INSPECTION, OPERATION AND MAINTENANCE MANUAL

Lake Tomah Dam
City of Tomah, Wisconsin

City of Tomah
Public Works Department
819 Superior Avenue
Tomah, Wisconsin 54660
(608) 372-4106

Submitted: August 1993
SEH File: 91103.03
DNR Field File No. 41.19

SHORT ELLIOTT
HENDRICKSON INC.

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I. Introduction

A. Purpose and Scope

The purpose of the Lake Tomah Dam is to provide a recreational body of water for the City of Tomah, its residents and visitors, to improve water quality of the Lemonweir River, and to control discharge of water from the lake.

The scope of this Inspection, Operation and Maintenance Manual is to provide a uniform source of operating information and instructions to the operators of the Lake Tomah Dam over long periods of time, and through changes in personnel that will be operating the dam. It will also provide for periodic maintenance and inspection procedures that will assure a continuing safe condition of the dam structures and electrical and mechanical equipment.

B. Description of Project

The City of Tomah, Lake Tomah Dam is located on the South Fork of the Lemonweir River within the City limits of the City of Tomah in Monroe County, Wisconsin.

The dam has a normal head of 11 feet. The normal headwater elevation is 960.4, the normal tailwater elevation is 949.4 (National Geodetic Vertical Datum). The impoundment has a normal surface area of 207 acres and a normal stage volume of 1840 acre-feet. The dam consists of:

1. Earth embankments approximately 15 feet in height with riprap and grass surfaces upstream, abutted downstream by a roadway embankment with a bituminous surface and grass on the downstream slope. The crest elevation is 964.5.
2. A concrete roller gate structure, approximately 18 feet wide and 15 feet high with a 12 by 12 steel gate. Downstream from the gate structure is a 20 foot wide by 8 foot high double box culvert to bridge the road over the downstream channel. The sill elevation is 950.0.
3. A concrete tainter gate structure, approximately 38 feet wide and 20 feet high with a 30 by 12.8 steel gate. Downstream from the gate structure is a bridge structure with a 42 foot long by 30.5 foot wide deck over the downstream channel. Downstream from the bridge and box culvert structures is a 120 foot wide by 80 foot long riprap stilling pool. The sill elevation is 949.2.
4. An emergency spillway structure constructed of an earth embankment approximately 12 feet in height and 250 feet in length. The embankment is riprapped on the upstream face and over the crest, and has a 25 foot wide concrete flume over the crest at the center of its length. The remainder of the length is filled with a three foot high erodable fuse plug dike over the riprap crest. The riprap and earth structure is contained within sheetpile sills and abutments. Immediately downstream of the sheetpile sill wall is a 40 foot wide bituminous roadway. Beneath the road subgrade is a full length and width high density

polyethylene membrane. The downstream slope is reinforced with a geotextile wrap and is covered with sod and riprap. The elevation of the flume crest is 961.7, the elevation of the sill below the fuse plug is 961.5.

From left to right, looking downstream, the dam consists of approximately 400 feet of earth embankment (1. above), the roller gate structure (2. above), approximately 30 feet of earth embankment with sheetpile face upstream and combination of concrete wingwalls and riprap downstream (similar to 1. above), the tainter gate structure (3. above), another 40 feet of earth embankment (1. above), the emergency spillway structure (4. above), and approximately 500 feet of earth embankment (similar to 1. above).

From the dam site the Lemonweir River flows Northeasterly with residences and businesses along the both edges of the flood plain of the river, and a few structures within the flood plain.

The dam equipment building is located 15 feet to be left of the roller gate structure upon the crest of the earth embankment. The roller gate will operate on a lake level sensor by electric winch with a hand crank backup. The tainter gate will operate by manually switching its electric winch or with a hand crank backup. The dam is equipped with an automated dialer. The system will respond to different alarm conditions reciting different messages to two different telephone numbers.

C. Project Location

The Lake Tomah Dam is located on the South Fork of the Lemonweir River within the City limits of Tomah, Wisconsin. The Reservoir is located in Monroe County in the southeast one-quarter of the southeast one-quarter of Section 32, Township 18 North, Range 1 West, on the South Fork of the Lemonweir River.

D. Ownership and Operation Responsibilities

The Lake Tomah Dam is owned by the City of Tomah, Wisconsin. The responsibilities for operation, inspection and maintenance of the dam, its structures and equipment, has been assumed by the City of Tomah, Department of Public Works.

II. Standard Operating Procedures

A. Dam Operators and Requirements for Attendance by Operators for Operation and Observation

City of Tomah Department of Public Works employees are available through the Department of Public Works Office at the Tomah City Hall during the hours of 8:00 AM to 4:00 PM Monday through Friday. Telephone (608) 372-4106 or (608) 372-3223. During emergency conditions or after hours, call the Tomah Police Department (608) 372-4141 or 911.

The primary dam operator will be Mr. William Phillips (home phone (608) 372-2772), Foreman, Department of Public Works. The backup operator is Mr. Fred Callaway (home phone (608) 378-4544).

Department of Public Works employees periodically visit the site to check impoundment levels, to retrieve data logs from the gate Process Controller/Data Logger, and other dam functions. During these visits the employees shall observe flow, gate positions and impoundment levels. Any irregular conditions shall be immediately reported to the Dam Operator that is presently on call.

Employees of the City of Tomah Department of Public Works are responsible for initiating the warning procedure, under the Emergency Action Plan (EAP), by contacting the Department Director, Mr. Ken Patterson. The EAP is included as Appendix A of this manual.

In addition to the employee warning initiation, there has been installed an auto-dialing two-channel alarm system. This system will automatically alert city employees of flow conditions that require observation and programmed responses (see operational flow chart).

B. Gate Operation Information

1. Pertinent Elevations Of Structures And Equipment

Normal Impoundment Water Level = 960.40
Normal Impoundment Deviation = ±0.25'
Drawdown level = 949.20
Maximum Flood Pool Elevation = 963.20
Minimum Impoundment Level (Except for Emergency Drawdown) = 959.40'
Emergency Spillway Elevation:
  Flume Slab = 961.70
  Sill Wall = 961.50
Top of Roller Gate Stop Log Slots = 961.00
Roller Gate Sill Elevation = 950.00
Tainter Gate Sill Elevation = 949.20
Top of Tainter Gate (in closed position) = 962.0
Top of Earth Embankment = 964.70

2. Pertinent Data

Minimum Base Flow = 3.5 cubic feet per second; the Roller Gate opening required to discharge 3.5 cfs for normal lake water level is 0.25 inches. This minimum flow is based upon the needs for dilution of the effluent of the City of Tomah Waste Water Treatment Plant (WWTP). The needs of the WWTP may change from time to time based upon output and changing regulations and water quality. The director of the WWTP will review this requirement from time to time and institute the required changes to this manual.

3. Gate Settings for Automatic Operation

The roller gate is equipped with a level sensor. The level sensor is located on the sheet pile wing between the gate outlets, in a steel pipe stilling well that is freeze protected with a heat tape system. The set point for normal pool operation is elevation 960.40 feet. This level, when set on the gate controller, will be maintained within ±0.25 feet. The controller will operate the Roller Gate unless power failure or equipment failures occur.

The electronic equipment of this dam is connected to an auto dialer alarm system. This alarm system will dial two phone numbers to verbally report changing conditions at the dam that require observation or programmed responses to the condition. These conditions are:

a. The roller gate has opened to 50%, or more, of the highest position.

b. The roller gate has opened or closed 2 feet in one hour or less.

c. A power failure at the site for 30 minutes or longer.

d. Failure of the level sensor, or exceedingly high or low water levels.

This alarm system, although convenient, is not fail-safe. It is not a substitute for human observation and judgement. Whenever conditions arise that may cause high flow levels, an operator should be dispatched to the dam. These conditions include heavy, continuing and/or long duration rains, rapid snow melt, power outages during high flow events, or any combination of the above.

