TOLLAND COUNTY
STAFFORD, CONNECTICUT

CRYSTAL LAKE DAM
CT-00341

NATIONAL DAM INSPECTION PROGRAM
CORPS OF ENGINEERS

ENGINEERING
PLANNING
ARCHITECTURE

cahn INC 20 Alexander Drive, P.O. Box 767, Wallingford, CT 06492 (203) 265-6741

Civil Engineering
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Transportation
Water Resources

June 2, 1981

Mr. Joseph B. Fryar
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

RE: Contract No. DACW 33-80-C-0052
Crystal Lake Dam (CT 00341)
CI 27 785 KH

Dear Mr. Fryar:

Our investigation of Crystal Lake Dam indicates that it is a low hazard dam. Attached is an inspection report based on work completed as of June, 1981, when all work on the project was stopped.

The following work has been completed:

1. Data Collection
2. Field Inspection
3. Geotechincal Evaluation
4. Hydraulic/Hydrologic Evaluation
5. Inspection Checklist
6. Project Sketch

Included with the attached inspection report are the national inventory forms, visual inspection checklist, sketch, hydraulic/hydrologic computations, and photo negatives for your file.

If you have any questions, please feel free to contact me.

Very truly yours,

CAHN, INC.

Peter M. Heynen, P.E.
Chief Geotechnical Engineer

PMH:awp
Attachment

LOW HAZARD
PHASE I INSPECTION REPORT
NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	CRYSTAL LAKE DAM
Inventory Number:	CT 00341
State Located:	CONNECTICUT
County Located:	TOLLAND
Town Located:	STAFFORD/ELLINGTON
Stream:	CRYSTAL LAKE BROOK
Owner:	STAFFORD PRINTERS, INC.
Date of Inspection:	MARCH 1981
Inspection Team:	PETER M. HEYNEN, P.E.
	JAY A. COSTELLO
	HECTOR MORENO, P.E.

Crystal Lake Dam is located on Crystal Lake Brook (Thames River Basin) in a rural area of the towns of Stafford and Ellington, Connecticut. The dam is shown on the Stafford Springs USGS Quadrangle Map, having coordinates latitute N 41° 56.7' and longitude W 72° 22.5'. The dam has a drainage area of 2.8 square miles and a maximum impoundment capacity to the top of the dam of 1450 acre-feet.

Crystal Lake Dam is a 250 foot long earth embankment with a stone masonry spillway section at the central part of the dam. The dam is estimated to have been built around 1900 to raise the level of the lake. The present owner, Stafford Printers Inc. of Stafford, Connecticut, acquired the dam with property purchased from the Rhode Island Worcester Mills, in the early 1950's. Conklin Road extends across the top of the embankment and a concrete bridge extends across the spillway.

The top of the dam is 23 feet wide, is paved with asphalt for Conklin Road, and has an approximate elevation of 639.5. The highest section of the dam is about 11 feet at the dry-laid stone masonry spillway section. The spillway crest is 18.5 feet long, 3.5 feet below the top of the dam and 2 feet below the low chord of the bridge. The concrete abutments for the bridge provide side walls for the spillway weir and headwalls at the spillway approach. The outlet is a pipe of unknown type or size, which outlets at the right side of the spillway structure. The intake appears to be a concrete drop inlet structure with a trash rack located at the upstream side of the right bridge abutment.

Based on the visual inspection, the project appears to be in fair condition. The following features which could influence the future condition and/or stability were identified.

1. The concrete and trash rack at the intake structure are in poor condition and need repair.

2. There is no riprap or vegetation along the upstream slope of the embankment to protect against erosion and sloughing resulting from wave action and runoff.

3. The sides of the spillway discharge channel are eroding, possibly undermining the stone wall in this area.

The owner should retain the services of a registered professional engineer, qualified in dam design and inspection, to perform services pertaining to the following items. The engineer should establish corrective measures which should then be implemented by the owner.

1. An attempt should be made to inspect the dam during a period of low flow, so a more detailed inspection of the stone spillway structure can be made. Also, the condition of the outlet pipe and intake should be investigated, including operation of the outlet valve.

2. Riprap protection should be placed on the upstream slope between expected high and low water elevations and a grass cover established between the riprap and top of dam. Riprap should also be placed along the banks of the spillway discharge channel to prevent erosion in this area.

