The Harrisburg Authority

Letter of Transmittal

One Keystone Plaza, Suite 104
Front and Market Streets
Harrisburg, PA 17101
Phone: 717-232-3777
Fax: 717-232-8590

To: Mr. Daniel L. Galbraith
The City of Harrisburg
Bureau of Water
100 Pine Street
Harrisburg, PA 17103

Date: December 17, 2008

Re: Emergency Action Plan
Dehart Dam
DEP Number – D22-009

We are sending the following items:

Copies	Date	Description
1	October 1995 (Rev. April 17, 2008)	Emergency Action Plan for The Dehart Dam, Dauphin County, Rush Township, Pennsylvania – Surveillance, Warning and Evacuation Procedures

These are transmitted as checked below:

- ☒ Approved
- ☐ Approved and Noted
- ☐ Revise and Resubmit
- ☐ Not Approved
- ☒ As Requested
- ☐ For Your Use
- ☐ For Approval
- ☐ For Your Files
- ☐ For Your Information
- ☐ For Review & Comment
- ☐ For Repairs
- ☐ For Signature and Return

Remarks:

SIGNED: Pamela E. Adens
Pamela E. Adens
Administrative Assistant

EMERGENCY ACTION PLAN

SURVEILLANCE, WARNING AND EVACUATION PROCEDURES

DEHART DAM

DEP NUMBER D22-009

LOCATED IN DAUPHIN COUNTY, RUSH TOWNSHIP
PENNSYLVANIA

LATITUDE 40° 27' 42" **LONGITUDE 76° 44' 43"**

OPERATED BY:	**THE CITY OF HARRISBURG**
	BUREAU OF WATER
	DANIEL L. GALBRAITH
TELEPHONE:	**WORK: (717) 238-8725**
	HOME: (717) 921-2392
	24- HOUR: (717) 255-3136
OWNED BY:	**THE HARRISBURG AUTHORITY**
ADDRESS:	**ONE KEYSTONE PLAZA, SUITE 104**
	FRONT AND MARKET STREETS
	HARRISBURG, PA 17101
TELEPHONE:	**WORK: (717) 232-3777**

DATE: OCTOBER 1995
REVISED: APRIL 17, 2008

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ATTACHMENTS

PROMULGATION AND CONCURRENCE

We, the undersigned, on date indicated, have reviewed the requested support activity in the Emergency Action Plan for the DeHart Dam. Our support action will be executed in accordance with existing Standing Operation Procedures.

Chairman, The Harrisburg Authority - Owner — DATE 12/17/08

DeHart Dam Supr, City of Harrisburg - Operator — DATE 12/17/08

Dauphin County EMA Director — DATE 12/17/08

PEMA AND DEP APPROVALS

The Pennsylvania Emergency Management Agency, hereby finds the Emergency Action Plan contains sufficient elements for an effective warning and evacuation plan.

_____ _____

Director, PEMA Central Area Office DATE

The Department of Environmental Protection, Bureau of Waterways Engineering, Division of Dam Safety hereby approves the Emergency Action Plan for DEHART DAM (D22-009).

_____ _____

Chief, Division of Dam Safety DATE

I. PURPOSE AND SCOPE

A. To safeguard the lives, as well as to reduce property damage of the citizens living within the dam's potential downstream flood or inundation area.

B. To provide for effective dam surveillance, prompt notification to local emergency management agencies, citizen warning and evacuation response, when required.

C. To identify emergency actions to be taken by the dam owner/operator, public officials, emergency personnel, and to outline response actions in the event of a potential or imminent failure of the dam.

II. SITUATION

A. DeHart Dam is a rolled earthfill structure constructed on Clarks Creek in 1940 for the purpose of creating a water supply reservoir for the City of Harrisburg. Clarks Creek has a drainage area of 21.3 square miles at the dam site. The dam is approximately 2,000 feet long, 105 feet high and 600 feet thick at the base with a 30 foot wide roadway on the top. The dam, at normal pool level, maintains approximately 23,000 acre-feet with a maximum pool of 30,800 acre-feet. The length of the reservoir is 4.55 miles.

B. The dam is located along the Clarks Creek, 16 miles Northeast of Harrisburg and 13 miles Northeast of Dauphin. Refer to Location Map at ***Attachment A.***

C. The inundation area resulting from a sudden dam failure is bordered on the north by State Rt. 325 and on the south by Third and Middle Mountains from the DeHart Dam to the Susquehanna River. See Inundation Map at ***Attachment B.***

D Within the inundation area are approximately 1000 residents, 112 homes, and 11 Highway bridges. Refer to the Inundation Map at ***Attachment B***

E. The reach from DeHart Dam to the mouth of Clarks Creek is 17.06 miles and has 11 bridges. Because of the magnitude of flow resulting from a dam breach, 10 of the 11 bridges can be expected to fail. The remaining structure, on U.S. Route 22/322 is near the mouth of the creek and the roadway elevation is approximately 42 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create the worst possible conditions during a dam break, it is expected that the pool created by the bridge structure will overflow the roadway.

1. The inundation study prepared for DeHart Dam concludes:

   a. The flood which results from a "sunny day" breach would flood 112 dwellings of which 14, at Camp Shikellimy, are within 40 minutes of a 31 foot wave.

   b. The flood wave from a "sunny day" breach would reach the mouth of the Clarks Creek in 2 hours and 47 minutes. The flood wave would be 38 feet high at the mouth of the creek.

   c. The flood which would result from a dam breach resulting in the Probable Maximum Flood (PMF) would affect an additional 60 dwellings, 16 of which are located at Camp Shikellimy and are within 40 minutes of the flood wave.

   d. The flood wave during a PMF breach would reach the mouth of Clarks Creek in 2 hours and 14 minutes. The flood wave would be 14 feet at the mouth of the creek.

   e. All 11 bridges between DeHart Dam and the mouth of Clarks Creek would be overtopped by a breach, and it is possible that all 11 would fail as a result of the flood wave.

   f. Regarding the depth of water at the Route 22/322 over Clarks Creek, the invert and crown of the water opening at the bridge are elevations 317.3 and 344.8 respectively. The low point on the centerline of the top of the road is elevation 359.0. After a dam failure, it is expected that the bridge will create a pool upstream and that a major portion of the flow will be carried over the existing bridge. Under a "sunny day" breach scenario, the peak water surface will be elevation 375.5 at the upstream side of the bridge. This is approximately 16.5 feet above the lowest point of the road. Under the full PMF with breach, the peak water surface will be elevation 391.8 at the upstream side of the bridge. This is approximately 33 feet above the lowest point of the road.

III. CONCEPT OF OPERATIONS

A. SURVEILLANCE - (CITY OF HARRISBURG, BUREAU OF WATER)

1. Normal Conditions

   a. The DeHart Dam Superintendent or designated representative will conduct an on-site visual inspection of the dam, the dam's spillway(s), control systems, and the toe area below the dam at a minimum of once every three months. Any abnormal or questionable conditions will be immediately brought to the attention of the owner's engineer and the Division of Dam Safety of DEP.

2. Unusual Event Conditions

   a. Possible failure of this dam, considered a very unlikely event due to its structural integrity, is most likely to occur during severe thunderstorms, heavy rains with local flood warnings, tropical storms and hurricanes, or heavy rains with frozen ground and/or snow cover.

   b. The DeHart Dam Superintendent or designated representative will commence 24-hour continuous around-the-clock surveillance of conditions at the dam site when:

      (1) The water level in the impoundment area has reached the threshold level 5 feet below the top of the dam, or

      (2) The National Weather Service issues a flash flood watch or warning and conditions warrant, or

      (3) Any conditions listed in paragraph 3.C.1 is observed during routine dam maintenance or an inspection, or

      (4) Following the occurrence of an earthquake in the general region of the dam.

B. TERMINATION OF SURVEILLANCE

1. The DeHart Dam Superintendent or designated representative may terminate 24 -hour surveillance of dam site conditions when:

a. The National Weather Service ends a flash flood watch or warning, and

b. Heavy rains have ended and the water level in the reservoir has dropped 6 feet below the top of the dam and is receding.

c. After personal inspection by a knowledgeable professional engineer of the dam site, following an earthquake, overtopping of the dam, or an evacuation of the inundation area as a result of this EAP, or other serious problems resulting in a notification of a dam site emergency.

C. WARNING NOTIFICATION

1. The DeHart Dam Superintendent or designated representative is responsible for determining the dam's threat potential. The following conditions constitute a dam emergency and require warning notification to the Dauphin County Emergency Communication Center and the Department of Environmental Protection's Southcentral Regional Office.

   a. The water level in the impoundment area has reached the threshold level of 2 feet below the top of the dam.

   b. Imminent failure of this dam might be indicated by observance of one or more of the following conditions at the dam site.

      (1) The reservoir level is at or near the top of the dam and water is flowing, or about to flow, over the top of the dam.

      (2) The spillway is damaged, or clogged with debris or ice, which is resulting in a rapid rise in the lake or pond level.

      (3) The emergency spillway is experiencing heavy flows which are causing severe erosion to the spillway or the dam embankment.

      (4) Any structural movement or failure of the concrete (masonry) spillway or the spillway abutment walls.

      (5) Any sloughing or sliding of the embankment upstream or downstream slope. Also, earth slides in the spillway channel, either upstream or downstream the dam's crest, which could impede the flow in the spillway.

(6) Subsidence, sinkholes or cracks found in any part of the dam's embankment or abutting slopes.

(7) Any new discharge of water is observed through the dam's embankment or abutting slopes, adjacent to any conduit outlets, or under the dam, which appears as a boil along the downstream toe. Should such a discharge occur and the water is cloudy or muddy in color, then a very serious problem exists.

2. Warning notification will be relayed from the Dauphin County Emergency Communications Center to all emergency responders and designated government officials and agencies.

3. Emergency management officials will accomplish the needed actions, which are explained in this EAP, in accordance with their existing recommended operating guidelines, and existing municipal or county emergency operation plan.

D. EVACUATION

Evacuation or pre – evacuation warning of the public may commence upon notification by the DeHart Dam Superintendent or their designated representative of a potential or imminent failure of the dam. Emergency responders will initiate action in accordance with this plan's outline and any existing internal organizational Standard Operating Procedures (SOP's).

IV. RESPONSIBILITIES AND DUTIES – EMERGENCY RESPONSE

A. DAM OWNER (SURVEILLANCE – DAM SITE EMERGENCY)

1. The DeHart Dam Superintendent or their designated representative will provide for 24 – hour on site dam surveillance and monitoring.

2. When a situation meets the criteria under the warning notification guidelines, presented in Section 3.C.1, indicating a failure of the dam is possible or a significant threat condition is developing, the DeHart Dam Superintendent or their designated representative will initiate warning communication to the Dauphin County Emergency Communication Center and the Department of Environmental Protection's Southcentral Regional Office.

B. DAUPHIN COUNTY EMERGENCY COMMUNICATIONS CENTER

1. The DAUPHIN COUNTY EMERGENCY COMMUNICATIONS CENTER will notify (Telephone numbers and points of contact are listed in Attachment D):

   a. Dauphin County EMA.
      (1) Emergency: 911
      (2) Non-emergency: 558-6800

   b. Fire Services/ Rescue Services.
      (1) Dauphin-Middle Paxton Fire Company: 911
      (2) West End Fire Company: 911

   c. Police Services.
      (1) Pennsylvania State Police: 671-7500
      (2) Harrisburg City Police: 255-3131

   d. Emergency Medical Services.
      (1) Dauphin-Middle Paxton Community Ambulance Association: 911

   e. All schools, nursing homes, hospitals, day care centers, camp/ recreation sites, large businesses within the inundation area.
      (1) Happy Hollow Child Care: 921-8092

   f. PENNDOT District: 783-0342

   g. Public Transportation Services.
      (1) Norfolk Southern: 541-2158 or 541-2151

C. DAUPHIN COUNTY EMA

1. The Dauphin County EMA will contact the following personnel and agencies (See Attachment D):

   a. Rush Township EMA.

   b. Dauphin Borough/Middle Paxton Township EMA.

   c. County Elected Officials.

d. Activate/ mobilize County EOC, as necessary.

e. Pennsylvania Emergency Management Agency Area Office.

f. American Red Cross of the Susquehanna Valley (when mass care or family assistance is required)

g. Media - Advisory and/or Warning (Activate EAS). Refer to Attachment

h. Adjacent county EMA's if warranted.

2. The Dauphin County EMA will ascertain and report to PEMA any unmet needs requirements.

3. The Dauphin County EMA will cooperate with PEMA and initiate Damage Assessment and Recovery procedures as the situation requires.

D. HARRISBURG, DAUPHIN BOROUGH/MIDDLE PAXTON TOWNSHIP, AND RUSH TOWNSHIPS EMA's

1. Notify municipal elected officials.

2. Advise municipal services (water, sewer, etc.).

3. Keep the County EMA apprised of the situation.

4. Coordinate the evacuation (where appropriate).

E. WEST END AND DAUPHIN-MIDDLE PAXTON TOWNSHIP FIRE COMPANIES

1. Provide citizen notification and route alerting to advise residents living in the designated areas (See Inundation Map at Attachment B).

2. Assist in evacuation as requested.

3. Assist police and EMS, as requested.

4. Provide communications.

F. THE PENNSYLVANIA STATE POLICE TROOP H, HARRISBURG CITY POLICE

1. Dispatch radio vehicle to dam site in order to provide alternate communications system with the HARRISBURG Police Bureau.

2. Augment communications.

3. Assist evacuation traffic flow and establish traffic control points (TCP) at predesignated locations (See Inundation Map at Attachment B).

4. Prevent unauthorized entry into emergency areas and establish access control points (ACP) at predesignated locations (See Inundation Map at Attachment B).

5. Provide helicopter to assist in route alerting.

G. EMERGENCY MEDICAL SERVICES (EMS) – DAUPHIN-MIDDLE PAXTON COMMUNITY AMBULANCE ASSOCIATION

1. Assist fire and police departments as required.

2. Provide evacuation transportation assistance and coordinate with designated fire service agencies for transportation of the mobility impaired and any other person(s) with special needs.

3. Provide EMS support to any established mass care center.

H AMERICAN RED CROSS OF THE SUSQUEHANNA VALLEY

1. Alert person(s) responsible to set-up and operate mass care centers at Halifax Elementary School and/or the Middle Paxton Elementary School.

2. Support operations of the reception center and activate mass care center staff.

3. Maintain operations of reception center/ mass care center as requested by EMA officials until final disposition of evacuees is completed.

I. PENNSYLVANIA DEPARTMENT OF TRANSPORTATION (PENNDOT)

1. Provide services, signs, and guidance on roads and bridges affecting the evacuation and recovery.

2. Assist police, fire, and EMA with personnel resources and equipment, as necessary, for the evacuations.

V. ADMINISTRATION AND LOGISTICS

A. Notices will be posted at the following public places (See Notices at Attachment F):

1. Dauphin Borough Building. 200 Church Street, Dauphin

2. Rush Township Building 245 Reiners School Road, Tower City

3. Middle Paxton Township. 1304 Overlook Street, Dauphin

4. Harrisburg Police Bureau, 123 Walnut Street, Harrisburg

5. Pennsylvania State Police, Troop H, 8000 Bretz Drive, Harrisburg

6. West End Fire Company No. 3, 326 Rear, West Grand Avenue, Tower City

7. Dauphin-Middle Paxton Fire Co. 233 Erie Street, Dauphin

8. Dauphin County Tax office, 2 S.2nd Street, Harrisburg

B. The Notice (see Attachment F) must state that copies of the Emergency Action Plan for this dam are available for inspection at the following locations (include physical address):

1. Dauphin County Emergency Management Agency Office.
911 Gibson Boulevard, Steelton PA 17113.

2. City of Harrisburg 123 Walnut Street, Harrisburg PA 17101.

3. The Harrisburg Authority (Dam Owner) One Keystone Plaza, Suite 104, Front and Market Streets, Harrisburg PA 17101

4. The City of Harrisburg, Bureau of Water (Dam Operator)
100 Pine Drive, Harrisburg PA 17103

5. Rush Township 245 Reiners School Road, Tower City, PA 17980

6. Middle Paxton Township 1304 Overlook Street, Dauphin, PA 17018

C. New Notices will be sent to those agencies in paragraph "A" above whenever Plan is revised.

VI. AUTHORITY AND REFERENCES

A. AUTHORITY

1. The Dam Safety and Encroachments Act (32 P.S. sections 693.1-693.27), May 16, 1985.

2. The Pennsylvania Code - Title 25, Chapter 105 Dam Safety and Waterways Management, Section 105.63 and 105.134.

3. Emergency Management Services Code, 35 Pa C.S. Section 7101 et seq., as amended.

B. REFERENCES

1. Guidelines for Developing an Emergency Action Plan for Hazard Category 1 & 2 Dams. Prepared by the Department of Environmental Protection, Water Management, Bureau of Waterways Engineering, Division of Dam Safety, and the Pennsylvania Emergency Management Agency, July 2005.

2. Inspection, Maintenance and Operation of Dams in Pennsylvania. Prepared by the Department of Environmental Protection, Water Management, Bureau of Waterways Engineering, Division of Dam Safety, August 2004.

3. Dauphin County Emergency Operations Plan.

VII. DEFINITIONS

A. **ABUTMENT** - The part of the valley's hillside against which the dam abuts. Right and left abutments are those on respective sides of the dam as an observer looks downstream.

B. **AFFECTED COUNTIES/MUNICIPALITIES** – Those jurisdictions within Pennsylvania or adjoining states that, according to the inundation map, may experience flooding as a result of a failure of the dam.

C. **BOIL** - A disturbance in the surface layer of soil caused by water escaping under pressure from behind a water-retaining structure such as a dam or a levee. The boil may be accompanied by deposition of soil particles (usually sand or silt) in the form of a ring (miniature volcano) around the area where the water escapes.

D. **BREACH** - An opening or a breakthrough of a dam sometimes caused by rapid erosion of a section of earth embankment by water.

E. **CONDUIT** - A pipe used to convey water through or around or under a dam.

F. **CONTROL TOWER** - A structure in the dam or reservoir used to control withdraw of water from the reservoir thru pipes or culverts.

G. **CREST OF DAM** - The crown of an overflow section of the dam. In the United States, the term "crest of dam" is often used when "top of dam" is intended. To avoid confusion, the terms **crest of spillway** and **top of dam** should be used for referring to the overflow section and dam proper, respectively.

H. **CULVERT** - (a) A drain or waterway structure built transversely under a road, railway, or embankment. A culvert usually comprises a pipe or a covered channel of box section. (b) A gallery or waterway constructed through any type of dam, which is normally dry but is used occasionally for discharging water; hence the terms scour culvert, drawoff culvert and spillway culvert.

I. **DAM** - A barrier built across a watercourse for impounding or diverting the flow of water.

J. **DAM FAILURE** - The uncontrolled release of a dam's impounded water. It is recognized that there are degrees of failure. Any malfunction or abnormality, outside the design assumptions and parameters, which adversely affect a dam's primary function of impounding water, is properly considered a failure. Minor malfunctions or abnormalities can result in a sudden failure of a dam.

K. **EARTH DAM (EARTHFILL DAM)** - An embankment dam in which more than 50% of the total volume is formed of compacted fine-grained earth.

L. **EMBANKMENT** - Fill material, usually earth or rock, placed with sloping sides.

M. **EMERGENCY** - A condition of serious nature which develops unexpectedly and endangers the structural integrity of a dam or endangers downstream property and human life. An emergency requires immediate action.

N. **EMERGENCY ACTION PLAN (EAP)** - A formal plan of procedures designed to minimize consequences to life and property in the event of an emergency at a dam.

O. **FACE** - With reference to a structure, the external surface that limits the structure, e.g., the face or a wall or dam.

P. **FAILURE** - An incident resulting in the uncontrolled release of water from an operating dam. See "Dam Failure".

Q. **FOUNDATION OF DAM** - The natural material on which the dam structure is placed.

R. **GROIN** - That area along the contact (or intersection) of the face of a dam with the abutment.

S. **HAZARD** - A situation which creates the potential for adverse consequences such as loss of life, property damage, and adverse social and environmental impacts. Impacts may be for a defined area downstream of a dam from floodwaters released through spillways and outlet works of the dam or waters released by partial or complete failure of the dam. They may also be for an area upstream of the dam from effects of backwater flooding or effects of landslides around the reservoir perimeter.

T. **INUNDATION AREA** - The downstream area that would be flooded or other wise affected by the failure of a dam or large flows. This area can be subject to a fast moving flood wave, 20 to 50 MPH is common, with a height of 1 foot to tens of feet

U. **INUNDATION MAP** - A map delineating the area that would probably be flooded in the event of a dam failure. This map must be prepared by a registered professional engineer.

V. **NOTIFICATION** - To promptly inform appropriate individuals or emergency agency about an emergency condition so they can initiate appropriate actions.

W. **NORMAL WATER LEVEL (NORMAL WATER POOL)** - For reservoir with a fixed overflow spillway crest, it is the lowest level of that crest.

X. **OPERATOR** - The person or position in a company or organization, who is responsible for a dam's operation and surveillance.

Y. **OUTLET** - A constructed opening through which water can be safely discharged for a particular purpose from a reservoir.

Z. **OWNER** - Any person, authority or agency that manages a dam or reservoir.

AA. **SEEPAGE** - The movement of water that might occur through the dam, its foundation or its abutments. Small amounts of clear water seepage is normal. Increase in the amount of water flow or change in color is a concern for a dam's safety.

BB. **SLIDE** - The movement of a mass of earth and/or down a slope. In embankments and abutments, this involves the separation of a portion of the slope from the surrounding materials.

CC. **SPECIAL NEEDS FACILITY** – A building or establishment relating to people who have specific needs, such as children or those associated with a disability.

DD. **SPILLWAY** - A structure over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway; if the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

EE. **SPILLWAY CHANNEL** - A channel conveying water from the spillway crest to the river downstream.

FF. **TOE OF DAM** - The junction of the downstream face of a dam with the ground surface. Also referred to as downstream toe. For an embankment dam, the junction of the upstream face with ground surface is called the upstream toe.

GG. **TOP OF DAM** - The elevation of the uppermost surface of a dam, usually a road or walkway, excluding any parapet wall, railings, etc.

HH. **TRAFFIC CONTROL POINT (TCP)** – Manned posts established at critical road junctions for the purpose of controlling or limiting traffic. TCPs are used to control evacuation movement and also limit entry into the inundation area when an emergency situation requires it.

VIII. EXERCISE AND TRAINING

The dam owner will advise and cooperate with the Dauphin County EMA of any exercises scheduled, and coordinate with the Dauphin County EMA to exercise all or portions of this EAP as part of the county's all-hazard exercise program schedule.

