[redacted]

MILE POST 7 WEST RIDGE RAILROAD RELOCATION, DAM EXTENSIONS, AND STREAM MITIGATION PROJECT EAW
RECORD OF DECISION - FINDING OF FACT 28.c
2012 EAP

EMERGENCY ACTION PLAN

Milepost 7 Tailings Basin
Dams 1, 2, and 5
Beaver River and East Branch Beaver River
Beaver Bay, Minnesota

Owned By:	***Northshore Mining Company*** ***10 Outer Drive*** ***Silver Bay, MN 55614***
Immediate Downstream Community:	***Beaver Bay, MN***
Date:	***December 26, 2012***

[redacted]

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Date:	***December 26, 2012***

BARR

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Minneapolis, MN 55435-4803
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Emergency Action Plan
Milepost 7 Tailings Basin
Dams 1, 2, and 5
Beaver Bay, Minnesota

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[redacted]

Certification

I hereby certify that this document was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Rita Weaver, P.E.

December 26, 2012 Reg. No. 46797

Section 1
Emergency Action Plan Summary

1.1 Statement of Purpose

The purpose of the emergency action plan (EAP) is to define responsibilities and provide procedures to be followed in the event of a flood, potential failure, or actual failure of the Milepost 7 Tailings Basin Dams 1, 2, or 5 (Dams 1, 2, or 5). In an emergency situation, the majority of the EAP can be implemented by trained personnel using the Notification Flowcharts and other EAP documentation. Supporting detailed information is given in the following sections and appendices.

1.2 Notification Flowchart

The Notification Flowcharts (Figures 1 and 2), on the following pages, summarizes the sequence of notifications and actions required during an "actual/imminent failure" or "hydrologic event/potential failure" at Dams 1, 2 or 5. The Emergency Call List (Figure 3) lists the current phone numbers for the staff included on the Notification Flowcharts.

The Notification Flowcharts apply to two conditions—imminent/actual failure, and hydrologic event and/or potential failure—as defined in Section 2. A priority change may occur during a hydrologic event/potential failure. In this case, the mitigative actions may be initiated before warning and evacuation measures are taken to avoid a panic situation. The Tailings Basin Coordinator is responsible for this judgment.

1.3 Site Description

Dams 1, 2, and 5 are perimeter dams that, along with natural topography, create the Milepost 7 Tailings Basin embankments. The tailings basin is located west of the corporate limits of Beaver Bay, Minnesota. [redacted] The tailings basin is owned and operated by Northshore Mining Company (NSM).

Dams 1, 2, and 5 are primarily earth embankment dams with a proposed spillway to be built upon closure of the basin to handle runoff and protect the integrity of the dams. Additional information on the earthen embankments and spillway can be found in Appendix C.

1.4 Supporting Documentation

Figure 4 shows a site map of the tailings basin and dams, and their proximity to the Beaver River and the City of Beaver Bay, Minnesota. Figures 5, 6, and 7 show the inundation area resulting from a failure of Dams 1, 2, and 5 respectively under the sunny day (baseflow) conditions in the downstream waterways concurrent with the maximum volume to be stored in the tailings basin. Tables 1 lists the inundation depths at downstream properties under breach conditions for the mapped scenario for each dam.

Appendix A lists examples of typical notification devices that may be used by NSM or Lake County Emergency Management in the event of an emergency. Appendix B provides information on the emergency operating procedures for the dams, and Appendix C gives an overview of the dams. Appendix D provides additional information regarding the purpose and requirements of the EAP. Appendix E includes the dam break analyses methodology and results summary. Appendix F discusses potential training and testing of the EAP. Appendix G shows contact information and EAP distribution list.

[redacted]

Figure 1 - Emergency Notification Flow Chart

Milepost 7 Tailings Basin – ID#

Imminent/Actual Failure

Contact List Provided on Figure 3

Observer

[redacted]

Original Publication Date: December 2012

[redacted]

Figure 2 - Emergency Notification Flow Chart

Milepost 7 Tailings Basin – ID#

Hydrologic Emergency/Potential Hazard

Contact List Provided on Figure 3

Observer

[redacted]

Original Publication Date: December 2012

[redacted]

Figure 3 - Emergency Notification Contact List
Milepost 7 Tailings Basin – ID#

[redacted] -	[redacted]
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted]	[redacted]
[redacted]	[redacted]

Additional Resources:

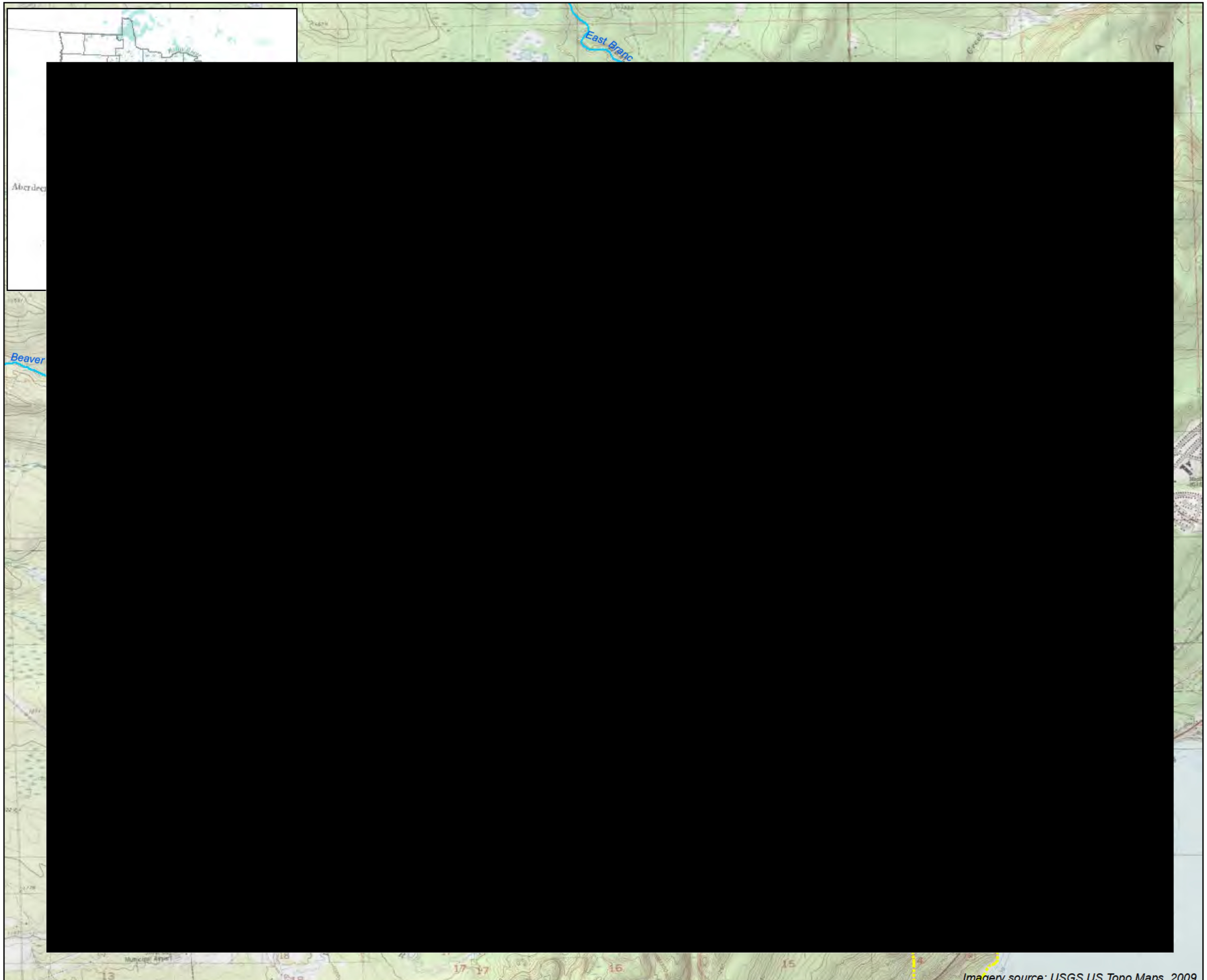
MnDNR Dam Safety
Jason Boyle (651) 259-5715 (office)
(651) 917-1715 (home)
Dale Homuth (651) 259-5133 (office)
(763) 785-9052 (home)

FEMA Regional V Manager
(312) 408-5500

MN Homeland Security and Emergency Management
(651) 201-7400

U.S. Army Corps of Engineers Emergency Operations
(651) 290-5205

Publication Date: December 2012



[redacted]

Ultimate Basin Extents

Structures Located Along Potential Breach Flowpath

Modeled Crossings

Dam

Bridge

Culvert

Potential Dam Breach Flowpaths

Rivers

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure 4

PROJECT LOCATION
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundated Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure 5

DAM 1 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundation Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure 6

DAM 2 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundation Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure 7

DAM 5 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN

Table 1 - Inundation Depths at Downstream Properties[1]

Address	Structure Type	First Floor Elevation (ft, NGVD88)	Sunny Day Event with Dam Breach: Water Surface Elevation (ft, NGVD88)	Sunny Day Event with Dam Breach: Depth of Inundation (ft)
Dam 1				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dam 2				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dam 5				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

SECTION 2
EMERGENCY RECOGNITION SUBPLAN

2.1 Emergency Definitions

2.1.1 Imminent/Actual Failure

Description: Impending or actual sudden release of water caused by an accident or failure of project structures. Example: Failure of the earthen embankment.

