as-built data or records of the reconstruction of the embankment and sluiceway in 1954 were located and none are believed to exist.

2.3 Operation Data

No operational data, other than prior inspection reports, were located for the facility.

2.4 Evaluation of Data

a. Availability. A list of the engineering data available for use in preparing this report is included on page B-1. Selected documents from the listing are also included in Appendix B.

b. Adequacy. There was a considerable amount of engineering data available to aid in the evaluation of Lake Kanasatka Dam. A review of these data in combination with visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement, was adequate for the purposes of a Phase I assessment.

c. Validity. The information contained in the engineering data may generally be considered valid. However, details on the drawings are shown as designed and vary from those actually built. For example, the configuration of the sluiceway inlet and internal dimensions for an upstream section of the box culvert are not as shown on the 1953 design drawings.

5. U/S channel.....	Lake Kanasatka; flared headwall forms approach to sluiceway
6. D/S channel.....	Small unnamed brook at S = 0.003 to Lake Winnipesaukee
7. General.....	D/S channel has sufficient capacity to convey test flood

j. Regulating Outlets. The sluiceway has a 7 ft. wide stoplog bay which regulates low flow discharges. The sill elevation of the stoplog bay is 1.0 ft. above the upstream invert elevation of the box culvert. If all stoplogs are removed, the recreational pond water surface elevation (El. 515.0) can be lowered 4.0 ft.

e. Storage (acre-ft.)

1. Recreation pool	1,620 at El. 515.0
2. Flood control pool	Not applicable
3. Winter pool	1,240 at El. 514.1
4. Top of dam	5,640 at El. 524.0
5. Test flood pool	
all stoplogs removed	5,000 at El. 514.1
stoplogs to El. 515.0	5,220 at El. 523.1

f. Reservoir Surface (acres)

1. Recreation pool	392
2. Flood control pool	Not applicable
3. Winter pool	371
4. Top of dam	527
5. Test flood pool (all stoplogs removed)	505

g. Dam

1. Type	Earth fill (roadway embankment)
2. Crest length	240 ft. (Est.)
3. Height	17 ft.
4. Crest width	48 ft.
5. Side slopes	Irregular U/S 10H to 1V; D/S 1.5H to 1V
6. Zoning	Unknown
7. Impervious core	Unknown
8. Cutoff	Unknown
9. Grout curtain	None
10. Other	Crest of dam paved; New Hampshire Route 25

h. Diversion and Regulating Tunnel — Not applicable

i. Spillway

1. Type	Stoplog controlled sluiceway
2. Length of weir	7.0 ft.
3. Crest elevation (all stoplogs in place)	515.0
4. Gates	None (stoplogs are maintained at a maximum of 5.0 ft. in height above invert of box culvert)

2. Maximum known flood at dam site..... 4 July 1973 maximum lake level estimated at El. 521.3
3. Ungated spillway capacity at top of dam (all stoplogs removed)..... 740 cfs at El. 524.0
4. Ungated spillway capacity at test flood pool elevation (all stoplogs removed)..... 660 cfs at El. 522.5
5. Gated spillway capacity at top of dam (stoplogs to El. 515.0)..... 230 cfs at El. 524.0
6. Gated spillway capacity at test flood pool elevation (stoplogs to El. 515.0)..... 220 cfs at El. 523.1
7. Total spillway capacity at test flood pool elevation (all stoplogs removed)..... 660 cfs at El. 522.5
8. Total project discharge at test flood pool elevation (all stoplogs removed)..... 660 cfs at El. 522.5

c. Elevation (ft. above NGVD)

1. Streambed at centerline of dam..... 507.0
2. Maximum tailwater..... Unknown
3. Upstream portal invert diversion tunnel..... Not applicable
4. Recreation pool..... 515.0
5. Full flood control pool..... Not applicable
6. Spillway crest
   without stoplogs..... 511.0
   with stoplogs - winter..... 514.1
   with stoplogs - summer..... 515.0
7. Design surcharge - original design..... Unknown
8. Top of dam..... 524.0
9. Test flood surcharge
   all stoplogs removed..... 522.5
   stoplogs to El. 515.0..... 523.1

d. Length of Reservoir (mi. estimated)

1. Recreation pool..... 2.0
2. Flood control pool..... Not applicable
3. Winter pool..... 2.0
4. Top of dam..... 2.1
5. Test flood pool (all stoplogs removed)..... 2.1

reconstruction of the roadway titled "Federal Aid Project No. 315-A, Whittier Road". The configuration of the then existing roadway and modifications planned for the project realignment are shown on Sheet No. 5 of these drawings (see Appendix page B-11).

The present earth embankment and sluiceway were designed in 1953 as part of a federally funded realignment of Route 25. Construction of the project, to its present configuration and alignment, (see Appendix page B-13), was completed in 1954.

In 1976 the New Hampshire Department of Public Works and Highways, Maintenance Division 03, rehabilitated portions of the box culvert endwall and downstream channel, (see Appendix pages B-7 and B-8). No plans of this work exist.

i. Normal Operational Procedures. There is no formal written procedure for the operation of Lake Kanasatka Dam. The sluiceway is operated seasonally to control the spring freshet. The wooden stoplogs, which may be removed in times of emergency or high runoff and discharge, are maintained by the State. The normal operating procedure is to lower the recreational pond level approximately 0.9 ft. during the winter and spring by removing two stoplogs. The resulting winter pool elevation is 514.1 and the summer (recreational) pool elevation is 515.0. It is understood that the dam is periodically inspected by the Owner.

1.3 Pertinent Data

All elevations reported herein are based on or were measured relative to a reservoir elevation given on the USGS Winnipesaukee Quadrangle Map. By comparison with information obtained from the files of the New Hampshire Water Resources Board, it appears reasonable to assume the given elevation is correct and that the elevations presented in this report are based on National Geodetic Vertical Datum (NGVD).

a. Drainage Area. The drainage area tributary to the dam site is 7.3 sq. mi. The southwestern portion of the watershed is sparsely developed rolling to mountainous terrain and the northeastern portion (Red Hill) is steeply sloped, heavily forested, undeveloped terrain, all of which drains to Wakondah Pond (upstream of Lake Kanasatka) and to Lake Kanasatka. The normal water surface area of Lake Kanasatka represents about 8 percent of the total drainage area and the surcharge area (water at top of dam) about 10.5 percent. The water surface area of Wakondah Pond is about 4 percent of the total drainage area.

b. Discharge at Dam Site

1. Outlet works (all stoplogs removed)..... 150 cfs with lake at normal pool El. 515.0

two homes located approximately 1,800 ft. downstream of the dam on the shore of Lake Winnipesaukee. Although the homes are located on the fringe of the impact area, one of the homes could be flooded by up to 4 ft. of water.

e. Ownership. The name, address and phone number of the current owner of Lake Kanasatka Dam are:

Water Resources Board
State of New Hampshire
37 Pleasant Street
Concord, New Hampshire 03301
Phone: (603) 271-3406

Mr. Vernon A. Knowlton is the Chief Engineer of the Water Resources Board.

The Department of Public Works and Highways has the responsibility of maintaining New Hampshire Route 25 and in turn monitors the condition of the roadway and embankment on an informal basis. Mr. Kenneth Kyle with the Department of Public Works can be reached at the following address and phone number:

Department of Public Works and
Highways
Maintenance Division 03
State of New Hampshire
P.O. Box 99
Laconia, New Hampshire 03246
Phone: (603) 524-6667

f. Operator. The Water Resources Board of the State of New Hampshire has been responsible for operation, maintenance and safety of the dam since about 1954. The Board may be reached at the address and phone number listed above. The Water Resources Board does not designate a particular individual as operator of a specific dam but operates all state-owned dams by their staff of engineers and operators on a continual basis.

g. Purpose of Dam. Lake Kanasatka serves as a large recreational reservoir. A measure of flood protection is obtained through seasonal operation of the sluiceway.

h. Design and Construction History. Prior to 1937 the site was occupied by a mill and an associated dam. The type of mill and year abandoned are unknown. The only record of the mill's existance is on 1937 drawings for the

of the dam site are N43°42.9' and W71°26.7', respectively.

Spillway discharge is conveyed by an unnamed brook approximately 1,800 ft. to Blackey Cove, an inlet at the northwestern end of Lake Winnipesaukee. Lake Winnipesaukee is tributary to the Merrimack River Basin.

b. Description of Dam and Appurtenances. Lake Kanasatka Dam consists of an earth embankment with a stoplog controlled box culvert, or sluiceway, type spillway. The crest of the embankment is paved and forms part of New Hampshire Route 25, or Whittier Road. The crest length of the dam is estimated to be 240 ft. with an associated height of 17 ft. The crest is about 48 ft. wide.

On the upstream side, from the sluiceway to the roadway shoulder for a distance of about 45 ft., the ground slopes gently at about 10 horizontal to 1 vertical. At the location of the dam, the Route 25 roadway is about 25 ft. wide with 8 to 9-ft. wide paved shoulders. The distance from the sluiceway endwall to the roadway shoulder is approximately 14.5 ft. The downstream slope of the embankment in the area of the sluiceway outlet is about 1.5 horizontal to 1 vertical. There are dry-laid stone walls at the ends of both the right and left concrete wingwalls that line the downstream channel at the outlet.

The inlet, culvert and outlet are all concrete. The culvert is 104 ft. long and traverses the embankment, in a slightly skewed alignment, about 160 ft. from the right end of the dam. The elevation difference from the top of the sluiceway at the inlet to the low point of the embankment, or top of dam, is approximately 5 ft.

c. Size Classification. The storage to the top of Lake Kanasatka Dam is estimated to be 5,640 acre-ft., and the corresponding height of the dam is approximately 17 ft. Storage of from 1,000 to 50,000 acre-ft. and/or a height of from 40 to 100 ft. classifies a dam in the "intermediate" size category, according to guidelines established by the Corps of Engineers. Although the height of this dam is much less than 40 ft., it is classified as an "intermediate" size dam by virtue of its storage capacity.

d. Hazard Classification. Dam failure analysis computations in Appendix D, which are based on Corps of Engineers "Guidance for Estimating Downstream Dam Failure Hydrographs", demonstrates why this dam has been determined to have a "significant" hazard potential classification. A failure of the dam could cause the loss of a few lives to the inhabitants of

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE KANASATKA DAM
NH 00125

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of New Hampshire and Maine. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 31 October 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW33-80-C-0009 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

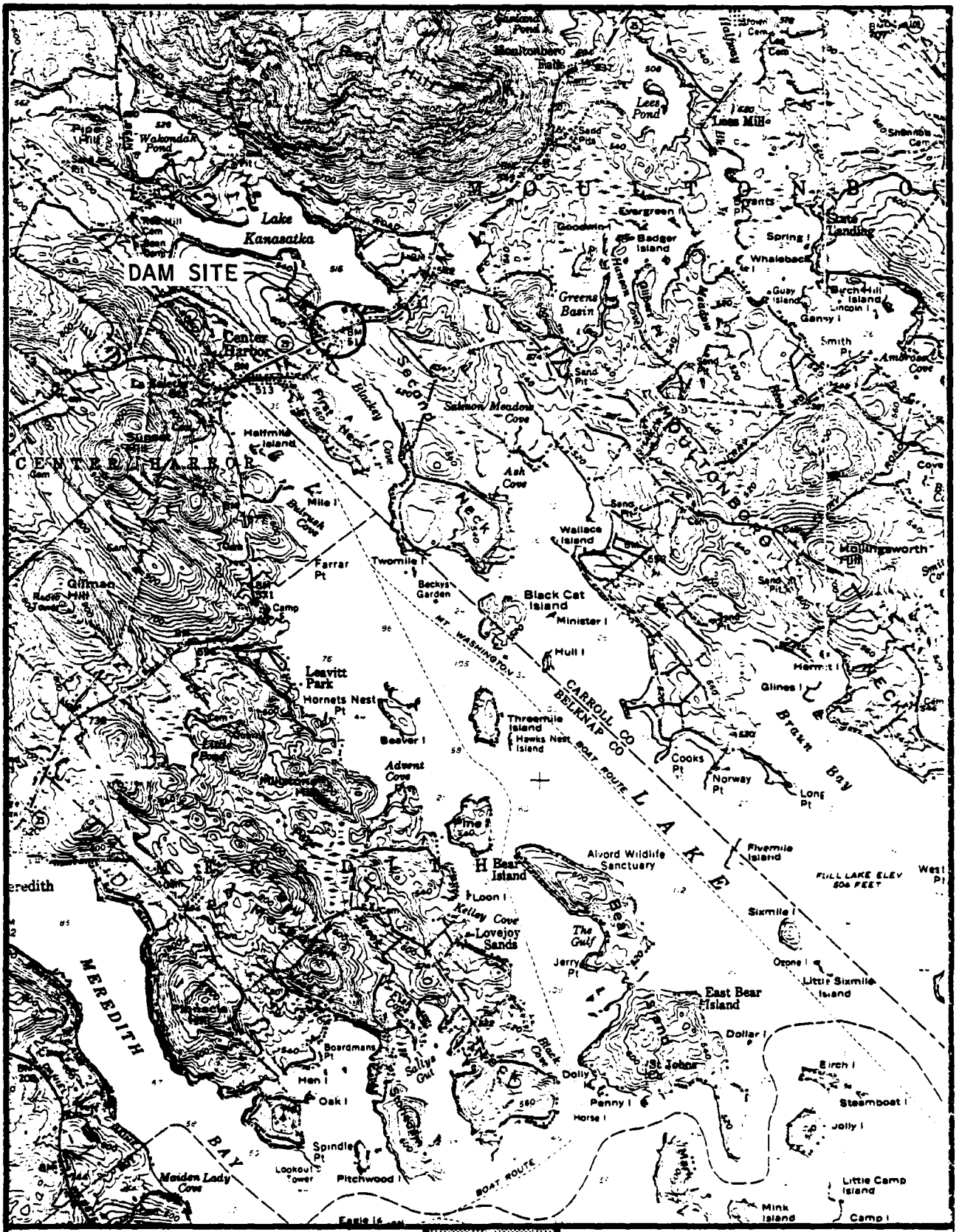
1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located at the southern end of Lake Kanasatka in Moultonboro, New Hampshire, as shown on the Location Map, page vii. The latitude and longitude



FILE NO. 4454 A21

DAM: Lake Kanasatka

IDENTIFICATION NO. NH 00125

N

LOCATION MAP

U.S.G.S. QUADRANGLE

WINNIPESAUKEE, NH

APPROX. SCALE: 1"= 1 MILE

1. Overview of Lake Kanasatka Dam showing downstream side

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SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. In general, there are no formal procedures for the operation of the dam. The stoplogs are normally maintained at full pond level (El. 515.0) during the summer and fall and approximately 0.9 ft. lower (two stoplogs removed) during the winter and spring. The Owner's instruction for emergency operations state, "pull stoplogs as required, if possible". The dam is visited three times a week by a New Hampshire Water Resources Board Operator and checked once a year by their maintenance group.

b. Description of any Warning System in Effect. There is no specific warning system or emergency preparedness plan in effect for this structure. However, the Owner is within the framework of the operations plan "Link-Up", an interagency plan in the State of New Hampshire for natural and man-made disaster operations. The plan establishes the procedure for notifying and calling upon the resources of other state agencies in times of emergency.

