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NATIONAL DAM SAFETY PROGRAM, ALMONESSON LAKE DAM (NJ 00401), DE--ETC(U)
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DELAWARE RIVER BASIN
ALMONESSON CREEK,
GLOUCESTER COUNTY
NEW JERSEY

LEVEL II

ALMONESSON LAKE DAM

NJ 00401

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

February, 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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3. RECIPIENT'S CATALOG NUMBER

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National Dam Safety Program
Almonesson Lake Dam
Gloucester County, N.J.

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7. AUTHOR(s): (10) F. Keith Jolls, P.E.

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9. PERFORMING ORGANIZATION NAME AND ADDRESS
Louis Berger & Assoc. Inc.
100 Halsted Ave.
East Orange, N.J.

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(6) National Dam Safety Program. Almonesson Lake Dam (NJ 00401), Delaware River Basin, Almonesson Creek, Gloucester County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

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

Dams
Embankments
Structural Analysis
Safety
Visual Inspection
Almonesson Lake Dam

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

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

9 APR 1978

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Almonesson Lake Dam in Gloucester County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Almonesson Lake Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 22 percent of the 100-year flood would overtop the dam. The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's low hazard classification, small size, and expectation that failure of the structure would probably result in no loss of life and very minimal economic loss. For the same reasons no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one year from the date of approval of this report, the following actions should be taken.

(1) Regrade and provide slope protection for the downstream embankment areas at the bridge wingwalls.

(2) Construct slope paving on the downstream embankment at the roadway profile low point to provide further protection should overtopping occur.

(3) Remove trees on the downstream embankment slope to lessen

the piping potential.

(4) Place additional riprap in the downstream stilling basin to provide scour protection.

(5) Construct curbs and additonal catch basins along the roadway gutters to better control the surface runoff.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Florio of the First District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
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ALMONESSON LAKE DAM (NJ00401)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 6 December 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Almonesson Lake Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate since 22 percent of the 100-year flood would overtop the dam. The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's low hazard classification, small size, and expectation that failure of the structure would probably result in no loss of life and very minimal economic loss. For the same reasons no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one year from the date of approval of this report, the following actions should be taken.

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(2) Construct slope paving on the downstream embankment at the roadway profile low point to provide further protection should overtopping occur.

(3) Remove trees on the downstream embankment slope to lessen the piping potential.

(4) Place additional riprap in the downstream stilling basin to provide scour protection.

(5) Construct curbs and additonal catch basins along the roadway gutters to better control the surface runoff.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 21 Nov 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Almonesson Lake Dam Fed ID# NJ 00401 and NJ ID# 87

State Located New Jersey
County Located Gloucester
Coordinates Lat. 3949.0 - Long. 7505.8
Stream Almonesson Creek
Date of Inspection 6 December 1978

ASSESSMENT OF GENERAL CONDITIONS

Almonessen Lake Dam is assessed to be in an overall good condition and is recommended to be downgraded from a high hazard to a low hazard category. Overtopping of the highway crossing the dam would not significantly increase the danger of loss of life or property damage as the downstream flood plain is uninhabited. No detrimental findings were uncovered to render a significantly hazardous assessment. Remedial actions recommended to be undertaken in the future are 1) regrade and protect the downstream embankment areas at the bridge wingwalls, 2) construct slope paving on the downstream backslopes at the roadway profile low points 3) remove root systems on the downstream embankment slopes and 4) place additional riprap in the downstream channel. The debris that collects on the spillway should be removed as part of a regular maintenance program.

This dam has an inadequate spillway capacity, being able to accommodate only 21% of the 100 year design flood.

F. Keith Jolls P.E.
Project Manager

STATE OF KENTUCKY
F. KEITH
JOLLS
5432
REGISTERED
PROFESSIONAL ENGINEER

OVERVIEW OF ALMONESSON LAKE DAM

December 1978

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of 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. 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 be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: ALMONESSON LAKE DAM, FED ID# NJ 00401

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Almonesson Lake Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Almonesson Lake Dam is an old earth highway embankment approximately 300 feet in length with a 50-year old bridge and spillway located about 80 feet from the west abutment. The road embankment carries Cooper Street across the entire north shore of Almonesson Lake and forms the dam structure. The spillway bridge has a total width of 42 feet face to face of parapet and is comprised of an eleven foot radius semi-circular arch concrete culvert. The wingwalls are 80 feet long overall and parallel the roadway centerline. The upstream

spillway is a three-sided concrete drop inlet structure with two sections of removable timber flashboards facing the reservoir. The spillway crest is approximately five feet below the bridge deck which forms the low point on top of the dam. The roadway embankment is about 42 feet wide with 1½H to 1V side slopes. A timber sheet piling cut-off wall is installed in the middle of the fill, according to the existing plans. The spillway bridge is approximately at the low point in a long sag roadway vertical curve that descends onto the dam from each end.

b. Location

Almonesson Lake Dam is located on Cooper Street (County Road 534) in Almonesson, Deptford Township, Gloucester County and is situated 1500 feet west of the intersection of Cooper Street and State Highway 41.

c. Size Classification

The maximum height of the dam is 23 feet at the spillway foundation and the maximum storage is estimated to be 257 acre-ft. Therefore, the dam is placed in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

Based upon the Corps of Engineers criteria and the fact that in the event of a failure little damage would take place to downstream property or endanger any lives, the classification of the dam is recommended to be downgraded to low hazard. With a clear downstream channel and all development well above the spillway crest, a failure would cause little damage except to the dam itself. Below the dam, Almonesson Creek flows thru a relatively broad and uninhabited flood plain with the next downstream road crossing about 1.3 miles below the dam.

e. Ownership

According to Division of Water Resources records, the dam is owned by Gloucester County as part of the road system. The County bridge designation is #3K3.

f. Purpose of Dam

The dam presently impounds a recreation lake.

g. Design and Construction History

The dam structure, as it exists today, was constructed in 1926 under supervision of the Gloucester County Engineer, Mr. William C. Cattell. The construction took place on the same alignment of an existing highway embankment that was overtopped and washed out during the spring of 1926. The bridge and spillway structure were constructed approximately 75' west of where this washout occured. The bridge was built inside a timber-sheeted cofferdam that was left in place according to available records. No apparent modifications have been made to the 1926 structure except for the replacement of the timber flashboards (in 1968).

h. Normal Operational Procedures

The roadway and bridge structure are operated as a part of the County road network system.

1.3 PERTINENT DATA

a. Drainage Area : 2.8 square miles

b. Discharge at Damsite

Maximum recorded flood at damsite : Unknown
Ungated spillway capacity : 810 cfs.

c. Elevation (ft. above MSL)

Top of dam (max. pool)	-	+29.0 (low point on roadway)
Design pool	-	+24.0

Recreation Pool (spillway crest) - +24.0
Streambed at centerline of dam - +16±
Maximum Tailwater - +12.5±

d. Reservoir

Length of recreation pool - 2,700 ft.
Length of maximum pool - 5,300 ft.

e. Storage

Recreation Pool - 125 acre-ft.
Maximum Pool (top of dam) - 257 acre-ft.

f. Reservoir Surface

Top of dam (Max. Pool) - 37± acres
Recreation Pool - 17.6 acres

g. Dam

Type - earth embankment with concrete spillway
Length - 300 feet
Height - 23 feet (to bottom of bridge foundation)
Top Width - 42 feet
Side slopes - 1.5H : 1V
Zoning & Core - Unknown
Cutoff - Wood sheet piling along axis of dam
Grout Curtain - none

h. Diversion and Regulating Tunnel

None

i. Spillway

Type - 3-sided narrow crested weir (drop inlet)
Overall Length - 44'
Crest Elevation - +24.0
Gates - None
U/S Channel - Almonesson Lake
D/S Channel - Almonesson Creek

j. Regulating Outlets

2 - sets of 4' wide removeable timber flashboards
Low invert elevation + 16.2 (all removed).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The only design information located for review were two sheets of the 1926 construction plans attached herein. The work was designed by Mr. William C. Cattell, the County Engineer to his own County Specifications.

2.2 CONSTRUCTION

The structure and roadway embankment was built by E.P. Henry and Sons, General Contractors.

2.3 OPERATION

Records indicate that the 1926 construction replaced an earlier bridge that was washed out. The present structure appears to have operated satisfactorily as designed since its completion.

2.4 EVALUATION

a. Availability

In view of the size and hazard classification it is felt that sufficient engineering data is available except for the geotechnical make-up of the embankment.

b. Adequacy

The original plans indicate that the spillway arch culvert was carefully and conservatively designed and from the results of the field inspection, is built in accordance with the design plans. The available engineering data is therefore believed to be adequate for the subject inspection.

c. Validity

Based on field observations, the validity of the 1926 design plans is not challenged but further investigations would be required to

assess the permeability of the embankment zones (its structural stability is not questioned.)