2.1.2 Hydrologic Event/Potential Failure

Hydrologic Event Description: For the Milepost 7 tailings basin, a hydrologic event is defined as conditions that result in significantly high water levels in the basin (i.e. a probable maximum precipitation event). A hydrologic emergency may result from higher than normal watershed yield over a prolonged period of time, a severe rainfall, snowmelt with a severe rainfall, [redacted]

Potential Failure Description: Potential sudden release of water caused by an accident or other unusual occurrence. Actions taken during such potentially hazardous events may prevent or mitigate failure. Even if failure is inevitable, more time generally is available than in the situation of imminent/actual failure to issue warnings and/or take mitigative actions.

Examples of hydrologic event/potential failure:

- Advance warning or signs of significantly high water levels in the pond
- Erosion or uncontrolled seepage of earthen embankments
- Extensive movement, cracking, settlement, or leakage at the structure
- Something looks different

2.2 Description and Maintenance of Detection and Monitoring Devices

2.2.1 Pond Water Level Monitoring

A reliable source of information regarding high water levels is the pond level monitoring within the tailings basin. Pond levels are monitored at least monthly by NSM staff.

2.3 Site and Flood Condition Surveillance

2.3.1 Hydrologic surveillance

National Weather Service forecasts are monitored during times of high precipitation or snowmelt to evaluate the potential for extreme rainfall events. The pond water level elevation of the tailings basin is monitored by NSM staff monthly, however water surface levels should be monitored as often as possible during extreme storm events.

2.3.2 Informal Daily Inspections

During normal operation periods, on-site maintenance inspections are performed by NSM staff on a daily basis. The inspections consist of visually observing the dams and tailings basin embankments from the best available vantage points.

If unusual conditions are observed, the date and time of the observations, a description of the observed conditions, and a description of the actions taken will be recorded. Any unusual conditions will be [redacted]

2.3.3 Formal Inspections

Formal inspections of the Milepost 7 Tailings Basin dams and embankments are conducted yearly by Barr Engineering Personnel. A dam safety inspection report is submitted to NSM summarizing inspection of dams.

SECTION 3
EMERGENCY NOTIFICATION SUBPLAN

3.1 Incident Command System

[redacted]

3.2 Notification Sequence

The Notification Flowcharts (Section 1), summarize the sequence of notification and responsibilities for each participant in the EAP for Dams 1, 2, and 5. The chart applies to the two conditions—imminent/actual failure, hydrologic event (flood)/potential failure—as previously defined. If an individual cannot be reached, the next person on the list should be notified. If the flow of notification is altered, participants are encouraged to return to the order to ensure that every party is notified as needed.

The Notification Flowchart shows parties to be notified and the priority of notification for each participant in the EAP. Since the top priority is the protection of human life, participants are reminded that careful modifications to the order of notification or adaptations of the EAP may be necessary in unique circumstances. If failure is imminent or has occurred, warning and evacuation procedures are top priority. For a potentially hazardous situation, mitigation efforts may be most important to avoid a panic situation. The Tailings Basin Coordinator is responsible for this judgment.

[redacted]

3.3 Modes of Communication with Responsible Persons

The primary modes of communication with responsible persons are [redacted]

- [redacted]
- [redacted]

[redacted] for routine communication purposes. Other parties have equipment and personnel available to aid with communication such as the local police emergency manager, county emergency management, and federal organizations. [redacted]

3.4 Responsibilities

The following describes the chain of command and the responsibilities of the primary participants in the EAP.

3.4.1 Overall Responsibility: Tailings Basin Coordinator

[redacted]

The Tailings Basin Coordinator, with support of the Lake County Emergency Management, is also responsible for reviewing, updating, training, and testing, the EAP as set forth in Appendix F. The Tailings Basin Coordinator is responsible for ensuring that updated copies of the EAP are replaced when necessary.

3.4.2 Surveillance, Monitoring, and Initial Notification: NSM Staff

[redacted]

3.4.3 Warning and Evacuation: Lake County Dispatch

<u>The top priority in an imminent/actual failure is the warning and evacuation of downstream areas.</u> [redacted]

[redacted]

[redacted]

[redacted]

3.4.4 Coordinating Agency Communication: Tailings Basin Manager

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

Individual contacts are listed in the Notification Flowchart and Appendix F.

3.4.5 Mitigative Actions: Tailings Basin Coordinator/Tailings Basin Manager

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

3.5 Public Warning Statements

Preparation of warning messages should begin as soon as the need is apparent so that these messages can be issued promptly upon declaration of an emergency condition. In some cases, an emergency condition may be declared with little or no advance notice. Warning messages should be considered for the following emergency conditions; example messages can be found in Appendix A:

- Imminent/Actual failure
- Hydrologic emergency (flood)/Potential Failure

3.6 Updates and End of Emergency Declaration

[redacted]

[redacted]

SECTION 4
EMERGENCY EVACUATION SUBPLAN

4.1 Identification of Parties Responsible for Warning and Evacuation

[redacted]

4.2 Dam Breach Downstream Flow Paths

Risk to downstream roads and structures is dependent on which dam has failed. Individual flow paths were defined downstream of Dams 1, 2, and 5 to determine the boundaries of flood inundation downstream of each dam. It is important that the dam be identified during communication between NSM staff and to Lake County Emergency Management so mitigation, warning, and evacuation efforts can be appropriately directed.

4.3 Dam Break Analyses and Inundation Maps

[redacted] The dam break results and the impacts for the scenarios analyzed are summarized in Appendix E. The inundation maps derived from the dam break analyses are presented in Section 1. The figure illustrates the approximate extent of the flooding and approximate floodwave travel time assuming a breach occurs with the maximum pond elevation and baseflow in the Beaver River and its tributaries. Additional information on the floodwave travel time is presented in Appendix E.

4.4 Effect of Dam Failure

[redacted]

4.5 Special Considerations

[redacted]

- [redacted]
  - [redacted]
  - [redacted]
  - [redacted]

- [redacted]
  - [redacted]
  - [redacted]
  - [redacted]
  - [redacted]

- [redacted]
  - [redacted]
  - [redacted]
  - [redacted]

[redacted]

SECTION 5
MITIGATION—EMERGENCY OPERATIONS AND REPAIR SUBPLAN

5.1 General Emergency Response

The objective of emergency operations and repairs is to prevent or reduce the impact on an impending sudden release of water (see Section 2.1.1 and 2.1.2 for typical examples). It should be anticipated that this work may need to be performed during adverse conditions and will require various supplies and resources. The primary methods of mitigating the potential impact are: performance of emergency repairs and flood proofing.

5.2 Hydrologic Emergencies

In the event of hydrologic emergencies there are few additional actions available that could prevent or mitigate the effect of failure at Dams 1, 2, or 5. Pond levels should be monitored as often as possible during extreme events so NSM staff is prepared for a possible hydrologic emergency. [redacted]

5.3 Structural Emergencies or Potential Failure Conditions

In the event of structural emergencies or potential failure conditions some repair options are available that could prevent or mitigate the effect of failure at Dams 1, 2, or 5. The services of a qualified engineer experienced in dam design and construction should be obtained before the performance of any repairs affecting dam safety. The one exception is if the services of an engineering firm cannot be obtained in time to prevent a failure. [redacted] See Appendix F for engineering support.

