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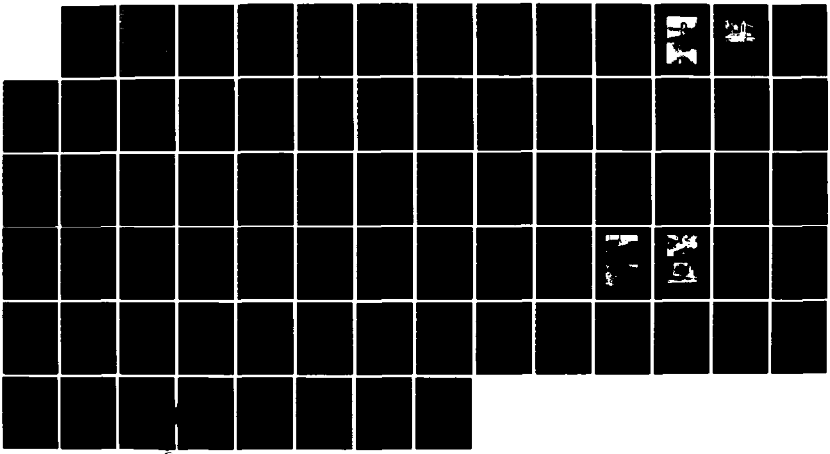

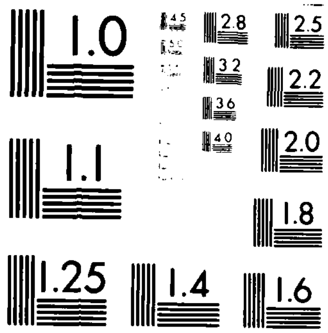
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SACO RIVER BASIN

OSSIPEE, NEW HAMPSHIRE

DAN HOLE POND DAM

NH 00376

NHWRB 188.01

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

NOVEMBER 1978

UNCLASSIFIED

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DAMS, INSPECTION, DAM SAFETY,

Saco RIver Basin
Ossipee, New Hampshire
Dan Hole River

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

The dam is a 114 ft. long, concrete faced, cemented stone masonry gravity structure with a maximu height of of about 12.5 ft. The dam is intermediate in size with a significant hazard potential. The test flood is in the range of ½ the PMF to full PMF. The dam is in poor condition at the present time. There was serious seepage noted at the toe of the dam; which requires prompt attention. Operationally, the dam requires some routine maintenance to preclude the development of more serious problems-

DISCLAIMER NOTICE

DAN HOLE POND DAM
NH 00376

SACO RIVER BASIN
OSSIPEE, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No: NH 00376
NHWRB No.: 188.01
Name of Dam: DAN HOLE POND DAM
Town: Ossipee
County and State: Carroll County, New Hampshire
Stream: Dan Hole River
Date of Inspection: 12 September 1978

BRIEF ASSESSMENT

Dan Hole Pond Dam is a 114 foot long, concrete faced, cemented stone masonry gravity structure with a maximum height of approximately 12.5 feet. The dam includes 54.5 feet of broad crested spillway separated into 33.5 foot and 21 foot sections by a gate house. Discharges are regulated by a rack gear operated, 3 foot wide by 4 foot high timber sluice gate discharging into a concrete culvert. Initial construction was probably in 1910 with subsequent alteration in 1958. The dam is presently owned by the Center Ossipee Fire District.

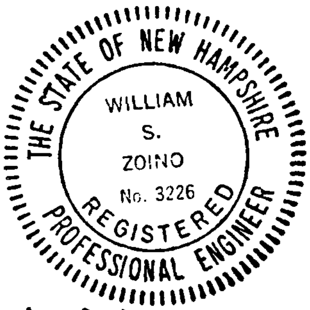
The dam lies on the Dan Hole River, which eventually discharges into Ossipee Lake. Dan Hole Pond's six square mile drainage area is heavily forested and steeply sloping. The dam's maximum impoundment of 1810 acre-feet places it in the INTERMEDIATE size category. In the event of failure, the significant property damage and remote possibility of loss of life anticipated warrant a SIGNIFICANT hazard potential classification.

Based on size and hazard potential rating and in accordance with the Corp's guidelines, the Test Flood (TF) is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. An inflow Test Flood of 12,000 cfs yields a maximum outflow at the dam of approximately 6000 cfs, which would result in overtopping on the order of 5.7 feet. The maximum discharge capacity of the dam without overtopping is only 500 cfs, or 8% of the Test Flood. Thus, the spillway is considered inadequate and a major storm could result in dam failure. The resolution of this problem requires a considerable increase in the discharge capacity of the dam or the provision of suitable emergency spillway facilities.

The dam's maximum discharge capacity is only 7800 cfs, or 78% of the Test Flood and, thus, the dam could be overtopped by as much as 2 feet. Based on this analysis, an improvement in the dam's discharge capacity is recommended.

The dam is in GOOD condition at the present time. Only a few relatively minor operating and maintenance improvements are necessary. Included in these are modification or replacement of the present hand crank system so that gates can be operated manually, monitoring of erosion at the end of the right training wall and of seepage through the square stone masonry near the left sluice gates when the gates are open, replacement of inadequate stoplogs, installation of a gauge at the dam and training of local officials in the dam operations to decrease response time in the event of emergencies. Additionally, the owner should implement a formal, written flood and emergency warning system.

The above recommendations and remedial measures should be implemented within 2 years of receipt of the Phase I Inspection Report by the owner. In light of the dam's GOOD condition, periodic technical inspections should be accomplished every two years.



William S. Zoino
New Hampshire Registration 3226

Nicholas A. Campagna
California Registration 21006

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 continued care and inspection can unsafe conditions be detected.

Phase I inspections 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 runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the Test Flood should not be interpreted as necessarily posing a highly inadequate condition. The Test Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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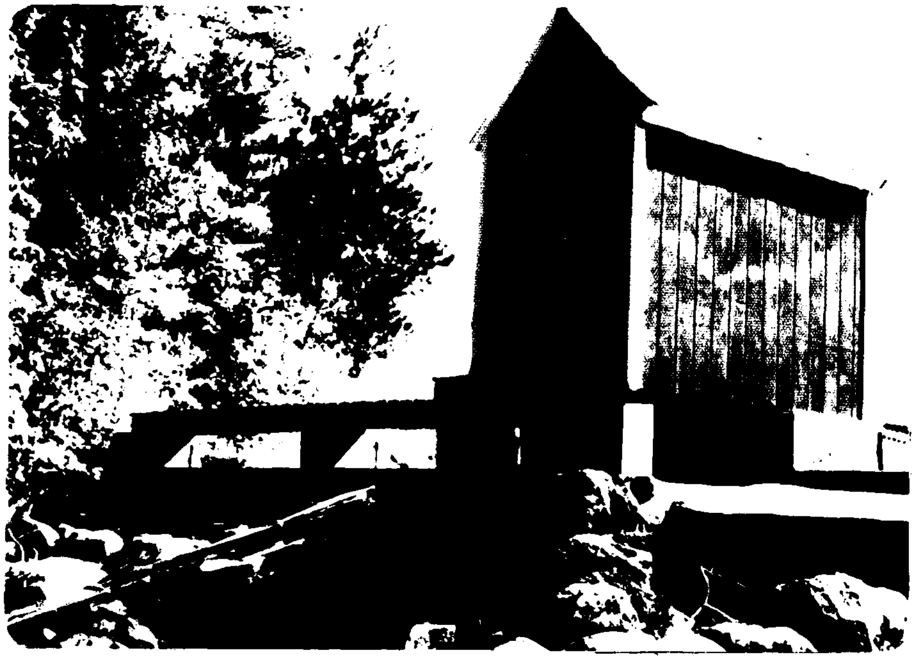
Overview from right side upstream

Overview from left side downstream



Overview of right side of dam and
gatehouse from downstream

SCALE

0 1/2 1 2 miles

FROM USGS WOLFEBORO, N.H. QUADRANGLE MAP

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC, INC. GEOTECHNICAL CONSULTANTS NEWTON UPPER FALLS, MASS.	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCUS PLAN

DAN HOLE POND DAM — NEW HAMPSHIRE

SCALE: AS NOTED

DATE: SEPT. [illegible]78

PHASE I INSPECTION REPORT

DAN HOLE POND DAM

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. Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to GZD under a letter of August 22, 1978 from Colonel Ralph T. Garver, Corps of Engineers. Contract No. DACW 33-78-C-0303 has been assigned by the Corps of Engineers for this work.

(b) Purpose

(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 quickly effective dam safety programs for non-federal dams.

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

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dam.

1.2 Description of Project

(a) Location

The dam is located approximately 3 miles southwest of the village of Center Ossipee on Route 16. The site, which is at the junction of Dan Hole Pond and Little Dan Hole Pond, is accessible by taking Eldrige Road approximately 1.7 miles from Doors Corner to the tennis court and then turning right into the woods on a heavily overgrown dirt road. The portion of the USGS Wolfeboro, N.H. quadrangle presented on page viii shows this locus. Figure 1 of Appendix B presents a site plan developed from the map and the site inspection.

(b) Description of Dam and Appurtenances

This dam is a concrete faced, cemented stone masonry gravity structure 114 feet long (Fig. 2). The downstream side of the dam is buttressed with dumped boulders (Fig. 3). A gate house located midway along the length of the dam divides a broad crested spillway, 21 feet long to the right of the structure and 33.5 feet long to the left. The top of the spillway is 1.5 feet below the dam crest. While the dam does contain stanchions for flashboards, this feature is not used. A wooden catwalk spans over the right spillway for access to the gate house. Foundation conditions at the site are not apparent. The dam has a maximum height of approximately 12.5 feet above the channel.

The wood framed gate house, which is approximately 7 feet by 9.5 feet in plan, contains the operating mechanism for a timber sluice gate which controls discharge through a 3 foot by 4 foot outlet culvert. Training walls abut the upstream face of the gate house structure and also serve as supports for a platform grating and vertical trash rack.

The timber sluice gate, which is 3 feet wide and 4 feet high, is set on an approximate 1 on 2 incline and is equipped with a single rack gear. Details of guides are unknown. The gate is operated by means of a ratchet gear equipped with an operating nut to receive a hand wrench and pipe extension.

The operating wrench and pipe extension are stored in the Town Hall as a precaution against vandalism. A bale of hay is stored within the gate house for placement in front of the gate when fully seated to preclude seepage.

(c) Size Classification

The dam's maximum impoundment of 1810 acre-feet falls within the 1000 acre-feet to 50,000 acre-feet range which defines the INTERMEDIATE size category as outlined in the "Recommended Guidelines."

(d) Hazard Potential Classification

While the dam is in a generally isolated location, its failure could cause considerable property damage and presents the remote potential for isolated loss of life in the nearby downstream village of Center Ossipee. For this reason, a hazard potential classification of SIGNIFICANT is appropriate.

(e) Ownership

The Center Ossipee Fire Precinct purchased the dam in 1976 from the Portland Dowel Company, which is no longer in business and which altered the dam in 1958. The Carroll Land and Lumber Company owned the structure prior to Portland Dowel.

(f) Operator

The Center Ossipee Fire Precinct operates the dam through its Commissioners, John Thompson, (603) 539-6615, and Keith Brownell, (603) 539-2186. The Commissioners each maintain keys to the gate house and an additional set is kept at the fire station, which is not always manned. To preclude vandalism, the tools required to operate the dam are also maintained at the fire station.

(g) Purpose of Dam

The dam impounds Dan Hole Pond, which is the water supply for the town of Center Ossipee. A gravity intake on Valley Road directs water to a chlorination building and then to the distribution system, both owned by a private water company.

(h) Design and Construction History

Historical records indicate that the Carroll Land and Lumber Company built the first structure at the site in 1908. The original dam was basically a gravity stone structure with an upstream facing of mortar-bound rubble. The crest of the dam served as the spillway. The Portland Dowel Company purchased the dam sometime later and, in 1958, altered it to its present configuration by placing an additional 8 inches of concrete facing on the upstream side, raising sections of the crest with concrete to create the two weir sections and adding the gate house. Only very sketchy plans are available for either the original structure or the later alterations. The last head of the family-run Portland Dowel Company, Mr. David Pearson (603) 539-4414, could provide no additional information.

(i) Normal Operational Procedures

The fire commissioners visit the dam weekly and adjust the discharge as necessary to meet downstream requirements at the water company's intake works.

1.3 Pertinent Data

(a) *Drainage Area*

Dan Hole Pond receives runoff from a six square mile drainage area. The majority of this area is heavily forested and steeply sloping. Both Dan Hole River, across which the dam lies, and Bodge Brook flow into the pond. With the exception of a seasonal campground near the dam, there is no development on the immediate shore of the pond.

(b) Discharge at Dam Site

(1) The dam's only regulating outlet is the 3 foot wide by 4 foot high timber sluice gate which discharge into a concrete culvert. The invert of the gate is at El. 816 $\pm$.

(2) No formal record of peak floods is available for Dan Hole Pond. Due to its isolated location, none of the residents contacted have ever observed the dam during a severe storm. All indicated, however, that the downstream channel, which runs through several residential areas, has never risen to the point of causing concern in the town.

(3) Spillway Capacity at maximum pool elevation: 300 cfs at El. 828.5

(4) Gate capacity at normal pool elevation: 180 cfs at El. 827

(5) Gate capacity at maximum pool elevation: 190 cfs at El. 828.5

(6) Total discharge capacity at maximum pool elevation: 490 cfs at El. 828.5

(c) Elevation (feet above MSL based on 1958 USGS)

(1) Top of dam: 828.5 ±

(2) Maximum pool: 828.5

(3) Recreational pool: 827 ±

(4) Spillway crest: 827 ±

(5) Streambed at centerline of dam: 816 ±

(6) Maximum tailwater: Unknown

(d) Reservoir

(1) Length of recreational pool: 1.5 miles ±

(2) Storage-recreational pool: 1200 acre-ft. ±
top of dam: 1810 acre-ft. ±

(3) Reservoir surface-recreational pool: 408 acres

(e) Dam

(1) Type: Concrete and stone gravity

(2) Length: 114 ft.