SECTION 3 - VISUAL INSPECTIONS

3.1 a. General

Visual inspections were conducted on September 22, and December 6, 1978. The reservoir water level at the time of the latter inspection was about 3 inches above the top of the intake flashboards and was flowing freely.

b. Dam

The embankment portions were found to be substantially as designed and in moderately good condition in view of the age. The lake water level appears to be quite constant during most periods excepting for very heavy inflows as the banks are well stabilized and show little evidence of sloughing at the waterline. The 1:5 to 1 sideslopes are grassed over and have several good-sized trees placed along the sides. There is evidence of considerable pavement run-off in certain locations which have cut out erosion channels. These appear to have been repeatedly patched, particularly of the northeast corner of the bridge wingwall. There are numerous roadway curb drains and catch basins along the gutter lines. The upstream embankment slope is very irregular and it appears the lake has silted up considerably against the upstream face of the dam.

c. Appurtenant Structures

The reinforced concrete arch bridge is in excellent structural condition in view of its age. The wingwalls and parapets display minor cracking and spalled areas but the structurally important zones are in an integral condition. Several horizontal construction joints in the wingwalls are eroded and two sets of transverse tie-rods have been installed between the east wings but whether or not these were placed during the initial construction is not known (they do not show on

the 1926 plans). The semi-circular culvert opening has 11 foot intrados and 15 foot extrados radii and a clear span of 20 feet. The headroom above a reinforced concrete paved invert is about 8 feet. The paved invert which forms the culvert floor is founded on 8 x 8" timber mudsills which are supported on timber piling as are the main footings of the arch and wingwall retaining walls.

At the outfall invert of the culvert (on the north bridge fascia) there is a drop of about 4.5 feet to the downstream channel and vertical steel sheeting has been driven at roughly 45° angles from the fascia line to protect the toes of slope at the base of each wingwall. Some loose riprap has been dumped into the outfall channel (which replaces 2 x 8 timber lagging originally constructed in this area). The drop in the outfall appears to be the long term result of erosion and scour.

The spillway inlet is a 3-sided reinforced concrete frame built right into the bridge wingwalls. It is of a design seen frequently in Gloucester County on construction built in the 1920's and 30's and functions very well for the purpose intended. Two sets of timber flashboards four feet wide are set in vertical slots formed in the concrete on the upstream face and the inlet frame is overtopped with a concrete slab 2 feet above the top of flashboards. However, as can be seen in Section 5, this top slab somewhat limits the hydraulic capacity of the intake. From the size of lake and drainage area, it is doubtful that this was designed as an anti-vortex device but probably served merely as a maintenance platform.

d. Reservoir Area

Almonesson Lake has a regular well-defined shoreline that extends about 0.5 mile upstream to its headwaters at Blackwood Avenue. The reservoir is bounded on both sides with suburban development which includes

a recreation beach immediately to the east of the right abutment area. The lake is clear of debris and there is little evidence of silting except immediately adjacent to the dam face.

e. Downstream Channel

Almonesson Creek flows almost due north after passing the dam in a low marshy valley between 200 to 300 feet wide. Above the undeveloped flood plain, the wooded side banks gradually rise 20 to 30 feet where there are a small number of residences constructed at the tops of the slopes. The low water channel is fairly well-defined and is about 30 feet wide on the average. The channel banks are well stabilized and it appears that heavy discharges inundate considerable portions of the river valley.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not physically observed by the inspection team. Discussions were held with personnel of the Gloucester County Road Department who handle the regular maintenance of the dam. There is little day-to-day operation as the sluice gates are infrequently adjusted.

4.2 MAINTENANCE OF DAM
4.3 MAINTENANCE OF OPERATING FACILITIES

The dam and reservoir are maintained by Gloucester County in a workmanlike fashion as part of their continual road program.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

None exists except for monitoring by County and local Municipal personnel during heavy storms.

4.5 EVALUATION

The present operational procedures and safeguards are deemed to be adequate, in view of the position of the dam (no downstream residential areas) and the relatively small contributory area.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

As described in Section 3, the spillway is a 3-sided concrete weir with 2 sets of timber flashboards, set a few inches below the top of concrete spillway. Two feet above the spillway crest is a maintenance slab which restricts the inflow for greater hydraulic heads. Based on the Recommended Guidelines for Safety Inspection of Dams, the spillway design flood (SDF) is either the 50 or 100-year frequency event. Inflow to the reservoir for the selected 100-year storm was computed utilizing precipitation data from Technical Publication 40 and Technical Memo NWS Hydro #35 by the HEC-1 program which gave a peak inflow of 5,085 cfs. Routing this storm through the reservoir reduced the peak discharge to 3,910 cfs. As the spillway capacity is 810 cfs, it can accommodate only 21% of the 100 year flood.

b. Experience Data

There are no stream flow records available for Almonesson Creek, but it was recorded that in 1926 a flood occurred that overtopped and washed out the road embankment. There is no evidence of recent overtoppings but it was felt that there was a considerable period of time (roughly two decades) for which the inspection team could not obtain any hearsay information.

c. Visual Observations

As a result of visual inspections and in view of the small drainage area, there is little danger from overtopping except that it could possibly occur immediately at the end of the bridge wingwalls and tend to concentrate there. As previously reported, the roadway is on a sag vertical curve.

d. Overtopping Potential

Employing the discharge and spillway capacities contained herein, overtopping would occur in the event of the 100-year frequency storm. Since the SDF considerably exceeds the spillway capacity, the overtopping potential was determined by calculating the overbank discharge which was determined to overtop the dam by approximately two feet. However, as pointed out in the preceding paragraph, the overtopping flow would initially be concentrated at the low point on the roadway and would most probably erode the downstream face of the embankment near the end of the bridge wingwall. It is unlikely that the discharge would damage the roadway itself except for possibly undercutting the edges of the pavement.

e. Drawdown

At the present time drawdown is not immediately possible as there is no practical method of removing all the stop logs. However, if in an emergency the planking were removed by force, the lake would take approximately one half day to drawdown from normal pool elevation (24.0) to the concrete sill (El. 16.2). There are no provisions to further dewater the lake.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Based on the existing conditions inspected and the 1926 single source of design plans, the dam is deemed to be in moderately good condition except for the continual maintenance problem of roadway drainage at the end of the bridge wingwalls. Although no safety hazard is foreseen, a collapse of the culvert structure due to vehicular overloads could block the discharge channel and create a hydraulic blockage. However, in view of its structural condition, and depth of cover, this is quite unlikely. The roadway embankment is quite wide in relation to its height and as a water impounding structure, has adequate stability. The depth and limits of the timber sheet piling core (see Figure 2) are unknown but certainly contribute to the adequate length of the flow network. Although some evidence of seepage was observed on the natural terrain immediately northwest of the dam, it could not be ascertained that this was an evidence of percolation or the result of overland flows from the higher ground immediately to the east.

b. Design and Construction Data

Although no hydraulic or structural computations were located, a review of the original plans indicates that the concrete intake and arch culvert were conservatively designed and in spite of their age, are believed to be in a safe condition.

c. Operating Records

No records are available but the dam appears to be operating satisfactorily. There are no known instances where overtopping caused any appreciable damage.

d. Post Construction Changes

The only post-construction changes in evidence is the steel sheet piling that has been installed along the sides of the downstream channel. Further, some large riprap stone has been dumped in the outfall area immediately below the culvert.

e. Seismic Stability

The Almonesson dam is located in Zone 1 and due to its embankment width and spillway geometry, has negligible potential vulnerability regarding potential earthquake loadings. As experience indicates, dams in Zone 1 will have adequate stability under dynamic loadings if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENATIONS/ PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Almonesson Lake Dam is classified as being in a sound and satisfactory structural condition although the spillway is incapable of passing the design flood. The dam embankment was built of unknown composition but due to its broad width, timber cut-off wall and lack of any evidence of seepage, is felt to be of a sufficient impervious condition to withstand normal hydraulic heads. The present spillway capacity is inadequate and does not meet the requirements of the Recommended Guidelines for Safety Inspection of Dams, being able to accommodate only 21% of the design flood as calculated by Corps of Engineers criteria. However, the SDF is calculated to overtop the dam by only slightly more than two feet at the low points along the roadway and except for the probable erosion of the downstream slopes, it is felt that little other damage would occur. The major distressed areas of embankment are at the ends of the bridge wingwalls but this is of secondary importance vis a vis the overall stability of the dam.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam. However, no recent surveys have been made.

c. Urgency

No urgency is attached to implementing further studies and it is recommended that the remedial measures enumerated below be taken under advisement in the future.

d. Necessity for Further Study

Due to the low hazard classification of the dam and the fact that no serious property damage is foreseen in case of a failure, further engineering studies are deemed unnecessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives

On the basis of visual inspection, improvements to the present spillway are not warranted. Consideration could be given to removing a portion of the access slab which is constructed atop the spillway but this might do more structural damage to the old structure than it is worth hydraulically. The downstream face of the embankment at the extreme low point in the roadway profile could be further protected with slope paving and in effect, act as an auxiliary spillway should overtopping occur. Additionally, the embankment areas at the ends of all the bridge wingwalls should be regraded and protected with concrete or asphalt slope protection. Other remedial measures to be taken under advisement include:

1) removal of the trees on the downstream embankment to lessen the piping potential;

2) place additional riprap in the downstream stilling basin; and

3) construct curbs and additional catch basins along the roadway gutters to better control the surface run-off.

b. O&M Maintenance and Procedures

No additional procedures other than those presently in effect appear to be warranted in view of the above assessment.