Potential emergency repairs that could be performed for some common deficiencies include:

- [redacted]

- [redacted]

[redacted]

5.4 Emergency Supplies

5.4.1 Supplies

[redacted]

5.5 Coordination of Flows

5.5.1 Advance Weather Runoff and Flow Forecasts

Advance weather runoff and flow forecasts/information are available from the National Weather Service. These forecasts and information can be extremely useful in the planning and timely implementation of mitigative measures. See the Notification Flowchart for telephone numbers.

5.5.2 Flow Regulation at the Milepost 7 Tailings Basin

[redacted]

5.5.3 Flow Regulation Upstream or Downstream

There is no flow regulation upstream or downstream along the Beaver River and its tributaries which could influence flows in the receiving waters at the time of a breach.

5.6 Maintenance Arrangements

5.6.1 Emergency Notification Contact List

The Emergency Notification Contact List (Figure 3) should be replaced whenever there is a change in NSM or Cliffs Technology Group personnel.

5.6.2 EAP Distribution List

The EAP distribution list is included in Appendix G and will be reviewed and updated at least annually.

5.6.3 Training

Personnel responsible for implementation of portions of the EAP will be trained as outlined in Appendix F.

SECTION 6
POST EMERGENCY ACTION SUBPLAN

6.1 Declaration of End of Emergency

The decision to declare the end of the emergency is left to the [redacted] After the threat of emergency has passed or the immediate consequences of a failure have been realized, it is important that the initiation of recovery or other post-emergency operations are based on a clearly defined decision. The declaration is to be transmitted through the notification chain as shown in the Notification Flowchart (Section 1).

6.2 Recovery

[redacted]

6.3 Inspection and Repair of the Dam

As soon as practicable following the emergency, irrespective of whether a failure actually occurred, the dam should be inspected by qualified engineers experienced in the design and inspection of dams. Appropriate notification of findings may be made to outside agencies. Repairs to the dam will be planned by experienced, technically competent personnel, and appropriate permits required by the regulatory agencies having jurisdiction over the project should be obtained.

However, if emergency conditions threatening life or property exist, NSM should, without special instructions, approvals, or permits, act at their discretion to prevent loss or injury.

6.4 Plan Critique

Soon after the emergency, a critique should be prepared describing the events prior to, during, and following the emergency: significant actions taken by each participant; improvements for future emergencies; and all deficiencies found in procedures, materials, equipment, manpower, leadership, and funding. Throughout the process it should be strongly emphasized that the purpose of the critique is not to assign credit or blame, but to determine how future emergencies at this and other sites can be handled with the minimum loss of life and property.

A post-emergency report should be prepared and distributed to all organizations that participated in emergency response or have a direct interest in the emergency, including the Department of Natural Resources.

SECTION 7
LIST OF PLAN REVISIONS

Date	Section(s) Revised	Revision Description	Revisions by:

Appendices

Appendix A

Example Public Warning Statements

Appendix A

Example Public Warning Statements

Example warning statements suitable for broadcast over local radio channels or emergency broadcast systems are as listed below.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendix B

Emergency Operating Procedures

Appendix B

Emergency Operating Procedures

Emergency operations are the procedures or operations that should be adhered to during conditions that represent eminent danger to life and personal property or to the dam. The purpose of this section is to recommend emergency operating procedures that are designed to prevent or minimize property damage, injury, and/or loss of life as the result of emergency conditions.

Emergencies may arise as the result of natural forces such as unusually severe precipitation or may be the result of failure of some portion of the dam. In this section, some of the emergencies that may arise are discussed. However, forces or events that are not contemplated in this manual may precipitate an emergency. For this reason, it is extremely important that personnel charged with operation of the dam be fully aware of the nature of that responsibility and become thoroughly familiar with all aspects of dam maintenance and operation.

B.1 Hydrologic Emergency Operating Procedures

Unusually severe precipitation is considered to be that which could threaten the safety of the dam or require the implementation of special procedures to ensure dam safety. It is the intention of this manual to provide NSM staff with a conservative set of procedures for anticipating and reacting to severe precipitation events that may result in pond elevations near the minimum freeboard or flow rates that potentially exceed the discharge capacity of the proposed spillway.

In order to provide the time necessary to implement the emergency procedures required in the event of unusually severe precipitation, the NSM staff must first be aware of the potential development of such a flood and anticipate its severity. This means that emergency procedures may be initiated in situations when the ultimate emergency conditions do not develop. This possibility should not detract from the importance of the recommended procedures in all situations that have the potential for developing into emergency conditions.

During intense summer rainstorms, the NSM personnel should remain onsite to monitor pond levels, and notify the [redacted] that there is potential for a hydrologic emergency. In the event of floods due to spring snowmelt or a combination of snowmelt and rainfall, the operator should prepare for a severe flood when floods in the area are predicted by the U.S. Weather Service flood forecaster. In addition to the flood predictions, the operator should monitor the daily and long-term forecasts. Forecasts predicting rapid warming trends in conjunction with rainfall should alert the operator to possible changes in the predictions of flood severity and timing. This procedure should continue until the snow cover is depleted.

B.2 Structural Emergency or Potential Failure Operating Procedures

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendix C

Description of Dams

Appendix C

Description of Milepost 7 Tailings Basin Dams

C.1 General Description

The Milepost 7 Tailings Basin is an approximately three square mile area used for deposition of tailings from Northshore Mining Company's mining operations. All the process water from plant operations and runoff from within the plant area is collected and pumped to the basin with the fine tailings. Once the tailings settle or are filtered out at the basin, clearer water is reclaimed and pumped back to the plant for process needs. Dams 1, 2 and 5, along with natural topography, create the embankments for the basin.

Dam 1 is located on the southern end of the tailings basin. The dam is approximately 10,000 feet long, and was initially constructed using a sand and gravel starter dam with an upstream clay face. Plant aggregate is used to increase the elevation of the dam, and the ultimate elevation of the dam is proposed to be 1,315 feet. Proposed overall upper dam slope will be 6H:1V. The current dam crest is at 1,227 feet based on the 2011 dam inspection, and the invert of the downstream flow path is approximately 1130 feet. A seepage collection ditch is used to control seepage from Dam 1.

Dam 2 is located on the northern end of the tailings basin. The dam is approximately 5,700 feet long. The dam was initially constructed using the glacial till cutoff, and plant aggregate is used to increase the dam elevation with the ultimate elevation of the dam proposed to be 1,315 feet. The proposed downstream slope will be 6H:1V. The current dam crest is at 1,228 feet based on the 2011 dam inspection, and the invert of the downstream flow path is 1154 feet. A seepage collection ditch is used to control seepage from Dam 2.

Dam 5 is on the east side of the tailings basin. The dam is approximately 3,000 feet long. The dam was initially constructed using a glacial till cutoff, and plant aggregate was used to increase the dam elevation with the ultimate dam elevation proposed to be 1,315 feet. The current dam elevation is 1,225 feet based on the 2011 dam inspection and the invert of the downstream flow path is 1188 feet. Seepage is controlled by a seepage pumping system consisting of a submersible sump pump and pipeline which pumps to the Reclaim Pond.

As stated in the Milepost 7 Tailings Basin Five-year Operations Plan (Years 2009-2013), the pond water level is controlled and water volume in the pond is kept to a minimum. The following processes are used to control the water volume in the pond:

1. [redacted]

Currently, there are no emergency spillways designed for the dams. Spillways will be designed upon permanent closure of the basin. The spillways will be built to handle runoff and protect the integrity of the dams.

C.2 Hydrology

The majority of surface runoff around the Milepost 7 Tailings Basin is diverted around the basin, so the direct watershed area is reduced to approximately five square miles. As part of the current Five-Year Operations Plans update (5YOP, 2009-2013), an evaluation of the watershed runoff during a PMP event and an evaluation of the annual watershed yield was completed. Below is a summary of the watershed runoff calculations included in the 5YOP.

- The annual watershed net yield associated with the 10-year annual precipitation is approximately 24.7 inches. This yield is equal to a 1.9-foot additional rise in the pond level with respect to average hydrologic conditions.

- The 5-year wet annual watershed net yield with a 1% probability of exceedance is 18.2 inches. This yield is equal to a 3.7-foot additional rise in the pond level over a period of 5 years with respect to average hydrologic conditions.