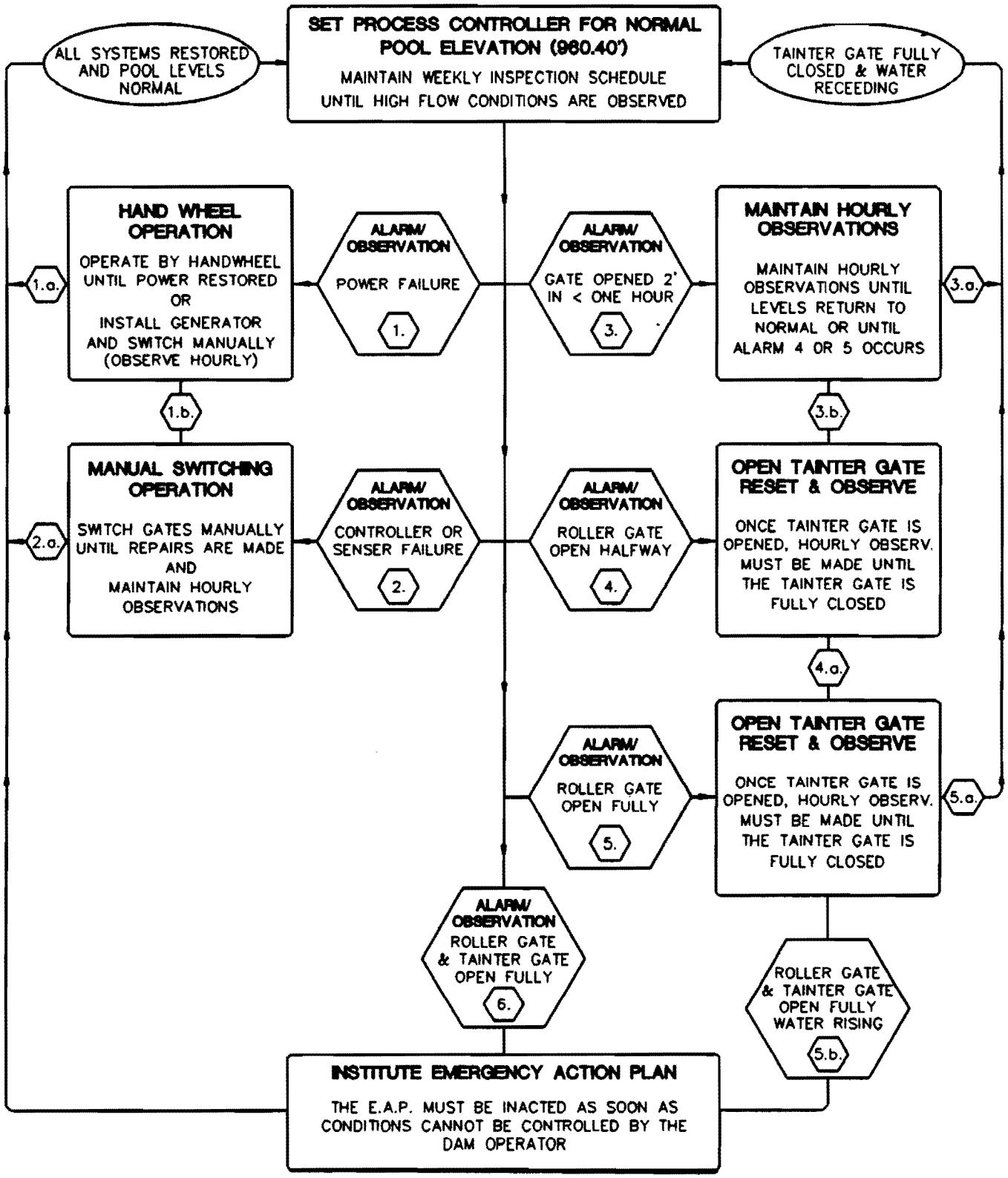
Further, this dam should be attended and inspected for routine operations on a weekly basis.

C. Operational Flow Chart

General - The following is a narrative description of the flow chart on the previous page. The paragraph numbers correspond to the numbers illustrated on the flow chart paths. Read these paragraphs for the full description of the operation in question.

The automatic operation of the dam is begun by setting the process controller to the desired impoundment level. The normal level for the impoundment is 960.40. Once set, except for conditions that require periodic observation of flow, the dam will function

LAKE TOMAH DAM - OPERATIONAL FLOW CHART FOR AUTOMATIC CONTROLLER FUNCTIONS



automatically to maintain the impoundment at the level set. Weekly inspection of this operation shall be made to insure proper equipment functions (See Section III and Section IV for Maintenance and Inspection).

1. When the automatic alarm dialer reports a power outage, or local observations indicate a power outage at the Dam, a Dam Operator shall be dispatched to maintain a constant impoundment level.

   If the outage occurs during a high flow event, the operator should remain at the Dam to continuously observe flow and adjust the gates. The maximum interval at which observations and adjustments should be made during above average flow events shall be one (1) hour. Otherwise, during average flow conditions, observations shall be made twice daily. Observations shall continue until power is restored.

   The methods of gate operation are:

   a. Hand wheel operation. The gates may be raised or lowered by turning the gate hand wheels. Note that the handwheel crank causes gate actuation through a special set of gear reducers. Many turns of the handwheel crank will be required even for small amounts of gate movement. For both gates, gate position is indicated by a mechanical dial position indicator located on the electric operator.

   b. Backup Generator and Manual Switching. The Gates may be raised or lowered by installing a backup generator at the transfer switch and then raising and lowering the Gates with the manual open/close switches.

During the power outage, records must by kept in the Manual Gate Operation Log. Record all changes in gate positions, impoundment levels at one hour intervals, and time of changes/observations.

When power is restored, remove temporary power (if provided) and reset Process Controller and the Data Logger. Rescue the hand wheels.

2. When the automatic alarm dialer, or periodic inspection indicates a failure of the lake level sensor or the process controller, manual gate adjustments, impoundment level observations, and records must be kept.

   a. Manual operation procedures shall include hourly observation and Gate adjustments during high flow events, or twice daily observations and Gate adjustments during average flow conditions.

   b. When systems are repaired, and normal pool levels restored, reset Process Controller and Data Logger for automatic operation.

3. When the automatic alarm dialer, by issuing the warning of the gate being opened two (2) or more feet in less than one (1) hour, or operator observations indicates the beginning of a high flow condition, an operator shall be dispatched to the Dam. The operator shall observe conditions and respond according to the following.

   a. A flow condition of short duration and moderate volumes may be controlled with the Roller Gate and the Process Controller. Hourly observations shall be continued until flow levels decline.

   b. Flow conditions of a greater volume and longer durations shall be controlled by opening the Tainter Gate.

      Open the Tainter Gate to a height that will provide for flow rate through the Tainter Gate that is equivalent to the flow rate being discharged through the Roller Gate. The Roller Gate shall be closed concurrently as the Tainter Gate is opened by opening the Tainter Gate one (1) foot at a time and then closing the Roller Gate an increment that is equivalent to this flow level increase (See Flow Curves, Appendix C).

      Once opened to a fully equivalent flow rate, the Roller Gate may be reset to automatic operation at the Process Controller.

      If the Tainter Gate is opened, see Paragraph 4. below for procedures for restoring automatic operation and routine inspection and observations.

4. When the automatic alarm dialer, by issuing the warning that the Roller Gate has opened to half height, or operator observations indicates the beginning of a high flow condition, an operator shall be dispatched to the Dam. The operator shall observe conditions and respond according to the following:

   a. If the flow level is continuing to rise, continue the Tainter Gate opening procedure outlined in Paragraph 3.b. above. If the Roller Gate and Tainter Gates are opened to the maximum position and the impoundment level is still rising, implement the EAP (see Appendix A of this manual). Condition B applies.

      When flow levels begin to decline, incrementally close the Tainter Gate as describe in Paragraph 5.a. Immediately after this type of high flow condition occurred a thorough inspection of the Dam shall be made according to the procedures described in Section IV of this manual.

   b. Flow conditions of a greater volume and longer durations shall be controlled by opening the Tainter Gate. See Paragraph 3.b. for this procedure.

If the flow has peaked and is beginning to decline, the Tainter Gate may be closed incrementally. Close the Tainter Gate one foot with each adjustment. Open Roller Gate to balance flow rate before and after the adjustment. Reset the roller gate to automatic operation and maintain hourly observations.

Repeat this step of incrementally closing of the Tainter Gate and opening the Roller Gate until the Tainter Gate is fully closed. The Process Controller shall then be set to normal pool elevation and automatic operation.

5. When the automatic alarm dialer issues the warning that the Roller Gate has opened to full height, an operator shall remain at the Dam continuously until flow levels decline. The operator shall observe conditions and respond according to the following.

6. If during a high flow event, and after having opened the Tainter Gate to the maximum position, any additional alarm conditions are issued, or observations indicate a continued increase in flow and a rise in impoundment levels, implement the EAP (see Appendix A of this manual). Condition A or B may apply. See Paragraph 5.b. for procedures to restore routine Dam function and operating procedures.

III. Standard Maintenance Procedures

The dam structures require periodic maintenance to insure soundness and continued serviceability. All deficiencies noted during periodic inspections shall be immediately attended.

A. Annual Maintenance

1. Concrete Surfaces

Repair Caulk Joints
Patch Spalled Areas
Repair Minor Cracks

See also, Section IV regarding inspection and observations required of concrete cracking and deterioration.

Areas requiring patching or recaulking shall be thoroughly cleaned by power washing or sandblasting.

Repair surfaces with a grout mixed with equal parts silica sand and portland cement, with water added to bring the mixture to a paste consistency. Grout for deeper patches shall be mixed as above, except replace 50% of sand portion with pea gravel. Areas patched shall be thoroughly wetted before applying grout mixtures.

Caulk repairs shall be made with a caulk meeting Federal Specification TT-S-230, type II and shall be gray in color.

2. Earth Embankments

Debrushing slopes
Repairing the earth embankments

Brush should be removed at least annually from all embankment slopes, including downstream slopes to the toe of the slope and rip rapped areas downstream of the embankment.

The earth embankment shall, also, be repaired once annually, for any erosion, cracking, animal burrows and settlements. Areas repaired shall be fertilized and either seeded or sodded to prevent erosion.

Mowing should be performed as growth conditions require, but, should be frequent enough to prevent the beginning development of brushy growth. Debris and litter should be removed frequently.

Riprap shall be observed or probed to find areas of displacement and shall be repaired by restoring rip rap cover to original contours and depths.

See also Section IV regarding inspection and observations required of earth embankment deterioration.

3. Mechanical Equipment

Paint Touch Up
Lubrication

Mechanical units needing replacement due to malfunction or damage shall be immediately attended. See Section IV for inspection procedures. See Appendix F.1. for Manufacturer's Maintenance recommendations.