4.2 Maintenance Procedures

a. General. There are no established procedures or manuals for inspection and maintenance of the dam. Remedial measures such as the replacement of stoplogs and repairs to the box culvert are performed on an as needed basis.

b. Operating Facilities. The spillway structure appears to have received regular maintenance. There is no formal plan to maintain the stoplogs or keep the outlet works free of debris. Two stoplogs were inserted and removed during the site inspection and no conditions were observed which would hinder the removal of all stoplogs with pond at normal elevation. However, stoplog removal during flood stages greater than 4 ft. above normal pond level could be difficult and dangerous.

4.3 Evaluation

The Owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on

the dam to provide satisfactory operation and minimize deterioration of the facility. For example, an annual observation and maintenance program should be established to examine the dam, control vegetation growth and maintain slopes, walls and channels. A formal procedure should be established for the removal of stoplogs during flood conditions.

Since failure of the dam would probably cause loss of life and property damage downstream, the owner should also prepare and implement a formal emergency preparedness plan and warning system for the specific dam to compliment the existing operations plan "Link-Up".

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Lake Kanasatka Dam is a recreation pond dam approximately 240 ft. long. The sluiceway, or outlet works, consists of a stoplog regulated box culvert. The stoplog bay is 7 ft. long with a maximum stoplog height of 4 ft. The upstream end of the box culvert is approximately 7.5 ft. square and its entrance invert is 1.0 ft. below the stoplog sill elevation. The dam is basically a high surcharge-low spillage facility having a 9 ft. freeboard between normal pond level and top of dam which results in an available surcharge storage of about 4,000 acre-ft. Discharges from the outlet works are conveyed approximately 1,800 ft. by an unnamed brook to the Blackey Cove portion of Lake Winnipesaukee. The southwest side of Red Hill (20 percent slope) constitutes about 35 percent of the total 7.3 sq. mi. drainage area. The normal water surface area of Lake Kanasatka represents approximately 8 percent of the total watershed.

5.2 Design Data

There is no hydraulic/hydrologic design data available for the dam.

5.3 Experience Data

No records of historical floods were located for the dam site. According to the New Hampshire Department of Public Works and Highways, the most significant flood in recent years occurred on 4 July 1973 when the Lake reached an estimated stage of 2 ft.-3 in. above the top slab of the inlet structure (estimated surcharge El. 521.3). Since the inlet control conditions during that event are unknown (i.e.: number of stoplogs inplace and amount of debris), it is not possible to estimate the peak discharge from the dam.

5.4 Test Flood Analysis

Based on the Corps of Engineers Guidelines, the recommended test flood range for the size "intermediate" and hazard potential "significant" is the 1/2 PMF to the PMF (Probable Maximum Flood). The 1/2 PMF was adopted as the

test flood for the facility as the size is near the low end of the classification range. The 1/2 PMF was determined using the Corps of Engineers Guidelines for "Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The 7.3 sq. mi. drainage area includes the steeply sloped, undeveloped southwest side of Red Hill which drains to Lakes Wakondah and Kanasatka. A peak inflow rate of 1,050 csm based on the Guidelines' "mountainous" curve was selected for the 1/2 PMF which results in test flood inflow of 7,660 cfs.

Surcharge storage routing of the test flood inflow, assuming all stoplogs are in place initially and then removed when the water level rises to the bottom of the inlet platform, resulted in a routed test flood outflow of 660 cfs at a stage elevation of 522.5. The drastic reduction between inflow and outflow (7,660 cfs vs. 660 cfs) is a function of the limited discharge capacity of the box culvert together with the abundance of available surcharge storage between normal pond level and top of dam. Furthermore, surcharge storage routing of the test flood inflow, assuming that no stoplogs are removed, results in a routed test flood outflow of 220 cfs at El. 523.1. Since the top of dam is at El. 524.0, the facility is considered hydraulically adequate to pass the test flood without overtopping the dam. It should be recognized, however, that a test flood stage of about 8 ft. above normal pool would result in extensive damage to properties located along the reservoir shoreline.

5.5 Dam Failure Analysis

Based on the Corps of Engineers guidelines for estimating dam failure hydrographs, and assuming that a failure would occur along 40 percent of the mid-height length of the dam, the peak failure outflow is estimated to be 4,700 cfs in addition to the 740 cfs outlet works discharged occuring prior to failure. As a result of a dam failure, Route 25 would be rendered impassable and 2 to 3 homes located near the mouth of the discharge channel along the shore of Lake Winnipesaukee and the fringe of the impact area would be subject to shallow depth-high velocity flooding less than 2 ft. in depth. Furthermore, additional future development of the potential impact area appears likely.

The potential loss of life resulting from a dam failure is a few and the dam is accordingly classified in the "significant" hazard category.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

There was no visual evidence of ongoing settlement, lateral movement or other signs of structural instability in the earth embankment or sluiceway of this dam. Based on the conditions observed during the visual examination of the facility, no reason was found to question the structural stability of this facility.

6.2 Design and Construction Data

No plans were located for the construction of the original dam that occupied the site prior to 1937. Plans for the 1937 and 1954 reconstructions of the facility were located at the New Hampshire Department of Public Works and Highways, Maintenance Division 03, in Laconia, New Hampshire. Though no detailed stability analyses are available, the general dimensions of the embankment and sluiceway are within the range of what usually would be expected for stable structures of this size. For this reason, combined with conditions observed during the site examination, the dam is expected to have an adequate factor of safety relative to overall stability.

6.3 Post-Construction Changes

The discharge end of the sluiceway was renovated in 1976 as discussed in Section 1.2h. Nothing is known about possible other post-construction changes at this facility.

6.4 Seismic Stability

Lake Kanasatka is located in a Seismic Zone 2 and in accordance with Recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Lake Kanasatka Dam revealed that the structure was in good condition. Although there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, a few deficiencies were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is capable of passing the test flood, which for this structure is the 1/2 PMF, without overtopping the dam. With the water level at the top of the dam, the spillway capacity is approximately 740 cfs with all stoplogs removed. The routed test flood outflow of 660 cfs (inflow of 7,660 cfs or 1,050 csm) could be passed with a freeboard of about 1.5 ft. and an unused surcharge-storage of about 640 acre-ft. remaining.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally the information available or obtained was adequate for the purposes of a Phase I assessment.

c. Urgency. The recommendations for remedial measures outlined in Section 7.3 should be undertaken by the Owner and completed within two years after receipt of this report.

7.2 Recommendations

It is recommended that an investigation of the need for trash racks at the upstream end of the sluiceway be conducted. This investigation should be performed under the direction of a registered professional engineer qualified in the design and construction of dams. The Owner should then implement corrective measures on the basis of this engineering investigation.

7.3 Remedial Measures

Although the dam is generally in good condition, it is considered important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Reset loose stones from the training wall and remove debris from the discharge channel immediately downstream of the sluiceway outlet.

2. Plug the leak on the right side wall of the box culvert where the newer section joins the older section.

3. Provide a means of access to and removal of the sluiceway stoplogs during high reservoir stages.

4. Prepare an operations and maintenance manual for the dam. The manual should include provisions for biennual technical inspection of the dam and for surveillance of the dam during periods of heavy rainfall or flood conditions. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility.

5. Develop a written emergency preparedness plan and warning system to compliment the existing disaster operations plan "Link-Up" to be used in the event of impending failure of the dam or other emergency conditions. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A - INSPECTION CHECK LIST

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

Dam: Lake Kanasatka

Date: 1 November 1979

Time: 0745-0945

Weather: Clear and cold, (approximately 32°F)

Water Surface Elevation Upstream: El. 515 (Assumed same as shown on USGS Map)
(4.1 ft. below top of concrete at spillway inlet)

Stream Flow: Unknown

Inspection Party:

Harl P. Aldrich, Jr. Charles R. Nickerson Haley & Aldrich, Inc.	-	Soils/Geology
Roger Wood	-	Structural Mechanical
Joseph E. Downing Camp, Dresser & McKee, Inc.	-	Hydraulic/Hydrologic

Present During Inspection:

Kenneth T. Stern, N.H. Water Resources Board
Kenneth Kyle, N.H. Department of Public Works and Highways

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Kanasatka DATE: 1 Nov. 1979

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	El. 524.1 (approximately at low point, left end)
Current Pool Elevation	El. 515 (Assumed as shown on USGS topographic sheet)
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Excellent; several minor transverse cracks not more than 1/8 in. wide
Movement or Settlement of Crest	None observed; pavement smooth
Lateral Movement	None observed
Vertical Alignment	Roadway grade varies; low point at left end of dam
Horizontal Alignment	Good
Condition at Abutments and at Concrete Structures	Satisfactory
Indications of Movement of Structural Items on Slopes	No structural items on slopes
Trespassing on Slopes	Unrestricted; very common on gentle upstream slope
Animal Burrows in Embankment	None observed
Vegetation on Embankment	Upstream slope bare over a large area; mowed grass at left end; weeds at right end. Downstream slope weeds and grass; few small bare areas
Sloughing or Erosion of Slopes or Abutments	Considerable erosion beyond paved shoulder of roadway on upstream side right of spillway intake. Erosion of earth fill about 8 ft. directly right of intake (see text)
Rock Slope Protection - Riprap Features	No rock on upstream slope, except at waterline; not continuous
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None known to exist
Toe Drains	None known to exist
Instrumentation Systems	None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Kanasatka DATE: 1 Nov. 1979

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Intake at edge of lake
Bottom Conditions	Eroded area adjacent to stop logs
Rock Slides or Falls	Not applicable
Log Boom	None
Debris	None observed
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	None observed
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	Good
Railing	Railing removed - stubs have been capped
OUTLET WORKS - CONDUIT	
General Condition of Concrete	Fair - U/S right monolith is tilted (may have been constructed that way)
Rust or Staining on Concrete	No material condition observed
Spalling	No material condition observed
Erosion or Cavitation	Surface erosion base slab
Cracking	Crack where new culvert joins older culvert. Flow of water from crack on right side (6 in. above base slab)
Alignment of Monoliths	See "General Condition of Concrete"
Alignment of Joints	Good
Numbering of Monoliths	Not applicable

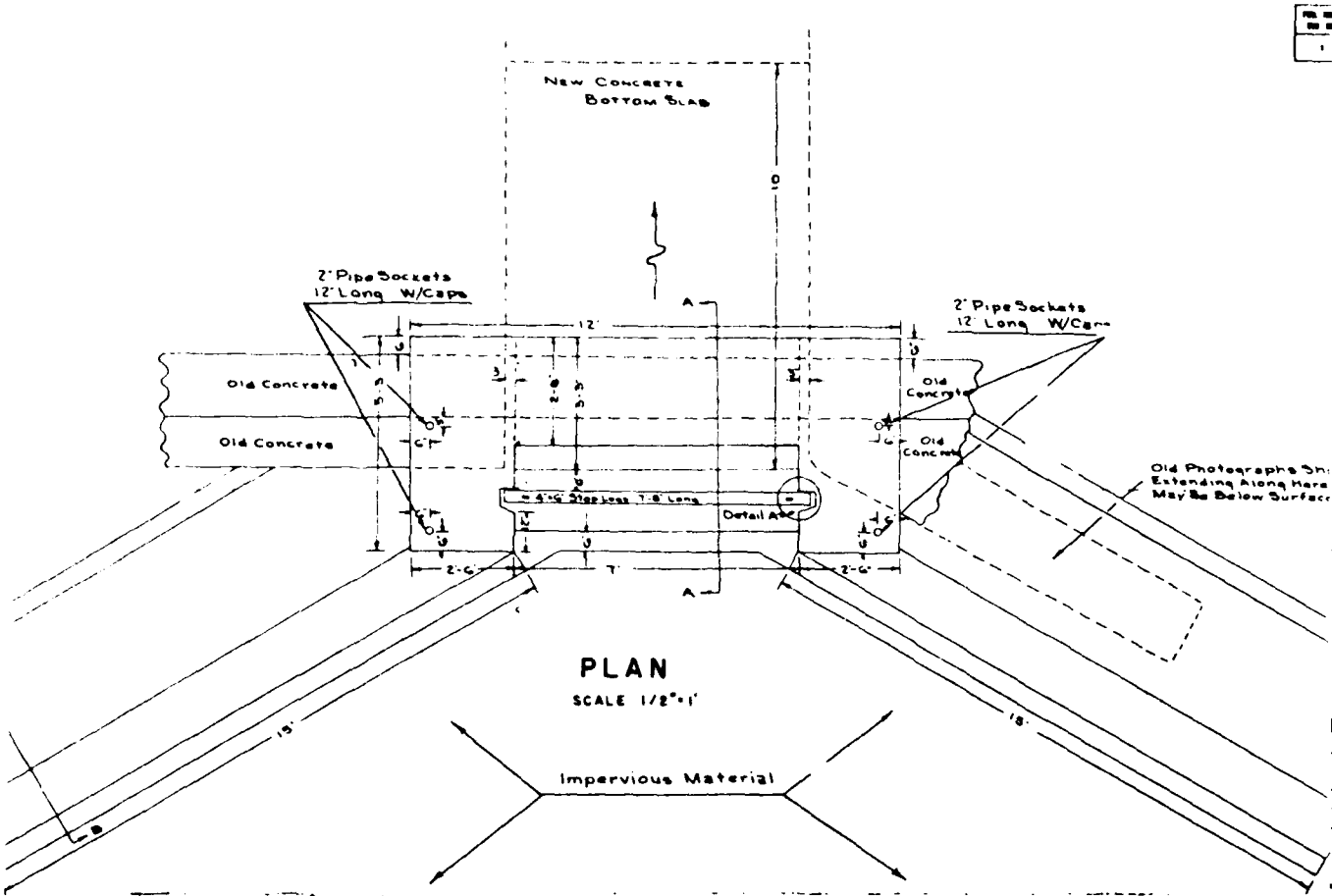
VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Lake Kanasatka DATE: 1 Nov. 1979

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Excellent
Rust or Staining	None observed
Spalling	None observed
Erosion or Cavitation	None observed
Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Condition at Joints	None noted
Drain holes	None observed
Channel	Natural woodland stream
Loose Rock or Trees Overhanging Channel	Few loose rocks at left training wall. Minor debris (branches in channel)
Condition of Discharge Channel	Good

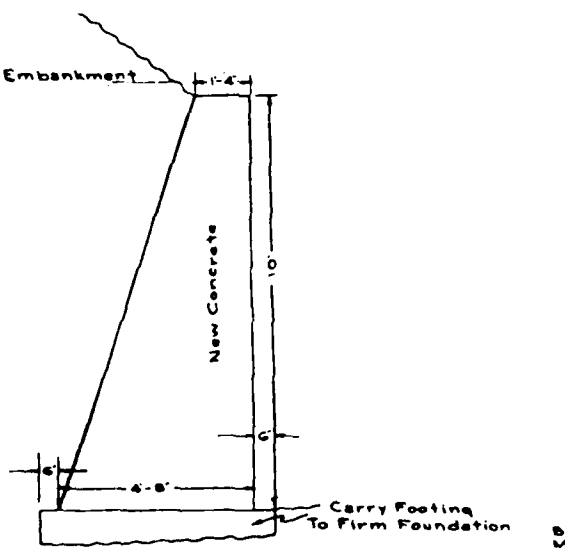
APPENDIX B - ENGINEERING DATA

Document	Contents	Location
Report, Schedule of Dams, Town of Moultonboro, New Hampshire	Lists the owner's name and address for dams in Moultonboro dated 6 May 1935	Water Resources Board State of New Hampshire 37 Pleasant Street Concord, New Hampshire 03301
State of New Hampshire Public Service Commission Notice of Inspection and Inspection Report	Four items related to inspection of dams in Moultonboro on 8 July 1936	Water Resources Board State of New Hampshire
New Hampshire Water Control Commission, Data on Dams in New Hampshire	Three data sheets on inspection of dam dated 10 April 1939	Water Resources Board State of New Hampshire
Correspondence to and from the Water Resources Board	Three letters concerning possible transfer of ownership and needed repairs to dam dated from 15 September 1949 to 3 August 1953	Water Resources Board State of New Hampshire
Water Resources Board letter to Mrs. Kathyrn Hall	Reply to complaint dated 28 July 1959	Water Resources Board State of New Hampshire
Army Corps of Engineers Dam Inventory Program	Two sheets with three pictures of dam dated 14 March 1974	Water Resources Board State of New Hampshire
Inspection Report by Members Lake Kanasatka Association, Inc.	Three items concerned with condition of stoplogs and dam structure dated 26 August 1974 and 8 October 1974	Water Resources Board State of New Hampshire (See Appendix page B-3 through B-6)