- The 3-day PMP is estimated to be 24.6 inches. Conservatively assuming, for this very extreme event, that all precipitation within the watershed becomes runoff (i.e., no losses due to infiltration or evapotranspiration), the 3-day PMP will result in a watershed net yield of 24.6 inches, which is equal to a 4.4-foot rise in the pond level.

- [redacted]

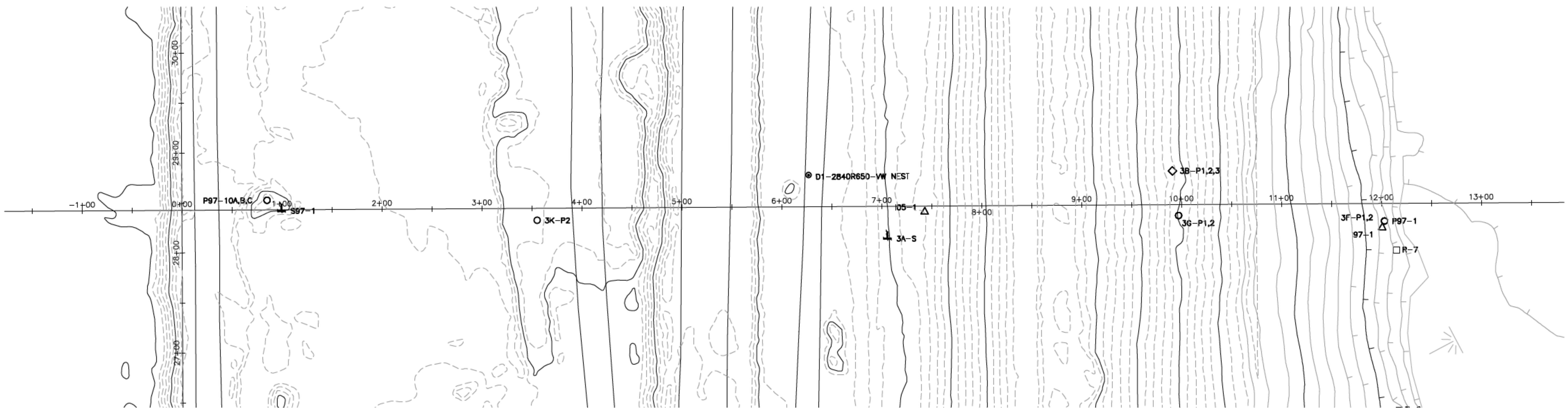
[redacted]

[redacted]

Two scenarios were evaluated to determine the maximum runoff to the site and the maximum increase in water surface elevation in the pond. The first scenario included the annual watershed yield with the 10% probability of exceedance occurring with the 5-year wet annual watershed yield with a 1% probability of exccedence. The second scenario included runoff from the PMP event concurrent with a shutdown of discharge from the basin.

The increase in water surface elevation resulting from each scenario increased the water surface elevation in the pond of 6.4 feet. Including the necessary wave run-up height (2.0 feet), the required freeboard was calculated to be 8.4 feet. The basin has been designed with a freeboard requirement of 10.0 feet based on discussions with the MnDNR.

This freeboard analysis was used to determine the maximum possible water surface elevation that could be in the basin at the time of a breach. As a conservative estimate, our analyses assumed that the water surface elevation would be as high as two feet below the top of the dam, whereas the hydrologic calculations show the water surface elevation should get no higher than 3.6 feet below the top of the dam under the most extensive hydrologic conditions.

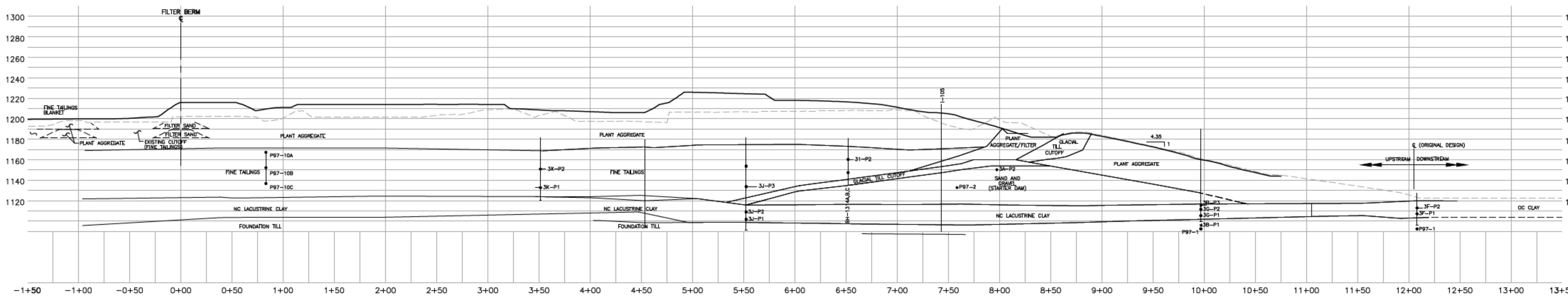


PLAN: DAM 1 - STA. 28+40

0 50 100
SCALE IN FEET

LEGEND:

- PNEUMATIC PIEZOMETER
- CASAGRANDE PIEZOMETER
- INCLINOMETER
- RELIEF WELL
- SETTLEMENT PLATE
- VIBRATING WIRE PIEZOMETER



NOTE: CROSS SECTION SURFACE DEVELOPED FROM 2010 FLYOVER.

SECTION: DAM 1 - STA. 28+40

0 50 100
SCALE IN FEET

LEGEND

- - -?- - - UNAVAILABLE INFORMATION FOR ACCURATE CONTACT INTERPRETATION

——— STRATIGRAPHIC CONTACTS BETWEEN FOUNDATION SOILS ARE BASED ON INTERPRETATION BETWEEN BORINGS. CONTACTS BETWEEN INTERNAL DAM FILL ZONES ARE BASED ON INTERPRETATION BETWEEN BORINGS AND CONSTRUCTION RECORDS INFORMATION, WHERE AVAILABLE.

INVESTIGATIVE BORING

3F-P2 ← PIEZOMETER IDENTIFIER

M:\cad\N_shore\2338_086\Geotechnical\2009 update\G-04.dwg Plot at 1 07/13/2009 14:58:28

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE ________

PRINTED NAME ________

DATE ________ REG. NO. ________

RELEASED TO/FOR	A	B	C	0	1	2	3
CLIENT							
BID							
CONSTRUCTION							
DATE RELEASED							

BARR

Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office: BARR ENGINEERING CO. 4700 WEST 77TH STREET MINNEAPOLIS, MN. 55435-4803 Ph: 1-800-632-2277 Fax: (952) 832-2601 www.barr.com

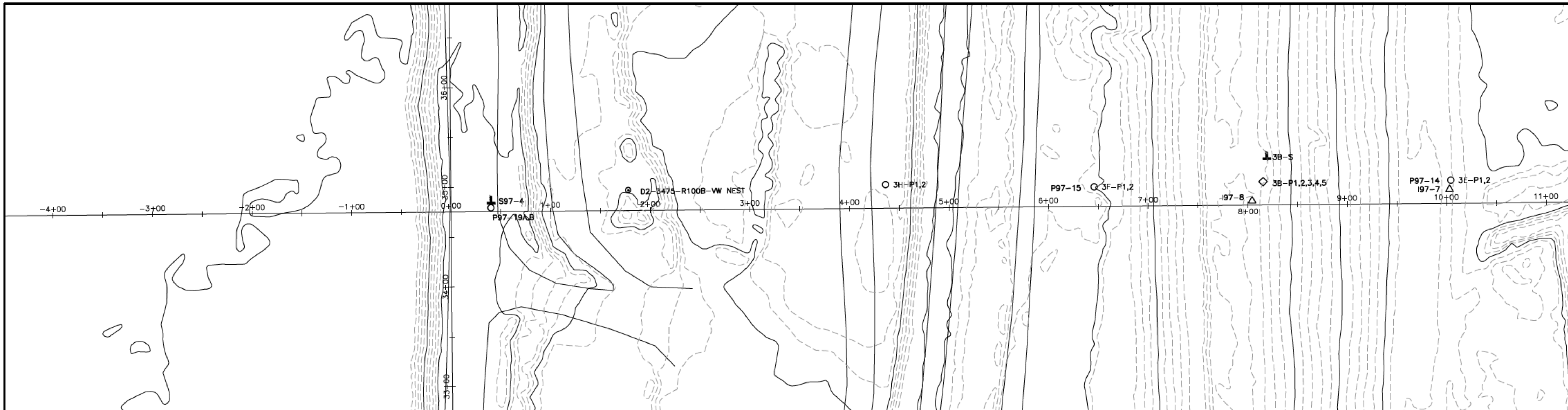
Scale	AS SHOWN
Date	6/15/11
Drawn	GSJ
Checked	
Designed	
Approved	