Paint touch up shall include, surface preparation by sanding or wire brushing to remove rust, sediment and algae. Priming and finish coating with a coal tar epoxy paint, mixed and applied per the manufacturers instructions.

All lubrication of motors, winches, trunnion pins, rollers, gearcases, and screw hoist shall be performed according to the following schedule regarding frequency, type of lubricants, etc., as per Manufacturer's recommendations (Appendix F.1.)

Description	Location	Lubrication	Frequency
Roller Axles	Roller Gate Edges	Lithium Grease	Spring & Fall
Winch Motors	Operator Bridges	None Required	Spring & Fall
Winch Axles	Operator Bridges	Lithium Grease	Spring & Fall
Trunnion Pins	Tainter Gate Abutments	Lithium Grease	Spring & Fall
Screw Hoist	Roller Gate Platform	Lithium Grease	Spring & Fall
Gearcases	Operator Bridges	Gear Lube	Spring & Fall

4. Electrical Equipment

Electrical equipment needing repair or replacement shall be attended to immediately. Repairs and replacement shall be performed by licensed journeymen, familiar with this type of equipment (see Section IV regarding inspection and testing procedures for electrical equipment).

5. Electronic Equipment

Electronic equipment needing repair or replacement shall be attended to immediately. Repairs and replacement shall be performed by competent technicians, familiar with this type of equipment (see Section IV regarding inspection and testing procedures for electrical equipment).

6. Appurtenances

a. Emergency Spillway: Flume, Roadway Surface, Storm Ditch, Rip Rap (upstream & downstream), Geotextile Wrapped Slope, Geomembrane, Trail Surface, Fuse Plug Dike, Sod.

b. Downstream Utilities: Water Main, Gas Main, Telephone, Cable TV, and Overhead Electric Line.

c. Road Structures: Guard Rail, Bridge and Box Culvert.

d. Pedestrian Appurtenances: Trail, Sidewalk, Pedestrian Bridge, and Handrails

e. Wing Walls: Steel Sheet Pile, Cast-in-Place Concrete, Modular Precast Concrete Units.

f. Equipment Building: Roof shingles, Painted Surfaces, Door and Lock, Masonry Surfaces.

B. Seasonal Maintenance

1. Spring

Remove Debris
Turn Off Gate and Stilling Well Heaters
Spring Inspection Schedule (See Section IV)
Road Surface Repairs
Lubrication
Mechanical
Surfaces

2. Summer

Remove Litter and Debris
Mowing and Debrushing

3. Fall

Remove Litter and Debris
Turn On Gate and Stilling Well Heaters
Fall Inspection Schedule (See Section IV)
Road Surface Repairs
Lubrication

4. Winter

Snow Removal From Road and Bridges
Snow Removal From Trail and Emergency Spillway Flume Slab
Snow Removal Paths to Equipment Building and Operators Bridges
Debris Removal

IV. Standard Inspection and Testing Procedures

General - Inspections shall be performed continuously throughout the life of the dam. Inspections must be an inherent part of the maintenance program. Inspections shall be performed according to the Inspection Calender in Part A of this section.

All inspection and testing documents shall be available at the offices of the Department of Public Works for review by State of Wisconsin Agencies and Federal Agencies responsible for Dam Safety.

If during inspection, testing or maintenance procedures, conditions are noticed that are unfamiliar to the operator, or threatening to the downstream community, or the integrity of the structure has been compromised, see Appendix A for the Emergency Action Plan Notification Flow Charts for Emergency Procedures.

If conditions are not immediately threatening, contact the State of Wisconsin, DNR, Dam Safety Engineer, Mr. Richard Knitter, (608) 266-1925 or the State Warning Center at (608) 266-3232. Additional help may also be reached by contacting a consulting engineer, experienced in the construction and maintenance of hydraulic structures.

A. Inspection Calendar

1. Casual Inspections - Each time a Department of Public Works employee is at the Dam Site to perform routine functions associated with Dam operation, the employee shall make a routine inspection of the Dam structures and functions. Inspection shall be detailed enough to insure that automated equipment is functioning properly.

2. Monthly Inspections - Once each month, upon a schedule established by the Director of Public Works, a Dam operator shall formally inspect all Dam functions, equipment, structures and appurtenances. Monthly inspections shall utilize the monthly inspection form from Appendix C of this manual.

3. Seasonal Inspections - Inspection forms for each season, covering the details to be inspected. Requirements vary seasonally. Conduct these inspections based upon the proper inspection forms found in Appendix C. Inspections shall be made at the beginning of each season. These seasonal inspections shall be formal, shall be conducted by the principal operator or by the Director of Public Works, and shall be fully documented.

   The spring inspection shall be designated as the "Annual" inspection and shall include all Dam structures, functions, equipment and appurtenances.

4. Engineering Inspections - Engineering inspections shall be performed every five (5) years. These inspections shall cover all elements listed on the Engineering Inspection checklist in Appendix C and any other elements or tests as directed by the professional responsible for this inspection.

This inspection shall be performed by Wisconsin D.N.R. Dam Safety Engineers, or by an engineering consultant, hired by the City of Tomah, and experienced in hydraulic structures.

5. Post High Flow Event Inspection - Inspections shall be performed, by the Director of Public Works, the state Dam Safety Engineer, or a consulting engineer, familiar with hydraulic structures, after a flow event where the Tainter Gate was utilized at full capacity, or where water was discharged through the Emergency Spillway.

B. What to Inspect

1. Structures

All concrete, steel and earthen structures shall be thoroughly inspected.

For Concrete and Steel structures, the inspector shall erect ladders and scaffolding required to closely inspect all surfaces. This includes the Roller Gate Structure, Tainter Gate Structure, Box Culvert, Roadway Bridge, and all wingwalls. Use the inspection log form as a checklist. The inspector shall look for:

Cracks
Spalling
Joint Deterioration
Plumbness and Level
Signs of Distress
Seepage

For Earthen structures, the inspector shall observe and probe the embankment, stream beds and reservoir floor. All results, positive and negative, shall be recorded on inspection forms. The inspector shall look for:

Seepage
Cracks
Settlement
Slumps (Sink Holes)
Erosion
Scour
Animal Borrows
Erosion Cover (Turf)
Brushy Growth

2. Mechanical Equipment

All mechanical equipment shall be visually inspected and operationally tested. All inoperative components shall be immediately repaired. Also, manual methods of restoring dam functions shall be instituted and maintained until equipment functions have been restored, see Section II.C.1. Equipment to be inspected shall be:

Gear Boxes
Winches
Gates

Equipment shall be inspected for:

Proper Maintenance, i.e., Lubrication and Adjustments
Functions
Finishes, i.e., Paint and Galvanizing
Stress, i.e., Worn Parts, Frayed Cables, Cracks in Motors and Gearcases, and Seals

3. Electrical Equipment

All electrical equipment shall be visually inspected and operationally tested. All inoperative equipment shall be immediately repaired or replaced. Also, manual methods of restoring dam functions shall be instituted and maintained until equipment functions have been restored, see Section II.C.1. Equipment that shall be inspected:

Gate and Stilling Well Heaters
Equipment Building Heater
Motors
Switches and Switching Gear

Inspect for:

Proper Calibrations. Equipment out of calibration shall be immediately adjusted.
Proper Functions
Weather Tightness
Other Visual Signs of Distress

4. Electronic Equipment

All electronic equipment shall be visually inspected and operationally tested. All inoperative equipment shall be immediately repaired or replaced. Also, manual methods of restoring dam functions and data logging shall be instituted, see Section II.C.1. and Section V. Equipment that shall be inspected:

Process Controller
Lake Level Sensor
Data Logger
Thermostats
Auto Dialer Alarm

Equipment shall be inspected for:

Proper calibration. Equipment out of calibration shall be immediately adjusted to bring it back within conformance to specified tolerances.
Proper Functions
Other Visual Signs of Distress

5. Appurtenances

All appurtenances shall be visually inspected. Repairs shall be made if any damages are noticed, or items replaced if damaged beyond repair or missing. Items to be inspected include:

Handrails
Guardrails
Equipment Building
Roadway (Emergency Spillway Channel)
Site Lighting
Site Utilities
Trails and Paths

V. Documentation

A. Data Logger

The Lake Tomah Dam is equipped with an automated electronic Data Logger to record lake levels, gate positions, and to calculate discharge rates and volumes. See Appendix E for information on the operation of and the downloading of data from this equipment.

B. Manual Documentation (Electronic Equipment Failure)

In the event of failure of the Data Logger equipment, manual records will need to be kept on lake levels and gate positions. Manual calculations will need to be performed to calculate discharge rates and volumes. See Appendix D for forms for manual documentation of dam discharges.

C. Manual Documentation (Discharges Beyond Gate Capacity)

In addition to data gathered by the Data Logger, or in the case of equipment failure, manual records of lake levels and gate positions, data will need to be kept on discharges that are beyond gate capacity, i.e., discharges from the Emergency Spillway. See Appendix D for forms for documentation of flows over the Emergency Spillway.

D. Inspections

Logs shall be kept on all inspections performed. Records shall include completed inspection forms, photographs of all structures during inspection periods, photographs of all abnormal flow conditions, photographs of all cracking, settlement, movements, erosion, and seepage. Further documentation shall be kept on all ongoing observations of changing conditions, i.e., widening of cracks, increases in seepage, changes in clarity of seepage water.