IX. PLAN MAINTENANCE AND DISTRIBUTION

A. This Plan will be reviewed every five years by the owner or the owner's engineer. During the five year review:

1. The owner's engineer will field review the flood (inundation) area for any increase in downstream development and revise the Inundation Map, if needed.

2. The owner's engineer will review and revise surveillance conditions as needed.

3. The owner will coordinate with Dauphin County EMA if population increase or development within the inundation area could affect the emergency response requirements. If so, a new or revised plan should be developed.

4. The owner will obtain concurrence from the affected county EMA offices.

5. The owner will submit revised plan to DEP for approval.

B. A copy of the approved EAP will be distributed to those emergency response agencies listed in Section 4 and a letter certifying distribution of the approved EAP will be sent to the DEP, Division of Dam Safety.

ATTACHMENTS:

ATTACHMENT A - DOWNSTREAM FLOOD AREA (INUNDATION) MAP
ATTACHMENT B - TRAFFIC CONTROL POINTS
ATTACHMENT C - LOCATION MAP
ATTACHMENT D - TELEPHONE ROSTER
ATTACHMENT E - MEDIA ANNOUNCEMENT
ATTACHMENT F - NOTICE

INSERT

ATTACHMENT A

INUNDATION MAP

INSERT

ATTACHMENT B

TRAFFIC CONTROL POINTS

ATTACHMENT B

TRAFFIC CONTROL POINTS

TCP-1	AT THE INTERSECTION OF BEN STAHL DRIVE AND SR 325/CLARKS VALLEY RD.	PENNSYLVANIA STATE POLICE
TCP-2	AT THE INTERSECTION OF CARSONVILLE ROAD AND SR 325/CLARKS VALLEY ROAD.	PENNSYLVANIA STATE POLICE
TCP-3	AT THE INTERSECTION OF SR 325/MOUNTAIN ROAD AND SR 225/PETERS MOUNTAIN ROAD.	PENNSYLVANIA STATE POLICE
TCP-4	AT THE INTERSECTION OF USZTICS ROAD AND SR 225/PETERS MOUNTAIN ROAD.	PENNSYLVANIA STATE POLICE
TCP-5	AT THE RAMP OF THE DAUPHIN BORO-STONY CREEK EXIT ON 22/322 WEST.	PENNSYLVANIA STATE POLICE
TCP-6	ON SR 225/PETERS MOUNTAIN ROAD AT THE EXIT RAMP GOING TO ALLEGHENY STREET.	PENNSYLVANIA STATE POLICE
TCP-7	AT THE RAMP OF MOUNTAIN ROAD/SR 325 EXIT ON 22/322 EAST.	PENNSYLVANIA STATE POLICE

INSERT

ATTACHMENT C

LOCATION MAP

INSERT

ATTACHMENT D

TELEPHONE ROSTER

ATTACHMENT D

TELEPHONE ROSTER

	EMERGENCY	NON-EMERGENCY
DAM OWNER: THE HARRISBURG AUTHORITY	717-255-3131	717-232-3777
DAM OPERATOR: CITY OF HARRISBURG, BUREAU OF WATER	717-238-8725 EXT. 241	717-238-8725
DAUPHIN COUNTY EMA	911	717-558-6800
HARRISBURG EMA	717-255-3136	717-255-3136
DAUPHIN-MIDDLE PAXTON FIRE COMPANY	911	
WEST END FIRE COMPANY	911	
PA. STATE POLICE	717-671-7500	717-671-7500
DAUPHIN EMS	911	
RED CROSS	717-234-3101	717-234-3101
DEP REGION (SOUTH CENTRAL)	877-333-1904	717-705-4704
PEMA (CENTRAL AREA OFFICE)		717-651-7060
PEMA (HARRISBURG)	800-424-7362	717-651-2001 717-651-2005
PA DEPT. OF TRANSPORTATION	717-783-0502	
NORFOLK SOUTHERN	717-541-2158	
DEP AND DAM SAFETY	717-787-4343	717-787-8568
DAUPHIN BOROUGH/MIDDLE PAXTON TOWNSHIP EMA	911	
RUSH TOWNSHIP EMA	911	
EAS AND MEDIA	911	

ATTACHMENT E

MEDIA ANNOUNCEMENT

WARNING MESSAGE:

The Dauphin County Emergency Management Agency advises that due to conditions at the DeHart Dam in Clarks Valley, Rush Township that could pose a threat to public safety, the public should avoid the area downstream of the dam along Clarks Creek and State Rt. 325 in Middle Paxton Township. Stay tuned for further information.

REPEAT PERIODICALLY

EVACUATION MESSAGE:

The Dauphin County Emergency Management Agency is advising all residents living downstream of the DeHart Dam in Rush Township to evacuate the area immediately. Evacuate the area downstream of the dam along Clarks Creek and State Rt. 325 in Middle Paxton Township as soon as possible and proceed to higher ground. If you require shelter during this emergency you should report to the Halifax or Middle Paxton Township Elementary Schools. If you have no means of transportation, or if you are physically unable to evacuate on your own, ask a neighbor to assist you, or dial 911. Otherwise, please do not use your telephone except to report an emergency.

REPEAT PERIODICALLY

INCIDENT RESOLVED, SAFE TO RETURN:

The Dauphin County Emergency Management Agency is advising residents of the Clarks Creek Valley, downstream of the DeHart Dam in Rush Township, that the problem at the dam has been resolved and that residents may return to their homes.

REPEAT PERIODICALLY

ATTACHMENT F

NOTICE

DEHART DAM HAS BEEN CLASSIFIED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION AS A HIGH HAZARD DAM; THIS IS A DAM SO LOCATED AS TO ENDANGER POPULATED AREAS DOWNSTREAM BY ITS FAILURE.

AN EMERGENCY ACTION PLAN HAS BEEN DEVELOPED FOR DEHART DAM. A COPY OF THIS PLAN, INCLUDING AN INUNDATION MAP NOTING AREAS IN RUSH AND MIDDLE PAXTON TOWNSHIPS SUBJECT TO FLOODING IN THE EVENT OF FAILURE, IS AVAILABLE FOR PUBLIC INSPECTION AT THE FOLLOWING LOCATIONS:

THE HARRISBURG AUTHORITY
ONE KEYSTONE PLAZA, SUITE 104, FRONT AND MARKET STREETS
HARRISBURG, PA 17101

DAUPHIN COUNTY EMERGENCY MANAGEMENT OFFICE
911 GIBSON BOULEVARD, STEELTON, PA 17113

CITY OF HARRISBURG - BUREAU OF WATER
100 PINE DRIVE, HARRISBURG, PA 17103

CITY OF HARRISBURG - EMERGENCY OPERATIONS CENTER
123 WALNUT STREET, HARRISBURG, PA 17101

RUSH TOWNSHIP
245 REINERS SCHOOL ROAD, TOWER CITY, PA 17980

MIDDLE PAXTON TOWNSHIP
1304 OVERLOOK STREET, DAUPHIN, PA 17018

EMERGENCY ACTION PLAN

SURVEILLANCE, WARNING AND EVACUATION PROCEDURES

DEHART DAM

DEP NUMBER: D22-09

LOCATED IN DAUPHIN COUNTY, RUSH TOWNSHIP
PENNSYLVANIA

OWNER:
THE HARRISBURG AUTHORITY
ONE KEYSTONE PLAZA, SUITE 104
FRONT AND MARKET STREETS
HARRISBURG, PA 17101
TELEPHONE WORK: (717) 232-3777

OPERATOR:
THE CITY OF HARRISBURG
DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER
TELEPHONE WORK: (717) 238-8725
24 HOUR EMERGENCY: (717) 255-3136

DATE: OCTOBER 1995
DATE REVISED: December 17, 1997

EMERGENCY ACTION PLAN

SURVEILLANCE, WARNING AND EVACUATION PROCEDURES

DEHART DAM

DEP NUMBER: D22-09

LOCATED IN DAUPHIN COUNTY, RUSH TOWNSHIP
PENNSYLVANIA

OWNER:
THE HARRISBURG AUTHORITY
ONE KEYSTONE PLAZA, SUITE 104
FRONT AND MARKET STREETS
HARRISBURG, PA 17101
TELEPHONE WORK: (717) 232-3777

OPERATOR:
THE CITY OF HARRISBURG
DEPARTMENT OF PUBLIC WORKS
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PROMULGATION AND CONCURRENCE

We, the undersigned, on the date indicated, understand our responsibilities in support of the Emergency Action Plan for DeHart Dam.

Mayor, City of Harrisburg - Operator — Date 6-10-97

Chairman, The Harrisburg Authority - Owner — Date 6-12-97

Primary Observer — Date 6-12-97

City EMA Coord. — Date 6/11/97

Dauphin County EMA Director — Date 6-11-97

Middle Paxton Twp. EMA Director — Date 6-11-97

Rush Twp. EMA Director — Date 6-11-97

Chief, Dauphin-Middle Paxton Twp. Amb. Co. — Date 6-11-97

Chief, West End Fire Dept. — Date 6-12 97

Chief, Dauphin-Middle Paxton Twp. Fire Dept. — Date 06-11-97

Troop H, PA State Police — Date 06-11-97

Hbg. Chapter Amercian Red Cross — Date 10 June 97

PennDOT — Date 12/22/97

PROMULGATION AND CONCURRENCE (Cont.)

The Pennsylvania Emergency Management Agency, hereby finds the Emergency Action Plan contains all the key elements for an effective warning and evacuation plan.

Director, PEMA Central Area Office

Date 1/20/98

The Department of Environmental Protection, Bureau of Waterways Engineering Division of Dam Safety, hereby approves the Emergency Action Plan for Dehart Dam.

Chief, Division of Dam Safety

Date 1/21/98

EMERGENCY ACTION PLAN
SURVEILLANCE, WARNING AND EVACUATION PROCEDURES
DEHART DAM

1. PURPOSE AND SCOPE

A. To safeguard the lives, and secondarily, to reduce property damage of the citizens living within the dam's potential downstream flood area - inundation area.

B. To provide for effective dam surveillance, citizen warning and evacuation response, when required.

C. To assign emergency actions to be taken by the dam operator/owner, public officials, emergency personnel, and outline resident's response in the event of a potential or imminent failure of the dam.

2. SITUATION

A. DeHart Dam is a rolled earthfill structure constructed on Clarks Creek in 1940 for the purpose of creating a water supply reservoir for the City of Harrisburg. Clarks Creek has a drainage area of 21.3 square miles at the dam site. The dam is approximately 2,000 feet long, 105 feet high, and 600 feet thick at the base with a 30 foot wide roadway on the top. The dam, at normal pool level, maintains approximately 23,000 acre-feet with a maximum pool of 30,800 acre feet. The length of the reservoir is 4.55 miles.

B. The dam is located along the Clarks Creek, 16 miles northeast of Harrisburg and 13 miles northeast of Dauphin. Refer to Location Map at Attachment A.

C. The inundation area resulting from a sudden dam failure is bordered on the north by State Rt. 325 and on the south by Third and Middle Mountains from the DeHart Dam to the Susquehanna River. See Inundation Map at Attachment B.

D. Within the inundation area are approximately 1000 residents, 112 homes, and 10 Highway bridges. Refer to the Inundation Map at Attachment B.

E. The reach from DeHart Dam to the mouth of Clarks Creek is 17.06 miles and has 10 bridges. Because of the magnitude of flow resulting from a dam breach, nine of the ten bridges can be expected to fail. The remaining structure on U.S. Route 22 is near the mouth of the creek and the roadway elevation is approximately 40 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create

the worst possible conditions during a dam break it is expected that the pool created by the bridge structure will overflow the roadway.

1. The inundation study prepared for DeHart Dam concludes:

   a. The flood which results from a "sunny day" breach would flood 112 dwellings of which 14, at Camp Shikellimy, are within 40 minutes of a 31 foot wave.

   b. The flood wave from a "sunny day" breach would reach the mouth of Clarks Creek in two hours and 47 minutes. The flood wave would be 38 feet high at the mouth of the creek.

   c. The flood which would result from a dam breach resulting in the Probable Maximum Flood (PMF) would affect an additional 57 dwellings, sixteen of which are located at Camp Shikellimy and are within 40 minutes of the flood wave.

   d. The flood wave during a PMF breach would reach the mouth of Clarks Creek in two hours and 14 minutes. The flood wave would be 14 feet at the mouth of the creek.

   e. All ten bridges between DeHart Dam and the mouth of Clarks Creek would be overtopped by a breach and it is possible that all ten would fail as a result of the flood wave.

   f. Regarding the depth of water at the Route 22-322 over Clarks Creek, the invert and crown of the water opening at the bridge are elevations 317.3 and 344.8 respectively. The low point on the centerline of the top of the road is elevation 357.0. After a dam failure, it is expected that the bridge will create a pool upstream and that a major portion of the flow will be carried over the existing bridge. Under a "Sunny Day'" breach scenario, the peak water surface will be elevation 375.5 at the upstream side of the bridge. This is approximately 18.5 feet above the lowest point of the road. Under the full PMF with breach, the peak water surface will be elevation 391.8 at the upstream side of the bridge. This is approximately 35 feet above the lowest point of the road.

3. CONCEPT OF OPERATIONS

A. SURVEILLANCE - (DAM OPERATOR)

1. Normal Conditions:

   a. The operator will conduct an on-site visual review of the dam, the dam's spillway, control systems, and the toe area below the dam at a minimum of once every three months. Any abnormal or questionable conditions will be immediately brought to the attention of the owner's engineer and the Division of Dam Safety of DEP.

   b. If any condition is found during a normal inspection which meets or exceeds those of paragraph 4.A., Responsibilities and Duties - Dam Operator, the operator will immediately notify the designated central warning point Dauphin County Communications Center - 911.

2. Possible failure of this dam, considered a very unlikely event due to its structural integrity, would occur only during severe thunderstorms with very heavy rain and local flood warnings, or tropical storms and hurricanes with the same very heavy rain condition, or heavy rains when there is frozen ground and/or snow cover.

   a. The dam operator will commence 24 hour continuous around-the-clock surveillance of conditions at the dam site when:

      (1) Adverse weather conditions observed by the primary or alternate observer dictate;

      (2) The National Weather Service provides public notification that flash floods could occur;

      (3) There has been 5.5 inches or more of rain in 6 hours and the pool elevation is at elevation 650, 6 feet above the spillway crest.

      (4) Any conditions listed in paragraph 4.A.2 below is observed during a routine dam maintenance review; or

      (5) Following the occurrence of an earthquake in the general region of the dam.

3. Termination of Surveillance:

a. The dam operator will terminate 24 hour surveillance of conditions at the dam site when:

(1) The National Weather Service ends a flash flood warning.

(2) Heavy rains have ended and the water level in the reservoir has dropped to a pool elevation of 649, 5 feet above the crest of the spillway.

(3) After personal review and clearance by a knowledgeable professional engineer of the dam site, following an earthquake, overtopping of the dam, or an evacuation of the inundation area as a result of this plan, or other serious problems resulting in a notification of a dam site emergency.

B. NOTIFICATION

The dam operator or its designated representative will initiate the warning notification to the Dauphin County Communications Center - 911, which shall be the central warning point, and to the Department of Environmental Protection Regional Office. The warning will be initiated from the Dauphin County Communications Center - 911 to all emergency responders.

C. WARNING

1. When the situation meets the criteria under the surveillance guidelines indicating a failure of the dam is likely or a significant threatening condition is developing, the dam owner or its designated representative will initiate warning communications to the Dauphin County Communications Center - 911 as the designated central warning point.

2. Warning notification will be initiated from the Dauphin County Communications Center - 911 to all emergency responders and designated governmental officials and agencies.

3. Emergency management officials will execute the plans for warning the public in the affected area described in the EAP.

D. EVACUATION

Evacuation or pre-evacuation warning of the public may commence upon notification by the dam owner or its designated representative of a potential or imminent failure of the dam. Emergency responders will initiate action in accordance with this plan's outline and any existing internal organizational Standard Operating Procedures (SOP).

4. RESPONSIBILITIES AND DUTIES - EMERGENCY RESPONSE

A. DAM OPERATOR (SURVEILLANCE - DAM SITE EMERGENCY)

1. The operator will provide for 24 hour dam surveillance and monitoring.

2. The operator or its designated representative is responsible for determining the dam's threat potential. The following conditions constitute a dam emergency and require notification to the designated central warning point: Dauphin County Communications Center - 911.

   a. The pool elevation has reached elevation 653, 9 feet above the spillway crest.

   b. Imminent failure of this dam may be indicated by observance of one or more of the following conditions at the dam site.

      (1) The lake or pond level is at or near the top of the dam; and water is flowing, or about to flow, over the top of the dam.

      (2) The spillway is clogged with debris or ice which is resulting in a rapid rise in the lake or pond level.

      (3) The emergency spillway is experiencing heavy flows which are causing severe erosion to the spillway or the dam embankment.

      (4) Any structural movement or failure of the concrete (masonry) spillway or the spillway abutment walls.

      (5) Any sloughing or sliding of the embankment upstream or downstream slope. Also, earth slides in the spillway channel, either upstream or downstream of the dam's crest, which could impede the flow in the spillway.

(6) Subsidence, sinkholes or cracks found in any part of the dam's embankment or abutting slopes.

(7) Any new discharge of water is observed through the dam's embankment or abutting slopes, adjacent to any conduit outlets, or under the dam which appears as a boil along the downstream toe. Should such a discharge occur and the water is cloudy or muddy in color, then a very serious problem exists.

(8) Other conditions which the owner's engineer knows are a concern for the DeHart Dam's safety.

3. The operator or its designated representative is responsible for initiating warning notification to the Dauphin County Communications Center - 911 as the designated central warning point and the DEP Southcentral Regional Office.

B. WARNING POINT - DAUPHIN COUNTY COMMUNICATIONS CENTER 911

1. The designated central warning point will notify (See Telephone Information List at Attachment C):

a. Dauphin County EMA.
   (1) Emergency: 911
   (2) Non-emergency: 558-6800

b. Fire Services/Rescue Services.
   (1) Dauphin/Middle Paxton Fire Department: 911
   (2) West End Fire Department: 911

c. Police Services.
   (1) Pennsylvania State Police: 787-7777
   (2) Dauphin Police: 911

d. Emergency Medical Services.
   (1) Dauphin Middle Paxton EMS: 911

e. All schools, nursing homes, hospitals, day care centers, camp/recreation sites, large businesses within the inundation area.
   (1) None

f. PennDOT District.

(1) 783-8150

g. Public Transportation Services.

(1) Conrail: 783-8150

C. **DAUPHIN COUNTY EMA**

1. The County EMA will contact the following personnel and agencies (See Telephone Information List at Attachment C):

a. Rush Township Municipal EMA.

b. Middle Paxton Township EMA

c. County elected officials.

d. Activate/mobilize County EOC, as necessary.

e. Pennsylvania Emergency Management Agency Area Office.

f. Emergency Alerting System (EAS).

g. American Red Cross Chapter (when mass care or family assistance is required).

h. Media (Advisory and/or Warning).

i. Adjacent county EMA's, if warranted.

2. The County EMA will ascertain and report to PEMA Area Office any unmet needs or requirements.

3. The County EMA will cooperate with PEMA and initiate Damage Assessment and Recovery procedures as the situation requires.

D. **HARRISBURG, MIDDLE PAXTON AND RUSH TOWNSHIPS EMAs**

1. Notify municipal elected officials.

2. Advise municipal services (water, sewer, etc.).

3. Keep the County EMA apprised of the situation.

4. Coordinate the evacuation (where appropriate).

E. **WEST END AND DAUPHIN-MIDDLE PAXTON TOWNSHIP FIRE DEPARTMENTS**

1. Provide citizen notification and route alerting to advise residents living in the designated areas (See Inundation Map at Attachment B).

2. Assist in evacuation as requested.

3. Assist police and EMS, as requested.

4. Provide communications.

F. **THE PENNSYLVANIA STATE POLICE TROOP H, HARRISBURG CITY POLICE**

1. Dispatch radio vehicle to dam site in order to provide alternate communications system with the HARRISBURG Police Bureau.

2. Augment communications.

3. Assist evacuation traffic flow and establish traffic control points (TCP) at predesignated locations (See Inundation Map at Attachment B).

4. Prevent unauthorized entry into emergency areas and establish access control points (ACP) at predesignated locations (See Inundation Map at Attachment B).

5. Provide helicopter to assist in route alerting.

G. **EMERGENCY MEDICAL SERVICES (EMS) - DAUPHIN-MIDDLE PAXTON TOWNSHIP AMBULANCE COMPANY**

1. Assist fire and police departments as required.

2. Provide evacuation transportation assistance and coordinate with designated fire service agencies for transportation of the mobility impaired and any other person(s) with special needs.

3. Provide EMS support to any established mass care center.

H. **AMERICAN RED CROSS - CAPITOL REGION CHAPTER**

1. Alert person(s) responsible to set-up and operate mass care centers at Halifax Elementary School and/or the Dauphin - Middle Paxton Township Elementary School.

2. Support operations of the reception center and activate mass care center staff.

3. Maintain operations of reception center/mass care center as requested by EMA officials until final disposition of evacuees is completed.

I. **PENNSYLVANIA DEPARTMENT OF TRANSPORTATION (PENNDOT)**

1. Provide services, signs and guidance on roads and bridges affecting the evacuation and recovery.

2. Assist police, fire, and EMA with personnel resources and equipment, as necessary, for the evacuation.

5. **ADMINISTRATION AND LOGISTICS**

A. Notices will be posted at the following public places (See Notice at Attachment E):

1. Dauphin Borough Building. 200 Delaware St., Dauphin.

2. Rush Township Building. Schoolhouse Road, Tower City

3. Middle Paxton Township. 1340 Overlook Street, Dauphin

4. Harrisburg Police Bureau. 123 Walnut St., Harrisburg.

5. Troop H, Pennsylvania State Police, Harrisburg Barracks. Elmerton Avenue and Kohn Road, Harrisburg.

6. West End and Dauphin Middle Paxton Township Fire Departments. 200 Delaware Street, Dauphin.

7. Dauphin County Tax Office. 112 Market Street, Harrisburg, PA17101

B. The Notice must state that copies of the Emergency Action Plan for this dam are available for inspection at the following locations:

1. Dauphin County Emergency Management Agency Office. 911 Gibson

Boulevard, Steelton, PA 17113.