(3) Height: 12.5 ft. ±

(4) Top width: 2 ft. ±

(5) Sideslopes - D/S 2:1
U/S 1:2

(6) Cutoff grout curtain No information

(f) <u>Spillway</u>

(1) Type Concrete weir

(2) Length of weir: 54.5 ft. (33.5 ft. and 21 ft. sections)

(3) Crest elevation: 827 ft. ±

(4) Gates: None

(5) Upstream channel: Deep approach from pond

(6) Downstream channel: Narrow channel with steep sides and rocky bottom

(g) <u>Regulating Outlets</u>

The dam's only regulating outlet is a 3 foot wide by 4 foot high concrete culvert with a sluice gate operated by a ratchet mechanism in the gate house on top of the dam. The timber gate is set on a 1:2 incline.

SECTION 2 - ENGINEERING DATA

2.1 Design Records

The design of the existing structure is quite simple and appears adequate in all respects except ability to pass the test flood. However, no hydrologic, hydraulic or structural calculations are available for review.

2.2 Construction Records

Only a rough sketch of the 1958 repairs is available for review. The sketch is not accurate, however, as it contains several minor deficiencies in dimensions and in proposed versus as-built configuration.

2.3 Operational Records

The owner operates the dam in a manner consistent with its intended purpose and engineering features.

2.4 Evaluation of Data

(a) Availability

The absence of any accurate design or construction data warrants an unsatisfactory evaluation for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of this dam cannot be assessed from the standpoint of reviewing design and construction data. The assessment is thus based primarily on the visual inspection, past performance history and sound engineering judgement.

(c) Validity

While the available construction drawing contains many inaccuracies, close scrutiny of the structure in conjunction with the sketch permitted development of the plans shown in Appendix B. For this reason, the available data warrants a marginal evaluation for validity.

SECTION 3 - VISUAL OBSERVATIONS

3.1 Findings

(a) General

The Dan Hole Pond Dam is in POOR condition at the present time. Of particular concern is the significant seepage eminating from the toe of the dam and which may have been present for over 20 years.

(b) Dam

(a) Abutments (Photos 1 and 2)

In general, the concrete facing on both abutments is in fair condition with the exception of some surface cracks and minor spalls. On the right abutment, a horizontal crack extends over 90% of the concrete at a point some 3 feet below the crest. The crack appears to be the result of construction procedures. There is no evidence of checking, erosion or efflourescence on either abutment.

Both abutments display signs of erosion of the surrounding soil. The problem is more acute on the left side where it is obvious that significant amounts of water have flowed around the dam. Just upstream of the left abutment, the root structure of a large tree is almost completely eroded; this situation could result in the tree falling, crushing the gate house and impeding flow over the dam. This problem was apparently evident long ago, as the 1958 sketch indicates that the concrete at the abutments was to be raised 1.5 feet higher than its present level. This work, however, was not accomplished.

(2) Spillway (Photos 3 and 4)

The left spillway contains two continuous, horizontal cracks over its entire length, probably resulting from construction procedures. There is some minor cracking at the junction of the right spillway and right abutment, probably owing to shrinkage.

The wooden catwalk over the right spillway is in good condition.

A significant amount of seepage exists at the toe of the dam approximately 10 feet left of the gate house. This same area is shown on the 1958 sketch with the notation "bad leak here" over a 15 square foot area. It is apparent that an unsuccessful attempt was made to repair the seepage as an excavation approximately 4 to 6 feet wide exists in the downstream boulder slope at this location. The fact that a seepage of this size has existed for over 20 years raises serious questions as to what extent the foundation of this dam has been damaged.

(3) Outlet Works

The upstream training walls are generally in good condition. The trash rack, while displaying some surface rust, reveals no serious deficiencies. The heavy wire grate spanning the walls is in poor condition with several repaired areas and two 6-inch square holes which could result in injuries to personnel.

The timber sluice gate was not operated due to a lack of tools, which are stored in the fire station to preclude valdalism. The fire commissioner accompanying the inspection team indicated that the gate and its operating mechanism are in good condition; visual examination of the operating mechanism supports his observation.

The outlet culvert could not be inspected due to its submerged condition on the upstream side and the irregular placement of rubble stone masonry on the downstream side. This rubble stone material could impede flow through the culvert.

The wooden gate house containing the operating mechanism for the sluice gate is in good condition.

(c) Appurtenant Structures

This dam has no appurtenant structures.

(d) Reservoir

An inspection of the reservoir shore revealed no evidence of movement or other instability. No sedimentation was noted behind the spillway. Examination of the surrounding area revealed no work in progress or recently completed which might increase the flow of sediment into the pond. Additionally, there were no changes to the surrounding watershed which might adversely affect the runoff characteristics of the basin.

(e) Downstream Channel

The immediate downstream channel is full of debris and has many overhanging trees. This situation could result in flow restrictions were the trees to be felled in a storm. With the exception of this potentially troublesome channel, there are no downstream conditions which adversely affect the operation of the dam or which pose a hazard to the safety of the structure.

3.2 Evaluation

The significant seepage at the toe of the dam is a deficiency with potentially hazardous consequences. The existence of such a situation for as long as 20 years raises doubts as to the integrity of the dam's foundation. For this reason, the dam must be rated in POOR condition as long as this problem remains undefined. If corrected, the evaluation would change to fair. In general, because most of the dam's major components are accessible for inspection, the visual inspection permitted an overall satisfactory evaluation of those items which affect the safety of the structure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The fire commissioners visit the dam weekly and adjust the discharge as necessary to meet the town's water requirements.

4.2 Maintenance of Dam

During their weekly visits, the commissioners note any deficiencies in the dam. Problem areas are discussed at their formal meetings and appropriate remedial measures initiated. The condition of the dam, especially in regards to operations and maintenance type work, indicates that a more vigorous maintenance program is warranted.

4.3 Maintenance of Operating Facilities

The procedures discussed in section 4.2 also apply to the sluice gate and its operating mechanism.

4.4 Description of Any Warning System in Effect

No formal warning system exists for the dam.

4.5 Evaluation

The established operational procedures are adequate for Dan Hole Pond Dam given its limited operational capacity. The lack of a formal warning system does, however, warrant attention, as does the quality and quantity of routine maintenance.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

(a) Design Data

Data sources available for Dan Hole Pond Dam include prior inventory and inspection reports. The New Hampshire Water Control Commission's "Data on Dams in New Hampshire" dated April, 1925 contains much of the basic data for the site. Other sources are an undated New Hampshire Water Control Commission report entitled "Data on Reservoirs and Ponds in New Hampshire" and a New Hampshire Water Resources Board inspection report of June 12, 1973. Undated plans, apparently prepared in the early 1950's, shows the modifications proposed for the 1958 reconstruction at which time the dam was capped and faced with concrete. A 1952 New Hampshire Water Resources Board worksheet gives a calculation of the flow capacity and the 100-year flood flow for the dam.

(b) Experience Data

Subparagraph 1.3 (b) above presents experience data for this dam.

(c) Visual Observations

Dan Hole Pond Dam is a concrete masonry structure on the Dan Hole River near Center Ossipee, New Hampshire. The regulating outlet at the dam is a 3 foot x 4 foot sliding gate at channel level, 11 feet below the spillway crest. There are two spillways, one in two 10 feet sections separated by a pier and another 33.5 feet long. Both spillway crests are at approximately the same elevation, which is taken to be the elevation shown on the USGS topo map of 827.0 feet, and are 1.5 feet below the dam crest. The dam crest, at approximately elevation 828.5 feet, has an overall length of 114 feet (including spillways) with an 8.5 foot wide middle section containing a 7 foot wide gate house.

Downstream of the dam, a short channel of approximately 500 feet leads to Little Dan Hole Pond. This channel consists of natural rock and boulders with a number of small falls several feet high. Large boulders have been placed on the downstream face of the dam as additional support and as rip rap.

(d) Overtopping Potential

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. None of the original hydraulic and hydrologic design records are available for use in this study.

Guidelines for establishing a recommended Test Flood based on the size and hazard potential classifications of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers (COE). As shown in Table 3 of that document, the appropriate Test Flood for a dam classified as INTERMEDIATE in size with SIGNIFICANT hazard potential would be between one-half the Probable Maximum Flood (PMF) and the full PMF.

The chart of "Maximum Probable Peak Flow Rates" obtained from the COE, New England Division is used to determine the PMF. For the six square mile drainage area to Dan Hole Pond, which has mountainous topography, the chart indicates a PMF of 2150 cfs per square mile or a total of 13,000 cfs. One-half of the PMF is 6,500 cfs.

The "Recommended Guidelines" suggest that if a range of values is indicated for the Test Flood, the magnitude most closely relating to the involved risk should be selected. Since the risk may be considered to be on the higher side of the SIGNIFICANT category, a Test Flood of 12,000 cfs is selected as the inflow to Dan Hole Pond.

Applying the procedure suggested by the COE, New England Division for "Estimating the Effect of Surcharge Storage on Maximum Probable Discharges" produces a Test Flood, corrected for storage, of 5,930 cfs. Thus, the lake has a significant damping effect on the magnitude of the peak flow. The storage-stage curve used to determine surcharge storage for these calculations is developed assuming that the surcharge storage available is equal to the lake area (408 acres) times the depth of surcharge. No spreading or increase of area with depth is considered.

The Stage-Discharge curve is developed by defining discharge as the sum of flow through the gate, flow over the spillway, flow over the dam crest and flow over the side slopes at the ends of the dam. The datum for flow calculations is the spillway crest at approximately elevation 827.0. The invert of the gate is 11.0 feet below the spillway crest and the gate acts as an underflow sluice. The spillway has a total length of 54.5 feet, and acts as a broad-crested weir. When the water level is 1.5 feet or more above the spillway crest, the dam crest also acts as a broad-crested weir with a length of 54.3 feet. The overbanks at either end of the dam are assumed to rise at 2:1 slopes and act as broad-crested weirs with lengths varying as a function of water level.

The peak test discharge of 5930 cfs would result in a maximum stage of 7.22 feet above the spillway crest, or 5.72 feet above the top of the dam.

5.2 Hydrologic/Hydraulic Evaluation

The results of the hydrologic and hydraulic calculations indicate that the dam would be significantly overtopped for a flood of the magnitude of the PMF. A potential depth of overtopping of about 5.7 feet is indicated. It is estimated that the flow capacity of the dam with full spillways and the sluice gate fully open (but with no overtopping) is about 500 cfs, or only about ten percent of the Test Flood.

5.3 Downstream Dam Failure Hazard Estimates

The flood hazards in downstream areas resulting from a failure of Dan Hole Pond Dam are estimated using the procedure suggested in the COE New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." This procedure accounts for the attenuation of dam failure hydrographs in computing flows and flooding depths for downstream reaches.

For the purposes of these calculations, failure is assumed to occur as soon as the dam crest is overtopped or at an elevation of 828.5 feet. This corresponds to a height of 12.5 feet above the stream bed.

A gap of 40 feet is assumed to be opened in the center of the dam during failure. The resulting peak dam failure discharge is then estimated as 2970 cfs.

The Dan Hole River may be considered in 4 reaches downstream of the dam for flood hazard determinations. The first reach of 3200 feet includes Little Dan Hole Pond. The second section of 6200 feet extends through the flat swampy area below Little Dan Hole Pond. The third reach of 4750 feet includes the steep portion of channel downstream of the swamp up to the split in the channel near Center Ossipee. The fourth reach follows the north channel from the split to an old mill dam near the center of Center Ossipee. It is assumed that one half of the flow would follow this channel and one half would follow the south channel through Center Ossipee. The channels rejoin slightly downstream of the mill dam.

Reach 1 offers significant storage capacity in Little Dan Hole Pond and would reduce the peak flow to approximately 2800 cfs. The depth of flooding would be low in this area and would not affect any development around Little Dan Hole Pond. Reach 2 further attenuates the peak to 2550 cfs which would produce a flood depth of 9 feet, but still would not threaten any structures. Reach 3 is steeper and narrower and attenuates the peak only slightly, to about 2500 cfs. A flooding depth of about 7 feet would not threaten any structures along this section.

The channel splits at the upstream end of Reach 4 and only one-half of the flow from Reach 3 enters Reach 4. This flow is not attenuated significantly and remains at approximately 1250 cfs. The flooding depth of about 8 feet does not threaten structures along the reach. However, an old mill dam at the downstream end of Reach 4 dams the Dan Hole River at a narrow gorge and is some 30 to 40 feet in height. Due to the very limited freeboard and deteriorating condition of this structure, it is possible that the flow caused by failure of Dan Hole Pond Dam could cause its failure as well. If this were to occur, signficant depths of flooding would result and several dwellings just downstream in Center Ossipee would be threatened, with the remote possibility of loss of life. It is, however, beyond the scope of this Phase I investigation to determine the potential for failure of the old mill dam in Center Ossipee.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

The field investigation revealed no significant displacements or distress which warrant the preparation of structural stability calculations based on assumed sectional properties and engineering factors. The seepage area at the downstream toe, however, could threaten the long-term stability of the dam.

(b) Design and Construction Data

No plans or calculations of value to a stability assessment are available for this dam.

(c) Operating Records

There are no formal operating records for this dam. Contact with local residents, however, reveal no evidence of instability after past floods.

(d) Post Construction Changes

The alterations accomplished in 1958 should not adversely affect the stability of the structure. The results of the field inspection and a check of the available records produced no evidence of other changes which might influence stability.

(e) Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The Dan Hole Pond Dam is in POOR condition at the present time.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is thus based primarily on the visual inspection, past performance and sound engineering judgement.

(c) Urgency

The engineering studies and recommendations regarding the foundation seepage should be implemented by the owner immediately upon receipt of the Phase I Inspection Report. Other studies and improvements warrant attention within one year.

(d) Need for Additional Investigation

The following areas should receive additional investigation:

(1) Determination of the extent of the foundation seepage problem and development of a feasible repair procedure, if necessary.

(2) Analysis of alternatives for increasing the dam's discharge capacity or for providing suitable emergency spillway facilities.

(3) Analysis of the height of which the abutments should be raised, particularly in light of the ongoing erosion process.

(4) Investigation of the deteriorating downstream mill dam to determine if it should be repaired or removed, particularly as it presents a hazard which might not otherwise exist.