E. Repairs and Maintenance

Logs shall be kept on all repair and maintenance work. Logs shall include type of repair work, dates, who performed work, receipts for services or materials, and photographs of before and after conditions.

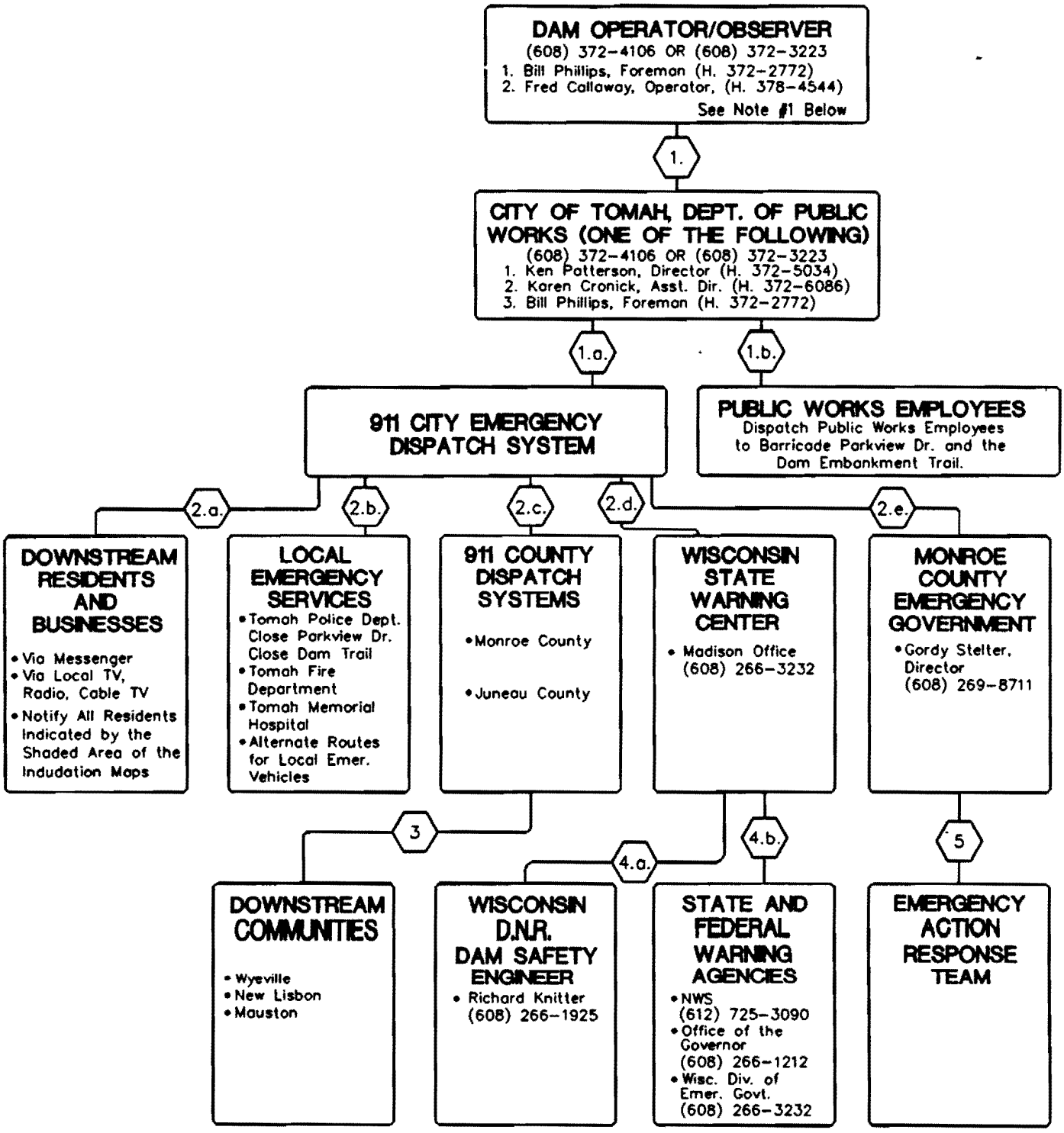
APPENDIX A

Emergency Action Plan – Notification Flow Charts

CONDITION A:

FAILURE OF THE LAKE TOMAH DAM IS IMMINENT OR HAS OCCURRED

DESCRIPTION: Rapid increase in flow from any of the earthen or concrete structures, which if not immediately controlled will cause failure of the structure, OR notification that a structure has failed and is releasing water from the reservoir.

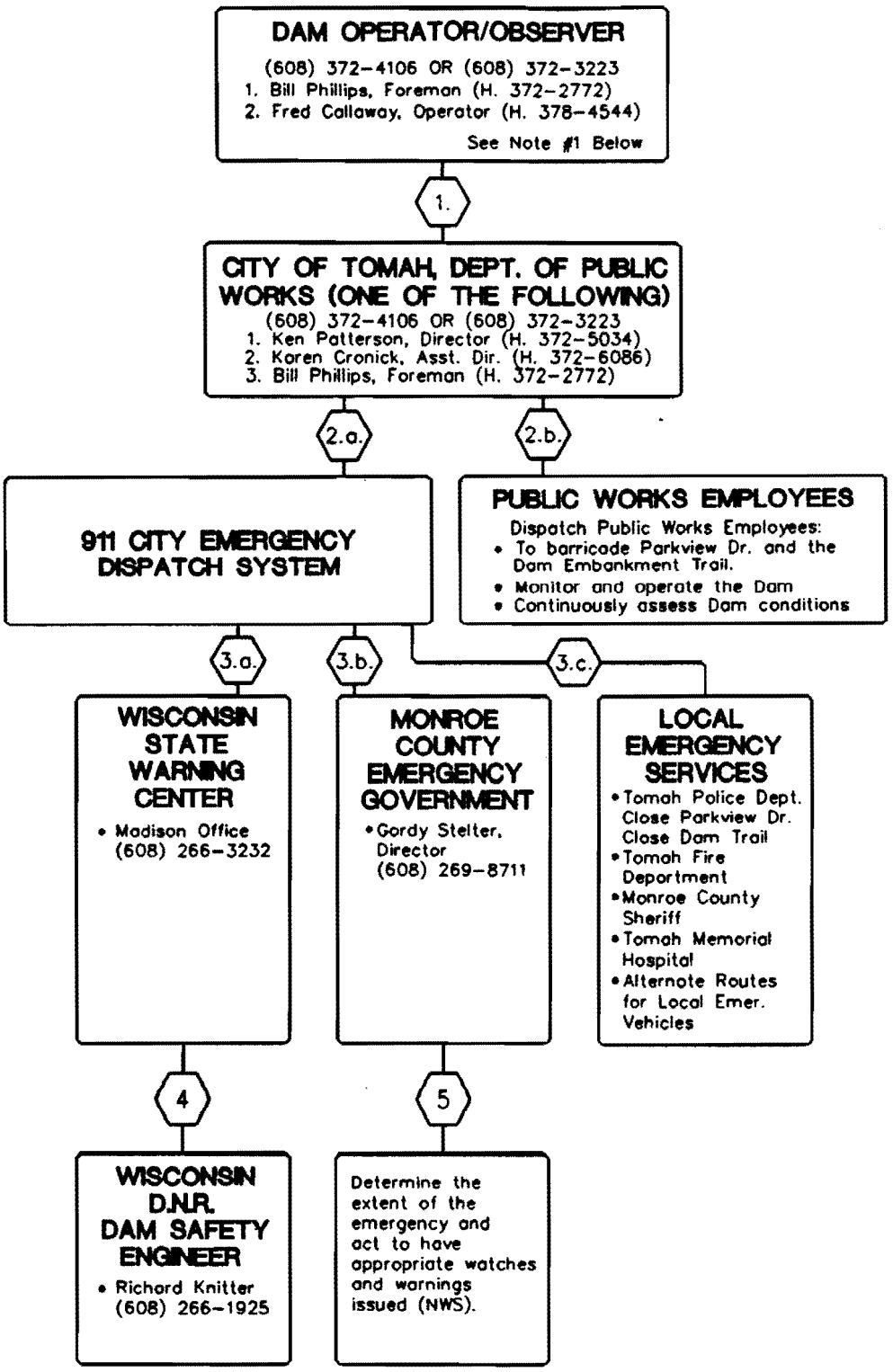


NOTE 1:
The automated alarm, which if sounded, through the Public Phone System, requires that a Dam Operator be dispatched to the Dam to observe conditions and perform programmed reponses to the conditions observed. If Condition A: or Condition B: exists at the site, the Dam Operator will initiate the E.A.P. by contacting the Public Works Director or his Alternates.