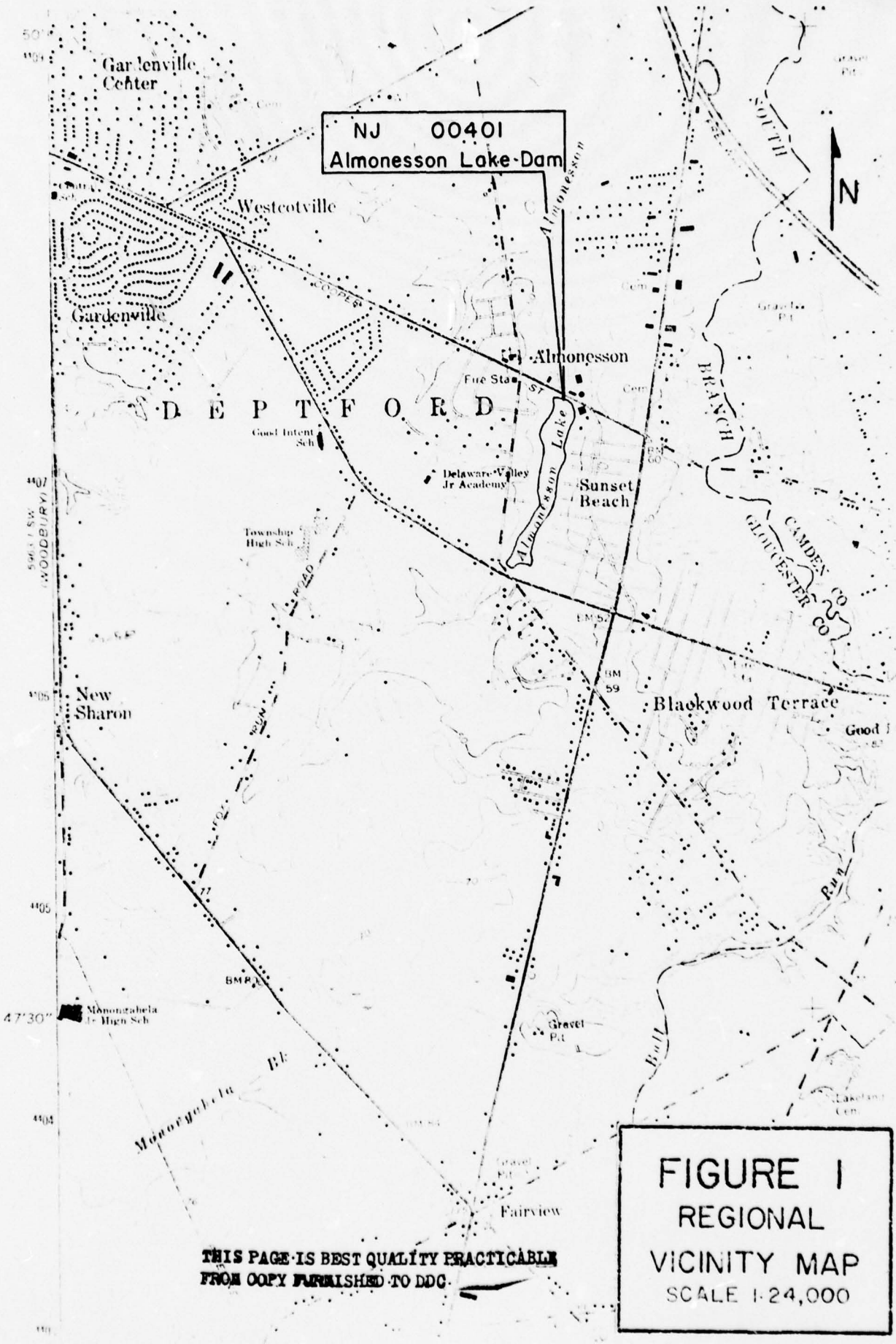

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FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