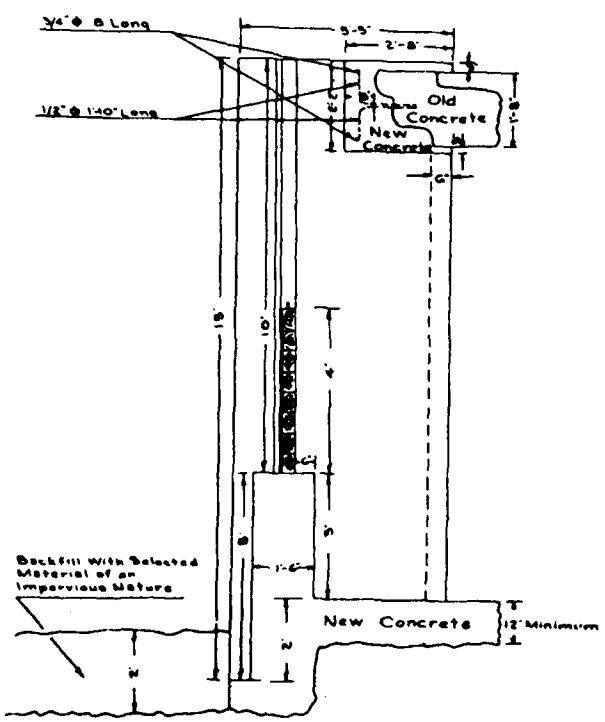
PLAN

SCALE 1/8"=1'



SECTION BB

SCALE 1/8"=1'



SECTION AA

SCALE 1/2"=1'

PROPOSED RECONSTRUCTION OF LAKE KANASATKA DAM

MOULTONBORO N.H.

NEW HAMPSHIRE WATER RESOURCES BOARD
CONCORD, N.H.

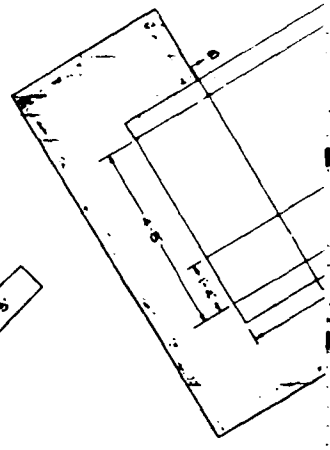
SCALE AS SHOWN	OCTOBER 20, 1953	No. 164.02

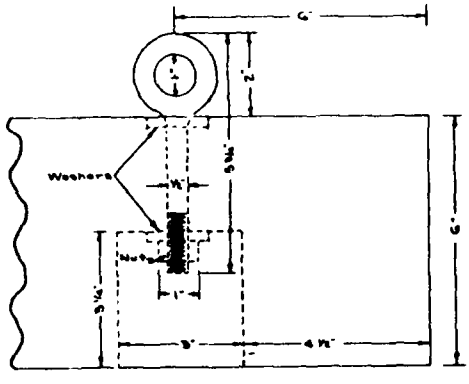
DESIGNED BY L.R.F.
DRAWN BY F.S.M.
TRACED BY F. Yatuta
CHECKED BY

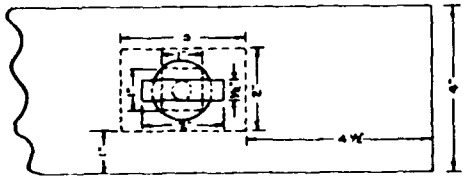
NONPARTICIPATING
QUANTITIES FOR RECONSTRUCTION
OF LAKE KANASATKA DAM AT
STA 152+59 LT

ITEM NO	G1	G2	321
ITEM	EARTH TR EXCAV R	LEDGE TR EXCAV R	CLASS A CONC
UNIT	CU YD	CU YD	CU YD
	15	10	48.27
SUB TOTAL	15	10	48.27
ESTIMATED	—	—	1.73
TOTAL	15	10	5000

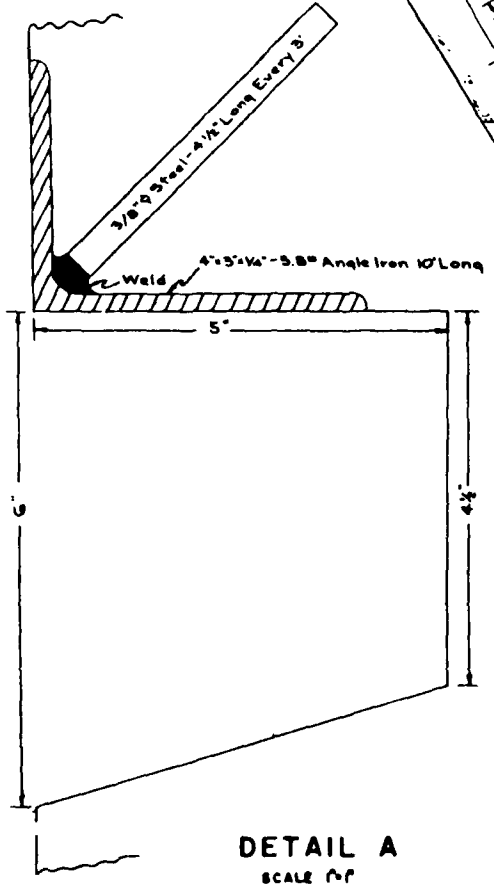
THE FOLLOWING ITEMS WILL BE CONSIDERED SUBSIDIARY TO THE ITEM:
8- 3/8" ϕ 4 1/2" LONG
2- 3/4" ϕ 8' LONG
4- 1/2" ϕ 1'10" LONG
2- 4"x3"x1/4" ANGLE IRONS 5.8# 10' LONG
4- 4"x6"x16 STOP LOGS
4- 2" STD PIPE 12" LONG W/CAPS
16- 1/2" EYE BOLTS
32- 1/2" FLAT WASHERS
16- 1/2" SQUARE NUTS
IMPERVIOUS BACKFILL





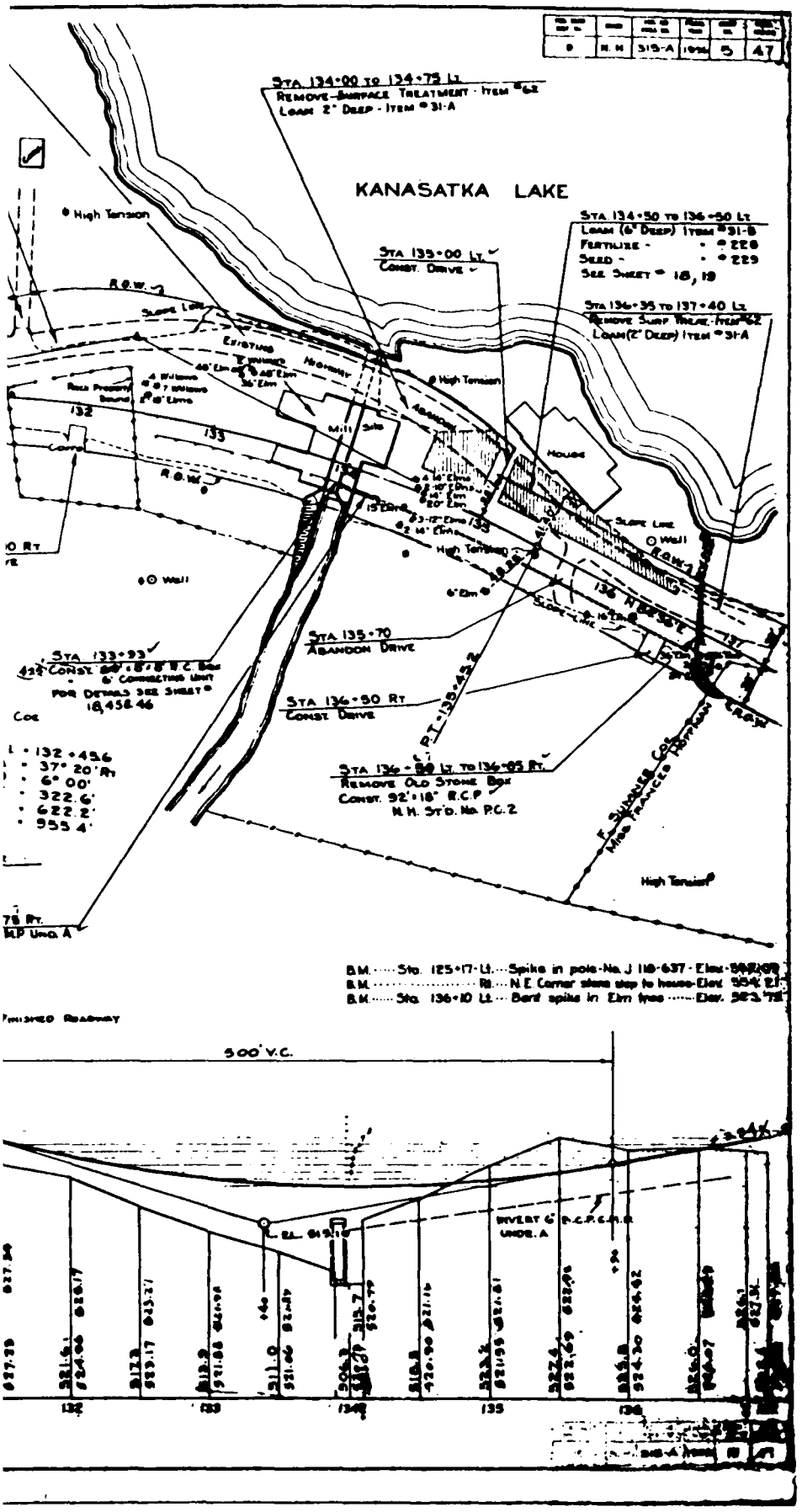


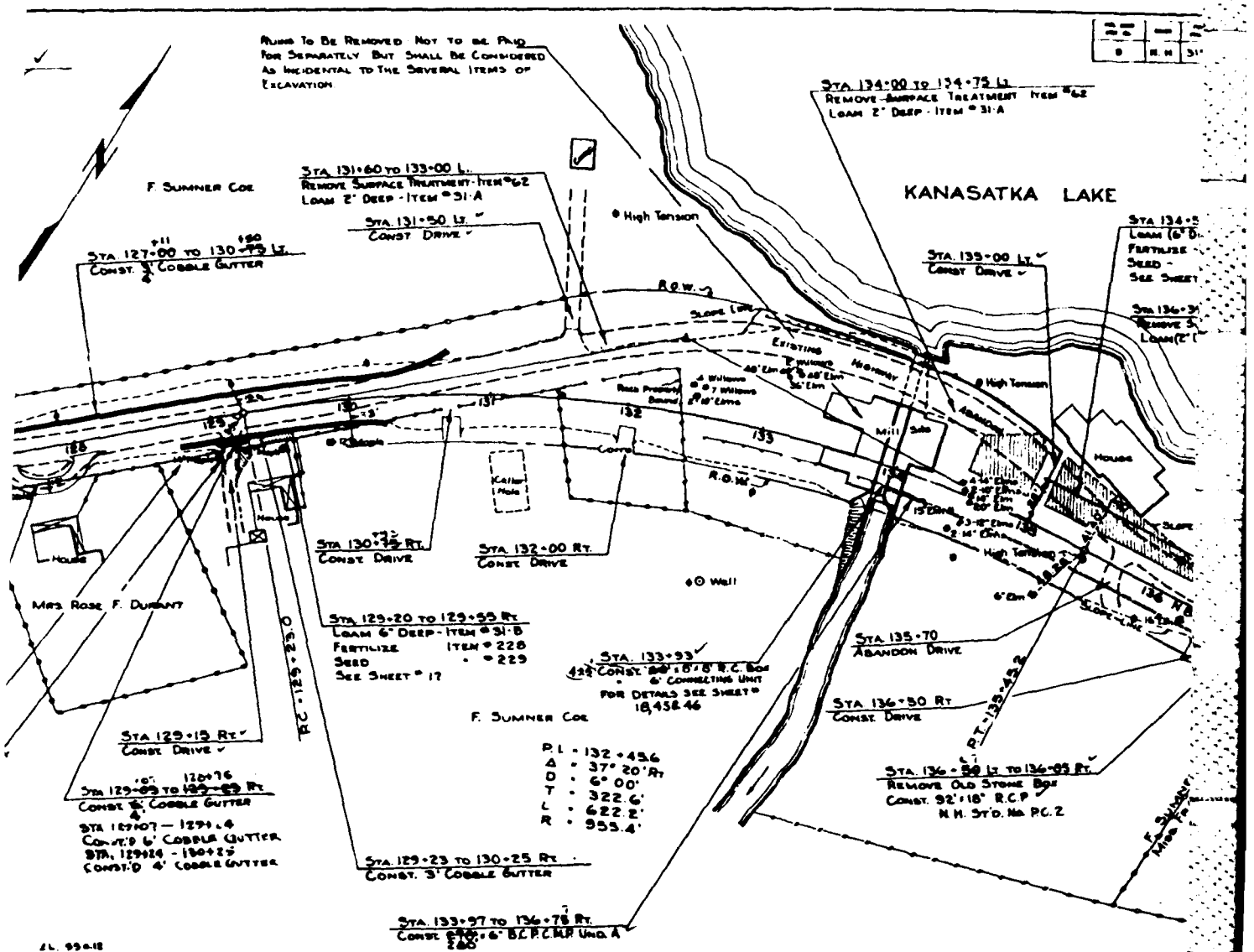
STOP LOG
DETAILS
SCALE 1/2"=1'