CONDITION B:

WARNING PROCEDURE IF A POTENTIALLY HAZARDOUS SITUATION IS DEVELOPING AT THE LAKE TOMAH DAM - WATCH CONDITION

DESCRIPTION: Actual or potential increase in flow from any of the earthen or concrete structures, which if not controlled, will cause failure of the structure

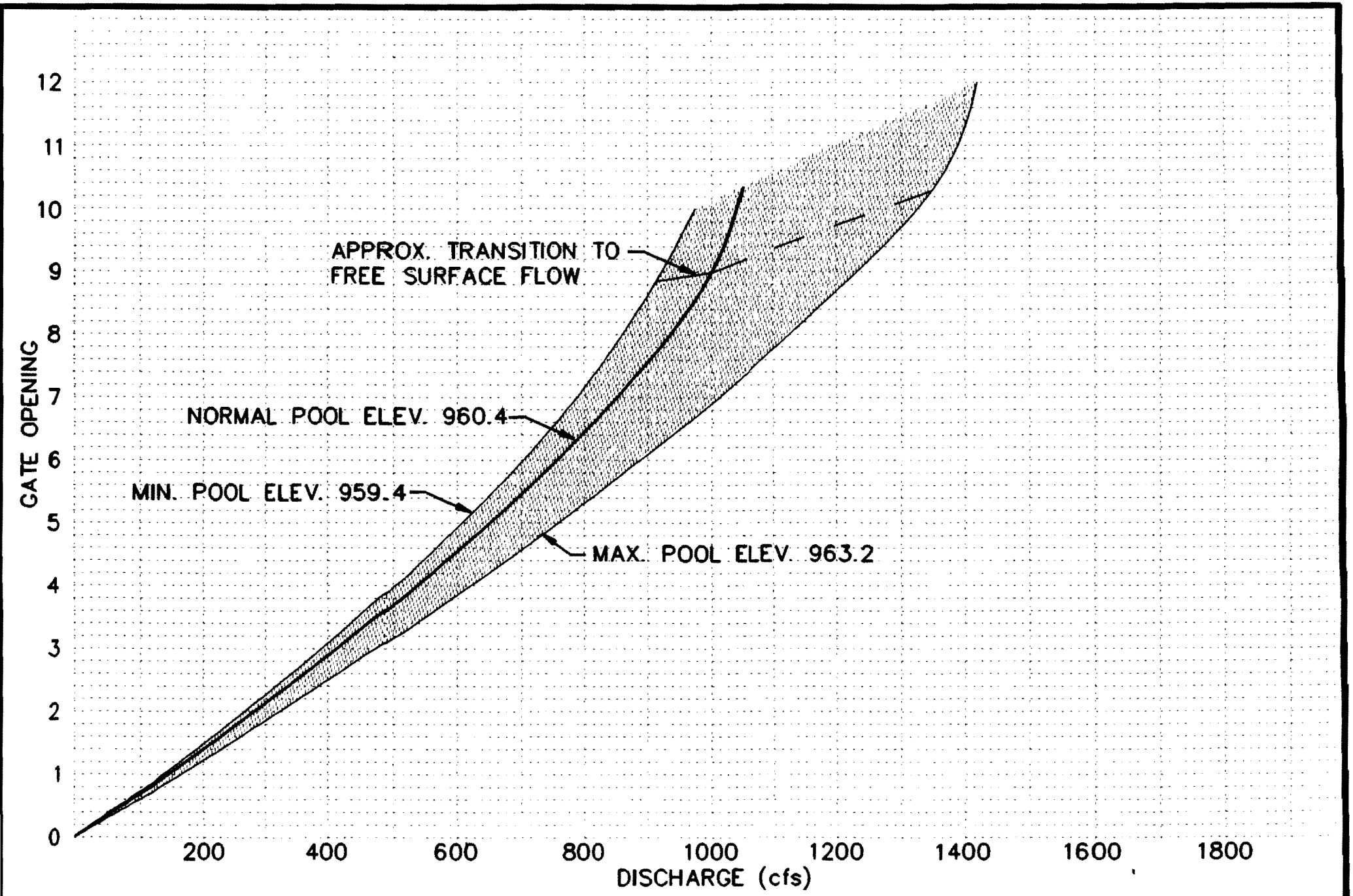


NOTE 1:

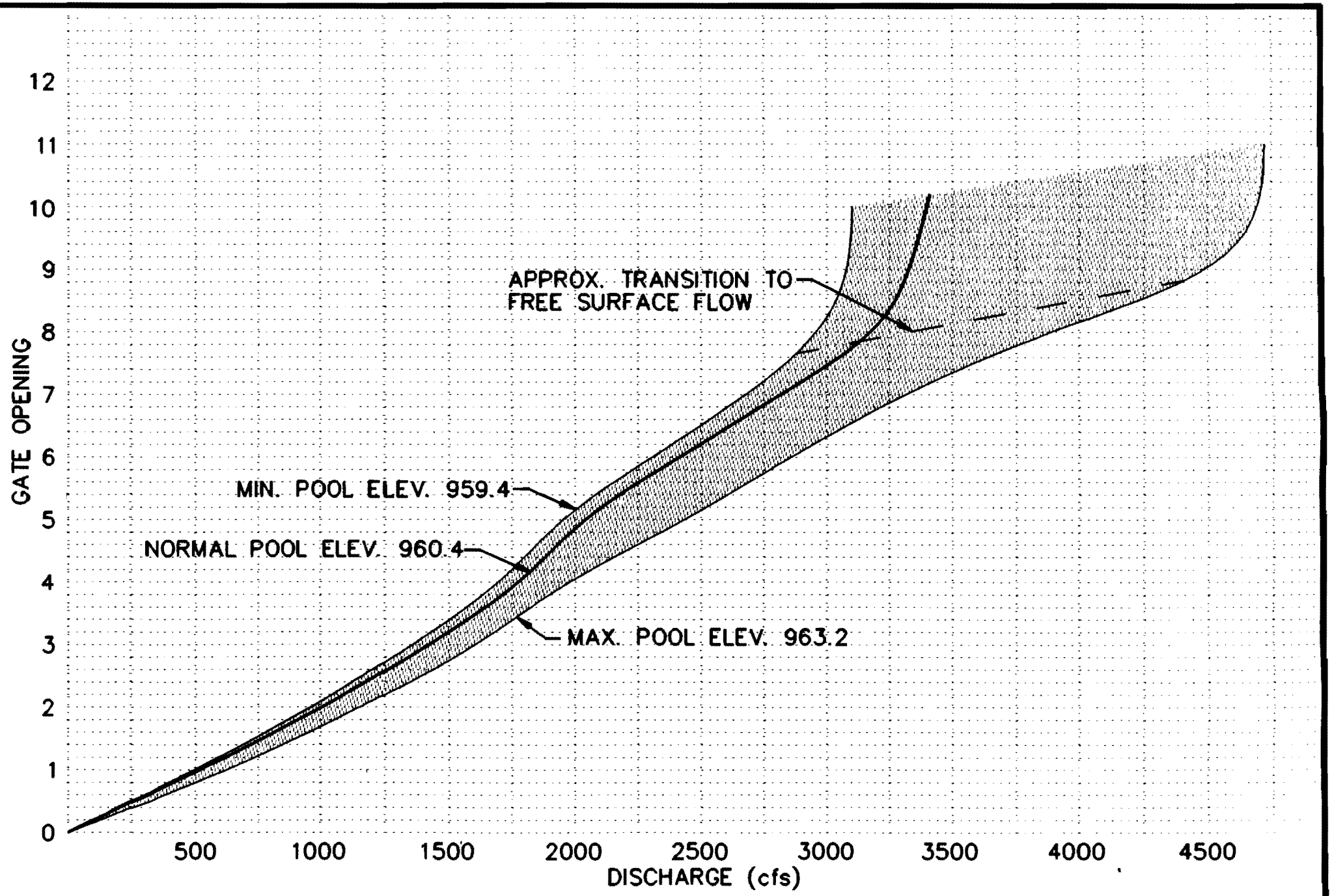
The automated alarm, which if sounded, through the Public Phone System, requires that a Dam Operator be dispatched to the Dam to observe conditions and perform programmed reponses to the conditions observed. If Condition A: or Condition B: exists at the site, the Dam Operator will initiate the E.A.P. by contacting the Public Works Director or his Alternates.

