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Example Emergency Plan for Blue Marsh Dam and Lake

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14. ABSTRACT
This report provides an example emergency plan for operations of a dam and lake in the event of dam failure or other major flood emergencies. It addresses methods for determining inundate areas, identifying various types of emergencies, preparing operations and repair plans, and developing a warning and notification plan.

15. SUBJECT TERMS
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PREFACE

This example emergency plan has been developed to illustrate planning pursuant to the guidance provided in Flood Emergency Plans--Guidelines for Corps Dams. The subject of the example is Blue Marsh Dam and Lake, Berks County, Pennsylvania.

While the data and conditions presented are relevant to most field conditions at Blue Marsh Lake, the example emergency plan is idealized. It is written to include some equipment and other relevant arrangements that represent ideal conditions for which other arrangements could be substituted. This document should not be relied on as a operational plan or as an accurate representation of the actually existing arrangements for identifying and dealing with emergencies affecting Blue Marsh Dam and Lake.

The example plan has been developed only to the point necessary to demonstrate the planning guidelines. Site-specific and/or task-specific details have been omitted in many instances. For example, the form of a listing of persons and organizations to be contacted in an emergency is shown as part of the Notification Subplan but actual names and telephone numbers are not. Actual plans should be complete with respect to such details.

The example emergency plan presents all of the emergency procedures and other components as part of a single plan. This format is not required by the Guidelines. Emergency provisions may be handled as separate documents, supplements to existing project documents or a combination of both so long as all of the essential components of an adequate plan are present. Each plan to deal with flood emergencies at dams must be tailored to the specific conditions at the structure and downstream areas, and to the organizational and operational structure of the responsible office.

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EXAMPLE EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE

1. Introduction

Much of the land surrounding Blue Marsh Lake that would be inundated by a spillway design flood is not in Federal ownership. The possibility therefore exists that high water levels could cause a hazard to life and property in the vicinity of the lake. In addition, large flows from the lake during design floods could be hazardous to life and property in downstream areas.

a. Purpose

This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of Blue Marsh Dam. Specific information on emergency actions to be taken is provided in the following appendicies:

(1) Appendix 1, Emergency Identification Subplan.

(2) Appendix 2, Emergency Operations and Repair Subplan.

(3) Appendix 3, Emergency Notification Subplan.

b. Applicability

The emergency plan is applicable to all Corps elements and field offices concerned with operation of Blue Marsh Dam.

c. References

(1) Federal Guidelines for Dam Safety. Prepared by the Ad Hoc Interagency Committee on Dam Safety of the Federal Coordinating Council for Science, Engineering and Technology. Washington, DC. June 25, 1979.

(2) Flood Emergency Plans, Guidelines for Corps Dams. June 1980.

(3) DAEN-CWR-P letter dated 30 November 1979, Subject: Policy Issue No. 79-13, Corps Role in Emergency Planning for Areas Downstream of Corps of Engineers Dams.

(4) ER 1130-2-417, Major Rehabilitation Program and Dam Safety Assurance Program (Revised Edition, 1980).

(5) ER 1130-2-419, Dam Operations Management Policy, dated 18 May 1978.

(6) ER 1110-2-101, Reporting of Evidence of Distress of Civil Works Projects, dated 16 May 1968.

(7) ER 1105-2-40, Floodplain Management Services Program, dated 14 September 1979.

(8) ER 500-1-1, Emergency Employment of Army and Other Resources, Natural Disaster Procedures, dated 9 January 1978.

(9) DAEN-CWE letter dated 20 March 1978. Subject: Evacuation Plans for Areas Downstream of Corps Dams and Corps/State Cooperation on Safety Review of Corps Dams.

(10) Analysis of Hypothetical Dam-Break Flood Waves for Blue Marsh Dam Near Reading, Pennsylvania. Special Projects Memo No. 79-1, Hydrologic Engineering Center, U.S. Army Corps of Engineers. June 1979.

(11) Blue Marsh Dam and Reservoir, Design Memorandum No. 4, General Design Memorandum. U.S. Army Corps of Engineers. August 1967.

(12) Blue Marsh Lake, Design Memorandum No. 15A. Recreation-Resource Management, Appendicies to the Master Plan. U.S. Army Corps of Engineers. June 1975.

(13) Blue Marsh Lake Instrumentation Plan. U.S. Army Corps of Engineers (Undated).

(14) Reservoir Regulation Manual, Blue Marsh Lake. (Preliminary) U.S. Army Corps of Engineers. Revised April 1980.

(15) Report on the Comprehensive Survey of the Water Resources of the Delaware River Basin. House Document 522, 87th Congress, 2nd Session. August 1962.

(16) Status Report, Blue Marsh Lake Hydropower Reconnaisance. U.S. Army Corps of Engineers (Undated).

(17) Draft Feasibility Report, Schuylkill River Review Study. U.S. Army Corps of Engineers, 1980.

(18) Blue Marsh Lake Operation and Maintenance Manual. (Preliminary) U.S. Army Corps of Engineers. 1981.

d. Scope

This plan addresses emergencies related to above normal reservoir water levels and/or rapid release of large volumes of water past the dam. It covers identification of impending or existing emergencies, notification of other parties concerning impending or existing emergencies, and emergency operations and repairs. Areas potentially affected by emergencies are identified for the cases of Spillway Design Flood without dam failure; Spillway

Design Flood with dam failure; and dam failure at normal high pool level (top of flood control pool).

e. Definitions

(1) Pre-Emergency

A "Pre-Emergency" condition is one in which some impending or existing threat to the safe operation of the dam and reservoir is recognized but no significant hazard to life or property is expected to occur. Notification of other Corps offices is required upon declaration of a Pre-Emergency condition.

(2) Emergency

An "Emergency" condition is one in which the occcurrence of a significant hazard to life or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent, such as breach of the dam or uncontrollable piping, or longer term, such as predicted large inflows. Warnings to evacuate are required upon declaration of an Emergency condition.

2. Description of Project Area

a. Location

The Blue Marsh project is located in Berks County in southeastern Pennsylvania (Plate 1). Blue Marsh Dam is on Tulpehocken Creek, about seven miles northwest of the confluence of the creek with the Schuylkill River at Reading, Pennsylvania.

b. Topography

The project area is in the Great Valley section of the Appalachian Valley and Ridge Province. The Tulpehocken watershed is aligned in a southeasterly direction and traverses gently rolling northwest-southwest trending ridges. Relief varies from 70 feet to 280 feet. Elevations of the stream valley vary from 235 feet NGVD at the dam site to 305 feet NGVD at the upstream reservoir limits. The elevation of the valley walls vary from 310 feet NGVD at the dam site to 580 feet NGVD at the upstream reservoir limits.

c. Geology

Tulpehocken Creek has entrenched its valley into thinly bedded to highly fissile rocks belonging mostly to the Martinsburg formation of Upper Ordovician age. Limestones, sandstones and shales are interfolded in a tight

system of northeast-southwest trending anticlines and synclines. They present no problem of leakage. A 5,000 foot by 800 foot oval-shaped inlier of dolomitic limestone occurs in the reservoir area about 2,000 feet upstream of the dam axis. The inlier contains cavities, solution holes and one known cave but, for the most part, is covered with a 5-to 20-foot deep layer of impervious material consisting of clay, silt and rock fragments. Bedrock is weathered to as much as 50 feet below the ground surface in some locations with an average depth of weathering of 10 to 20 feet. The area is designated as seismic zone 2.

d. Climate

The project area is located in the temperate northeast Atlantic Coast climatic zone, an area of frequently changing temperatures and moderate, year-round precipitation. A precipitation rate of 0.1 inch or more per day occurs an average of 5 to 8 days per month, while a daily fall of 0.5 inch or more has a mean frequency of only 2 or 3 days per month. On most of these days, precipitation occurs in the form of showers. However, three types of storms occasionally occur in the Tulpehocken Creek watershed: warm front storms, cold front storms and hurricanes. The most severe basin-wide floods of record in the Tulpehocken Creek watershed were caused by warm front storms and hurricanes. Cold front storms frequently cause flash floods and bank overflow along tributaries to the creek. Snowfall averages about 30 inches per year over the entire Tulpehocken Creek watershed. Historically, snow has never accumulated and melted suddenly in sufficient quantities to cause flooding. However, snowmelt flooding is a possibility.

e. Principal Streams

Tulpehocken Creek has its source near Lebanon, Pennsylvania. It flows in a southeasterly direction to its confluence with the Schuylkill River in the City of Reading, Pennsylvania. From the confluence with Tulpehocken Creek, the Schuylkill river flows in a southeasterly direction to its confluence with the Delaware River in Philadelphia, Pennsylvania.

The Tulpehocken Creek watershed is approximately 18 miles in length and varies in width from 7 to 17 miles. It has a drainage area of about 219 square miles, 175 square miles of which are located above Blue Marsh Dam. The creek has a length of approximately 30 miles and a slope of approximately 14 feet per mile.

The major tributaries to Tulephocken Creek are Spring, Northkill, Little Northkill, Cacoosing, and Plum Creeks. There are numerous other smaller tributaries.

Annual runoff from the area above the damsite averages 27.4 inches. The average discharge on Tulpehocken Creek four miles downstream of the damsite is 289 cfs. The mean flow at the damsite is estimated to be 1.32 cfs per square mile.

There are 22 small or low head dams in the upper reaches of Tulpehocken Creek and its tributaries. Fourteen of these are located above Blue Marsh Dam and Lake. The largest of these has a storage volume of 260 acre-feet and the remainder are less than half that capacity.

The Schuylkill River above the mouth of Tulpehocken Creek has a length of approximately 77 miles and a drainage area of approximately 661 square miles. The reach of the Schuylkill River in the vicinity of Reading has a slope of approximately 6.5 feet per mile.

3. Description of Project Features

The Blue Marsh Project consists of a lake impounded by Blue Marsh Dam and saddle dikes, outlet works, protection works for the borough of Bernville, and various public use lands and facilities. Principal features of the area are shown on Plate 2.

a. Blue Marsh Dam

Blue Marsh Dam is a rolled earth-fill dam with an impervious core and random-fill outer sections. It has a top elevation of 332 feet NGVD. Height at the maximum section is 98 feet. The dam's top width is 30 feet and it has a crest length of 1,775 feet. The dam includes an uncontrolled, open-channel cut spillway. The spillway has a 300-foot wide concrete sill with a crest elevation of 307 feet NGVD. The spillway is designed to pass 69,000 cfs at full pool. A maximum water surface elevation of 326.4 feet NGVD is reached during that Spillway Design Flood (SDF).

b. Saddle Dikes

The project includes three saddle dikes located in the vicinity of the dam to contain the lake in the event of extreme high water levels. Two of the dikes are constructed of compacted earth and rock-fill and one of only compacted earth-fill. The top width of the dikes is 15 feet and both upstream and downstream faces have 1 on 3 slopes.

c. Outlet Works

The outlet works for the lake consists of a multi-level intake structure and a horseshoe-shaped 10-foot diameter conduit. The outlet works have a maximum discharge capacity of approximately 6,200 cfs with the lake at the Spillway Design Flood elevation of 326.4 feet NGVD. The intake structure is equipped with hydraulically operated service gates and a fixed wheel, crane operated, transferable emergency gate. A channel has been excavated from the original channel of Tulpehocken Creek to the intake structure to enable dewatering of the dam.

The outlet works also contains gates for water quality control. Lake regulation plans call for a conservation release of 41 cfs, equivalent to

the 7-day, 10-year discharge of Tulpehocken Creek and a 9 cfs release for water supply for the Western Berks Water Authority for a total minimum release of 50 cfs, at the gaging station below the dam. Discharges can be made from various elevations in the outlet works to adjust the quality of releases.

d. Blue Marsh Lake

The lake has an area at the spillway crest elevation of 2,160 acres and a volume below the spillway crest of 50,010 acre-feet. The lake provides approximately 32,380 acre-feet of flood control storage when operating at the winter rule curve elevation (Oct. 15 to April 1) which is sufficient to contain the estimated 1% chance flood. At the spillway crest level, Blue Marsh Lake extends about 12 miles up Tulpehocken Creek and 3 miles up Spring Creek, its principal tributary.

Seasonal rule curve operational plans for the lake specify maintenance during summer months of a water level of 290.0 ft. NGVD while during winter months, the reservoir water level is maintained at 285.0 ft. NGVD.

e. Bernville Protection Works

The borough of Bernville is located adjacent to Blue Marsh Lake. A local protection project prevents the community from being flooded by high reservoir water levels. The protection works include a levee, ponding area, pumping station and two dry dams with conduit outlets. The crest elevation of the levee varies from 320 to 322 feet NGVD. A considerable portion of Bernville would flood in the event the reservoir reached the Spillway Design Flood level of 326.4 NGVD.

f. Public Use Areas

Public use areas associated with the project include a visitor center, nature education area, day use recreational areas and boat launching facilities. The public use facilities provide capacity to accomodate a total of 437,000 visitors annually.

g. Instrumentation

Instrumentation related to the operation of Blue Marsh Dam and Lake includes equipment to collect and monitor meteorological conditions, reservoir inflow and outflow, reservoir level, embankment surface motion, embankment settlement, hydrostatic pressures in the embankment, seepage, and water quality characteristics of low-flow releases.

Meteorological instrumentation at the damsite includes a nonrecording rain gage, maximum and minimum temperature indicators, a psychrometer, an evaporation pan, and an anemometer. Nonrecording precipitation gages located at Meyerstown and Straustown, Pennsylvania are read once daily by volunteers

for the National Weather Service. Recording precipitation gages operated by the National Weather Service are located at Reading and Lebanon, Pennsylvania. Four self-reporting, radio transmitting precipitation gages are located in the Tulpehocken Creek watershed above the dam. The gages are monitored at the NWS office in Philadelphia. Transmissions from the gages are also received, decoded, and recorded at the dam site.

Crest stage gages are located on Northkill Creek (drainage area of 18.8 sq. mi.) and Little Northkill Creek (drainage area of 21.2 sq. mi.) near Bernville. A recording stream gage equipped for telephone interrogation is located on Tulpehocken Creek near Bernville (drainage area 66.5 sq. mi.). Two self-reporting, radio transmitting stream gages are located in the upper reaches of the Tulpehocken Creek watershed. The gages are continuously monitored by the NWS office at Philadelphia. Transmissions are also received, decoded and recorded at the dam site.

Reservoir level gages include a staff gage and an automatic manometer type recording gage equipped for telephone interrogation. Outflow is measured at a recording stream gage located downstream of the dam. Seepage through the deep valley section of the dam and its foundation is collected by a sand drainage blanket on the downstream toe and directed to a "V" notch weir. The weir is equipped with an alarm to signal high flows. The alarm rings at the administration building and both operators' homes as well as triggering a high intensity strobe light located atop the intake tower.

Nineteen Cassagrande type piezometers are located at the dam to enable measurement of hydrostatic pressures in the foundation and various sections of the enbankment. Three are located in the embankment, 10 in the foundation, and three each in the impervious core and the drainage zone.

h. Operations and Maintenance

Blue Marsh Dam and Lake is operated by the Corps of Engineers. Two dam operators reside at the dam to carry out operations and routine repairs. Recreational, visitor, and fish and game facilities associated with the project are operated by the Corps of Engineers, Pennsylvania Fish Commission and Pennsylvania Game Commission.

4. Potentially Affected Project Areas

Emergencies at Blue Marsh Dam and Lake could endanger the safety of people and property within the borders of the project. The principal areas of concern are the reservoir surface and the Tulpehocken, Dry Brooks, State Hill, and Spring Creek public access areas.

a. Reservoir Surface

The reservoir surface is heavily used for swimming, fishing and boating. It extends several miles upstream from the dam and includes numerous branches and coves.

Dangers to those on the reservoir as the result of an emergency could include strong surface currents in the event of a dambreak or flow over the spillway, and high waves during storms. However, weather conditions usually accompanying large storms make recreation on the reservoir surface unlikely during such periods.

b. Tulpehocken Public Access Area

Tulpehocken public access area is located along Tulpehocken Creek downstream of the dam. It is 45 acres in size and includes parking facilities, 100 picnic tables, and trails. The area enables use of the fishery downstream of the dam.

This area is vulnerable to inundation by high flows resulting from large discharges over the spillway or through a breach in the dam.

c. Dry Brooks Public Access Area

The Dry Brooks public access area is located on the left bank of the reservoir near the dam. It is 453 acres in size and includes two beaches, boat rental area, four boat launching lanes, and approximately 960 picnic tables.

Potential hazards at this area due to an emergency affecting the dam and reservoir are small. The area would be gradually inundated as the reservoir water surface water rose.

d. State Hill Public Access Area

The State Hill public access area is located on the right bank of the reservoir near the dam. It is 1,420 acres in size and includes an amphitheater, nature trails, two beaches, approximately 750 camp sites of various types including group camp sites, and a camp control station.

Potential hazards at this area due to an emergency affecting the dam and reservoir are small. The area would be gradually inundated as the reservoir water surface rose.

e. Spring Creek Public Access Area

The Spring Creek public access area is located on the right bank of the reservoir, upstream from the State Hill public access area. It is 670 acres in size and includes 8 picnic tables and 2 boat launching lanes.

Potential hazards at this area due to an emergency affecting the dam and reservoir are small. The area would be gradually inundated as the reservoir water surface rose.

5. Potentially Affected Non-Project Areas

Emergencies at Blue Marsh Dam and Lake could create a hazard to life and property on non-project lands including those in the vicinity of the reservoir, along Tulpehocken Creek below the dam, along Tulpehocken Creek and the Schuylkill River in the Reading metropolitan area, and along the Schuylkill River below Reading.

a. Vicinity of Reservoir

The majority of lands outside the perimeter of the Blue Marsh Project are privately owned and used for farming or woodlots. State game lands, abutting the project on the north, also consist of farmlands and woodlots. The only areas of appreciable development adjacent to Blue Marsh Lake are county owned lands to the northwest of the reservoir and the borough of Bernville, located near Northkill Creek. The Berks County lands include cultivated areas and woodlots interspersed with scattered buildings, all at a relatively high elevation. The borough of Bernville is primarily a rural residential community with an estimated 1980 population of 798. Bernville is protected from high reservoir water levels by the protection project described in paragraph 3(e).

b. Tulpehocken Creek Area

The floodplains along Tulpehocken Creek immediately below the dam are largely undeveloped. Much of the land is county recreation area with trails linking various heavily used recreation centers. Small parcels of land with gentle slopes are used for various agricultural purposes but these tend to be at higher elevations.

Residences are scattered along and near the banks of Tulpehocken Creek from Blue Marsh Dam to within about one and one-half miles of the Schuylkill River. The remaining distance to the Schuylkill River is intensly developed for residential, commercial and industrial uses. Developments in this downstream area are generally 40 to 60 feet above the normal banks of the creek.

Provisions for warning of high releases through Blue Marsh Dam were installed in the Tulpehocken Creek area when the dam was constructed. They consist of 120 db sirens located respectively .75, 2.25 and 3.34 miles below the dam. Each is independently powered by rechargeable batteries and can be triggered by radio from the county complex located immediately northeast of the dam.

c. Reading Metropolitan Area

The Reading metropolitan area includes the city of Reading, boroughs of West Reading, Wyomissing, and Shillington, and several other smaller communities. The city of Reading is located on the east side of the Schulkill River and the other named communities on the western side. The

metropolitan area had total population in 1980 of approximately 100,000. Tulpehocken Creek enters the Schuylkill River slightly upstream of the center of this urban area.

The Reading metropolitan area is a regional center for trade and finance and provides services to the surrounding agricultural area and numerous small communities. The city also contains a large number of industries with several major manufacturing facilities located along the east bank of the Schuylkill River in the vicinity of its confluence with Tulpehocken Creek.

The land along Highway 183 between the city of Reading and Blue Marsh Dam is undergoing strip development as a residential area. As of 1980, development had proceeded from the city to within a few miles of the dam. Most of the residential development is on high ground distant from Tulpehocken Creek.

[The description included here deals only with basic information on the Reading Metropolitan area and the immediately downstream areas as an example. Fully developed plans should provide sufficient information on each portion of the affected downstream area to convey an understanding of its character and size.]

d. Schuylkill River Below Reading

The principal communities along the Schuylkill River below the Reading metropolitan area which could be affected by an emergency at Blue Marsh Dam and their 1980 populations are Birdsboro (3,312), Pottstown (22,729), Norristown (34,684), Conshohocken (8,475), and Philadelphia (1,688,210). Philadelphia is approximately 60 river miles downstream of Reading.

The area between the named cities includes several small communities and numerous isolated structures along or on the floodplains of the Schuylkill River.

6. Potential Causes of an Emergency

The potential causes of an emergency affecting the operation or safety of Blue Marsh Dam which were selected for planning are described in the following subparagraphs.

a. Excess Seepage

A potential exists for seepage through, around or under the dam. Some seepage is normal and not considered hazardous. However, seepage that increases in amount or contains suspended solids may indicate piping which can lead to breach of the dam. Seepage problems are potentially controllable depending on their severity, location and other circumstances.

b. Sabotage

A potential exists that operation of the dam could be affected by sabotage disrupting communications, disabling gate controls or equipment, breaching the dam or various combinations of the foregoing. Only breaching of the dam, for instance by use of explosives, would cause sudden release of a dangerous volume of water.

c. Extreme Storm

An extreme storm could occur in the area of the reservoir or over the watershed upstream of the reservoir. An extreme storm could result in large inflows to the reservoir causing a high reservoir level, large discharges over the emergency spillway, and/or high waves on the reservoir surface. The potential for mitigating such problems depends on their severity and other circumstances.

d. Slope Failure

A sliding or sloughing of the dam face could occur. A slope failure that extended to the top of the embankment would effectively lower the crest. This could result in sudden release of a large volume of water if the reservoir water surface exceeded the elevation of the resulting dam crest. The potential for control of slope failure problems depends on their magnitude, severity, reservoir water surface elevation and other circumstances.