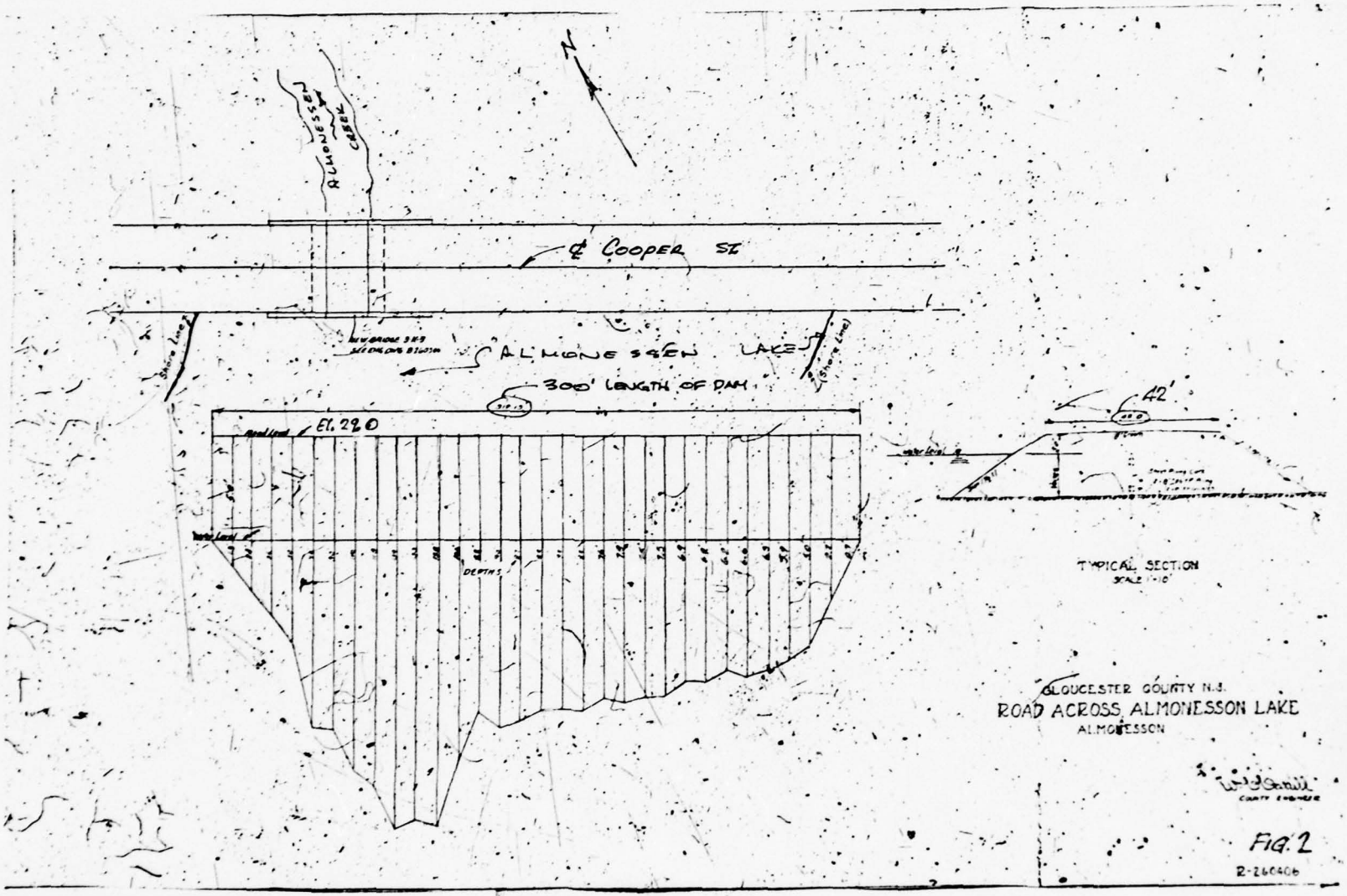


FIGURE 2

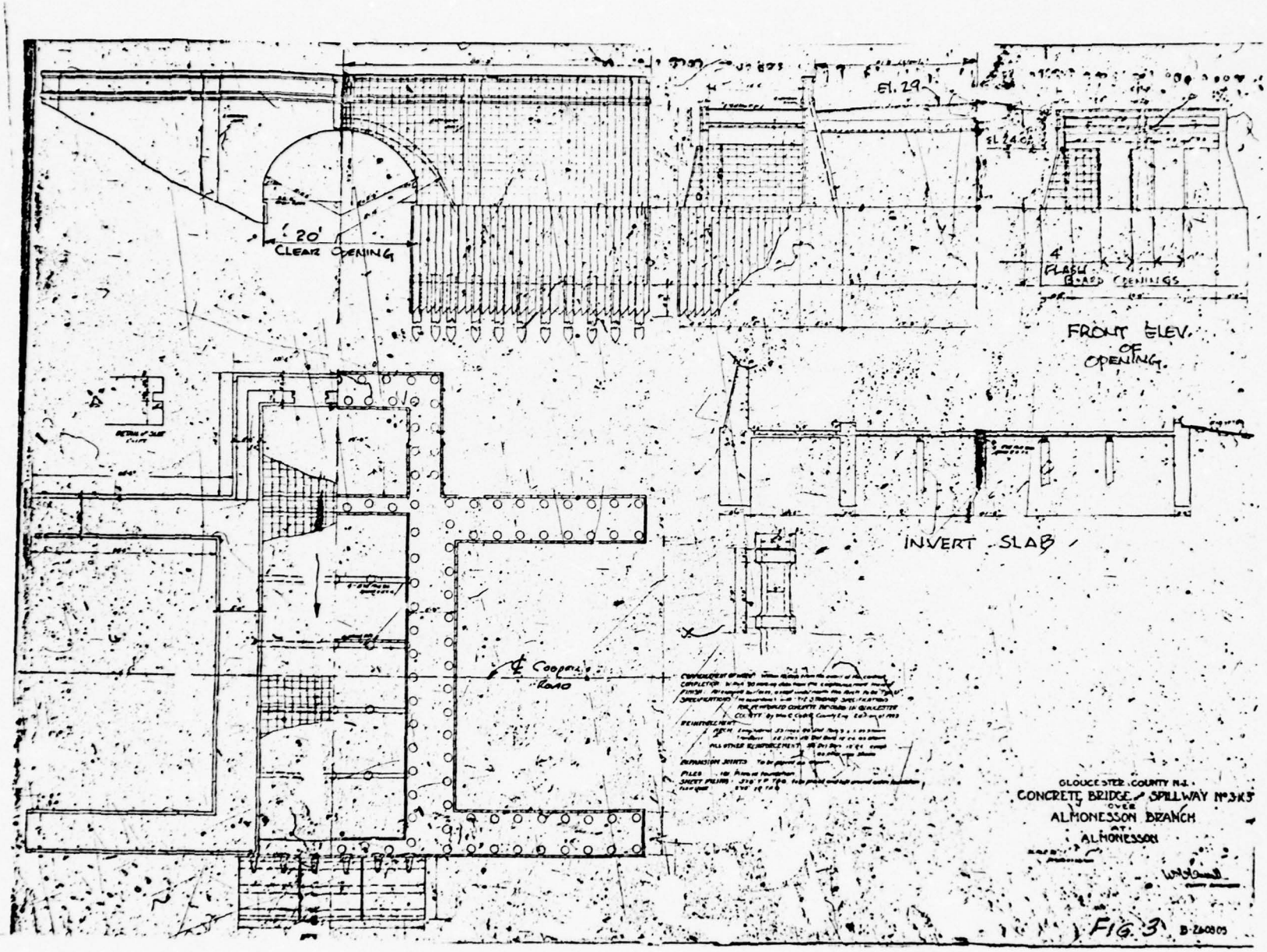


FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Almonesson Lake Dam County Gloucester State New Jersey Coordinators NJDEP

Date(s) Inspection Sept. 22, Dec. 6, 1978 Weather Clear Temperature 35°

Pool Elevation at Time of Inspection 24 M.S.L. Tailwater at Time of Inspection 12.5 M.S.L.

Inspection Personnel:

K. Jolls E. Simone

D. Lang

M. Carter

K. Jolls Recorder

Dam No. 00401

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Satisfactory - small elevation differential at abutments (see road plans)	County Bridge No. 3K3 original condition
DRAINS	Several inlets on both sides of bridge from road catch basins and curb inlets.	
WATER PASSAGES	None	
FOUNDATION	Structure on timber pilings (see bridge plans)	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some spalling and deteriorated areas on inlet structure	
STRUCTURAL CRACKING	Yes Tierods installed between east wingwalls (condition good)	Horizontal cold joints show some efflorescence.
VERTICAL AND HORIZONTAL ALIGNMENT	Satisfactory	
MONOLITH JOINTS	None	
CONSTRUCTION JOINTS	Satisfactory	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	Entire top of dam asphalt-paved roadway (26' wide). Some curbed sections.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Severe erosion at end of wingwall on Northeast corner of bridge (apparently due to roadway runoff). Asphalt slope protection placed near NE wingwall end.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Satisfactory - Roadway is on top of embankment, on a long sag vertical curve.	
RIPRAP FAILURES	None	Some large rock dumped in downstream channel at culvert outfall.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory (very ill-defined)	
ANY NOTICEABLE SEEPAGE	No	
STAFF GAGE AND RECORDER	None	
DRAINS	Roadway catch basins and curb inlets.	Road runoff scouring out ends of wingwalls.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None	
INTAKE STRUCTURE		
OUTLET STRUCTURE		Steel sheeting driven along channel banks.
OUTLET CHANNEL	Natural stream channel - clear no obstructions. Approximately 10'-15' wide. Secondary growth on side banks.	
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	2-4' wide notches in intake wall	Partially clogged by floating debris.
APPROACH CHANNEL	None - Almonesson Lake directly above bridge and spillway.	
DISCHARGE CHANNEL	See previous page	
BRIDGE AND PIERS	Bridge No. 3-K-3 on Cooper Street 80'± long, constructed 1926.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Flat	Recreation immediately Southeast of dam (just past catering service on corner).
SEDIMENTATION	Some about spillway. Banks well-defined.	Appears to be only minor fluctuation in lake level.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Clear natural channel approximately 15' - 20' wide. Secondary growth on banks.	Clear channel = 30' ±.
SLOPES	Natural erosion but banks are well established.	
APPROXIMATE NO. OF HOMES AND POPULATION	None in immediate vicinity. No danger of flood damage 1 mile ± downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available
TYPICAL SECTIONS OF DAM	Available
HYDROLOGIC/HYDRAULIC DATA	Not available
OUTLETS - PLAN	Available
- DETAILS	Available
-CONSTRAINTS	Not available
-DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	Not available

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	
DAM STABILITY	
SEEPAGE STUDIES	
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	Not available
LABORATORY	Not available
FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Not available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM	Available
DESCRIPTION	Available
REPORTS	Not available
MAINTENANCE	None available
OPERATION	None available
RECORDS	None available

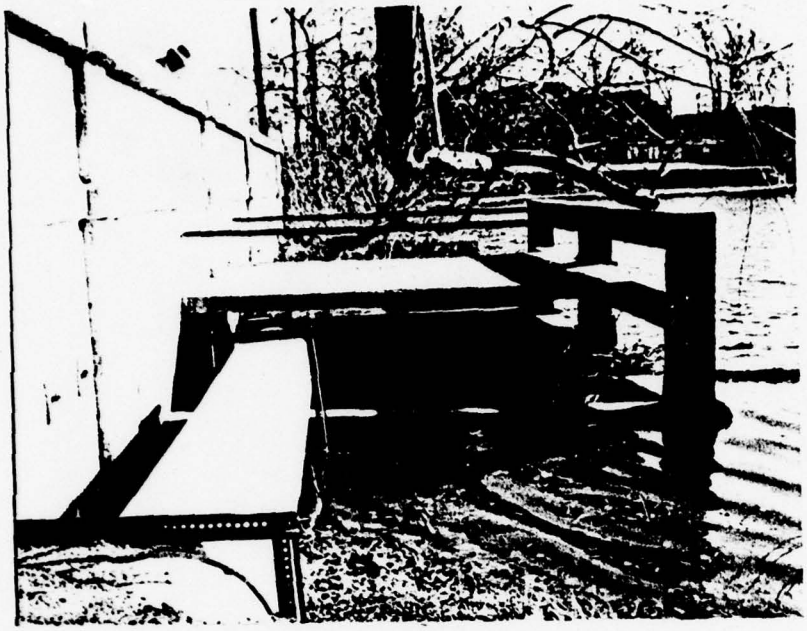
ITEM	REMARKS
SPILLWAY PLAN	Available
SECTIONS	Available
DETAILS	Available
OPERATING EQUIPMENT PLANS & DETAILS	N/A