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS POND
2011 CONDITIONS

DAM 1 - STA. 28+40
CROSS SECTION OF EXISTING CONDITIONS

BARR PROJECT No. 23/38-086
CLIENT PROJECT No.
DWG. No. G-04
REV. No. A

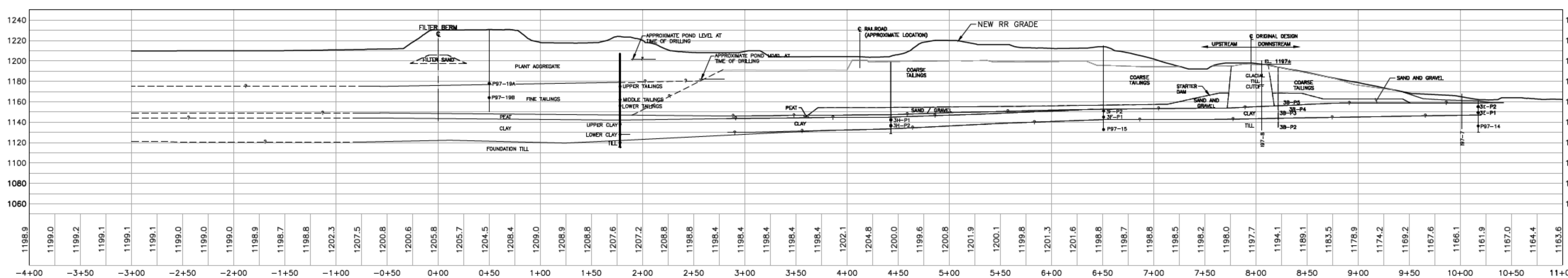


1 G-07 PLAN: DAM 2 – STA. 34+75

0 50 100
SCALE IN FEET

LEGEND:

- PNEUMATIC PIEZOMETER
- CASAGRANDE PIEZOMETER
- INCLINOMETER
- RELIEF WELL
- SETTLEMENT PLATE



1 G-07 SECTION: DAM 2 – STA. 34+75

0 50 100
SCALE IN FEET

CROSS SECTION SURFACE DEVELOPED FROM 2010 FLYOVER.

LEGEND

– – ? – – UNAVAILABLE INFORMATION FOR ACCURATE CONTACT INTERPRETATION

——— STRATIGRAPHIC CONTACTS BETWEEN FOUNDATION SOILS ARE BASED ON INTERPRETATION BETWEEN BORINGS. CONTACTS BETWEEN INTERNAL DAM FILL ZONES ARE BASED ON INTERPRETATION BETWEEN BORINGS AND CONSTRUCTION RECORDS INFORMATION, WHERE AVAILABLE.

NOTE:

INVESTIGATIVE BORING

3F-P2 PIEZOMETER IDENTIFIER

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE ______
PRINTED NAME ______
DATE ______ REG. NO. ______

	A	B	C	0	1	2	3
CLIENT							
BID							
CONSTRUCTION							
RELEASED TO/FOR	DATE RELEASED						

BARR

Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office: BARR ENGINEERING CO. 4700 WEST 77TH STREET MINNEAPOLIS, MN. 55435-4803 Ph: 1-800-632-2277 Fax: (952) 832-2601 www.barr.com

Scale	AS SHOWN
Date	6/15/11
Drawn	GSJ
Checked	
Designed	
Approved	

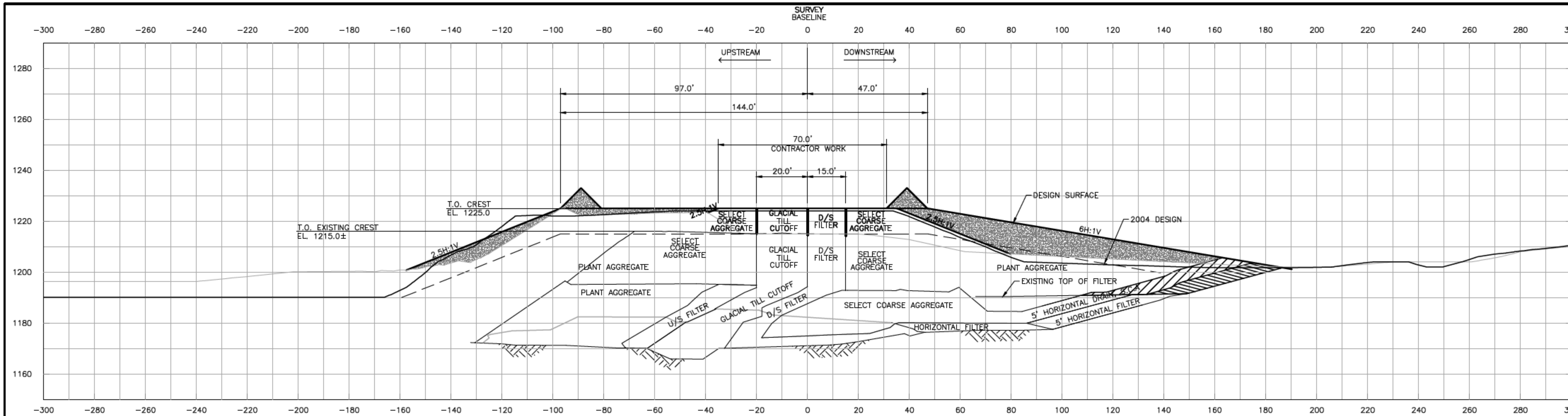
NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILING BASIN
2011 CONDITIONS

DAM 2 – STA. 34+75
CROSS SECTION OF EXISTING CONDITIONS

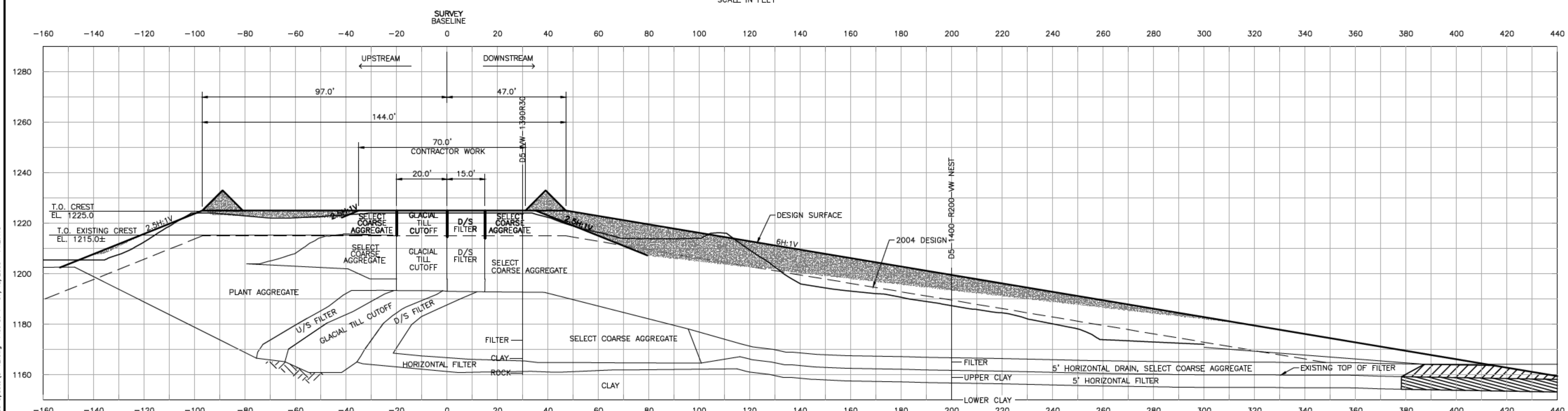
BARR PROJECT No. 23/38-086
CLIENT PROJECT No.
DWG. No. G-08
REV. No. A

gsj M:\cad\N_shore\2338_086\Geotechnical\2009 update\G-08.DWG Plot at 0 07/13/2009 14:43:58



SECTION: STATION 8+00

0 20 40 SCALE IN FEET



SECTION: STATION 14+00

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gsj M:\cad\N_shore\2338_086\Geotechnical\2009 update\G-12.dwg Plot at 1 07/13/2009 14:27:13