APPENDIX C

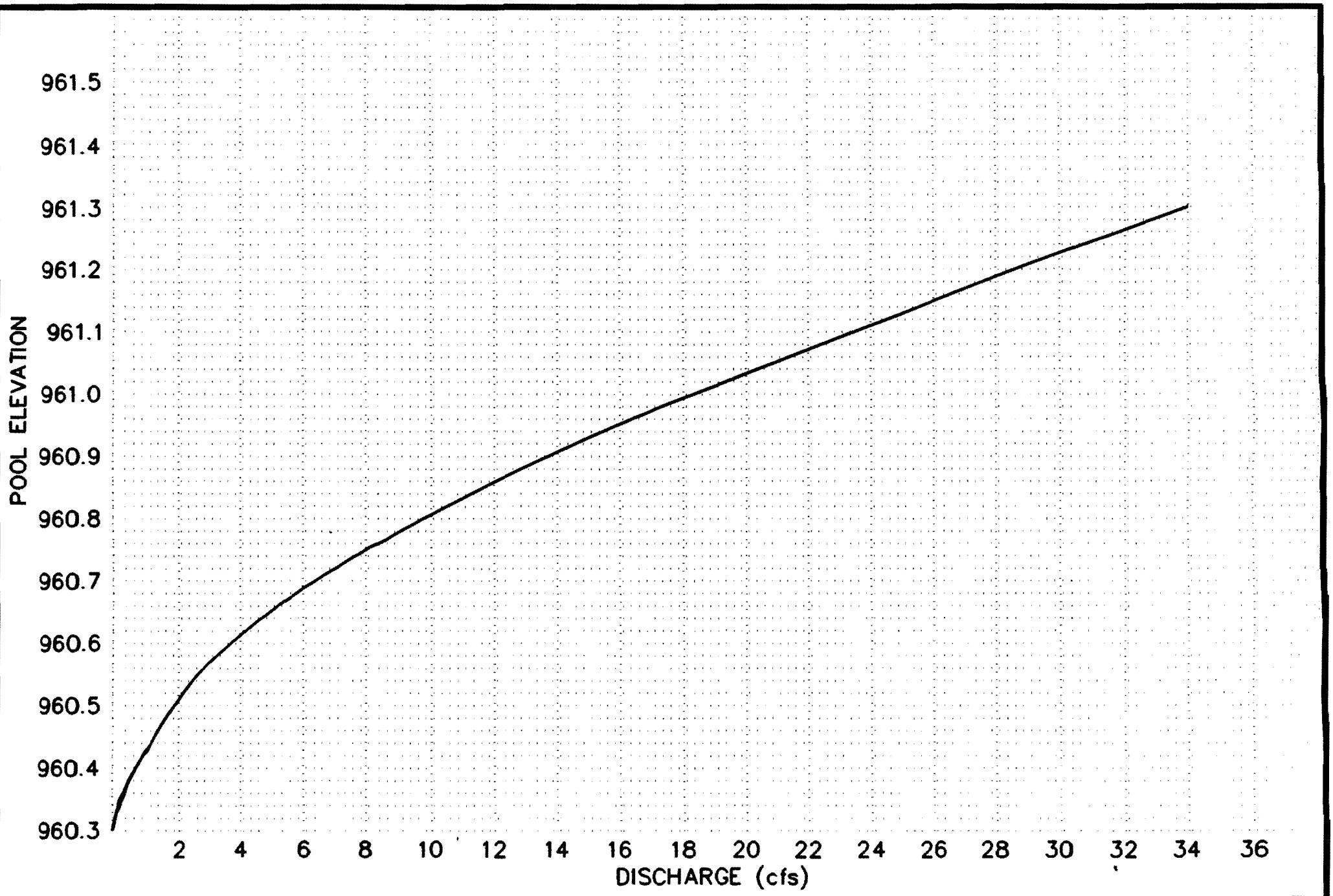
Discharge Rating Curves



ENGINEERS ARCHITECTS PLANNERS	LAKE TOMAH DAM	ROLLER GATE RATING CURVE	FILE NO. 91103.03 DATE JULY '93	FIGURE C-1



SEH ENGINEERS ARCHITECTS PLANNERS	LAKE TOMAH DAM	TAINTER GATE RATING CURVE	FILE NO. 91103.03 DATE JULY '93	FIGURE C-2



SEH ENGINEERS ARCHITECTS PLANNERS	LAKE TOMAH DAM	ROLLER GATE OVERFLOW RATING CURVE (STOP LOGS IN PLACE)	FILE NO. 91103.03 DATE JULY '93	FIGURE C-3

LDL-120

EMERGENCY ACTION PLAN

Lake Tomah Dam
City of Tomah, Wisconsin

City of Tomah
Public Works Department
819 Superior Avenue
Tomah, Wisconsin 54660
(608) 372-4106

Submitted: August 1993
SEH File: 91103.03
DNR Field File No. 41.19

SHORT ELLIOTT
HENDRICKSON INC.

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I. Notification Flow Charts

This Emergency Action Plan (EAP) provides specific guidelines to be followed by the City of Tomah and emergency warning agencies in the event of a failure of the Lake Tomah Dam on the South Fork of the Lemonweir River. A failure of the dam would cause an uncontrolled release of flow and could result in property damage or loss of life.

This EAP includes specific chains of command and sequences of notification to be implemented for the following possible failure situations:

A. Failure is imminent or has occurred.

B. A potentially hazardous situation is developing.

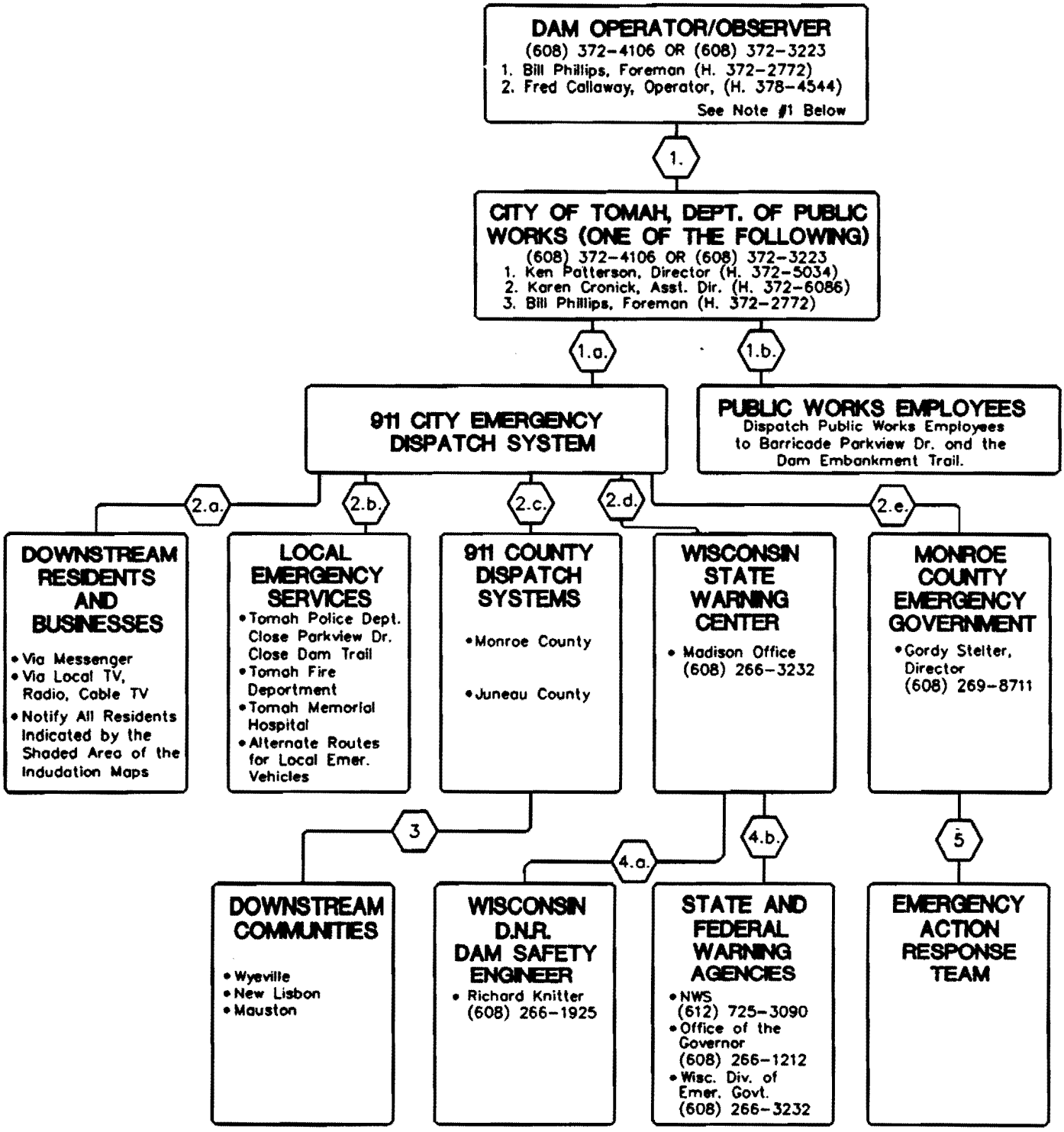
Notification flowcharts for both failure situations are included on subsequent pages in this section. These flowcharts should be prominently displayed in the Lake Tomah Dam Equipment Building, the City of Tomah in City Hall, the Public Works Department Offices in City Hall and the Monroe County Sheriff Department's Dispatch Office.

For a list of EAP recipients, refer to Appendix E.

CONDITION A:

FAILURE OF THE LAKE TOMAH DAM IS IMMINENT OR HAS OCCURRED

DESCRIPTION: Rapid increase in flow from any of the earthen or concrete structures, which if not immediately controlled will cause failure of the structure, OR notification that a structure has failed and is releasing water from the reservoir.