(2) Monitor erosion at the end of the right training wall and improve the rock slope protection if necessary.

(3) Monitor seepage through squared stone masonry near the left side sluice gates, noting particularly any changes in quantity. If the situation presents itself, conduct a detailed inspection of these areas under drawn down or other low water conditions.

(4) Install a gauge at the dam site to better monitor flow.

(5) Replace the inadequate maintenance stoplogs for the five bay sluiceway.

(6) Instruct local officials such as the police and fire chiefs in the proper operation of the dam and arrange for their access to operating equipment in the event of an emergency. Such a program might decrease response time in the event of unforseen circumstances.

(7) Institute a formal, written flood and emergency warning system.

7.4 Alternatives

As an alternative to an improvement of the dam's discharge capacity, the structure could be left as is with the potential for flooding in the event of a Test Flood magnitude storm. Since the storm of record in this area, which occurred in 1938, is less than 40 percent of the Test Flood, this alternative may be a viable one.

There are no meaningful alternatives to the operating and maintenance type improvements.

APPENDIX A

VISUAL INSPECTION CHECKLIST

INSPECTION TEAM ORGANIZATION

Date: 12 September 1978

NH 00376
DAN HOLE POND DAM
Ossipee, New Hampshire
Dan Hole River
NHWRB 188.01

Weather: Cloudy and cool

INSPECTION TEAM

Nicholas Campagna	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD)	Team Captain
Robert Minutoli	GZD	Soils
Andrew Christo	Andrew Christo Engineers (ACE)	Structural
Paul Razgha	ACE	Structural
Richard Laramie	Resource Analysis, Inc.	Hydrology

Mr. John Thompson, one of the Center Ossipee fire commissioners, accompanied the inspection team.

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
SUPERSTRUCTURE		
a. Vertical alignment and movement	nac	No deficiencies noted
Horizontal alignment and movement		No deficiencies noted
Condition at abutments		Evidence of erosion around both abutments; sufficiently severe on left side to undermine roots of a large tree which could fall on gate house and block dam
Unusual movement or cracking at or near toe		None noted
Unusual downstream seepage	nac	Evidence of 50 to 100 gpm seepage at toe of dam to left of gate house; seepage in same area shown in 1958 sketch; some attempt at repair evident
b. Condition of concrete	PP	
Erosion or cavitation		None noted
Spalling or cracking	PP	Minor surface spalls on both abutments; horizontal and diagonal surface cracks on both abutments; horizontal crack 3 feet below crest over 90% of right abutment; diagonal and vertical crack at end of right abutment and at junction with spillway

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Condition of joints (sealing, alignment, etc.)		Good
Rusting or staining on concrete		None noted
Visible reinforcing		None noted
Seepage or efflourescence		None noted
OUTLET WORKS		
a. Approach Channel		
Slope conditions	[initials]	Broad approach from pond
Bottom conditions		Sandy with some rocks
Rock slides or falls		None noted
Log boom		None
Control of debris		Considerable debris on downstream slope
Trees overhanging channel		None
Training walls	[initials]	Good condition; grating spanning walls has six inch square holes; trash rack has surface rust
b. Concrete Spillway		
Erosion or cavitation		None noted

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Spalling	TC	Two surface spalls 6 inches in diameter on left side
Cracking		Some cracking near right end; two continuous horizontal cracks over entire length of left spillway
Condition of joints		No deficiencies noted
Rusting or staining		None noted
Visible reinforcing		None noted
Seepage or efflourescence		None noted
c. Gate		
Condition of gate		Not inspected due to submerged state; operator states gate in good condition
Gate mountings		Unknown
Serviceability of operating mechanism		Not operated due to lack of equipment, but appears serviceable; operator substantiates good condition
Adequately secured (tamperproof)	TC	Locked gate house, but operating tools stored at firehouse due to previous vandalism
d. Outlet Channel (immediate area)		
Discharge tunnel		Not visible; outlet covered with boulders
Slope conditions		Stable slopes

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
Rockslides or falls	[initials]	None noted, but very rocky
Control of debris		Considerable debris in channel
Trees overhanging channel		Many
Other obstructions		None noted
Erosion at toe of dam		None noted
e. Existence of gages	[initials]	None and no records maintained

CHECK LISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
RESERVOIR		
a. Shoreline		
Evidence of slides	[signature]	None
Potential for slides		Shoreline stable
b. Sedimentation		None noted
c. Upstream hazard areas in the event of back-flooding		No development other than seasonal campground near left abutment
d. Changes in nature of watershed (agriculture, logging, construction, etc.)		None noted
DOWNSTREAM CHANNEL		
Restraints on dam operation		None, especially in light of limited operational capability
Potential flooded areas	[signature]	In town only if deteriorated lower dam fails
OPERATION AND MAINTENANCE FEATURES		
a. Reservoir regulation plan		
Normal procedures	[initials]	Maintain sufficient flow for water supply
Emergency procedures	[initials]	None, as potential procedures very limited

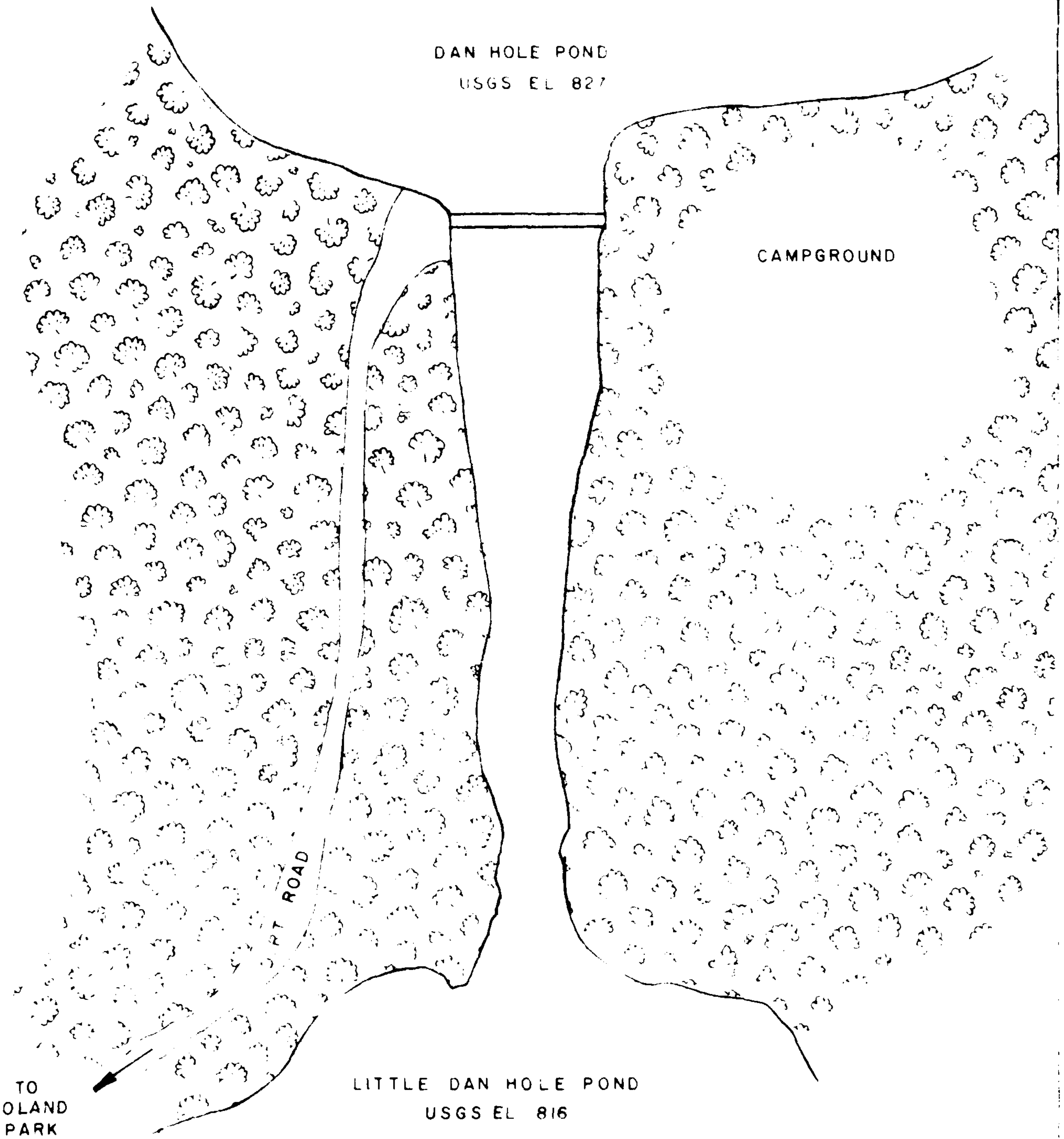
Dan Hole Pond Dam
Ossipee, N.H.

September 12, 1978
NH 00376

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Compliance with designated plan	MAC	Satisfactory
b. Maintenance		
Quality		Requires attention
Adequacy	MAC	Routine maintenance not being performed

APPENDIX B



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GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

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FIG. 1

SITE PLAN

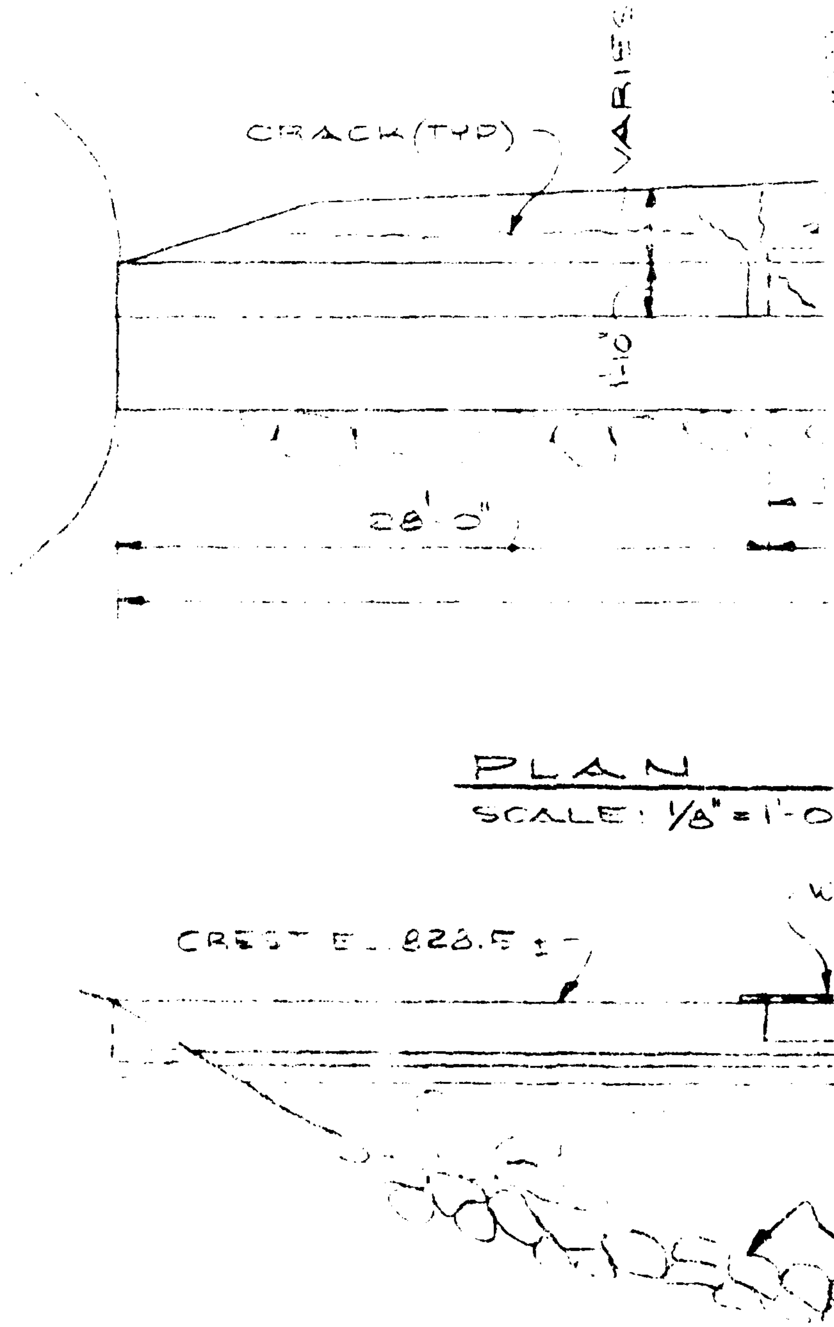
DAN HOLE POND DAM — NEW HAMPSHIRE

SCALE 1" : 100'