7. Computation of Outflow Hydrographs

Outflow hydrographs were computed for the hypothetical cases of Spillway Design Flood without failure, Spillway Design Flood with failure, and failure at normal high pool level. These three conditions encompass the types of situations potentially resulting from the causes of failure described in paragraph 6.

a. Computational Procedures

All outflow hydrographs were computed using the National Weather Service Dam Break Model. Table 1 describes the principal parameters of the respective computations for the three cases investigated.

b. Outflow Hydrograph

The outflow hydrographs immediately below Blue Marsh Dam which were computed for the three cases are shown in Plate 3.

c. Maximum Pool Elevations

The maximum pool elevation computed as occurring in the event of a Spillway Design Flood is 326.4 feet NGVD (Reservoir Regulation Manual).

TABLE 1
INFORMATION ON COMPUTATION OF OUTFLOW HYDROGRAPHS
BLUE MARSH DAM AND LAKE

Condition	Spillway Design Flood (SDF) Without Failure	Spillway Design Flood (SDF) With Failure	Failure at Normal High Pool Level
Initial Pool Elev. (ft.)	307	307	307
Inflow Hydrograph	SDF	SDF	10% chance flood
Reservoir Release (cfs)	5,400	5,400	3,000
Flow on Schuylkill R. (cfs)	45,000	45,000	27,000
(Flow frequency)	(5% chance)	(5% chance)	(10% chance)
Breach Type	N/A	Erosion	Piping
Pool Elev. when Failure Begins (ft)	N/A	325*	307
Maximum Pool ELev. (Reached (ft)	326.4	325.2	307
Maximum Release Rate (cfs)	75,200	492,800	216,700
Ultimate Bottom Width of Breach (ft)	N/A	80	100
Ultimate Bottom Elev. of Breach (ft)	N/A	234	234
Side Slope of Breach (units horiz. to 1 unit vert.)	N/A	2	0
Time to Develop (hrs)	N/A	2	2

*Breach assumed to begin shortly before maximum SDF water surface elevation is reached.

d. Comparison of Computed Peak Outflows

The computed maximum peak outflow for the case of Spillway Design Flood with failure is 492,800 cfs. Plate 4 shows this outflow in comparison to outflows from known dam failures. The hydraulic depth of Blue Marsh Dam (from Spillway Design Flood level to invert of outlet) is approximately 93 feet. The value of the envelope curve shown in Plate 4 for a hydraulic depth of 93 feet is approximately 362,000 cfs which is 130,800 cfs less than the maximum outflow computed for Blue Marsh Dam. This difference is approximately 27 percent of the computed maximum outflow.

Several failure scenarios for Blue Marsh dam were studied. The case of failure concurrent with a Spillway Design Flood represents a compounding of extremely unlikely events. The case of failure at normal high pool represents much less severe conditions such as a piping failure that might occur under normal nonflood conditions. It is doubtful that the historical failure data (Plate 4) contain events of the magnitude of a Spillway Design Flood. The envelope curve on that figure probably lies somewhere between failure at normal high pool and failure at the Spillway Design Flood peak. For this reason, the computed result for the Spillway Design Flood with failure lies outside the historical envelope curve.

8. Routing of Outflow Hydrographs

Computational procedures for routing each outflow hydrograph downstream are described in the Special Projects Memo No. 79-1 referenced in paragraph 1.c.

a. Maximum Flood Elevations

Table 2 lists the computed maximum flood elevation at each cross section between the dam and Birdsboro and the time of its occurrence. Locations of cross sections are shown in Plate 5. Crest profiles for the three conditions considered are shown in Plate 6. Plates 7, 9 and 11 show the approximate stage hydrographs at downstream cross sections for each condition and Plate 12 shows the change in reservoir elevation for the condition of Spillway Design Flood with failure. *[Fully developed plans should list and/or show these types of information for the whole reach under study.]*

b. Occurrence of Hazardous Conditions

Hazardous conditions are defined as those in which:

(1) Flood depths are in excess of two feet.

(2) Velocities exceed four feet per second.

(3) Flood depths are sufficient to damage property.

TABLE 2
COMPUTED ELEVATIONS AND TIMES OF ARRIVAL FOR FLOOD WAVE
BLUE MARSH DAM AND LAKE

Cross Section	Dist. Below Dam (mi.)	Spillway Design Flood Without Failure		Spillway Design Flood With Failure		Failure at Normal High Pool Level	
		Max. Elev. (ft.)	Time of Max. Elev. (hr.)	Max. Elev. (ft.)	Time of Max. Elev. (hr.)	Max. Elev. (ft.)	Time of Max. Elev. (hr.)
T23	.18	266.0	.1	304.1	2.0	282.5	2.3
T16	1.88	259.5	2.8	291.9	2.4	274.1	3.0
T12	3.40	250.4	2.9	280.6	2.7	265.2	3.3
T10	4.13	246.8	3.1	273.3	3.0	258.0	3.5
T7	5.17	240.7	3.5	267.6	3.2	251.2	3.7
T1	6.71	225.3	4.0	253.9	3.8	229.4	4.3
SBE	7.23	223.8	4.1	251.6	4.0	228.2	4.5
SBF	7.47	222.3	4.2	247.4	4.4	226.6	4.5
SBG	7.91	220.7	4.3	243.9	4.5	225.7	5.3
SBH	8.21	219.5	4.5	244.2	4.7	225.5	5.3
SBI	8.74	318.6	4.6	243.5	4.8	224.9	5.4
SBK	10.08	213.2	5.1	237.4	4.9	219.4	5.5
SBN	12.09	206.3	5.7	229.3	5.1	211.5	5.8

Table 3 lists the minimum water elevation which causes a hazardous condition to exist in the vicinity of each cross section and the time at which that elevation would be reached under each condition considered.

9. Inundation Maps

Plates 8, 10 and 13 respectively show the boundary of the area expected to be inundated by the hypothesized conditions of Spillway Design Flood without failure, failure at normal high pool level, and Spillway Design Flood with failure. *[Inundated areas are shown only for the Reading quadrangle. Fully developed plans should include inundation maps for all populated areas within the reach under study.]* An Inundation Map Package is published under separate cover (see example that is included as an attachment to this document).

10. Affected Areas

Plates 8, 10 and 13 indicate the areas affected for the respective conditions of Spillway Design Flood without failure, failure at normal high pool level, and Spillway Design Flood with failure. Unless otherwise noted, affected areas outside the inundation boundary are potentially subject to isolation, in most cases by flooding of roads serving the area. Notes on the plates indicate any area outside the inundation boundary which is potentially affected by secondary problems which might stem from inundation. Table 4 lists the potential secondary problems noted on each plate.

11. Identification of Needed Evacuation Planning

a. Jurisdictions Affected

The area affected in the maximum case of Spillway Design Flood with failure encompasses parts or all of the following jurisdictions:

(1) [Insert list of jurisdictions]

b. Existing Evacuation Plans

Plans pertinent to dissemination of flood warnings and evacuation in the portions of the jurisdictions which would be affected in the case of a Spillway Design Flood with failure include:

(1) *[List of plans, standard operating procedures, etc. to be inserted after on-site visit.]*

c. Evaluation of Existing Evacuation Plans

Table 5 lists the principal characteristics of existing evacuation plans which affect their potential for successful execution.

TABLE 3(a)
COMPUTATION OF HAZARDOUS ELEVATIONS
AND TIMES OF OCCURRENCE
BLUE MARSH DAM AND LAKE
(Spillway Design Flood Without Failure)

Cross Section	Dist. Below Dam (mi.)	Max.[1] Vel. (ft/sec)	25%[2] Max. Vel. (ft/sec)	Low Bank Elev. (ft.)	Low Bank Elev. +2 ft. (ft.)	Damage Elev. (ft.)	Lowest[3] Hazardous Elev. (ft.)	Time[4] of Arrival (hr.)
T23	.18	4.7	1.2	239	241	310	241	N/A[5]
T16	1.88	4.0	1.0	230	232	254	232	N/A
T12	3.40	9.2	2.8	231	233	244	233	N/A
T10	4.13	3.0	0.8	221	223	228	223	N/A
T7	5.17	6.3	1.6	216	218	230	218	N/A
T1	6.71	13.5	3.4	219	221	204	204	N/A
SBE	7.23	6.9	1.7	195	197	218	197	N/A
SBF	7.47	8.0	2.0	194	196	250	196	N/A
SBG	7.91	5.9	1.5	193	195	220	195	N/A
SBH	8.21	7.6	1.9	192	194	205	194	N/A
SBI	8.74	6.0	1.5	186	188	202	188	N/A
SBK	10.08	7.7	1.9	183	185	202	185	N/A
SBN	12.09	8.4	2.1	181	183	227	183	N/A

[1]Based on modeling results.

[2]Overbank velocity assumed to be 25% of maximum velocity.

[3]Dangerous elevation is low bank elevation if overbank velocity is 4 ft/sec or greater. Otherwise, dangerous elevation is low bank elevation plus 2 ft. or elevation at which damage occurs, whichever is lowest.

[4]Measured from time zero.

[5]Lowest hazardous elevation is exceeded by assumed reservoir release and/or assumed 5% chance flood on Schuylkill River.

TABLE 3(b)
COMPUTATION OF HAZARDOUS ELEVATIONS
AND TIMES OF OCCURRENCE
BLUE MARSH DAM AND LAKE
(Spillway Design Flood With Failure)

Cross Section	Dist. Below Dam (mi.)	Max.[1] Vel. (ft/sec)	25%[2] Max. Vel. (ft/sec)	Low Bank Elev. (ft.)	Low Bank Elev. +2 ft. (ft.)	Damage Elev. (ft.)	Lowest[3] Hazardous Elev. (ft.)	Time[4] of Arrival (hr.)
T23	.18	9.5	2.4	239	241	310	241	N/A[5]
T16	1.88	6.1	1.5	230	232	254	232	N/A
T12	3.40	11.7	2.9	231	233	244	233	N/A
T10	4.13	5.7	1.4	221	223	228	223	N/A
T7	5.17	5.9	1.5	216	218	230	218	N/A
T1	6.71	9.7	2.4	219	221	204	204	N/A
SBE	7.23	8.7	2.2	195	197	218	197	N/A
SBF	7.47	13.2	3.3	194	196	250	196	N/A
SBG	7.91	11.4	2.9	193	195	220	195	N/A
SBH	8.21	3.4	0.9	192	194	205	194	N/A
SBI	8.74	5.9	1.5	186	188	202	188	N/A
SBK	10.08	11.3	2.8	183	185	202	185	N/A
SBN	12.09	6.9	1.7	181	183	227	183	N/A

[1]Based on modeling results.

[2]Overbank velocity assumed to be 25% of maximum velocity.

[3]Dangerous elevation is low bank elevation if overbank velocity is 4 ft/sec or greater. Otherwise, dangerous elevation is low bank elevation plus 2 ft. or elevation at which damage occurs, whichever is lowest.

[4]Measured from time zero.

[5]Lowest hazardous elevation is exceeded by assumed reservoir release and/or assumed 5% chance flood on Schuylkill River.

TABLE 3(c)
COMPUTATION OF HAZARDOUS ELEVATIONS
AND TIMES OF OCCURRENCE
BLUE MARSH DAM AND LAKE
(Failure at Normal High Pool Level)

Cross Section	Dist. Below Dam (mi.)	Max.[1] Vel. (ft/sec)	25%[2] Max. Vel. (ft/sec)	Low Bank Elev. (ft.)	Low Bank Elev. +2 ft. (ft.)	Damage Elev. (ft.)	Lowest[3] Hazardous Elev. (ft.)	Time[4] of Arrival (hr.)
T23	.18	6.8	1.7	239	241	310	241	N/A[5]
T16	1.88	4.8	1.2	230	232	254	232	N/A
T12	3.40	9.1	2.3	231	233	244	233	N/A
T10	4.13	3.5	0.9	221	223	228	223	N/A
T7	5.17	5.9	1.5	216	218	230	218	N/A
T1	6.71	21.6	5.4	219	221	204	204	N/A
SBE	7.23	8.1	2.0	195	197	218	197	N/A
SBF	7.47	9.6	2.4	194	196	250	196	N/A
SBG	7.91	7.1	1.8	193	195	220	195	N/A
SBH	8.21	7.2	1.8	192	194	205	194	N/A
SBI	8.74	6.9	1.7	186	188	202	188	N/A
SBK	10.08	8.6	2.2	183	185	202	185	N/A
SBN	12.09	8.7	2.2	181	183	227	183	N/A

[1]Based on modeling results.

[2]Overbank velocity assumed to be 25% of maximum velocity.

[3]Dangerous elevation is low bank elevation if overbank velocity is 4 ft/sec or greater. Otherwise, dangerous elevation is low bank elevation plus 2 ft. or elevation at which damage occurs, whichever is lowest.

[4]Measured from time zero.

[5]Lowest hazardous elevation is exceeded by assumed reservoir release and/or assumed 5% chance flood on Schuylkill River.

TABLE 4
POTENTIAL SECONDARY PROBLEMS STEMMING FROM INUNDATION
BLUE MARSH DAM AND LAKE[1]

Plate	Area[2]	Potential Secondary Problem Affecting Area
13A	1.	Exit roads inundated. Potential for isolation.
	2.	Exit roads inundated. Potential for isolation.
	3.	Exit roads inundated. Potential for isolation.
	4.	Exit roads inundated. Potential for isolation.
	5.	Exit roads inundated. Potential for isolation.

[1] Includes areas around periphery of lake.

[2] Key numbers as shown on Plates.

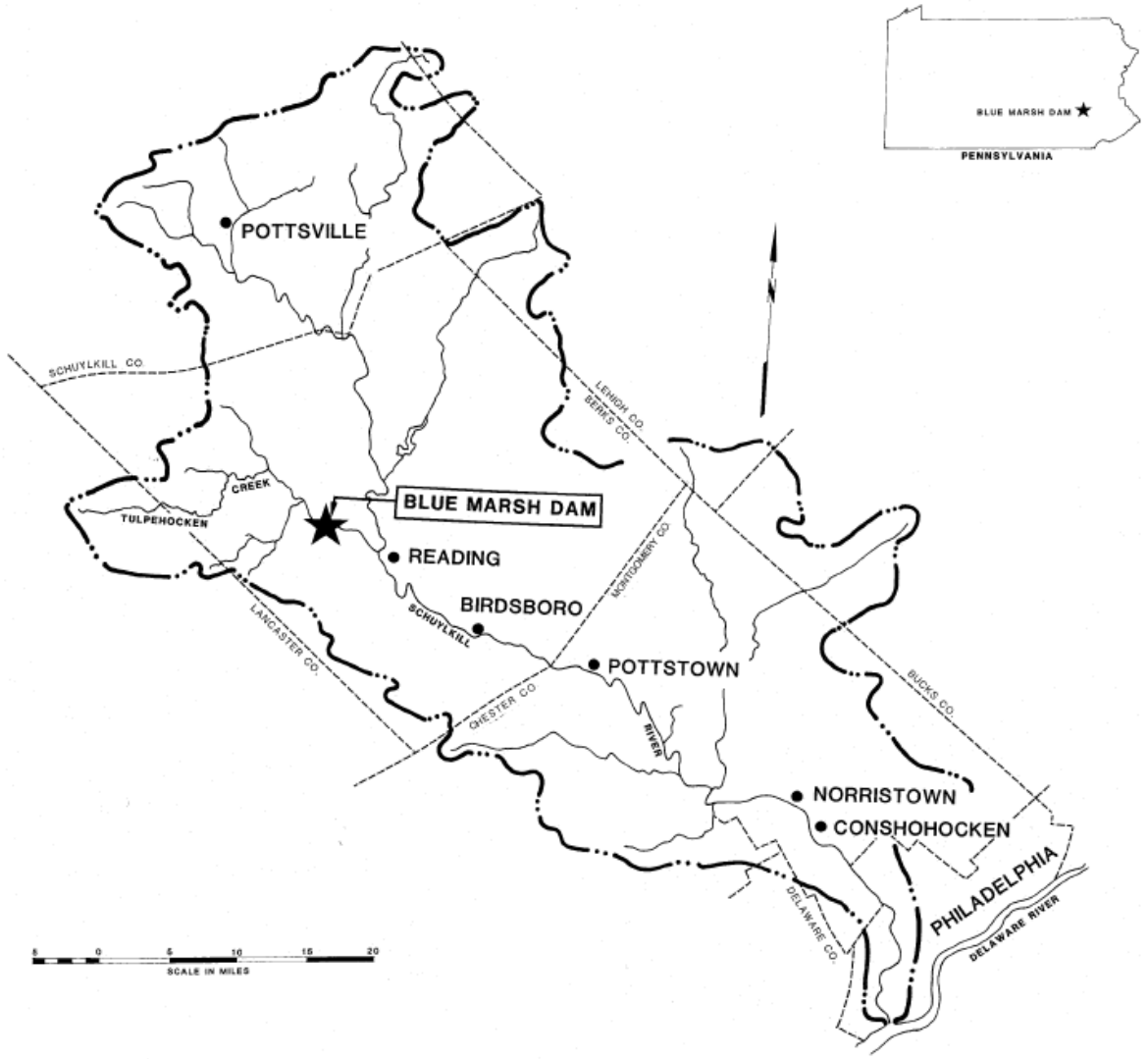
TABLE 5
CHARACTERISTICS OF EXISTING EVACUATION PLANS
BLUE MARSH DAM AND LAKE

Plan Characteristic	Plan 1	Plan[1] 2	Plan 3
Is plan written?			
Is plan current?			
Does plan have formal legal status through appropriate adoption or recognition by non-federal authorities?			
Does plan specify actions to be taken in sufficient detail to avoid indecision on whether or not to execute the plan and how it should be executed?			
Does plan make specific assignments of responsibility for its initiation and execution?			
Does plan cover all parts of the jurisdiction requiring evacuation?			
Is successful execution of plan in potential emergency situations reasonable in view of the warning time likely to be available for an emergency?			
Is plan consistent with various causes of emergencies likely to exist at time evacuation is required?			
Does plan evidence realistic analysis of means of warning and transporting evacuees, lane capacities of escape routes and other pertinent matters?			
Are equipment, personnel and materials required for execution of the plan identified?			
Does plan contain adequate provisions for updating, testing, practice and other maintenance activities to assure its continued viability?			

[1]Plans evaluated should include those for all areas that might become hazardous including areas upstream of dam.

d. Needed Evacuation Planning

[Appropriate section to be inserted based on evaluation of existing evacuation plans.]