Almonesson Lake

December 1978

Downstream channel

December 1978

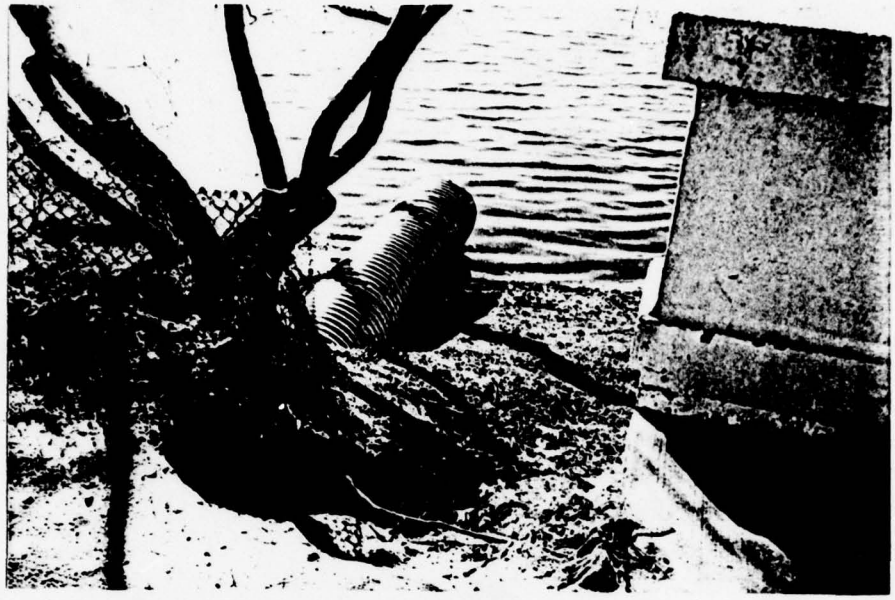


Spillway structure

December 1978

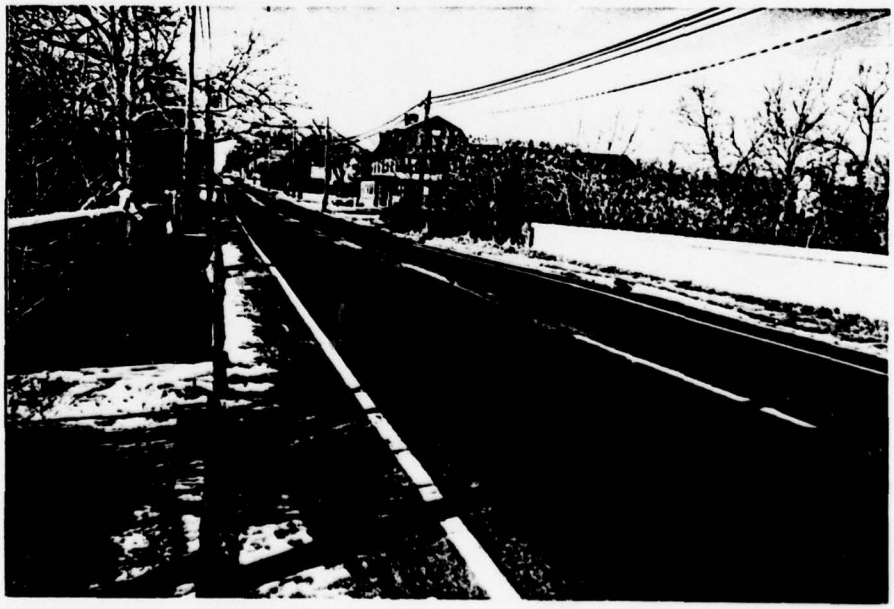
Downstream bridge opening (22' dia.)

December 1978



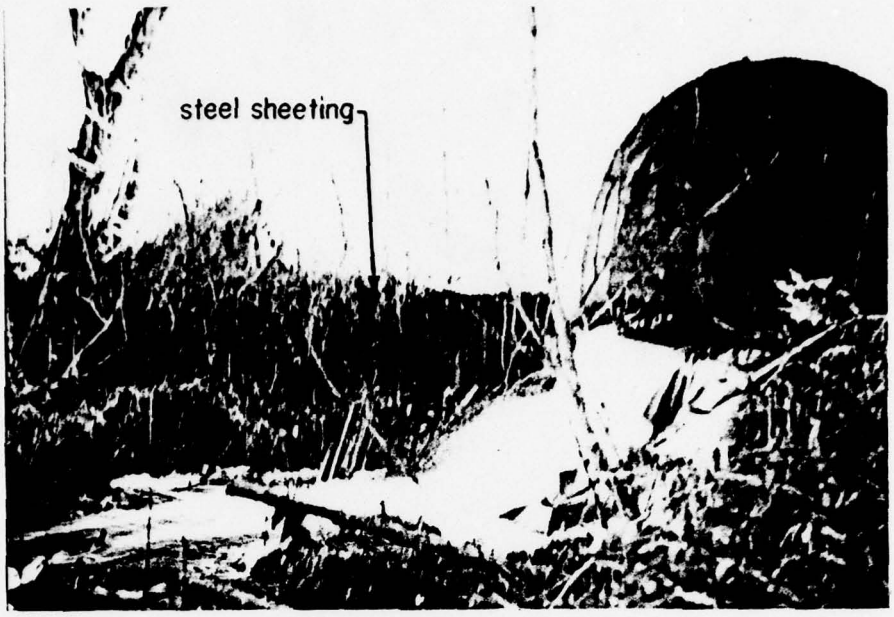
Roadway drain at S.E. wingwall

December 1978



View West along Cooper Street

December 1978



Downstream of bridge opening

December 1978

View S.E. from spillway of lake

December 1978

Dam No. 00401

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Drainage Area = 2.8 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 24 MSL (125 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 29 (257 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 29.0

ELEVATION TOP DAM: 29.0

CREST:

a. Elevation 24.0 (MSL)
b. Type Sharp crested weir (3 sided drop inlet)
c. Width 1 foot
d. Length 44 feet (3 sides)
e. Location Spillover 80' from west end
f. Number and Type of Gates none

OUTLET WORKS: None

a. Type
b. Location
c. Entrance inverts
d. Exit inverts
e. Emergency draindown facilities Removeable flashboards

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 810 cfs

BY D.J.M DATE 12-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY DATE ALMONESSON LAKE DAM INSPECTION PROJECT C226

SUBJECT UNITGRAPH DATA FOR HEC-1 INPUT

Time of concentration

CALIFORNIA CULVERT METHOD $L = 1$ mile, $H = 20'$

$$T_c = \left(\frac{11.9}{20}\right)^{0.385} = 0.82 \text{ hours}$$

From SCS Nomograph pg. 71 'Design of Small Dams'

$T_c = 0.8$ hours

US. NAVY & Texas Highway department method

Flow in watercourse

$$\text{Slope} = \frac{20}{5280} \times 100 = 0.4\% \qquad \text{use } v = 2.0 \text{ ft s}^{-1}$$

$$\text{time} = \frac{5280}{2 \times 3600} = 0.73 \text{ hrs}$$

Overland flow $L \simeq 1300'$ $H \simeq 10'$

Slope $= 0.8\%$ use $v = 1.5$ ft s^{-1}

time $= 0.24$ hrs

Σ time $= 0.73 + 0.24 \simeq 1$ hr

Use $T_c = 1$ hour

BY D.J.M DATE 12-78
CHKD. BY _____ DATE _____
SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

ALMONESSON LAKE DAM INSPECTION

SHEET NO. A2 OF _____
PROJECT C226

$$T_p = \frac{0.25}{2} + 0.6 \times 1 = 0.73 \text{ hours}$$

$$Q_p = \frac{484 \times 2.8 \times 1}{0.73} = 1856$$

Time	T/T_p	Dimensionless ordinate (DO)	D.O $\times Q_p$
0.25	0.34	0.208	386
0.50	0.68	0.736	1366
0.75	1.03	1.000	1856
1.00	1.37	0.777	1442
1.25	1.71	0.483	896
1.50	2.05	0.300	557
1.75	2.40	0.18	334
2.00	2.74	0.1076	200
2.25	3.08	0.0688	128
2.50	3.42	0.0422	78
2.75	3.77	0.0263	49
3.00	4.11	0.0160	30
3.25	4.45	0.0099	18
3.50	4.79	0.0061	11