DATE SEPT 1978

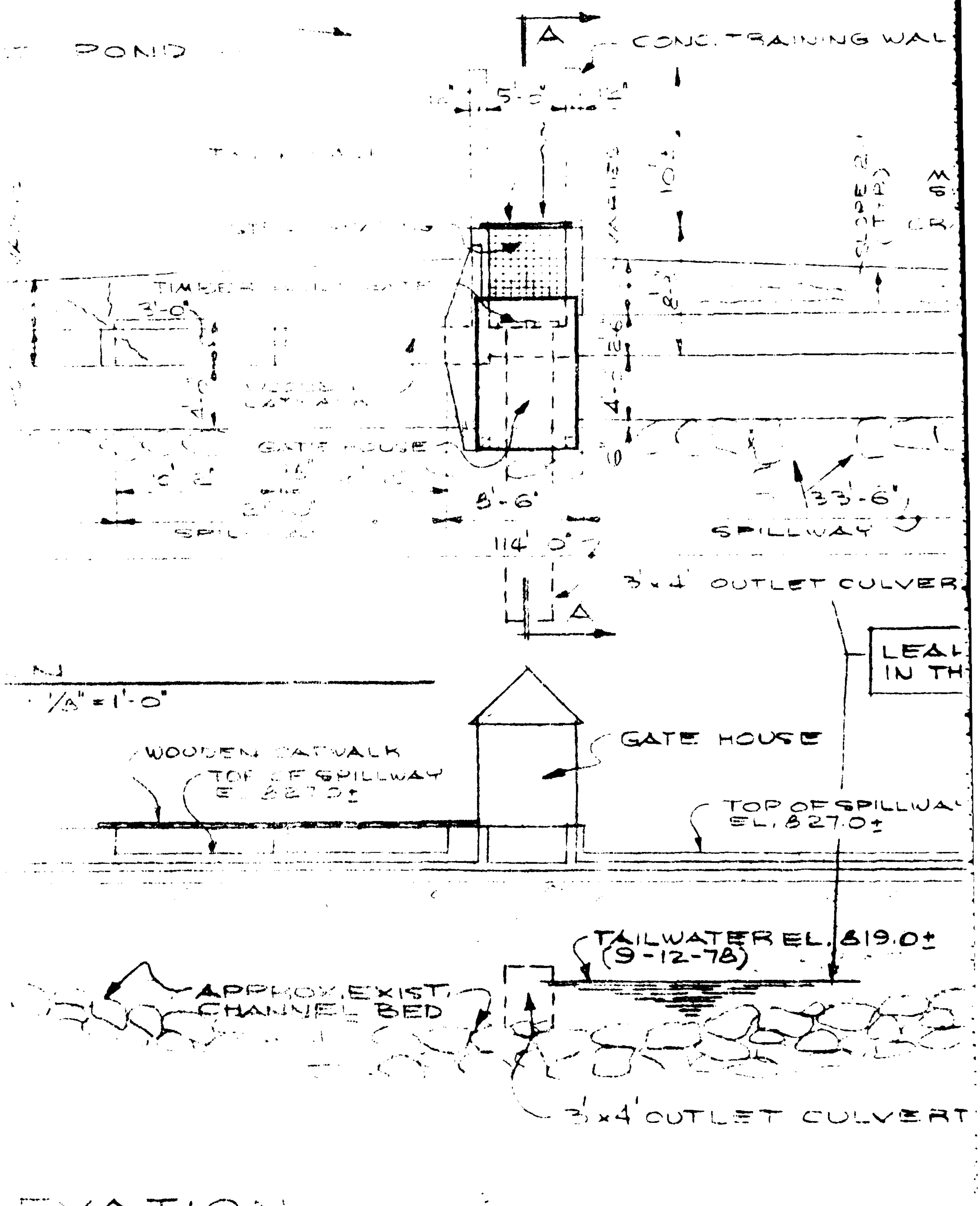
FILE No. 2067

DAN HOLE PON



PLAN
SCALE: 1/8"=1'-0

ELEVAT
SCALE 1/8"=1'



EVATION

LE 1/8" = 1'-0"

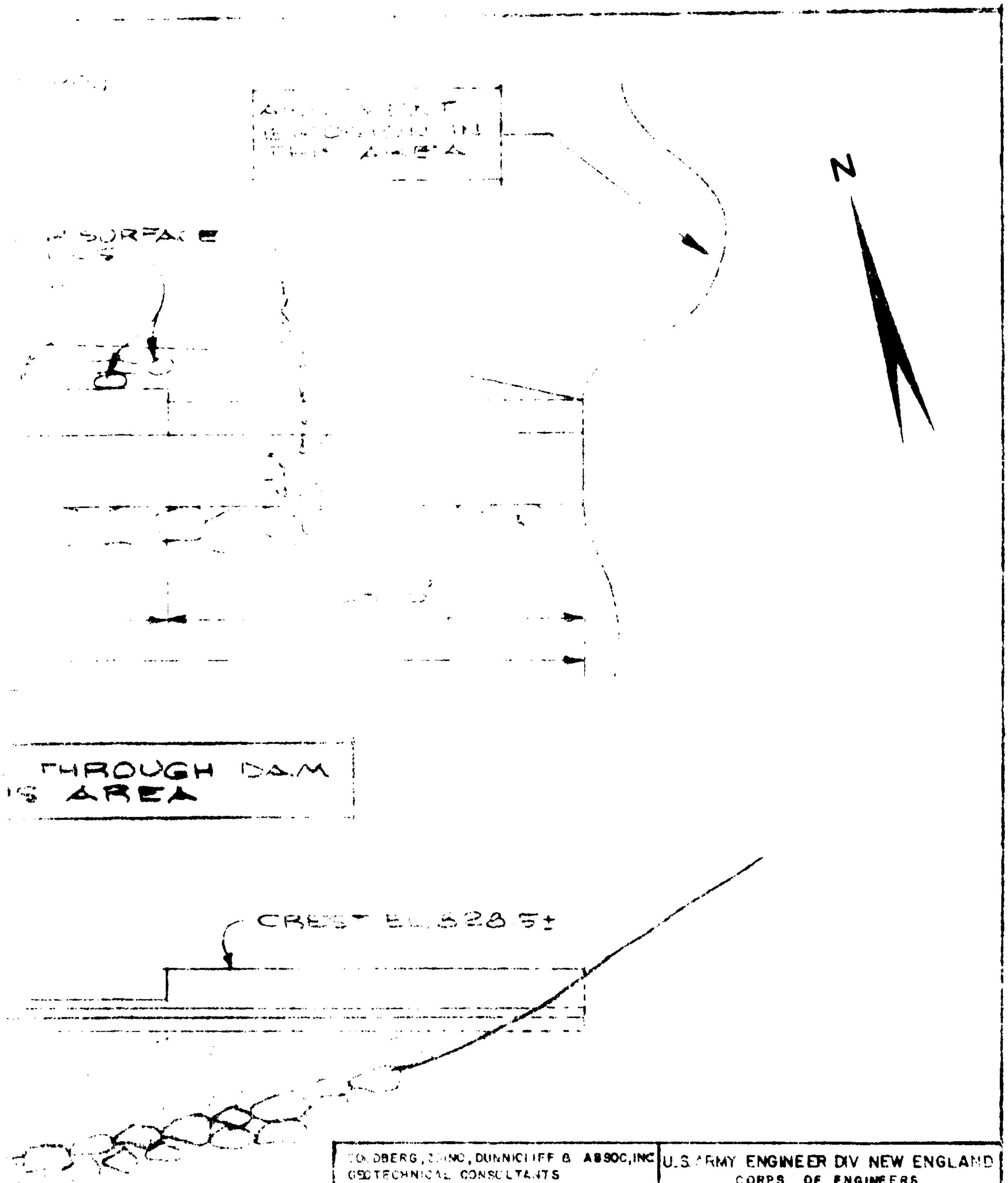


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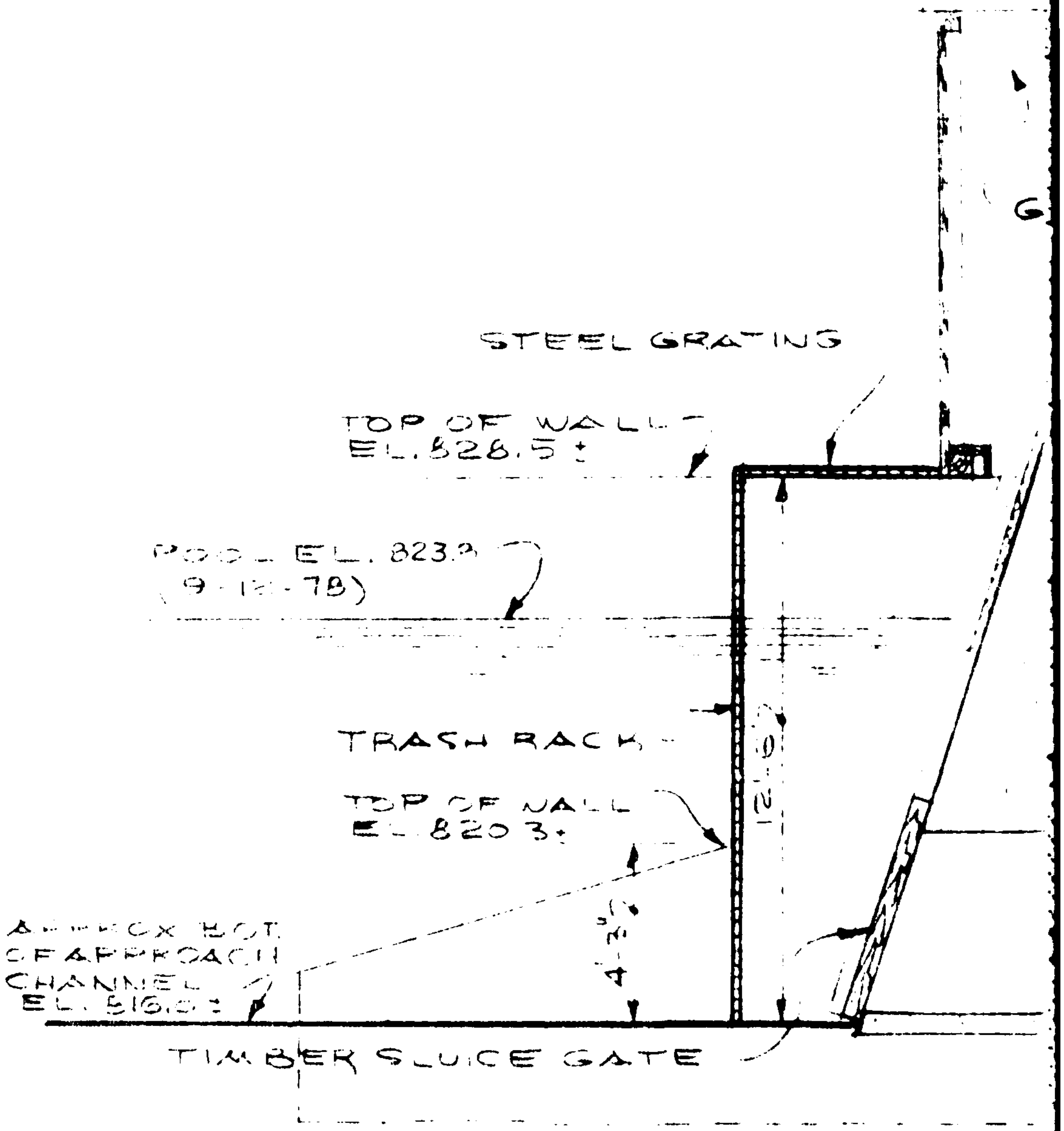
FIG. 2