(District Name)

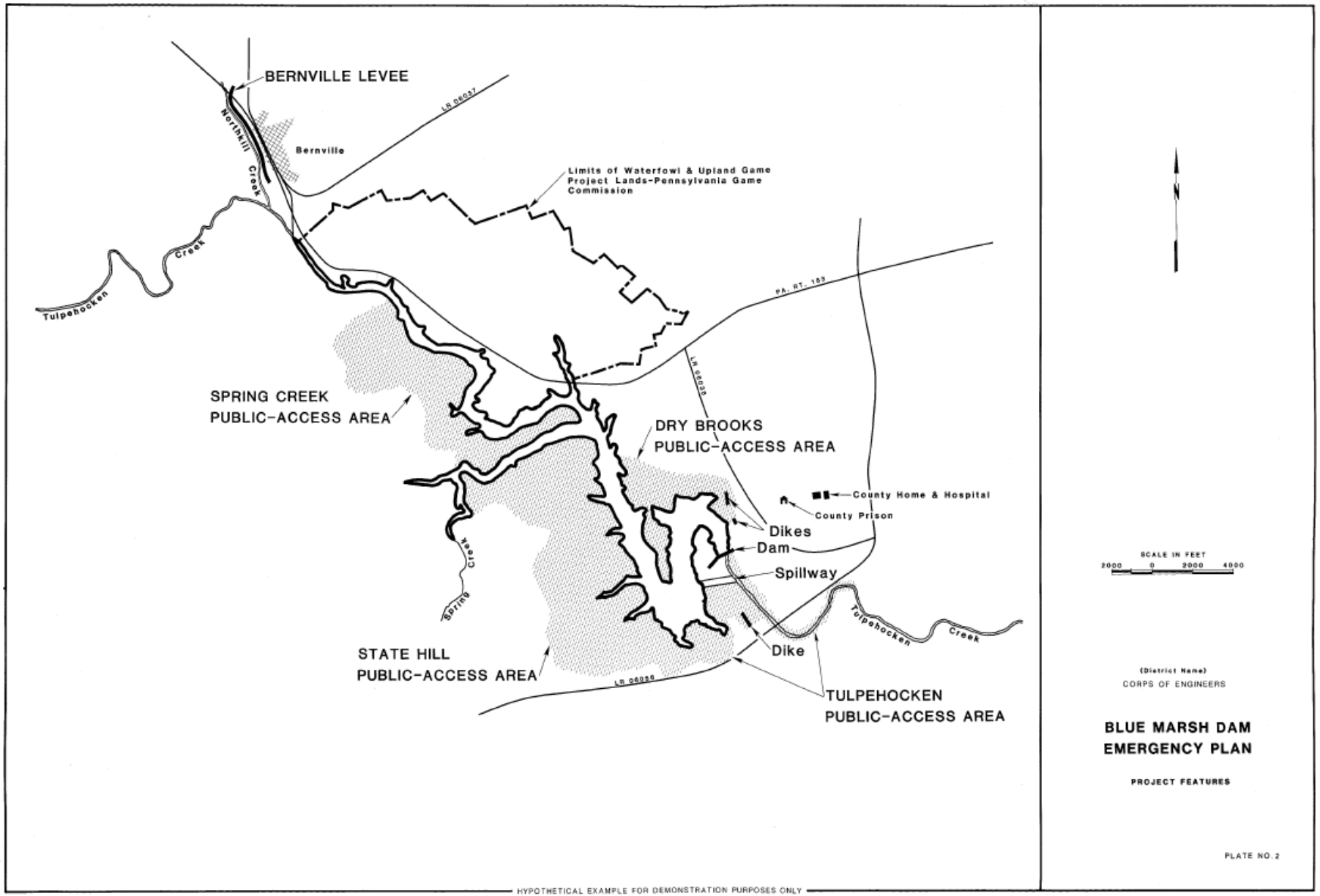
CORPS OF ENGINEERS

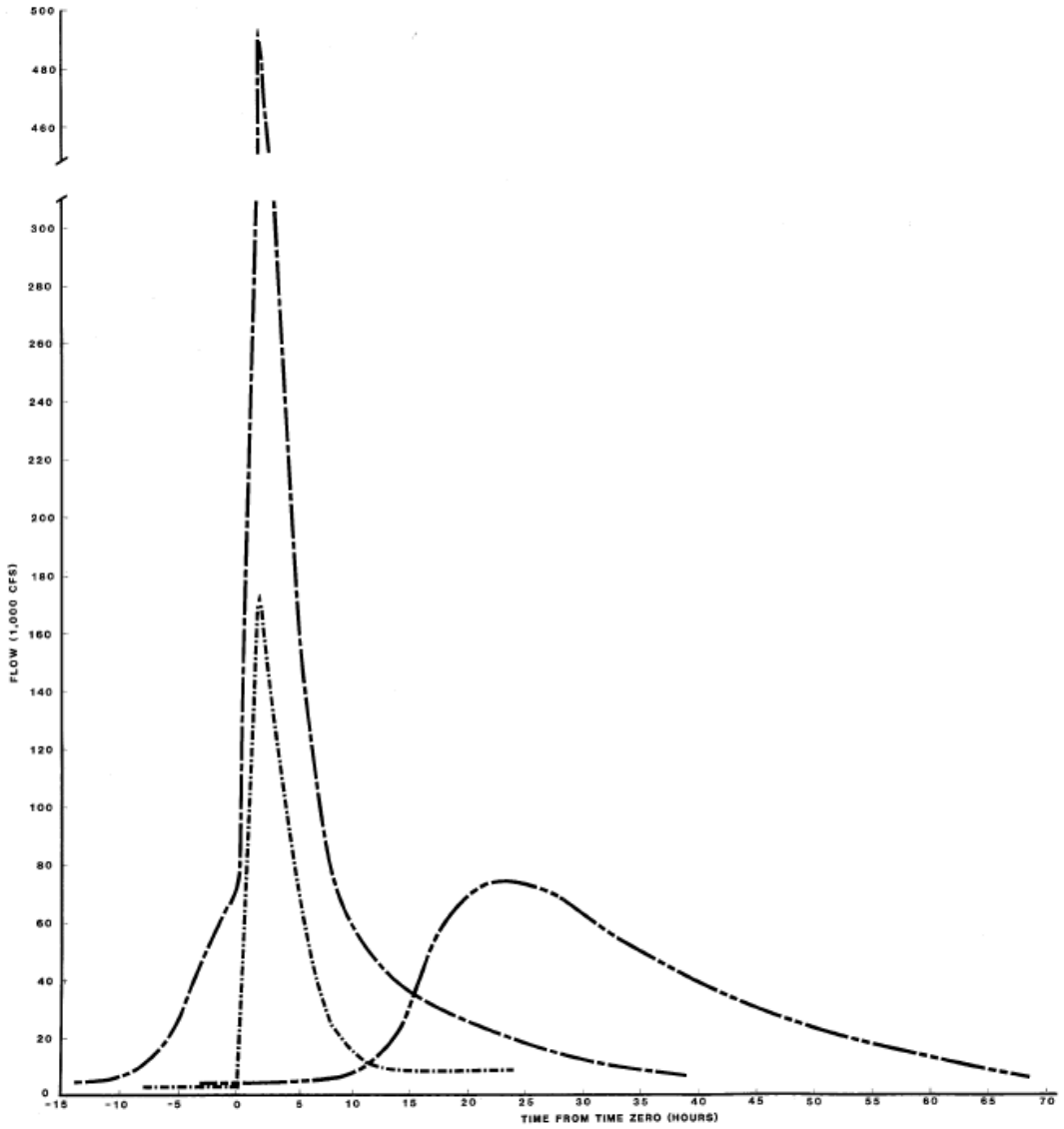
BLUE MARSH DAM EMERGENCY PLAN

LOCATION MAP

PLATE NO. 1

Hypothetical Example for Demonstration Purposes Only


BERNVILLE LEVEE
Northkill Creek
Bernville
LR 06037
Limits of Waterfowl & Upland Game Project Lands-Pennsylvania Game Commission
Tulpehocken Creek
PA. RT. 183
LR 06038
SPRING CREEK PUBLIC-ACCESS AREA
DRY BROOKS PUBLIC-ACCESS AREA
County Home & Hospital
County Prison
Dikes
Dam
Spillway
Spring Creek
Tulpehocken Creek
Dike
STATE HILL PUBLIC-ACCESS AREA
LR 06050
TULPEHOCKEN PUBLIC-ACCESS AREA
SCALE IN FEET
2000 0 2000 4000
(District Name)
CORPS OF ENGINEERS
BLUE MARSH DAM
EMERGENCY PLAN
PROJECT FEATURES
PLATE NO. 2
HYPOTHETICAL EXAMPLE FOR DEMONSTRATION PURPOSES ONLY



LEGEND

Spillway Design Flood
Spillway Design Flood with Failure
Failure at Normal High Pool Level

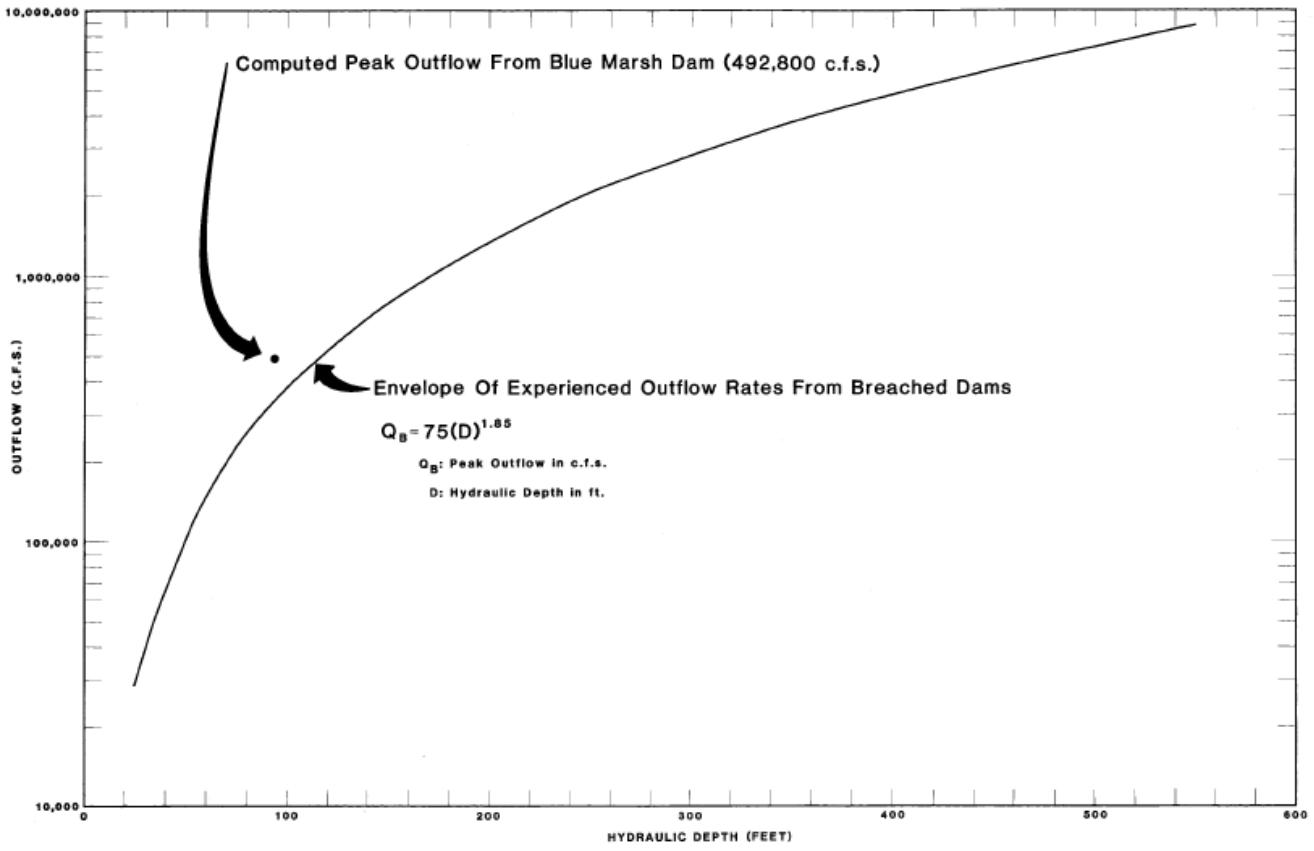
(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

DISCHARGE HYDROGRAPHS

PLATE NO. 3

Hypothetical Example for Demonstration Purposes Only



(District Name)

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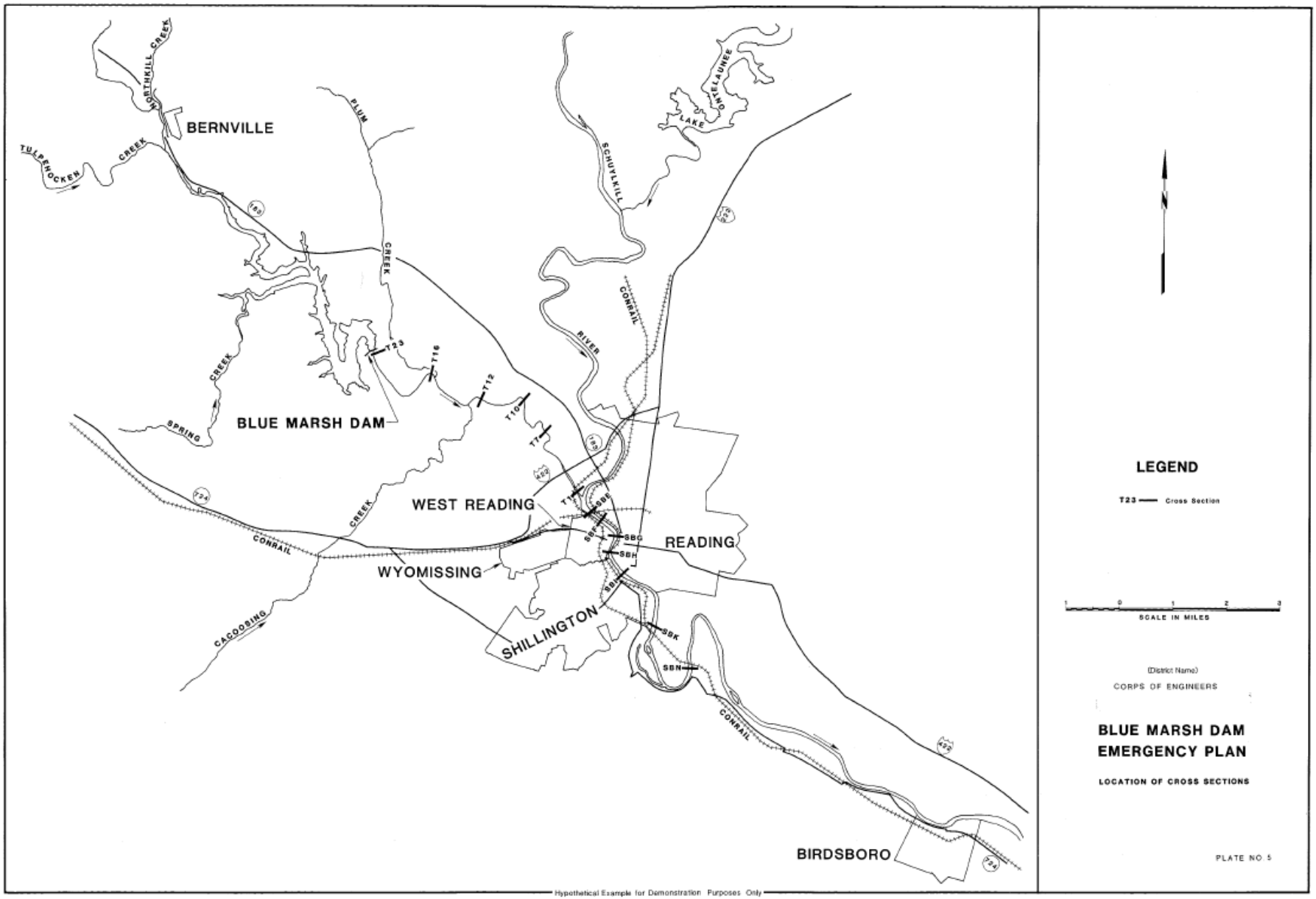
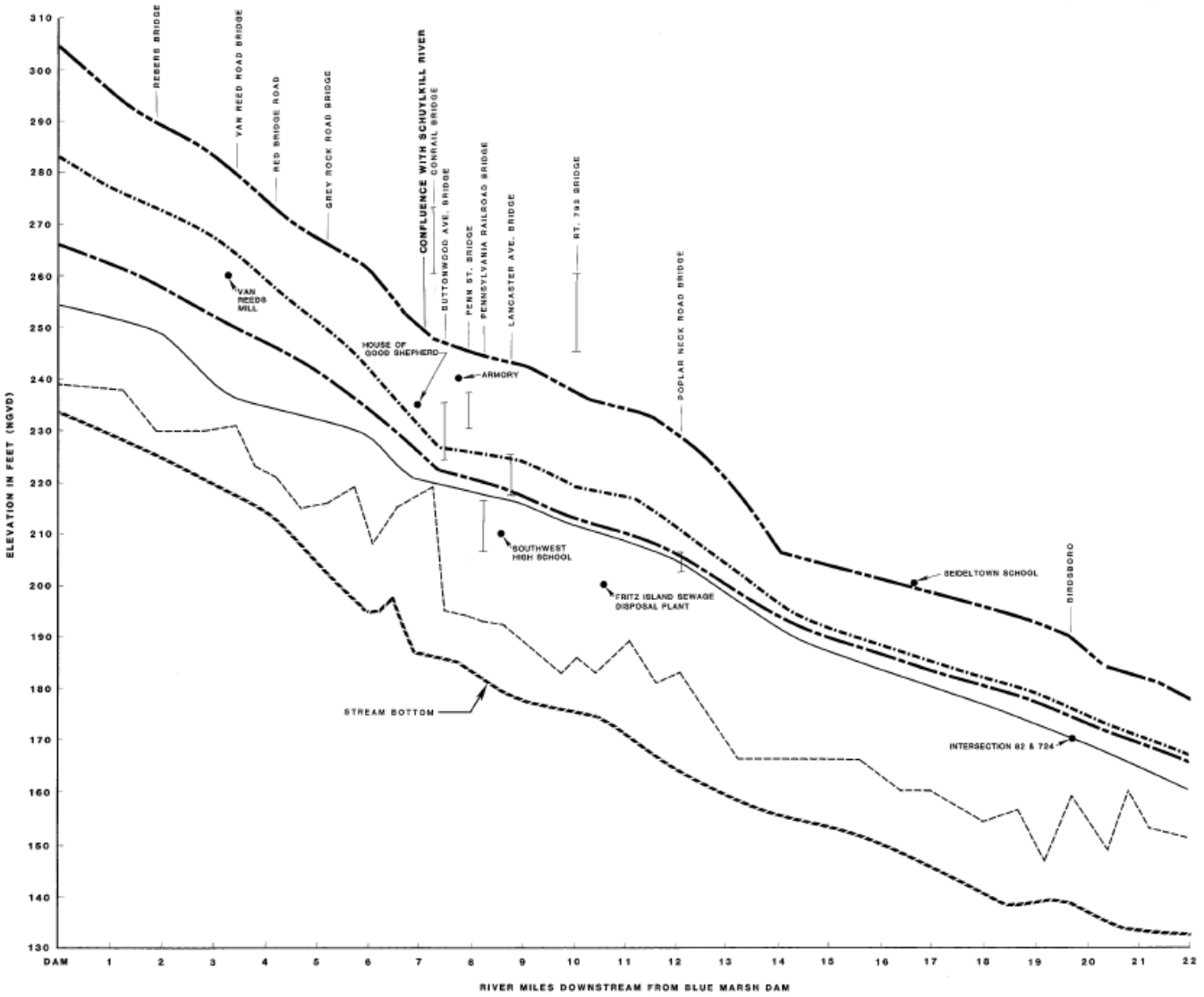
BLUE MARSH DAM EMERGENCY PLAN

COMPARISON OF COMPUTED OUTFLOW RATES

PLATE NO. 4

Hypothetical Example for Demonstration Purposes Only


NORTHKILL CREEK
BERNVILLE
TULPEHOCKEN CREEK
PLUM CREEK
SCHUYLKILL RIVER
LAKE ONTELAUNEE
CONRAIL
SPRING CREEK
BLUE MARSH DAM
T23
T16
T12
T10
T7
WEST READING
READING
WYOMISSING
SHILLINGTON
CACOOSING CREEK
BIRDSBORO
SBC
SBH
SBK
SBN
LEGEND
T23 Cross Section
SCALE IN MILES
(District Name)
CORPS OF ENGINEERS
BLUE MARSH DAM
EMERGENCY PLAN
LOCATION OF CROSS SECTIONS
PLATE NO. 5
Hypothetical Example for Demonstration Purposes Only



LEGEND

- Spillway Design Flood
- Spillway Design Flood With Failure
- Failure at Normal High Pool Level
- Tropical Storm Agnes
- Low Bank Elevation
- Approximate Ground Elevation At Noted Location
- Top of Roadbed or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTE: Crest profiles are approximate. A conservative margin of safety should be allowed in estimating peak water elevations. Tulpehocken flows may cause flooding on Schuylkill River upstream of confluence.