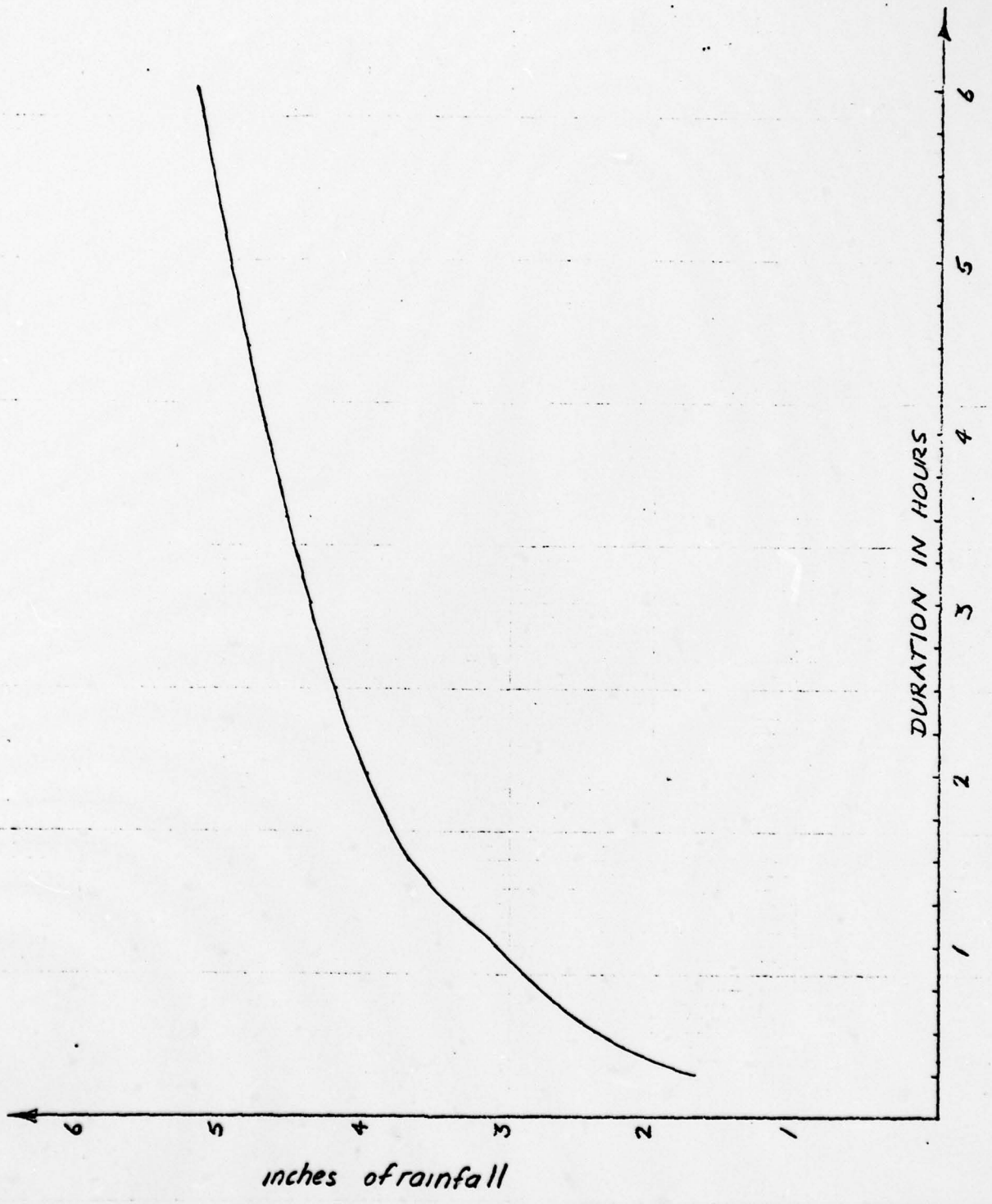
BY D J M DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF
CHKD. BY DATE ALMONESSON LAKE DAM PROJECT C227
SUBJECT

PRECIPITATION DATA FROM T.P 40 (See depth duration curve overleaf)
& HMR 35

Time	Precipitation	Δ	Rearrange
0.25	1.7	1.7	0.06
0.50	2.4	0.7	0.06
0.75	2.8	0.4	0.06
1.00	3.1	0.3	0.06
1.25	3.5	0.4	0.07
1.50	3.7	0.2	0.07
1.75	3.86	0.16	0.08
2.00	4.00	0.14	0.09
2.25	4.11	0.11	0.09
2.50	4.22	0.11	0.09
2.75	4.31	0.09	0.11
3.00	4.40	0.09	0.11
3.25	4.49	0.09	0.30
3.50	4.57	0.08	0.70
3.75	4.64	0.07	1.70
4.00	4.71	0.07	0.40
4.25	4.78	0.07	0.40
4.50	4.84	0.06	0.20
4.75	4.90	0.06	0.16
5.00	4.96	0.06	0.14
5.25	5.02	0.06	0.07
5.50	5.05	0.06	0.06
5.75	5.14	0.06	0.06
6.00	5.20	0.06	0.06

BY D.J.M DATE 1-79 SUBJECT T.P. 40 & H.M.R. 35 SHEET NO. A4 OF

CHKD. BY DATE DEPTH DURATION CURVE JOB NO. C227

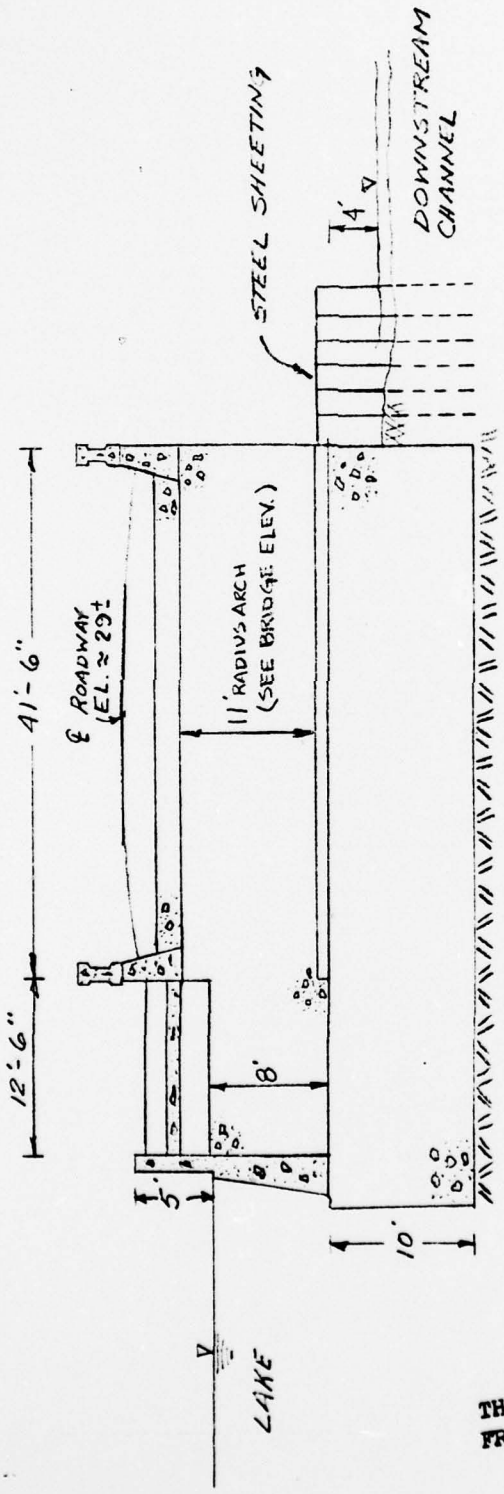


BY D.L. DATE 12-78
CHKD. BY DATE
SUBJECT

LOUIS BERGER & ASSOCIATES INC.

ALMONESSON LAKE DAM
SPILLWAY SECTION

SHEET NO. A6 OF
PROJECT C-226

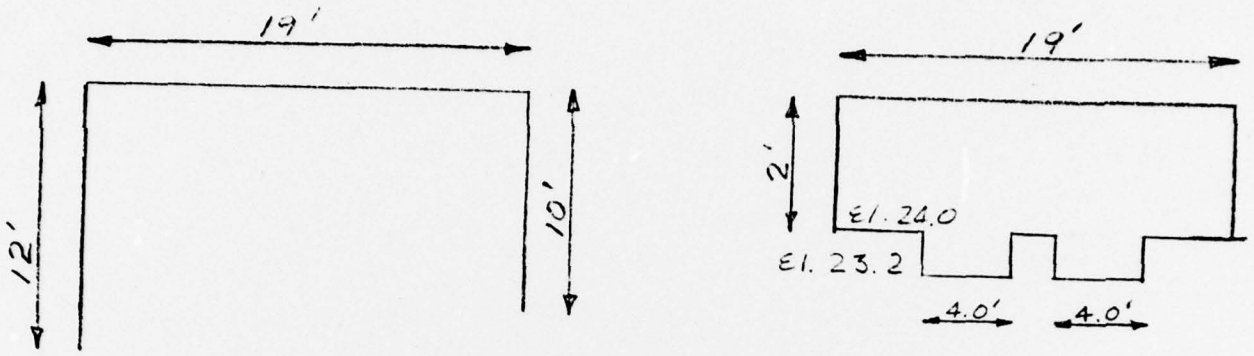


SPILLWAY SECTION

BY D J M DATE 12-78
CHKD. BY ____ DATE ____
SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.
ALMONESSON LAKE DAM INSPECTION