2. City of Harrisburg - 123 Walnut Street, Harrisburg, PA 17101.

3. The Harrisburg Authority - Dam Operator. 100 Pine Drive, Harrisburg, PA 17103.

4. DeHart Dam - Dam Owner, One Keystone Plaza, Suite 104, Front and Market Streets, Harrisburg, PA 17101.

5. Rush Township - Schoolhouse Road, Tower City, PA 17980.

6. Middle Paxton Township - 1340 Overlook Street, Dauphin, PA 17018.

C. New Notices will be sent to those agencies in paragraph "A" above whenever the plan is revised.

6. AUTHORITY AND REFERENCES

A. AUTHORITY

1. The Dam Safety and Encroachments Act (32 P.S. Sections 693.1-693.27), May 16, 1985.

2. The Pennsylvania Code - Title 25, Chapter 105 Dam Safety and Waterways Management, Section 105.63 and 105.134.

3. Emergency Management Services Code, 35 Pa C.S. Section 7101 et seq; as amended.

B. REFERENCES

1. Emergency Action Planning Guidelines for Dams. Subcommittee on Emergency Action Planning, Inter-Agency Committee on Dam Safety, February 1985.

2. Manual for the Inspection, Maintenance and Operation of Dams in Pennsylvania, prepared by the Department of Environmental Protection, Office of Resources Management, Bureau of Dams and Waterways Management, Division of Dam Safety, 1986.

3. County Emergency Operations Plan.

7. DEFINITIONS

A. **ABUTMENT** - A point or surface provided to withstand thrust (end supports of an arch, bridge, etc.)

B. **BOIL** -An unwanted flow of water and solid matter into an excavation due to excessive outside water pressure.

C. **CONDUIT** - An enclosed channel used to convey flows through or under a dam.

D. **CREST OF DAM** - Top of a slope, top of a dam (highest point).

E. **CULVERT** - A structure with appurtenant works which carries a stream under or through an embankment or fill.

F. **DAM** - A barrier constructed across a watercourse for the purpose of storage, control or diversion of water.

G. **DAM FAILURE** - Failure or non-performance of something due, required, or expected.

H. **EARTH DAM (EARTH FILL DAM)** - A dam made by compacting excavated earth obtained from a burrow area.

I. **EMBANKMENT (WALL)** - A retaining wall from the top of which the supported earth normally rises at a slope.

J. **EMERGENCY** - A condition which develops unexpectedly, endangers the structural integrity of a dam and/or downstream property and human life, and requires immediate action.

K. **EMERGENCY ACTION PLAN (EAP)** - A formal plan of procedures designed to minimize consequences to life and property in the event of an emergency at a dam.

L. **FAILURE** - The catastrophic breakdown of a dam, characterized by the sudden, rapid, and uncontrolled release of impoundment water.

M. **HAZARD** -Something causing unavoidable danger, peril, risk or difficulty.

N. **INUNDATION AREA** - The downstream area that would be inundated or otherwise affected by the failure of a dam or large flows.

O. **INUNDATION MAP** - A map showing areas that would be affected by flood conditions and/or by an uncontrolled release of reservoir water due to the failure of a dam.

P. **NOTIFICATION** - An act or instance of notifying, making known or giving notice.

Q. **NORMAL WATER LEVEL (NORMAL WATER POOL)** - The elevation of the spillway, outlet control or dam crest which maintains the body of water at a specified height.

R. **OUTLET** - Used to regulate the release of water from the reservoir. It usually consists of an intake and an outlet connected by a water passage and is usually provided with gates.

S. **OPERATOR** - City of Harrisburg, Bureau of Water, 100 Pine Drive, Harrisburg, PA 17103.

T. **OWNER** - The Harrisburg Authority, One Keystone Plaza, Suite 104, Front and Market Streets, Harrisburg, PA 17101.

U. **SEEPAGE** - Water which passes, flows, or oozes gradually through a porous substance.

V. **SLIDE** -The mass of matter sliding down.

W. **SPILLWAY** - A structure over or through which flood flows are discharged. If the flow is controlled by mechanical means, such as gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

X. **SPILLWAY CHANNEL** - Channel which conveys released water in excess of storage capacity so that the dam and its foundation are protected against erosion and possible failure.

Y. **TOE OF DAM** - The junction of the downstream face of a dam and the natural ground surface, also referred to as downstream toe. For an earth dam the junction of the upstream face with ground surface is called the upstream toe.

Z. **TOP OF DAM** - The higher end of anything on a slope.

8. EXERCISE AND TRAINING

The dam operator will advise the County EMA of any/all exercises scheduled and coordinated with the County EMA to exercise all or portions of this plan as part of the county's all-hazard exercise program schedule.

9. PLAN MAINTENANCE

A. This plan will be reviewed every two years as part of DEP's annual dam inspection program.

B. During the two year review:

1. The owner's engineer will field review the flood (inundation) area for any increase in downstream population and revise the flood (inundation) area, if needed.

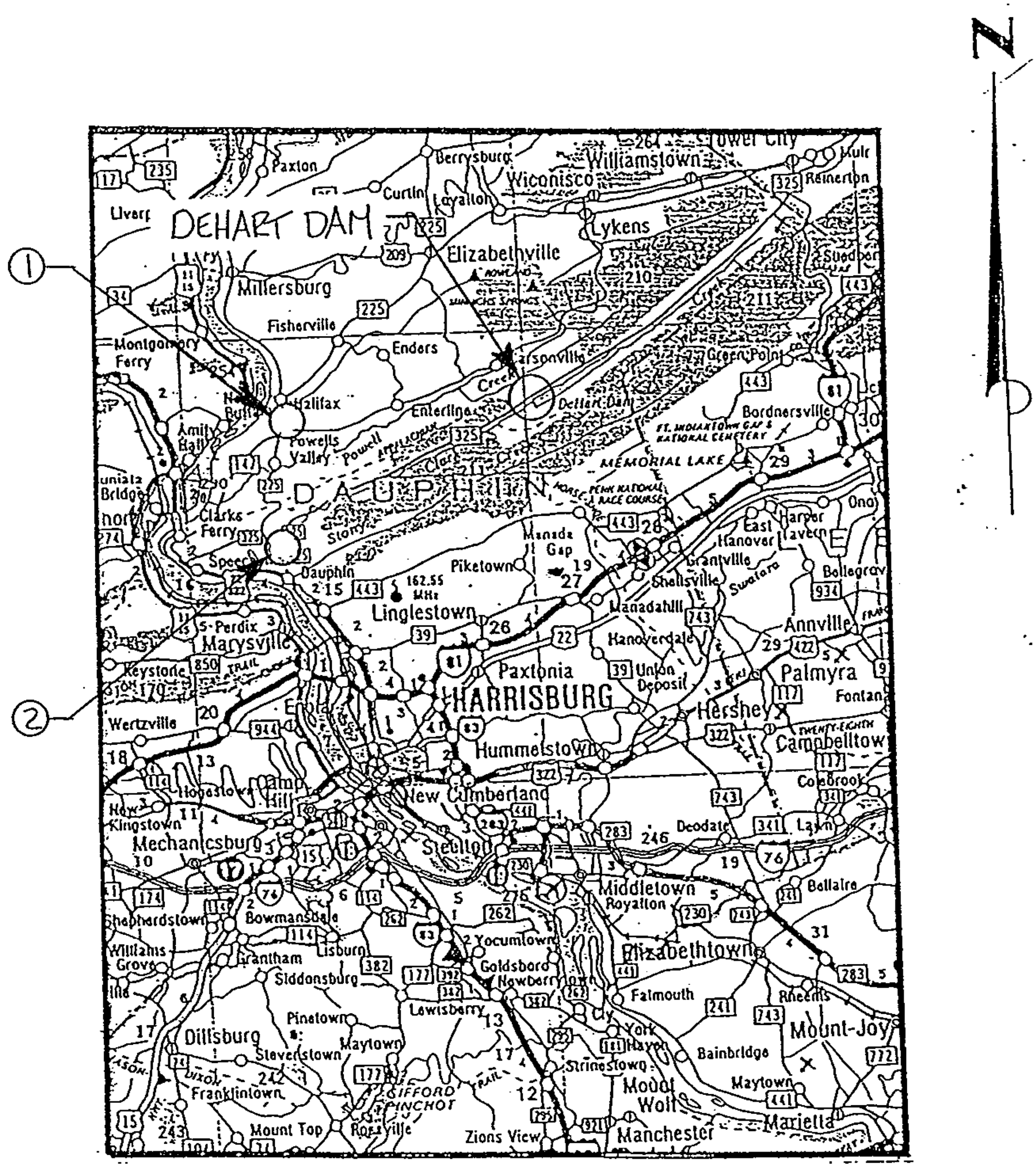
2. The owner's engineer will review and revise surveillance conditions as needed.

3. The owner/operator will coordinate with County EMA if population increases within the inundation area could affect the emergency response capabilities. If so, a new or revised plan should be developed.

4. The owner/operator will obtain concurrence from emergency response agency officials attesting to their continued understanding of their role (s).

5. The owner/operator will submit revised plan to DEP for approval.

ATTACHMENT A
LOCATION MAP
(NO SCALE)



① MASS CARE CENTER - HALIFAX ELEMENTARY SCHOOL

② MASS CARE CENTER - MIDDLE PAXTON SCHOOL

ATTACHMENT B
INUNDATION MAP

ATTACHMENT C
TELEPHONE INFORMATION LIST

DAM OPERATOR City of Harrisburg Bureau of Water	TELEPHONE: 717-238-8725 24 HR: 717-255-3136
DAM OWNER The Harrisburg Authority	TELEPHONE: 717-232-3777 24 HR: 717-255-3136
DAUPHIN COUNTY EMA	WORK: 717-558-6800 24 HR: 911
HARRISBURG EMA	24 HR: 717-255-3136
DAUPHIN, MIDDLE PAXTON AND WEST END FIRE DEPTS	24 HR: 911
PA. STATE POLICE	24 HR: 717-787-7777
DAUPHIN EMS	24 HR: 911
RED CROSS	24 HR: 717-234-3101
DEP REGION (South Central)	24 HR: 717-657-4585
PA EMERGENCY MANAGEMENT AGENCY CENTRAL AREA OFFICE	NORMAL HOURS: 717-374-2055
PA EMERGENCY MANAGEMENT AGENCY - HARRISBURG	24 HR: 800-424-7362 PHONE: 717-651-2001/5
PA DEPT OF TRANSPORTATION	24 HR: 717-783-8150
CONRAIL	24 HR: 1-800-572-0911
COUNTY ELECTED OFFICIALS	24 HR: 911
EAS AND MEDIA	24 HR: 911
DEP DAM SAFETY	24 HR: 717-787-4343 PHONE: 717-787-8568
DEP SOUTHCENTRAL REGIONAL OFFICE	24 HR: 800-812-3782 PHONE: 717-657-4505
MIDDLE PAXTON FIRE AND EMA	24 HR: 911
RUSH TWP FIRE AND EMA	24 HR: 911

ATTACHMENT D

MEDIA ANNOUNCEMENT (SAMPLE 1)

The following announcement has been released by the Dauphin County Emergency Management Agency.

The flooding condition continues in the Clarks Creek Valley and may worsen. For your safety the Dauphin County Emergency Management Agency recommends that you leave the area below the DeHart Dam in the Clarks Creek Valley as soon as possible and proceed to higher ground.

Be sure to take essential items - medicine, special foods, personal items, baby supplies, clothes, money and valuable papers - but do not overload your vehicle. Secure your home before you leave. Be sure to check on neighbors who may need assistance. Above all, do not delay.

Proceed by the shortest route to one of the Red Cross shelters at either the Halifax or Dauphin-Middle Paxton Township Elementary Schools.

If you have no means of transportation or if you are physically unable to evacuate on your own, ask a neighbor to assist you or dial 911. Otherwise, please do not use your telephone except to report an emergency.

I repeat. If you live in the Clarks Creek Valley below the DeHart Dam you are requested to evacuate for your own safety. Stay tuned to this station for more information and instructions.

MEDIA ANNOUNCEMENT (SAMPLE 2)

Conditions exist at the DeHart Dam in Clarks Valley, Middle Paxton Township, that could pose a threat to public safety.

Persons located below the DeHart Dam along Clarks Creek and State Rt. 325 in Middle Paxton Township should leave the area without delay. Persons in this area should proceed by the most direct route to either the Middle Paxton or Halifax Elementary Schools. If roadways are flooded, persons should seek the nearest high ground away from Clarks Creek.

If you do not have transportation, telephone 911 for assistance.

ATTACHMENT E

NOTICE

DEHART DAM HAS BEEN CLASSIFIED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION AS A HIGH HAZARD DAM; THIS IS, "A DAM SO LOCATED AS TO ENDANGER POPULATED AREAS DOWNSTREAM BY ITS FAILURE."

AN EMERGENCY ACTION PLAN HAS BEEN DEVELOPED FOR DEHART DAM. A COPY OF THIS PLAN, INCLUDING AN INUNDATION MAP NOTING AREAS IN RUSH AND MIDDLE PAXTON TOWNSHIPS SUBJECT TO FLOODING IN THE EVENT OF FAILURE, IS AVAILABLE FOR INSPECTION AT THE FOLLOWING LOCATIONS:

DAUPHIN COUNTY EMERGENCY MANAGEMENT OFFICE
911 GIBSON BOULEVARD, STEELTON, PA 17113

CITY OF HARRISBURG - EMERGENCY MANAGEMENT OFFICE
123 WALNUT STREET, HARRISBURG, PA 17101

CITY OF HARRISBURG - BUREAU OF WATER
100 PINE DRIVE, HARRISBURG, PA 17103

THE HARRISBURG AUTHORITY
ONE KEYSTONE PLAZA, SUITE 104, FRONT AND MARKET SREETS
HARRISBURG, PA 17101

RUSH TOWNSHIP
SCHOOLHOUSE ROAD, TOWER CITY, PA 17980

MIDDLE PAXTON TOWNSHIP
1340 OVERLOOK STREET, DAUPHIN, PA 17018

ATTACHMENT F
DEHART DAM BREAK ANALYSIS

THE HARRISBURG AUTHORITY
BRINJAC-CHESTER ENGINEERS

DEHART DAM
DAM BREAK ANALYSIS

7/24/97

P9872.00

ACRES INTERNATIONAL CORPORATION
140 John James Audubon Parkway
Amherst, New York 14228-1180

ACRES

DAM BREAK ANALYSIS ON DEHART DAM

1 - GENERAL

Dehart Dam is a rolled earthfill structure constructed on Clark Creek in 1940 with the purpose of creating a water supply reservoir for the City of Harrisburg. The facility, which is located about 16 miles northeast of Harrisburg, Pennsylvania, was designed by Gannett, Eastman and Fleming, Inc. The creek has a drainage area of 21.3 square miles at the dam site. The dam is about 2,000 feet long, 105 feet high, and 600 feet thick at the base with a 30-foot wide roadway on the top. When the reservoir is full at Elevation 644, the reservoir is 4.55 miles long and contains about 23,000 Ac-ft of water.

A Phase I Inspection Report (Ref. 1) was completed for the Corps of Engineers by Berger Associates, Inc. of Harrisburg, Pennsylvania in 1978. The report classified the dam as a large high-hazard structure.

A dam break analysis was used to determine the flood levels and time of the flood wave which would occur downstream of the dam as a result of a hypothetical break. Two breach conditions were used to evaluate the flood limits downstream of Dehart Dam: (1) "sunny-day", and (2) during a Probable Maximum Storm Event.

2 - METHODOLOGY

The Corps of Engineers HEC-1 program (Ref. 2) was used to develop the Probable Maximum Flood inflow hydrograph to the reservoir. The input hyetograph to the HEC-1 model was developed using the U.S. National Weather Service Hydrometeorological Report Nos. 51 and 52 (Ref. 3 and 4). The U.S. Department of Agriculture, Soil Conservation Service (Ref. 5) parameters for curve number (CN) and lag were used in the HEC-1 model to determine the peak discharge and the volume of the hydrograph for each of the drainage areas in the Clark Creek basin. A summary of the values used for each subarea are listed in Table 1. Soil survey maps (Ref. 6), published by the Dauphin County Soil Conservation Service, were used to determine the soil group classification and the general land use from which a curve number (CN) was chosen.

The National Weather Service DAMBRK Program (Ref. 7) was used to develop the dam breach and route the flood downstream. The model uses the dynamic wave method based on the solution of the complete St. Venant equations of

unsteady flow to route the flood hydrograph through the downstream valley. This accounts for the unsteady nature of the wave and the attenuation of the wave as it travels downstream.

The DAMBRK model was set up using cross section data collected by Hartman and Associates of Camp Hill, Pennsylvania (Ref. 8). The survey incorporated 13 valley cross sections and nine bridges. The U.S. Geological Survey topographic maps (Ref. 9-14) were used to supplement and increase the height of the cross sections to allow for an additional 20 feet in elevation and ensure that the flood wave would be contained within the cross sections.

The analysis used breach parameters within FERC guidelines (Ref. 15-16). A time to breach of 0.4 hours was used in consideration of the size of the dam. The time parameter is within the FERC guidelines and is appropriate for a dam of this size. FERC guidelines are based on the Corps of Engineers criteria for dam safety and are appropriate for this analysis.

The reach from Dehart Dam to the mouth of Clark Creek is 17.06 miles and has 10 bridges. Because of the magnitude of flow resulting from a dam breach, nine of the 10 bridges can be expected to fail. The remaining structure, U.S. Route 22, is near the mouth of the creek. The roadway elevation is approximately 40 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create the worst possible conditions during a dam break, it was assumed that this bridge would not fail. A determination of the pool elevation immediately upstream of the bridge was made by using the most downstream hydrograph from the DAMBRK model and routing it in a HEC-1 model to obtain an outflow hydrograph and the maximum pool elevation.

The limits of the inundation, with and without a breach, were plotted on topographic base mylars (Sheets 1 to 7). The index to the mylars is shown on Drawing 987201-001.

All the input data and results are included in a 5¼ inch floppy disk which is included with this report.

3 - BREACH PARAMETERS

Identical breach parameters were selected for the break under "sunny-day" conditions and during the Probable Maximum Flood. The average breach width

was set equal to 420 feet. Since the dam is 105 feet high (HD), the average breach width is equal to 4.0 HD. The upper limit average breach width suggested by FERC is 5 HD (Ref. 15-16) with the breach width usually being between 2 HD and 4 HD. The actual bottom width of the breach is 315 feet with 1H:1V side slopes. The bottom of the breach was set at Elevation 551.0.

The start of the breach was set to occur at time zero on the "sunny-day" break and be completely failed to the above breach dimensions after 0.4 hours. FERC's guidelines (Ref. 15-16) suggest a time to failure of 0.1 to 1.0 hours for a compacted earthen dam. Because of the size of the dam, the time to failure was deemed appropriate.

An initial discharge of 2,400 cfs was assumed to pass through the dam for the "sunny-day" break model. This was the minimum discharge at which the flow became stable in the DAMBRK model. This flow is assumed constant from the start of computation until the dam is 25 percent breached; thereafter, the flow will linearly decrease to zero when the dam is 50 percent breached.

The beginning of breach during the Probable Maximum Flood was set to occur when the reservoir pool for Dehart Dam reached Elevation 659.0. This is approximately the maximum elevation reached in the pool during the PMF. The breach will be complete after 0.4 hours.

4 - BREACH IMPACTS AND INUNDATION LIMITS

4.1 - General

The mouth of Clark Creek is approximately 17.06 river miles downstream of Dehart Dam. There are ten bridges in this reach, all of which are expected to fail except the U.S. 22 bridge, which is near the mouth of Clark Creek. The waterway opening for this bridge is 1,600 square feet, and it is markedly inadequate to accommodate the discharge as a result of a failure of Dehart Dam. The invert and the crown of the water opening are Elevation 317.3 and 344.8, respectively. The low point on the centerline of the top of the road is at Elevation 357.0. After a dam failure, it is expected that the bridge will create a pool upstream and that a major portion of the flow will be carried over the road.

4.2 - Sunny-Day Break

The maximum calculated discharge was 805,200 cfs, which occurred 0.4 hours after the time the breach began to form. The outflow hydrograph for this breach is shown on Figure 1. Immediately downstream from Dehart Dam, the maximum computed flood wave was 47 feet with the wave crest at Elevation 584.4. By the time the flood wave reached the U.S. 22 bridge over Clark Creek, 16.96 miles downstream, the peak flow was attenuated to 152,300 cfs with an elevation of 375.5 at the upstream side of the bridge. The maximum flood elevation reached the U.S. Route 22 bridge about 2.7 hours (162 minutes) after time zero, the start of the breaching. The travel time of the peak discharge is shown on Figure 2.

The extent of the dam break's influence on downstream areas was determined by plotting the maximum flood elevations obtained from the DAMBRK model on 500 scale topographic maps, which are enclosed with this report. There are 19 surveyed cross sections in the DAMBRK model, and the program generated another 153 cross sections in between the surveyed ones. The program calculates a water surface elevation at all cross sections. By interpolating between elevations at each cross section, the maximum water surface was determined. The water surface elevation and time of travel of the flood wave peak are shown in Table 3, attached.

The flood wave created by the dam break extends well out into the overbank areas of the channel. A total of 112 dwellings are affected by the "sunny-day" breach. Fourteen of the dwellings are located at Camp Shikellimy, which is near river mile 4.7. Some of the dwellings will be inundated by as much as 20 feet. Another 10 dwellings will be inundated between river miles 11.0 and 11.6, and at river mile 16.9, 12 dwellings will be inundated, some by as much as 30 feet. The time of travel of the flood wave is most critical at Camp Shikellimy, where a 31 foot wave reaches the camp in about 40 minutes from the beginning of the start of the breach. The number of dwellings was determined from the U.S.G.S. topographic maps.

4.3 - Full PMF With Breach

The maximum calculated discharge was 1,074,400 cfs, which occurred 0.4 hours after the time the breach began to form. The inflow and outflow hydrographs for this breach are shown on Figure 3. Immediately downstream from Dehart Dam, the maximum computed flood wave was 30 feet with the wave crest at

Elevation 589.9. By the time the flood wave reached the U.S. Route 22 bridge over Clark Creek, 16.96 miles downstream, the peak flow was attenuated to 401,500 cfs with an elevation of 391.8 at the upstream side of the bridge. The maximum flood elevation reached the U.S. Route 22 bridge about 2.2 hours (132 minutes) after time zero, the start of the breaching. The travel time of the peak discharge is shown on Figure 4. The water surface elevation and time of travel of the flood wave peak are shown in Table 4, attached.

The extent of the dam break's influence on downstream areas was determined by plotting the maximum flood elevations obtained from the DAMBRK model on the 500 scale topographic maps.