(District Name)

CORPS OF ENGINEERS

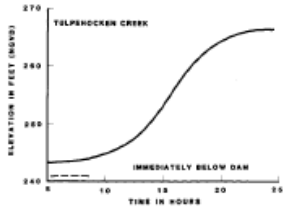
BLUE MARSH DAM EMERGENCY PLAN

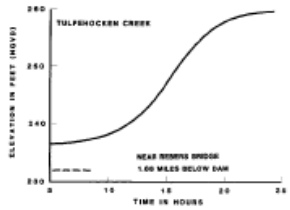
CREST PROFILES

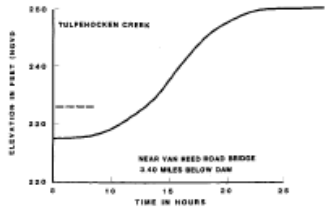
SEPTEMBER 1981

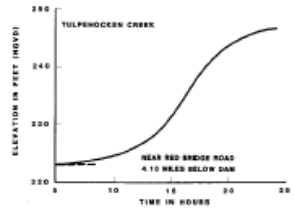
PLATE NO. 6

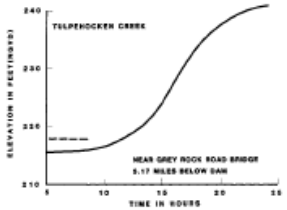
Hypothetical Example for Demonstration Purposes Only

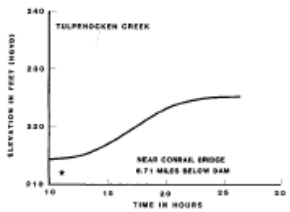


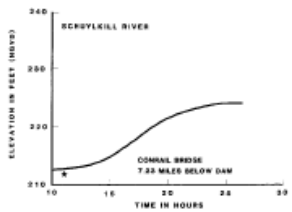


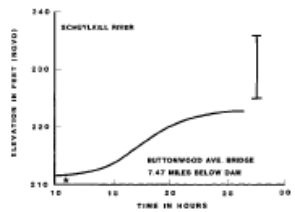


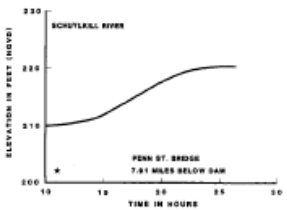


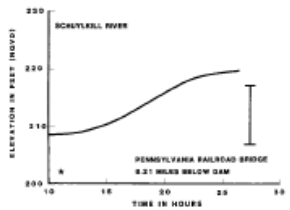


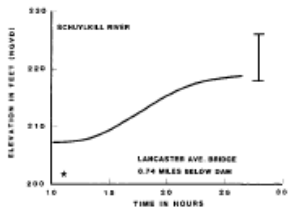


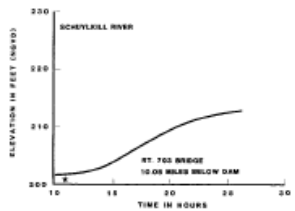


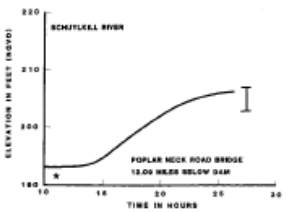












LEGEND

- Dangerous Elevation
- Top of Roadway or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTES:
1. Time is referenced to beginning of flow over spillway.
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage, whichever is lower. A ★ denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

(District Name)
CORPS OF ENGINEERS

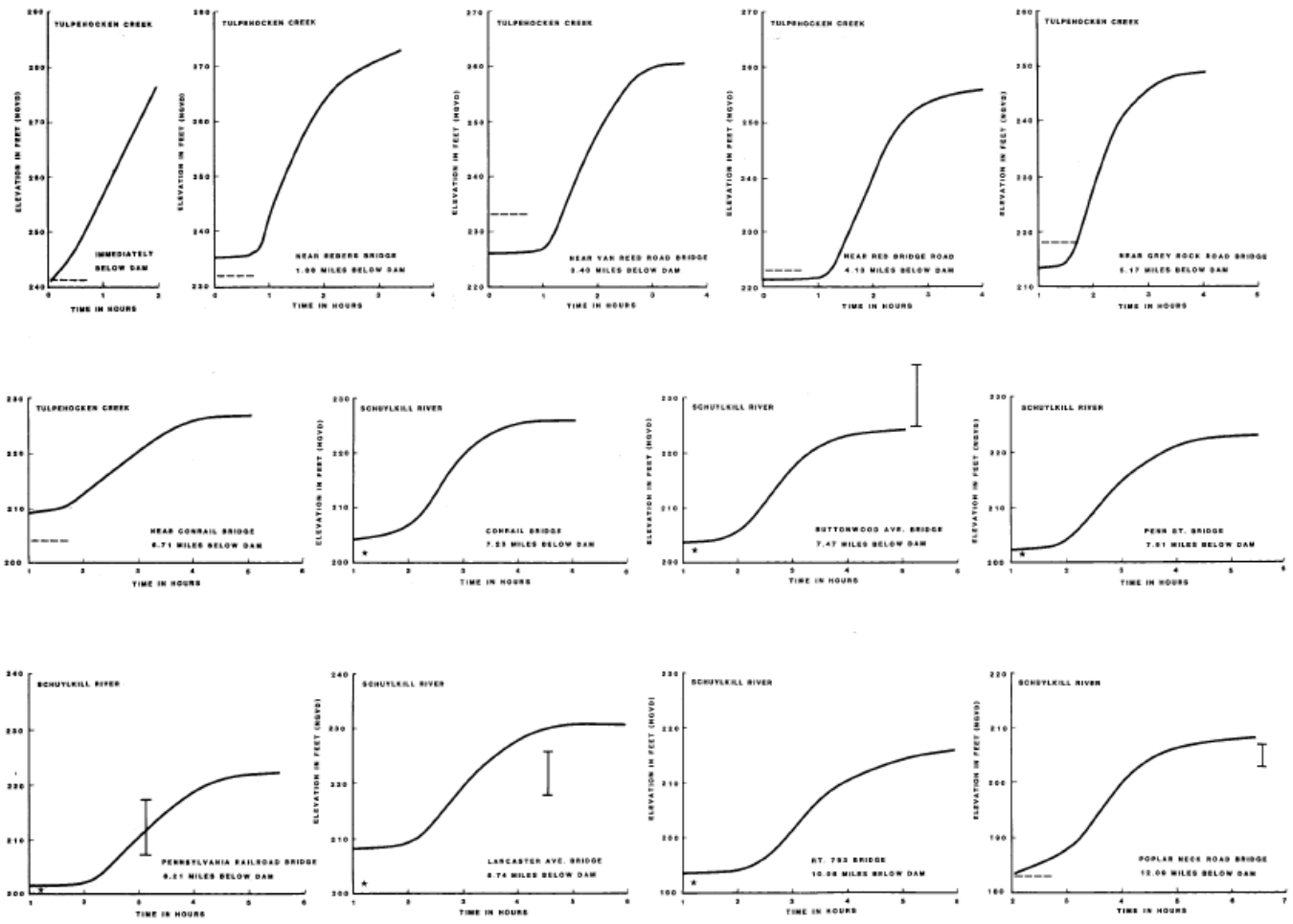
BLUE MARSH DAM
EMERGENCY PLAN

STAGE HYDROGRAPHS
FOR
SPILLWAY DESIGN FLOOD WITHOUT FAILURE
(APPROXIMATELY 75,000 C.F.S.)

PLATE NO 7

Hypothetical Example for Demonstration Purposes Only

PLATE NO. 8 NOT INCLUDED
SEE PLATE 13 FOR FORMAT



LEGEND

- Dangerous Elevation
- Top of Roadbed or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTES:
1. Time is referenced to the beginning of uncontrolled release of water (other than over spillway).
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage, whichever is lower. A ★ denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

(District Name)
CORPS OF ENGINEERS

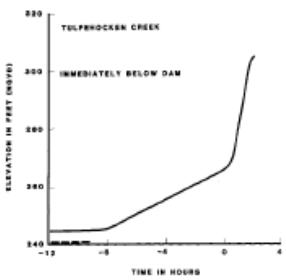
BLUE MARSH DAM
EMERGENCY PLAN

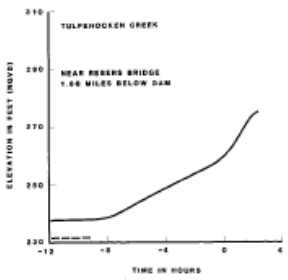
STAGE HYDROGRAPHS
FOR
FAILURE AT NORMAL HIGH POOL LEVEL
(APPROXIMATELY 217,000 C.F.S.)

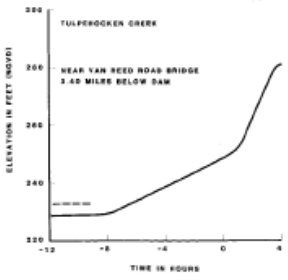
PLATE NO. 9

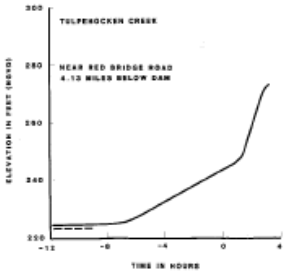
Hypothetical Example for Demonstration Purposes Only

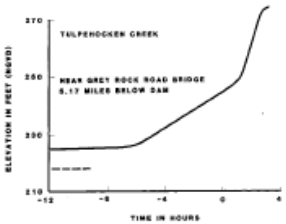
PLATE NO. 10 NOT INCLUDED
SEE PLATE 13 FOR FORMAT

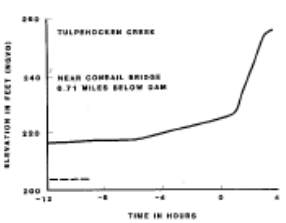


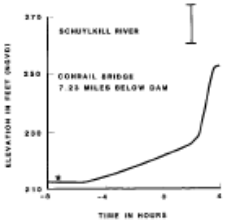


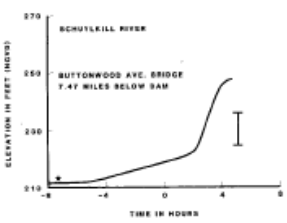


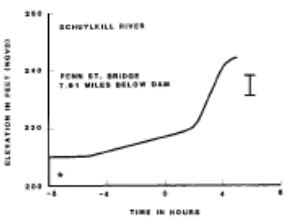


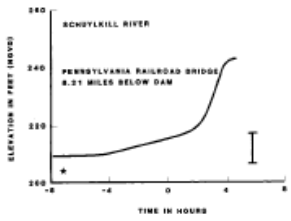


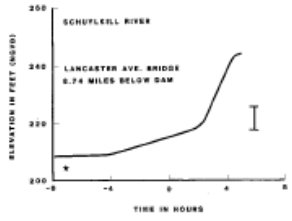


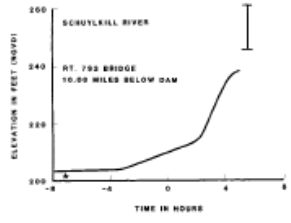


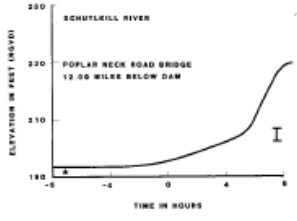












LEGEND

- Dangerous Elevation
- Top of Roadbed or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTES:
1. Time is referenced to beginning of uncontrolled release of water (other than over spillway).
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage,whichever is lower. A ★ denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

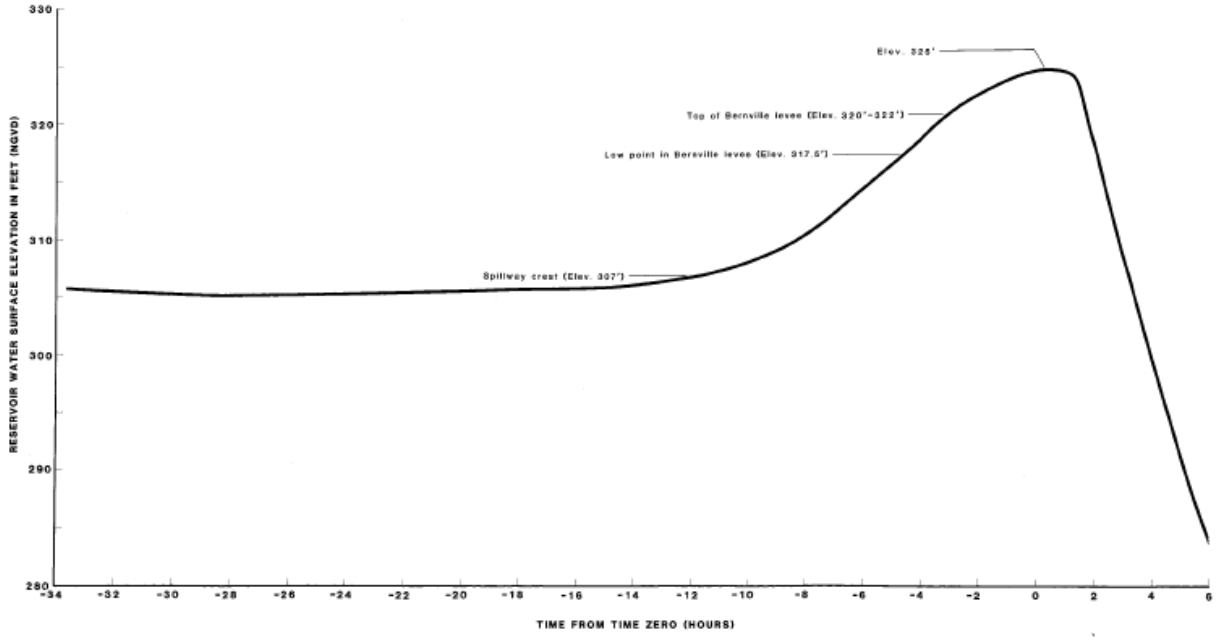
(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

STAGE HYDROGRAPHS
FOR
SPILLWAY DESIGN FLOOD WITH FAILURE
(APPROXIMATELY 493,000 C.F.S.)

PLATE NO. 11

Hypothetical Example for Demonstration Purposes Only



Hypothetical Example for Demonstration Purposes Only

NOTE: Reservoir elevation data is approximate. A conservative margin of safety should be allowed in estimating the time of occurrence of specific water elevations.

(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

RESERVOIR ELEVATION CHANGE
FOR
SPILLWAY DESIGN FLOOD WITH FAILURE
(APPROXIMATELY 493,000 C.F.S.)

PLATE NO. 12

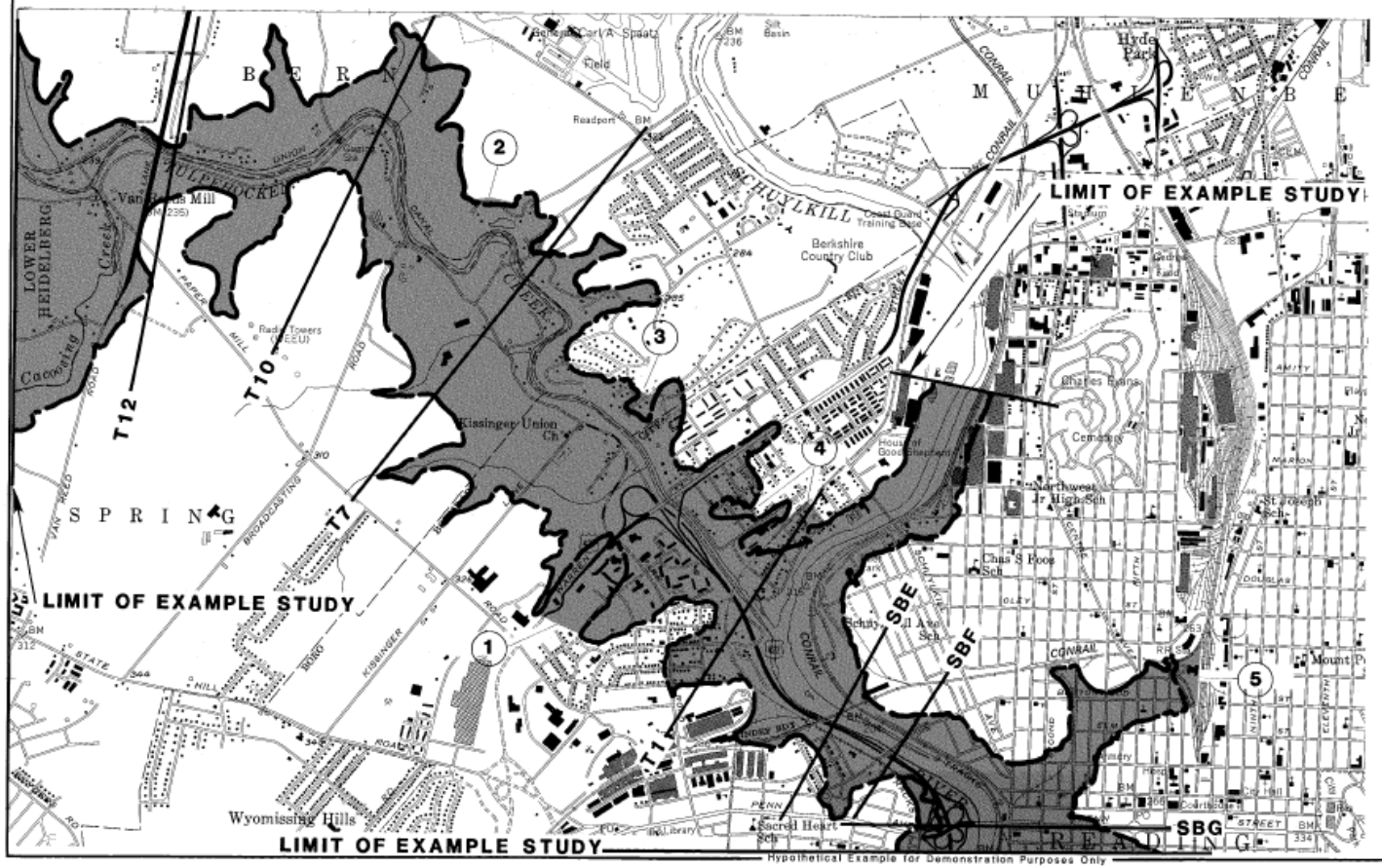
CROSS SECTION DATA

CROSS SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)	TIME OF ARRIVAL OF PEAK ELEVATIONS[a]	PEAK ELEV. (FEET)[b,c]
T12	Near Van Reed Road Bridge	3.40	2 Hrs. 42 Min.	280.6
T10	Near Red Bridge Road	4.13	3 Hrs. 0 Min.	273.3
T7	Near Grey Rock Road Bridge	6.17	3 Hrs. 12 Min.	267.6
T1	Near Conrail Bridge	6.71	3 Hrs. 48 Min.	253.9
SBE	Conrail Bridge	7.23	4 Hrs. 0 Min.	251.6
SBF	Buttonwood Ave. Bridge	7.47	4 Hrs. 24 Min.	247.4
SBG	Penn St. Bridge	7.91	4 Hrs. 30 Min.	243.9

[a] Measured from the time at which uncontrolled release of water begins (other than over the spillway).

[b] NGVD.

[c] Lowest hazardous elevation is exceeded by assumed reservoir release and/or assumed 25 year flood on Schuylkill River.



LEGEND

- Boundary of Inundated Area
- Area Affected by Inundation
- T7 Cross Section
- Corporate Limits

National Geodetic Vertical Datum of 1929

Sources of base map: U.S. Geological Survey 7.5minute series Reading, 1956 photorevised 1968 and 1974

NOTES:
1. The inundated area shown on this map reflects an event of an extremely remote nature. This map is not in any way intended to reflect upon the integrity of Blue Marsh Dam.
2. Boundaries shown are approximate. An ample margin of safety should be allowed in estimating the extent of flooding and time of arrival of dangerous water levels.

1/2 0 1/2
SCALE IN MILES

(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM EMERGENCY PLAN

INUNDATION BOUNDARY AND AFFECTED AREA FOR SPILLWAY DESIGN FLOOD WITH FAILURE (APPROXIMATELY 493,000 C.F.S.)

PLATE NO. 13

EMERGENCY IDENTIFICATION SUBPLAN

APPENDIX 1

TO

EXAMPLE EMERGENCY PLAN

FOR

BLUE MARSH DAM AND LAKE

EMERGENCY IDENTIFICATION SUBPLAN

APPENDIX 1
TO
EXAMPLE EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE

1. Introduction

Conditions affecting operation of Blue Marsh Dam and Lake could result in a hazard to life and/or property due to high lake levels and/or sudden release of large volumes of water. Early identification of the existance or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for identifying impending and existing emergencies affecting the operation and safety of Blue Marsh Dam and Lake.

b. Scope

This subplan deals with identification of impending or existing emergencies related to excess seepage, spillway flow, slope failure and sabotage. Instructions are included concerning:

(1) Monitoring and reporting of conditions.

(2) Communications between the project administration office, District office and Northern Area Office.

(3) Criteria for action including declaration of a Pre-Emergency or Emergency condition and activation of the Notification Subplan and/or Emergency Operations and Repair Subplan.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Blue Marsh Dam and Lake.

2. Definitions

a. Pre-Emergency

A "Pre-Emergency" condition is one in which some impending or existing threat to the safe operation of the dam or lake is identified but no

significant hazard to life or property is expected to occur. Declaration of a Pre-Emergency condition is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent or longer term. Declaration of an Emergency condition requires notification to others and issuance of warnings to evacuate potentially hazardous areas.

c. Dam Operator

The term "Dam Operator" means the Head Dam Operator or the individual in charge at the Blue Marsh Dam project site.

d. District

The term "District" means one of the following elements depending upon which is appropriate for the situation at hand.

(1) Hydrology and Hydraulics Branch (for matters involving lake regulation).

(2) Foundation and Materials Section (for matters involving structural integrity of dam).

(3) Emergency Operations Center

e. Northern Area Office

The term "Northern Area Office" means the person in charge of the Northern Area Office.

3. Responsibility for Conduct

a. Dam Operator

(1) Carrying out routine surveillance (paragraph 4.a.).

(2) Carrying out non-routine observations and measurements directed by District (paragraph 4.b.).

(3) Advising District of potentially hazardous situations (paragraph 4.c.).

(4) Maintaining proper records of communications (paragraph 5).

(5) Acting independently, when required by disruption of communications or the urgency of the circumstances, to declare a Pre-Emer-

gency or Emergency condition (paragraph 8) and to activate the Notification Subplan and/or Emergency Operations and Repair Subplan as appropriate.

b. Northern Area Office

(1) Providing assistance to Dam Operator and District as requested.

(2) Assuming responsibilities of District in event of disruption of communications between the project area and District office.

c. District

(1) Carrying out routine monitoring of conditions potentially affecting regulation of Blue Marsh Dam (paragraph 6.a.) and alerting the Dam Operator and Northern Area Office of situations requiring increased readiness and/or 24 hour supervision.

(2) Providing guidance to the Dam Operator on all potentially hazardous situations which arise and directing any non-routine observations and measurements needed to assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam (paragraph 6.b.).

(3) Providing personnel for on-site evaluation of potentially hazardous conditions relating to geology, soils and other aspects requiring expert analysis.

(4) Declaring the existance of Pre-Emergency and Emergency conditions and directing activation of the Notification Subplan and/or Emergency Operations and Repair Subplan.

(5) Activating the Reservoir Control Center as part of the Emergency Control Center when appropriate.

(6) Maintenance of the subplan (paragraph 9).

4. Observations, Tests and Reports by Dam Operator

a. Routine Observations and Tests

(1) Daily

(a) Snow cover, water content and predicted temperature (seasonal).

(b) Local precipitation.

(c) Local runoff (inflow and staff gage).

(d) Pool elevation (telemark and staff gage).

(e) Schuylkill River stage at Reading, Pennsylvania.