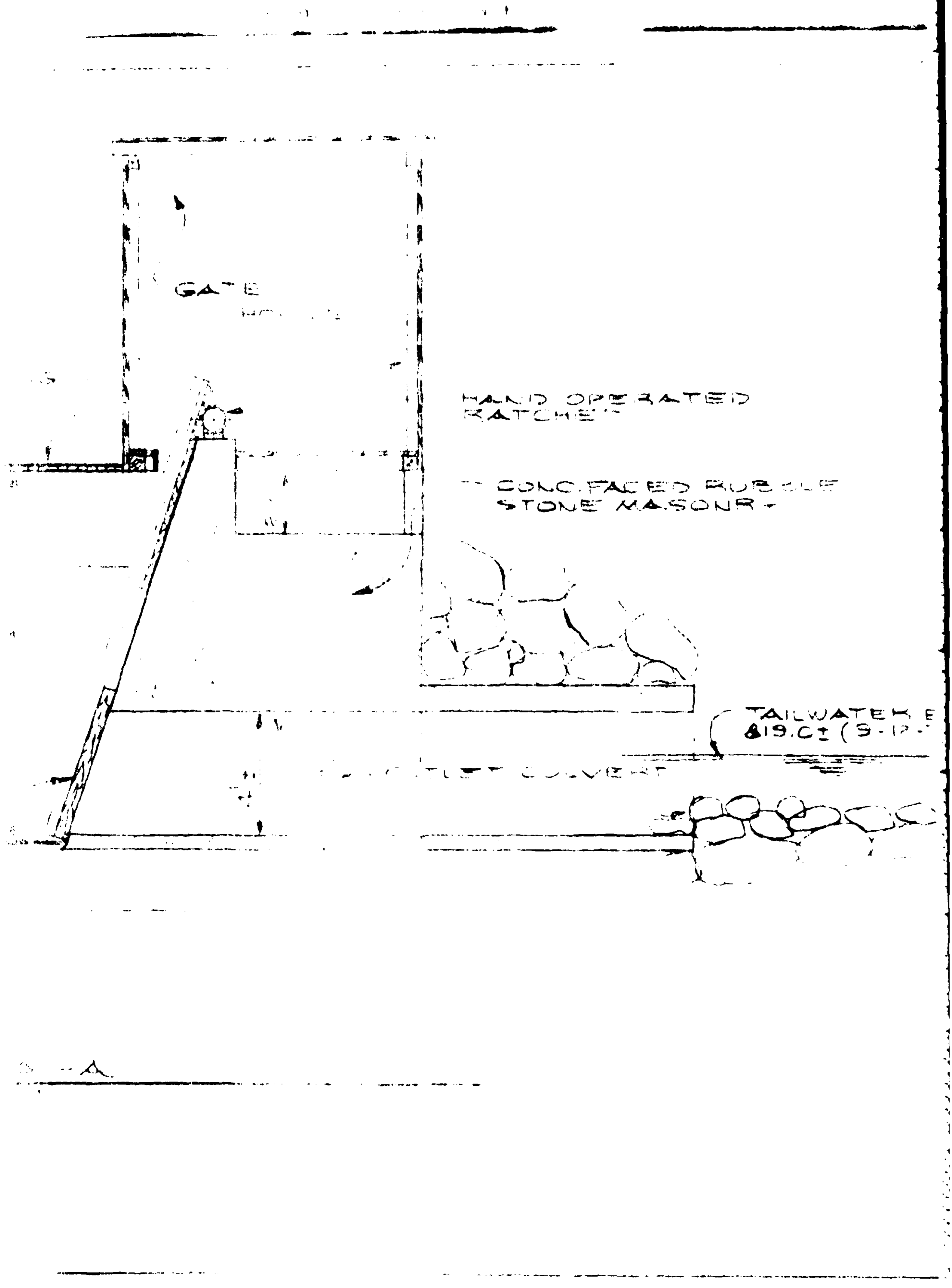
PLAN AND ELEVATION

DAM HOLE POND DAM — NEW HAMPSHIRE

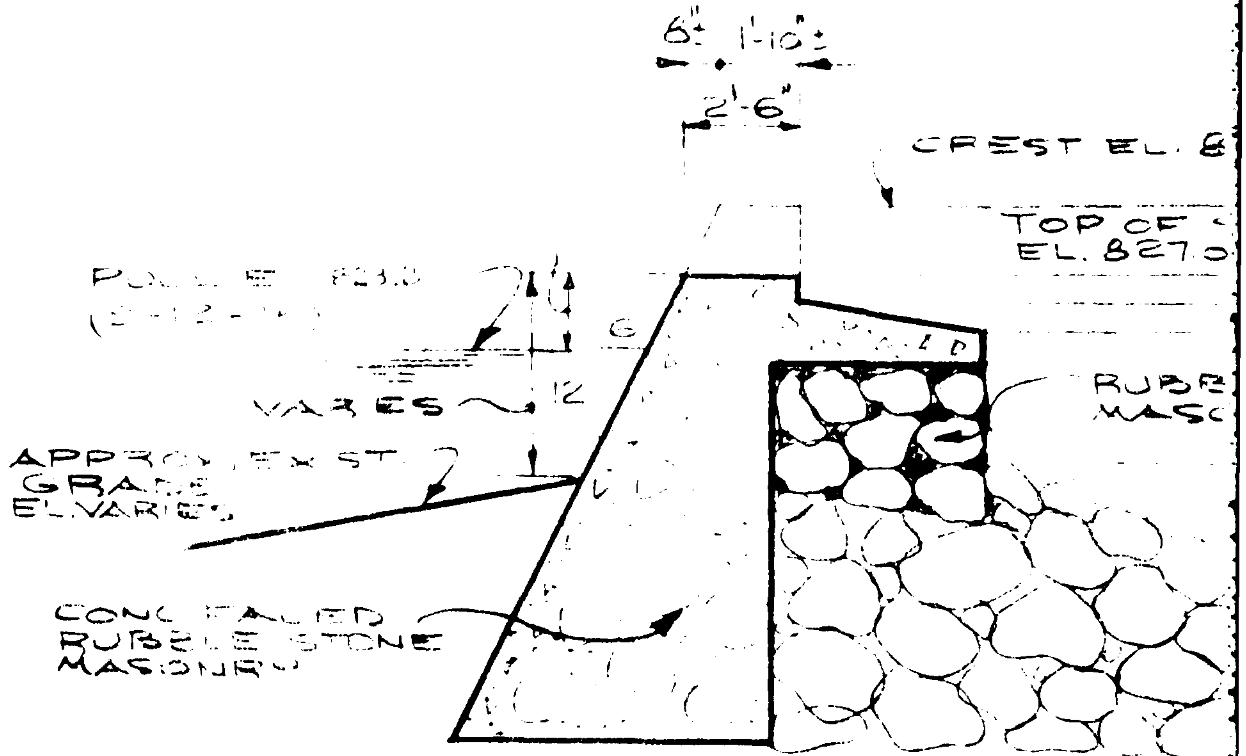
			SCALE	AS NOTED
			DATE	SEPT 1978



SECTION A-A
SCALE: 1/4" = 1'-0"

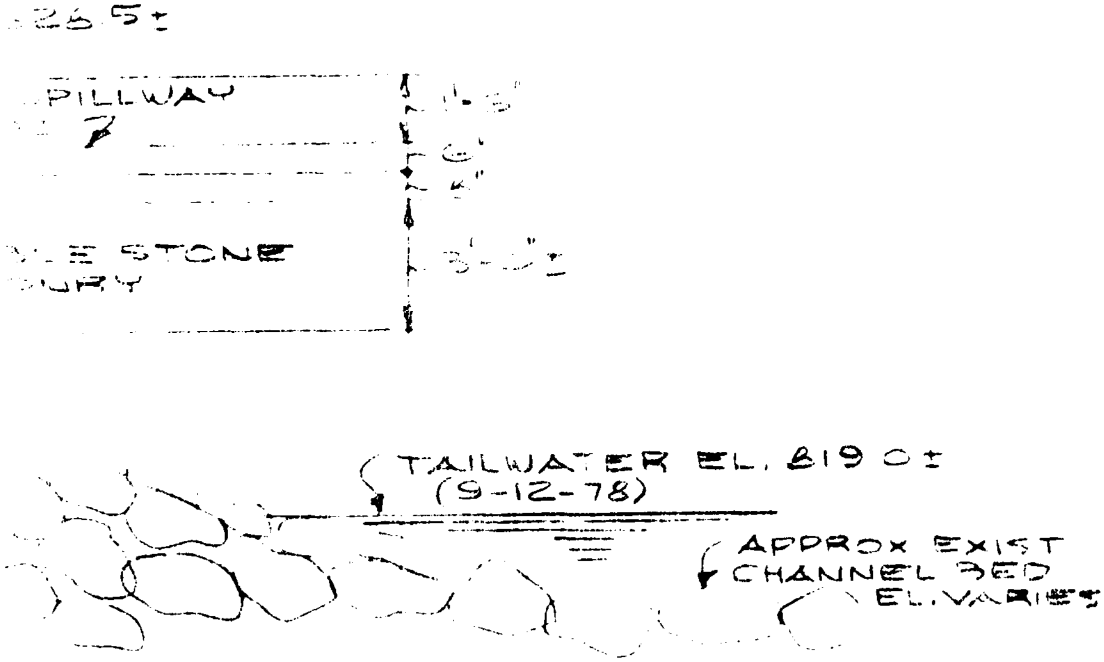


GATE
HAND OPERATED
RATCHET
CONC. FACED RUBBLE
STONE MASONRY
TAILWATER E
619.0±
CULVERT



TYPICAL DAM S

SCALE: 1/4" = 1'-0"



SECTION

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC, INC GEOTECHNICAL CONSULTANTS NEWTON UPPER FALLS, MASS	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

FIG. 3

SECTIONS

DAN HOLE POND DAM — NEW HAMPSHIRE

FILE No 2067

SCALE: AS NOTED

DATE: SEPT 1978

The New Hampshire Water Resources Board (NHWRB), 37 Pleasant Street, Concord, N.H. 03301 maintains the following records on this dam:

(a) Report of a June 12, 1973 inspection by the NHWRB.

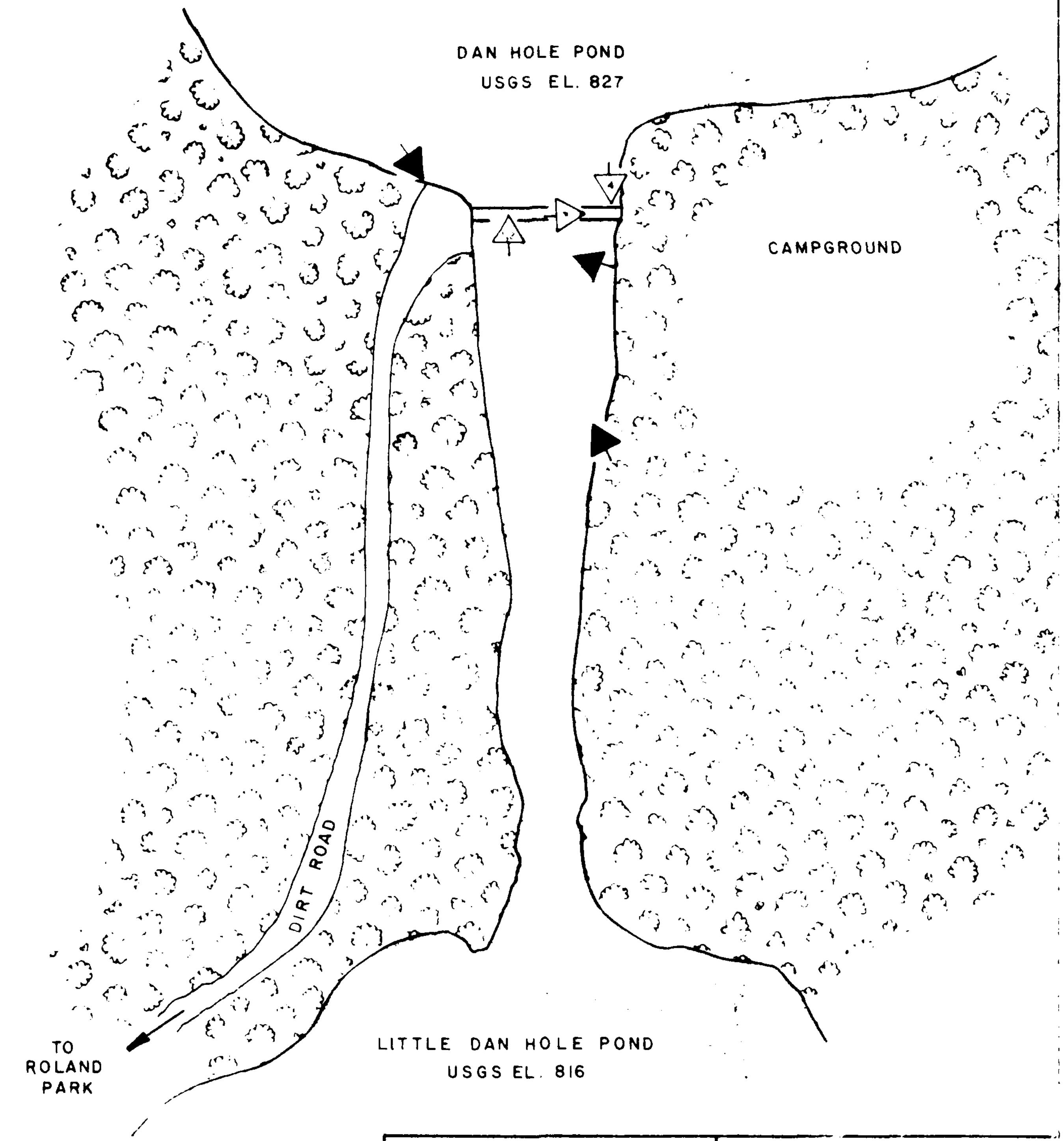
(b) An undated New Hampshire Water Control Commission report entitled "Data on Dams in New Hampshire."

(c) An undated report by the same agency entitled "Data on Reservoirs and Ponds in New Hampshire."

The Board's telephone numbers are (603) 271-3406 or (603) 271-1110.

APPENDIX C

SELECTED PHOTOGRAPHS



OVERVIEW PHOTOS

APPENDIX C PHOTOS

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LOCATION AND ORIENTATION OF PHOTOS

FILE No. 2067

DAN HOLE POND DAM — NEW HAMPSHIRE

SCALE 1" = 100'