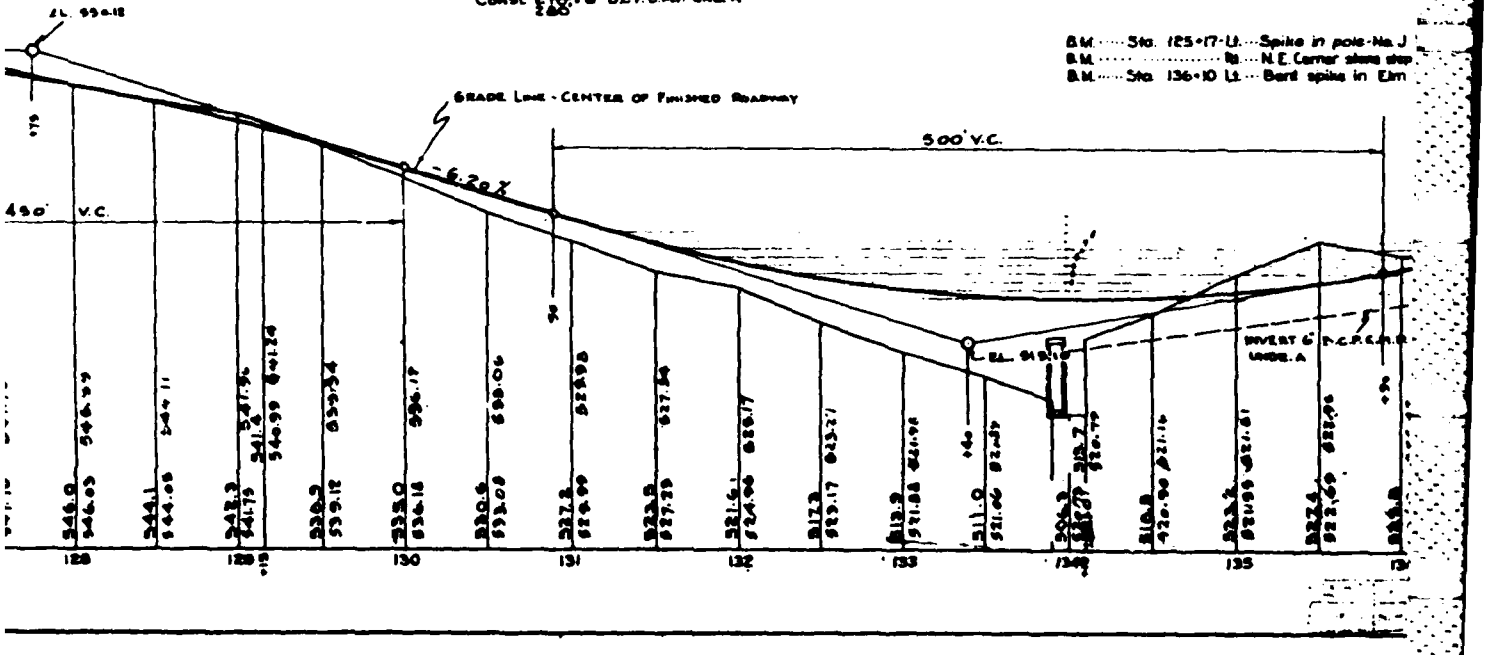


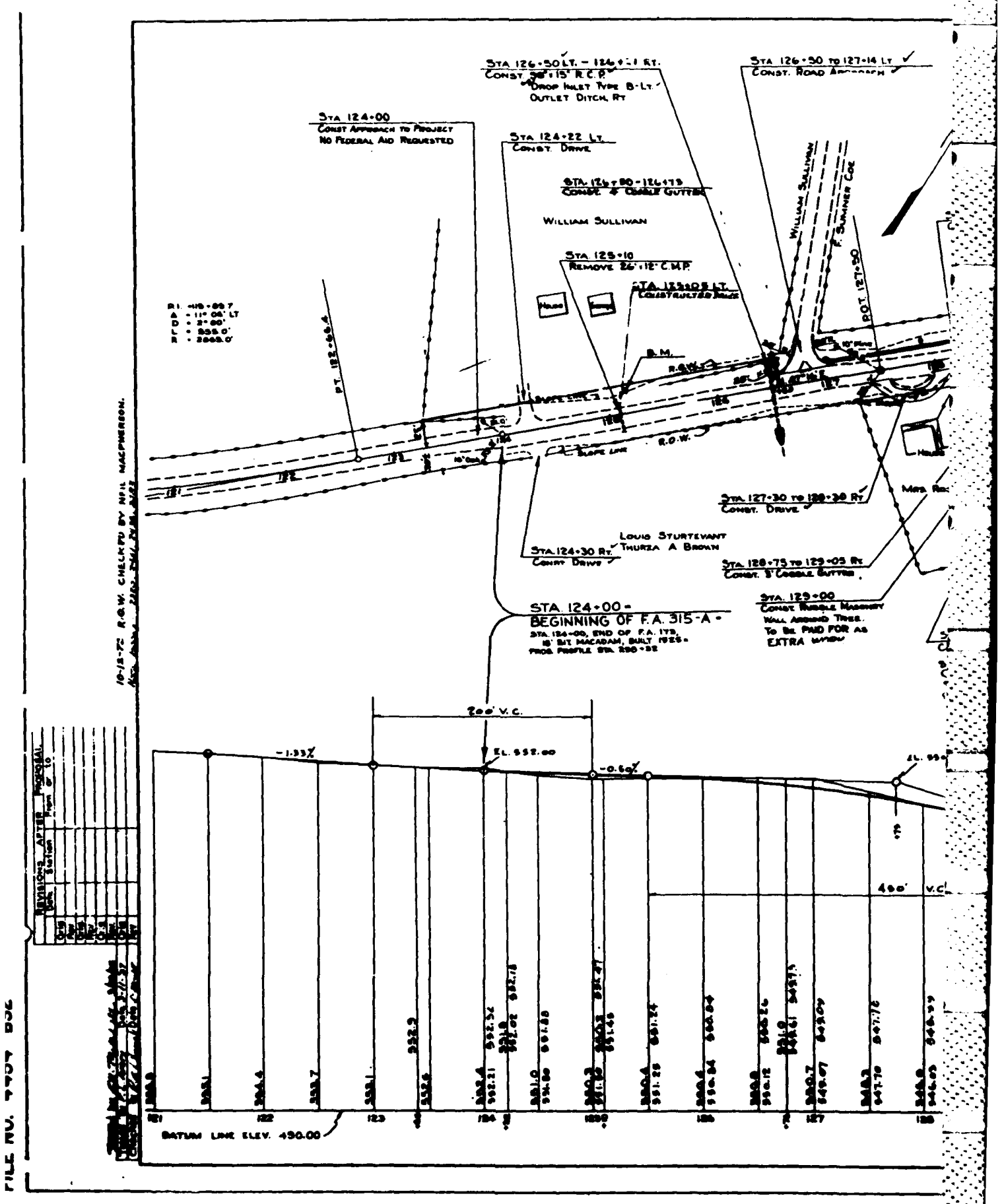
DETAIL A
SCALE 1"=1'

DESIGNED BY L.R.F. DATE 11-9-53
DRAWN BY F.S.M.
TRACED BY F. Yatuta
CHECKED BY









FILE NO. 7907 B36

103

KANASATKA LAKE, MOULTONBORO 164.02

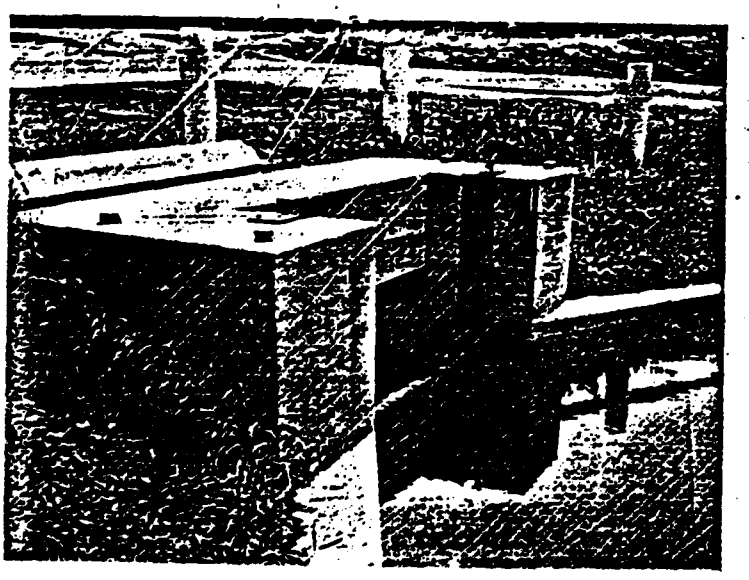
Spring - After runoff (late) fill to 12" below concrete
by June 1 . Lake is fast to fill and slow to drain

Fall - November 1 pull 2 stoplogs

EMERGENCY OPERATION: Pull stoplogs as required if possible

1. Remove stop log locks with 2402 key, and remove desired amount of stoplogs (or replace if necessary).
2. Lake reading is taken from the apron to your right when looking out on the lake, go to the far end of the apron and measure down to lake level.
3. Relock stoplogs in bays and lock extra logs to the railing.

BEFORE ANY EMERGENCY OPERATION
Call N. H. Water Resources Board
Office - 271-3406



Kanasatka Lake

Moultonboro

164.02 #

Drainage Area (mi^2) 7.5	Freeboard w/o ~~flashboards~~ stoplogs (ft.) 9
Pool Area (Acres) 371	~~flashboard~~ stoplog height (ft) 4±
Storage Perm. (Ac. Ft.)	Freeboard ~~flashboards~~ stoplog (ft) 5
Storage Artificial (Ac. Ft.) 208	Spacing of pins (ft)
Gage reading @ Full Lake -12" concrete abutment	Number of pins NONE
Datum on gage translates to top of concrete abutment	Design head over flashboards for automatic failure (ft)
U.S.G.S. Elev. at full pond 514 ±	
"Bankfull Flow" 0.2 cfs per mi^2	
10 year storm flow (cfs)	Gate #1 on left/right. (circle one) bank looking downstream
100 year storm capacity (cfs)	Number of gates
Design flow capacity (cfs) 500 capacity of culvert	Size of gates NONE
Time to Peak (hours)	Gate sill elev. (gage)
Discharge (manual-cfs) 380 with all logs removed	
(automatic-cfs) 120	# 1 Stoplog bay on right/left bank looking downstream
Spillway length (ft.) 7	
Spillway crest elev. 510.8 (USGS)	Number of stoplog bays 1
Acreage of fee ownership elev.	Number of S.L.'s in each bay 6
Flood Stage (gage-ft)	Size of each S.L. 7'7" x 4" x8"
Name	Elev. of sill of stoplog sect. 510.8 MSL
Contracts Prior to a) #	
Name	16.4" rise per inch runoff
Operation of dam b) #	
Name	
How much c) #	
Name	
d) #	

INSTRUCTIONS TO PETITIONERS DESIRING TO FILL, DREDGE
OR PERFORM CONSTRUCTION IN WATERS OF THE STATE

1. The applicant shall submit to the Special Board two (2) copies of all application forms and inclusions.

2. Obtain signature of appropriate town or city clerk in Section 10 on all copies.

3. File three (3) copies of said application with the town/city clerk as required by Chapter 483-A.1 as amended 1973.

4. Return two (2) copies to the following address:

   Mr. George M. McGee, Sr., Chairman
   Spacial Board
   Concord, New Hampshire 03301

5. The permit must be received by the applicant prior to commencement of the work and posted in a secured manner in a prominent place at the site of the approved project.

PERMIT APPLICATIONS SHALL INCLUDE AT LEAST THE FOLLOWING INFORMATION:

a) United States Geological Survey sheet(s) (Machine copy or other facsimile acceptable) showing exact location(s) of project(s) for which a permit is being requested.

b) A map showing the location of the project in relation to all abutters. Scales shall be appropriate for clarity.

c) Specific directions and/or map so that inspector may drive to the site. (town, street, etc.)

d) One detailed plan of each project drawn to scale appropriate for clarity.

e) A complete list of abutting owners, their mailing addresses and telephone numbers, with certification that all such abutters have been notified of the project plans (not required for logging operations or highway construction).

NOTE: Repair work to consist of following items:

1. Form and place concrete along the wall/floor joints where needed.

2. Widen wing wall footings at outlet end and construct an 8" wide new face on the wing walls, and raise height of wing walls and header 2 feet.

3. Remove channel obstruction such that back water will be eliminated within the culvert (8"±). Dredged materials will be relocated to the box outlet.

4. We intend to control pollution/siltation by using baled hay just downstream of the work area.

NOTE: We intend to carry the discharge thru a 24" pipe within the box culvert during the work period. Any planned change in the current rate of discharge (or lake level) would seriously affect our plans. Our proposed schedule is flexible.

FILL OUT ACCURATELY AND COMPLETELY TO AVOID RETURN AND DELAY

STATE OF NEW HAMPSHIRE

APPLICATION FOR PERMIT TO EXCAVATE, DREDGE, FILL, MINE OR CONSTRUCT, IN ANY WATERS OF THE STATE

Permit No._____ Date_____
Hearing Required_____
Permit Approved/Denied By:_____
For the Special Board

Application is hereby made for a permit to accomplish work described below relating to excavating, dredging, or filling, in accordance with the Rules and Regulations established under the provisions of Chapter 387 of the Laws of 1969, and RSA Chapter 149:8A

1. Name of applicant (owner) N.H.D.P.W.&H., Div. 03 Telephone No. 524-6667
(please print or type)
Resident or principal business address P.O. Box 99, Laconia, NH 03246

2. Location of proposed construction
Town or City Moultonboro County Carroll

3. Adjacent to, or in ~~tidal~~ (fresh) water.

4. Name of water body Outflow from Lake Kanasatka.

5. Type of project - Fill ( ) Dredge ( ) Wharf (X) Other Culvert Maintenance
(Specify)

6. Reason(s) for proposed construction: repairs to 103' x 8' x 8' concrete box culvert

7. (a) Proposed starting date 8/2/76 (b) Completion date 9/3/76

8. If work is to be done by self, contractor, or agent, give his name and address below:
N.H.D.P.W.& H. Maint. Division 03 Telephone Number 524-6667
(This information to be submitted prior to construction)

9. Description of construction (use reverse side for additional information):
   (a) Type of material Gravel (see reverse)
   (b) Estimated quantity of dredged material (cu. yd.): 50 CY
   (b) Estimated quantity of fill material (cu. yd.): 50 CY
   (d) Final disposition of dredged material: Restore channel
   (e) If any channel is to be constructed, the distance the flow of water is to be rerouted: N/A
   (f) Enclosed for your information is a copy of RSA Chapter 149:8-A, which is administered and enforced by the Water Supply and Pollution Control Commission. One copy of your application will be acted upon by the W.S.P.C.C. and such action will be incorporated in one distribution.

10. I hereby certify that the applicant has filed three (3) copies of said application with the Town/~~City~~ of Moultonboro as required by Chapter 483-A.1 as amended 1973.

DATE_____ Signature_____
Town/City Clerk

11. Complete list of all abutting owners, their addresses and phone numbers: (They have been contacted and the work proposed has been explained to them. Note on separate sheet objections raised by abutters).

A permit issued under this application shall be non-transferable and shall expire two years from date of issue.

Signature of Applicant [signature]

Date 7/26/76

Rev. 8/25/73

[illegible]

[illegible] 27, 1977

[illegible]

SURVEY OF ABOVE DAM WAS MADE AND ITS CONDITION IS AS FOLLOWS:

1. LAKE WATER LEVEL : 14 INCHES BELOW NORMAL LEVEL.

2. LAKE WATER LEVEL AT DAM: 4 INCHES BELOW TOP OF EXISTING BOARD.

3. LEAKS IN DAM : AT EVERY BOARD SEAM WATER IS LEAKING IN VAST AMOUNTS. AT APPROX 32 INCHES BELOW EXISTING TOP DAM BOARD A VERY LARGE LEAK IS EVIDENT (ON THE LAKE SIDE OF THIS LEAK IS A SHOE STUCK IN DAM)

4. VOLUME OF LEAKS : ESTIMATED 150 GAL. PER MINUTE (PLUS)

5. DAM BOARDS : MADE OF WOOD AND IN BAD CONDITION. ROT IS APPARANT ESPECIALLY AT SEAMS.

6. ROCKS AT DAM : ROCKS HAVE BEEN STACKED ON LAKE SIDE OF DAM APPARENTLY IN EFFORT TO STOP LEAKS.

HAZZARDS:

1. DAM BOARDS IN BAD CONDITION COULD GIVE AWAY AT ANY TIME.

2. BAD CONDITION OF BOARDS LOCATED BELOW THE 32 INCH LEVEL SO IF BOARDS GAVE AWAY LAKE COULD LOSE AT LEFT 4 FOOT OF WATER.