3. Large trees should be removed from the dam and within 10 feet of the toe of the dam.

4. Spalling of concrete at the intake structure and bridge abutments should be repaired.

Also, the owner should initiate a formal program of operation and maintenance procedures, including a monthly inspection by the owner or owner representative and proper documentation to provide accurate records for future reference. A comprehensive program of inspection by a registered professional engineer qualified in dam design and inspection should be instituted on a biennial basis.

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT CRYSTAL LAKE DAM

DATE: MARCH 1981

TIME: 2:00 PM

WEATHER: SUNNY, 50°F

W.S. ELEV. 636.2 U.S. _____ DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. PETER M. HEYNEN	PMH	CAHN INC - GEO.
2. HECTOR MORENO	HM	CAHN INC - H/H
3. JAY A. COSTELLO	JAC	CAHN INC - GEO.
4.		
5.		
6.		

PROJECT FEATURE	INSPECTED BY	REMARKS
1. DAM EMBANKMENT	PMH, JAC, HM	A-2
2. SPILLWAY WEIR	PMH, JAC, HM	A-3
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

PERIODIC INSPECTION CHECK LIST

Page A-2

PROJECT CRYSTAL LAKE DAM DATE MARCH 1981

PROJECT FEATURE EMBANKMENT BY PMH, JAC, HM

AREA EVALUATED		CONDITION
DAM EMBANKMENT		
Crest Elevation		639.5±
Current Pool Elevation		636.2±
Maximum Impoundment to Date		UNKNOWN
Surface Cracks		NONE OBSERVED
Pavement Condition		GOOD
Movement or Settlement of Crest		NONE OBSERVED
Lateral Movement		
Vertical Alignment		APPEARS GOOD
Horizontal Alignment		
Condition at Abutment and at Concrete Structures		
Indications of Movement of Structural Items on Slopes		NONE
Trespassing on Slopes		SOME - U/S SLOPE
Sloughing or Erosion of Slopes or Abutments		SLOUGHING AT BANKS OF SPILLWAY DISCHARGE
Rock Slope Protection-Riprap Failures		N/A
Unusual Movement or Cracking at or Near Toes		NONE OBSERVED
Unusual Embankment or Downstream Seepage		
Piping or Boils		
Foundation Drainage Features		
Toe Drains		
Instrumentation System		

PERIODIC INSPECTION CHECK LIST

Page A-3

PROJECT CRYSTAL LAKE DAM DATE MARCH 1981

PROJECT FEATURE SPILLWAY BY PMH, JAC, HM

AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		DRY-LAID STONE MASONRY WITH CONCRETE BRIDGE OVER WEIR
a) Approach Channel		
General Condition		FAIR
Loose Rock Overhanging Channel		NONE
Trees Overhanging Channel		
Floor of Approach Channel		FLAT, SAND & GRAVEL
b) Weir and Training Walls		WEIR - STONE MASONRY WALLS - CONCRETE
General Condition of Concrete		GOOD
Rust or Staining		NONE OBSERVED
Spalling		SLIGHT
Any Visible Reinforcing		NONE OBSERVED
Any Seepage or Efflorescence		
Drain Holes		
c) Discharge Channel		
General Condition		POOR - EROSION & SLOUGHING OF BANKS
Loose Rock Overhanging Channel		NONE
Trees Overhanging Channel		SOME TREES & BRUSH
Floor of Channel		LOGS, DEBRIS
Other Obstructions		N/A