SHEET NO. A6 OF ...
PROJECT C226



Assume control at inlet and that spillway acts as a weir for 2' then as a culvert

Discharge over crest
$L = 33'$

H	C	Q
1	3.0	99
2	3.0	280

Use $Q = CA\sqrt{2gH}$
$a = 33 \times 2 = 66$

3	458
4	530
5	592
6	649
7	701
8	749

over flash boards
$L = 8'$

H	C	Q
1.8	3.0	58
2.8	3.0	112

Use $C \approx 0.5$
$a = 8 \times 2.8 = 22.4$

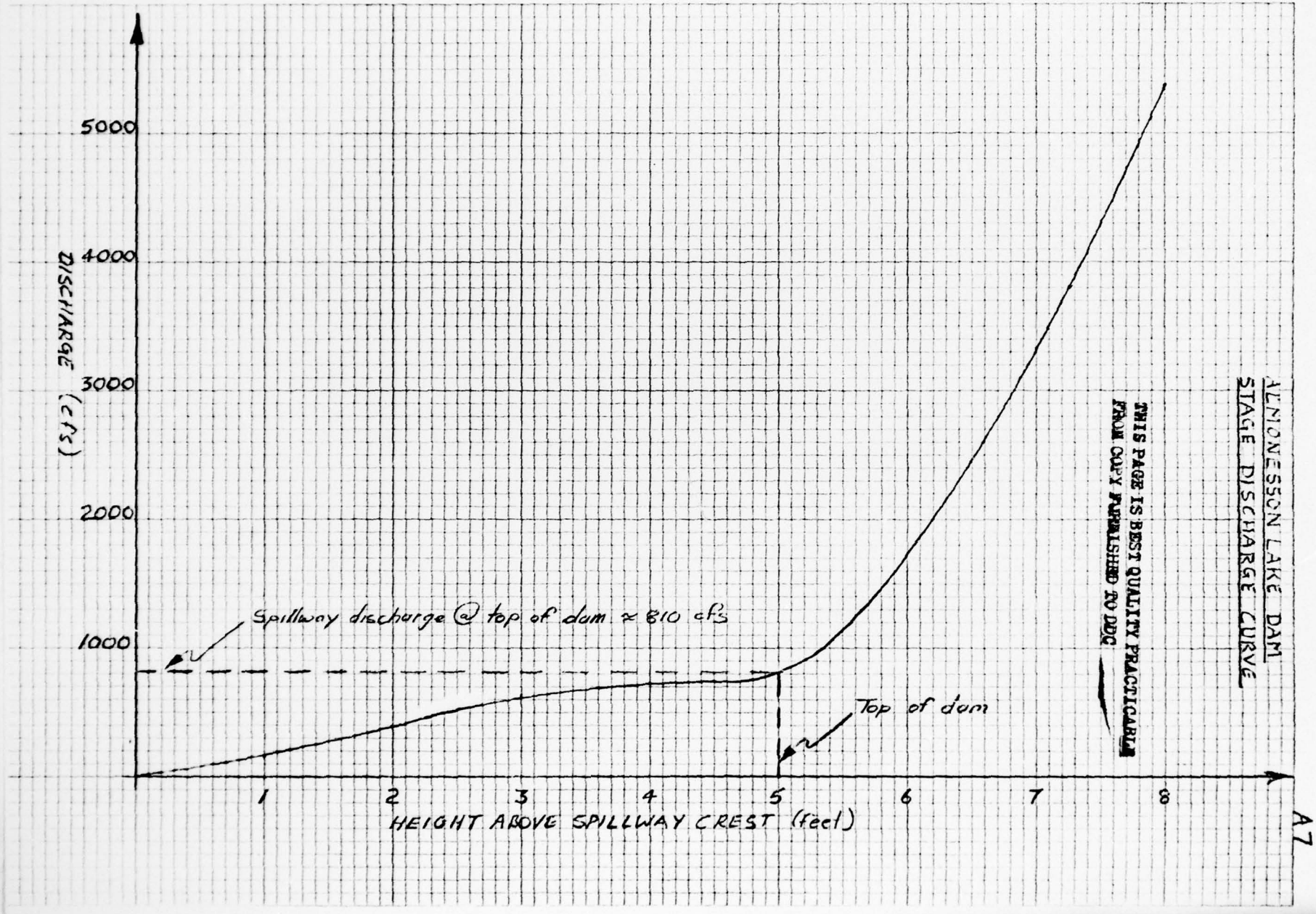
3.8	175
4.8	197
5.8	216
6.8	234
7.8	251
8.8	266

overdam
$L = 300'$

H	C	Q
1	2.8	840
2	2.8	2376
3	2.8	4365

H	Q
1	157
2	392
3	633
4	727
5	808
6	1723
7	3328
8	5380

Culvert under highway does not control



ALMONESSON LAKE DAM
STAGE DISCHARGE CURVE

BY D.J.M. DATE 12-78

CHKD. BY _____ DATE _____

SUBJECT _____

LOUIS BERGER & ASSOCIATES INC.