3. BOARDS CAN BE REMOVED WITH EASE. ANY ONE CAN TAMPER WITH LAKE LEVEL. EFFORT SHOULD BE MADE TO LOCK & SECURE BOARDS IN PLACE SO ONLY AUTHORIZED PERSON MAY REMOVE BOARD

RECOMENDATIONS:

SECURE BOARDS . STOP LEAKS. RAISE BOARD LEVEL AT LEST 12 TO 14 INCHES.

Thomas F. Dowling II

THOMAS F. DOWLING II
DEER CROSSING ROAD
MOULTONBORO, N.H.

Paul H. Schmidt

PAUL SCHMIDT
DEER CROSSING ROAD
MOULTONBORO, N.H.

MEMBERS LAKE KANASATKA ASSOCIATION, INC.

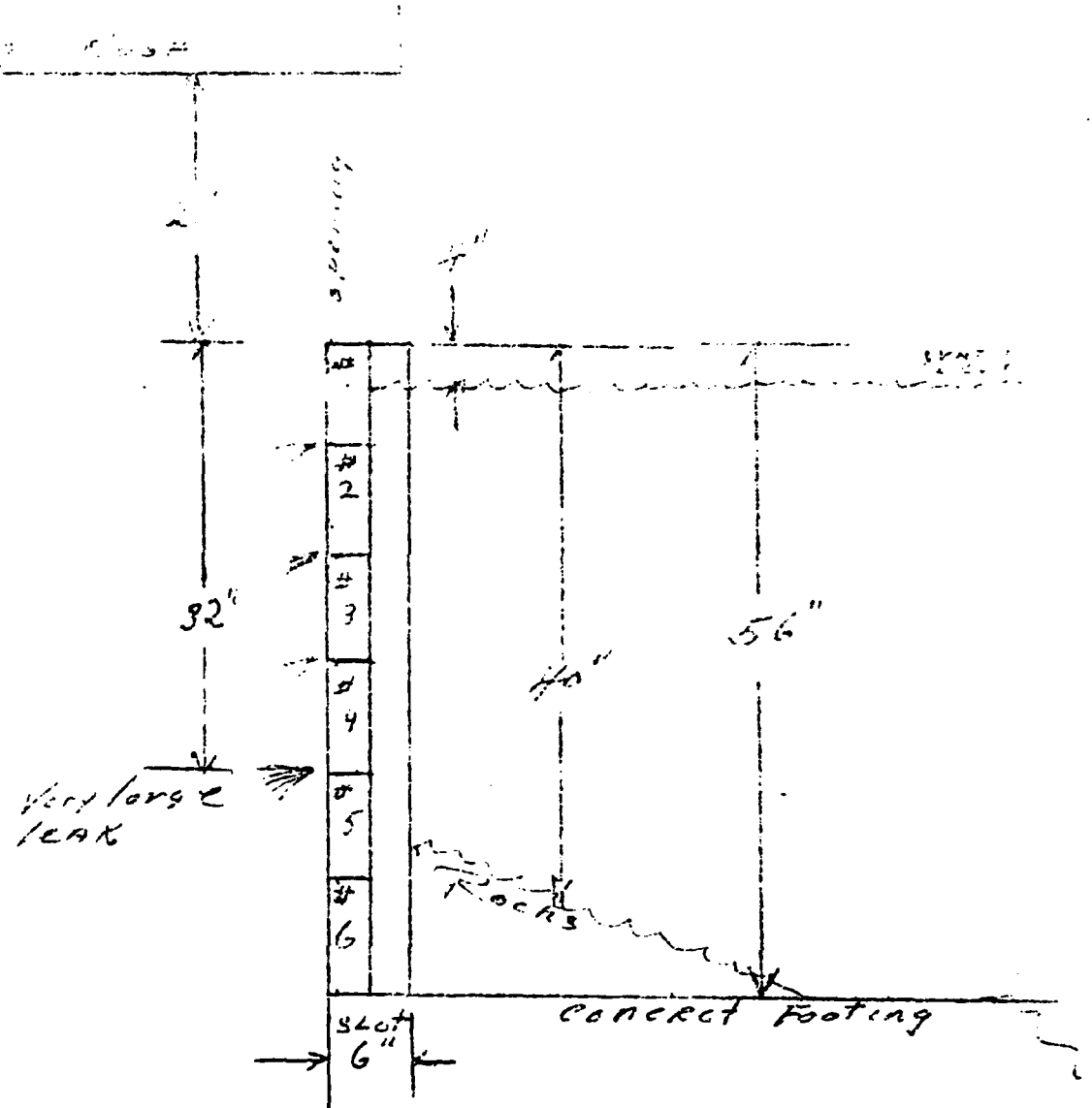


FIGURE # 2 : END VIEW - DAM AT ROUTE # 25 - LAKE KANASATKA

1. ROCKS HAVE BEEN STACKED AT APPROX BOARD $ 5 LEVEL

2. LEAKS AT ALL BOARD SEAMS - VERY LARGE LEAK AT BOARD 4 & 5 - A SHOE IS STUCK IN BOARD

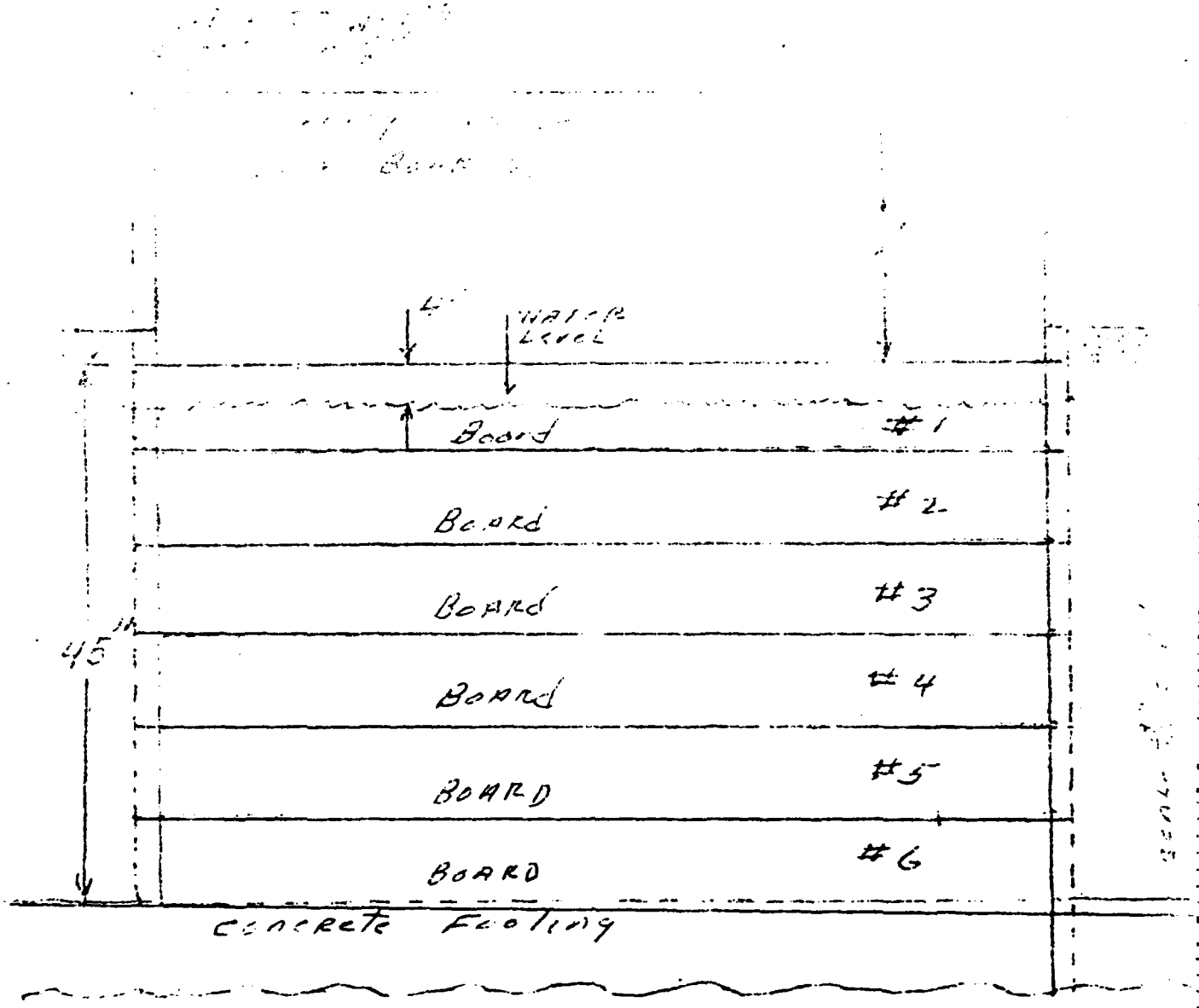


FIGURE # 1 : LAKE SIDE VIEW - DAM AT ROUTE # 25 - LAKE KANASATKA.

GENERAL SPECIFICATIONS:

DAM BOARDS	:	LENGTH 7' 7", WIDTH 7 1/2" THICKNESS 3 1/2" WOOD
NUMBER DAM BOARDS	:	APPROX 6
WIDTH BOARD SLOT	:	6"
OPENING ABOVE BOARD	:	PRESENT OPENING 2 "
WATER LEVEL	:	PRESENT LEVEL 4 " BELOW PRESENT TOP BOARD.

IT APPEARS THAT BOARDS REST ON A CONCRETE FOOTING. HOWEVER AREA CLOSE TO BOARDS HAS ROCK.

John R. Taylor
Sandwich, N. H.
R.F.D. 1, Center Harbor
N. H. 03226

October 1, 1974

Hon. Lyle Kerson
Groveton, New Hampshire

Dear Lyle:

Certainly nice seeing you at the Republican State Convention. Thought all went off well and a good time was had by all.

Reference to my conversation with you on Lake Kanastka Watershed dam and the problem we are having. Enclosed is a report on said dam and needless to say it's in bad condition. Certainly hope you can be of some help to all concerned. Kindly keep me advised.

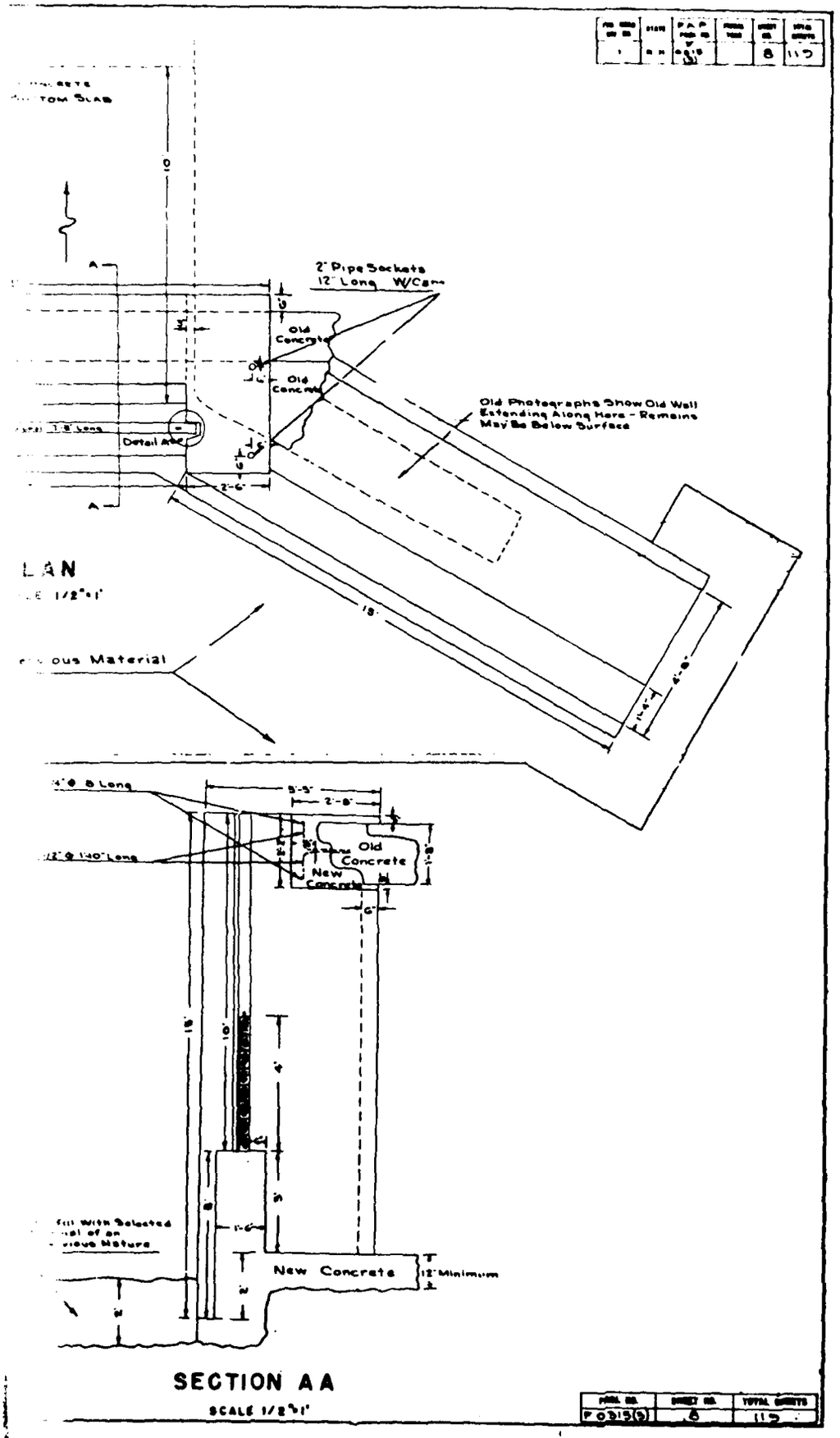
With usual best wishes; I remain

Sincerely.,
Jack Taylor
John R. Taylor, Treas.
Lake Kanastka Assoc. Inc.