DATE SEPT 1978

1. View of left abutment area showing erosion around end of dam

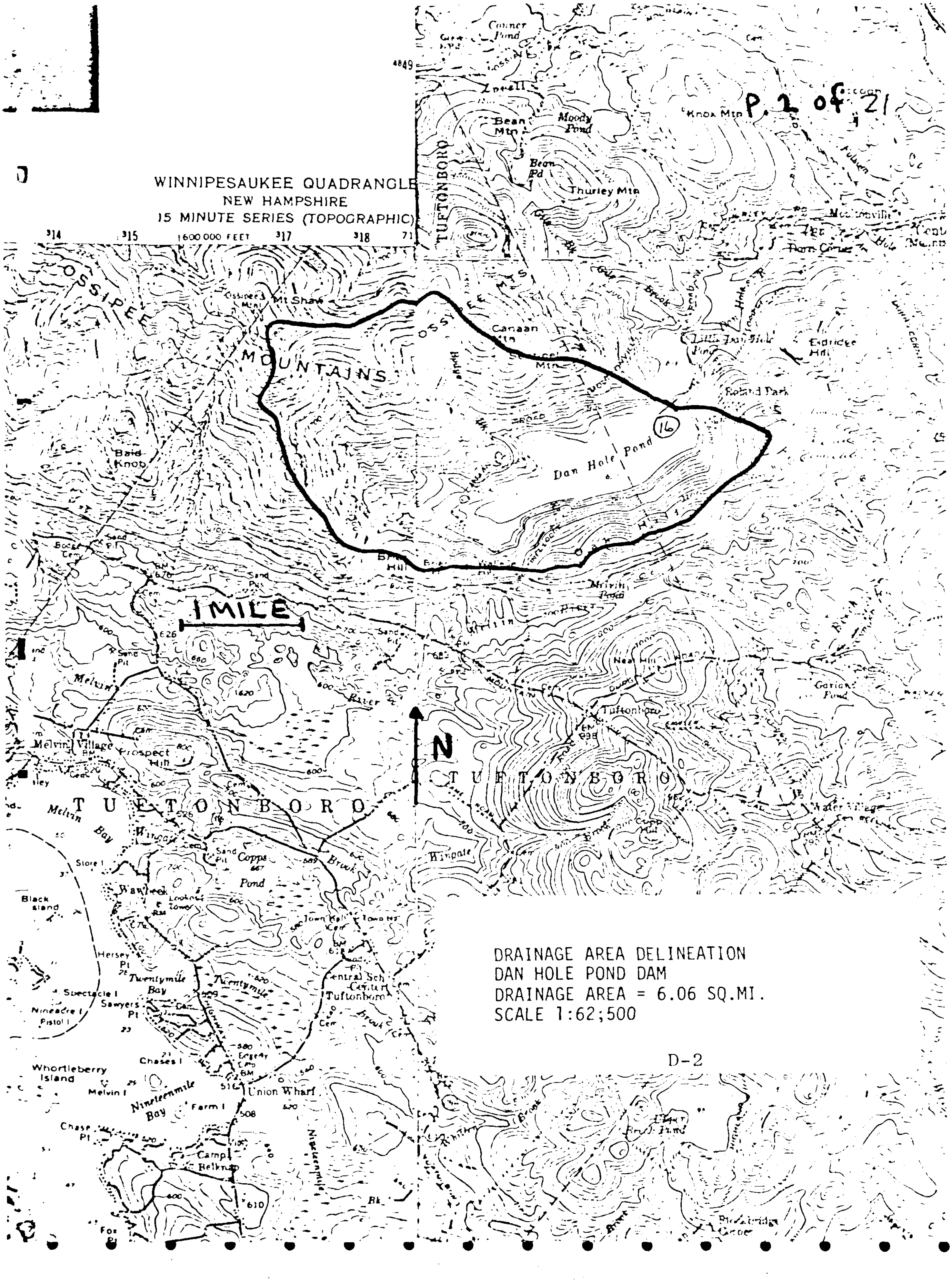
2. Detail of photo #4

3. View of seepage at downstream toe

4. View of excavated area in downstream dumped boulder slope

APPENDIX D

HYDROLOGIC/HYDRAULIC COMPUTATIONS



DRAINAGE AREA DELINEATION
DAN HOLE POND DAM
DRAINAGE AREA = 6.06 SQ.MI.
SCALE 1:62;500

DAMS 148 DAN HOLE POND 9-20-78 TCG 1 of 21

SIZE CLASSIFICATION = INTERMEDIATE

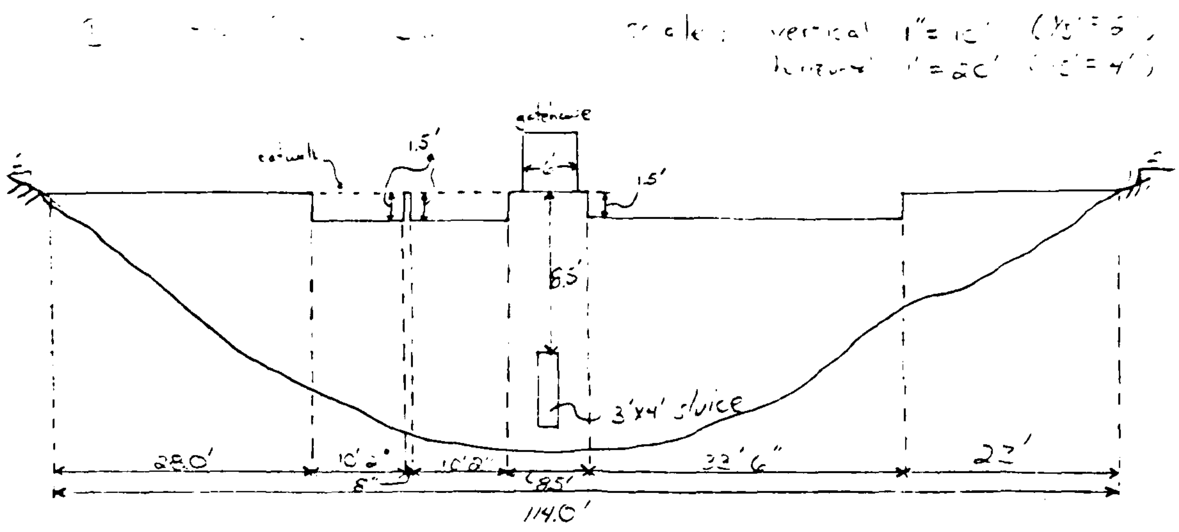
HAZARD CLASSIFICATION = SIGNIFICANT

BASED ON THE LOCATION OF THE TOWN OF OSSIPEE IN THE DOWNSTREAM FLOOD PLAIN.

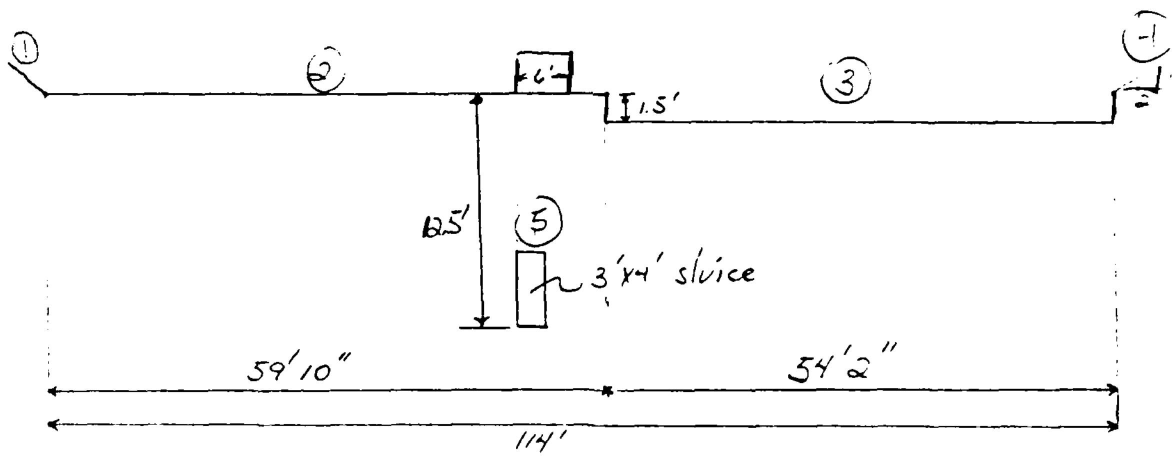
TEST FLOOD = 1/2 PMF to PMF

GIVEN a drainage area of 6.06 sq. mi. and Mountainous topography, the COE curve yields a PMF of 2150 cfs/sq. mi.:

PMF = 6.06(2150) = 13,000 cfs, so the Test flood is between 6,500 and 13,000 cfs. Since the risk is on the high side of significant, use 12,000 cfs.



Equivalent dam:



Assume h = 0 at spillway crest

for $h < 0$, $Q_5 = .56(12)\sqrt{2g(h+11.0)}$ [1] if 3'x4' gate is open, $= 0$ if closed, $Q_1 = Q_2 = Q_3 = Q_4 = 0$

for $0 < h < 1.5'$

$$Q_5 = .56(12)\sqrt{2g(h+11.0)} \text{ if gate open}$$

$$Q_3 = 3.0(54.17)h^{3/2}$$

$$Q_1 = Q_4 = Q_2 = 0$$

for $h > 1.5'$

$$Q_5 = .56(12)\sqrt{2g(h+11.0)} \text{ if gate open}$$

$$Q_3 = 3.0(54.17)h^{3/2}$$

$$Q_1 = Q_4 = 2.8(2(h-1.5))(.5(h-1.5))^{3/2}$$

$$Q_2 = 3.0(53.9)(h-1.5)^{3/2}$$

Listing of and output from a program to calculate a head-discharge relationship follow. The calculation is done assuming that the 3'x4' gate is fully open.

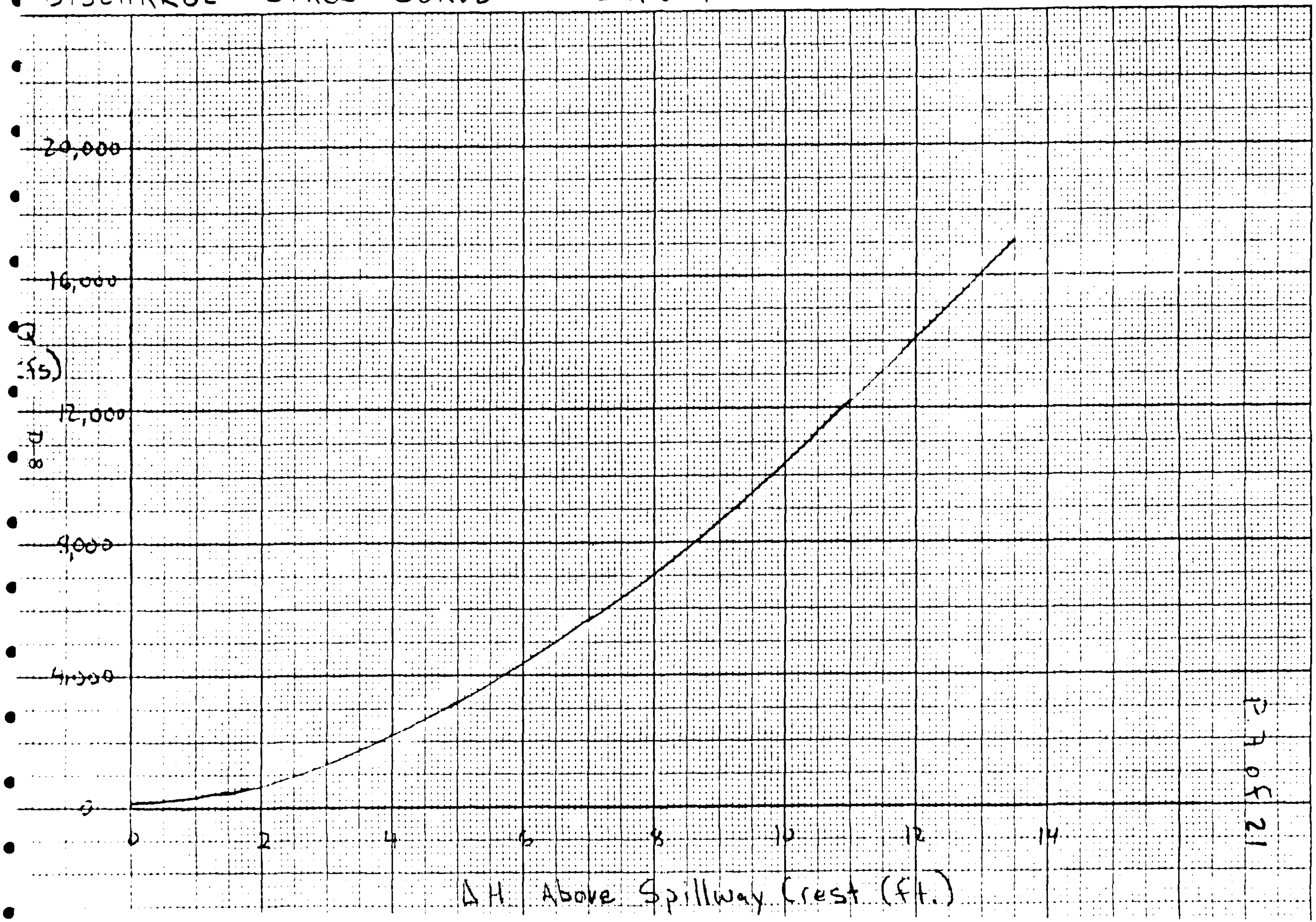
1. Underflow sluice gate equation, Rouse Engineering Hydraulics, p. 50

```
100 REMARK: DISCHARGE CALCULATION FOR DAN HOLE POND - GATE OPEN
110 PAGE
120 E=1.5
130 PRINT "DISCHARGE FROM DAN HOLE POND - GATE OPEN"
140 PRINT USING 150:
150 IMAGE // 2T"HEAD"30T"DISCHARGE"
160 PRINT USING 170:
170 IMAGE 1T"(FEET)"32T"(CFS)"
180 PRINT USING 190:
190 IMAGE 10T"TOTAL    GATE    SPILLWAY   DAM CREST   SIDE SLOPES"
200 REMARK:      Q1 is flow over the side slopes, Q2 is flow over the
210 REMARK: dam crest, Q3 is flow over the spillway, and Q4 is flow
220 REMARK: through the gate.
230 FOR H=0 TO 13.5 STEP 0.5
240 Q4=0.56*12*(2*32.2*(H+11))↑0.5
250 Q3=3*54.17*H↑E
260 Q1=0
270 Q2=0
280 Q5=0
290 IF H<=1.5 THEN 330
300 Q1=2.8*(2*(H-1.5))*(0.5*(H-1.5))↑E
310 Q1=Q1*2
320 Q2=3*54.17*(H-1.5)↑E
330 Q5=Q1+Q2+Q3+Q4
340 PRINT USING 350:H,Q5,Q4,Q3,Q2,Q1
350 IMAGE 1T,2D.2D,9D,8D,10D,11D,13D
360 NEXT H
370 END
```

DISCHARGE FROM DAN HOLE POND - GATE OPEN

HEAD (FEET)	DISCHARGE (CFS) TOTAL	GATE	SPILLWAY	DAM CREST	SIDE SLOPES
0.00	179	179	0	0	0
0.50	240	183	57	0	0
1.00	349	187	163	0	0
1.50	489	191	299	0	0
2.00	712	194	460	57	1
2.50	1007	198	642	163	4
3.00	1356	202	844	299	11
3.50	1751	205	1064	460	22
4.00	2190	209	1300	642	39
4.50	2670	212	1551	844	62
5.00	3187	216	1817	1064	91
5.50	3742	219	2096	1300	127
6.00	4332	222	2388	1551	170
6.50	4957	226	2693	1817	221
7.00	5616	229	3010	2096	281
7.50	6307	232	3338	2388	349
8.00	7032	235	3677	2693	427
8.50	7788	238	4027	3010	513
9.00	8577	241	4388	3338	610
9.50	9397	244	4758	3677	717
10.00	10247	247	5139	4027	834
10.50	11129	250	5529	4388	962
11.00	12042	253	5929	4758	1101
11.50	12985	256	6338	5139	1252
12.00	13958	259	6755	5529	1415
12.50	14961	261	7182	5929	1589
13.00	15995	264	7617	6338	1776
13.50	17058	267	8061	6755	1975