The flood wave created by the dam break extends well out into the overbank areas of the channel. A total of 57 additional structures will be inundated above the natural PMF flood stage elevations as a result of the dam breach occurring during the PMF. Sixteen of these dwellings are located at Camp Shikellimy, which is around river mile 4.7. Another five dwellings are located at river mile 11.5. The time of travel of the flood wave is critical at Camp Shikellimy as the wave reaches the camp in about 40 minutes from the beginning of the start of the breach.

5 - CONCLUSIONS

Based on the results of the analysis, it is concluded that:

(a) The flood, which would result from a "sunny-day" breach, would flood 112 dwellings of which 14 are within 40 minutes of a 31 foot wave;

(b) The flood wave from a "sunny-day" breach would reach the mouth of Clark Creek in two hours and 47 minutes. The flood wave would be approximately 38 feet at the mouth of Clark Creek;

(c) The flood, which would result from a dam break during a PMF, would inundate another 57 dwellings when compared with the natural PMF. Sixteen of the dwellings are within 40 minutes of the 21 foot wave;

(d) The flood wave during a PMF breach would reach the mouth of Clark Creek in two hours and 14 minutes. The flood wave would be approximately 14 feet at the mouth of Clark Creek; and

(e) All ten bridges between Dehart Dam and the mouth of Clark Creek would be overtopped by a dam breach. It is possible that all 10 bridges would fail as a result of the flood wave.

6 - RECOMMENDATIONS

It is recommended that:

(a) The elevation of all 144 dwellings within the inundation limits of the full PMF with breach be determined; and

(b) Those dwellings that will be affected by a flood wave should be included on the EAP notification list.

7 - REFERENCES

(1) Berger Associates, Inc., "Dehart Dam, Phase I Report, National Inspection Program", August 1978.

(2) U.S. Army Corps of Engineers, "HEC-1 Flood Hydrographic Package", September 1990, Version 4.0.

(3) U.S. National Weather Service, "Probable Maximum Precipitation Estimates, United States, East of 105th Meridian", Hydrometeorological Report No. 51.

(4) U.S. National Weather Service, "Application of Probable Maximum Precipitation Estimates - United States, East of 105th Meridian", Hydrometeorological Report No. 52.

(5) U.S. Department of Agriculture, Soil Conservation Service, "National Engineering Handbook, Section 4, Hydrology", January 1971.

(6) U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Dauphin County", 1970.

(7) U.S. National Weather Service, "The NWS DAMBRK Model", June 1988, Version 6/20/88-2.

(8) Hartman and Associates, Inc., Field Survey of Clark Creek, June 1991.

(9) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Grantville, PA, Photo revised 1976.

(10) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Halifax, PA, Photo revised, 1977.

(11) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Harrisburg West, PA, Photo revised, 1987.

(12) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Enders, PA, Photo revised, 1974.

(13) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Lykens, PA, Photo revised, 1977.

(14) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Tower City, PA, Photo revised, 1974.

(15) Federal Energy Regulatory Commission, "Engineering Guidelines for the Evaluation of Hydropower Projects", (FERC 0119-1), July 1987.

(16) Federal Energy Regulatory Commission, "Notice of Revised Emergency Action Plan Guidelines", February 22, 1988.

TABLE 1

HEC-1 HYDROGRAPH PARAMETERS

LOCATION	DELTA DRAINAGE AREA (SQUARE MILES)	CURVE NUMBER* (CN)	LAG HOURS
Dehart Dam	21.61	85	2.0
Camp Shikellimy	7.32	85	1.6
Grace Church	8.67	85	2.4
7000 Feet Upstream of Confluence of Susquehanna River	5.85	87	1.6
Tributary to Clark Creek	2.29	87	0.5

*Based on Antecedent Moisture Condition III

TABLE 2

DEHART DAM DAMBRK BREACH PARAMETERS

	SUNNY-DAY	100% PMF
Initial Reservoir Level	Elevation 644	Elevation 655.6
Reservoir Level at Start Breach	Elevation 644	Elevation 659.0
Breach Width	315 Feet	315 Feet
Breach Side Slopes	1H:1V	1H:1V
Elevation of Breach Bottom	Elevation 551	Elevation 551
Time of Failure	0.4 Hours	0.4 Hours

TABLE 3

SUNNY-DAY FLOOD WAVE AND TRAVEL TIME

WATER SURFACE ELEVATIONS
NATIONAL GEODETIC VERTICAL DATUM (NGVD)

RIVER MILE	W/O DAM BREAK	W/DAM BREAK	TRAVEL TIME TO MAXIMUM ELEV. W/DAM BREAK (HR)
1.08	537.5	584.4	0.40
2.03	527.2	570.0	0.50
3.33	512.0	554.3	0.60
4.56	498.8	533.2	0.80
4.72	498.5	529.6	0.80
6.16	471.6	503.5	0.95
8.35	437.6	476.5	1.22
11.04	413.3	445.3	1.61
11.31	408.6	442.9	1.63
11.52	404.8	437.7	1.67
12.05	392.6	429.2	1.72
12.42	388.0	422.3	1.77
13.24	376.0	407.5	1.83
13.62	372.5	400.8	1.91
13.76	369.5	399.2	1.93
14.65	360.0	388.6	2.07
15.90	349.0	375.5	2.23
16.88	324.4	375.5	2.77
17.06	321.5	359.9	2.77

TABLE 4

100% PMF FLOOD WAVE AND TRAVEL TIME

WATER SURFACE ELEVATIONS
NATIONAL GEODETIC VERTICAL DATUM (NGVD)

RIVER MILE	W/O DAM BREAK	W/DAM BREAK	TRAVEL TIME TO MAXIMUM ELEV. W/DAM BREAK (HR)
1.08	559.8	589.9	0.40
2.03	551.1	577.5	0.50
3.33	537.7	561.8	0.60
4.56	518.5	540.8	0.70
4.72	515.8	536.7	0.70
6.16	493.7	512.5	0.90
8.35	468.2	485.8	1.10
11.04	437.5	456.6	1.40
11.31	434.7	454.1	1.40
11.52	431.1	448.7	1.50
12.05	421.8	441.8	1.50
12.42	415.0	433.9	1.50
13.24	403.5	414.6	1.50
13.62	396.5	411.2	1.70
13.76	394.6	409.8	1.70
14.65	384.4	399.0	1.80
15.90	374.0	391.8	1.90
16.88	374.0	391.8	2.10
17.06	356.9	370.7	2.10

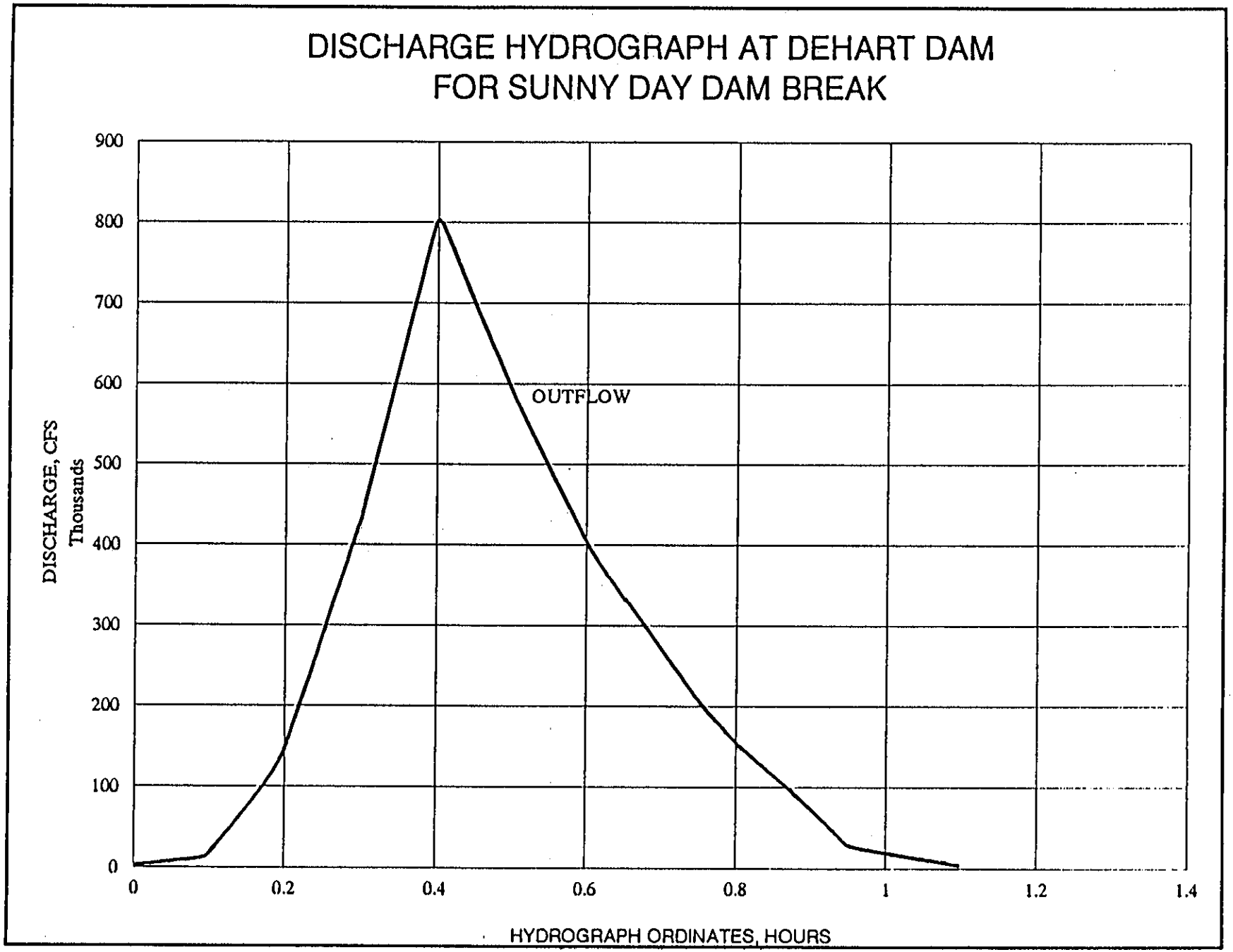

DISCHARGE HYDROGRAPH AT DEHART DAM
FOR SUNNY DAY DAM BREAK
900
800
700
600
500
400
300
200
100
0
DISCHARGE, CFS
Thousands
OUTFLOW
0
0.2
0.4
0.6
0.8
1
1.2
1.4
HYDROGRAPH ORDINATES, HOURS

FIGURE 1

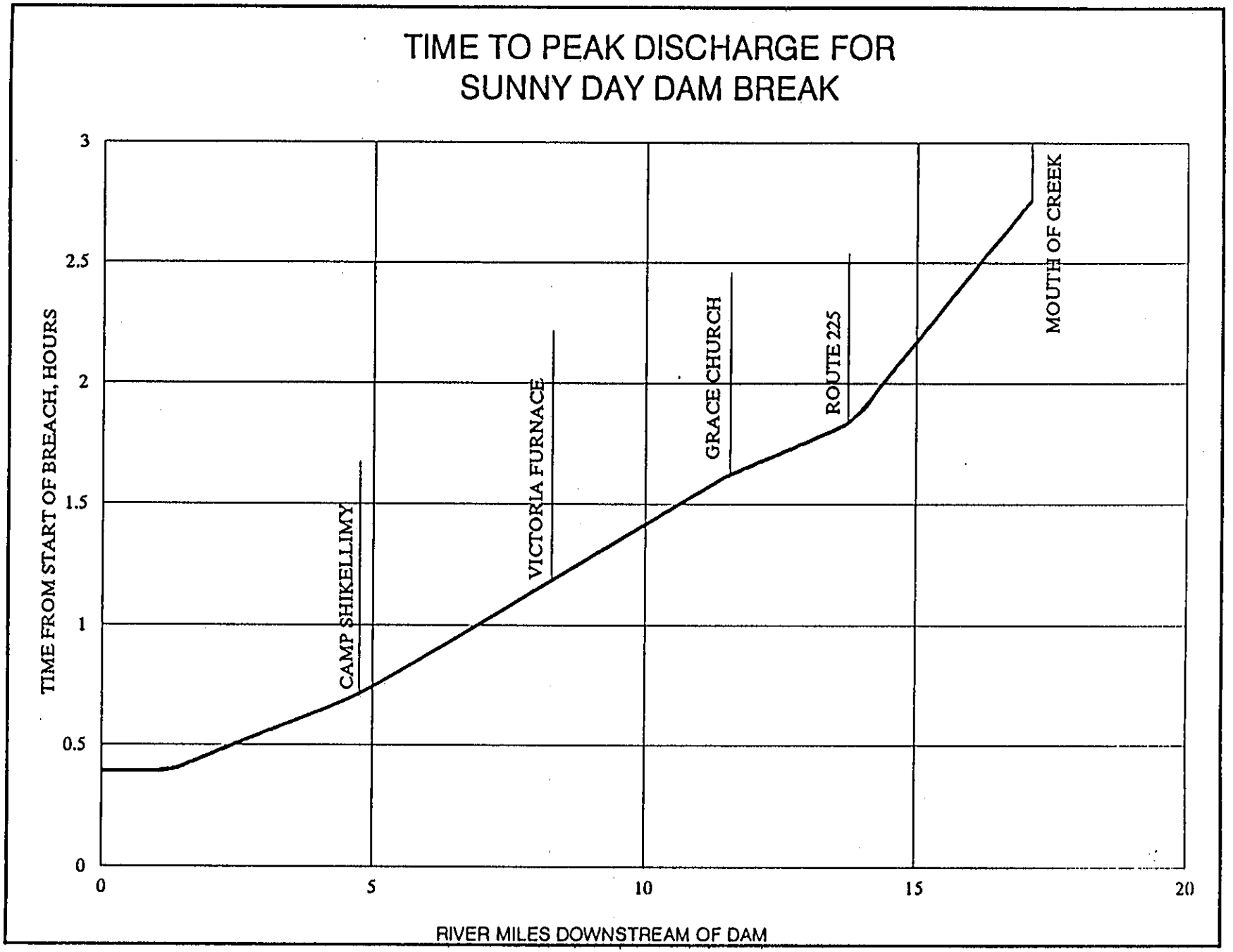

TIME TO PEAK DISCHARGE FOR
SUNNY DAY DAM BREAK
TIME FROM START OF BREACH, HOURS
0
0.5
1
1.5
2
2.5
3
0
5
10
15
20
RIVER MILES DOWNSTREAM OF DAM
CAMP SHIKELLIMY
VICTORIA FURNACE
GRACE CHURCH
ROUTE 225
MOUTH OF CREEK

FIGURE 2

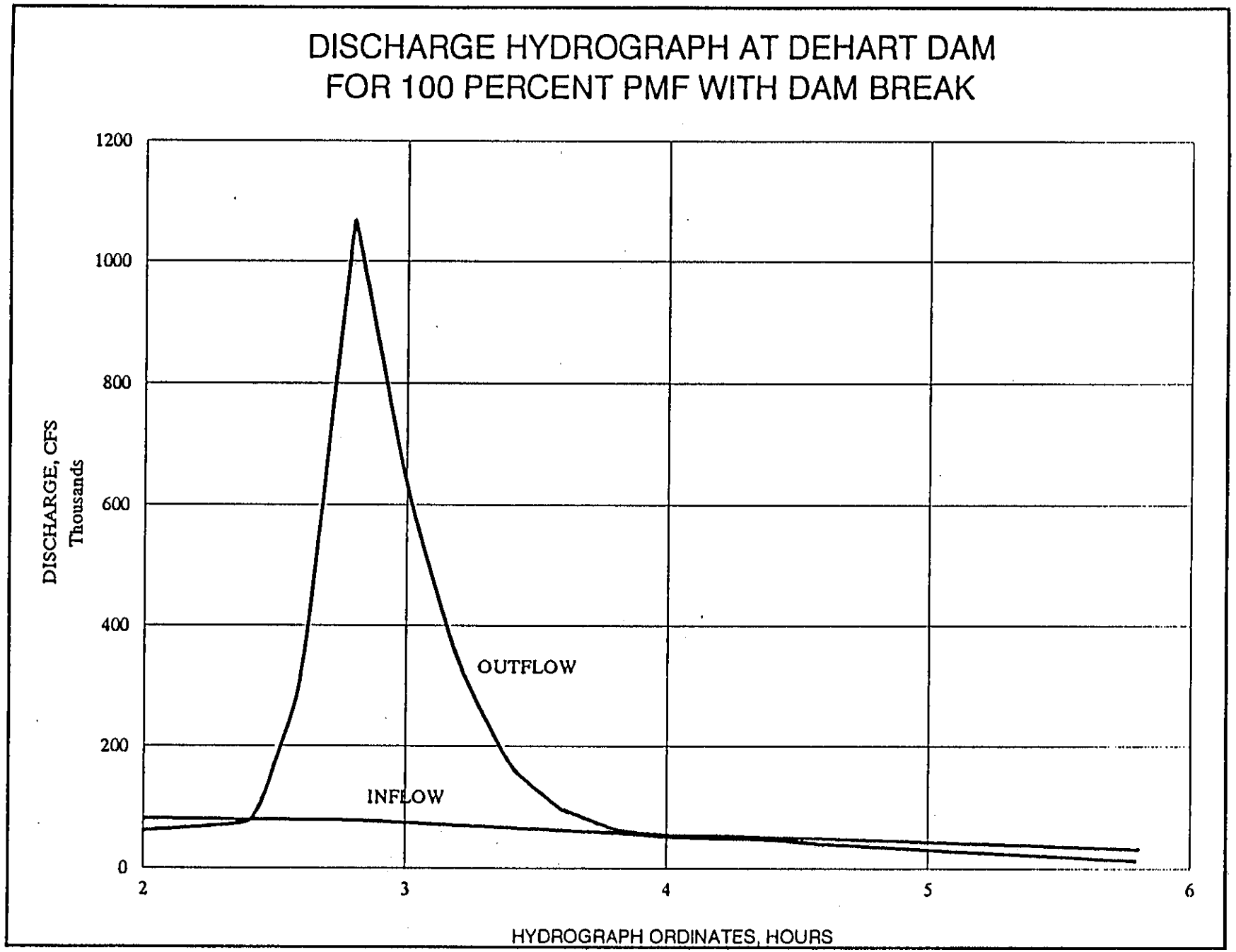

DISCHARGE HYDROGRAPH AT DEHART DAM
FOR 100 PERCENT PMF WITH DAM BREAK
DISCHARGE, CFS
Thousands
1200
1000
800
600
400
200
0
OUTFLOW
INFLOW
2
3
4
5
6
HYDROGRAPH ORDINATES, HOURS

FIGURE 3

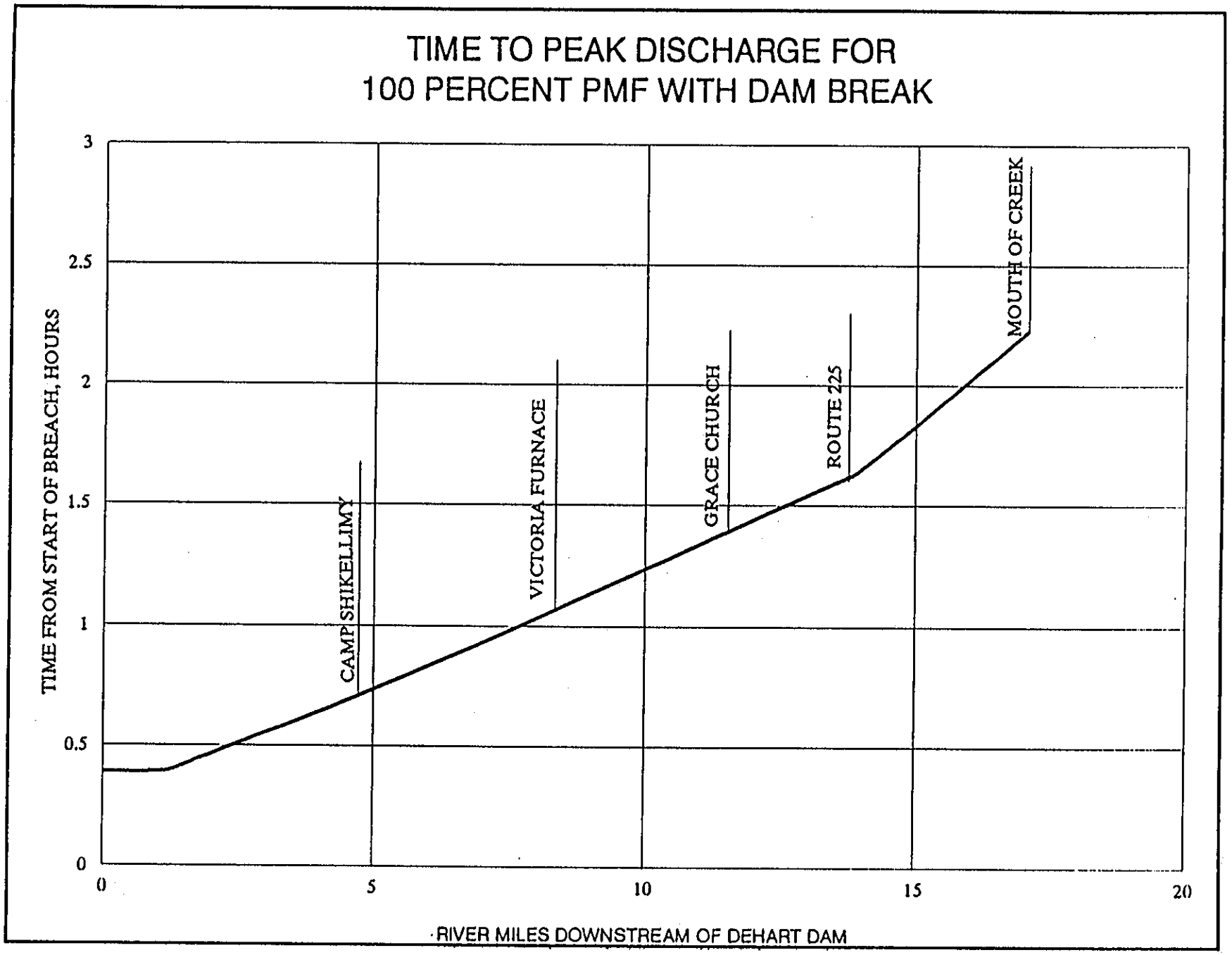
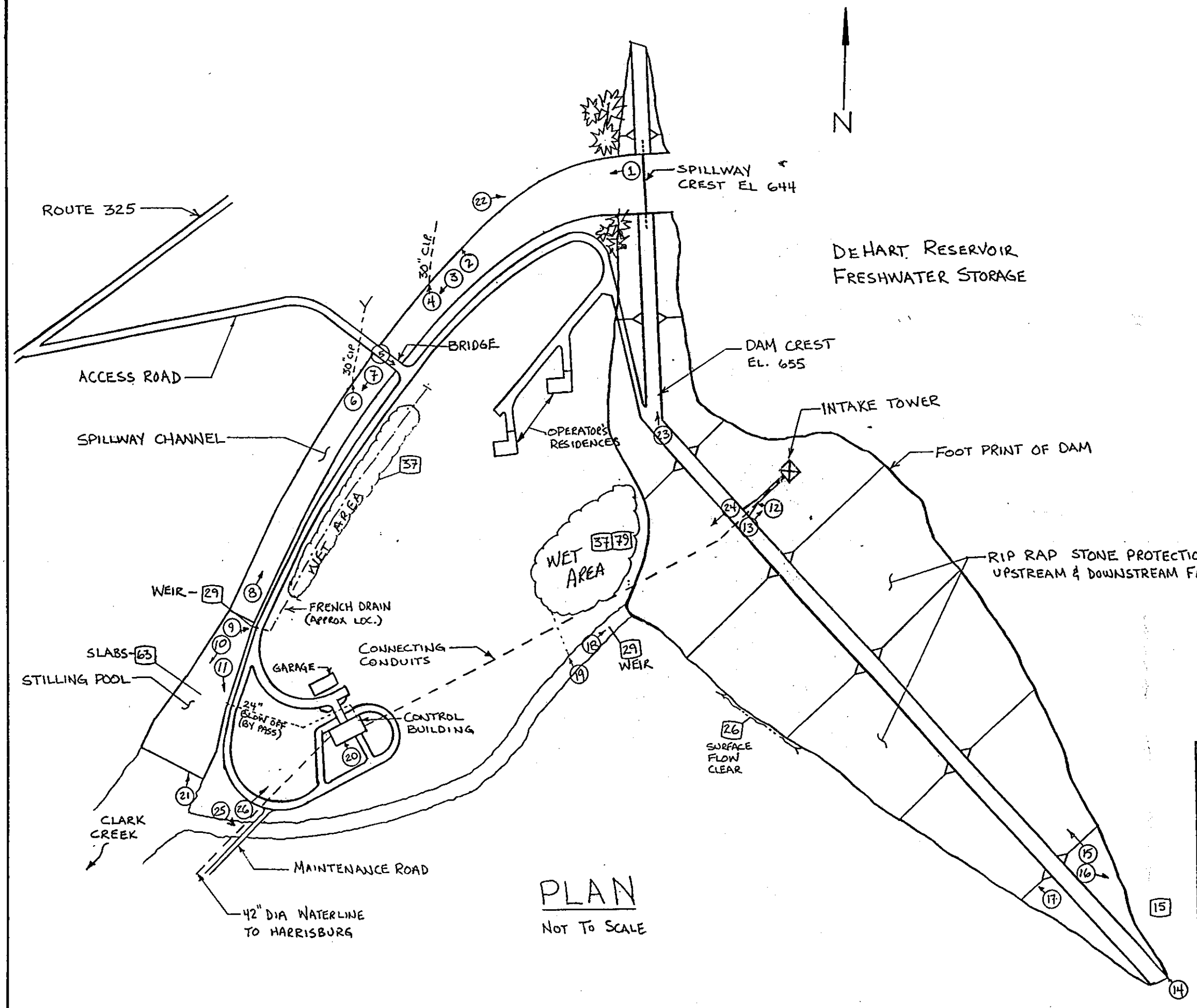