JRT/

LIST OF AVAILABLE DATA
LAKE KANASATKA DAM
(continued)

Document	Contents	Location
Water Resources Board letter to Board of Selectmen, Town of Moultonboro	Notice of dam inspection dated 21 January 1975	Water Resources Board State of New Hampshire
State of New Hampshire Application for Permit to Excavate, Dredge, Fill, Mine or Construct	Application by New Hampshire Department of Public Works and Highways to perform culvert maintenance dated 26 July 1976	Water Resources Board State of New Hampshire (See Appendix pages B-7 and B-8)
Date Sheet on Lake Kanasatka, Moultonboro	Hydraulic and physical data on Lake Kanasatka Dam	Water Resources Board State of New Hampshire (See Appendix pages B-9 and B-10)



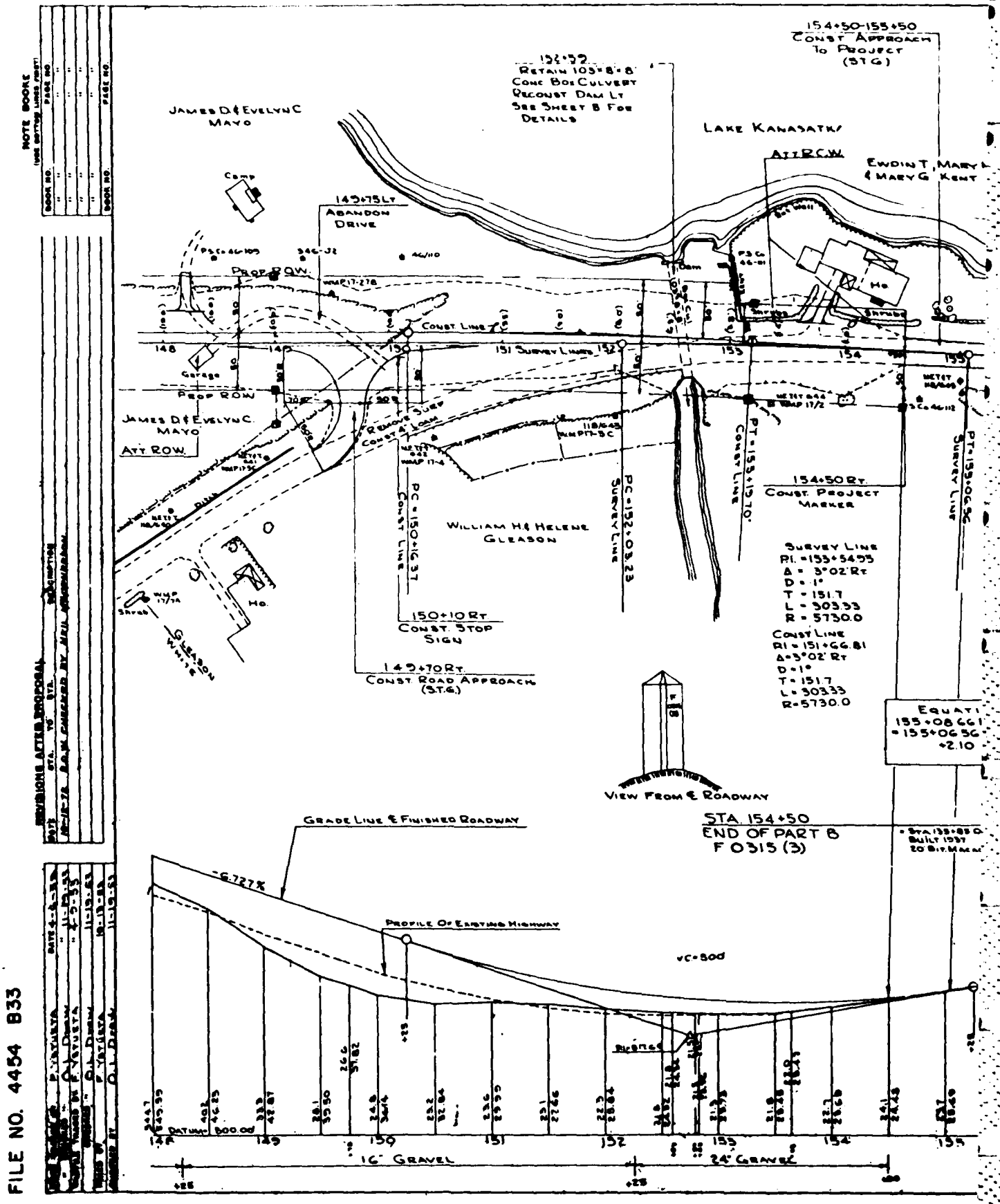
PLAN

SECTION A A

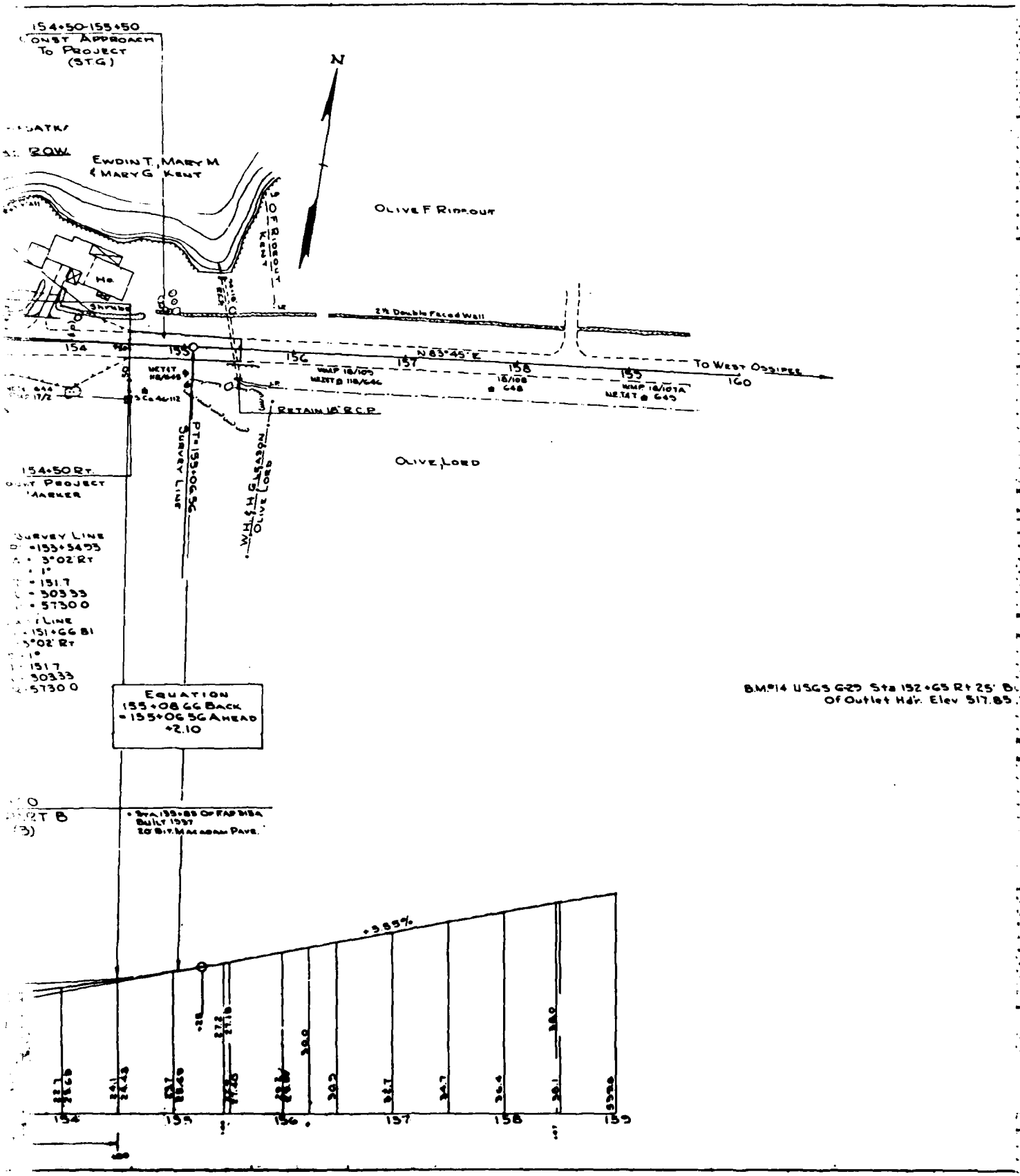
SCALE 1/2"=1'

B-12

343

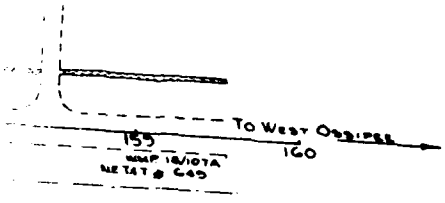


FILE NO. 4454 B33



BM #14 USGS G-29 Sta 152+65 Rt 25' B
Of Outlet Hdr. Elev 517.85

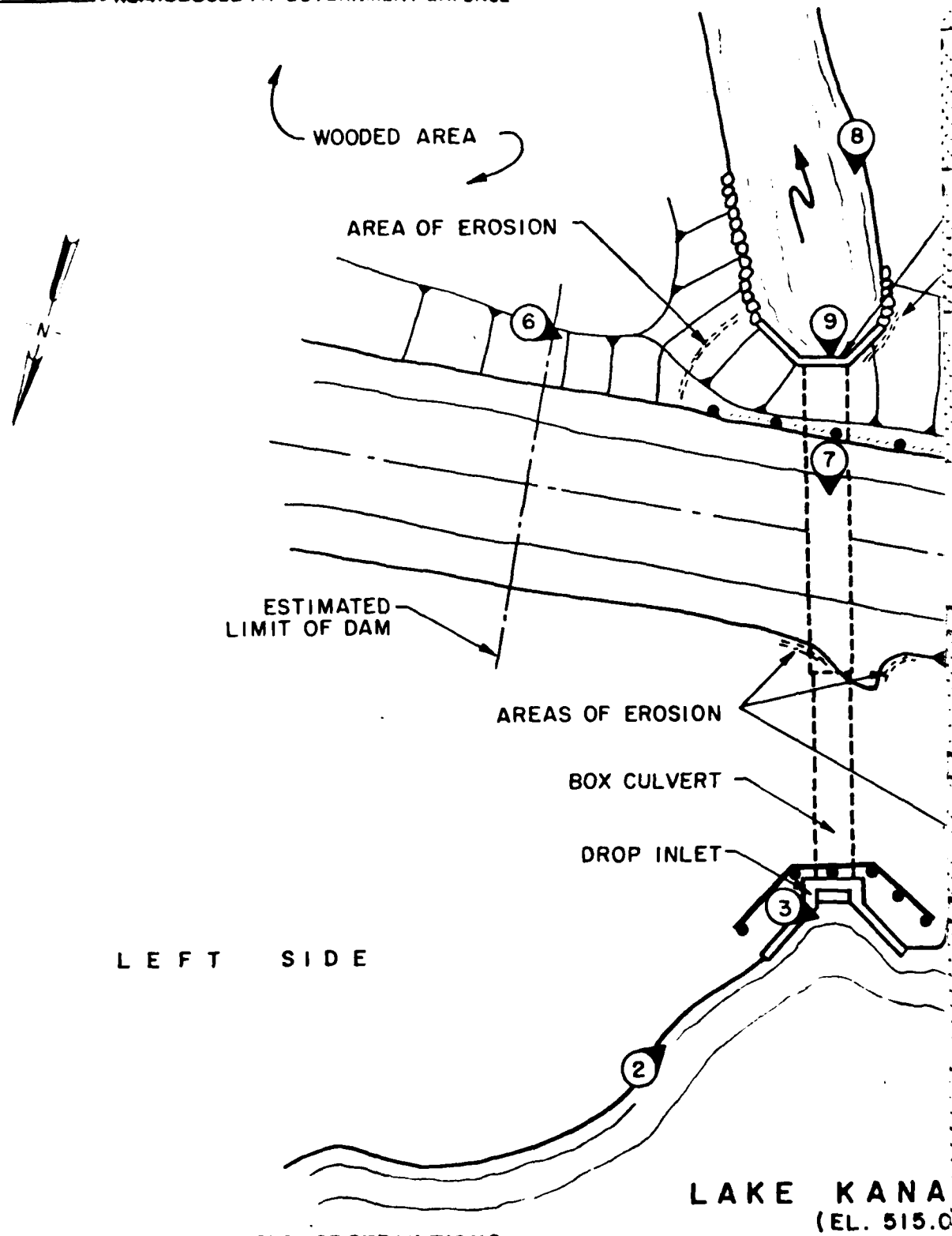
3/3



B.M.#14 USGS G-29 Sta 152+65 Rt 25' Bronze Tablet in End Of Outlet Hdr. Elev. 517.85'

393

APPENDIX C - PHOTOGRAPHS



NOTE

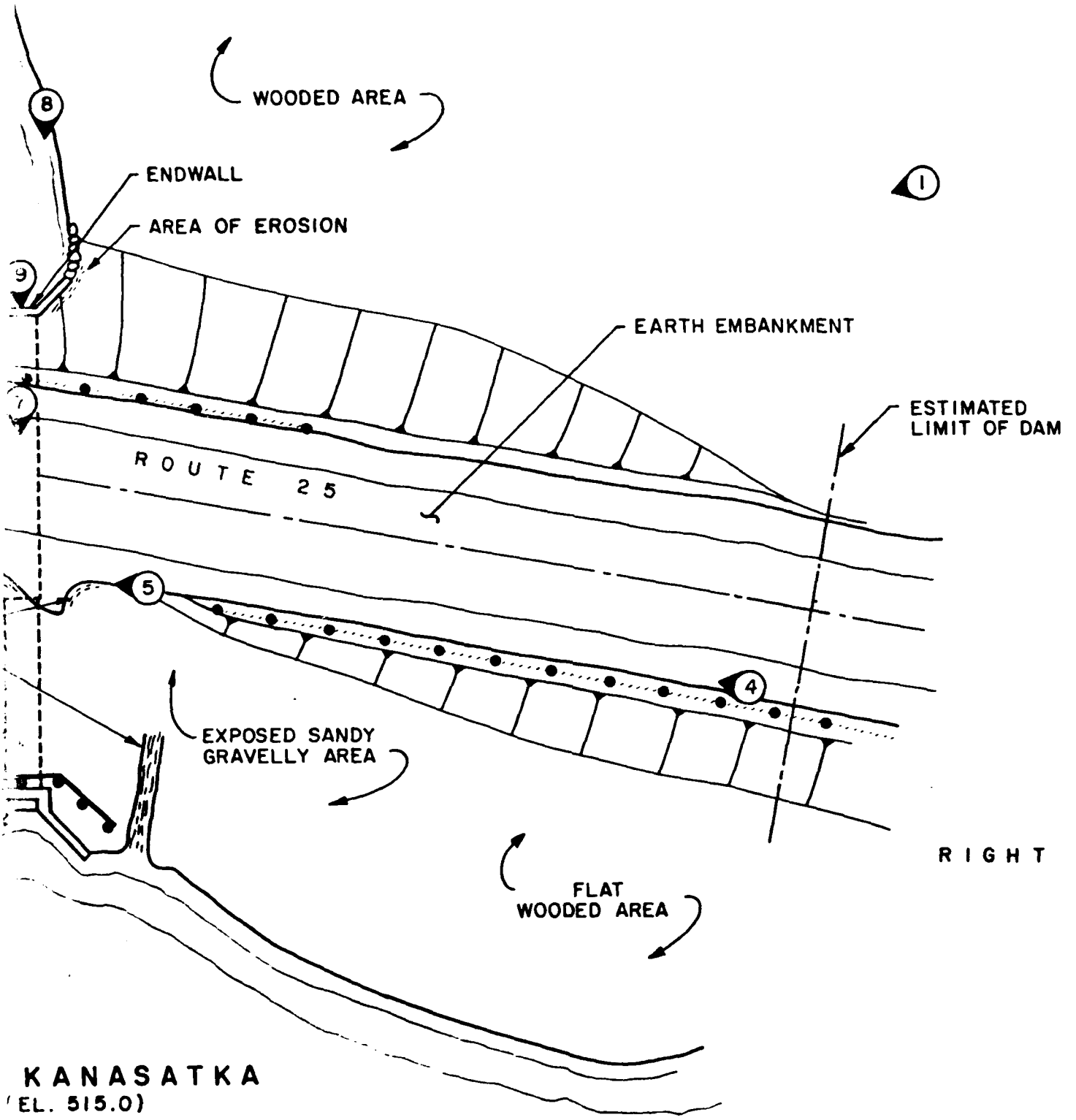
PLAN DEVELOPED FROM FIELD OBSERVATIONS MADE ON 1 NOVEMBER 1979.