(f) Schuylkill River stage at Pottstown, Pennsylvania.

(g) Visual inspection for excess seepage at downstream face of embankment, weir, discharge pipes into outlet works, abutment areas, and valley floor immediately downstream of dam.

(h) Check weather forecast for area over NOAA Weather Radio (weather radios to be in standby mode at all times when not in use).

(i) Examine transmissions from all self-reporting precipitation and stream level gages to confirm operational status.

(j) Visual inspection for slope movement of both faces of all embankments which are in contact with standing water.

(2) Monday, Wednesday, Friday and After Change in Gate Setting

(a) Downstream recording gage.

(b) Gate setting.

(c) Seepage weir.

(3) Weekly

(a) Examine all areas of significant seepage for presence of fines.

(b) Interrogate telemark gages to confirm operational status.

(c) Test radio, bull horns and other communications equipment.

(d) Compare gaged outflow to outflow computed for gate settings.

(e) Test standby generators.

(4) Monthly

(a) Perform snow survey (seasonal).

(b) Inspect control structure including lifting equipment, operating equipment and controls, seals of watertight doors and gates, and other equipment and facilities.

(c) Read all piezometers.

(d) Check calibration of alarm on seepage measurement weir (to trigger at water elevation 1" above lowest point of notch).

b. Non-Routine Observations and Tests

(1) Perform comprehensive examination of seepage (amount, rate of change of flow, and presence of fines) whenever potential problems are observed or alarm on seepage measurement weir sounds.

(2) Monitor precipitation gages on hourly basis when significant rains are forecast or occurring.

(3) Monitor, stream level gages, lake inflow gage and lake level on hourly basis whenever rainfall exceeds 2.0 inches in any 12-hour period or less.

(4) Examine all areas of embankment hourly if evidence of significant slope failure is found (to be continued until directed by District to cease).

(5) Perform other observations and tests as directed by District.

(6) Read piezometers at more frequent intervals as required by dam safety checklist instructions.

c. Reports

(1) To the Chief, Hydrology and Hydraulics Branch

(a) Reports or predictions of precipitation of 2.0 inches or more in 12 hours or less in the vicinity of the dam.

(b) Water equivalent of snow on the ground above the project of 2.5 inches or greater, if warmer temperatures are predicted.

(c) Forecast or observed Schuylkill River stages at Reading or Pottstown if they will require gate operation.

(d) Pool elevation above normal seasonal rule elevation if gate changes are necessary to prevent further rise in pool elevation.

(e) Reported severe ice conditions or temporary constrictions downstream of dam.

(f) Apparent discrepency between outflow indicated by downstream recorder gage and outflow computed from gate settings.

(g) Any conditions likely to require a change in gate operations or mode of regulation.

(2) To the Chief, Foundation and Materials Section

(a) Any conditions indicating distress of an embankment.

(b) Indications of unusual seepage.

(c) Occurrence of earhquake or landslide into lake.

(3) To the National Weather Service Forecasting Center, Philadelphia

(a) All changes in controlled discharges.

(b) Imminent flow over spillway.

5. Records

The Dam Operator will keep a log of all telephone, radio or other communications received from or sent to District and National Weather Service. This log should be in a bound ledger or notebook used only as an official diary. Each communication will be described including:

a. Date.

b. Time.

c. Person called or calling.

d. Information transmitted.

e. Action requested by the District.

f. Action taken in response to request.

g. Result of action.

h. Remarks.

i. Initials of person receiving communications.

6. Observations, Tests and Alerts by District

a. Routine Observations and Tests

(1) Daily

(a) Check weather forecasts for areas affecting runoff into and releases from Blue Marsh Dam.

(b) Check existing and predicted flows in Schuylkill River Basin.

(2) Monthly

(a) Check concurrence of pool level readings from staff gage and recording gage.

(b) Check concurrence of outflow based on reservoir routing of inflows, gate settings, and downstream recording gage.

(c) Record, review and analyze piezometer and weir reading data.

b. Non-Routine Observations and Tests

Specify additional observations and tests by the Dam Operator and make additional observations and tests as necessary to:

(1) Assure proper functioning of all instrumentation.

(2) Assist in identification, confirmation or analysis of existing or impending threats to safe operation of the dam.

c. Alerts

Provide alerts to Dam Operator, appropriate District personnel and Northern Area Office when:

(1) Weather, ice or other conditions require heightened readiness, increased surveillance or the possible need for activation of the Emergency Operating Center.

(2) Consideration is being given to declaration of a Pre-Emergency or Emergency Condition.

7. Communications

a. Normal

Communications between the District, Dam Operator and Northern Area Office will normally be by telephone. Telephones at the project administration office, Northern Area Office and District's Emergency Operating Center will be manned on a 24-hour basis whenever a Pre-Emergency or Emergency condition is in effect at Blue Marsh Lake or at another site that can be affected by operation of Blue Marsh Dam. Office and home phone numbers of key District, Blue Marsh Dam, Northern Area Office and other personnel are listed in Table 1-1.

b. Back-Up

The radio communications network between the District Office, project administration office and Northern Area Office will be used to back-up telephone communications. Radios at the project administration office, Northern Area Office and District's Emergency Operating Center will be manned on a 24-hour basis whenever telephone service is disrupted while a Pre-Emergency or Emergency condition is is effect at Blue Marsh Lake or at another site that can be affected by operation of Blue Marsh Dam. Radio frequencies and call letters for pertinent parties are listed in Table 1-1.

TABLE 1-1
INFORMATION ON KEY CONTACTS

Party	Telephone No.		Radio	
	Office	Residence	Freq.	Call Letters
DISTRICT PERSONNEL				
Hydraulics-Hydrology Branch (call in order listed until contact established)				
(Names to be inserted)				
Foundations & Materials Section				
(Names to be inserted)				
Others (call in order listed)				
(Names to be inserted)				
NON-DISTRICT CONTACTS				
Western Berks Water Authority*				
Berks County Civil Defense				
Berks County Park Supt.*				
Berks County Police Net*				
Reading Police Department*				
Delaware County Sheriff*				
Philadelphia Police Department*				
Pennsylvania State Police*				
FBI (Philadelphia)				
FBI (Reading)				

*Potential sources of assistance in communications.

c. Emergency

During a situation when both radio and telephone communications between the District Office and project area are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are listed in Table 1-1 along with information for telephone and radio contacts.

8. Declaration of Pre-Emergency and Emergency Conditions

a. Responsibility

The District is responsible for the declaration of "Pre-Emergency" or "Emergency conditions in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Dam Operator from conferring with the District.

Pre-Emergency and Emergency declarations will be made by the Commander/District Engineer. The Chief of Planning/Engineering Division, members of Hydrology and Hydraulics Branch, Foundation and Materials Section and the Emergency Operating Center will provide input in the decision making process.

b. Conditions Warranting Declaration

Not every situation requiring declaration of a Pre-Emergency or an Emergency condition can be specified. Initiative must be exercised by all involved personnel and each situation judged individually on the basis of all relevant factors.

(1) Pre-Emergency

Examples of circumstances warranting declaration of a Pre-Emergency condition include:

(a) Lake level at elevation 304 or higher with either inflow exceeding outlet capacity or a forecast of significant inflows from precipitation and/or snowmelt.

(b) Malfunction of flood control gate system during flood operations which impedes release of water and creates potential for spillway flow.

(c) Minor seepage problems including: unexplained increases or decreases in amount, cloudy appearance of seepage or presence of fines, development of new seepage areas as indicated by soft boggy areas or new or lush vegetation, and substantial unexplained fluctuation in piezometer readings.

(d) Minor slope failures including: tension cracks at crest or in slopes of embankment, small bulges in slopes or in foundation near toe of slope, small depressions or sags in

crest or slopes, changes in horizontal crest alignment, and gullies forming in or near embankment or junction of the embankment and abutments.

(e) Threats of sabotage or occurrence of sabotage of non-critical project features.

(2) Emergency

Examples of conditions warranting declaration of an Emergency condition include:

(a) Imminent or occuring spillway flow including: lake at elevation 307 and inflow greater than maximum discharge capacity (approximately 5,400 c.f.s. at elev. 307) or lake level at elevation 306 with forecast of significant inflows from precipitation and/or snowmelt to cause spillway flow.

(b) Major seepage problems including: large increases in piezometer readings, movement of large amounts of material in existing or new seeps, pipes in embankment or foundation materials, seepage at higher elevations on downstrem face of dam or in abutment areas, and substantial increases in normal seepage amounts (especially when associated with movement of material from embankment of foundation.

(c) Major slope failures including: appreciable depressions or sloughs in the crest or slopes of the dam or bulges in the slopes or foundation, large gullies developing and continuing to erode in the embankment or at the junction of the embankment and abutments, displacement of structures or instrumentation on the dam and continuing expansion of tension cracks after their appearance on the dam crest or slope.

(d) Threats of sabotage or occurrence of sabotage to critical project features.

c. Action Upon Declaration

(1) Dam Operator

(a) Monitor telephones on 24-hour basis.

(b) Activate appropriate portions of Notification Subplan and Emergency Operations and Repair Subplan.

(c) Maintain 24 - hour monitoring/surveillance of situation responsible for declaration.

(d) Perform non-routine observations and tasks as directed by District.

(e) Test radio communications.

(f) Request assistance needed from District to perform (a) through (e) above.

(2) Northern Area Office

(a) Monitor telephones on 24-hour basis.

(b) Place all personnel on standby for emergency duty.

(c) Test radio communications.

(3) District

(a) Activate Emergency Operating Center.

(b) Monitor telephones on 24-hour basis.

(c) Test radio communications.

(d) Place key staff on standby for emergency duty.

(e) Provide detailed instructions to Dam Operator for any needed non-routine observations and tests.

(f) Dispatch personnel to dam site as required to provide expert evaluation of situation and to assist Dam Operator as needed.

(g) Activate appropriate portions of Notifications Subplan and Emergency Operations and Repair Subplan.

9. Subplan Maintenance

a. Updating

This subplan shall be updated as needed by the Chief, Hydrology and Hydraulics Branch, including:

(1) Annually.

(2) Whenever needed by modifications in instrumentation at or affecting the project, dam operating procedures, overall District emergency procedures, and/or changes of personnel.

b. Testing

The Chief, Hydrology and Hydraulics Branch shall annually direct a thorough inspection of all mechanical, electrical and other equipment pertinent to conduct of this subplan. The inspection shall include all tests, servicing and calibration necessary to ensure proper functioning.

c. Familiarization

The Chief, Hydrology and Hydraulics Branch, shall ensure all pertinent Corps personnel are aware of and familiar with this subplan including:

(1) Circulation of each updated version for review and signature by pertinent District staff, Northern Area Office and the dam operators.

(2) Annual review session with staff of the Hydrology and Hydraulics Branch and dam operators.

(3) Briefing, within two weeks of assuming duties, of all pertinent Hydrology and Hydraulics Branch staff.

(4) Briefing, before assumption of duties, of any new Head Dam Operator or Assistant Dam Operator.

EMERGENCY OPERATIONS AND REPAIR SUBPLAN

APPENDIX 2

to

EXAMPLE EMERGENCY PLAN

for

BLUE MARSH DAM AND LAKE

EMERGENCY OPERATIONS AND REPAIR SUBPLAN
APPENDIX 2
TO
EXAMPLE EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE

1. Introduction

Conditions affecting operation of Blue Marsh Dam and Lake could result in a hazard to life and/or property due to high lake levels or sudden release of large volumes of water. Prompt conduct of emergency operations and repairs is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for emergency operations and repairs to deal with impending and existing emergencies affecting the operation and safety of Blue Marsh Dam and Lake.

b. Scope

This subplan describes a reservoir dewatering plan and other emergency operations and repairs to be implemented upon declaration of a Pre-Emergency or Emergency condition. Operations and repairs are described for cases of:

(1) Excess seepage and/or malfunctioning of the dam's internal drainage system.

(2) Wave erosion and/or erosion of downstream face of embankment.

(3) Threatened sabotage.

(4) Sabotage.

(5) High reservoir level.

(6) Slope failure.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Blue Marsh Dam and Lake.

2. Definitions

a. Pre-Emergency

A "Pre-Emergency" condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent or longer term.

c. Dam Operator

The term "Dam Operator" means the Head Dam Operator or the individual in charge at the Blue Marsh Dam project site.

d. District

The term "District" identifies one of the following elements depending upon which is appropriate for the situation at hand.

(1) Hydrology and Hydraulics Branch (for matters involving reservoir regulation).

(2) Foundation and Materials Section (for matters involving structural integrity of dam).

(3) Emergency Operations Center.

e. Northern Area Office

Means the person in charge of the Northern Area Office.

3. Basis of Activation

This subplan is to be activated immediately upon declaration of a Pre-Emergency or Emergency Condition. (See Appendix 1, Emergency Identification Subplan for procedure of declaring a Pre-Emergency or Emergency Condition.)

4. Responsibilities

a. Dam Operator

(1) Provide information to District on existing severity and rate of change of problem.

(2) Request provision by District of needed assistance including:

(a) Personnel, including expert supervision.

(b) Equipment.

(c) Materials.

(3) Carry out operations and repairs as directed by District.

(4) Act independently to implement emergency operations and repairs in the event communications with the District and Northern Area Office are disrupted or immediate action is required including:

(a) Deciding the urgency of correction.

(b) Carrying out appropriate emergency operations and repairs for the type of emergency.

(c) Obtaining needed personnel, equipment and materials (see paragraph 12).

b. Northern Area Office

(1) Provide personnel, equipment and materials to Dam Operator as directed by District.

(2) Direct emergency operations and repairs in the event communications between the Dam Operator and District are disrupted.

c. District

(1) Assess problem and Dam Operator's request for assistance with respect to:

(a) Urgency for correction.

(b) Type of corrective actions required.

(c) Personnel required for corrective actions including requirements for expert advice and/or on-site supervision.

(d) Equipment and materials required for corrective actions.

(2) Provide direction to the Dam Operator on emergency operations and repairs to be carried out.

(3) Dispatch needed personnel, equipment and materials to the project from the District and Northern Area Office (see paragraph 12).

(4) Arrange for needed personnel, equipment and materials from sources other than District and Northern Area Office.

5. Reservoir Dewatering Plan

The objective of the reservoir dewatering plan is to rapidly lower the water level of Blue Marsh Lake. Dewatering is accomplished by opening one or more outlet gates, depending on the speed of dewatering that is required. The speed of dewatering required depends on the reason for dewatering.

Too rapid lowering of the lake level may have adverse effects on the strength and stability of Blue Marsh Dam. Specified rates of drawdown must be observed unless embankment failure is occurring or imminent.

Dewatering of the reservoir will not be undertaken unless directed by District or Northern Area Office, so long as communications between the Dam Operator and one of these offices are intact. Dewatering may be undertaken on the Dam Operator's initiative if communications with both the District and Northern Area Office are disrupted.

a. Procedure for Dewatering

(1) Determine dewatering rate required.

(2) Determine duration of releases required for dewatering.

(3) Formulate and issue warning message for downstream areas along Tulpehocken Creek (See Notification Subplan).

(4) Activate sirens in areas immediately below outlet works.

(5) Initiate gate openings in accord with paragraph 5.c.

b. Specified Discharge Rates

The maximum flow capable of being conveyed without damage by Tulpehocken Creek is 5,400 c.f.s. Dewatering discharges will be limited to that amount unless an Emergency condition has been declared and/or dam failure is imminent.

c. Gate Opening Schedules

Outlet gates shall be opened for dewatering in the following sequence and at or less than the specified rates unless embankment failure has occurred or is imminent:

(1) Water quality control gate: (automatic motor operated; no rate control).

(2) Service Gate No. 1: 0.5 ft. every 5 min.

(3) Service Gate No. 2: 0.5 ft. every 5 min. (may be opened simultaneously with Service Gate No. 1).

In the event of an existing or imminent failure of the embankment, all gates may be opened as rapidly as possible.

6. Emergency Operations and Repairs - Excess Seepage and/or Malfunction of Internal Drainage System

a. Potential Problems

Abnormal seepage may occur as rapid and/or significant increases in the amount of flow through the sand collection blanket or the seepage drains emptying into the outlet works; boils in the embankment or foundation; and creation of new seep areas on the downstream face of the embankment, foundation, abutments or areas immediately downstream of the embankment. Seepage high on the face of the embankment, large amounts of seepage, and seepage carrying fines are especially serious. Boils and seep areas may also be caused by malfunction of the dams internal drainage system. Excess seepage problems are most likely to occur when the lake water level is at higher than normal elevation.

b. Corrective Action

Individual boils or small areas of seepage can often be controlled on a temporary basis by ringing them with sand bags or other materials. Figure 2-1 illustrates the general procedure for ringing small boils and includes information useful in estimating the amount of personnel and material requested. Longer-term control and control of large areas of seepage can be effected by covering the area with a 3- to 5-feet deep granular blanket graded from coarse sands at the bottom to coarse gravels at the top. Figure 2-2 illustrates the concept of a granular blanket and includes information useful in estimating the amount of personnel, equipment and materials required. Lowering of the reservoir pool level reduces pressure on seepage areas and aids in control (see dewatering plan, paragraph 5). Additional methods of control may be required in some cases.

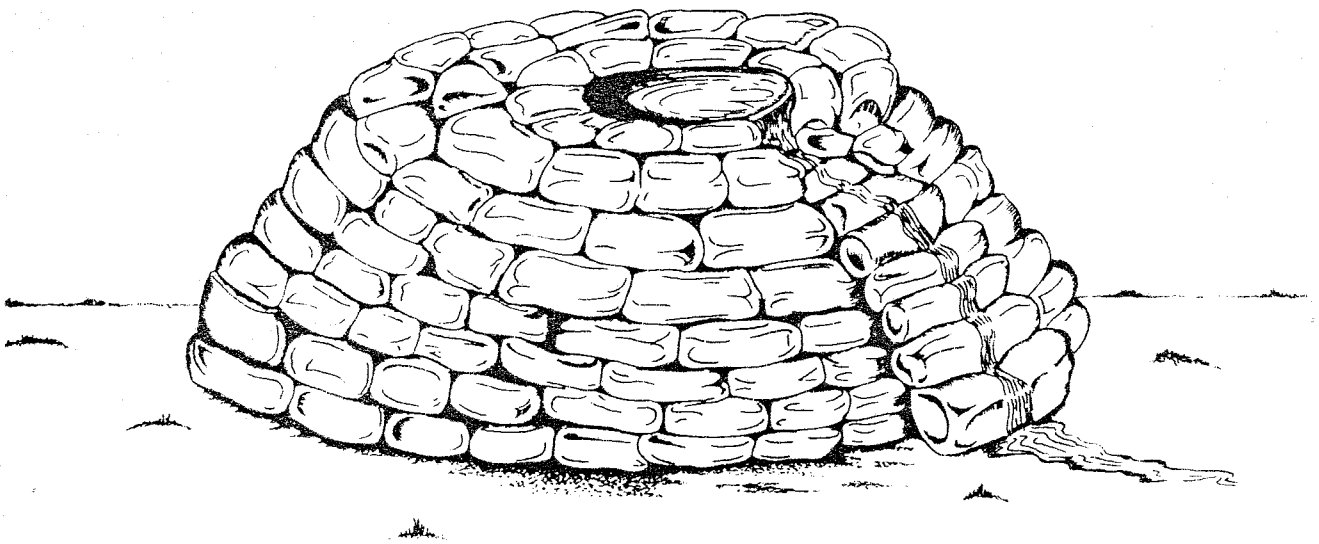
7. Emergency Operations and Repairs - Wave Damage and/or Erosion of Downstream Face of Embankment

a. Potential Problems

Wave damage may occur during periods of high westerly winds. Damage may include displacement of riprap and/or erosion of the underlying materials causing collapse of the riprap. Wave damage is particularly serious during abnormally high reservoir pool levels when serious erosion can cause a sudden collapse of the crest with subsequent overtopping of the embankment. The downstream face of the embankment is also subject to erosion due to runoff from heavy rains and waves breaking over the top of the embankment.

b. Corrective Action

The type of corrective action that is appropriate depends on the severity of damage, rate of progression of damage, and urgency of action. Temporary protection above and within 10-12 feet below the waterline can be provided quickly by use of plywood sheets, prefabricated panels or canvas as shown in Figure 2-3 or by filling eroded areas with sandbags. Tables 2-1 through 2-4 provide information useful in estimating the amount of personnel and materials required. Protection further below the water level can be provided by dumping riprap in the affected area. In cases of severe erosion, lowering of the reservoir pool level can shift wave forces to a lower

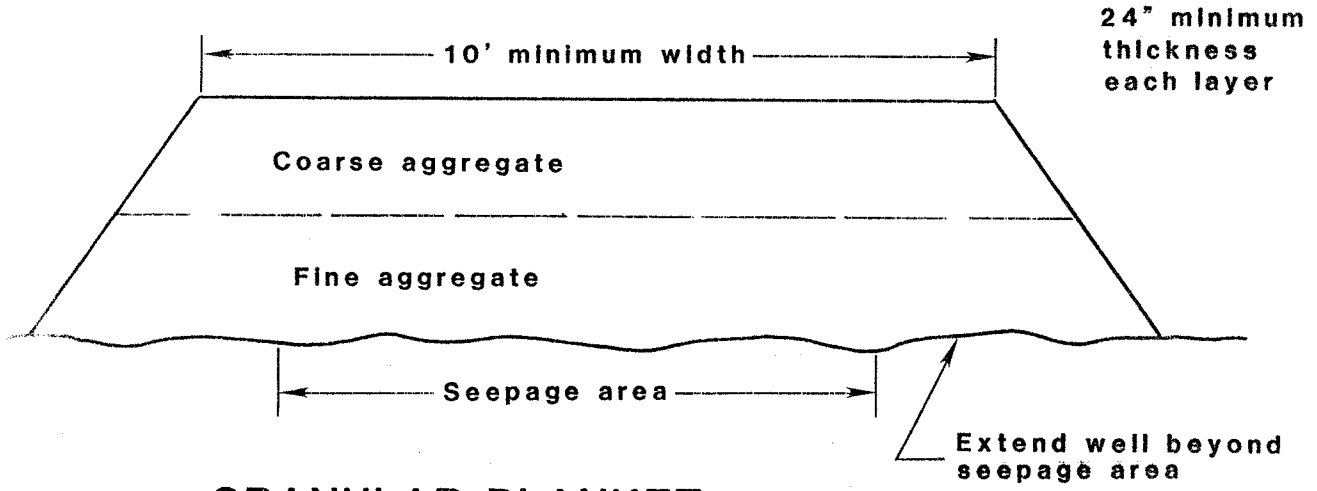


APPROXIMATE CONSTRUCTION REQUIREMENTS

Boil Dia. (ft.)	2			4			6			8			10		
Ring Height (ft.)	2	4	6	2	4	6	2	4	6	2	4	6	2	4	6
Vol. Sand Req'd.($Yd.^3$)	1	7	18	2	9	21	3	11	25	3	13	29	4	14	33
Sandbags Req'd.	124	475	1150	160	600	1400	197	707	1600	233	824	1850	270	921	2100
Personnel Req'd.	5	5	5	10	10	10	20	20	20	25	25	25	30	30	30
Time to Complete (Hrs.)	1	3	7	1	3	5	2	3	4	2	3	4	2	3	4

Note: Ring diameter is boil diameter plus 3 feet.