TIME TO PEAK DISCHARGE FOR
100 PERCENT PMF WITH DAM BREAK
TIME FROM START OF BREACH, HOURS
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
CAMP SHIKELLIMY
VICTORIA FURNACE
GRACE CHURCH
ROUTE 225
MOUTH OF CREEK
RIVER MILES DOWNSTREAM OF DEHART DAM

FIGURE 4



PLAN

NOT TO SCALE

NOTES

1. THIS SKETCH IS A COMPILATION OF DATA TAKEN FROM RECORD DRAWINGS, SITE INSPECTION OF 8 OCT 1991, AND INTERVIEWS WITH C.R.KERN DIRECTOR HARRISBURG BUREAU OF WATER, AND W. RABUCK SUPERINTENDENT DEHART DAM.
2. REFER TO INSPECTION CHECKLIST AND PHOTOGRAPHS FOR MORE SPECIFIC COMMENTS AND DETAILS.

LEGEND

TOP OF SLOPE

PHOTOGRAGH # & ORIENTATION ←(1)

INSPECTION CHECKLIST ITEM # [37]

THE HARRISBURG AUTHORITY

PROJECT NAME: DEHART DAM

DRAWING DESCRIPTION: ANNUAL INSPECTION BY OWNER
8 OCTOBER 1991 – DER I.D. NO. 21-9

DRAWN BY	APPROVED BY	CHECKED BY	DATE	SCALE
			OCTOBER 1991	

The Chester Engineers
P. O. Box 9356 Pittsburgh, PA 15225

BRINJAC, KAMBIC & ASSOCIATES, INC.
910 N. Second Street, Harrisburg, PA 17102

DRAWING NUMBER: FIGURE 1

EMERGENCY ACTION PLAN

SURVEILLANCE, WARNING AND EVACUATION PROCEDURES

DEHART DAM

DER NUMBER:22-9

LOCATED IN DAUPHIN COUNTY, RUSH TOWNSHIP
PENNSYLVANIA

OWNED BY: THE HARRISBURG AUTHORITY
27 NORTH FRONT ST
HARRISBURG PA. 17101-1678

OPERATED BY: THE CITY OF HARRISBURG
DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER

TELEPHONE: WORK: 717-238-8566
24 HOUR EMERGENCY: 717-255-3136

DATE: JULY 1992
DATE REVISED

STEPHEN R. REED
MAYOR

TABLE OF CONTENTS

We, the undersigned, on date indicated, understand our responsibilities in support of the Emergency Action Plan for Dehart Dam.

Mayor City of Harrisburg — Date: 10-30-92

The Harrisburg Authority — Date: 11/25/93

Primary Observer — Date: 2-3-93

City EMA Coord. — Date: 10/30/92

Dauphin County EMA Director — Date: 11/6/92

Middle Paxton Twp. EMA Director — Date: 1-20-92

Rush Twp. EMA Director — Date

Chief, Dauphin-Middle Paxton Twp. Amb. Co. — Date: 1-20-92

Chief, West End Fire Dept. — Date: 12-15-92

Chief, Dauphin-Middle Paxton Twp. Fire Dept. — Date: 1-20-93

Troop H PA State Police — Date

Hbg. Chapter American Red Cross — Date: 1/26/93

The Pennsylvania Emergency Management Agency, hereby finds the Emergency Action Plan contains all the key elements for an effective warning and evacuation plan.

Director, PEMA Area Office — Date

The Department of Environmental Resources, Bureau of Dams and Waterway, Division of Dam Safety, hereby approve the Emergency Action Plan for Dehart Dam.

Chief, Division of Dam Safety — Date

1. PURPOSE AND SCOPE

A. To safeguard the lives, and secondarily, to reduce property damage of the citizens living within the dam's potential downstream flood area - inundation area.

B. To provide for effective dam surveillance, citizen warning and evacuation response, when required.

C. To assign emergency actions to be taken by the dam operator/owner, public officials, emergency personnel, and outline resident's response in the event of a potential or imminent failure of the dam.

2. SITUATION

A. The dam is approximately 105 feet high, and is of rolled earthfill construction. It maintains a pool of approximately 23,000 acre-feet of water when full, and is 4.55 miles in length. See description at Attachment A.

B. The dam is located along the Clark Creek, 16 miles northeast of Harrisburg and 13 miles northeast of Dauphin. Refer to location map at Attachment C.

C. The inundation area resulting from a sudden dam failure is bordered on the north by State Rt. 325 and on the south by Third and Middle Mountains from the Dehart Dam to the Susquehanna River. See inundation map at Attachment B.

D. Within the inundation area are approximately 1000 residents, 112 homes, and 10 Highway bridges. Refer to the inundation map at Attachment B.

3. CONCEPT OF OPERATIONS

A. SURVEILLANCE - (DAM OWNER)

1. Normal Conditions:

a. The operator will conduct an on-site visual review of the dam, the dam's spillway, control systems, and the toe area below the dam at a minimum of once every three months. Any abnormal or questionable conditions will be immediately brought to the attention of the owner's engineer and the Bureau of Dams and Waterway Management of DER.

b. If any condition is found during a normal review which meets or exceeds those of paragraph 4.A., Responsibilities and Duties Dam Owner, the operator will immediately notify the central warning point.

2. Possible failure of this dam, considered a very unlikely event due to its structural integrity, would occur only during severe thunderstorms with very heavy rain and local flood warnings, or tropical storms and hurricanes with the same very heavy rain condition, or heavy rains when there is frozen ground and/or snow cover.

a. The dam operator will commence 24 hour continuous around-the-clock surveillance of conditions at the dam site when:

(1) Adverse weather conditions observed by the primary or alternate observer dictate,

(2) The National Weather Service provides public notification that flash floods could occur,

(3) Any conditions listed in paragraph 4.A.2. below is observed during a routine dam maintenance review or,

(4) Following the occurrence of an earthquake in the general region of the dam.

3. Termination of Surveillance

a. The dam operator will terminate 24 hour surveillance of dam site conditions when:

(1) The National Weather Service ends a flash flood warning.

(2) Heavy rains have ended and the water level in the lake has dropped to a pool elevation on the staff gauge to 6 ft.

(3) After personal review and clearance by a knowledgeable professional engineer or the dam site, following an earthquake, overtopping of the dam, or an evacuation of the inundation area as a result of this plan, or other serious problems resulting in a notification of a dam site emergency

B. NOTIFICATION

The dam owner or its designated representative will initiate the warning notification to the Dauphin County Communications Center, which shall be the central warning point, and to the Department of Environmental Resources Regional Office. The warning will be initiated from the central warning point to all emergency responders.

C. WARNING

1. When the situation meets the criteria under the surveillance guidelines indicating a failure of the dam is likely or a significant threatening condition is developing, the dam owner or its designated representative will initiate warning communications to the designated central warning point.
2. Warning notification will be initiated from the Dauphin County Comm. Center to all emergency responders and designated governmental officials and agencies.
3. Emergency management officials will execute the plans for warning the public in the affected area described in the EAP.

D. EVACUATION

Evacuation or pre-evacuation warning of the public may commence upon notification by the dam owner or its designated representative of a potential or imminent failure of the dam. Emergency responders will initiate action in accordance with this plans outline and any existing internal organizational Standard Operating Procedures (SOP).

4. RESPONSIBILITIES AND DUTIES - EMERGENCY RESPONSE

A. DAM OWNER (SURVEILLANCE - DAM SITE EMERGENCY)

1. The owner will provide for 24 hour dam surveillance and monitoring.

2. The owner or its designated representative is responsible for determining the dam's threat potential. The following conditions constitute a dam emergency and require notification to the designated central warning point:

A. The water level in the impoundment area has reached the threshold level of pool elevation on the staff gauge at 6 ft.

B. The depth of flow in the emergency spillway has reached the level of pool elevation on the staff gauge at 9 ft.

C. Imminent failure of this dam may be indicated by observance of one or more of the following conditions at the dam site.

1) The lake or pond level is at or near the top of the dam; and water is flowing, or about to flow, over the top of the dam.

2) The overflow pipe or spillway is clogged with debris or ice which is resulting in a rapid rise in the lake or pond level.

3) The emergency spillway is experiencing heavy flows which are causing severe erosion to the spillway or the dam embankment.

4) Any structural movement or failure of the concrete (masonry) spillway or the spillway abutment walls.

5) Any sloughing or sliding of the embankment upstream or downstream slope. Also, earth slides in the spillway channel, either upstream or downstream of the dam's crest, which could impede the flow in the spillway.

6) Subsidence, sinkholes or cracks found in any part of the dam's embankment or abutting slopes.

7) Any new discharge of water is observed through the dam's embankment or abutting slopes, adjacent to any conduit outlets , or under the dam which appears as a boil along the downstream toe. Should such a discharge occur and the water

is cloudy or muddy in color, then a very serious problem exists.

8) Other conditions which the owner's engineer knows are a concern for the Dehart Dam's safety.

3. The owner or its designated representative is responsible for initiating warning notification to the designated central warning point.

B. WARNING POINT

1. The designated central warning point will notify (Telephone numbers and points of contact are listed at Attachment D):

a. County/Municipal EMA, and adjacent County EMAs.

b. Fire Services/Rescue Services

c. Police Services.

d. Emergency Medical Services.

e. All schools, nursing homes, hospitals, day care centers, camp/recreation sites, large businesses within the inundation area.

f. PennDOT District.

g. Public Transportation Services.

C. COUNTY EMA

1. The County EMA will contact the following personnel and agencies (See Attachment D):

a. Municipal EMA.

b. County elected officials.

c. Activate/mobilize County EOC, as necessary.

d. Pennsylvania Emergency Management Agency Area Office.

e. Emergency Broadcast System (EBS).

f. American Red Cross Chapter (when mass care or family assistance is required).

g. Media (Advisory and/or Warning).

h. Adjacent county EMA's, if warranted.

2. The County EMA will ascertain and report to PEMA Area Office any unmet needs requirements.

3. The County EMA will cooperate with PEMA and initiate Damage Assessment and Recovery procedures as the situation requires.

D. DAUPHIN COUNTY, HARRISBURG, MIDDLE PAXTON AND RUSH TWP. EMAs

1. Notify municipal elected officials.

2. Advise municipal services (water, sewer, etc.).

3. Keep the County EMA apprised of the situation.

4. Coordinate the evacuation (where appropriate).

E. WEST END AND DAUPHIN-MIDDLE PAXTON TWP. FIRE DEPARTMENTS

1. Provide citizen notification and route alerting to advise residents living in the designated areas (see Inundation Map).

2. Assist in evacuation as requested.

3. Assist police and EMS, as requested.

4. Provide communications.

F. THE PENNSYLVANIA STATE POLICE TROOP H, HARRISBURG

1. Dispatch radio vehicle to dam site in order to provide alternate communications system with the HARRISBURG Police Bureau.

2. Augment communications.

3. Assist evacuation traffic flow and establish traffic control points (TCP) at predesignated locations (See Inundation Map).

4. Prevent unauthorized entry into emergency areas and establish access control points (ACP) at predesignated locations (See Inundation Map).

5. Provide helicopter to assist in route alerting.

G. EMERGENCY MEDICAL SERVICES (EMS) - DAUPHIN-MIDDLE PAXTON TWP. AMB.

1. Assist fire and police departments as required.

2. Provide evacuation transportation assistance and coordinate with designated fire services agencies for transportation of the mobility impaired and any other person(s) with special needs.

3. Provide EMS support to any mass care center established.

H. AMERICAN RED CROSS - CAPITOL REGION CHAPTER

1. Alert person(s) responsible to set-up and operate mass care centers at Halifax Elementary School and/or the Dauphin - Middle Paxton Twp. Elementary school.

2. Support operations of the reception center and activate mass care center staff.

3. Maintain operations of reception center/mass care center as requested by EMA officials until final disposition of evacuees is completed.

I. Pennsylvania Department of Transportation (PennDOT)

1. Provide services, signs and guidance on roads and bridges affecting the evacuation and recovery.

2. Assist police, fire, and EMA with personnel resources and equipment, as necessary, for the evacuation.

5. ADMINISTRATION AND LOGISTICS

A. Notices will be posted at the following public places:

1. Dauphin Borough Building.

2. Middle Paxton and Rush Township Buildings.

3. Harrisburg Police Bureau.

4. Troop H, Pennsylvania State Police, Harrisburg Barracks.

5. West End and Dauphin Middle Paxton Twp. Fire Departments.

6. Dauphin County Tax Office.

B. The Notice must state that copies of the Emergency Action Plan for this dam are available for inspection at the following locations:

1. Dauphin County Emergency Management Agency Office.

2. Harrisburg, Rush, Middle Paxton Twp. Emergency Management Offices.

3. Dehart Dam - Dam Operator.

C. New Notices will be sent to those agencies in paragraph "A" above whenever plan is revised.

6. AUTHORITY AND REFERENCES

A. AUTHORITY

1. The Dam Safety and Encroachments Act (32 P.S. sections 693.1-693.27), May 16, 1985.

2. The Pennsylvania Code - Title 25, Chapter 105 D am Safety and Waterway Management, Section 105.63 and 105.134.

3. Emergency Management Services Code, 35 Pa C.S. Section 7101 et seq; as amended.

B. REFERENCES

1. Emergency Action Planning Guidelines for Dams. Subcommittee on Emergency Action Planning, Inter-agency Committee on Dam Safety, February 1985.

2. Manual for the Inspection, Maintenance and Operation of Dams in Pennsylvania, Prepared by the Department of Environmental Resources, Office of Resources Management, Bureau of Dams and Waterway Management, Division of Dam Safety, 1986.

3. County Emergency Operations Plan.

7. DEFINITIONS

A. DAM - A barrier constructed across a watercourse for the purpose of storage, control or diversion of water.

B. EMERGENCY - A condition which develops unexpectedly , endangers the structural integrity of a dam and/or downstream property and human life, and requires immediate action.

C. EMERGENCY ACTION PLAN (EAP) - A formal plan of procedures designed to minimize consequences to life and property in the event of an emergency at a dam.

D. FAILURE - The catastrophic breakdown of a dam, characterized by the sudden, rapid, and uncontrolled release of impoundment water.

E. INUNDATION AREA - The downstream area that would be inundated or otherwise affected by the failure of a dam or large flows.

F. INUNDATION MAP - A map showing areas that would be affected by flood conditions and/or by an uncontrolled release of reservoir water due to the failure of a dam.

G. SPILLWAY - A structure over or through which flood flows are discharged. If the flow is controlled by mechanical means, such as gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

8. EXERCISE AND TRAINING

The dam operator will advise the County EMA of any/all exercises scheduled and coordinate with the County EMA to exercise all or portions of this plan as part of the county's all- hazard exercise program schedule.

9. PLAN MAINTENANCE

A. This plan will be reviewed every two years as part of DER's annual dam inspection program.

B. During the two year review:

1. The owner's engineer will field review the flood (inundation) area for any increase in downstream population and revise the flood (inundation) area, if needed.

2. The owner's engineer will review and revise surveillance conditions as needed.

3. The owner/operator will coordinate with County EMA if population increase within the inundation area could affect the emergency response capabilities. If so, a new or revised plan should be developed.

4. The owner/operator will obtain concurrence from emergency response agency officials attesting to their continued understanding of their role (s)

5. The owner/operator will submit revised plan to DER for approval.

ATTACHMENTS:

ATTACHMENT A - SITUATION AND INUNDATION SCENARIO
ATTACHMENT B - DOWN STREAM FLOOD AREA (INUNDATION) MAP
ATTACHMENT C - LOCATION MAP
ATTACHMENT D - TELEPHONE ROSTER
ATTACHMENT E - MEDIA ANNOUNCEMENT

ATTACHMENT A

Dehart Dam is a rolled earthfill structure constructed on Clark Creek in 1940 for the purpose of creating a water supply reservoir for the City of Harrisburg. The facility is located about 16 miles northeast of Harrisburg, Pennsylvania. The creek has a drainage area of 21.3 square miles at the dam site. The dam is about 2,000 feet long, 105 feet high, and 600 feet thick at the base with at 30 foot wide roadway on the top. When the reservoir is full at elevation 644, the reservoir is 4.55 miles long and contains about 23,000 acre feet of water, or approximately 6 billion gallons of water

The reach from DeHart Dam to the mouth of Clark Creek is 17.06 miles and has 10 bridges. Because of the magnitude of flow resulting from a dam breach nine of the ten bridges can be expected to fail. The remaining structure on U.S. Route 22 is near the mouth of the creek and the roadway elevation is approximately 40 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create the worst possible conditions during a dam break it is expected that the pool created by the bridge structure will overflow the roadway.

The inundation study prepared for DeHart Dam concludes

1. The flood which results from a "sunny day" breach would flood 112 dwellings of which 14, at Camp Shikellimy, are within 40 minutes of a 31 foot wave.
2. The flood wave from a "sunny day" breach would reach the mouth of Clark Creek in two hours and 47 minutes. The flood wave would be 38 feet high at the mouth of the creek.
3. The flood which would result from a dam breach resulting in the Probable Maximum Flood (PMF) would affect an additional 57 dwellings, sixteen of which are located at Camp Shikellimy and within 40 minutes of the flood wave.
4. The flood wave during a PMF breach would reach the mouth of Clark Creek in two hours and 14 minutes. The flood wave would be 14 feet at the mouth of the creek.
5. All ten bridges between DeHart Dam and the mouth of Clark Creek would be overtopped by a breach and it is possible that all ten would fail as a result of the flood wave.

ATTACHMENT B

LOCATION MAPS ARE BASICALLY STRIP MAPS WHICH IDENTIFY SOME MAJOR FEATURES (TOWNS, HIGHWAY ROUTES, RIVERS, ETC) THAT CAN BE USED BY SOMEONE WHO IS NOT FAMILIAR WITH THE AREA TO LOCATE THE DAM.

ATTACHMENT C

TELEPHONE INFORMATION LIST

DAM OPERATOR City of Harrisburg Bureau of water		TELEPHONE: 717-238-8566 24 HR: 717-255-3136
DAM OWNER The Harrisburg Authority		TELEPHONE: 717-232-3777 24 HR: 717-255-3136
DAUPHIN COUNTY EMA	WORK: 717-236-7976	24 HR: 911
HARRISBURG EMA		24 HR: 717-255-3136
DAUPHIN, AND WEST END FIRE DEPTS		24 HR: 911
PA. STATE POLICE		24 HR: 717-787-7777
DAUPHIN EMS		24 HR: 911
RED CROSS		24 HR: 717-234-3101
DER REGION		24 HR: 717-787-4343
PA EMERG MGT AGENCY AREA OFFICE		24 HR: 717-783-8150
PA DEPT OF TRANS		24 HR: 717-783-8150

ATTACHMENT D

MEDIA ANNOUNCEMENT (SAMPLE 1)

The following announcement has been released by the Dauphin County Emergency Management Agency.

The flooding condition continues in the Clark Creek valley and may worsen. For your safety the Dauphin County Emergency Management Agency recommends that you leave the area below the Dehart Dam in the Clark Creek valley as soon as possible and proceed to higher ground.

Be sure to take essential items - medicine, special foods, personal items, baby supplies, clothes, money and valuable papers - but do not overload your vehicle. Secure your home before you leave. Be sure to check on neighbors who may need assistance. Above all, do not delay.