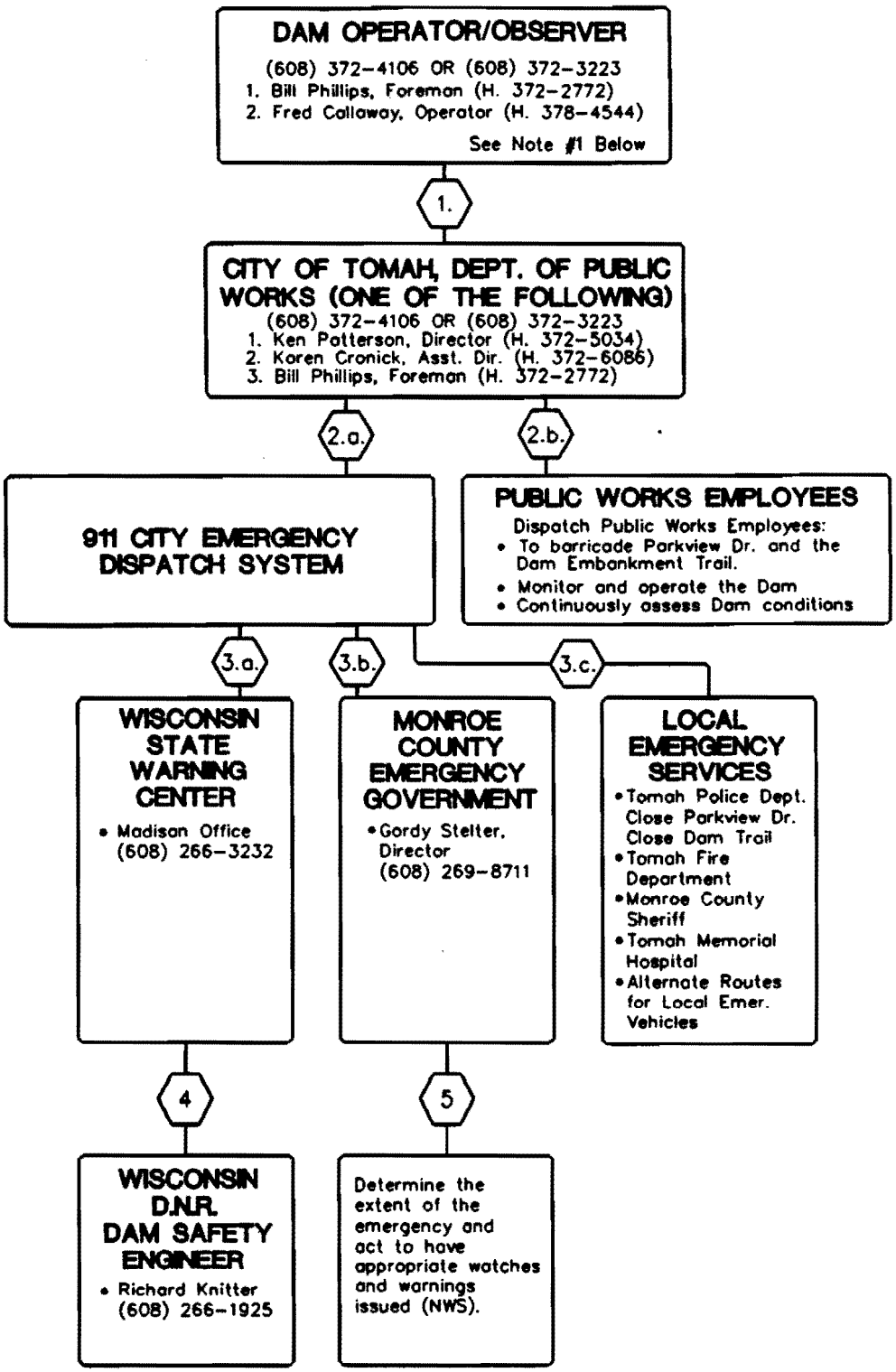


NOTE 1:
The automated alarm, which if sounded, through the Public Phone System, requires that a Dam Operator be dispatched to the Dam to observe conditions and perform programmed reponses to the conditions observed. If Condition A: or Condition B: exists at the site, the Dam Operator will initiate the E.A.P. by contacting the Public Works Director or his Alternates.

CONDITION B:

WARNING PROCEDURE IF A POTENTIALLY HAZARDOUS SITUATION IS DEVELOPING AT THE LAKE TOMAH DAM - WATCH CONDITION

DESCRIPTION: Actual or potential increase in flow from any of the earthen or concrete structures, which if not controlled, will cause failure of the structure



NOTE 1:

The automated alarm, which if sounded, through the Public Phone System, requires that a Dam Operator be dispatched to the Dam to observe conditions and perform programmed reponses to the conditions observed. If Condition A: or Condition B: exists at the site, the Dam Operator will initiate the E.A.P. by contacting the Public Works Director or his Alternates.

II. General Responsibilities Under The Emergency Action Plan

City of Tomah Department of Public Works employees are available through the Department of Public Works Office at the Tomah City Hall during the hours of 8:00 AM to 4:00 PM Monday through Friday. Operating employees periodically visit the site to check impoundment levels, to retrieve data logs from the gate Process Controller/Data Logger, and other dam functions. Due to the lack of available staff, operators are not present at the dam to continually observe, but are present during events of large flows.

Employees of the City of Tomah Department of Public Works are responsible for initiating the warning procedure by contacting the Department Director, Mr. Ken Patterson. In addition to the employee warning initiation, there has been installed an auto dialing two channel alarm system. This system will automatically alert city employees of high flow conditions that require observation and programmed responses (see communications flow chart).

Mr. Patterson will coordinate, through the City of Tomah 911 Dispatch Office, the warning and evacuation of areas immediately downstream of the dam and adjacent to the river.

III. Notification Procedures

A. Failure Is Imminent Or Has Occurred (Failure Condition A)

The Lake Tomah Dam at Tomah, Wisconsin will be considered about to fail if a serious structural deficiency, or an uncontrolled flow of water, which cannot be corrected or contained, develops making failure imminent. The dam will also be considered about to fail if the structural deficiency or uncontrolled flow has the potential of increasing to catastrophic proportions, causing a failure of the dam. A failure could occur during normal flows or flood flows.

The notification procedures are as follows:

1. Observer/Dam Operator

The dam operator is Bill Phillips and his alternate is Fred Callaway - While on site for normal operation procedures or in response to the automated alarm and observing the site, finds CONDITION A to exist, contact by phone, or by radio if the phone system has failed:

City of Tomah Public Works Department at telephone (608) 372-4106 or 372-3223 and talk to;

Ken Patterson, Director (home number 372-5034), or Karen Cronick, Assistant Director (home number 372-6086), or Bill Phillips, Foreman (home number 372-2772).

a. In the event that warning time is very limited and the City of Tomah 911 Dispatch Office would be unable to contact downstream residents before flooding occurs, the 911 Dispatch System will blow the Northside Fire Station Siren for a 1 minute period of time, and notify local radio and television stations and cable TV. Mr. Patterson or his alternate will notify residents immediately downstream by telephone or by messenger. Residents immediately downstream requiring notification are indicated by the shaded areas of the inundation maps.

While the City of Tomah Police Department has official responsibility for notification of downstream residents, Mr. Patterson must recognize that available warning time can be limited and take appropriate action to warn endangered residents accordingly.

b. When failure of the dam is imminent or has occurred, Mr. Patterson will contact the City of Tomah 911 Dispatch Office, and relay the message of impending or actual failure. The City of Tomah 911 Dispatch Office will notify Monroe and Juneau County 911 Dispatch Offices with this information. Mr. Patterson will inform the Dispatcher of the status of notices to residents and businesses that may be inundated by the failure. The Dispatcher will relay the message to the City of Tomah Police and Fire Departments via internal communication, radio or telephone.

c. After initiating the warning of residents through the City of Tomah 911 Dispatch Office, Mr. Patterson will dispatch City of Tomah Department of Public Works employees and equipment to the site to barricade Parkview Drive and the trail along the earth embankment.

d. Upon completion of his notification responsibilities, Mr. Patterson or his alternate will proceed to the Lake Tomah Dam to monitor the situation, to observe first hand the conditions at the site, reporting changes in status to the City of Tomah 911 Dispatch Office via telephone or two-way radio communication.

2. City of Tomah 911 Dispatch Office

Telephone 911

a. As informed by Mr. Patterson, if residents and businesses have not been warned, the Tomah Police Shift Commander on duty will dispatch law enforcement and fire department personnel to warn residents and businesses that may be inundated by the flood wave. The residents and businesses that require notification are indicated by the shaded area of the inundation maps (see Appendix C). The Tomah Police Shift Commander on duty will then notify local radio and cable TV of the Flood Warning Conditions of the South Fork of the Lemonweir River below the Lake Tomah Dam.

b. The Tomah Police Shift Commander will then notify the City of Tomah Chief of Police, the City of Tomah Fire Department, and the Tomah Memorial Hospital, 372-2181. The Dispatcher will send officers to the dam site to immediately close Parkview Drive and the trail along the earth embankment. The Tomah Police Shift commander will then advise, local fire departments and ambulance services of the need to use alternate routes around the Parkview Drive closure.

c. The Tomah Police Shift Commander will then contact both the Monroe and Juneau County 911 Dispatch Systems, which will then notify the downstream communities of Wyeville, New Lisbon and Mauston (see 3 below).

d. The Tomah Police Shift Commander will then contact the Wisconsin State Warning Center in Madison, (608) 266-3232 and relay the message of imminent or actual failure of the Lake Tomah Dam. The Dispatcher at the State Warning Center will then contact related State and Federal warning/ response agencies and the Wisconsin DNR Dam Safety Engineer (see 4 below).

e. The Tomah Police Shift Commander will then contact the Director of Emergency Government for Monroe County, Gordy Stelter at (608) 269-8711, and relay the message of imminent or actual failure of the Lake Tomah Dam. Mr. Stelter will then notify the Emergency Action Response Team (EART) (see 5 below).

3. Monroe And Juneau County 911 Dispatch System

Upon receiving the message of imminent or actual failure of the Lake Tomah Dam, the Monroe County 911 service will dispatch officers to the Village of Wyeville to warn residents.

Upon receiving the message of imminent or actual failure of the Lake Tomah Dam, the Juneau County 911 service will dispatch officers to Mauston and New Lisbon to warn residents.