LEGEND

(2) PHOTO NUMBER AND DIRECTION OF VIEW

FILE NO 4454 B34

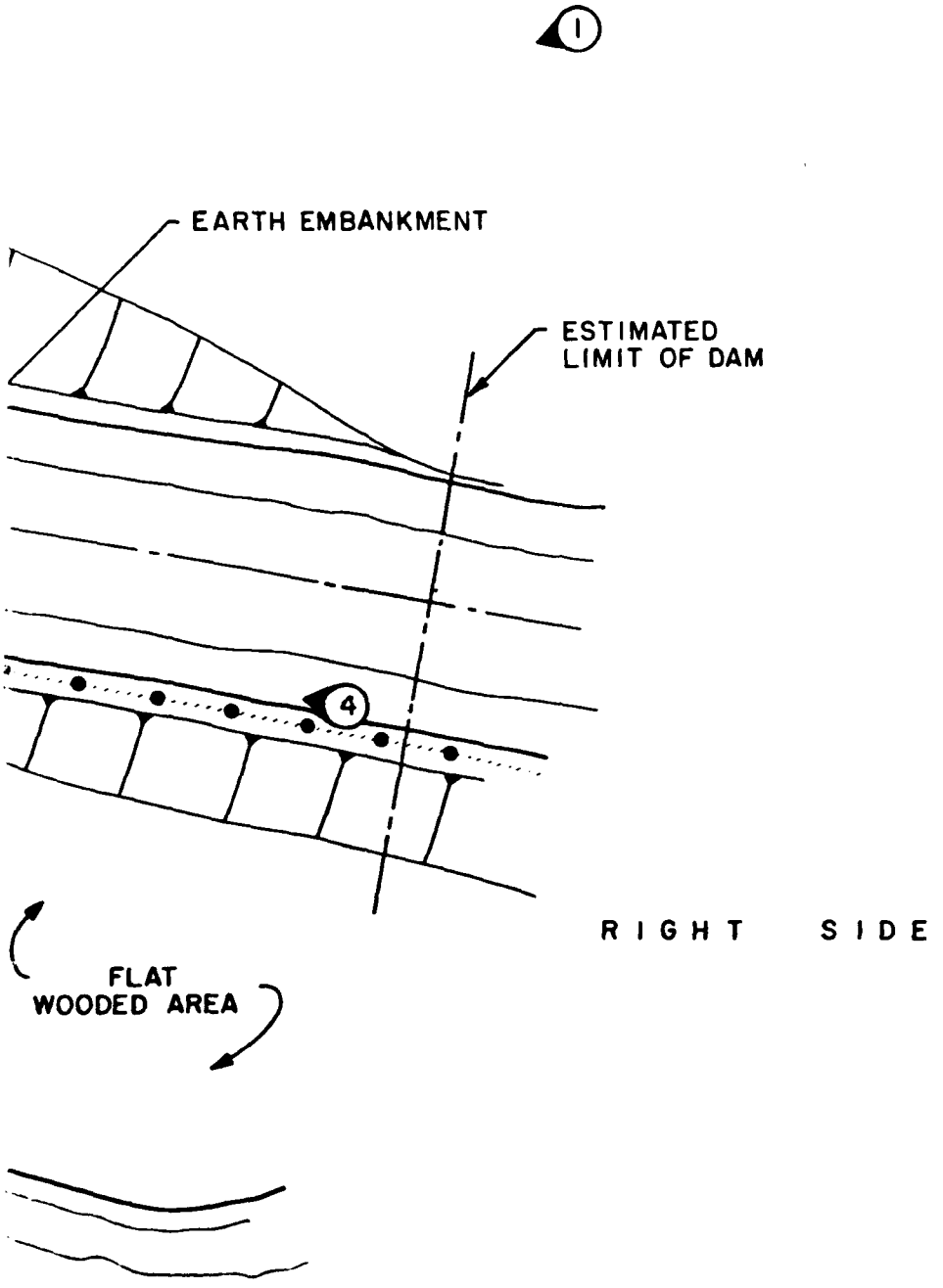
HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS



Lake Kanasatka Da
Moultonboro, NH

SITE PLAN SKET

Approx. Scale: 1" = 30'



Lake Kanasatka Dam
Moultonboro, NH

SITE PLAN SKETCH

Approx. Scale: 1" = 30' April 1980

C-1

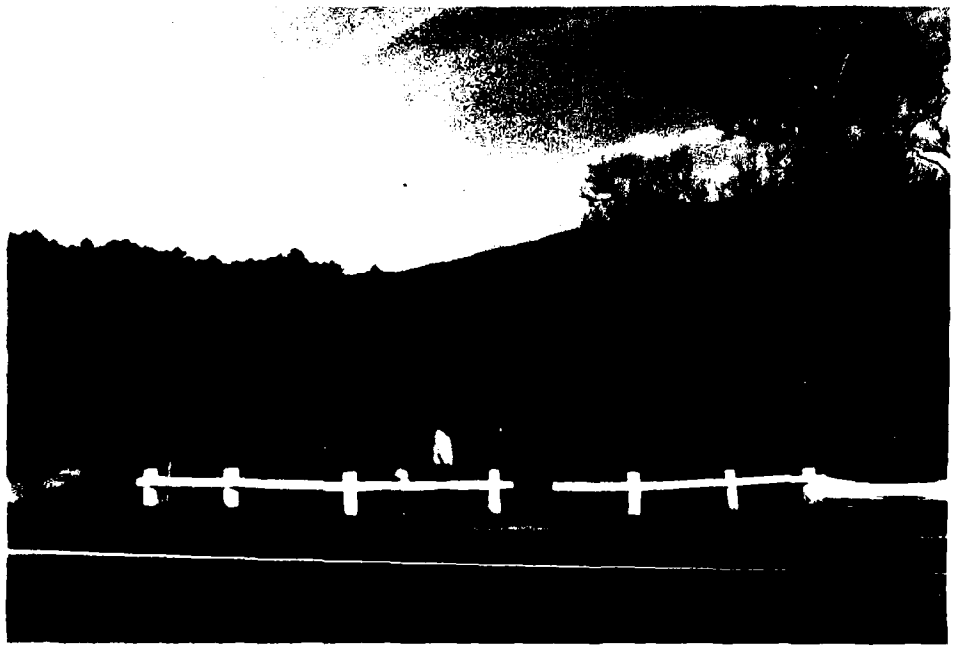
2. Drop inlet structure

3. Area of erosion on upstream side adjacent to right wingwall

4. Upstream side and alignment of roadway from right end of dam

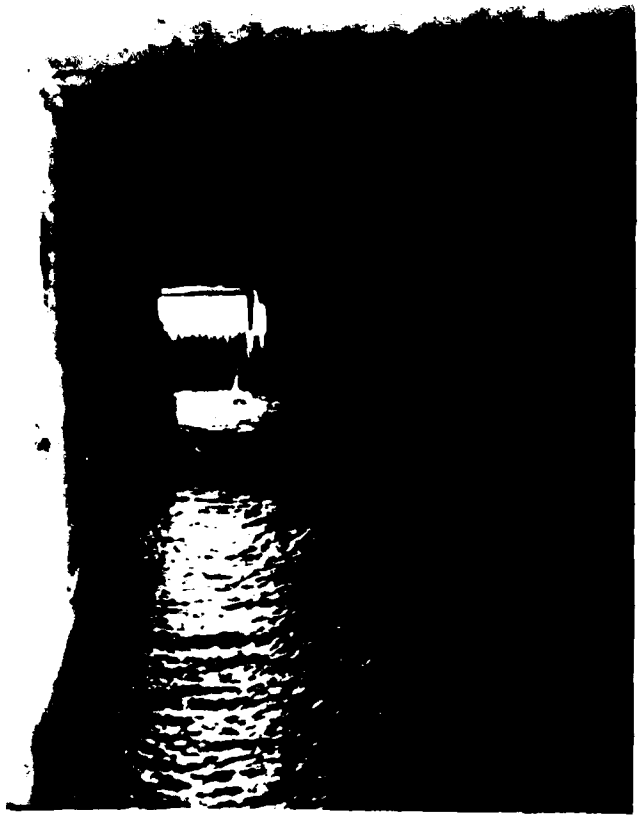
5. Area of erosion adjacent to roadway shoulder

6. Downstream side and alignment of roadway from left end of dam



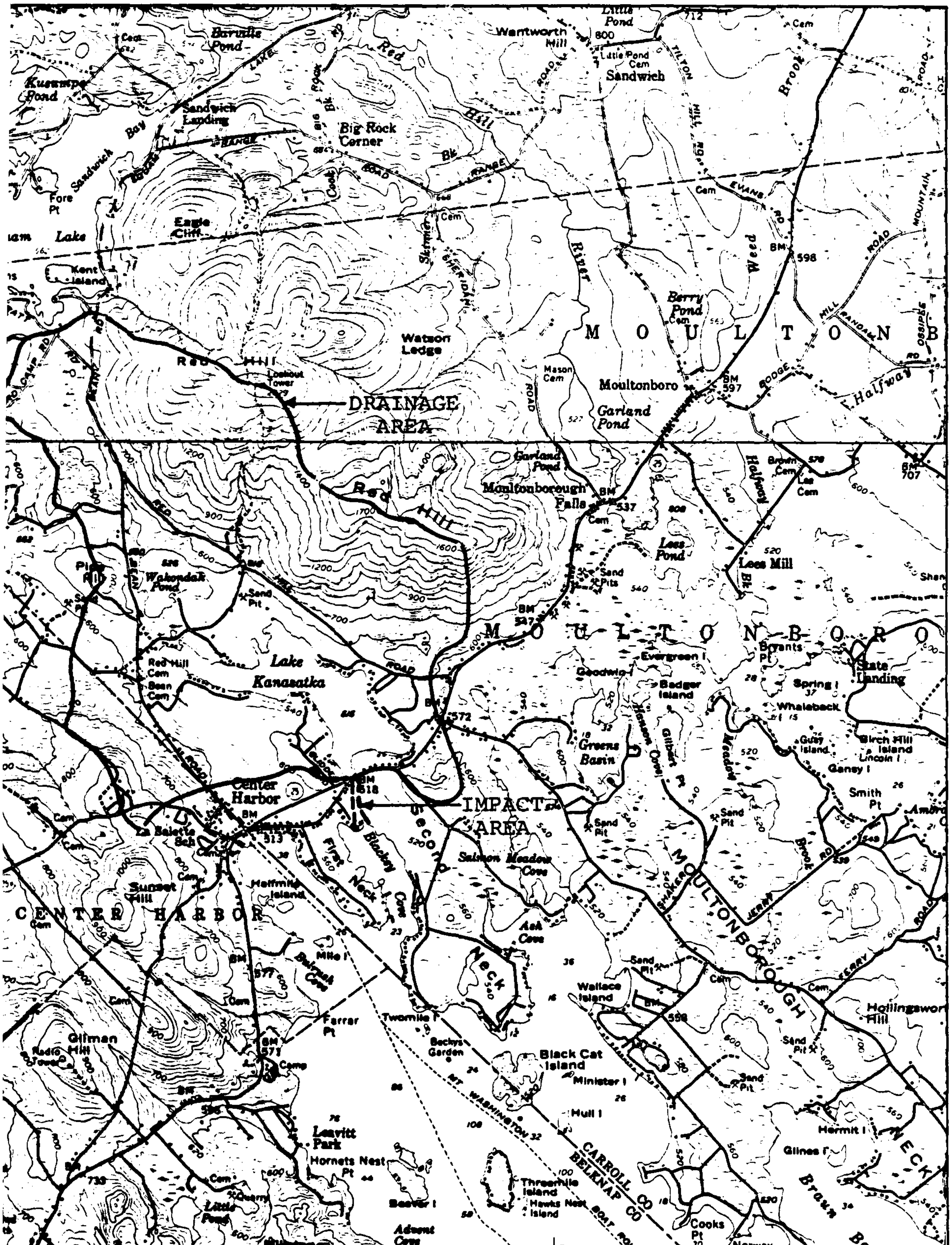
7. Crest of embankment and Lake Kanasatka looking upstream

8. Sluiceway outlet and dry-laid stone masonry walls



9. Inside of box culvert looking upstream

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS



KANASATKA LAKE DAM NH 00125		DRAINAGE AREA AND DAM FAILURE IMPACT AREA MAP APPROX. SCALE: 1" = 5200'

CAMP DRESSER & McKEE | CLIENT HALEY & ALDRICH | JOB NO. 561-10-RT-4 | COMPUTED BY JED
PROJECT DAM INSP. | DATE CHECKED 1-30-80 | DATE 1/22/80
DETAIL LAKE KANASATKA | CHECKED BY Joe A. | PAGE NO. 1

ELEVATIONS

Top of Dam El. 524.0
D/S Toe of Dam El. 507.0
Top of Stoplog Platform El. 519.0
Sill of Stoplog Bay El. 511.0
Inv. of Box Outlet El. 510.0
Inv. of Stilling Pool El. 506.5

Top of Stoplogs at time of Inspection El. 514.1, summer elev. 515.0
W.S. at time of Inspection El. 515.0

SURFACE AREAS (from USGS Quads)

Drainage Area = 4670 acres = 7.3 sq. mi.

Surface Area of Pond (W.S. El. 515.0) = 392 ac.; owner reports 371 ac. at El. 514±

Surface Area at El. 520.0 = 467 ac.

STORAGE CAPACITIES

Max. water depth reported as 30 ft.; Assume avg. depth = 10 ft.

Then storage at El. 514.0 = 371 ac. × 10 ft. × 1/3 = 1237, say 1,240 ac-ft.

Storage at El. 515.0 = 1240 + $\left(\frac{371+392}{2}\right)$ × 1' = 1,622 ac. ft.

Storage at El. 524.0 = 1,622 + $\left(\frac{392+467}{2}\right)$ 5' + 467 × 4' = 5,640 ac-ft.