Proceed by the shortest route to one of the Red Cross shelters at either the Halifax or Dauphin-Middle Paxton Twp. elementary schools.

If you have no means of transportation or if you are physically unable to evacuate on your own, ask a neighbor to assist you or dial 911. Otherwise, please do not use your telephone except to report an emergency.

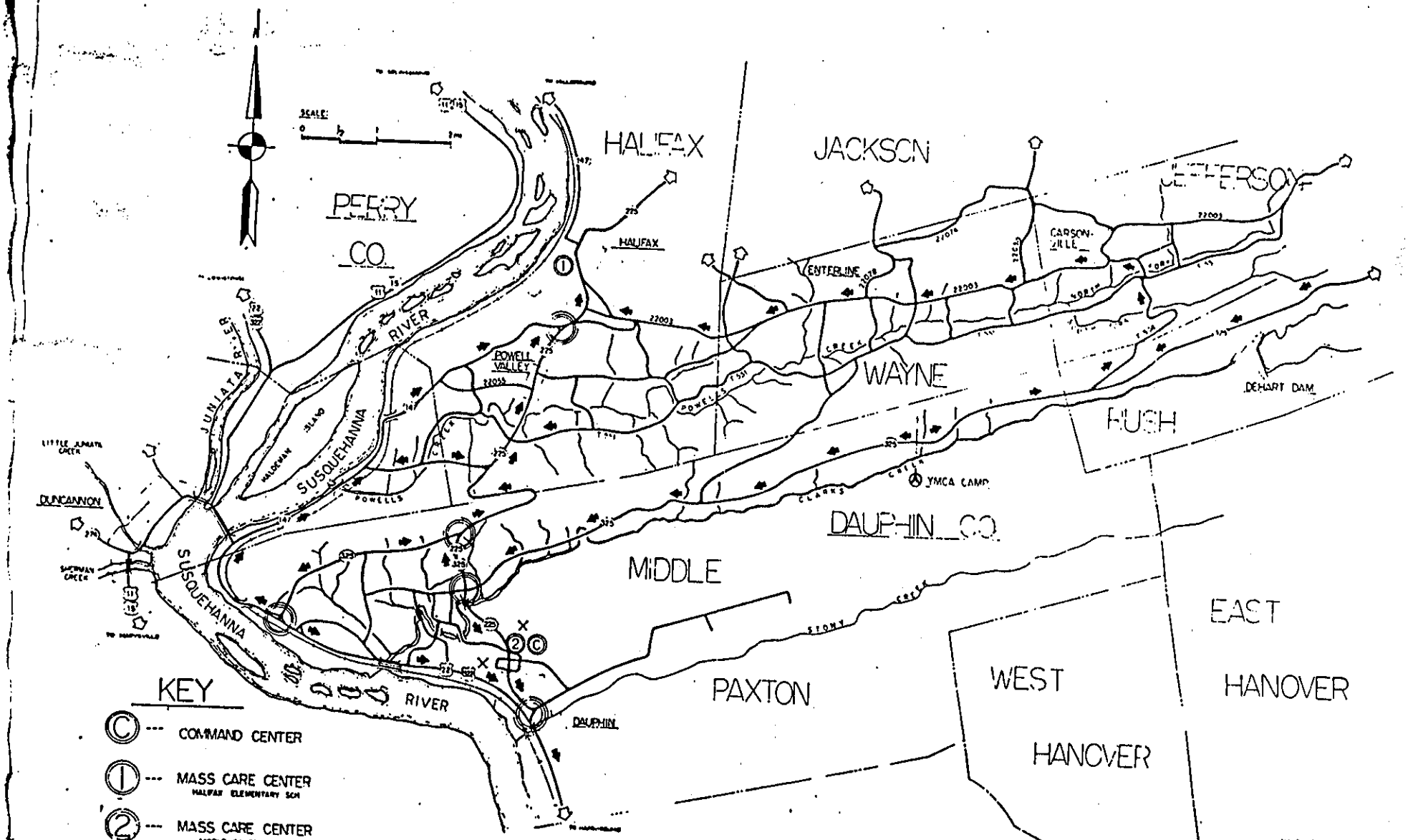
I repeat. If you live in the Clark Creek Valley below the Dehart Dam you are requested to evacuate for your own safety. Stay tuned to this station for more information and instructions.

MEDIA ANNOUNCEMENT (SAMPLE 2)

Conditions exist at the Dehart Dam in Clarks Valley, Middle Paxton Twp. that could pose a threat to public safety.

Persons located below the Dehart Dam along Clarks Creek and State RT 325 in Middle Paxton Twp. should leave the area without delay. Persons in this area should proceed by the most direct route to either the Middle Paxton or Halifax Elementary Schools. If roadways are flooded, persons should seek the nearest high ground away from Clarks Creek.

If you do not have transportation, telephone 911 for assistance.



EMERGENCY OPERATION PLAN
DEHART DAM

Stephen R. Reed, Mayor

BRINIAC, KAMBIC AND ASSOC
PROFESSIONAL ENGINEERS

EMERGENCY OPERATION PLAN
CITY OF HARRISBURG
DEHART DAM
TRAFFIC CONTROL POINTS &
EMERGENCY ROUTES.

V

1

LETTER OF TRANSMITTAL

THE HARRISBURG AUTHORITY

One Keystone Plaza, Suite 104
Front and Market Streets
Harrisburg, Pennsylvania 17101
(717) 232-3777
(717) 232-8590 FAX

DATE:	March 30, 2005
ATTENTION:	Chief Donald Konkle
REASON:	Emergency Action Plan-Dehart Dam

TO: Department of Public Safety Fire Bur
City Government Center
Ten North Second Street
Harrisburg, PA 17101

GENTLEMEN:

We are sending [X] herewith [ ] under separate cover the following items:

Copies	Date	Description
1	12/17/97	Surveillance, Warning and Evacuation Procedures
		DEP Number D22-09

These are transmitted as checked below:

[ ] Approved	[ ] As Requested	[ ] For Your Information
[ ] Approved as Noted	[X] For Your Use	[ ] For Review & Comment
[ ] Revise & Resubmit	[ ] For Approval	[ ] For Repairs
[ ] Not Approved	[ ] For Your Files	[ ] _____

REMARKS: See "blue" tab for the Break Analysis.

COPIES:

SIGNED: Thomas J Mealy

Thomas J. Mealy

EMERGENCY ACTION PLAN

SURVEILLANCE, WARNING AND EVACUATION PROCEDURES

DEHART DAM

DEP NUMBER: D22-09

LOCATED IN DAUPHIN COUNTY, RUSH TOWNSHIP
PENNSYLVANIA

OWNER:
THE HARRISBURG AUTHORITY
ONE KEYSTONE PLAZA, SUITE 104
FRONT AND MARKET STREETS
HARRISBURG, PA 17101
TELEPHONE WORK: (717) 232-3777

OPERATOR:
THE CITY OF HARRISBURG
DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER
TELEPHONE WORK: (717) 238-8725
24 HOUR EMERGENCY: (717) 255-3136

DATE: OCTOBER 1995
DATE REVISED: December 17, 1997

TABLE OF CONTENTS

PROMULGATION AND CONCURRENCE

We, the undersigned, on the date indicated, understand our responsibilities in support of the Emergency Action Plan for DeHart Dam.

Mayor, City of Harrisburg - Operator — Date 6-10-97

Chairman, The Harrisburg Authority - Owner — Date 6-12-97

Primary Observer — Date 6-12-97

City EMA Coord. — Date 6/11/97

Dauphin County EMA Director — Date 6-11-97

Middle Paxton Twp. EMA Director — Date 6-11-97

Rush Twp. EMA Director — Date 6-11-97

Chief, Dauphin-Middle Paxton Twp. Amb. Co. — Date 6-11-97

Chief, West End Fire Dept. — Date 6-12 97

Chief, Dauphin-Middle Paxton Twp. Fire Dept. — Date 06-11-97

Troop H, PA State Police — Date 06-11-97

Hbg. Chapter, American Red Cross — Date 10 June 97

PennDOT — Date 12/22/97

PROMULGATION AND CONCURRENCE (Cont.)

The Pennsylvania Emergency Management Agency, hereby finds the Emergency Action Plan contains all the key elements for an effective warning and evacuation plan.

Director, PEMA Central Area Office

Date 1/20/98

The Department of Environmental Protection, Bureau of Waterways Engineering Division of Dam Safety, hereby approves the Emergency Action Plan for Dehart Dam.

Chief, Division of Dam Safety

Date 1/21/98

EMERGENCY ACTION PLAN
SURVEILLANCE, WARNING AND EVACUATION PROCEDURES
DEHART DAM

1. PURPOSE AND SCOPE

A. To safeguard the lives, and secondarily, to reduce property damage of the citizens living within the dam's potential downstream flood area - inundation area.

B. To provide for effective dam surveillance, citizen warning and evacuation response, when required.

C. To assign emergency actions to be taken by the dam operator/owner, public officials, emergency personnel, and outline resident's response in the event of a potential or imminent failure of the dam.

2. SITUATION

A. DeHart Dam is a rolled earthfill structure constructed on Clarks Creek in 1940 for the purpose of creating a water supply reservoir for the City of Harrisburg. Clarks Creek has a drainage area of 21.3 square miles at the dam site. The dam is approximately 2,000 feet long, 105 feet high, and 600 feet thick at the base with a 30 foot wide roadway on the top. The dam, at normal pool level, maintains approximately 23,000 acre-feet with a maximum pool of 30,800 acre feet. The length of the reservoir is 4.55 miles.

B. The dam is located along the Clarks Creek, 16 miles northeast of Harrisburg and 13 miles northeast of Dauphin. Refer to Location Map at Attachment A.

C. The inundation area resulting from a sudden dam failure is bordered on the north by State Rt. 325 and on the south by Third and Middle Mountains from the DeHart Dam to the Susquehanna River. See Inundation Map at Attachment B.

D. Within the inundation area are approximately 1000 residents, 112 homes, and 10 Highway bridges. Refer to the Inundation Map at Attachment B.

E. The reach from DeHart Dam to the mouth of Clarks Creek is 17.06 miles and has 10 bridges. Because of the magnitude of flow resulting from a dam breach, nine of the ten bridges can be expected to fail. The remaining structure on U.S. Route 22 is near the mouth of the creek and the roadway elevation is approximately 40 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create

the worst possible conditions during a dam break it is expected that the pool created by the bridge structure will overflow the roadway.

1. The inundation study prepared for DeHart Dam concludes:

   a. The flood which results from a "sunny day" breach would flood 112 dwellings of which 14, at Camp Shikellimy, are within 40 minutes of a 31 foot wave.

   b. The flood wave from a "sunny day" breach would reach the mouth of Clarks Creek in two hours and 47 minutes. The flood wave would be 38 feet high at the mouth of the creek.

   c. The flood which would result from a dam breach resulting in the Probable Maximum Flood (PMF) would affect an additional 57 dwellings, sixteen of which are located at Camp Shikellimy and are within 40 minutes of the flood wave.

   d. The flood wave during a PMF breach would reach the mouth of Clarks Creek in two hours and 14 minutes. The flood wave would be 14 feet at the mouth of the creek.

   e. All ten bridges between DeHart Dam and the mouth of Clarks Creek would be overtopped by a breach and it is possible that all ten would fail as a result of the flood wave.

   f. Regarding the depth of water at the Route 22-322 over Clarks Creek, the invert and crown of the water opening at the bridge are elevations 317.3 and 344.8 respectively. The low point on the centerline of the top of the road is elevation 357.0. After a dam failure, it is expected that the bridge will create a pool upstream and that a major portion of the flow will be carried over the existing bridge. Under a "Sunny Day'" breach scenario, the peak water surface will be elevation 375.5 at the upstream side of the bridge. This is approximately 18.5 feet above the lowest point of the road. Under the full PMF with breach, the peak water surface will be elevation 391.8 at the upstream side of the bridge. This is approximately 35 feet above the lowest point of the road.

3. CONCEPT OF OPERATIONS

A. SURVEILLANCE - (DAM OPERATOR)

1. Normal Conditions:

   a. The operator will conduct an on-site visual review of the dam, the dam's spillway, control systems, and the toe area below the dam at a minimum of once every three months. Any abnormal or questionable conditions will be immediately brought to the attention of the owner's engineer and the Division of Dam Safety of DEP.

   b. If any condition is found during a normal inspection which meets or exceeds those of paragraph 4.A., Responsibilities and Duties - Dam Operator, the operator will immediately notify the designated central warning point Dauphin County Communications Center - 911.

2. Possible failure of this dam, considered a very unlikely event due to its structural integrity, would occur only during severe thunderstorms with very heavy rain and local flood warnings, or tropical storms and hurricanes with the same very heavy rain condition, or heavy rains when there is frozen ground and/or snow cover.

   a. The dam operator will commence 24 hour continuous around-the-clock surveillance of conditions at the dam site when:

      (1) Adverse weather conditions observed by the primary or alternate observer dictate;

      (2) The National Weather Service provides public notification that flash floods could occur;

      (3) There has been 5.5 inches or more of rain in 6 hours and the pool elevation is at elevation 650, 6 feet above the spillway crest.

      (4) Any conditions listed in paragraph 4.A.2 below is observed during a routine dam maintenance review; or

      (5) Following the occurrence of an earthquake in the general region of the dam.

3. Termination of Surveillance:

a. The dam operator will terminate 24 hour surveillance of conditions at the dam site when:

(1) The National Weather Service ends a flash flood warning.

(2) Heavy rains have ended and the water level in the reservoir has dropped to a pool elevation of 649, 5 feet above the crest of the spillway.

(3) After personal review and clearance by a knowledgeable professional engineer of the dam site, following an earthquake, overtopping of the dam, or an evacuation of the inundation area as a result of this plan, or other serious problems resulting in a notification of a dam site emergency.

B. NOTIFICATION

The dam operator or its designated representative will initiate the warning notification to the Dauphin County Communications Center - 911, which shall be the central warning point, and to the Department of Environmental Protection Regional Office. The warning will be initiated from the Dauphin County Communications Center - 911 to all emergency responders.

C. WARNING

1. When the situation meets the criteria under the surveillance guidelines indicating a failure of the dam is likely or a significant threatening condition is developing, the dam owner or its designated representative will initiate warning communications to the Dauphin County Communications Center - 911 as the designated central warning point.

2. Warning notification will be initiated from the Dauphin County Communications Center - 911 to all emergency responders and designated governmental officials and agencies.

3. Emergency management officials will execute the plans for warning the public in the affected area described in the EAP.

D. EVACUATION

Evacuation or pre-evacuation warning of the public may commence upon notification by the dam owner or its designated representative of a potential or imminent failure of the dam. Emergency responders will initiate action in accordance with this plan's outline and any existing internal organizational Standard Operating Procedures (SOP).

4. RESPONSIBILITIES AND DUTIES - EMERGENCY RESPONSE

A. DAM OPERATOR (SURVEILLANCE - DAM SITE EMERGENCY)

1. The operator will provide for 24 hour dam surveillance and monitoring.

2. The operator or its designated representative is responsible for determining the dam's threat potential. The following conditions constitute a dam emergency and require notification to the designated central warning point: Dauphin County Communications Center - 911.

   a. The pool elevation has reached elevation 653, 9 feet above the spillway crest.

   b. Imminent failure of this dam may be indicated by observance of one or more of the following conditions at the dam site.

      (1) The lake or pond level is at or near the top of the dam; and water is flowing, or about to flow, over the top of the dam.

      (2) The spillway is clogged with debris or ice which is resulting in a rapid rise in the lake or pond level.

      (3) The emergency spillway is experiencing heavy flows which are causing severe erosion to the spillway or the dam embankment.

      (4) Any structural movement or failure of the concrete (masonry) spillway or the spillway abutment walls.

      (5) Any sloughing or sliding of the embankment upstream or downstream slope. Also, earth slides in the spillway channel, either upstream or downstream of the dam's crest, which could impede the flow in the spillway.

(6) Subsidence, sinkholes or cracks found in any part of the dam's embankment or abutting slopes.

(7) Any new discharge of water is observed through the dam's embankment or abutting slopes, adjacent to any conduit outlets, or under the dam which appears as a boil along the downstream toe. Should such a discharge occur and the water is cloudy or muddy in color, then a very serious problem exists.

(8) Other conditions which the owner's engineer knows are a concern for the DeHart Dam's safety.

3. The operator or its designated representative is responsible for initiating warning notification to the Dauphin County Communications Center - 911 as the designated central warning point and the DEP Southcentral Regional Office.

B. WARNING POINT - DAUPHIN COUNTY COMMUNICATIONS CENTER 911

1. The designated central warning point will notify (See Telephone Information List at Attachment C):

a. Dauphin County EMA.
   (1) Emergency: 911
   (2) Non-emergency: 558-6800

b. Fire Services/Rescue Services.
   (1) Dauphin/Middle Paxton Fire Department: 911
   (2) West End Fire Department: 911

c. Police Services.
   (1) Pennsylvania State Police: 787-7777
   (2) Dauphin Police: 911

d. Emergency Medical Services.
   (1) Dauphin Middle Paxton EMS: 911

e. All schools, nursing homes, hospitals, day care centers, camp/recreation sites, large businesses within the inundation area.
   (1) None

f. PennDOT District.

(1) 783-8150

g. Public Transportation Services.

(1) Conrail: 783-8150

C. **DAUPHIN COUNTY EMA**

1. The County EMA will contact the following personnel and agencies (See Telephone Information List at Attachment C):

a. Rush Township Municipal EMA.

b. Middle Paxton Township EMA

c. County elected officials.

d. Activate/mobilize County EOC, as necessary.

e. Pennsylvania Emergency Management Agency Area Office.

f. Emergency Alerting System (EAS).

g. American Red Cross Chapter (when mass care or family assistance is required).

h. Media (Advisory and/or Warning).

i. Adjacent county EMA's, if warranted.

2. The County EMA will ascertain and report to PEMA Area Office any unmet needs or requirements.

3. The County EMA will cooperate with PEMA and initiate Damage Assessment and Recovery procedures as the situation requires.

D. **HARRISBURG, MIDDLE PAXTON AND RUSH TOWNSHIPS EMAs**

1. Notify municipal elected officials.

2. Advise municipal services (water, sewer, etc.).

3. Keep the County EMA apprised of the situation.

4. Coordinate the evacuation (where appropriate).

E. WEST END AND DAUPHIN-MIDDLE PAXTON TOWNSHIP FIRE DEPARTMENTS

1. Provide citizen notification and route alerting to advise residents living in the designated areas (See Inundation Map at Attachment B).

2. Assist in evacuation as requested.

3. Assist police and EMS, as requested.

4. Provide communications.

F. THE PENNSYLVANIA STATE POLICE TROOP H, HARRISBURG CITY POLICE

1. Dispatch radio vehicle to dam site in order to provide alternate communications system with the HARRISBURG Police Bureau.

2. Augment communications.

3. Assist evacuation traffic flow and establish traffic control points (TCP) at predesignated locations (See Inundation Map at Attachment B).

4. Prevent unauthorized entry into emergency areas and establish access control points (ACP) at predesignated locations (See Inundation Map at Attachment B).

5. Provide helicopter to assist in route alerting.

G. EMERGENCY MEDICAL SERVICES (EMS) - DAUPHIN-MIDDLE PAXTON TOWNSHIP AMBULANCE COMPANY

1. Assist fire and police departments as required.

2. Provide evacuation transportation assistance and coordinate with designated fire service agencies for transportation of the mobility impaired and any other person(s) with special needs.

3. Provide EMS support to any established mass care center.

H. **AMERICAN RED CROSS - CAPITOL REGION CHAPTER**

1. Alert person(s) responsible to set-up and operate mass care centers at Halifax Elementary School and/or the Dauphin - Middle Paxton Township Elementary School.

2. Support operations of the reception center and activate mass care center staff.

3. Maintain operations of reception center/mass care center as requested by EMA officials until final disposition of evacuees is completed.

I. **PENNSYLVANIA DEPARTMENT OF TRANSPORTATION (PENNDOT)**

1. Provide services, signs and guidance on roads and bridges affecting the evacuation and recovery.

2. Assist police, fire, and EMA with personnel resources and equipment, as necessary, for the evacuation.

5. **ADMINISTRATION AND LOGISTICS**

A. Notices will be posted at the following public places (See Notice at Attachment E):

1. Dauphin Borough Building. 200 Delaware St., Dauphin.

2. Rush Township Building. Schoolhouse Road, Tower City

3. Middle Paxton Township. 1340 Overlook Street, Dauphin

4. Harrisburg Police Bureau. 123 Walnut St., Harrisburg.

5. Troop H, Pennsylvania State Police, Harrisburg Barracks. Elmerton Avenue and Kohn Road, Harrisburg.

6. West End and Dauphin Middle Paxton Township Fire Departments. 200 Delaware Street, Dauphin.

7. Dauphin County Tax Office. 112 Market Street, Harrisburg, PA17101

B. The Notice must state that copies of the Emergency Action Plan for this dam are available for inspection at the following locations:

1. Dauphin County Emergency Management Agency Office. 911 Gibson

Boulevard, Steelton, PA 17113.

2. City of Harrisburg - 123 Walnut Street, Harrisburg, PA 17101.

3. The Harrisburg Authority - Dam Operator. 100 Pine Drive, Harrisburg, PA 17103.

4. DeHart Dam - Dam Owner, One Keystone Plaza, Suite 104, Front and Market Streets, Harrisburg, PA 17101.

5. Rush Township - Schoolhouse Road, Tower City, PA 17980.

6. Middle Paxton Township - 1340 Overlook Street, Dauphin, PA 17018.

C. New Notices will be sent to those agencies in paragraph "A" above whenever the plan is revised.

6. AUTHORITY AND REFERENCES

A. AUTHORITY

1. The Dam Safety and Encroachments Act (32 P.S. Sections 693.1-693.27), May 16, 1985.

2. The Pennsylvania Code - Title 25, Chapter 105 Dam Safety and Waterways Management, Section 105.63 and 105.134.

3. Emergency Management Services Code, 35 Pa C.S. Section 7101 et seq; as amended.

B. REFERENCES

1. Emergency Action Planning Guidelines for Dams. Subcommittee on Emergency Action Planning, Inter-Agency Committee on Dam Safety, February 1985.

2. Manual for the Inspection, Maintenance and Operation of Dams in Pennsylvania, prepared by the Department of Environmental Protection, Office of Resources Management, Bureau of Dams and Waterways Management, Division of Dam Safety, 1986.