DISCHARGE - STAGE CURVE DAN HOLE POND



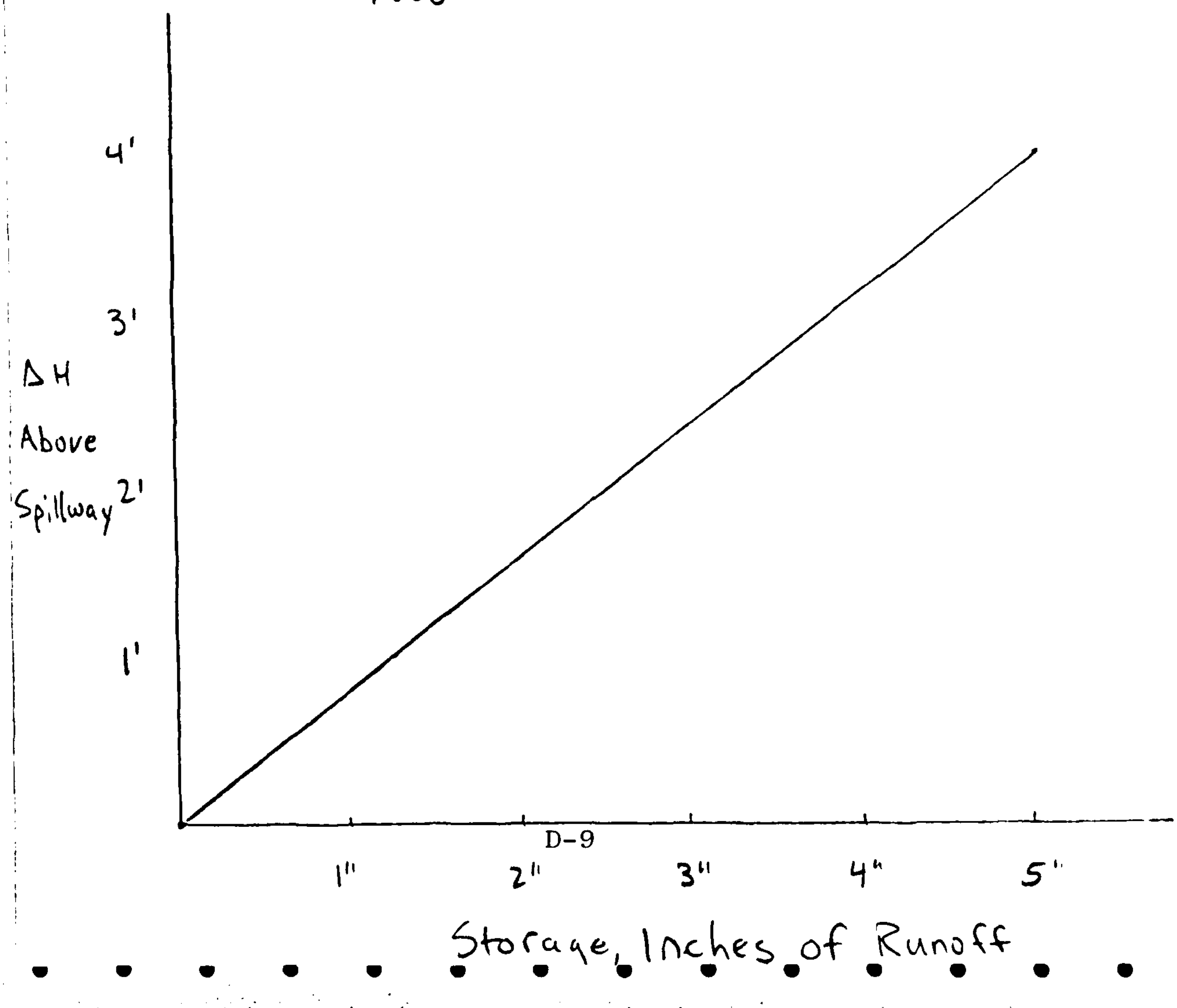
STORAGE-STAGE RELATIONSHIP:

Surface area of pond at normal level
= 408 acres = .6375 sq. mi.

$$1'' \text{ of runoff} \rightarrow \frac{1''(6.06 \text{ sq.mi } (640 \text{ ac/sq.mi}))}{408 \text{ acres}}$$

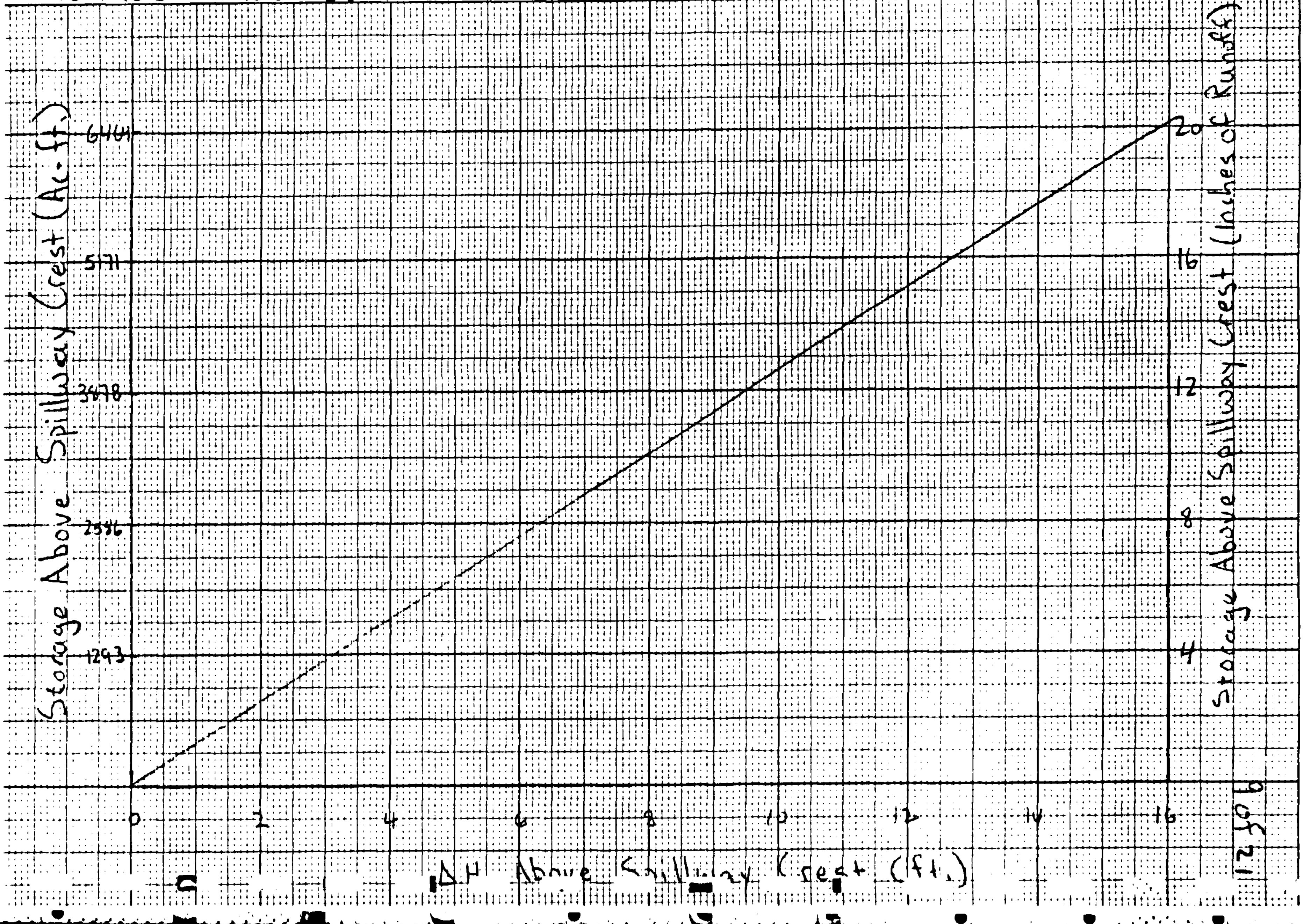
= 9.506" rise in water surface.

$$1' \text{ of rise} = \frac{12''}{9.506''} = 1.26'' \text{ of runoff}$$



STORAGE-STAGE CURVE

DAN HOLE POND



Reduction in flow due to Storage:
Assume total Storm Volume = 19"

Use COE suggested Methodology with additional iterations.

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{STOR1}{19}\right)$$

① Q_{P_1} = 12,000 cfs → H_1 = 10.98' above the spillway crest

H_1 = 10.98' gives 10.98 (1.26") = 13.83" of surcharge storage.

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{13.83}{19}\right) = 3{,}265 \text{ cfs}$$

② Q_{P_2} = 3265 → H_2 = 5.05' above the spillway crest.

H_2 = 5.05 gives 5.05 (1.26") = 6.36" of surcharge storage.

$$Q_{P_3} = Q_{P_1}\left(1 - \frac{6.36}{19}\right) = 7{,}983 \text{ cfs}$$

③ Q_{P_3} = 7,983 → H_3 = 8.62' above the spillway crest
H_3 = 8.62' gives 8.62 (1.26") = 10.86" of surcharge storage.

$$Q_{P_4} = Q_{P_1}\left(1 - \frac{10.86}{19}\right) = 5{,}141 \text{ cfs}$$

④ Q_{P_4} = 5,141 → H_4 = 6.66' above the spillway crest
H_4 = 6.63' gives 6.63 (1.26") = 8.35" of sur-

charge storage.

⑤ FOR a final Q_p, average STOR3 and STOR4:

$$STOR = \frac{8.35 + 10.86}{2} = 9.605''$$

which is only slightly greater than the 9.5" assumed for the TF.

$$Q_p = 12{,}000\left(1 - \frac{9.605}{19}\right) = 5{,}934 \text{ cfs}$$

→ H = 7.22', or 5.72' above the dam crest.

Calculation of Estimated Downstream Dam Failure Flood Stages - Based on COE "Rule of Thumb" Guidance, April 1978.

STEP 1: Reservoir Storage at Time of Failure

Assume failure occurs at when the dam is overtopped. (Water level 1.5' over the spillway.)

Storage = Normal + Surcharge = 1200 AF + 1.5(408) AF
= 1812 AF

STEP 2: PEAK FAILURE OUTFLOW

$$Q_{p_1} = 8/27 \; W_b \sqrt{g} \; y_0^{3/2}$$

W_b < 40% (Width) = .4(114.1) = 45.6'
Use 40 ft.

y_0 = 11.0 + 1.5 = 12.5

$$Q_{p_1} = 8/27 (40) \sqrt{32.2} (12.5)^{1.5}$$
= 2972 cfs → 2970 cfs

STEP 3: Develop Stage-Discharge Routing for Downstream Reaches

Assumed Cross-Sections for the downstream reaches shown on the USGS topo are plotted below.

Computer output tables of Stage-Discharge Relationships are attached.

Reach 1: Little Dan Hole Pond

L = 3200'

$S = \frac{11}{3200} = .00344$

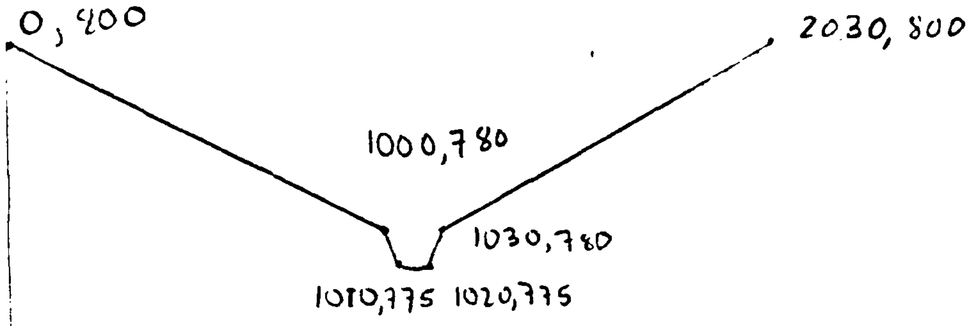
n = .045

Reach 2: Through Swamp

L = 6200'

$S = \frac{40}{5200} = .00769$

n = .100



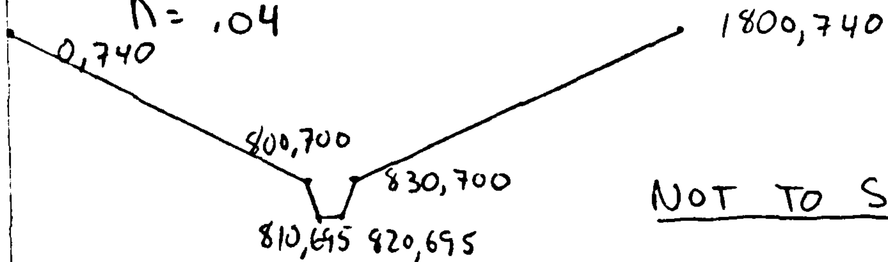
Not to Scale

Reach 3: To split in Channel

L = 4750'