ALMONESSON LAKE DAM INSPECTION

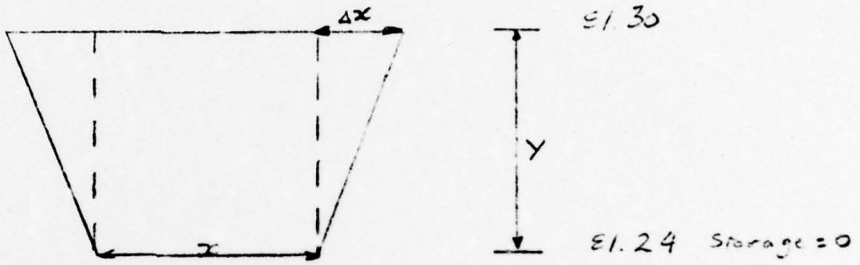
SHEET NO. A8 OF _____

PROJECT C226

Stage storage data

Area of lake @ El. 24 ≈ 17.6 acres

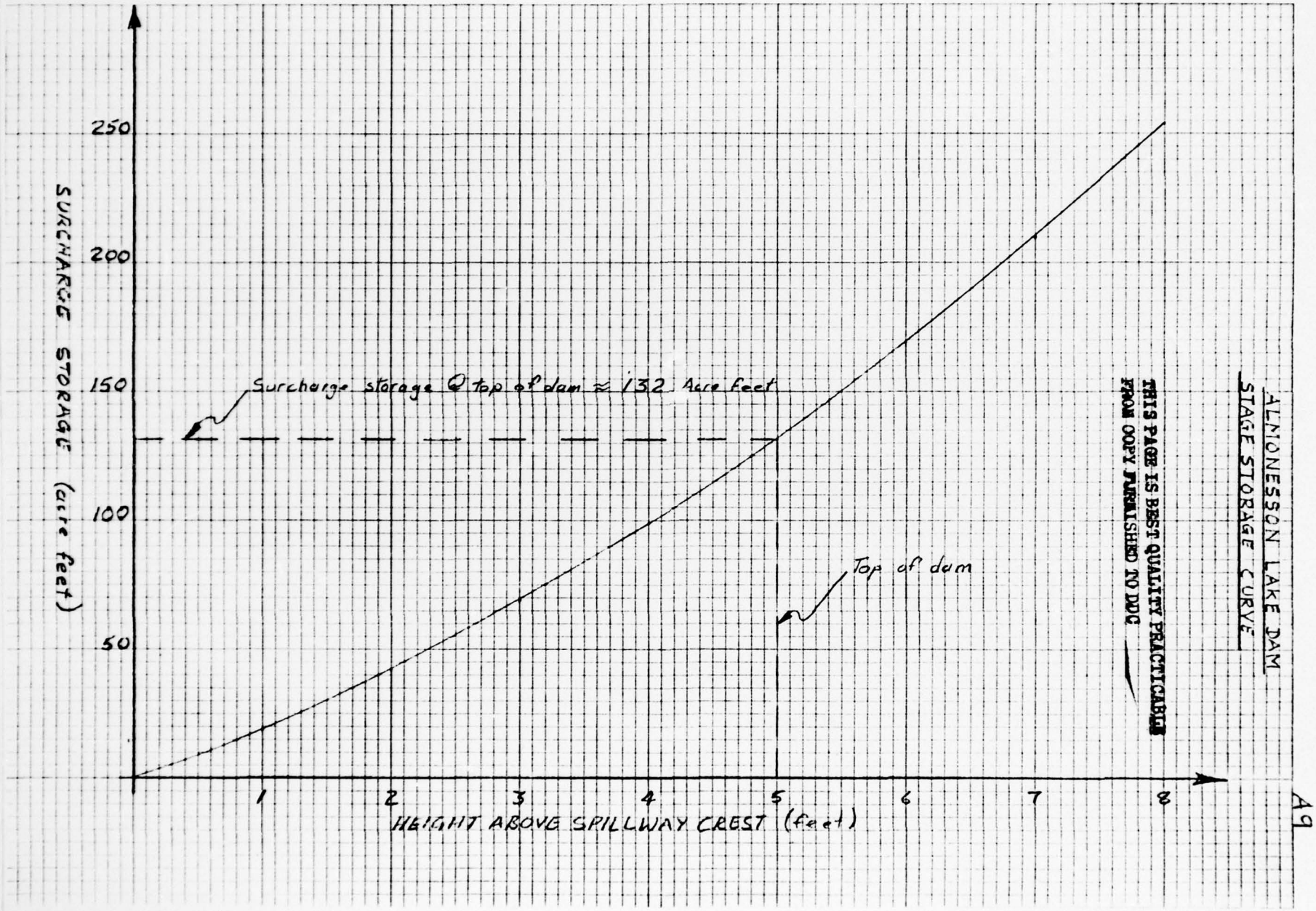
Area of contour @ El. 30 ≈ 38.6 acres



Formula for each increment in storage

$$\text{Volume} = (x + \Delta x) \times y$$

Height feet	Storage in acre feet
1	19
2	42
3	69
4	99
5	132.
6	169
7	210
8	254
9	302



BY D.J.M. DATE 2-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A10 OF...
CHKD. BY..... DATE..... ALMONESSON LAKE DAM INSPECTION PROJECT C226
SUBJECT Approximate drawdown calculations

Volume of lake between El. 24.0 & El. 16.2

≈ 125 acre feet

= 544 5000

Assume drawdown under average head

$H \simeq 7.8/2 = 3.9'$

$Q = 3.9^{1.5} \times 3 \times 8 = 185$ cfs

$\therefore$ Time $\approx \frac{5,445,000}{185 \times 3600} = 8.18$ hours

Say ½ day

assumes no inflow to reservoir & no tailwater

ALMONESSON LAKE DAM INSPECTION SOUTH GROUP C226
BY D.J.MULLIGAN
DECEMBER 1978

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	0	0

JOPER	NWT
3	0

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH 100-YEAR FREQUENCY EVENT

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
4	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	2.80	0.0	2.80	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
24	0.0	0.0	0.0

PRECIP PATTERN

0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.09
0.11	0.11	0.70	0.70	1.70	0.40	0.40	0.20	0.16	0.14
0.07	0.06	0.06	0.06						

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

GIVEN UNIT GRAPH, NUHGG= 14

786.	1366.	1856.	1442.	896.	557.	334.	200.	128.	78.
49.	30.	18.	11.						

UNIT GRAPH TOTALS 7351. CFS OR 1.02 INCHES OVER THE AREA

RECESSION DATA

STRTG= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.06	0.00	0.
2	0.06	0.00	0.
3	0.06	0.00	0.
4	0.06	0.00	0.
5	0.07	0.00	0.
6	0.07	0.00	0.
7	0.08	0.00	0.
8	0.09	0.04	14.
9	0.09	0.06	74.

BY DJM DATE 2-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A12 OF

CHKD. BY DATE

ALMONESSON LAKE DAM

PROJECT

SUBJECT

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10	0.09	0.06	181.
11	0.11	0.08	294.
12	0.11	0.08	396.
13	0.30	0.27	552.
14	0.70	0.67	1023.
15	1.70	1.67	2343.
16	0.40	0.37	4245.
17	0.40	0.37	5085.
18	0.20	0.18	4510.
19	0.16	0.13	3534.
20	0.14	0.11	2467.
21	0.07	0.05	1966.
22	0.06	0.04	1425.
23	0.06	0.04	1015.
24	0.06	0.04	725.
25	0.0	0.0	533.
26	0.0	0.0	373.
27	0.0	0.0	237.
28	0.0	0.0	142.
29	0.0	0.0	76.
30	0.0	0.0	44.
31	0.0	0.0	24.
32	0.0	0.0	14.
33	0.0	0.0	8.
34	0.0	0.0	4.
35	0.0	0.0	2.
36	0.0	0.0	1.
37	0.0	0.0	0.
38	0.0	0.0	0.
39	0.0	0.0	0.
40	0.0	0.0	0.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.

LOUIS BERGER & ASSOCIATES INC.

Almonesson Lake Dam

71	0.0	0.0	0.							
72	0.0	0.0	0.							
73	0.0	0.0	0.							
74	0.0	0.0	0.							
75	0.0	0.0	0.							
76	0.0	0.0	0.							
77	0.0	0.0	0.							
78	0.0	0.0	0.							
79	0.0	0.0	0.							
80	0.0	0.0	0.							
81	0.0	0.0	0.							
82	0.0	0.0	0.							
83	0.0	0.0	0.							
84	0.0	0.0	0.							
85	0.0	0.0	0.							
86	0.0	0.0	0.							
87	0.0	0.0	0.							
88	0.0	0.0	0.							
89	0.0	0.0	0.							
90	0.0	0.0	0.							
91	0.0	0.0	0.							
92	0.0	0.0	0.							
93	0.0	0.0	0.							
94	0.0	0.0	0.							
95	0.0	0.0	0.							
96	0.0	0.0	0.							
97	0.0	0.0	0.							
98	0.0	0.0	0.							
99	0.0	0.0	0.							
100	0.0	0.0	0.							
SUM	5.20	4.26	31507.							

HYDROGRAPH ROUTING

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5065.	1312.	328.	315.	31507.
INCHES		4.36	4.36	4.36	4.36
AC-FT		651.	651.	651.	651.

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
44	1	0	0	0	0	1

ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

ISTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE	0.	19.	42.	69.	99.	132.	169.	210.	254.	0.
OUTFLOW	0.	151.	392.	633.	727.	808.	1723.	3328.	5380.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.

BY DJM DATE 2-79

CHKD. BY ____ DATE ____

SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.

Almonesson Lake Dam

SHEET NO. A14 OF ___

PROJECT ____

4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	7.	1.
9	1.	44.	8.
10	3.	128.	27.
11	7.	238.	60.
12	13.	345.	105.
13	20.	474.	164.
14	31.	788.	283.
15	58.	1683.	532.
16	112.	3294.	760.
17	179.	4665.	2117.
18	218.	4798.	3704.
19	222.	4022.	3911.
20	211.	3100.	3384.
21	196.	2317.	2763.
22	180.	1696.	2148.
23	166.	1220.	1646.
24	153.	870.	1330.
25	142.	629.	1045.
26	132.	453.	806.
27	122.	305.	783.
28	110.	190.	753.
29	97.	109.	720.
30	84.	60.	679.
31	71.	34.	638.
32	59.	19.	542.
33	49.	11.	453.
34	40.	6.	375.
35	33.	3.	304.
36	28.	2.	246.
37	23.	1.	199.
38	19.	0.	161.
39	16.	0.	135.
40	14.	0.	114.
41	12.	0.	96.
42	10.	0.	81.
43	8.	0.	68.
44	7.	0.	57.
45	6.	0.	48.
46	5.	0.	41.
47	4.	0.	34.
48	4.	0.	29.
49	3.	0.	24.
50	2.	0.	21.
51	2.	0.	17.
52	2.	0.	15.
53	1.	0.	12.
54	1.	0.	10.
55	1.	0.	9.
56	1.	0.	7.
57	1.	0.	6.
58	1.	0.	5.
59	1.	0.	4.
60	0.	0.	4.
61	0.	0.	3.
62	0.	0.	3.
63	0.	0.	2.
64	0.	0.	2.

BY DJM DATE 2-79

CHKD. BY ____ DATE ____

SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.

ALMONESSON LAKE DAM

SHEET NO A15 OF ____

PROJECT ____

65	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.
66	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
67	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
68	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
69	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
70	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
71	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
72	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
73	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
74	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
75	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
78	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
79	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
82	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
83	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
84	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
85	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
86	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
87	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
88	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
89	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
91	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
92	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
93	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
94	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
95	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
96	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
97	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
98	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SUM										31507.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	AREA
	CFS	3911.	1255.	328.	315.	31507.	
	INCHES		4.17	4.36	4.36	4.36	
	AC-FT		623.	651.	651.	651.	
HYDROGRAPH AT	4	5065.	1512.	328.	315.		2.80
ROUTED TO	44	3911.	1255.	328.	315.		2.80