3. County Emergency Operations Plan.

7. DEFINITIONS

A. **ABUTMENT** - A point or surface provided to withstand thrust (end supports of an arch, bridge, etc.)

B. **BOIL** -An unwanted flow of water and solid matter into an excavation due to excessive outside water pressure.

C. **CONDUIT** - An enclosed channel used to convey flows through or under a dam.

D. **CREST OF DAM** - Top of a slope, top of a dam (highest point).

E. **CULVERT** - A structure with appurtenant works which carries a stream under or through an embankment or fill.

F. **DAM** - A barrier constructed across a watercourse for the purpose of storage, control or diversion of water.

G. **DAM FAILURE** - Failure or non-performance of something due, required, or expected.

H. **EARTH DAM (EARTH FILL DAM)** - A dam made by compacting excavated earth obtained from a burrow area.

I. **EMBANKMENT (WALL)** - A retaining wall from the top of which the supported earth normally rises at a slope.

J. **EMERGENCY** - A condition which develops unexpectedly, endangers the structural integrity of a dam and/or downstream property and human life, and requires immediate action.

K. **EMERGENCY ACTION PLAN (EAP)** - A formal plan of procedures designed to minimize consequences to life and property in the event of an emergency at a dam.

L. **FAILURE** - The catastrophic breakdown of a dam, characterized by the sudden, rapid, and uncontrolled release of impoundment water.

M. **HAZARD** -Something causing unavoidable danger, peril, risk or difficulty.

N. **INUNDATION AREA** - The downstream area that would be inundated or otherwise affected by the failure of a dam or large flows.

O. **INUNDATION MAP** - A map showing areas that would be affected by flood conditions and/or by an uncontrolled release of reservoir water due to the failure of a dam.

P. **NOTIFICATION** - An act or instance of notifying, making known or giving notice.

Q. **NORMAL WATER LEVEL (NORMAL WATER POOL)** - The elevation of the spillway, outlet control or dam crest which maintains the body of water at a specified height.

R. **OUTLET** - Used to regulate the release of water from the reservoir. It usually consists of an intake and an outlet connected by a water passage and is usually provided with gates.

S. **OPERATOR** - City of Harrisburg, Bureau of Water, 100 Pine Drive, Harrisburg, PA 17103.

T. **OWNER** - The Harrisburg Authority, One Keystone Plaza, Suite 104, Front and Market Streets, Harrisburg, PA 17101.

U. **SEEPAGE** - Water which passes, flows, or oozes gradually through a porous substance.

V. **SLIDE** -The mass of matter sliding down.

W. **SPILLWAY** - A structure over or through which flood flows are discharged. If the flow is controlled by mechanical means, such as gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

X. **SPILLWAY CHANNEL** - Channel which conveys released water in excess of storage capacity so that the dam and its foundation are protected against erosion and possible failure.

Y. **TOE OF DAM** - The junction of the downstream face of a dam and the natural ground surface, also referred to as downstream toe. For an earth dam the junction of the upstream face with ground surface is called the upstream toe.

Z. **TOP OF DAM** - The higher end of anything on a slope.

8. EXERCISE AND TRAINING

The dam operator will advise the County EMA of any/all exercises scheduled and coordinated with the County EMA to exercise all or portions of this plan as part of the county's all-hazard exercise program schedule.

9. PLAN MAINTENANCE

A. This plan will be reviewed every two years as part of DEP's annual dam inspection program.

B. During the two year review:

1. The owner's engineer will field review the flood (inundation) area for any increase in downstream population and revise the flood (inundation) area, if needed.

2. The owner's engineer will review and revise surveillance conditions as needed.

3. The owner/operator will coordinate with County EMA if population increases within the inundation area could affect the emergency response capabilities. If so, a new or revised plan should be developed.

4. The owner/operator will obtain concurrence from emergency response agency officials attesting to their continued understanding of their role (s).

5. The owner/operator will submit revised plan to DEP for approval.

ATTACHMENT C
TELEPHONE INFORMATION LIST

DAM OPERATOR City of Harrisburg Bureau of Water	TELEPHONE: 717-238-8725 24 HR: 717-255-3136
DAM OWNER The Harrisburg Authority	TELEPHONE: 717-232-3777 24 HR: 717-255-3136
DAUPHIN COUNTY EMA	WORK: 717-558-6800 24 HR: 911
HARRISBURG EMA	24 HR: 717-255-3136
DAUPHIN, MIDDLE PAXTON AND WEST END FIRE DEPTS	24 HR: 911
PA. STATE POLICE	24 HR: 717-787-7777
DAUPHIN EMS	24 HR: 911
RED CROSS	24 HR: 717-234-3101
DEP REGION (South Central)	24 HR: 717-657-4585
PA EMERGENCY MANAGEMENT AGENCY CENTRAL AREA OFFICE	NORMAL HOURS: 717-374-2055
PA EMERGENCY MANAGEMENT AGENCY - HARRISBURG	24 HR: 800-424-7362 PHONE: 717-651-2001/5
PA DEPT OF TRANSPORTATION	24 HR: 717-783-8150
CONRAIL	24 HR: 1-800-572-0911
COUNTY ELECTED OFFICIALS	24 HR: 911
EAS AND MEDIA	24 HR: 911
DEP DAM SAFETY	24 HR: 717-787-4343 PHONE: 717-787-8568
DEP SOUTHCENTRAL REGIONAL OFFICE	24 HR: 800-812-3782 PHONE: 717-657-4505
MIDDLE PAXTON FIRE AND EMA	24 HR: 911
RUSH TWP FIRE AND EMA	24 HR: 911

ATTACHMENT D

MEDIA ANNOUNCEMENT (SAMPLE 1)

The following announcement has been released by the Dauphin County Emergency Management Agency.

The flooding condition continues in the Clarks Creek Valley and may worsen. For your safety the Dauphin County Emergency Management Agency recommends that you leave the area below the DeHart Dam in the Clarks Creek Valley as soon as possible and proceed to higher ground.

Be sure to take essential items - medicine, special foods, personal items, baby supplies, clothes, money and valuable papers - but do not overload your vehicle. Secure your home before you leave. Be sure to check on neighbors who may need assistance. Above all, do not delay.

Proceed by the shortest route to one of the Red Cross shelters at either the Halifax or Dauphin-Middle Paxton Township Elementary Schools.

If you have no means of transportation or if you are physically unable to evacuate on your own, ask a neighbor to assist you or dial 911. Otherwise, please do not use your telephone except to report an emergency.

I repeat. If you live in the Clarks Creek Valley below the DeHart Dam you are requested to evacuate for your own safety. Stay tuned to this station for more information and instructions.

MEDIA ANNOUNCEMENT (SAMPLE 2)

Conditions exist at the DeHart Dam in Clarks Valley, Middle Paxton Township, that could pose a threat to public safety.

Persons located below the DeHart Dam along Clarks Creek and State Rt. 325 in Middle Paxton Township should leave the area without delay. Persons in this area should proceed by the most direct route to either the Middle Paxton or Halifax Elementary Schools. If roadways are flooded, persons should seek the nearest high ground away from Clarks Creek.

If you do not have transportation, telephone 911 for assistance.

ATTACHMENT ~~F~~ E

NOTICE

DEHART DAM HAS BEEN CLASSIFIED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION AS A HIGH HAZARD DAM; THIS IS A DAM SO LOCATED AS TO ENDANGER POPULATED AREAS DOWNSTREAM BY ITS FAILURE.

AN EMERGENCY ACTION PLAN HAS BEEN DEVELOPED FOR DEHART DAM. A COPY OF THIS PLAN, INCLUDING AN INUNDATION MAP NOTING AREAS IN RUSH AND MIDDLE PAXTON TOWNSHIPS SUBJECT TO FLOODING IN THE EVENT OF FAILURE, IS AVAILABLE FOR PUBLIC INSPECTION AT THE FOLLOWING LOCATIONS:

THE HARRISBURG AUTHORITY
212 LOCUST STREET, SUITE 302, HARRISBURG, PA 17101

DAUPHIN COUNTY EMERGENCY MANAGEMENT OFFICE
911 GIBSON BOULEVARD, STEELTON, PA 17113

CITY OF HARRISBURG - BUREAU OF WATER
100 PINE DRIVE, HARRISBURG, PA 17103

CITY OF HARRISBURG - EMERGENCY OPERATIONS CENTER
123 WALNUT STREET, HARRISBURG, PA 17101

RUSH TOWNSHIP
245 REINERS SCHOOL ROAD, TOWER CITY, PA 17980

6-29-12
NEW ADDRESS

MIDDLE PAXTON TOWNSHIP
~~1304 OVERLOOK STREET, DAUPHIN, PA 17018~~
→ 10 Elizabeth Avenue, Dauphin, PA 17018

ATTACHMENT F
DEHART DAM BREAK ANALYSIS

THE HARRISBURG AUTHORITY
BRINJAC-CHESTER ENGINEERS

DEHART DAM
DAM BREAK ANALYSIS

7/24/97

P9872.00

ACRES INTERNATIONAL CORPORATION
140 John James Audubon Parkway
Amherst, New York 14228-1180

DAM BREAK ANALYSIS ON DEHART DAM

1 - GENERAL

Dehart Dam is a rolled earthfill structure constructed on Clark Creek in 1940 with the purpose of creating a water supply reservoir for the City of Harrisburg. The facility, which is located about 16 miles northeast of Harrisburg, Pennsylvania, was designed by Gannett, Eastman and Fleming, Inc. The creek has a drainage area of 21.3 square miles at the dam site. The dam is about 2,000 feet long, 105 feet high, and 600 feet thick at the base with a 30-foot wide roadway on the top. When the reservoir is full at Elevation 644, the reservoir is 4.55 miles long and contains about 23,000 Ac-ft of water.

A Phase I Inspection Report (Ref. 1) was completed for the Corps of Engineers by Berger Associates, Inc. of Harrisburg, Pennsylvania in 1978. The report classified the dam as a large high-hazard structure.

A dam break analysis was used to determine the flood levels and time of the flood wave which would occur downstream of the dam as a result of a hypothetical break. Two breach conditions were used to evaluate the flood limits downstream of Dehart Dam: (1) "sunny-day", and (2) during a Probable Maximum Storm Event.

2 - METHODOLOGY

The Corps of Engineers HEC-1 program (Ref. 2) was used to develop the Probable Maximum Flood inflow hydrograph to the reservoir. The input hyetograph to the HEC-1 model was developed using the U.S. National Weather Service Hydrometeorological Report Nos. 51 and 52 (Ref. 3 and 4). The U.S. Department of Agriculture, Soil Conservation Service (Ref. 5) parameters for curve number (CN) and lag were used in the HEC-1 model to determine the peak discharge and the volume of the hydrograph for each of the drainage areas in the Clark Creek basin. A summary of the values used for each subarea are listed in Table 1. Soil survey maps (Ref. 6), published by the Dauphin County Soil Conservation Service, were used to determine the soil group classification and the general land use from which a curve number (CN) was chosen.

The National Weather Service DAMBRK Program (Ref. 7) was used to develop the dam breach and route the flood downstream. The model uses the dynamic wave method based on the solution of the complete St. Venant equations of

unsteady flow to route the flood hydrograph through the downstream valley. This accounts for the unsteady nature of the wave and the attenuation of the wave as it travels downstream.

The DAMBRK model was set up using cross section data collected by Hartman and Associates of Camp Hill, Pennsylvania (Ref. 8). The survey incorporated 13 valley cross sections and nine bridges. The U.S. Geological Survey topographic maps (Ref. 9-14) were used to supplement and increase the height of the cross sections to allow for an additional 20 feet in elevation and ensure that the flood wave would be contained within the cross sections.

The analysis used breach parameters within FERC guidelines (Ref. 15-16). A time to breach of 0.4 hours was used in consideration of the size of the dam. The time parameter is within the FERC guidelines and is appropriate for a dam of this size. FERC guidelines are based on the Corps of Engineers criteria for dam safety and are appropriate for this analysis.

The reach from Dehart Dam to the mouth of Clark Creek is 17.06 miles and has 10 bridges. Because of the magnitude of flow resulting from a dam breach, nine of the 10 bridges can be expected to fail. The remaining structure, U.S. Route 22, is near the mouth of the creek. The roadway elevation is approximately 40 feet above the centerline of the creek and is 118 feet wide measured parallel to the flow. To create the worst possible conditions during a dam break, it was assumed that this bridge would not fail. A determination of the pool elevation immediately upstream of the bridge was made by using the most downstream hydrograph from the DAMBRK model and routing it in a HEC-1 model to obtain an outflow hydrograph and the maximum pool elevation.

The limits of the inundation, with and without a breach, were plotted on topographic base mylars (Sheets 1 to 7). The index to the mylars is shown on Drawing 987201-001.

All the input data and results are included in a 5¼ inch floppy disk which is included with this report.

3 - BREACH PARAMETERS

Identical breach parameters were selected for the break under "sunny-day" conditions and during the Probable Maximum Flood. The average breach width

was set equal to 420 feet. Since the dam is 105 feet high (HD), the average breach width is equal to 4.0 HD. The upper limit average breach width suggested by FERC is 5 HD (Ref. 15-16) with the breach width usually being between 2 HD and 4 HD. The actual bottom width of the breach is 315 feet with 1H:1V side slopes. The bottom of the breach was set at Elevation 551.0.

The start of the breach was set to occur at time zero on the "sunny-day" break and be completely failed to the above breach dimensions after 0.4 hours. FERC's guidelines (Ref. 15-16) suggest a time to failure of 0.1 to 1.0 hours for a compacted earthen dam. Because of the size of the dam, the time to failure was deemed appropriate.

An initial discharge of 2,400 cfs was assumed to pass through the dam for the "sunny-day" break model. This was the minimum discharge at which the flow became stable in the DAMBRK model. This flow is assumed constant from the start of computation until the dam is 25 percent breached; thereafter, the flow will linearly decrease to zero when the dam is 50 percent breached.

The beginning of breach during the Probable Maximum Flood was set to occur when the reservoir pool for Dehart Dam reached Elevation 659.0. This is approximately the maximum elevation reached in the pool during the PMF. The breach will be complete after 0.4 hours.

4 - BREACH IMPACTS AND INUNDATION LIMITS

4.1 - General

The mouth of Clark Creek is approximately 17.06 river miles downstream of Dehart Dam. There are ten bridges in this reach, all of which are expected to fail except the U.S. 22 bridge, which is near the mouth of Clark Creek. The waterway opening for this bridge is 1,600 square feet, and it is markedly inadequate to accommodate the discharge as a result of a failure of Dehart Dam. The invert and the crown of the water opening are Elevation 317.3 and 344.8, respectively. The low point on the centerline of the top of the road is at Elevation 357.0. After a dam failure, it is expected that the bridge will create a pool upstream and that a major portion of the flow will be carried over the road.

4.2 - Sunny-Day Break

The maximum calculated discharge was 805,200 cfs, which occurred 0.4 hours after the time the breach began to form. The outflow hydrograph for this breach is shown on Figure 1. Immediately downstream from Dehart Dam, the maximum computed flood wave was 47 feet with the wave crest at Elevation 584.4. By the time the flood wave reached the U.S. 22 bridge over Clark Creek, 16.96 miles downstream, the peak flow was attenuated to 152,300 cfs with an elevation of 375.5 at the upstream side of the bridge. The maximum flood elevation reached the U.S. Route 22 bridge about 2.7 hours (162 minutes) after time zero, the start of the breaching. The travel time of the peak discharge is shown on Figure 2.

The extent of the dam break's influence on downstream areas was determined by plotting the maximum flood elevations obtained from the DAMBRK model on 500 scale topographic maps, which are enclosed with this report. There are 19 surveyed cross sections in the DAMBRK model, and the program generated another 153 cross sections in between the surveyed ones. The program calculates a water surface elevation at all cross sections. By interpolating between elevations at each cross section, the maximum water surface was determined. The water surface elevation and time of travel of the flood wave peak are shown in Table 3, attached.

The flood wave created by the dam break extends well out into the overbank areas of the channel. A total of 112 dwellings are affected by the "sunny-day" breach. Fourteen of the dwellings are located at Camp Shikellimy, which is near river mile 4.7. Some of the dwellings will be inundated by as much as 20 feet. Another 10 dwellings will be inundated between river miles 11.0 and 11.6, and at river mile 16.9, 12 dwellings will be inundated, some by as much as 30 feet. The time of travel of the flood wave is most critical at Camp Shikellimy, where a 31 foot wave reaches the camp in about 40 minutes from the beginning of the start of the breach. The number of dwellings was determined from the U.S.G.S. topographic maps.

4.3 - Full PMF With Breach

The maximum calculated discharge was 1,074,400 cfs, which occurred 0.4 hours after the time the breach began to form. The inflow and outflow hydrographs for this breach are shown on Figure 3. Immediately downstream from Dehart Dam, the maximum computed flood wave was 30 feet with the wave crest at

Elevation 589.9. By the time the flood wave reached the U.S. Route 22 bridge over Clark Creek, 16.96 miles downstream, the peak flow was attenuated to 401,500 cfs with an elevation of 391.8 at the upstream side of the bridge. The maximum flood elevation reached the U.S. Route 22 bridge about 2.2 hours (132 minutes) after time zero, the start of the breaching. The travel time of the peak discharge is shown on Figure 4. The water surface elevation and time of travel of the flood wave peak are shown in Table 4, attached.

The extent of the dam break's influence on downstream areas was determined by plotting the maximum flood elevations obtained from the DAMBRK model on the 500 scale topographic maps.

The flood wave created by the dam break extends well out into the overbank areas of the channel. A total of 57 additional structures will be inundated above the natural PMF flood stage elevations as a result of the dam breach occurring during the PMF. Sixteen of these dwellings are located at Camp Shikellimy, which is around river mile 4.7. Another five dwellings are located at river mile 11.5. The time of travel of the flood wave is critical at Camp Shikellimy as the wave reaches the camp in about 40 minutes from the beginning of the start of the breach.

5 - CONCLUSIONS

Based on the results of the analysis, it is concluded that:

(a) The flood, which would result from a "sunny-day" breach, would flood 112 dwellings of which 14 are within 40 minutes of a 31 foot wave;

(b) The flood wave from a "sunny-day" breach would reach the mouth of Clark Creek in two hours and 47 minutes. The flood wave would be approximately 38 feet at the mouth of Clark Creek;

(c) The flood, which would result from a dam break during a PMF, would inundate another 57 dwellings when compared with the natural PMF. Sixteen of the dwellings are within 40 minutes of the 21 foot wave;

(d) The flood wave during a PMF breach would reach the mouth of Clark Creek in two hours and 14 minutes. The flood wave would be approximately 14 feet at the mouth of Clark Creek; and

(e) All ten bridges between Dehart Dam and the mouth of Clark Creek would be overtopped by a dam breach. It is possible that all 10 bridges would fail as a result of the flood wave.

6 - RECOMMENDATIONS

It is recommended that:

(a) The elevation of all 144 dwellings within the inundation limits of the full PMF with breach be determined; and

(b) Those dwellings that will be affected by a flood wave should be included on the EAP notification list.

7 - REFERENCES

(1) Berger Associates, Inc., "Dehart Dam, Phase I Report, National Inspection Program", August 1978.

(2) U.S. Army Corps of Engineers, "HEC-1 Flood Hydrographic Package", September 1990, Version 4.0.

(3) U.S. National Weather Service, "Probable Maximum Precipitation Estimates, United States, East of 105th Meridian", Hydrometeorological Report No. 51.

(4) U.S. National Weather Service, "Application of Probable Maximum Precipitation Estimates - United States, East of 105th Meridian", Hydrometeorological Report No. 52.

(5) U.S. Department of Agriculture, Soil Conservation Service, "National Engineering Handbook, Section 4, Hydrology", January 1971.

(6) U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Dauphin County", 1970.

(7) U.S. National Weather Service, "The NWS DAMBRK Model", June 1988, Version 6/20/88-2.

(8) Hartman and Associates, Inc., Field Survey of Clark Creek, June 1991.

(9) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Grantville, PA, Photo revised 1976.

(10) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Halifax, PA, Photo revised, 1977.

(11) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Harrisburg West, PA, Photo revised, 1987.

(12) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Enders, PA, Photo revised, 1974.

(13) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Lykens, PA, Photo revised, 1977.

(14) U.S. Geological Survey, 7½ Minute Quadrangle Maps for Tower City, PA, Photo revised, 1974.

(15) Federal Energy Regulatory Commission, "Engineering Guidelines for the Evaluation of Hydropower Projects", (FERC 0119-1), July 1987.

(16) Federal Energy Regulatory Commission, "Notice of Revised Emergency Action Plan Guidelines", February 22, 1988.