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

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SIGNATURE ____
PRINTED NAME ____
DATE ____ REG. NO. ____

RELEASED TO/FOR	A	B	C	0	1	2	3
CLIENT							
BID							
CONSTRUCTION							
	DATE RELEASED						

BARR

Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office: BARR ENGINEERING CO. 4700 WEST 77TH STREET MINNEAPOLIS, MN. 55435-4803 Ph: 1-800-632-2277 Fax: (952) 832-2601 www.barr.com

Scale	AS SHOWN
Date	6/15/11
Drawn	GSJ
Checked	
Designed	
Approved	

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS BASIN
2011 CONDITIONS

DAM 5 – STA. 8+00 AND 14+00
CROSS SECTION OF EXISTING CONDITIONS

BARR PROJECT No. 23/38-086
CLIENT PROJECT No.
DWG. No. G-12
REV. No. A

Appendix D

Purpose of the Emergency Action Plan

Appendix D

Purpose of the Emergency Action Plan

The purpose of the Emergency Action Plan (EAP) is to document a workable plan of action to be followed in the event of failure of the Milepost 7 Tailings Basin dams or severe hydrologic conditions at the tailings basin. In 1980, the State of Minnesota promulgated rules regulating the operation and maintenance of dams, however the dams are not currently regulated by the MnDNR. If the dams were to be classified at Class 1 by the MnDNR, then in accordance with Minnesota Rules 6115.0340 NSM would be required to prepare an emergency action plan. At this time NSM has initiated the creation of this plan for their own use, in order to be prepared in the event of an emergency situation at the dam.

A copy of Minnesota Rules Section 6115.0490 Warning Systems and Emergency Procedures is attached.

Minnesota Rules for Emergency Plans

Minnesota Rules 6115 Department of Natural Resources

6115.0490 WARNING SYSTEMS AND EMERGENCY PROCEDURES.

Class I dam owners shall prepare and file for approval a contingency plan for notifying any persons whose lives, property, or health may be endangered by failure, misoperation, or other circumstances or occurrence affecting the dam, identifying most practical and expeditious means for warning considering the time factor involved based on the proximity of the dam to affected parties. If there is no feasible or practical means to provide for adequate evacuation warning in sufficient time if a catastrophe occurs the owner shall be responsible for notifying affected downstream property owners of that fact.

STAT AUTH: MS s 105.535

Current as of 06/11/08

Appendix E

Dam Break Analyses Methodology and Results Summary

Appendix E

Dam Break Analyses Methodology and Results Summary

E.1 Project Background

Barr Engineering was retained by Norhshore Mining Company (NSM) to develop the Emergency Action Plan (EAP) for Dams 1, 2 and 5 at the Milepost 7 Tailings Basin (basin). The basin is located upstream of the Beaver River and 2.5 miles Northwest of the city of Beaver Bay, Minnesota. Dams 1, 2, and 5 are earthen perimeter dams, which along with natural topography, create basin embankments. A large portion of the EAP is dedicated to determining the extent of flooding in the event of a breach at one of the dams. Dam failure analyses were completed to calculate the floodwave travel time and determine the inundation extents downstream of the basin.

E.2 Hydraulic Modeling

The HEC-RAS model, developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers, was used to create the hydraulic model to compute water surface elevations along the breach paths downstream of Dams 1, 2 and 5. A project location map showing all modeled crossings is included in Section 1 of the EAP document.

The Dam 1 model [redacted]

The approximate length of the Dam 2 model [redacted]

[redacted]

The total length of the Dam 5 model [redacted]

In the Dam 5 model, [redacted]

[redacted]

Manning's n values for the channel and floodplain were defined based on site topography, geology, and photos from the survey. Behind the dams and in Bear Lake a value of 0.03 was used for the channel. In the Beaver River and its East Branch a value of 0.03 was used for the channel, and in the flow paths between the dams and the rivers a value of 0.05 was used for the main channel. In sections of the Beaver River and East Branch of the Beaver River where there were steep falls, a channel value of 0.05 was used. Manning's values used for the floodplain was universally set to 0.07.

Select bridges and culvert information was obtained by a Barr survey. Bridge low member elevations, pier geometry, and abutments are approximate and were estimated from site photos. Road information was obtained from a combination of a survey data, site photos, and LiDAR data. Data for the Highway 61 Bridge was obtained from a Mn/DOT as-built plan set.

Channel and floodplain geometry were mostly defined using Lake County LiDAR topographic data. Several small areas were not covered by the LiDAR data, and the 10-meter resolution National Elevation Dataset (NED) grid was used to supplement the LiDAR data. LiDAR and NED data reflect topography above the water surface elevation at the time it was gathered, so assumptions were made on the channel geometry below the normal water level in the channel. Often the lowest LiDAR or NED elevation was assumed as the channel low point since the channel conveyance is insignificant compared to the floodplain conveyance in the event of flood resulting from a dam breach.

For each of the dam breach scenarios, Sunny Day (base flow) conditions were assumed in the downstream flow paths and rivers. Base flows are required for the model to compute, and the minimum base flow which allowed for model stability was used in each of the flow paths. These base flows were insignificant when compared to the flow rates during a flood resulting from a dam breach. The base flows do not reflect any gauging data on the Beaver River or the East Branch of Beaver River.

E.3 Dam Breach Modeling

Dams 1, 2, and 5 are entirely earthen embankment dams and were modeled using ultimate dam build-out information obtained from proposed dam contours. All three Milepost 7 dams were modeled with a top elevation of 1315 feet, which is the final dam elevation. The water surface in the tailings basin was assumed to be at 1313 feet during the simulated breach. This elevation is the maximum possible elevation based on the freeboard and watershed runoff calculations completed as part of the 5-Year Operating Plan.

[redacted]

[redacted]

FERC guidelines for breach parameters were used to define the breach geometry. For all dams the average breach width was set to [redacted] height of the dam. The FERC guidelines recommend an average breach width between two to four times the height of the dam. Breach side slopes were set at [redacted]. This failure slope is the average value in the range recommended by FERC (0.25 to 1). The time to breach formation was set to [redacted], which is typical for earthen dams with similar specifications. This average time recommended by FERC for earthen dams is 0.1 to 1.0 hours, so the time to breach formation of [redacted] is conservative.

No failure was considered at of any of the road crossings or subsequent dams downstream of Dams 1, 2 and 5. If failure of a bridge structure were to occur, there could potentially be a decrease in the amount of response time.

E.4 Modeling Results

[redacted]

[redacted]

[redacted]

[redacted]

The downstream inundation areas for Dams 1, 2, and 5, along with peak flow rates, maximum velocities, and travel time at select locations are shown on Figures E.4 through E.6. The maximum water surface profiles for Dams 1, 2, and 5, and the Dam 5 overflow path are shown in Figures E.7 through E.10 respectively. Modeled bridge sections and their maximum floodwave elevations are shown in Figures E.11 through E.25. Flow hydrographs immediately downstream of the dam and at bridge crossings downstream are shown in Figures E.26 through E.29 for Dams 1, 2, and 5, and the Dam 5 overflow path respectively.

Since our analyses assumed a worst case scenario for dam breach geometry and water surface elevation, a sensitivity analysis was completed to determine how much the downstream inundation area would change using a current water surface elevation. Figure E.30 shows the inundation area resulting from a breach for a starting water surface elevation after the PMP event (as it is mapped in Figure 5 and Figure E.4) as well as the inundation area resulting from a breach with a starting water surface elevation under current conditions. If less conservative breach geometry or a longer time to failure were assumed, it would further decrease the extent of downstream inundation.