FIGURE 2-1. BOIL RING

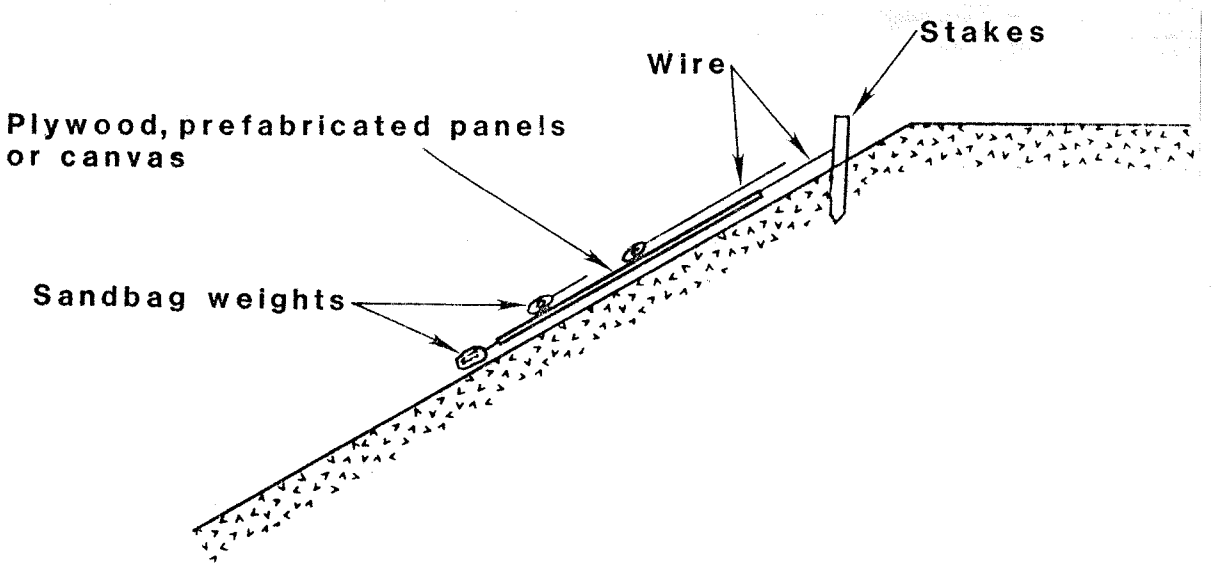


GRANULAR BLANKET

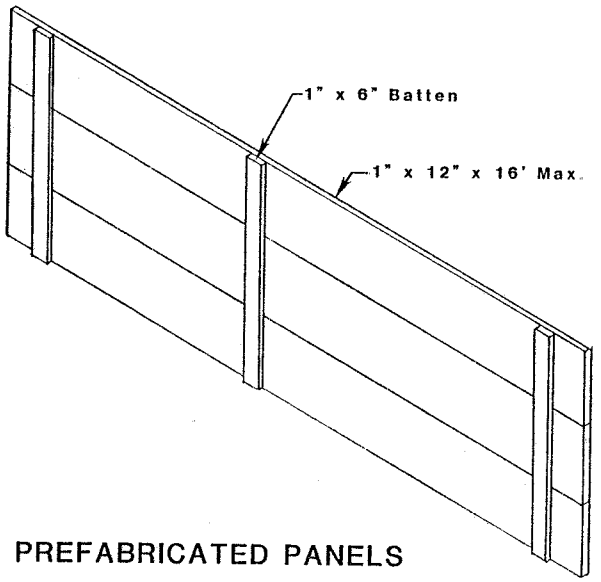
APPROXIMATE CONSTRUCTION REQUIREMENTS

Blanket Area ($ft.^2$)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
Material Req'd Per Layer ($yd.^3$)	40	80	120	150	190	225	270	300	330	370
No. Trucks & Drivers	3	3	6	6	6	8	10	10	12	12
No. Graders & Operators	5	5	10	10	15	15	15	20	20	20
Total Time Req'd. (Hrs.)	4	8	6	8	8	8	8	8	9	10

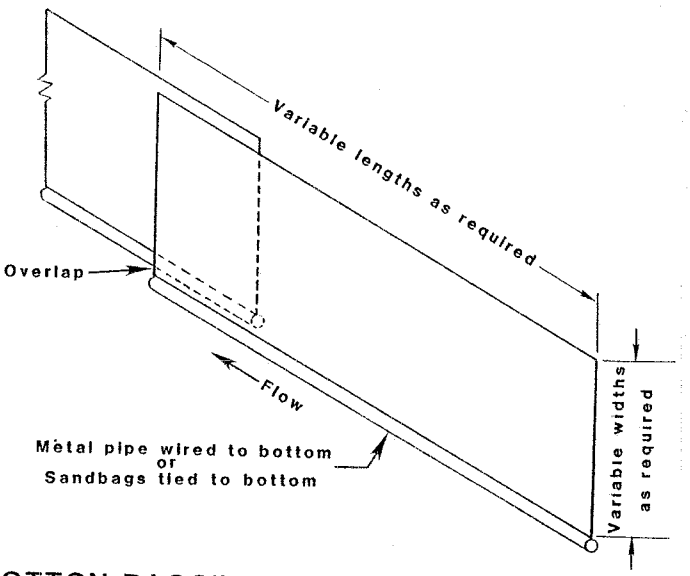
FIGURE 2-2. GRANULAR BLANKET



GENERAL SCHEME FOR TEMPORARY EROSION PROTECTION



PREFABRICATED PANELS



COTTON BAGGING OR CANVAS

FIGURE 2-3. TEMPORARY EROSION PROTECTION

TABLE 2-1
APPROXIMATE REQUIREMENTS
FOR
EROSION PROTECTION WITH PLYWOOD

Length To Be Protected	No. Plywood Sheets Req'd.	No. Stakes Req'd.	No. Sandbags Req'd.	Personnel Req'd.	Hours To Complete
10	3	8	15	6	1.5
20	5	13	25	6	2.5
30	8	20	40	6	3.0
40	10	25	50	6	3.5
50	13	33	65	6	4.0
60	15	38	75	6	5.0
70	18	45	90	10	3.5
80	20	50	100	10	3.5
90	23	58	115	10	4.0
100	25	63	125	10	4.5
150	38	95	190	16	5.0
200	50	125	250	16	4.0
300	75	188	375	20	6.0
400	100	250	500	24	6.0

TABLE 2-2
APPROXIMATE REQUIREMENTS
FOR
EROSION PROTECTION WITH PREFABRICATED PANELS

Length to Protect (ft)	100		200		300		400		500		1000	
No. Panels Req'd. (@ 16' ft)	7		13		19		25		32		63	
Panel Width (ft)	3	5	3	5	3	5	3	5	3	5	3	5
Length 1" X 12" Req'd. (ft)	340	630	625	1170	900	1700	1200	2250	1500	2900	3000	5700
Length 1" X 6" Req'd. (ft)	80	140	160	260	230	380	300	500	400	640	750	1300
Stakes Req'd.	30	30	60	60	90	90	115	115	150	150	300	300
Sandbags Req'd.	35	60	70	100	100	150	125	200	160	250	320	500
Time to Complete	3	4.3	4.3	5.3	2.9	3.6	3.6	4.7	4.5	5.8	5.6	7.3
No. Personnel	8	8	8	8	16	16	16	16	16	16	24	24

TABLE 2-3
APPROXIMATE REQUIREMENTS
FOR
EROSION PROTECTION WITH CANVAS

Length To Be Protected	Length Canvas Req'd.	No. Stakes Req'd.	No. Sandbags Req'd.	Personnel Req'd.	Hours To Complete
10	35	15	30	6	1
20	50	20	40	6	1.5
30	80	35	60	6	2.0
40	100	40	70	6	2.5
50	130	55	100	6	3.0
60	150	65	110	6	3.5
70	160	70	120	6	4.0
80	190	85	150	6	4.5
90	210	90	160	10	3.3
100	350	100	180	10	3.5
150	400	150	275	10	4.8
200	500	200	350	16	4.3
300	700	300	520	20	4.8
400	1000	400	700	24	5.0

TABLE 2-4
APPROXIMATE REQUIREMENTS
FOR
FILLING AREAS WITH SANDBAGS

Volume (ft^3)	No. Bags Req'd.	Personnel Req'd.	Hours to Complete
100	250	6	1.5
200	500	6	3
300	700	6	4
500	1500	10	3.5
1000	2500	10	6.5
2000	4700	14	8.5
3000	7000	24	8
4000	9500	34	7.5
5000	11,700	38	8

elevation (See dewatering plan, paragraph 5). Repairs normally require reconstruction of the eroded slope and replacement of both bedding materials and riprap. Lowering of the pool level is usually required prior to making permanent repairs on the upstream face of the dam.

8. High Reservoir Level

a. Potential Problems

High reservoir levels cause large hydrostatic forces on the dam, reduce freeboard available to contain wave action and reduce the capability of the dam to impound major inflows without overtopping or uncontrolled spillway flow. High reservoir levels contribute to excess seepage, piping, wave erosion and other safety problems. High water levels can also result in property damage and creation of safety problems around the periphery of the lake. Sufficiently high water levels will overtop the Bernville levee.

b. Corrective Action

The only corrective action for high water levels is increasing releases. When necessary, this should be done in accord with the dewatering plan (paragraph 5).

9. Slope Failure

a. Potential Problems

Slope failure may occur as the mass movement of a portion of the embankment. Such failures weaken the dam and, if located sufficiently high on the embankment may cause a breach or lead to collapse of the dam crest. Slope failures of any significant magnitude are serious and require immediate corrective action.

b. Corrective Action

(1) Dewatering of the reservoir (paragraph 5) should be begun in the event of any slope failure that is sufficiently serious to threaten the safety of the dam and which is located below the existing lake level. Dewatering should be continued until the lake level is equal to or lower than the bottom of the area of slope failure.

(2) Dewatering of the reservoir (paragraph 5) should be begun in the event of any slope failure intersecting the crest or which could lead to collapse of the crest. Dewatering should be continued until sufficient capacity exists below the bottom of the slope failure to impound all inflows anticipated in the coming 24 hours, assuming continuing discharges at a rate of 5,400 c.f.s.

(3) Immediate treatment of slope failures consists of filling slide areas with rip rap, sand bags or a granular blanket. The preferred method depends on materials and labor available and the urgency of action. When the urgency of the situation permits, filling of slide areas will be carried out under supervision of District staff and constitute rebuilding of the affected portion of the embankment. Immediate treatment in urgent situations will consist of filling slide areas with sand bags, riprap or other available materials.

10. Threatened Sabotage

a. Potential Problems

Sabotage by professional saboteurs or terrorists is not likely to be preceded by threats. Threats of sabotage are therefore most likely to be received from non-professionals lacking modern weapons, high explosives or sophisticated knowledge about the design and operation of the dam and its appurtenent facilities. However, all such threats are to be taken seriously. Threats considered most probable to occur are those related to disruption of communications, blocking access to the project, and interference with project operations. Threats could also relate to damaging the embankment or other key project features affecting safety.

b. Corrective Action

(1) All threats concerning Blue Marsh Dam will be reported immediately to the Philadelphia Office of the Federal Bureau of Investigation and to the District's Hydraulics and Hydrology Branch.

(2) Immediate assistance to secure and protect the dam, dikes and appurtenent facilities will be requested in the event a threatened action could jeopardize the safety of project visitors and staff or downstream areas if carried out. Agencies from which law enforcement assistance can be obtained are listed in Table 2-5.

(3) Every effort shall be made to operate Blue Marsh Dam so as to avoid injury to all parties. However, the catastrophic consequences of dam failure require that actions necessary to maintain the safety of the dam must not be compromized by persons seeking to block access to the site, limit reservoir levels or releases, or otherwise impede essential operations.

TABLE 2-5
SOURCES OF LAW ENFORCEMENT ASSISTANCE

Agency	Telephone Numbers		Radio Freq.	Call Letters
	Home	Office		
Burks Co. Sheriffs Dept.				
Bernville Police				
Pennsylvania State Police				
Waterways Patrolman				

11. Sabotage

a. Potential Problems

Acts of sabotage may range from minor disruptions to quasi-military attacks by knowledgeable and well equipped professionals. The effects of sabotage fall into one of three categories: a) not affecting safety of the dam; b) posing a minor or future safety problem; or c) posing an immediate, serious safety problem.

b. Corrective Actions

(1) All acts of sabotage will be reported immediately to the Philadelphia office of the Federal Bureau of Investigation and to the District's Hydraulics and Hydrology Branch.

(2) Immediate remedial action shall be initiated in all cases of sabotage causing an imminent or future safety problem of a serious nature. As appropriate, remedial action shall include:

(a) Declaration of an Emergency condition and activation of the Notification Subplan.

(b) Activation of dewatering plan (paragraph 5).

(c) Initiation of emergency repairs according to the nature of damage.

12. Inventory of Resources

Resources available for carrying out emergency operations and repairs are listed in Tables 2-6, 2-7 and 2-8. Sources of additional resources are listed in Table 2-9.

TABLE 2-6
RESOURCES AVAILABLE AT BLUE MARSH PROJECT SITE

Item	Number Available	Location
EQUIPMENT		
(To be inserted)		
MATERIALS		
(To be inserted)		
LABOR		
(To be inserted)		

TABLE 2-7
RESOURSES AVAILABLE AT NORTHERN AREA OFFICE

Item	Number Available	Location
EQUIPMENT		
(To be inserted)		
MATERIALS		
(To be inserted)		
LABOR		
(To be inserted)		

TABLE 2-8
RESOURCES AVAILABLE AT DISTRICT OFFICE

Item	Number Available	Location
EQUIPMENT		
(To be inserted)		
MATERIALS		
(To be inserted)		
LABOR		
(To be inserted)		

TABLE 2-9
SOURCES OF ADDITIONAL RESOURCES

Item	Source Name	Location	Telephone No.
EQUIPMENT			
(To be inserted)			
MATERIALS			
(To be inserted)			
LABOR			
(To be inserted)			

EMERGENCY NOTIFICATION SUBPLAN

APPENDIX 3

TO

EXAMPLE EMERGENCY PLAN

FOR

BLUE MARSH DAM AND LAKE

EMERGENCY NOTIFICATION SUBPLAN

APPENDIX 3
TO
EXAMPLE EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE

1. Introduction

Conditions affecting operation of Blue Marsh Dam and Lake could result in a hazard to life and/or property due to high lake levels or sudden release of large volumes of water. Prompt issuance of appropriate notifications is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for issuing notifications of impending and existing emergencies affecting the operation and safety of Blue Marsh Dam and Lake.

b. Scope

This subplan specifies notifications and other actions to be taken upon declaration of a Pre-Emergency or Emergency condition. Notifications and actions specified are those necessary for:

(1) Ensuring safety.

(2) Vacating project areas where emergency operations and repairs may be conducted.

(3) Internal coordination of Corps of Engineers activities.

(4) Coordination with non-Federal units of government and other Federal agencies.

c. Applicability

This subplan is applicable to all Corps elements and field offices concerned with operation of Blue Marsh Dam and Lake.

2. Definitions

a. Pre-Emergency

A "Pre-Emergency" condition is one in which some impending or existing threat to the safe operation of the dam or lake is identified but no significant hazard to life or property is expected to occur.

b. Emergency

An "Emergency" condition is one in which the occurrence of a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent or longer term.

c. Dam Operator

The term "Dam Operator" means the Head Dam Operator or the individual in charge at the Blue Marsh Dam project site.

d. District

The term "District" identifies one of the following elements depending upon which is appropriate for the situation at hand.

(1) Hydrology and Hydraulics Branch (for matters involving lake regulation).

(2) Foundation and Materials Section (for matters involving structural integrity of dam).

(3) Emergency Operations Center.

e. Northern Area Office

Means the person in charge of the Northern Area Office.

3. Basis of Activation

This subplan is to be activated immediately upon declaration of a Pre-Emergency or Emergency Condition.

4. Parties to be Notified

a. Corps Offices

Corps Offices to be notified of all Pre-Emergency or Emergency conditions that are declared are listed in Table 3-1.

b. Other parties

Other parties to be notified according to the nature of an emergency or pre-emergency condition are listed in Table 3-2.

c. For High Lake Levels

Additional parties to be notified in the event of anticipated high lake levels are listed in Table 3-3.

TABLE 3-1
CORPS OFFICES NOTIFICATION LIST
FOR ALL DECLARED EMERGENCIES AND PRE-EMERGENCIES

Office[1]	Telephone Number		Radio	
	Office	Residence	Freq.	Call Letters
Dam Operator				
(Head Dam Operator)				
(Assistant Dam Operator)				
(Park Superintendent)				
Northern Area Office				
(Officer in Charge)				
Philadelphia District				
(H&H Branch)[2]				
(F& M Branch)[2]				
(EOC)				
North Atlantic Division				
(to be inserted)				
Office of the Chief of Engineers				
(to be inserted)				

include names and titles)

[1]Call personnel listed for each office in order until contact is made.

[2]First to be called depends on nature of problem.

TABLE 3-2
KEY CONTACTS FOR EMERGENCY NOTIFICATIONS

CITIES AND BOROUGHS	Telephone Number		Radio	
	Office	Home	Freq.	Call Letters
Bernville				
Police[1]				
Mayor				
Birdsboro				
Police				
Mayor				
Conshohocken				
Police				
Mayor				
Civil Defense Coordinator				
Norristown				
Police				
Mayor				
Civil Defense Coordinator				
Philadelphia				
Civil Defense Office				
Director				
Ass't. Director				
Police				
Pottstown				
Police				
Mayor				
Civil Defense Coordinator				
Reading				
Police[1,2]				
Mayor				
Civil Defense Coordinator				
Shillington				
Police				
Mayor				
Civil Defense Coordinator				
West Reading				
Police				
Civil Defense Coordinator				
Mayor				

TABLE 3-2 (cont'd)
KEY CONTACTS FOR EMERGENCY NOTIFICATIONS

CITIES AND BOROUGHS (con't)	Telephone Number Office	Home	Radio Freq.	Call Letters
Wyomissing				
Police				
Civil Defense Coordinator				
Mayor				
COUNTIES				
Berks County				
Civil Defense Office				
Director				
Ass't. Director				
County Farm				
Administrator				
Security Office				
Police Net[1]				
Sheriff's Department[1,2]				
Chester County				
Civil Defense Office				
Director				
Ass't. Director				
PENNSYLVANIA STATE AGENCIES				
Bureau of State Parks, DER[1]				
Blue Marsh Park Sup.				
Blue Marsh Park Security Officer[2]				
State Headquarters				
Director				
Ass't. Director				
Department of Transportation				
_____Regional Office				
Fish Commission				
Area Fisheries Manager				
Waterways Patrolman[2]				

TABLE 3-2 (cont'd)
KEY CONTACTS FOR EMERGENCY NOTIFICATIONS

PENNSYLVANIA STATE AGENCIES (con't)	Telephone Number Office	Home	Radio Freq.	Call Letters
Game Commission				
Blue Marsh Project Sup.				
FEDERAL AGENCIES				
Federal Emergency Management Agency				
Philadelphia Regional Office				
Regional Director				
Ass't. Regional Director				
Washington Headquarters				
(to be inserted)				
National Weather Service				
National Weather Service				
Harrisburg River Forecast Center				
(to be inserted)				
Philadelphia Weather Service				
Forecast Office				
(to be inserted)				

[1] Can provide assistance in communications.

[2] Can provide assistance in evacuation and traffic control on project lands.