PERIODIC INSPECTION CHECK LIST

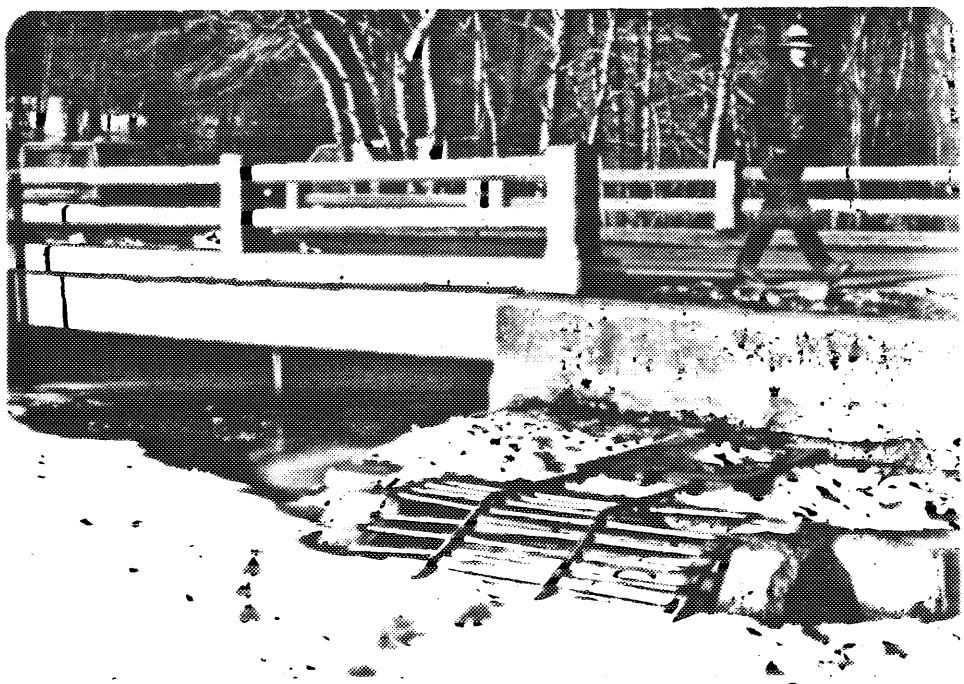
PROJECT CRYSTAL LAKE DAM DATE MARCH 1981

PROJECT FEATURE INTAKE STRUCTURE BY JAC, PMH

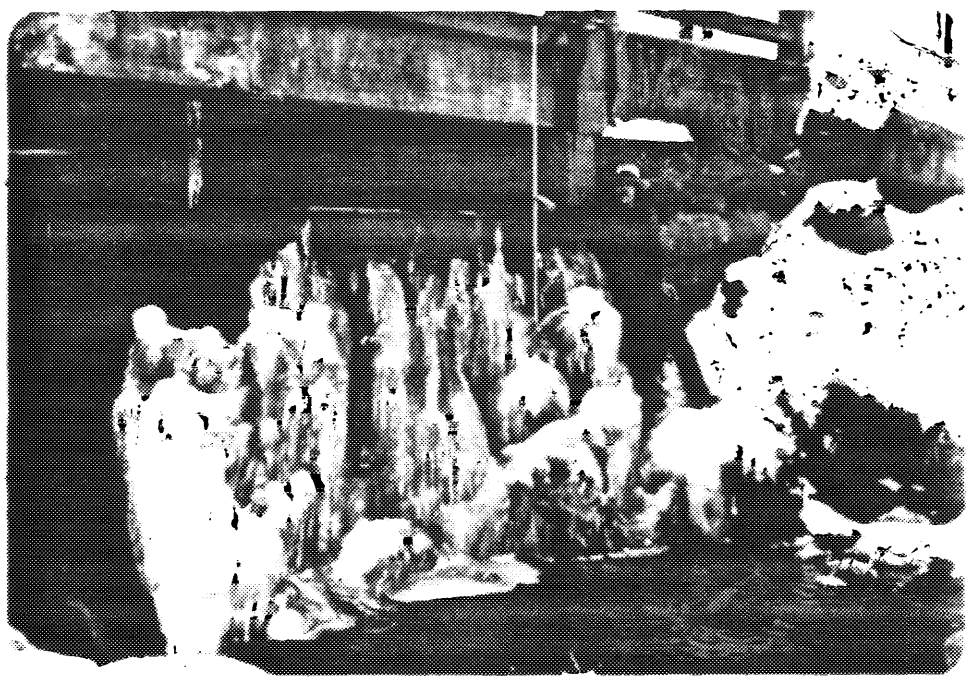
AREA EVALUATED		CONDITION
OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE		APPEARS TO BE A FLAT DROP INLET - FROZEN OVER SO HARD TO INSPECT
a) Approach Channel		
Slope Conditions		N/A
Bottom Conditions		FLAT, SAND & GRAVEL
Rock Slides or Falls		N/A
Log Boom		
Debris		
Condition of Concrete Lining		
Drains or Weep Holes		
b) Intake Structure		
Condition of Concrete		POOR - SPALLING & DETERIORATION OF CONCRETE, SOME REINFORCING SHOWING
Stop Logs and Slots		TRASHRACK - METAL, POOR CONDITION, BENT, RUSTING

OVERVIEW PHOTO
(MARCH 1981)

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	CRYSTAL LAKE DAM	STAFFORD/ELLINGTON	DATE JUNE, '81
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED DAMS	CRYSTAL LAKE BROOK	CONNECTICUT	CE # 27785KH PAGE



View of bridge, spillway and intake from upstream side of dam (March 1981).