E.5 Conclusions and Recommendations

The following are our conclusions and recommendations:

1. [redacted]

2. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Ultimate Basin Extents

Structures Located Along Potential Breach Flowpath

Modeled Crossings

Dam

Bridge

Culvert

river sta
Dam 1 Cross-sections

Potential Dam Breach Flowpaths

Rivers

[redacted]

Miles

0.25 0 0.25 0.5

Figure E.1

DAM 1 MODEL LAYOUT
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Structures Located Along Potential Breach Flowpath

Modeled Crossings

Dam

Bridge

Culvert

river sta

Dam 2 Cross-sections

Potential Dam Breach Flowpaths

Rivers

[redacted]

Miles

0.25 0 0.25 0.5

Figure E.2

DAM 2 MODEL LAYOUT
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Structures Located Along Potential Breach Flowpath

Modeled Crossings

Dam

Bridge

Culvert

river sta **Dam 5 Cross-sections**

Potential Dam Breach Flowpaths

Dam 5 Upper

Dam 5 Mid

Dam 5 Lower

Dam 5 Overflow

Rivers

[redacted]

Miles

0.25 0 0.25 0.5

Figure E.3

DAM 5 MODEL LAYOUT
MP7 Dambreak Analysis
Near Silver Bay, MN

Barr Footer: ArcGIS 10.0, 2012-11-06 15 22 File: I:\Projects\23\38\1030\Maps\Reports\MP7_Dam 5 Model Layout.mxd User: mjh2

[redacted]

Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundated Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure E.4

DAM 1 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN

[redacted]

Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundation Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

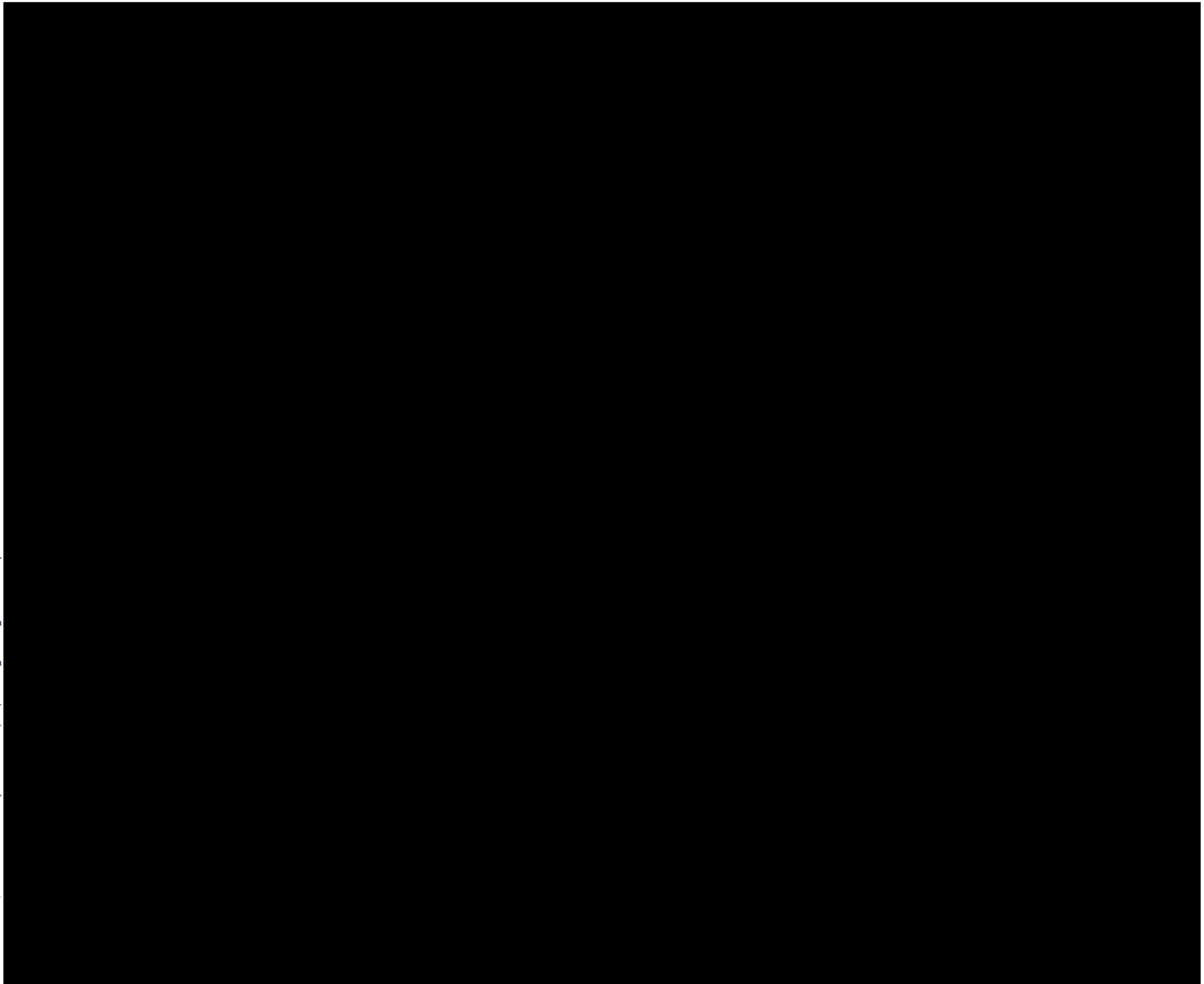
Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure E.5

DAM 2 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN



Ultimate Basin Extents

Inundation Extent

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundation Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Beaver Bay Municipal Boundary

Miles

0.25 0 0.25 0.5

Figure E.6

DAM 5 BREACH INUNDATION AREA
MP7 Dambreak Analysis
Near Silver Bay, MN

Figure E.7. The maximum water surface profile along [redacted].

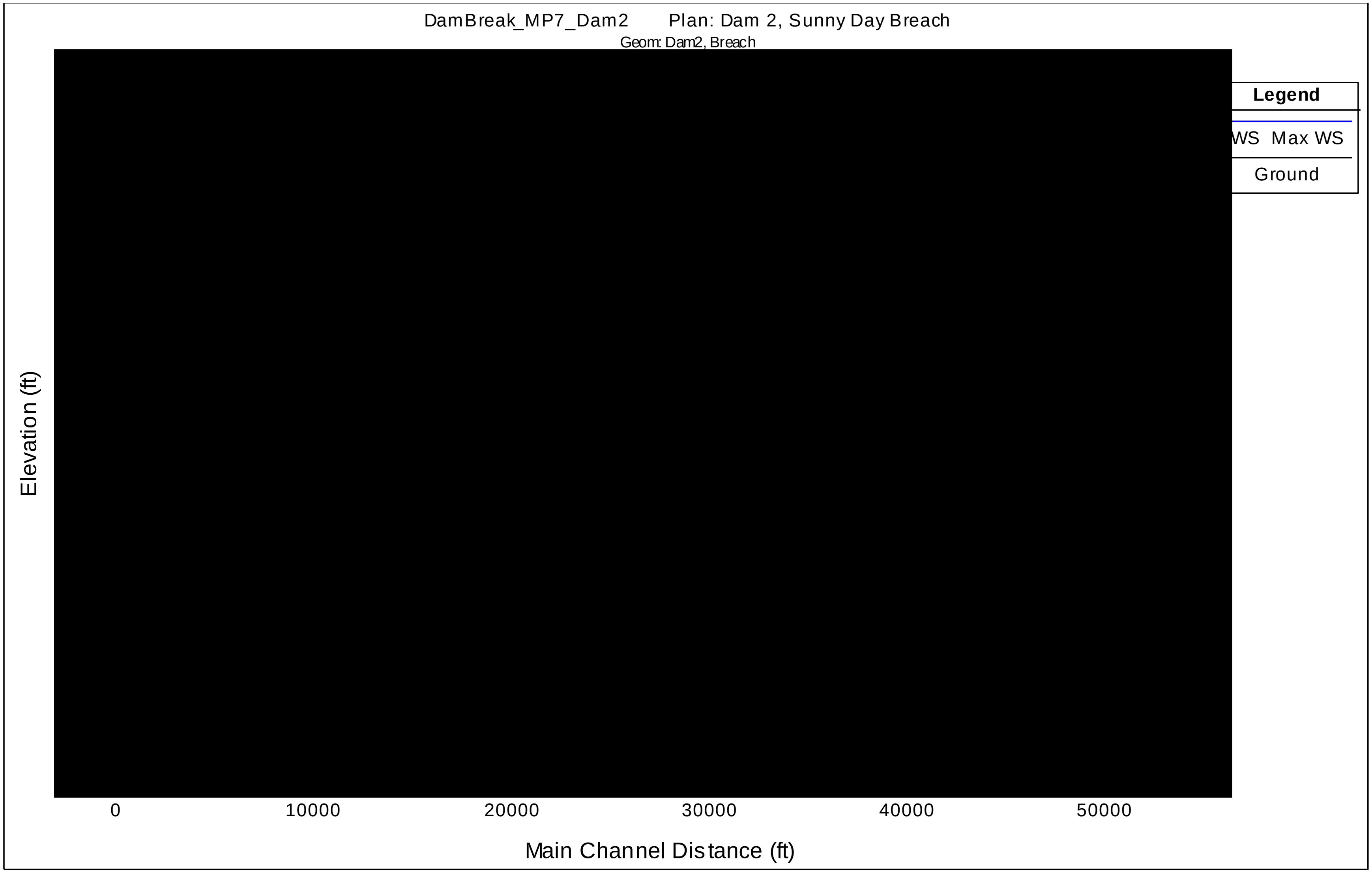


Figure E.8. The maximum water surface profile along [redacted].