SIZE & HAZARD CLASSIFICATIONS

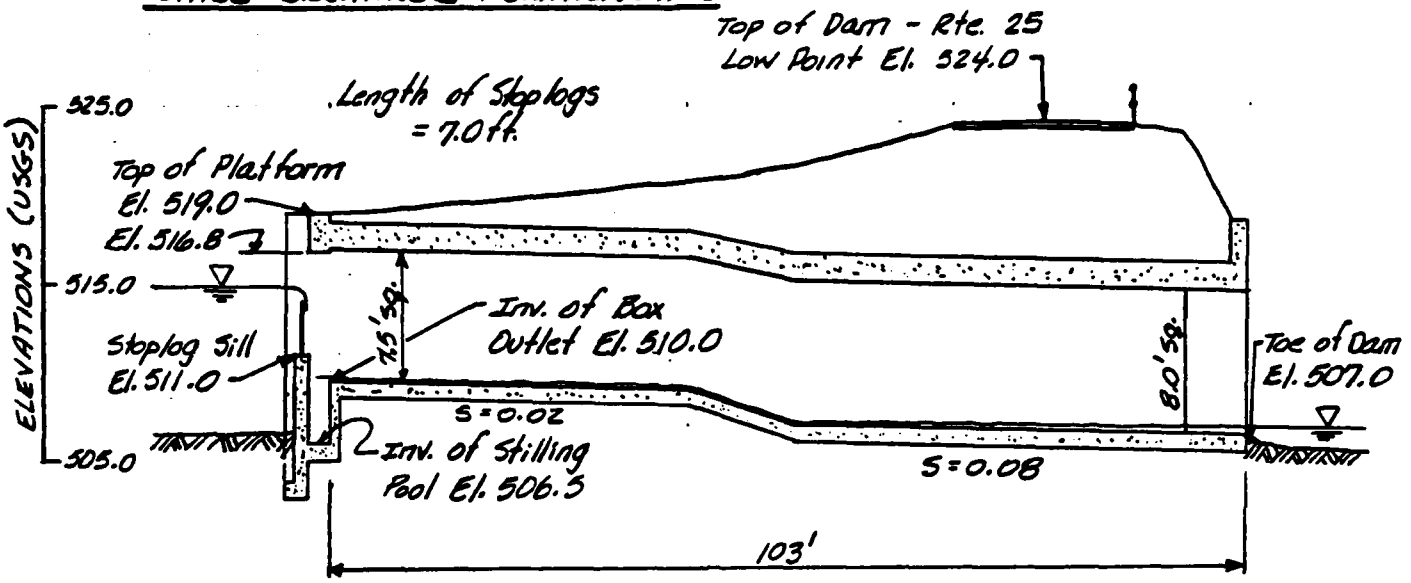
Height = 524 - 507 = 17 ft. and storage at El. 524.0 = 5,640 ac-ft.
∴ Size is INTERMEDIATE based on storage

Hazard is SIGNIFICANT base on Dam Failure Analysis

TEST FLOOD DETERMINATION

Intermediate size and Significant hazard, COE give test flood range of 1/2 PMF to PMF. Adopt 1/2 PMF as size is at low end of size range. Since terrain is Mountainous, Test Flood Inflow = 7.3 sq.mi. × 2100 csm × 1/2 = 7,660 cfs

STAGE - DISCHARGE RELATIONSHIPS



X-SECT. THRU DAM AND BOX OUTLET

Determine stage - discharge relationships for 2 conditions:

1) All stoplogs (summer level of elev. 515.0) in place at start of storm and not removed

2) Same as 1) but stoplogs removed when W.S. reaches bottom of inlet platform (elev. 516.8)

Hydraulic Controls:

1) & 2) a W.S. Elev. from 515.0 to 516.8

$Q = CLH^{3/2}$; $C = 3.4$, $L = 7.0'$ $\therefore Q = 23.8H^{3/2}$
where H = W.S. - 515.0

1) b W.S. Elev. from 516.8 to 524.0 (top of dam)

$Q = CA\sqrt{2gH}$, assume submerged orifice

let $C = 0.85$; $A = 1.8' \times 7.0' = 12.6$ s.f.

$Q = 0.85 \times 12.6 \times \sqrt{64.4}\ H^{1/2}$

$= 86H^{1/2}$

where H = W.S. - 516.8

2) c W.S. Elev. from 516.8 to 520 with stoplogs removed

$Q = CA_c\left[2g\left(H - \alpha V_1^2/2g - d_c - h_{f1.2}\right)\right]^{1/2}$; Inlet Control

assume: $\alpha V_1^2/2g$ and $h_{f1.2}$ to be negligable

$d_c \simeq 2/3\,H$

then $Q = CA_c\left[2g\left(H - 2/3H\right)\right]^{1/2} = CA_c\left[2/3\,gH\right]^{1/2}$

let $C = 0.85$; $A_c = d_c \times (W = 7') = 2/3H \times 7 = 4.67H$

$\therefore Q = 0.85 \times 4.67H\left(2/3 \times 32.2 \times H\right)^{1/2} = 3.97H(21.5H)^{1/2}$

$= 3.97H(21.5)^{1/2}H^{1/2} = 18.4H^{3/2}$

where H = W.S. Elev. − 511.0

2) d W.S. Elev. from 520 to 524 with stoplogs removed

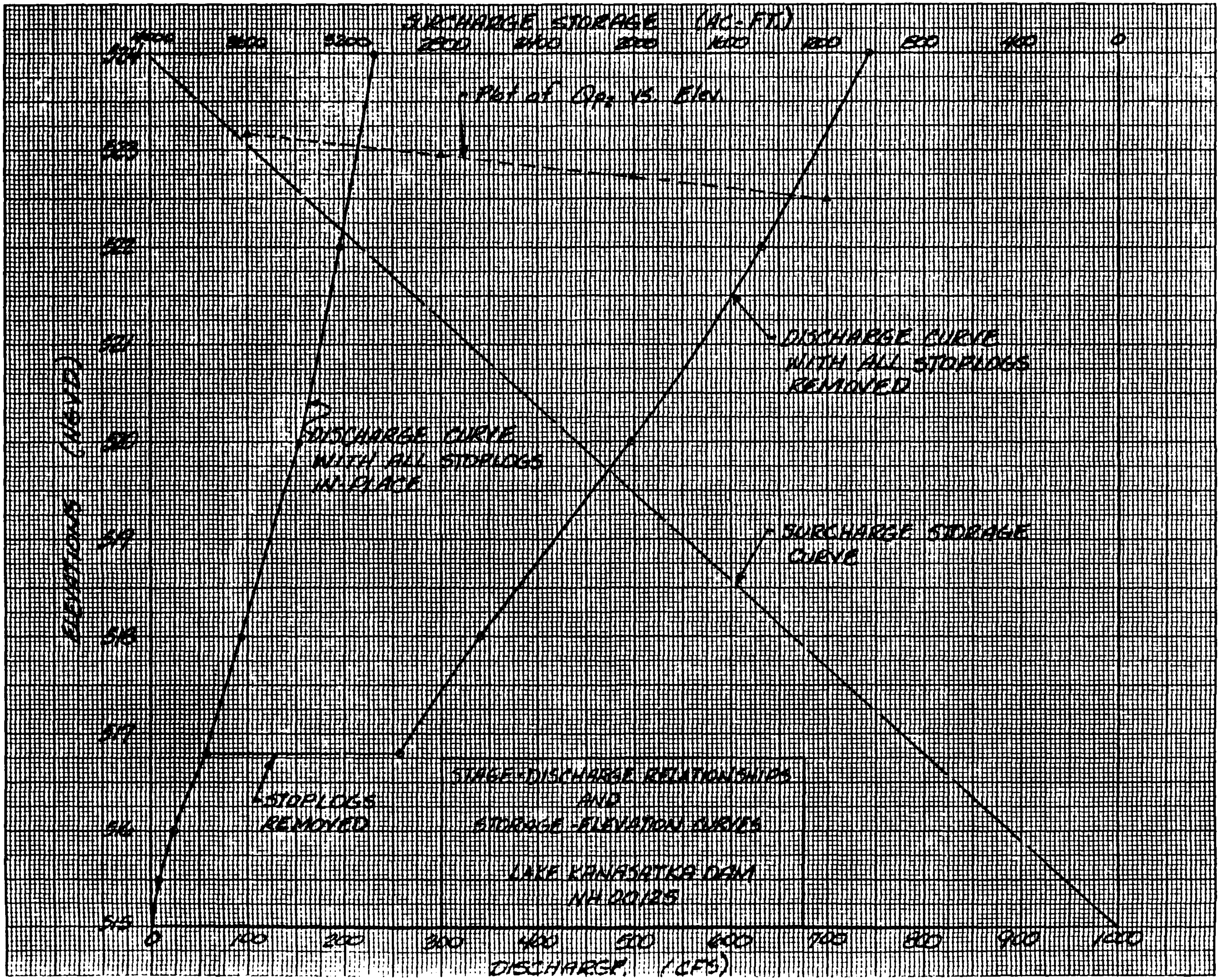
$Q = CA\sqrt{2gH} = CA\sqrt{2g}\sqrt{H}$

let $C = 0.85$; $A = 7' \times 5.8' = 40.6$ s.f.

then $Q = 0.85 \times 40.6 \times (64.4)^{1/2}H^{1/2} = 277H^{1/2}$

where H = W.S. El. − 516.8

W.S. ELEV.	STOPLOGS TO ELEV. 515.0, NONE REMOVED				STOPLOGS TO ELEV. 515.0, REMOVED @ W.S. ELEV. 516.8			
	H	Q (cfs) (a)	H	Q (cfs) (b)	H	Q (cfs) (c)	H	Q (cfs) (d)
515.0	0	0	-		0	0		
515.5	0.5	8	-		0.5	8		
516.0	1.0	24	-		1.0	24		
516.8	1.8	57	0		1.8/5.8	57/257	-	
518.0	N/A		1.2	94	7	341	N/A	
520.0	N/A		3.2	154	9	497	3.2	496
522.0	N/A		5.2	196	N/A		5.2	632
524.0	N/A		7.2	231	N/A		7.2	743


SURCHARGE STORAGE (AC-FT)
Plot of Q_{P2} VS. Elev.
DISCHARGE CURVE WITH ALL STOPLOGS REMOVED
DISCHARGE CURVE WITH ALL STOPLOGS IN PLACE
SURCHARGE STORAGE CURVE
STOPLOGS REMOVED
STAGE-DISCHARGE RELATIONSHIPS AND STORAGE-ELEVATION CURVES
LAKE KANASATKA DAM NH 00125
ELEVATIONS (NGVD)
DISCHARGE (CFS)
0
100
200
300
400
500
600
700
800
900
1000

SURCHARGE-STORAGE RELATIONSHIPS

Estimated total volume of R.O. during test flood

$$= 9.5'' \times \frac{1 ft.}{12''} \times (D.A. = 4670 \text{ acres}) = 3{,}700 \text{ ac-ft}$$

Since available storage between winter pool (El. 514.0) and top of dam (El. 524.0) = 4,400 ac-ft. and between summer pool (El. 515.0) and top of dam = 4,020 ac-ft, the dam will not be overtopped by the test flood.

Since a continuous outflow would be occurring during the test flood event, surcharge-storage routing must be performed to determine the actual stages.

SURCHARGE-STORAGE ROUTING

Use graphical solution:

Since $Qp_2 = Qp_1 (1 - STOR/R.O.)$

then $STOR = (R.O.)(1 - Qp_2/Qp_1)$

$= (9.5'')(1 - Qp_2/7660)$

Qp_2 (cfs)	STOR. (in)	STOR. (ac-ft.)	ELEV.
100	9.38	3650	523.17
300	9.13	3550	522.95
500	8.88	3460	522.75
700	8.63	3360	522.50

Plotting the above points (Qp_2 vs Elev.) on the stage Discharge Curve results in the following:

	Stoplogs Remain	Stoplogs Removed
Test Flood Outflow:	215 cfs	665 cfs
Test Flood Pond El.:	523.05	522.54
Test Flood Surch.-Stor.:	3600 ac-ft.	3380 ac-ft.

OUTLET WORKS

Determine discharge capacity if all stoplogs are removed with pond at summer pool elev. 515.0

Assume control to be at inlet to box culvert,

then $Q = CA_c\left[2g\left(H - \alpha V_1^2/2g - d_c - h_{f1.2}\right)\right]^{1/2}$

from page 3, $Q = 18.4H^{3/2}$ where H = W.S. - El. 511.0

$\therefore Q = 18.4(515-511)^{3/2} = 150$ cfs

Check if $S_c < S_o$ where $S_o = 0.02$

$S_c = (Q/K_c)^2$ where $Q = 150$ cfs

$K_c = (1.49/n)R^{2/3}A_c$

and

$n = 0.015$

$A_c = 7' \times d_c = 7 \times 2/3H$

$= 7 \times 2/3 \times 4 = 18.67$

$R = A_c/P = 18.67/(7+2d_c)$

$= 18.67/12.33 = 1.51$

then $K_c = (1.49/0.015)(1.51)^{2/3}(18.67) = 2,444$

$\therefore S_c = (150/2444)^2 = 0.0038$

Since $(S_c = 0.0038) < (S_o = 0.02)$, the assumption of critical depth at inlet is correct

DAM FAILURE ANALYSIS

Top of Dam El. 524.0
Toe of Dam El. 507.0
} Ht. = 524 - 507 = 17ft.

Length of Dam at mid-height ≃ 100 ft.

then $Q_f = 8/27\ W_o \sqrt{g}\ Y_o^{3/2}$

$= 8/27\ (0.4 \times 100)(32.2)^{1/2}(17)^{3/2} = 4{,}700$ cfs

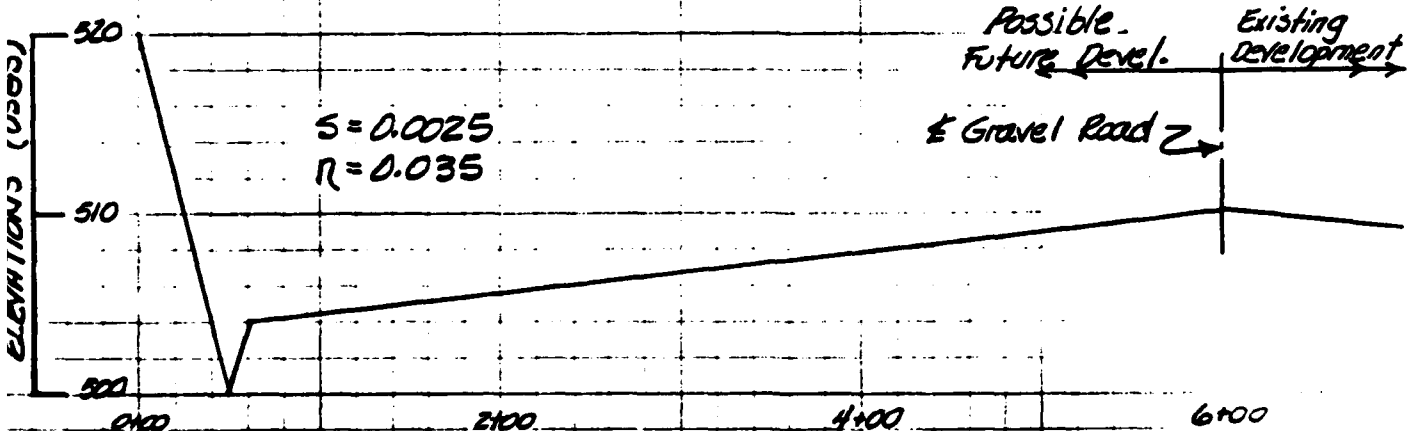
Project discharge prior to failure:
Inlet control .... submerged orfice

then $Q_o = CA\sqrt{2gH}$ where $C = 0.85$
$A = 7.0 \times 5.8' = 40.6$ s.f.
$H = 524 - 516.8 = 7.2'$
℄ crown of inlet

$\therefore Q_o = 0.85(40.6)(64.4 \times 7.2)^{1/2}$
$= 1743$ cfs

then $Q_{P_1} = 1740 + 4700 = 5{,}440$ cfs

Determine Stage - Discharge Relationship of D/S Channel:



TYP. D/S CHANNEL X-SECT.

W.S. ELEV.	AREA (s.f.)	R	FLOW (cfs)
504	40	1.857	130
506	225	1.087	510
508	820	2.090	2,850
510	1765	3.035	7,910

D/S W.S. prior to failure:

Q_o = 740 cfs

W.S. El. = $\frac{740-510}{2850-510} \times 2 + 506 = 506.2$

D/S W.S. after failure:

Q_{P_1} = 5,440 cfs

W.S. El. = $\frac{5440-2850}{7910-2850} \times 2 + 508 = 509.0$

Based on the field observations, a flow of 740 cfs would have no significant effect on existing development. However, in the event of a dam failure, at the end of the gravel road, on the shore of Lake Winnipesaukee, there are 2 to 3 homes which would experience shallow depth - high velocity flooding. Furthermore, future development between the gravel road and the d/s channel appears likely.
Therefore, potential hazard in the event of a dam failure is considered to be significant.

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

8-85

DTIC