View of dry-laid stone masonry at spillway from right side of discharge channel (March 1981).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	CRYSTAL LAKE DAM CRYSTAL LAKE BROOK STAFFORD/ELLINGTON, CT
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED. DAMS	CE# 27785 KH DATE JUNE '81 PAGE C-1

CRYSTAL LAKE DAM, STAFFORD, CT

TENTATIVE DOWNSTREAM FAILURE HAZARD ANALYSIS

1) POTENTIAL IMPACT AREA.

REACH OF CRYSTAL LAKE BROOK (±) 3000' TO 5000' D/S FROM DAM WITH 6 HOUSES WITH FIRST FLOOR ELEVATIONS RANGING FROM (+) 3.8' TO (+) 5.3' ABOVE STREAM. (±) 10,000' D/S ONE HOUSE IS BEHIND A LOW DIKE (±) 2' ABOVE THE W.L. OF A SMALL POND FORMED BY A MASONRY DAM WITH (±) 60' LONG SPILLWAY.

2) FAILURE @ CRYSTAL LAKE DAM.

ASSUME SURCHARGE TO TOP OF DAM. FIRST PT. OF OVERFLOW EL. 639.5' NGVD

a) MAX. HEIGHT OF DAM: $H_{MAX} \cong 10.9'$ (639.5 − 628.6)

b) MID-HEIGHT LENGTH: $\ell \cong 40'$

c) BREACH WIDTH: $W = 0.4 \times 40 = 16'$ ASSUME $W_b = \underline{16'}$

d) ASSUMED WATER DEPTH AT TIME OF FAILURE: $Y_o \cong \underline{10.9'}$

e) SPWY DISCHARGE AT TIME OF FAILURE

CULVERT FLOWING FULL (BOX ± $2^H \times 18.5^W \times 23^L$);
INV. ELEV 636' NGVD. $HW/D = 3.5/2 = 1.75 > 1.2$ TO 1.5 − FULL FLOW

CULVERT GEOMETRIC PARAMETERS: $A = 37$ SQ FT $K = 2860$ (FOR $n \cong 0.018$)
$L = 23'$

$\therefore Q_{S} \cong 225 H_*^{0.5}$ FOR $H_* = 3.5 - 1 = 2.5'$ $Q_{S} \cong \underline{350}$ CFS

f) BREACH OUTFLOW

$$Q_b = \frac{8}{27} W_b \sqrt{g}\, y_0^{3/2} \approx \underline{970}^{CFS}$$

g) PEAK FAILURE OUTFLOW:

$$Q_p \approx 350 + 970 = \underline{1320}^{CFS}$$ (ASSUME FULL CONVEY (SPILL) OUTFLOW IN ADDITION TO BREACH FLOW)

3) FLOOD DEPTH IMMEDIATELY D/S FROM DAM

$$y = 0.44 y_0 \approx 4.8'$$

4) ESTIMATE OF D/S FAILURE CONDITIONS AT POTENTIAL IMPACT AREA.

a) THE CHANNEL OF CRYSTAL LAKE BROOK D/S FROM THE DAM IS APPROXIMATELY TRAPEZOIDAL WITH (±) 20' BASE AND (±) 60" AND 30" TO 1" SIDE SLOPES. THE AVERAGE SLOPE OF THE CHANNEL TO THE REACH (±) 3000' D/S CONSIDERED TO BE THE POTENTIAL INITIAL IMPACT AREA IS (±) 0.2%. (ASSUME n = 0.050 FOR THE CHANNEL AT FLOOD STAGE)

b) RESERVOIR STORAGE AT TIME OF FAILURE,

ELEVATION (FT-NGVD)	AREA (ACR)	AVE. AREA (ACR)	INCR. STOR. (ACR-FT)	STORAGE (ACR-FT)
636	179	↑	↑	740 *
(639.5)	(219)	202	810	(1450)
640	225	↓	↓	1550