TABLE 1

HEC-1 HYDROGRAPH PARAMETERS

LOCATION	DELTA DRAINAGE AREA (SQUARE MILES)	CURVE NUMBER* (CN)	LAG HOURS
Dehart Dam	21.61	85	2.0
Camp Shikellimy	7.32	85	1.6
Grace Church	8.67	85	2.4
7000 Feet Upstream of Confluence of Susquehanna River	5.85	87	1.6
Tributary to Clark Creek	2.29	87	0.5

*Based on Antecedent Moisture Condition III

TABLE 2

DEHART DAM DAMBRK BREACH PARAMETERS

	SUNNY-DAY	100% PMF
Initial Reservoir Level	Elevation 644	Elevation 655.6
Reservoir Level at Start Breach	Elevation 644	Elevation 659.0
Breach Width	315 Feet	315 Feet
Breach Side Slopes	1H:1V	1H:1V
Elevation of Breach Bottom	Elevation 551	Elevation 551
Time of Failure	0.4 Hours	0.4 Hours

TABLE 3

SUNNY-DAY FLOOD WAVE AND TRAVEL TIME

WATER SURFACE ELEVATIONS
NATIONAL GEODETIC VERTICAL DATUM (NGVD)

RIVER MILE	W/O DAM BREAK	W/DAM BREAK	TRAVEL TIME TO MAXIMUM ELEV. W/DAM BREAK (HR)
1.08	537.5	584.4	0.40
2.03	527.2	570.0	0.50
3.33	512.0	554.3	0.60
4.56	498.8	533.2	0.80
4.72	498.5	529.6	0.80
6.16	471.6	503.5	0.95
8.35	437.6	476.5	1.22
11.04	413.3	445.3	1.61
11.31	408.6	442.9	1.63
11.52	404.8	437.7	1.67
12.05	392.6	429.2	1.72
12.42	388.0	422.3	1.77
13.24	376.0	407.5	1.83
13.62	372.5	400.8	1.91
13.76	369.5	399.2	1.93
14.65	360.0	388.6	2.07
15.90	349.0	375.5	2.23
16.88	324.4	375.5	2.77
17.06	321.5	359.9	2.77

TABLE 4

100% PMF FLOOD WAVE AND TRAVEL TIME

WATER SURFACE ELEVATIONS
NATIONAL GEODETIC VERTICAL DATUM (NGVD)

RIVER MILE	W/O DAM BREAK	W/DAM BREAK	TRAVEL TIME TO MAXIMUM ELEV. W/DAM BREAK (HR)
1.08	559.8	589.9	0.40
2.03	551.1	577.5	0.50
3.33	537.7	561.8	0.60
4.56	518.5	540.8	0.70
4.72	515.8	536.7	0.70
6.16	493.7	512.5	0.90
8.35	468.2	485.8	1.10
11.04	437.5	456.6	1.40
11.31	434.7	454.1	1.40
11.52	431.1	448.7	1.50
12.05	421.8	441.8	1.50
12.42	415.0	433.9	1.50
13.24	403.5	414.6	1.50
13.62	396.5	411.2	1.70
13.76	394.6	409.8	1.70
14.65	384.4	399.0	1.80
15.90	374.0	391.8	1.90
16.88	374.0	391.8	2.10
17.06	356.9	370.7	2.10

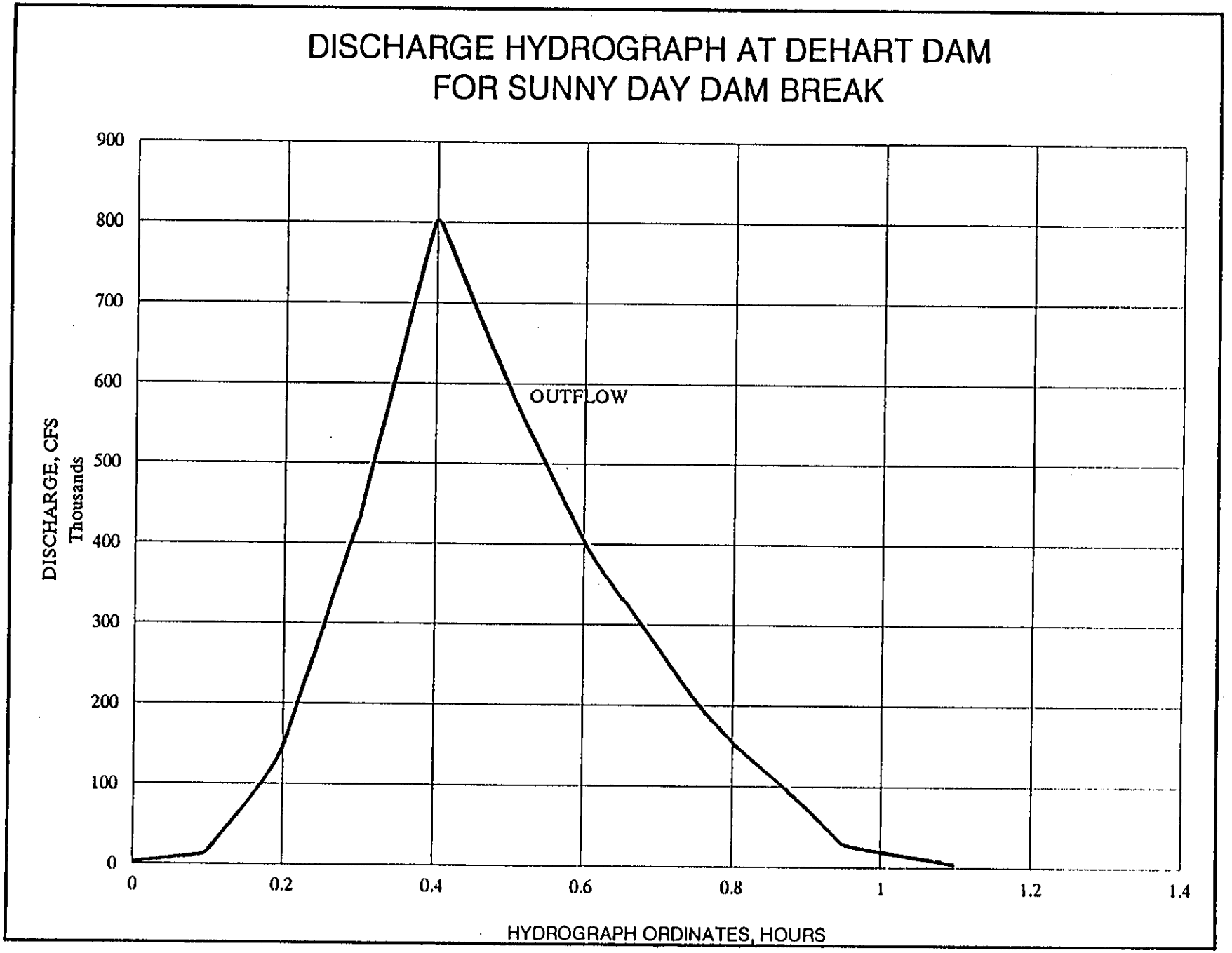

DISCHARGE HYDROGRAPH AT DEHART DAM
FOR SUNNY DAY DAM BREAK
900
800
700
600
500
400
300
200
100
0
DISCHARGE, CFS
Thousands
OUTFLOW
0
0.2
0.4
0.6
0.8
1
1.2
1.4
HYDROGRAPH ORDINATES, HOURS

FIGURE 1

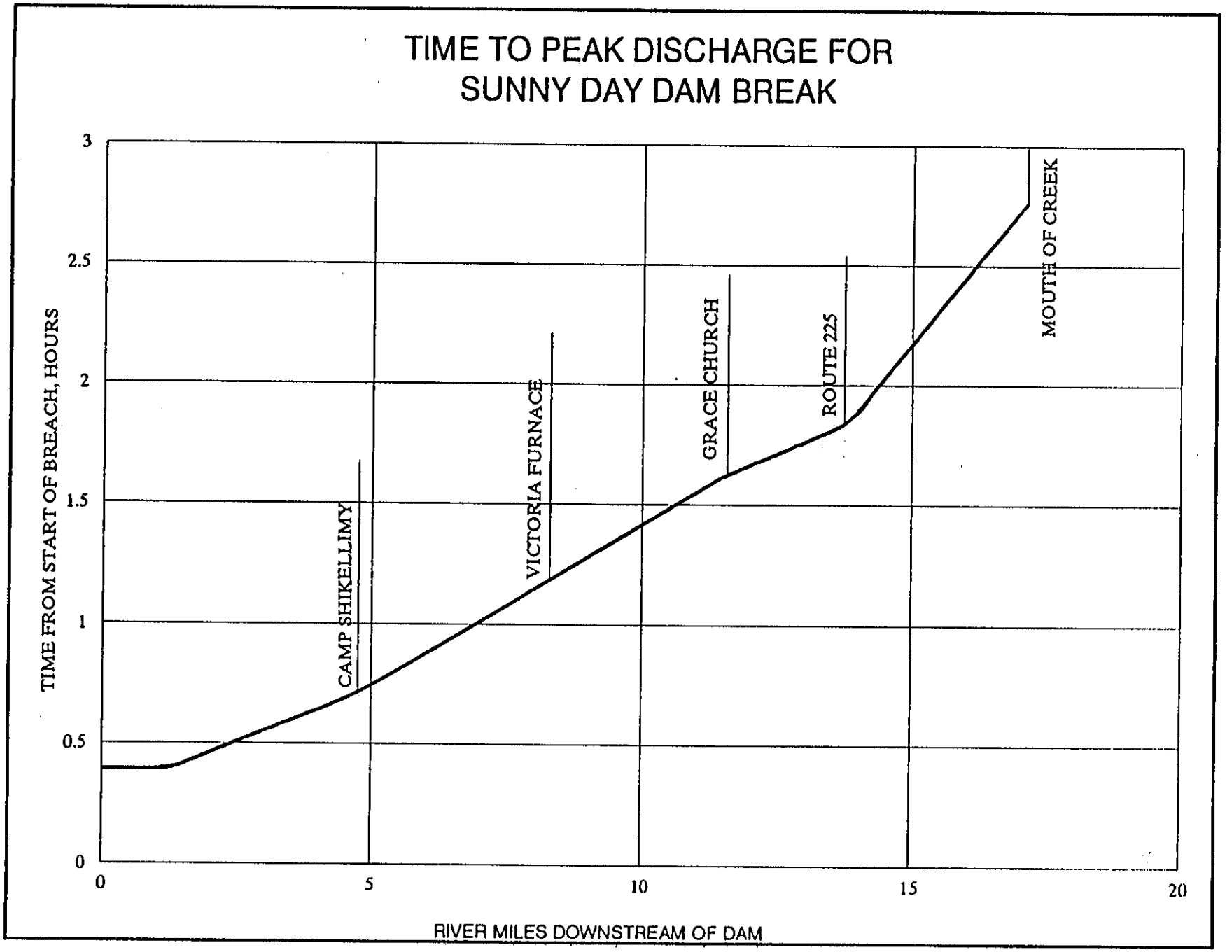

TIME TO PEAK DISCHARGE FOR
SUNNY DAY DAM BREAK
TIME FROM START OF BREACH, HOURS
0
0.5
1
1.5
2
2.5
3
0
5
10
15
20
RIVER MILES DOWNSTREAM OF DAM
CAMP SHIKELLIMY
VICTORIA FURNACE
GRACE CHURCH
ROUTE 225
MOUTH OF CREEK

FIGURE 2

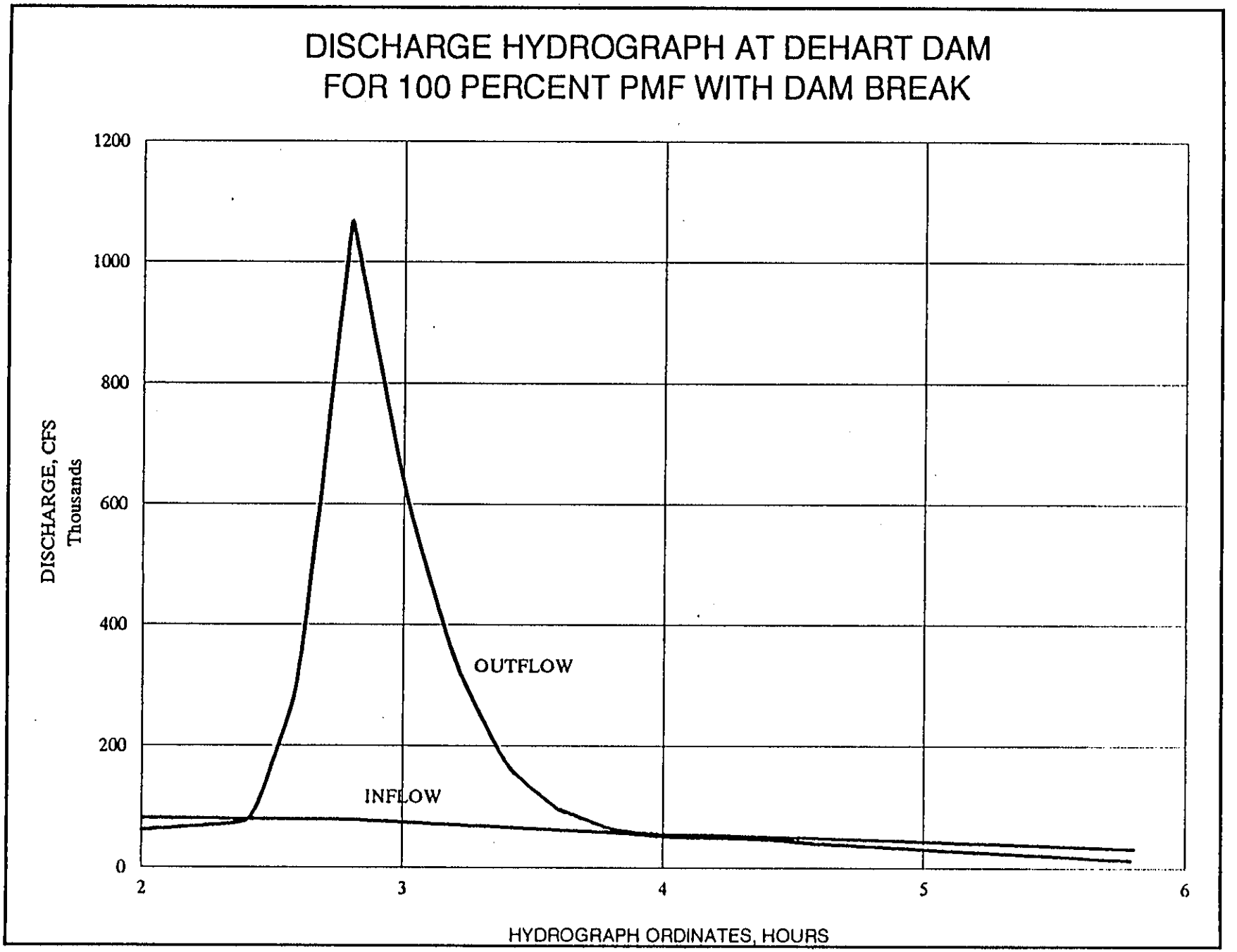

DISCHARGE HYDROGRAPH AT DEHART DAM
FOR 100 PERCENT PMF WITH DAM BREAK
DISCHARGE, CFS
Thousands
1200
1000
800
600
400
200
0
OUTFLOW
INFLOW
2
3
4
5
6
HYDROGRAPH ORDINATES, HOURS

FIGURE 3

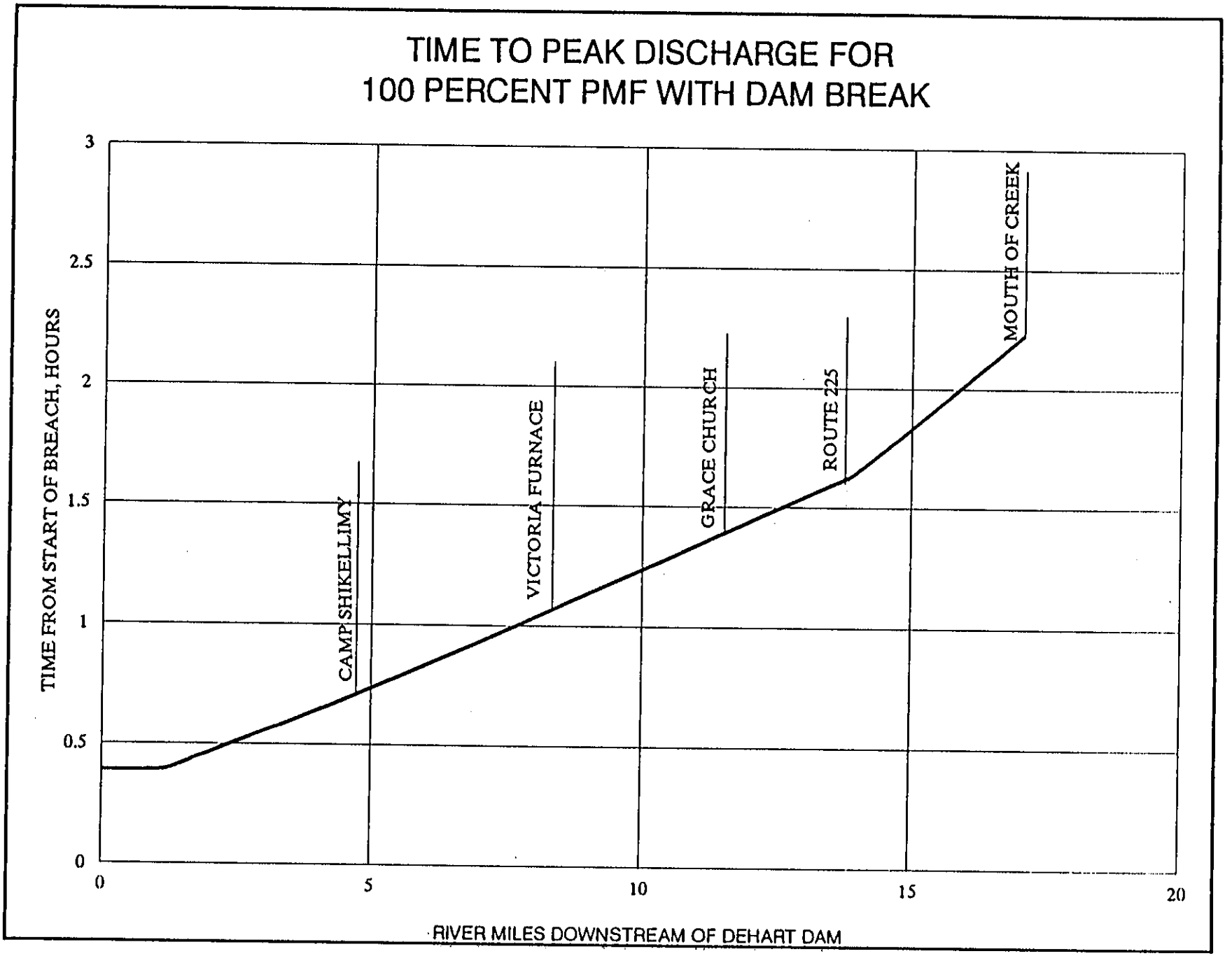
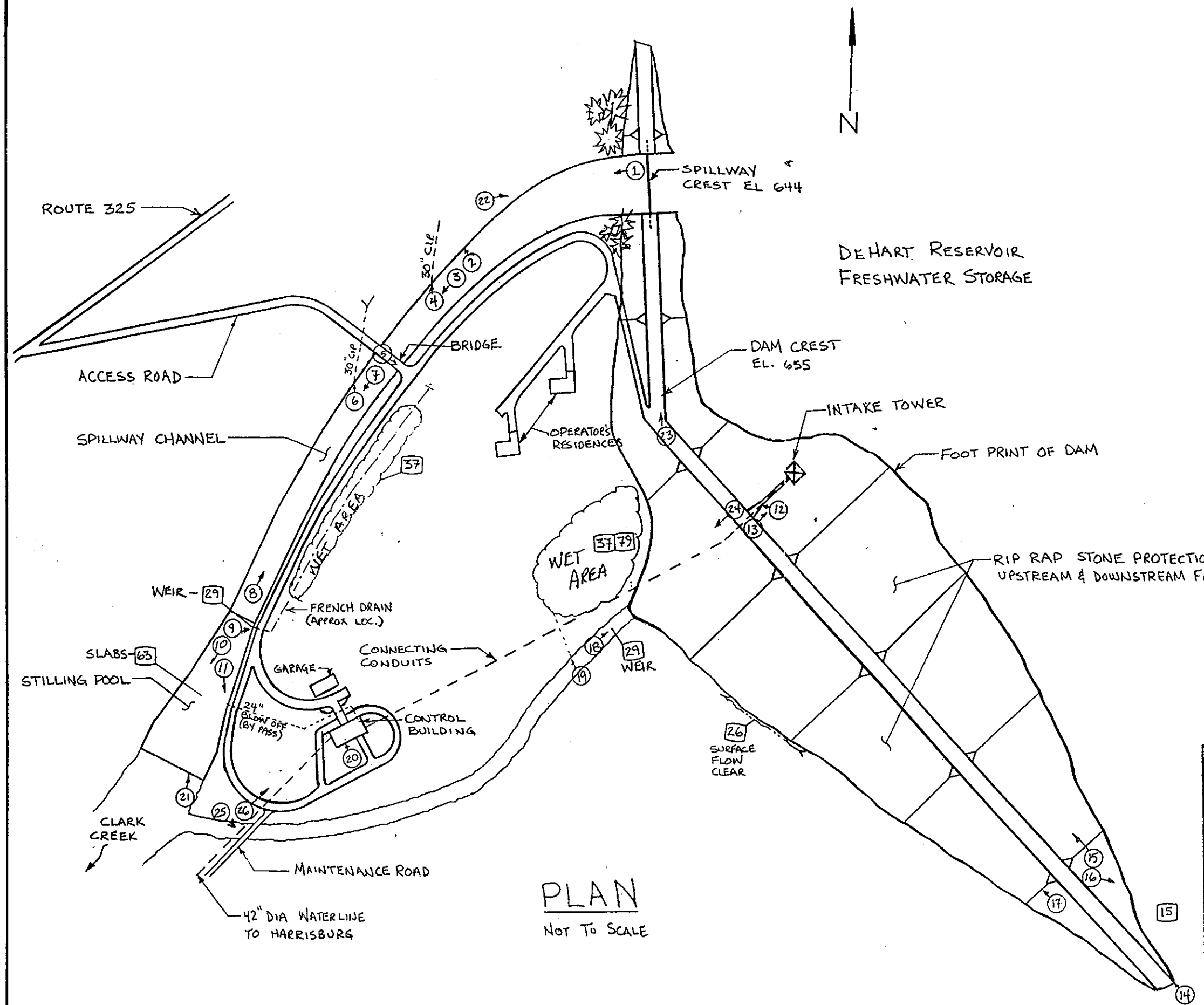

TIME TO PEAK DISCHARGE FOR
100 PERCENT PMF WITH DAM BREAK
TIME FROM START OF BREACH, HOURS
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
CAMP SHIKELLIMY
VICTORIA FURNACE
GRACE CHURCH
ROUTE 225
MOUTH OF CREEK
RIVER MILES DOWNSTREAM OF DEHART DAM

FIGURE 4



PLAN

NOT TO SCALE

NOTES

1. THIS SKETCH IS A COMPILATION OF DATA TAKEN FROM RECORD DRAWINGS, SITE INSPECTION OF 8 OCT 1991, AND INTERVIEWS WITH C.R. KERN DIRECTOR HARRISBURG BUREAU OF WATER, AND W. RABUCK SUPERINTENDENT DEHART DAM.
2. REFER TO INSPECTION CHECKLIST AND PHOTOGRAPHS FOR MORE SPECIFIC COMMENTS AND DETAILS.

LEGEND

TOP OF SLOPE Y

PHOTOGRAGH # & ORIENTATION ←(1)

INSPECTION CHECKLIST ITEM # [37]

THE HARRISBURG AUTHORITY

PROJECT NAME

DEHART DAM

DRAWING DESCRIPTION

ANNUAL INSPECTION BY OWNER
8 OCTOBER 1991 – DER I.D. NO. 21-9

DRAWN BY	APPROVED BY	CHECKED BY	DATE	SCALE
			OCTOBER 1991	

The Chester Engineers
P. O. Box 9356 Pittsburgh, PA 15225

MINJAC, KAMBIC & ASSOCIATES, INC.
910 N. Second Street, Harrisburg, PA 17102

DRAWING NUMBER

FIGURE 1