4. State Of Wisconsin Warning Center, Madison

Upon Receiving the message of imminent or actual failure of the Lake Tomah Dam, the Duty Officer at the State Warning Center will relay the message to:

a. The Wisconsin DNR Dam Safety Engineer, Mr. Richard Knitter, at (608) 266-1925.

b. The local office of the Wisconsin Division of Emergency Government In Tomah, (608) 372-3251.

c. The National Weather Service, North Central River Forecast Center, (612) 725-3401 or 725-3402. Upon notification that the Lake Tomah Dam on the South Fork of the Lemonweir River will fail or has failed, the National Weather Service will issue flash flood warnings to radio, television and cable TV. A warning will be issued for Monroe County residents along the South Fork of the Lemonweir River Below the Lake Tomah Dam.

d. The Office of the Governor.

5. Monroe County Office Of Emergency Government Director, Mr. Gordy Stelter

Upon receiving the message of imminent or actual failure of the Lake Tomah Dam, Mr. Stelter will relay the message to the Emergency Action Response Team (EART). The EART will stand by in case their services are required.

B. Potentially Hazardous Situation Is Developing (Failure Condition B)

The most likely condition, for which there could be advance notification and time for corrective measures and watches, would be a breach failure of the embankment. The actual development of the breach could be rapid. However, the flow event which could initiate failure may develop slowly. The rise of water levels which could cause overtopping of the dam could occur over a period of several hours to several days.

When the emergency spillway, located on the south earth embankment, is in use by flood waters, close and continuous observation for excessive erosion should be made. However, do not attempt to block or sand bag the concrete flume to prevent erosion of the fuse plug or prevent water from flowing over the road. The road has been constructed to carry water from the Emergency Spillway.

Notification procedures are as follows:

1. Observer/Dam Operator

   The Dam Operator is Bill Phillips (H 372-2772), his alternate, if he's not available is Fred Callaway (H 378-4544). If during routine dam operation or, upon being summoned to the dam by the automated alarm system and upon finding Condition B to exist will contact by telephone (372-4106 or 372-3223) or by radio the Director of Public Works, Mr. Ken Patterson, home phone 372-5034, (Assistant Director Karen Cronick, home phone 372-6086, or Foreman Bill Phillips, home phone 372-2772, as alternates).

2. Mr. Patterson, or his alternate, will then go to the Dam site to assess the situation and order emergency repairs if such action would be beneficial. If Mr. Patterson determines the situation is a Condition A emergency, he will implement the procedures outlined for imminent or actual failure as described in Failure Condition A.

   a. Mr. Patterson, or his alternate, will contact the City of Tomah 911 Emergency Dispatch Office and relay the message of the WATCH CONDITION at the Lake Tomah Dam.

   b. Mr. Patterson, or his alternate, will dispatch Department of Public Works employees to monitor and operate the dam. He will also dispatch employees to barricade Parkview Drive and the trail along the dam embankment.

3. City of Tomah 911 Emergency Dispatch Office

   The officer at the 911 Emergency Dispatch Office will relay the message of the WATCH CONDITION at the Lake Tomah Dam to:

   a. The State of Wisconsin State Warning Center in Madison (608) 266-3232.

   b. The Monroe County Emergency Government Director, Mr. Gordy Stelter (608) 269-8711.

   c. Local emergency services, including: Monroe County 911 Dispatch System, Tomah Police Department, Tomah Fire Department, Monroe County Sheriff, and Tomah Memorial Hospital.

4. State Warning Center, Madison (608) 266-3232

   The warning center will relay the message to the Wisconsin DNR Dam Safety Engineer, Mr. Richard Knitter (608) 266-1925.

5. Monroe County Emergency Government, Mr. Gordy Stelter, Director (608) 269-8711

   Mr. Stelter will keep apprised of the situation at the dam, by phone, radio or by going to the site, to assist in upgrading or downgrading the Watch condition at the Lake Tomah Dam. Mr. Stelter, if he deems necessary, will order the issuance of public watches and warnings through local broadcast and cable media and the NWS River Forecast Center.

IV. Mitigative Activities

A. General Provisions For Surveillance

The City of Tomah Lake Tomah Dam is periodically visited by City of Tomah Department of Public Works employees. During heavy rains or when heavy rains are anticipated, an employee will be present at the dam to operate the gates and check headwater and tailwater elevations and to make visual observation to verify conditions at the dam. During overtopping flow conditions at the emergency spillway, the dam will be manned and attended on an hourly basis to monitor water levels, to detect any weaknesses or potential failure areas, and to close and barricade Parkview Drive and the trail along the embankment.

There are no upstream impoundments that would effect operation of the Tomah Dam. No advance warning of upstream conditions will be available to the Tomah Dam Operator.

B. Response During Periods Of Darkness And Power Outage

The area at the dam is illuminated at night. The roller gate is normally operated by electric winch on a lake level sensor. An alarm will summon personnel to the dam in the event of abnormal operating conditions by voice messages including power outages. A transfer switch is available for providing backup generator power to the winch and a hand wheel is also available for backup operation. The tainter gate is normally operated by manually switching and electric winch. The tainter gate may also be operated by use of the transfer switch and a backup generator or by its backup hand wheel.

C. Availability and use of Alternative Means of Communication

The normal mode of communication between the operator and emergency personnel is the public telephone system which is available in the dam equipment building. The backup to the telephone is the Public Works radio, this mode is functional and independent of telephone system failure.

The principle means of communication between City staff and emergency personnel is the public telephone system. In the event of failure of the telephone system, the City of Tomah two-way radio system, the Monroe County Sheriff's point-to-point radio, the time system, and the National Warning System (NAWAS) will be used.

D. Coordination of Flows

Inflows to the reservoir of the Lake Tomah Dam are not monitored. There are no sources available upstream to report this data.

In the event of slowly developing failure, or advance warning of a condition which could lead to failure, action shall be taken to lower the reservoir in a controlled manner on an emergency basis which is consistent with existing river flows. This shall be accomplished by opening spillway gates. Prior to beginning drawdown, the EAP Failure Condition B Notification Procedure shall be initiated. Also, the communities of Wyeville, New Lisbon and Mauston will be contacted to coordinate flow levels through these communities and their impoundments.

APPENDIX A

Description of Project

APPENDIX A

DESCRIPTION OF PROJECT

The City of Tomah, Lake Tomah Dam is located on the South Fork of the Lemonweir River within the City limits of the City of Tomah in Monroe County, Wisconsin.

The dam has a normal head of 11 feet. The normal headwater elevation is 960.4, the normal tailwater elevation is 949.4 (National Geodetic Vertical Datum). The impoundment has a normal surface area of 207 acres and a normal stage volume of 1,840 acre-feet. The dam consists of:

1. Earth embankments approximately 15 feet in height with riprap and grass surfaces upstream, abutted downstream by a roadway embankment with a bituminous surface and grass on the downstream slope. The crest elevation is 964.5.

2. A concrete roller gate structure, approximately 18 feet wide and 15 feet high with a 12 by 12 steel gate. Downstream from the gate structure is a 20 foot wide by 8 foot high double box culvert to bridge the road over the downstream channel. The sill elevation is 950.0.

3. A concrete tainter gate structure, approximately 38 feet wide and 20 feet high with a 30 by 12.8 steel gate. Downstream from the gate structure is a bridge structure with a 42 foot long by 30.5 foot wide deck over the downstream channel. Downstream from the bridge and box culvert structures is a 120 foot wide by 80 foot long riprap stilling pool. The sill elevation is 949.2.

4. An emergency spillway structure constructed of an earth embankment approximately 12 feet in height and 250 feet in length. The embankment is riprapped on the upstream face and over the crest, and has a 25 foot wide concrete flume over the crest at the center of its length. The remainder of the length is filled with a three foot high erodable fuse plug dike over the riprap crest. The riprap and earth structure is contained within sheetpile sills and abutments. Immediately downstream of the sheetpile sill wall is a 40 foot wide bituminous roadway. Beneath the road subgrade is a full length and width high density polyethylene membrane. The downstream slope is reinforced with a geotextile wrap and is covered with sod and riprap. The elevation of the flume crest is 961.7, the elevation of the sill below the fuse plug is 961.5.

From left to right, looking downstream, the dam consists of approximately 400 feet of earth embankment (1. above), the roller gate structure (2. above), approximately 30 feet of earth embankment with sheetpile face upstream and combination of concrete wingwalls and riprap downstream (similar to 1. above), the tainter gate structure (3. above), another 40 feet of earth embankment (1. above), the emergency spillway structure (4. above), and approximately 500 feet of earth embankment (similar to 1. above).

From the dam site the Lemonweir River flows Northeasterly with residences and businesses along the both edges of the flood plain of the river, and many structures within the flood plain.

The dam equipment building is located 15 feet to left of the roller gate structure upon the crest of the earth embankment. The roller gate will operate on a lake level sensor by electric winch with a hand crank backup. The tainter gate will operate by manually switching its electric winch or with a hand crank backup. The dam is equipped with an automated dialer. The system will respond to different alarm conditions reciting different messages to two different telephone numbers. The abnormal alarm conditions include:

a. The roller gate has opened to 50% or more.
b. The roller gate has opened or closed 2 feet in one hour or less.
c. A power outage at the site for 30 minutes or longer.
d. Failure of the level sensor system or excessively high or low lake levels.