* STORAGE TO FLOWLINE ASSUMED $S \approx 0.56 AH = 0.56 \times 179 \times 7.4 \approx 740^{AC\text{-}FT}$
(H TO FLOWLINE ≈ 7.4')

c) APPROXIMATE STAGE AT POTENTIAL IMPACT AREA:

$Q_{P_1} = 1320^{CFS}$ ∴ $Y_1 \cong 3.6'$; $^*V_1 = 44.7^{ACFT}$; $Q_{P_2} = 1280^{CFS}$; $Y_2 = 3.5'$
$V_2 = 43.5^{ACFT}$; $\bar{V} = 44.1^{ACFT}$ ∴ $Q_{P_3} \cong 1280^{CFS}$; $Y_3 \cong 3.5'$

∴ $Q_{P_3} \cong \underline{1280^{CFS}}$; $Y_3 \cong \underline{3.5'}$ *(±) 3000' D/S FROM DAM

d) APPROXIMATE STAGE BEFORE FAILURE

$Q_S \cong 350^{CFS}$ ∴ $Y_S \cong \underline{2.1'}$

e) RAISE IN STAGE D/S FROM CRYSTAL LAKE DAM: $\Delta Y \cong \underline{1.4'}$

III) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES:

a) SIZE: STORAGE (MAX) $\cong 1450^{ACFT}$ $(1000 < S < 50000^{ACFT})$
HEIGHT (MAX) $\cong 10.9'$ $(H < 25^{FT})$

∴ SIZE CLASSIFICATION: <u>INTERMEDIATE</u>

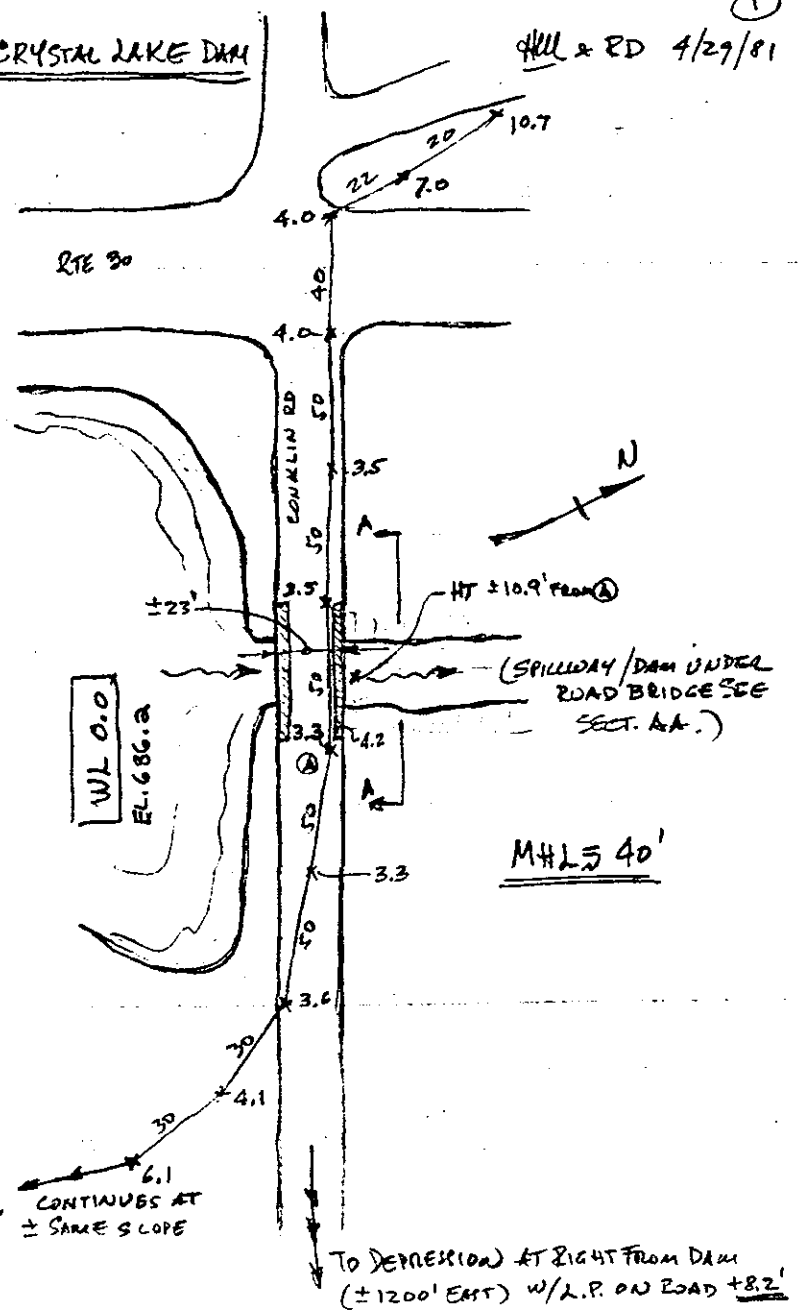
b) HAZARD POTENTIAL: AS A RESULT OF THE D/S FAILURE ANALYSIS AND IN VIEW OF THE IMPACT THAT FAILURE OF CRYSTAL LAKE DAM MAY HAVE ON THE POTENTIAL IMPACT AREA (P. 1). THE DAM IS CLASSIFIED AS HAVING:

HAZARD CLASSIFICATION: <u>LOW</u>

CRYSTAL LAKE DAM

HLL & RD 4/29/81

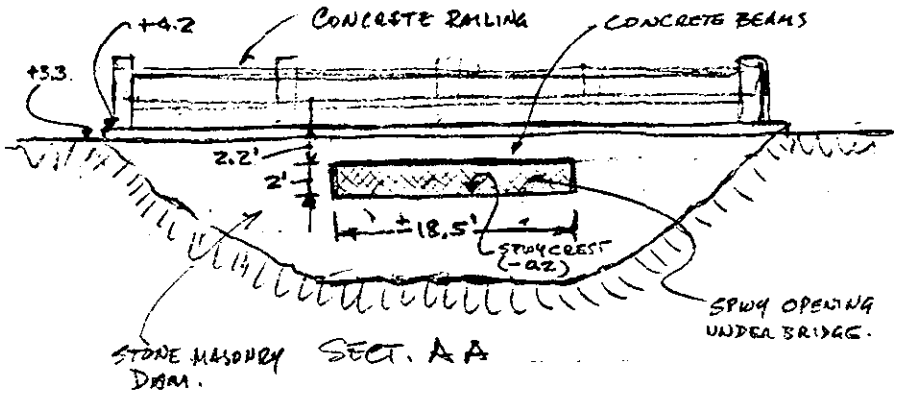
(1)