TABLE 3-3
ADDITIONAL NOTIFICATIONS FOR HIGH LAKE LEVELS[1]

Elev.	Problem	Parties to be Notified	Telephone Numbers	Radio Freq.	Radio Call Letters	Action
-	Inundation of Rt. 183 at point ____ miles east of Bernville	Pennsylvania Dept. of Trans.				Sandbag low areas to keep road open
-	Inundation of Township Road ____ at point ____	-				Barricade low areas to prevent accidental crossing
-	Submersion of electrical service at Dry Brooks Recreation	Metropolitan Edison Co.				Shut off electrical service to affected areas.
-	Inundation of (landowners giving flowage	(land owners)				Use extreme caution or evacuate (as appropriate)
-	High water level on Bernville levee	Bernville Police Bernville Mayor State Police				Patrol levee for erosion and seepage
-	Inundation of (leases on Game Commission lands)	Leases				Use extreme caution/evacuate (as appropriate
-	Loss of access to (project recreation sites)	(site visitors)				Evacuate
307	Imminent spillway flow	Philadelphia Weather Service				For information only
320.5	Overtopping of Bernville levee	Bernville Police Bernville Mayor State Police				Evacuate
-	Flooding of County Farm	County Farm				Evacuate
-	Inundation of Northkill Electrical Substation	Metropolitan Edison Co.				Shut off power to substation

[1]Table is illustration only. All information should be provided in fully developed plans.

5. Responsibility for Notification

Notifications listed in Tables 3-1 and 3-2 are the responsibility of the office (Dam Operator or District) making the declaration of a Pre-Emergency or Emergency Condition. Assistance in making notifications may be requested from other Corps offices and/or other parties. In the event all communications between offices are disrupted after declaration of a Pre-Emergency or Emergency declaration, each office will assume responsibility for making all notifications.

6. Communications

a. Normal

Notifications will normally be by telephone. Telephones at the project administration office, Northern Area Office and District's Emergency Operating Center will be manned on a 24-hour basis whenever a Pre-Emergency or Emergency condition is in effect at Blue Marsh Dam or at another site that can be affected by operation of Blue Marsh Dam. Office and home phone numbers of parties to be notified are listed in Tables 3-1 and 3-2.

b. Back-Up

The radio communications network between the District Office, project administration office and Northern Area Office will be used to back-up telephone communications. Radios at each office will be manned on a 24 hour basis whenever telephone service is disrupted while a Pre-Emergency or Emergency condition is in effect at Blue Marsh Dam or at another site that can be affected by operation of Blue Marsh Dam. Radio frequencies and call letters for parties to be notified are listed in Tables 3-1 and 3-2.

c. Emergency

During a situation when both radio and telephone communications between the District Office and project administration office are disrupted, others equipped with radio or telephone facilities will be called on for assistance. Those most likely to be capable of providing assistance are identified in Table 3-1 (see footnote 1).

7. Timing of Notifications

Parties listed in Table 3-1 are to be notified as soon as possible after declaration of a Pre-Emergency or Emergency condition. Notifications listed in Tables 3-2 and 3-3 are dependent on reservoir water elevation and other conditions and should be made as soon as a high probability of the eventual need for notification is predicted.

8. Content of Notification Messages

a. Corps Offices

Notifications to other Corps offices are to include the key information needed as a basis for decisionmaking and/or action including, as appropriate and to the extent possible, the following:

(1) Description of Situation

(a) Nature and severity of problem(s).

(b) Current and predicted reservoir conditions including water elevation, inflow and discharge.

(c) Current and forecasted weather conditions.

(2) Action Planned or Underway

(a) Type of corrective actions.

(b) Estimated time to complete corrective actions.

(c) Outlook for success.

(d) Assistance required/being furnished.

(e) Potential complications.

(f) Recommended evacuation.

(3) Other

(a) Staff at dam site.

(b) Visitors at project.

(c) Road conditions.

b. Other Parties

Notification messages to other parties are to include a description of the nature of impending or existing hazard, potential timing of its occurrence, and recommendations for evacuation and other action. Paragraph 10 contains example notification messages which can be adapted for use in various circumstances.

9. Additional Actions

The following additional actions will be taken upon declaration of an Emergency condition:

a. Dam Operator

(1) Cancel normal work schedule and provide for 24-hour duty.

(2) Assess project areas which are or may become unsafe including but not limited to:

(a) Reservoir water surface.

(b) Day use and recreational areas within project boundaries including those managed by others.

(3) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(4) Take action to notify and evacuate areas which are unsafe, potentially unsafe, or where emergency operations and repair work may be carried out including, as appropriate:

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Recommending evacuation of project areas managed by others including:

i. Pennsylvania Game Commission.

ii. Pennsylvania Fish Commission.

(d) Moving equipment to safe areas.

(5) Request assistance as needed in carrying out items (4)(a) and (4)(b) from agencies listed in Table 3-2 (see footnote 2).

(6) Verify appropriate warnings are announced over local radio and television.

b. Northern Area Office

(1) Cancel normal work schedule and provide for 24-hour availability of key staff.

c. District

(1) Cancel normal work schedule and provide for 24-hour availability of key staff.

(2) Determine which of the three planning conditions (SDF without failure, SDF with failure, or failure at normal high pool level) best represents potential inundation and needs for evacuation.

(3) Determine need for warning of high reservoir levels.

(4) Verify appropriate warnings are released over local radio and television.

d. North Atlantic Division

(1) Notify the regional office of the Federal Emergency Management Agency.

(2) Notify the Office of the Chief of Engineers.

e. Office of the Chief of Engineers

(1) Notify other Federal agencies as appropriate.

10. Example Messages

Preparation of warning messages should be begun as soon as their potential need is apparent so that they can be issued promptly upon declaration of an Emergency condition. Where time is available for their preparation, the initial message should contain all pertinent information. However, in some cases, an Emergency condition may be declared with little or no advance notice. The following example messages provide a model for the first announcements in such cases. Subsequent announcements should provide additional details.

a. Announcement for Slowly Developing Conditions

THE ARMY CORPS OF ENGINEERS AT PHILADELPHIA ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTED AT BLUE MARSH DAM DUE TO (general description of problem).THE DAM IS LOCATED ON TULPEHOCKEN CREEK ABOUT SEVEN MILES UPSTREAM OF READING, PENNSYLVANIA.

A CORPS SPOKESMAN SAID THAT THE WATER LEVEL OF BLUE MARSH LAKE WAS BEING LOWERED (as a precautionary measure/to reduce pressure on the dam/to enable repair work).

THE SPOKESMAN EMPHASIZED THAT THE DRAWNDOWN OF THE LAKE WAS BEING CARRIED OUT UNDER CONTROLLED CONDITIONS AND THERE IS NO IMMEDIATE DANGER OF THE DAM FAILING. HOWEVER, THE LARGE RELEASES OF WATER THAT ARE BEING MADE MAY CAUSE FLOODING ALONG TULPEHOCKEN CREEK. RESIDENTS OF LOW LYING AREAS ALONG TULPEHOCKEN CREEK SHOULD (evacuate/be alert for high water and prepare to evacuate).

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

b. Announcement for Rapidly Developing Conditions

URGENT: THE ARMY CORPS OF ENGINEERS HAS ANNOUNCED THAT BLUE MARSH DAM IS IN IMMINENT DANGER OF FAILURE. THE DAM IS LOCATED ABOUT SEVEN MILES UPSTREAM OF READING, PENNSYLVANIA.

ATTEMPTS TO SAVE THE DAM ARE UNDERWAY BUT THEIR SUCCESS CANNOT BE DETERMINED AS YET. RESIDENTS ALONG TULPEHOCKEN CREEK SHOULD EVACUATE TO HIGH GROUND IMMEDIATELY. RESIDENTS ALONG THE SCHUYLKILL RIVER IN THE VICINITY OF READING AND DOWNSTREAM SHOULD REMAIN ALERT FOR FURTHER INFORMATION.

IF THE DAM FAILS, WATER WILL TAKE APPROXIMATELY FOUR HOURS TO REACH THE LOWER END OF TULPEHOCKEN CREEK. AREAS CLOSER TO THE DAM WILL BE FLOODED SOONER.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

c. Announcement for Major Failure

URGENT: BLUE MARSH DAM ON TULPEHOCKEN CREEK HAS FAILED. A LARGE FLOOD WAVE IS NOW MOVING DOWN THE CREEK AT A HIGH RATE OF SPEED. RESIDENTS ALONG TULPEHOCKEN CREEK SHOULD MOVE TO HIGH GROUND IMMEDIATELY. REPEAT, RESIDENTS ALONG TULPEHOCKEN CREEK SHOULD MOVE TO HIGH GROUND IMMEDIATELY.

WATER FROM THE DAM IS EXPECTED TO CAUSE FLOODING ALONG THE SCHUYLKILL RIVER AT READING AND ADJACENT COMMUNITIES BEGINNING AT APROXIMATELY (time). LOW LYING AREAS SHOULD BE EVACUATED WELL IN ADVANCE OF THIS TIME.

STAY ALERT FOR FURTHER ANNOUNCEMENTS. ADDITIONAL INFORMATION ON ESTIMATED DEPTH AND TIME OF FLOODING WILL BE RELEASED AS SOON AS POSSIBLE.

d. Announcement for High Lake Levels

THE ARMY CORPS OF ENGINEERS AT PHILADELPHIA ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AROUND BLUE MARSH LAKE DUE TO EXPECTED HIGH WATER LEVELS. THE LAKE IS LOCATED ON TULPEHOCKEN CREEK ABOUT SEVEN MILES UPSTREAM OF READING, PENNSYLVANIA.

THE CORPS SPOKESMAN SAID THAT THE WATER LEVEL IN THE LAKE WAS EXPECTED TO REACH ELEVATION (elev.) AT (time). DUE TO (general description of problem). THIS WATER LEVEL WILL (describe major effects).

LARGE RELEASES OF WATER ARE BEING MADE FROM THE DAM IN AN ATTEMPT TO CONTROL THE LAKE LEVEL. RESIDENTS OF LOW LYING AREAS ALONG TULPEHOCKEN CREEK SHOULD BE ALERT TO POSSIBLE FLOODING AND PREPARE TO EVACUATE.

FURTHER INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

ATTACHMENT

EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE
BERKS COUNTY, PENNSYLVANIA

INUNDATION MAPS

PREPARED

BY

( ) DISTRICT

U.S. ARMY CORPS OF ENGINEERS

LATEST UPDATING: (To be inserted)

EMERGENCY PLAN
FOR
BLUE MARSH DAM AND LAKE
BERKS COUNTY, PENNSYLVANIA

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Plate 2 INUNDATION BOUNDARY AND AFFECTED AREA FOR LEVEL 1 FLOOD

Plate 3 STAGE HYDROGRAPHS FOR LEVEL 1 FLOOD

Plate 4 INUNDATION BOUNDARY AND AFFECTED AREA FOR LEVEL 2 FLOOD

Plate 5 STAGE HYDROGRAPHS FOR LEVEL 2 FLOOD

Plate 6 INUNDATION BOUNDARY AND AFFECTED AREA FOR LEVEL 3 FLOOD

Plate 7 STAGE HYDROGRAPHS FOR LEVEL 3 FLOOD

Plate 8 RESERVOIR LEVEL CHANGE FOR LEVEL 3 FLOOD

EXPLANATION OF MAPS

The attached maps indicate the area which would be flooded under hypothesized emergency conditions having peak flows past Blue Marsh Dam of approximately 75,000 c.f.s. (Level 1); 217,000 c.f.s. (Level 2); and 493,000 c.f.s. (Level 3). The possibility is extremely remote that any of these conditions will occur.

Preparation of the maps does not reflect on the safety or integrity of Blue Marsh Dam. They have been prepared as part of a national program to prepare similar maps for all Federal dams.

The information contained herein is intended for use as an aid in planning. The maps do not represent a precise definition of the effects of potential emergencies since the various conditions which might exist cannot be forecasted.

The attached maps provide a basis for evaluating existing evacuation plans for affected areas and developing any further plans which are needed. The Corps of Engineers recommends that such evaluations be made and any needed supplemental plans be developed. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers.

USE OF MAPS

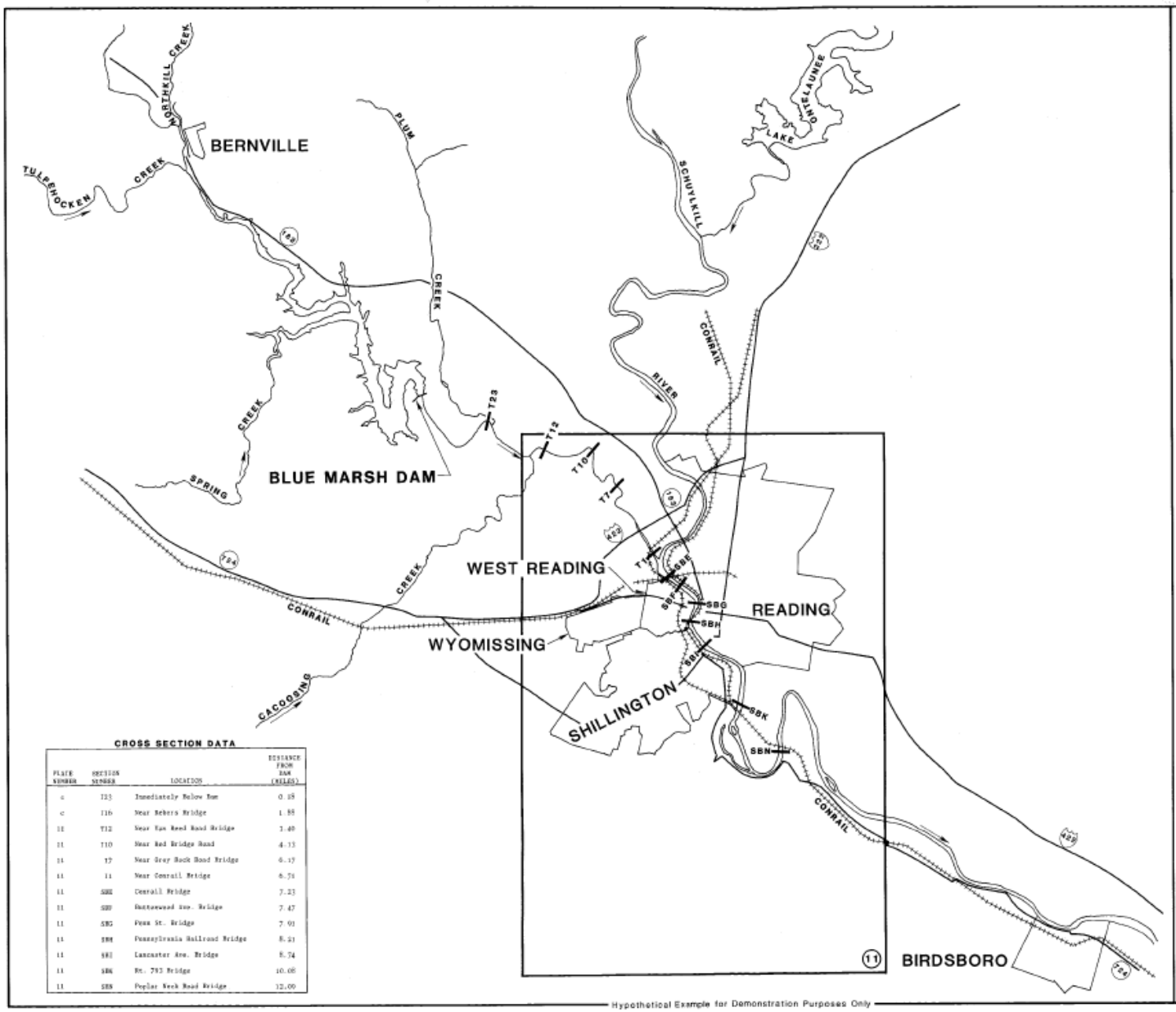
The general procedure for use of the attached maps is as follows:

1. Determine the portion of your area of concern which would be affected by inundation or isolation.
2. Identify routes which would be used for movement of people from each part of the affected area.
3. Identify the amount of time available for evacuation.
4. Use the information to assess whether existing evacuation plans cover all of the affected area and will provide for timely evacuation.

DEFINITION OF TERMS

River Mile	The distance along the channel of the Susquehanna River and Tulpehocken Creek measured from the confluence of the Susquehanna River with the Delaware River.
Peak elevation	The computed maximum water surface elevation which would be reached at a location downstream of Blue Marsh Dam due to assumed conditions.
Peak time	Elapsed time* after assumed event until peak elevation occurs.
Arrival time	Elapsed time* after assumed event until arrival of dangerously high flows at a point.
NGVD	National Geodetic Vertical Datum (distance above 1929 mean sea level).
Spillway Design Flood	The maximum flow (75,200 c.f.s.) which Blue Marsh Dam is designed to pass.
Emergency	A condition in which the occurrence of a significant hazard to life or property is possible or certain to occur.
Cross section	Point at which the shape of a stream channel or valley is measured, usually in a direction perpendicular to the direction of flow.

*Elapsed time for the Level 1 emergency condition is measured from the time at which the reservoir level exceeds the top of the flood control pool (elev. 307 NGVD) and begins to flow over the spillway. Elapsed time for the Level 2 and Level 3 emergency conditions is measured from the time at which uncontrolled release of water begins (other than over the spillway).



CROSS SECTION DATA

PLATE NUMBER	SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)
a	T23	Immediately Below Dam	0.18
c	T16	Near Bebers Bridge	1.88
11	T12	Near Van Reed Road Bridge	3.40
11	T10	Near Red Bridge Road	4.13
11	T7	Near Gray Rock Road Bridge	6.17
11	T1	Near Conrail Bridge	6.76
11	SBE	Conrail Bridge	7.23
11	SBF	Chestnutwood Ave. Bridge	7.47
11	SBG	Penn St. Bridge	7.91
11	SBH	Pennsylvania Railroad Bridge	8.21
11	SBJ	Lancaster Ave. Bridge	8.74
11	SBK	Rt. 783 Bridge	10.08
11	SBN	Poplar Neck Road Bridge	12.00

LEGEND

Plate No. — Locations of Map Panels

T23 — Cross Section

SCALE IN MILES

(District Name)
CORPS OF ENGINEERS

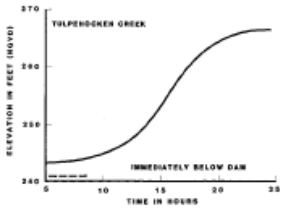
BLUE MARSH DAM EMERGENCY PLAN

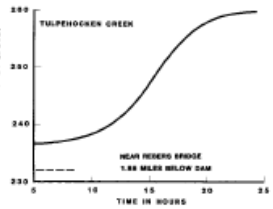
INDEX MAP

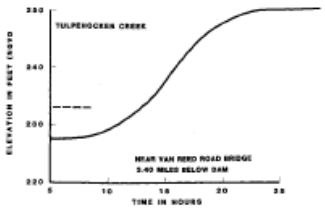
PLATE NO. 1

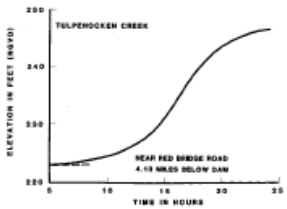
Hypothetical Example for Demonstration Purposes Only

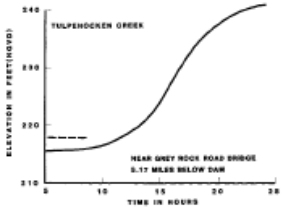
PLATE 2 NOT INCLUDED
SEE PLATE 6 FOR FORMAT OF INUNDATION MAPS

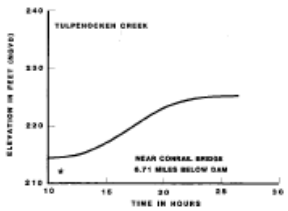


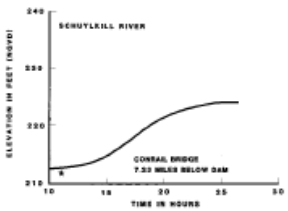


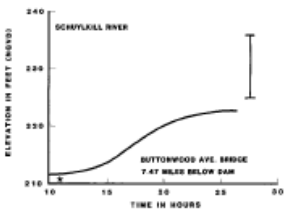


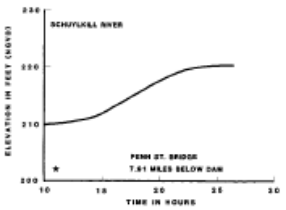


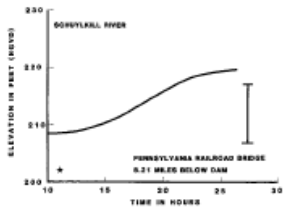


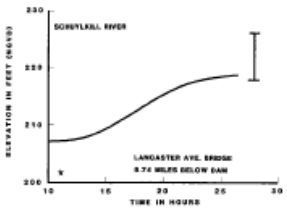


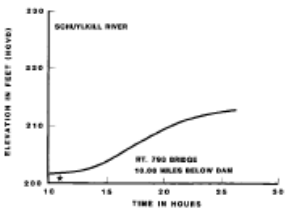


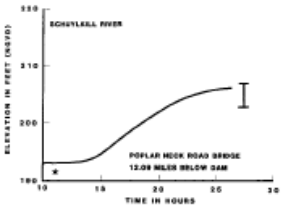












CROSS SECTION DATA

SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)	TIME OF ARRIVAL OF PEAK ELEVATIONS[a]	PEAK ELEV.-[b] (FEET)
T25	Immediately Below Dam	0.18	0 Hrs. 9 Min.	286.8
T16	Near Rebers Bridge	1.88	0 Hrs. 45 Min.	259.5
T12	Near Van Reed Road Bridge	3.40	2 Hrs. 54 Min.	250.4
T10	Near Red Bridge Road	4.13	3 Hrs. 6 Min.	246.8
T7	Near Grey Rock Road Bridge	5.17	3 Hrs. 30 Min.	240.7
T4	Near Conrail Bridge	6.71	4 Hrs. 0 Min.	225.3
SBE	Conrail Bridge	7.33	4 Hrs. 6 Min.	221.8
SBF	Buttonwood Ave. Bridge	7.47	4 Hrs. 12 Min.	222.3
SBG	Penn St. Bridge	7.91	4 Hrs. 18 Min.	220.7
SBH	Pennsylvania Railroad Bridge	8.21	4 Hrs. 30 Min.	219.5
SBI	Lancaster Ave. Bridge	8.74	4 Hrs. 36 Min.	215.6
SBK	Rt. 795 Bridge	10.08	5 Hrs. 6 Min.	211.2
SBM	Poplar Hook Road Bridge	12.09	5 Hrs. 42 Min.	209.3