$S = \frac{160}{4750} = .0337$

n = .04



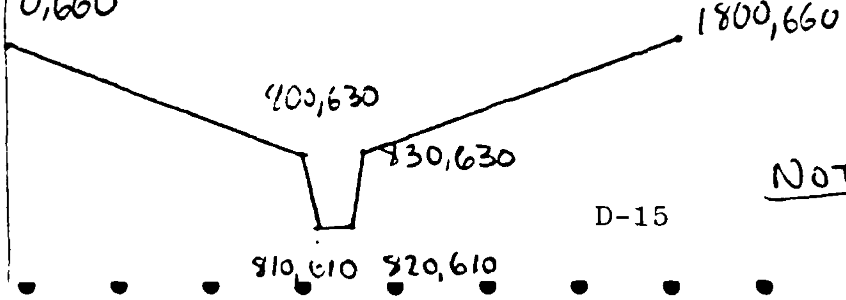
NOT TO SCALE

REACH 4: Split in Channel to Dam is Ossipee

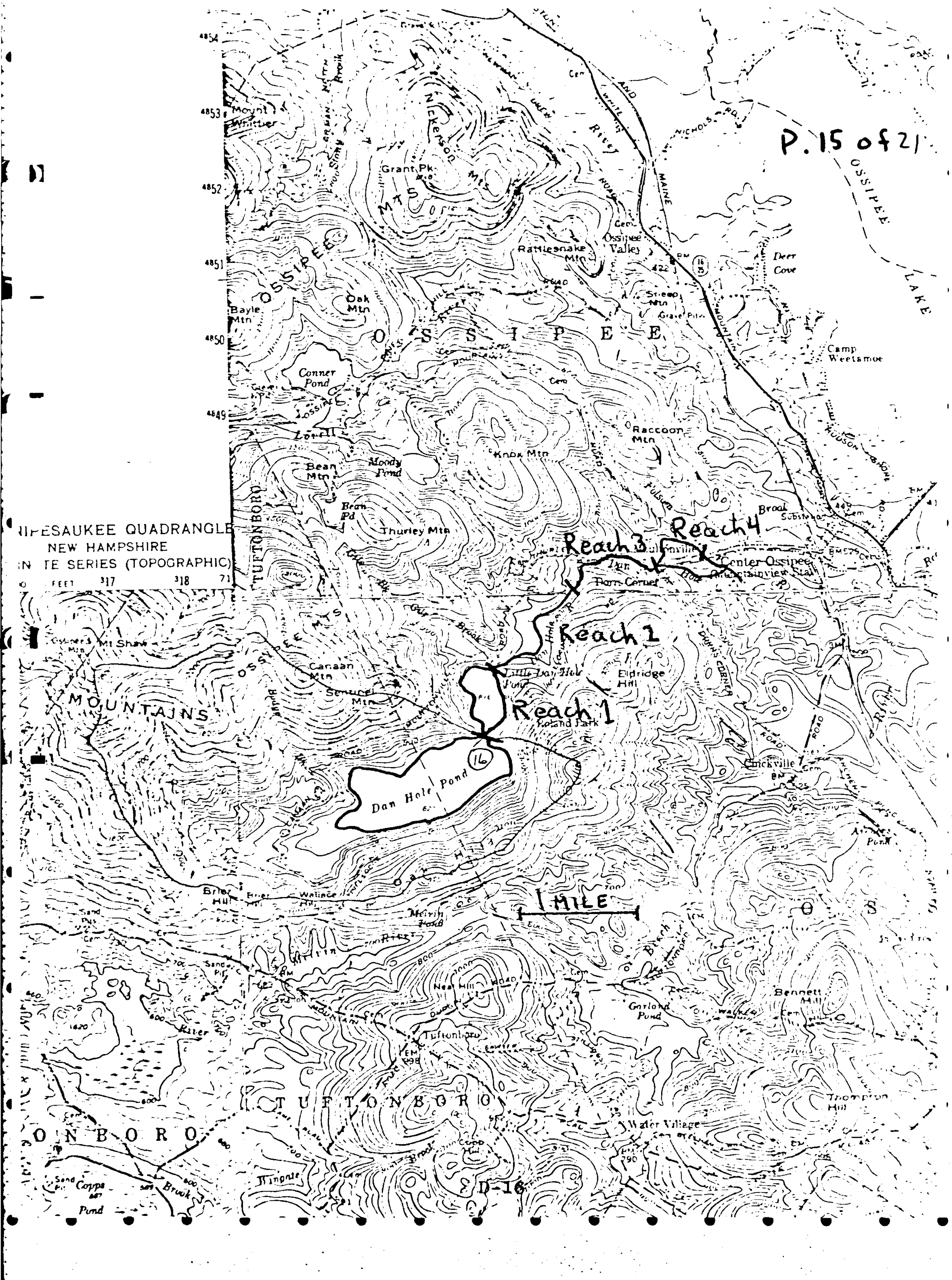
L = 3000'

$S = \frac{40}{3000} = .0133$

n = .04



NOT TO SCALE



IPESAUKEE QUADRANGLE
NEW HAMPSHIRE
TE SERIES (TOPOGRAPHIC)
Reach 1
Reach 2
Reach 3
Reach 4
1 MILE
Dan Hole Pond
Little Dan Hole Pond
Center Ossipee
Mountainview
Roland Park
Eldridge Hill
Knox Mtn
Raccoon Mtn
Thurley Mtn
Moody Pond
Bean Mtn
Bean Pd
Conner Pond
Oak Mtn
Bayle Mtn
Mount Whittier
Grant Pk
Nickerson Mts
Rattlesnake Mtn
Ossipee Valley
Sheep Mtn
Deer Cove
Camp Weetamoe
OSSIPEE
OSSIPEE MTS
OSSIPEE LAKE
MOUNTAINS
TUFTONBORO
Canaan Mtn
Sentinel Mtn
Mt Shaw
Ossipee Mtn
Chickville
Brier Hill
Wallace Hill
Melvin Pond
Neal Hill
Garland Pond
Bennett Hill
Thompson Hill
Tuftonboro
Water Village
Copps Pond
Wingate
Ossipee River
Danforth Corner
D-16

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	806.0	0.0	0.0	0.0	0.0	0.0
0.5	806.5	765.0	1535.0	0.5	480.7	933.6
1.0	807.0	1534.9	1544.9	1.0	1528.2	2967.9
1.5	807.5	2309.8	1554.9	1.5	3007.5	5840.6
2.0	808.0	3089.6	1564.8	2.0	4863.6	9445.1
2.5	808.5	3874.3	1574.8	2.5	7062.9	13716.2
3.0	809.0	4664.0	1584.7	2.9	9582.0	18608.5
3.5	809.5	5458.7	1594.7	3.4	12403.5	24087.8
4.0	810.0	6258.3	1604.6	3.9	15513.4	30127.3
4.5	810.5	7062.8	1614.6	4.4	18900.5	36705.0
5.0	811.0	7872.3	1624.5	4.8	22555.3	43802.7
5.5	811.5	8686.8	1634.5	5.3	26469.8	51404.8
6.0	812.0	9506.1	1644.4	5.8	30637.2	59498.0
6.5	812.5	10330.5	1654.4	6.2	35051.5	68070.6
7.0	813.0	11159.8	1664.3	6.7	39707.3	77112.3
7.5	813.5	11994.0	1674.3	7.2	44600.0	86614.0
8.0	814.0	12833.1	1684.3	7.6	49725.4	96567.5
8.5	814.5	13677.3	1694.2	8.1	55079.5	106965.4
9.0	815.0	14526.3	1704.2	8.5	60659.2	117801.2
9.5	815.5	15380.3	1714.1	9.0	66461.2	129068.7
10.0	816.0	16239.3	1724.1	9.4	72482.7	140762.5
10.5	816.5	17103.2	1734.0	9.9	78721.1	152877.6
11.0	817.0	17972.0	1744.0	10.3	85174.0	165409.4
11.5	817.5	18845.8	1753.9	10.7	91839.4	178353.6
12.0	818.0	19724.6	1763.9	11.2	98715.1	191706.3
12.5	818.5	20608.3	1773.8	11.6	105799.3	205464.0
13.0	819.0	21496.9	1783.8	12.1	113090.3	219623.2
13.5	819.5	22390.5	1793.7	12.5	120586.5	234181.0
14.0	820.0	23289.0	1803.7	12.9	128286.4	249134.4

DAN HOLE POND - REACH 1

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	775.0	0.0	0.0	0.0	0.0	0.0
1.0	776.0	12.0	14.5	0.8	10.6	13.8
2.0	777.0	28.0	18.9	1.5	36.3	47.5
3.0	778.0	48.0	23.4	2.0	77.5	101.2
4.0	779.0	72.0	27.9	2.6	135.5	177.1
5.0	780.0	100.0	32.4	3.1	212.2	277.3
6.0	781.0	180.0	132.4	1.4	220.9	288.7
7.0	782.0	360.0	232.4	1.5	482.0	629.8
8.0	783.0	640.0	332.4	1.9	990.7	1294.5
9.0	784.0	1020.0	432.4	2.4	1807.9	2362.2
10.0	785.0	1500.0	532.5	2.8	2993.0	3910.7
11.0	786.0	2080.0	632.5	3.3	4601.6	6012.6
12.0	787.0	2760.0	732.5	3.8	6686.0	8736.1
13.0	788.0	3540.0	832.5	4.3	9295.8	12146.0
14.0	789.0	4420.0	932.5	4.7	12478.2	16304.2
15.0	790.0	5400.0	1032.6	5.2	16278.7	21270.0
16.0	791.0	6480.0	1132.6	5.7	20741.1	27100.7
17.0	792.0	7660.0	1232.6	6.2	25907.8	33851.7
18.0	793.0	8940.0	1332.6	6.7	31820.0	41576.7
19.0	794.0	10320.0	1432.6	7.2	38517.7	50328.0
20.0	795.0	11800.0	1532.7	7.7	46039.9	60156.7
21.0	796.0	13380.0	1632.7	8.2	54424.8	71112.6
22.0	797.0	15060.0	1732.7	8.7	63709.7	83244.4
23.0	798.0	16840.0	1832.7	9.2	73931.1	96599.9
24.0	799.0	18720.0	1932.7	9.7	85124.8	111225.8
25.0	800.0	20700.0	2032.8	10.2	97326.0	127168.2

DAN HOLE POND - REACH 2

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	695.0	0.0	0.0	0.0	0.0	0.0
1.0	696.0	12.0	14.5	0.8	10.6	72.4
2.0	697.0	28.0	18.9	1.5	36.3	248.5
3.0	698.0	48.0	23.4	2.0	77.5	529.8
4.0	699.0	72.0	27.9	2.6	135.5	926.9
5.0	700.0	100.0	32.4	3.1	212.2	1451.3
6.0	701.0	152.1	76.7	2.0	240.3	1643.1
7.0	702.0	248.5	121.0	2.1	401.7	2746.9
8.0	703.0	389.1	165.2	2.4	688.9	4711.1
9.0	704.0	574.0	209.5	2.7	1124.1	7687.0
10.0	705.0	803.1	253.8	3.2	1731.5	11840.6
11.0	706.0	1076.5	298.1	3.6	2534.7	17333.1
12.0	707.0	1394.1	342.4	4.1	3556.2	24318.3
13.0	708.0	1756.0	386.7	4.5	4817.5	32943.2
14.0	709.0	2162.1	431.0	5.0	6339.2	43348.8
15.0	710.0	2612.5	475.3	5.5	8141.1	55670.7
16.0	711.0	3107.1	519.6	6.0	10242.5	70039.8
17.0	712.0	3646.0	563.9	6.5	12661.7	86583.2
18.0	713.0	4229.1	608.2	7.0	15417.0	105424.2
19.0	714.0	4856.5	652.5	7.4	18525.8	126682.8
20.0	715.0	5528.1	696.8	7.9	22005.3	150476.1
21.0	716.0	6244.0	741.1	8.4	25872.2	176918.8
22.0	717.0	7004.1	785.4	8.9	30142.9	206122.7
23.0	718.0	7808.5	829.7	9.4	34833.4	238197.7
24.0	719.0	8657.1	874.0	9.9	39959.6	273251.6
25.0	720.0	9550.0	918.3	10.4	45536.9	311390.1

DAN HOLE POND - REACH 3

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.0	610.0	0.0	0.0	0.0	0.0	0.0
1.0	611.0	10.5	12.2	0.9	9.5	40.7
2.0	612.0	22.0	14.5	1.5	29.1	125.0
3.0	613.0	34.5	16.7	2.1	56.0	240.4
4.0	614.0	48.0	18.9	2.5	89.2	383.4
5.0	615.0	62.5	21.2	3.0	128.6	552.6
6.0	616.0	78.0	23.4	3.3	174.0	747.7
7.0	617.0	94.5	25.7	3.7	225.5	968.7
8.0	618.0	112.0	27.9	4.0	283.1	1216.2
9.0	619.0	130.5	30.1	4.3	347.0	1490.5
10.0	620.0	150.0	32.4	4.6	417.2	1792.3
11.0	621.0	170.5	34.6	4.9	494.0	2122.3
12.0	622.0	192.0	36.8	5.2	577.5	2481.1
13.0	623.0	214.5	39.1	5.5	667.9	2869.4
14.0	624.0	238.0	41.3	5.8	765.4	3288.0
15.0	625.0	262.5	43.5	6.0	870.0	3737.6
16.0	626.0	288.0	45.8	6.3	982.1	4219.0
17.0	627.0	314.5	48.0	6.6	1101.7	4732.8
18.0	628.0	342.0	50.2	6.8	1229.0	5279.8
19.0	629.0	370.5	52.5	7.1	1364.3	5860.8
20.0	630.0	400.0	54.7	7.3	1507.6	6476.4

DAN HOLE POND - REACH 4

STEP 4: CALCULATE DOWNSTREAM ATTENUATION

REACH 1: $Q_{P_1} = 2970$ cfs

$H = f(Q_{P1}) = 1.0'$

AREA at 1.0' = 1535 sq. ft.

$V_1 = L_1 \times \text{AREA} = \frac{3200\ (1535)}{43{,}560} = 112.8$ Ac. FT. ($\leq \frac{1}{2}S$)

$QP2T = QP1\left(1 - \frac{112.8}{1812}\right) = 2{,}785$ cfs

$H = f(QP2T) = .95'$

AREA at .95 = 1458 sq ft.

$V2 = \frac{1458(3200)}{43{,}560} = 107.1$ AF

VAVE = 109.95 AF

$QP2 = 2970\left(1 - \frac{109.95}{1812}\right) = 2790$ cfs → .95'

REACH 2: QP1 = 2790 cfs

H = 9.28' → AREA: 1153 sq. ft.

$V1 = \frac{6200\ (1153)}{43{,}560} = 164.1$ AF ($\leq \frac{1}{2}S$)

$QP2T = 2790\left(1 - \frac{164.1}{1812}\right) = 2537$

H = 9.11 ft → AREA = 1074 SQ FT.

$V2 = \frac{6200\ (1074)}{43{,}560} = 152.8$ AF

VAVE = 158.45

$QP2 = 2795\left(1 - \frac{158.45}{1812}\right) = 2546$ cfs

DAMS 148 DAN HOLE POND TCG [illegible]

REACH 3 : QP1 = 2546

H = 6.82 → AREA = 2[illegible]1.0 sq [illegible]

$$V1 = \frac{4750\ (2[illegible]1.0)}{43560} = [illegible]$$

$$QP2T = 2546 \left(1 - \frac{25.[illegible]}{1812}\right) = [illegible]$$

→ H = 6.79 → AREA = 227.9

$$V = \frac{4750(227.9)}{43560} = 24.9\ AF$$

$$QP2 = 2546 \left(1 - \frac{24.9}{1812}\right) = 2511\ cfs [illegible]$$

REACH 4: QP1 = 2511. Assume 1/2 flow goes each way at SPLIT IN STREAM → QP1 = 1255.5 H = 8.14 → A = 114.7

$$V = \frac{3000(114.7)}{43560} = 7.90\ AF$$

$$QP2T = \frac{2511}{2}\left(1 - \frac{7.90}{1812}\right) = 1250$$

H = 8.12 → AREA = 114.3

$$V = \frac{3000\ (114.3)}{43560} = 7.87\ AF$$

VAVE = AF

$$QP2 = \left(1 - \frac{7.89}{1812}\right)\frac{2511}{2} = 1250\ cfs$$

→ H = 8.12'

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

FILMED

8-85

DTIC