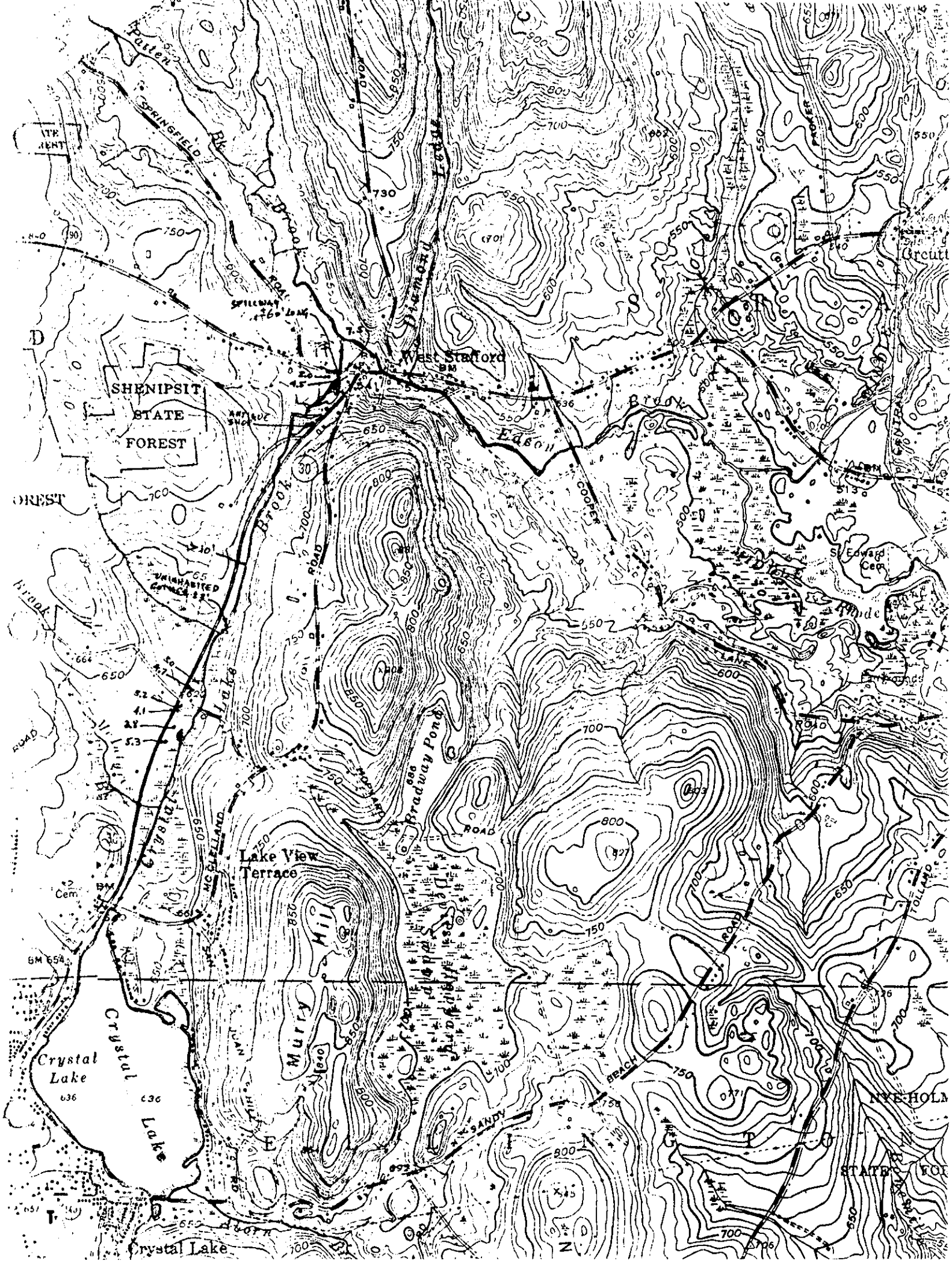
CRYSTAL LAKE DAM

HLL & RD 4/29/81

(2)



NOTE U/S SPILLWAY OPENING (±) THE SAME AS ABOVE EXCEPT IT IS (±) 2.8' HIGH (BOTTOM ±1.2' BELOW WL) ie. APPROACH CHANNEL DROPS ± 1' IN THE (±) 23' WIDTH OF THE BRIDGE/OPENING. – TOP OF THE U/S BRIDGE CURB IS (±) 2.3' ABOVE LOW CHORD (SOFFIT OF SPWY. OPENING)



SHENIPSIT
STATE
FOREST
West Stafford
Edson
Brook
Lake View
Terrace
Crystal
Lake
Crystal
Lake
Murry
Hill
Bradway Pond
Diamond
Ledge
Patten
Brook
SPRINGFIELD
ROAD
COOPER
LANE
ROAD
BEACH
SANDY
TOLLAND
St Edward
Cem
Crystal Lake
NYE-HOLM
STATE

(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

OMB NO. 49-R0421

REQUIREMENTS CONTROL SYMBOL DAEN-CWE-17

STATE	NUMBER
CT	00341

IDENTIFICATION	DIVISION [2]	STATE [3]	COUNTY [4]	CONGR DIST [5]	STATE [6]	COUNTY [7]	CONGR DIST [8]	NAME [9]	LATITUDE (North) [10] ° ′	LONGITUDE (West) [11] ° ′	REPORT DATE [12] DAY MO YR	
	NED	CT	01	302				CRYSTAL LAKE DAM	41567	72225	31 JUN 81	0

IDENTIFICATION (Continued)	POPULAR NAME [13]	NAME OF IMPOUNDMENT [14]	
		CRYSTAL LAKE	1

LOCATION	REGION [15]	BASIN [16]	RIVER OR STREAM [17]	NEAREST DOWNSTREAM CITY – TOWN – VILLAGE [18]	DIST. FROM DAM (mi) [19]	POPULATION [20]	
			CRYSTAL LAKE BROOK	WEST STAFFORD	1	1500	2