[a] Measured from time at which water begins to flow over spillway

[b] NGVD

LEGEND

- Dangerous Elevation
- Top of Roadway or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTES:
1. Time is referenced to beginning of flow over spillway.
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage, whichever is lower. A * denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

(District Name)
CORPS OF ENGINEERS

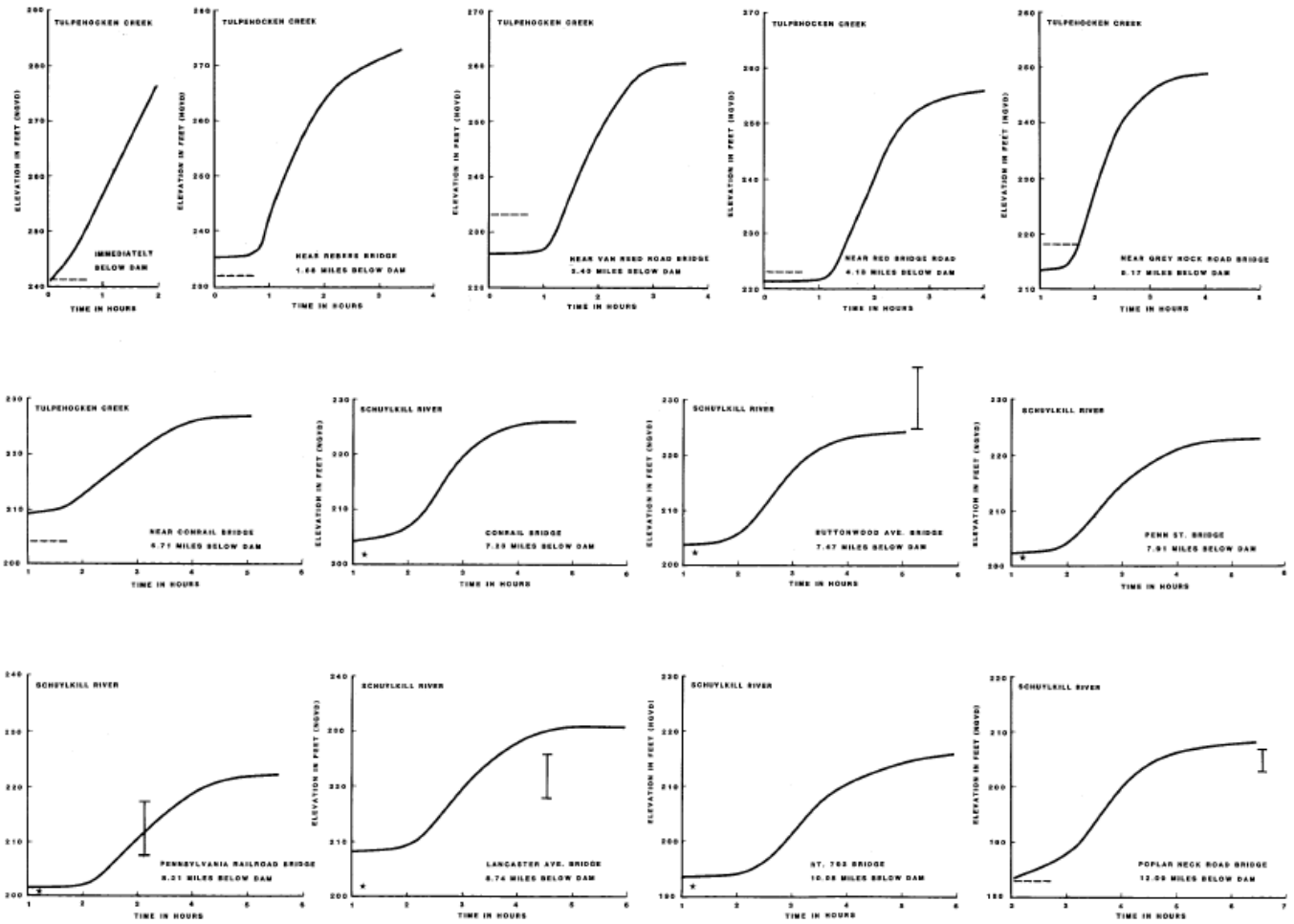
BLUE MARSH DAM
EMERGENCY PLAN

STAGE HYDROGRAPHS
FOR
LEVEL 1 FLOOD
(APPROXIMATELY 75,000 C.F.S.)

PLATE NO. 3

Hypothetical Example for Demonstration Purposes Only

PLATE 4 NOT INCLUDED
SEE PLATE 6 FOR FORMAT OF INUNDATION MAPS



SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)	TIME OF ARRIVAL OF PEAK ELEVATIONS[a]	PEAK ELEV. (FEET)[b]
T23	Immediately Below Dam	0.18	2 Hrs. 18 Min.	282.5
T16	Near Rebers Bridge	1.88	3 Hrs. 0 Min.	274.1
T12	Near Van Reed Road Bridge	3.48	3 Hrs. 18 Min.	265.2
T10	Near Red Bridge Road	4.13	3 Hrs. 30 Min.	258.0
T7	Near Grey Rock Road Bridge	8.17	3 Hrs. 42 Min.	251.2
T1	Near Conrail Bridge	6.71	4 Hrs. 18 Min.	229.4
SR8	Conrail Bridge	7.23	4 Hrs. 30 Min.	225.2
SR7	Buttonwood Ave. Bridge	7.47	4 Hrs. 30 Min.	226.6
SR6	Penn St. Bridge	7.91	5 Hrs. 18 Min.	225.7
SR4	Pennsylvania Railroad Bridge	8.21	5 Hrs. 18 Min.	225.5
SR1	Lancaster Ave. Bridge	8.74	5 Hrs. 24 Min.	224.9
SR5	Rt. 793 Bridge	10.08	5 Hrs. 30 Min.	219.4
SR9	Poplar Neck Road Bridge	12.09	5 Hrs. 48 Min.	211.5

[a] Measured from time at which uncontrolled release of water begins (other than over spillway).

[b] NGVD

LEGEND

- Dangerous Elevation
- Top of Roadbed or Wall
- Bridge Elevation
- Low Chord or Top of Arch

NOTES:
1. Time is referenced to the beginning of uncontrolled release of water (other than over spillway).
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage, whichever is lower. A * denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

STAGE HYDROGRAPHS
FOR
LEVEL 2 FLOOD
(APPROXIMATELY 217,000 C.F.S.)

PLATE NO. 5

Hypothetical Example for Demonstration Purposes Only

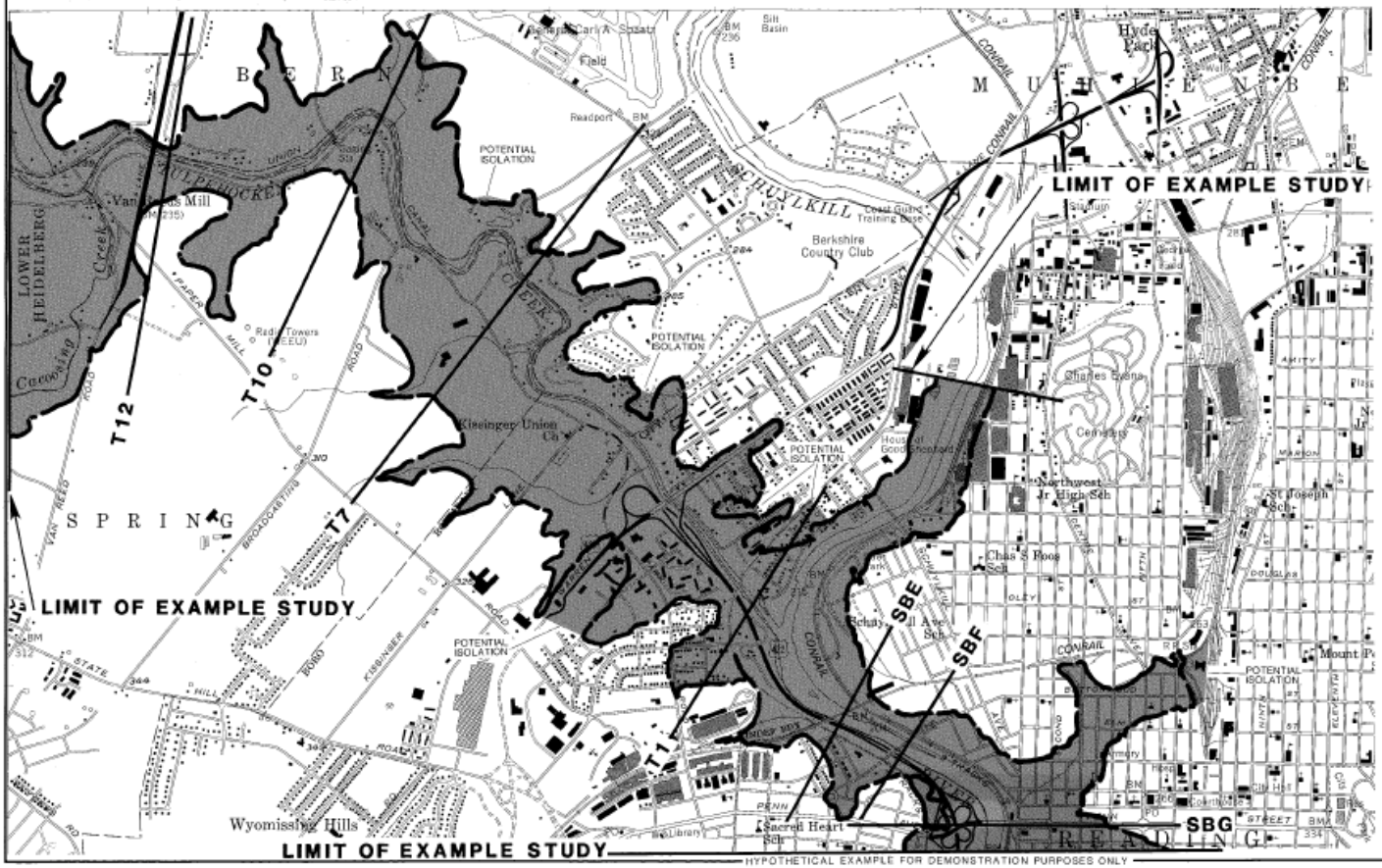
CROSS SECTION DATA

CROSS SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)	TIME OF ARRIVAL OF PEAK ELEVATIONS[A]	PEAK ELEV. (FEET)[B,C]
T12	Near Van Reed Road Bridge	3.40	2 Hrs. 42 Min.	280.6
T10	Near Red Bridge Road	4.13	3 Hrs. 0 Min.	273.3
T7	Near Grey Rock Road Bridge	6.17	3 Hrs. 12 Min.	267.6
T1	Near Conrail Bridge	6.71	3 Hrs. 48 Min.	253.9
SBE	Conrail Bridge	7.23	4 Hrs. 0 Min.	251.6
SBF	Buttonwood Ave. Bridge	7.47	4 Hrs. 24 Min.	247.4
SBG	Penn St. Bridge	7.91	4 Hrs. 30 Min.	243.9

[A] Measured from the time at which uncontrolled release of water begins (other than over the spillway).

[B] NGVD.

[C] Lowest hazardous elevation is exceeded by assumed reservoir release and/or assumed 25-year flood on Schuylkill River.



HYPOTHETICAL EXAMPLE FOR DEMONSTRATION PURPOSES ONLY

LEGEND

- Boundary of Inundated Area
- Area Affected by Inundation
- T7 Cross Section
- Corporate Limits

National Geodetic Vertical Datum of 1929

Sources of base map: U.S. Geological Survey 7.5minute series Reading, 1956 photorevised 1966 and 1974

NOTES:
1. The inundated area shown on this map reflects an event of an extremely remote nature. This map is not in any way intended to reflect upon the integrity of Blue Marsh Dam.
2. Boundaries shown are approximate. An ample margin of safety should be allowed in estimating the extent of flooding and time of arrival of dangerous water levels.

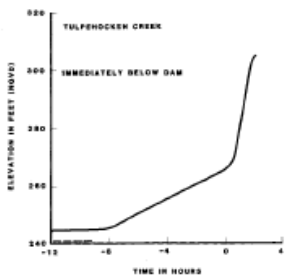
1/2 0 1/2
SCALE IN MILES

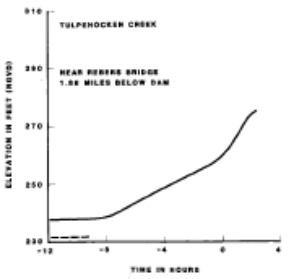
(District Name)
CORPS OF ENGINEERS

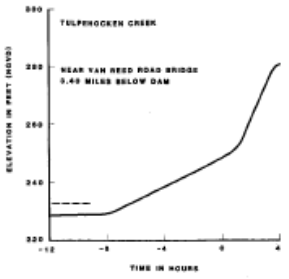
BLUE MARSH DAM EMERGENCY PLAN

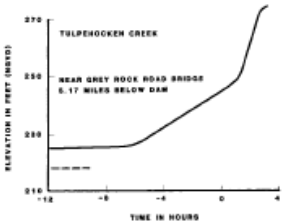
INUNDATION BOUNDARY AND AFFECTED AREA FOR LEVEL 3 FLOOD (APPROXIMATELY 493,000 C.F.S.)

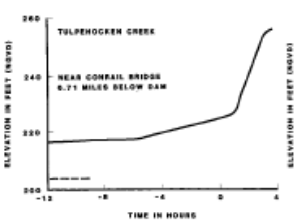
PLATE NO. 6

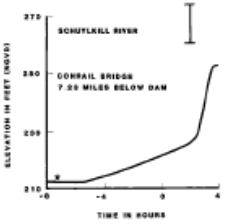


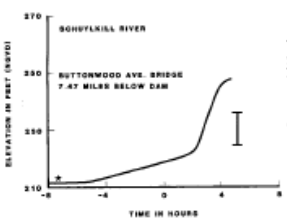


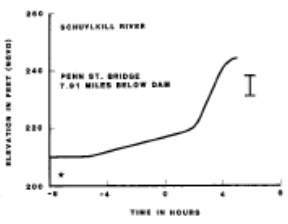


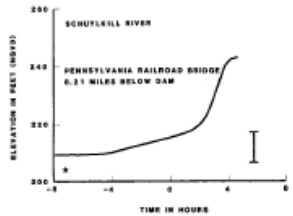


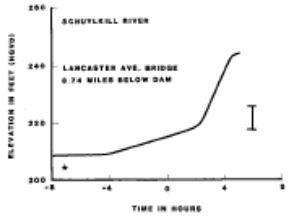


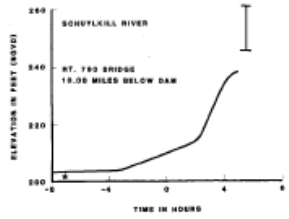


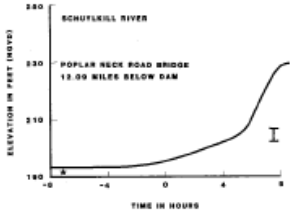












CROSS SECTION DATA

SECTION NUMBER	LOCATION	DISTANCE FROM DAM (MILES)	TIME OF ARRIVAL OF PEAK ELEVATION[a]	PEAK ELEV., (FEET)[b]
T23	Immediately Below Dam	0.18	2 Hr. 0 Min.	304.1
T16	Near Rebers Bridge	1.55	2 Hrs. 24 Min.	291.9
T12	Near Van Reed Road Bridge	3.48	2 Hrs. 42 Min.	280.6
T10	Near Red Bridge Road	4.15	3 Hrs. 0 Min.	273.3
T7	Near Grey Rock Road Bridge	5.17	3 Hrs. 12 Min.	267.6
T1	Near Conrail Bridge	6.71	3 Hrs. 48 Min.	253.9
SBE	Conrail Bridge	7.23	4 Hrs. 0 Min.	251.6
SBF	Buttonwood Ave. Bridge	7.47	4 Hrs. 24 Min.	247.4
SBG	Penn St. Bridge	7.91	4 Hrs. 30 Min.	243.9
SBH	Pennsylvania Railroad Bridge	8.21	4 Hrs. 42 Min.	244.2
SBI	Lancaster Ave. Bridge	8.74	4 Hrs. 48 Min.	243.5
SBK	Rt. 793 Bridge	10.05	4 Hrs. 54 Min.	237.4
SBM	Poplar Neck Road Bridge	12.09	5 Hrs. 6 Min.	229.3

[a] Measured from time at which uncontrolled release of water begins (other than over spillway).

[b] NGVD

LEGEND

Dangerous Elevation

Top of Roadbed or Wall

Bridge Elevation

Low Chord or Top of Arch

NOTES: 1. Time is referenced to beginning of uncontrolled release of water (other than over spillway).
2. Stage hydrographs are approximate. A conservative margin of safety should be allowed in estimating the arrival time of specific water elevations.
3. Dangerous elevation is low bank plus two feet or beginning of significant damage, whichever is lower. A * denotes water elevation exceeds dangerous level due to assumed flow in Schuylkill River.
4. Schuylkill River hydrographs include base flow effects.

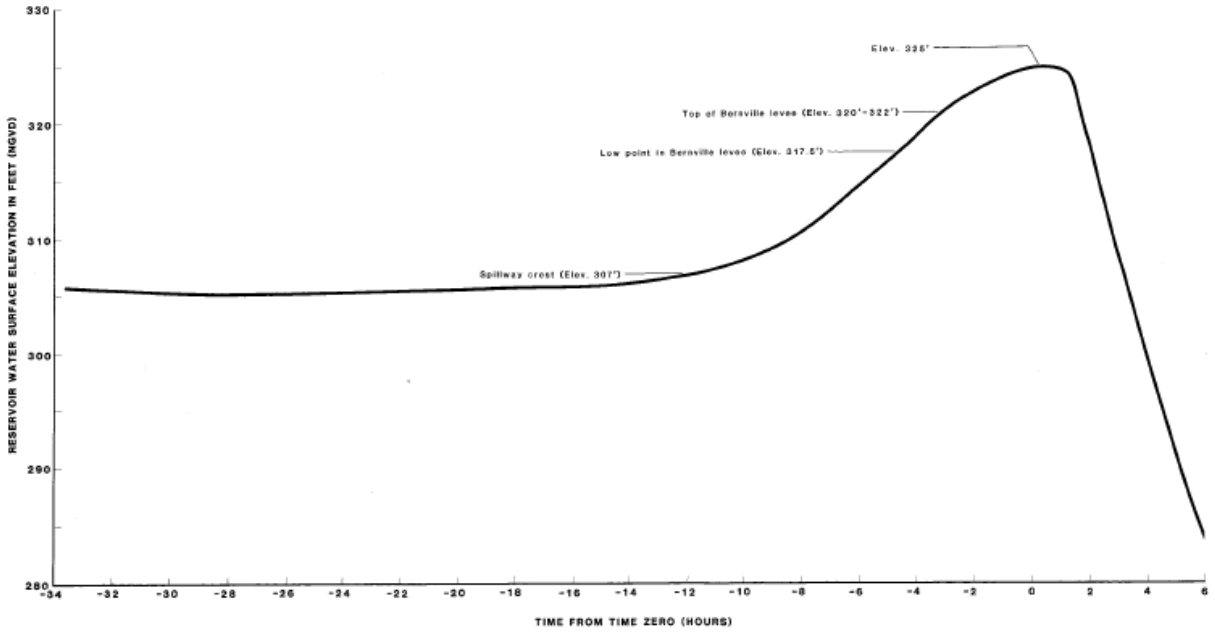
(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

STAGE HYDROGRAPHS
FOR
LEVEL 3 FLOOD
(APPROXIMATELY 493,000 C.F.S.)

PLATE NO. 7

Hypothetical Example for Demonstration Purposes Only



Hypothetical Example for Demonstration Purposes Only

NOTE: Reservoir elevation data is approximate. A conservative margin of safety should be allowed in estimating the time of occurrence of specific water elevations.

(District Name)
CORPS OF ENGINEERS

BLUE MARSH DAM
EMERGENCY PLAN

RESERVOIR ELEVATION CHANGE
FOR
LEVEL 3 FLOOD
(APPROXIMATELY 493,000 C.F.S.)

PLATE NO. 8