STATISTICS	TYPE OF DAM [21]	YEAR COMPLETED [22]	PURPOSES [23]	STRUCTURAL HEIGHT (ft) [24]	HYDRAULIC HEIGHT (ft) [25]	IMPOUNDING CAPACITIES MAXIMUM (acre – ft.) [26]	IMPOUNDING CAPACITIES NORMAL (acre – ft.) [27]	CORPS ENGR. DIST. [27A]	OWN. [27B]	FED. R. [27C]	PRV/FED [27D]	SCS A. [27E]	VERIFICATION DATE [27F] DA MO YR	BLANK	
	RE OT	1900	R		11	1450	740	NED	N	N	N	N	31 JUN 81		3

REMARKS	REMARKS [28]	
	17 - ALSO FED BY APPRN BROOK 21 - STONE BLOCK MASONRY ON D/S SIDE EARTH U/S	4

ENG FORM 4474

(PURSUANT TO PUBLIC LAW 92–367)

See reverse side for instructions.

REQUIREMENTS CONTROL SYMBOL DAEN–CWE–17

1	2	3	4	5	6	7
C	T	0	0	3	4	1

	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	[37]	[38]	[39]	[40]	[41]	[42]	[43]	[44]	[45]	
STATISTICS	D/S HAZ	CREST LENGTH (ft)	SPILLWAY TYPE	SPILLWAY WIDTH (ft)	SPILLWAY MAXIMUM DISCHARGE (cfs)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	NAVIGATION LOCKS LENGTH (ft)	NAVIGATION LOCKS WIDTH (ft)	NAVIGATION LOCKS LENGTH (ft)	NAVIGATION LOCKS WIDTH (ft)	NAVIGATION LOCKS LENGTH (ft)	NAVIGATION LOCKS WIDTH (ft)	NAVIGATION LOCKS LENGTH (ft)	NAVIGATION LOCKS WIDTH (ft)	BLANK
	C3	250	U	19	350													5

	[46]	[47]	[48]	
MISC. DATA	OWNER	ENGINEERING BY	CONSTRUCTION BY	
	STAFFØRD PRINTERS INC			6

	[49]	[50]	[51]	[52]	
MISC. DATA (Continued)	REGULATORY AGENCY: DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE	
	CT DEP-DAM SAFETY	CT DEP-DAM SAFETY	CT DEP-DAM SAFETY	CT DEP-DAM SAFETY	7

	[53]	[54]	[55]	
MISC. DATA (Continued)	INSPECTION BY	INSPECTION DATE (DAY MO YR)	AUTHORITY FOR INSPECTION	
	CAHN ENGINEERS INC	08MAY81	PL 92-367	8

	[56]	
REMARKS	REMARKS	
		9

ENG FORM

PART III - INVENTORY OF DAMS IN THE UNITED STATES
SUPPLEMENTARY DATA

STA	NUMBER
CT	00341

LOCATION	TOWN (A-1)	NED PERMIT NO. (A-2)	STATE NUMBER (A-3)	FERC NO (A-4)	U.S.G.S. SHEET (A-5)	
	STAFFØRD, ELLINGTØN				STAFFØRD SPRINGS	A

DRAINAGE CHARACTERISTICS	DRAINAGE AREA SQ MI (B-1)	FLOW DATA MIN C.F.S. (B-2)	FLOW DATA AVE C.F.S. (B-3)	FLOW DATA MAX. C.F.S. (B-4)	CREST ELEV. M.S.L. (B-5)	ABUT. ELEV. M.S.L. (B-6)	USABLE STORAGE ACRE FEET (B-7)	RESERVOIR AREA ACRES (B-8)	FLASH BOARD HT FEET (B-9)	OUTLET CONDUITS NO. (B-10)	OUTLET CONDUITS SIZE (B-11)	INVERT ELEV. M.S.L. (B-12)	
	2.8				636	640	740	179					B

POWER DATA	GENERATION UNITS INSTALLED NO CAP K.W. (C-1)	GENERATION UNITS PLANNED NO CAP K.W. (C-2)	AVERAGE ANNUAL GENERATION K.W.H. (C-3)	LAST GEN YEAR (C-4)	RETIRED YEAR (C-5)	FORMER USE (C-6)	CAPACITY FACTOR (C-7)	
								C

A-5 ALSØ ELLINGTØN QUADRANGLE B-5 SPILLWAY CREST B-6 TØP ØF DAM	D

[illegible]	E

NED FORM 80/TEST