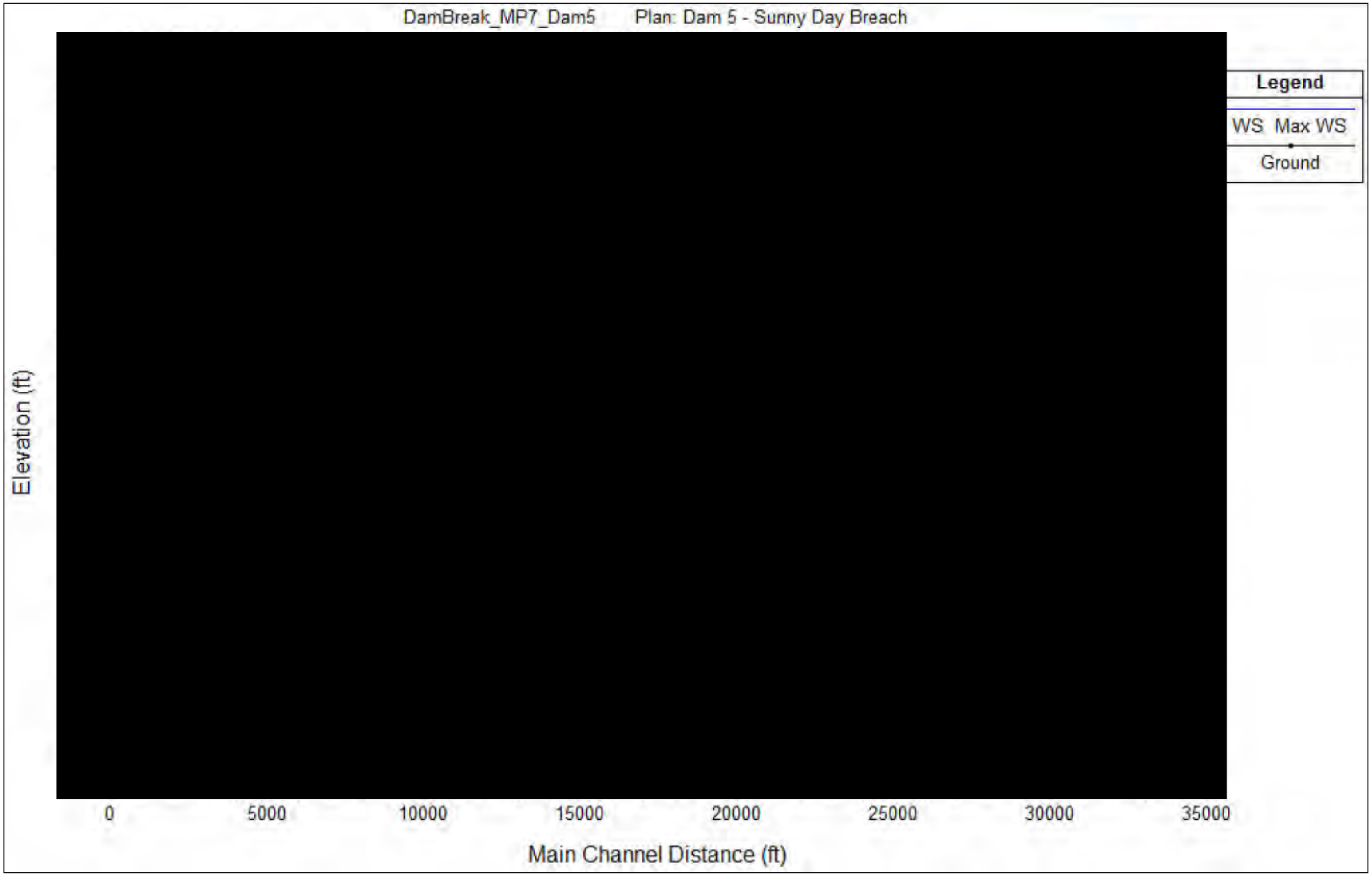


Figure E.9. The maximum water surface profile along [redacted].

Figure E.10. The maximum water surface profile along [redacted]

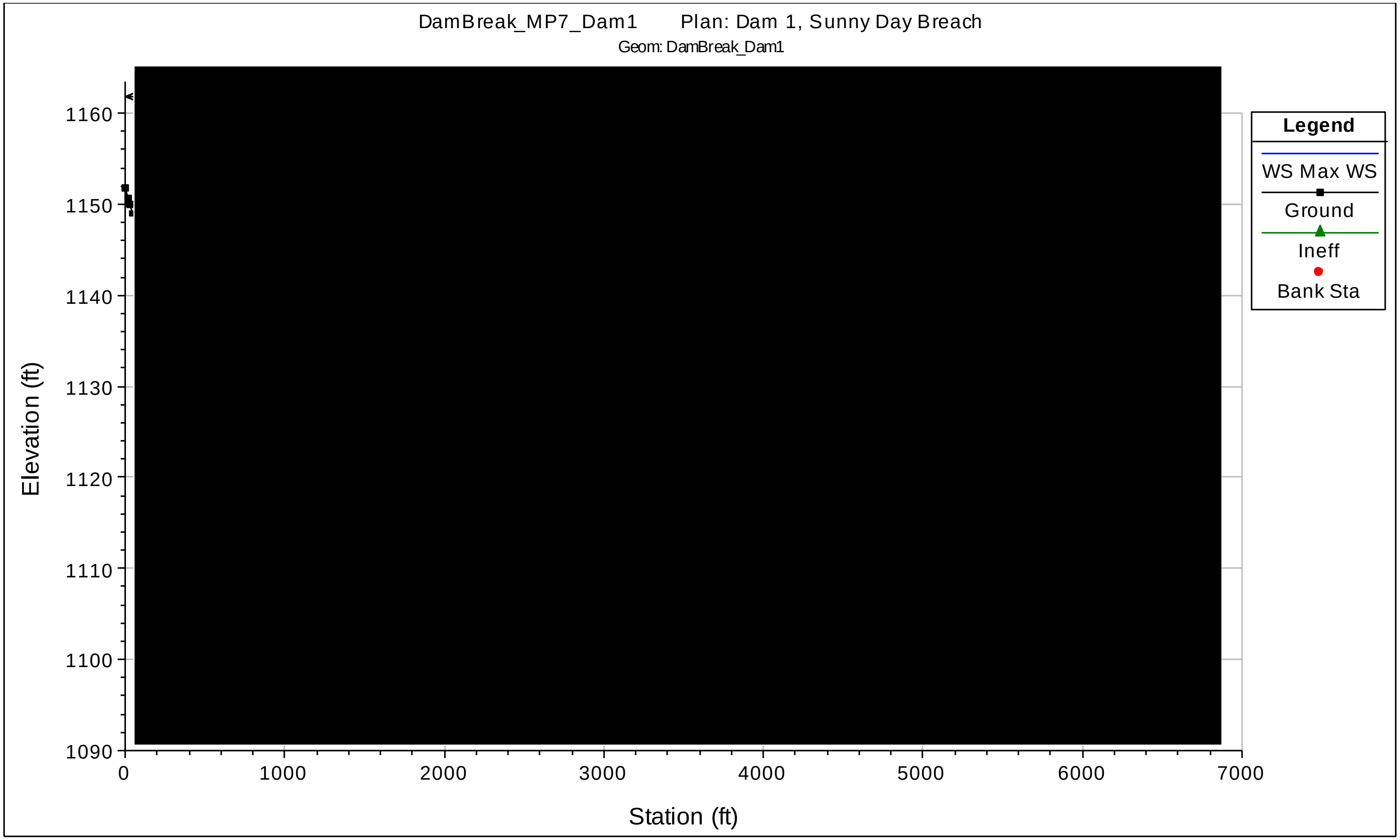


Figure E.11. Dam 1 flow path, maximum water surface elevation during breach [redacted]

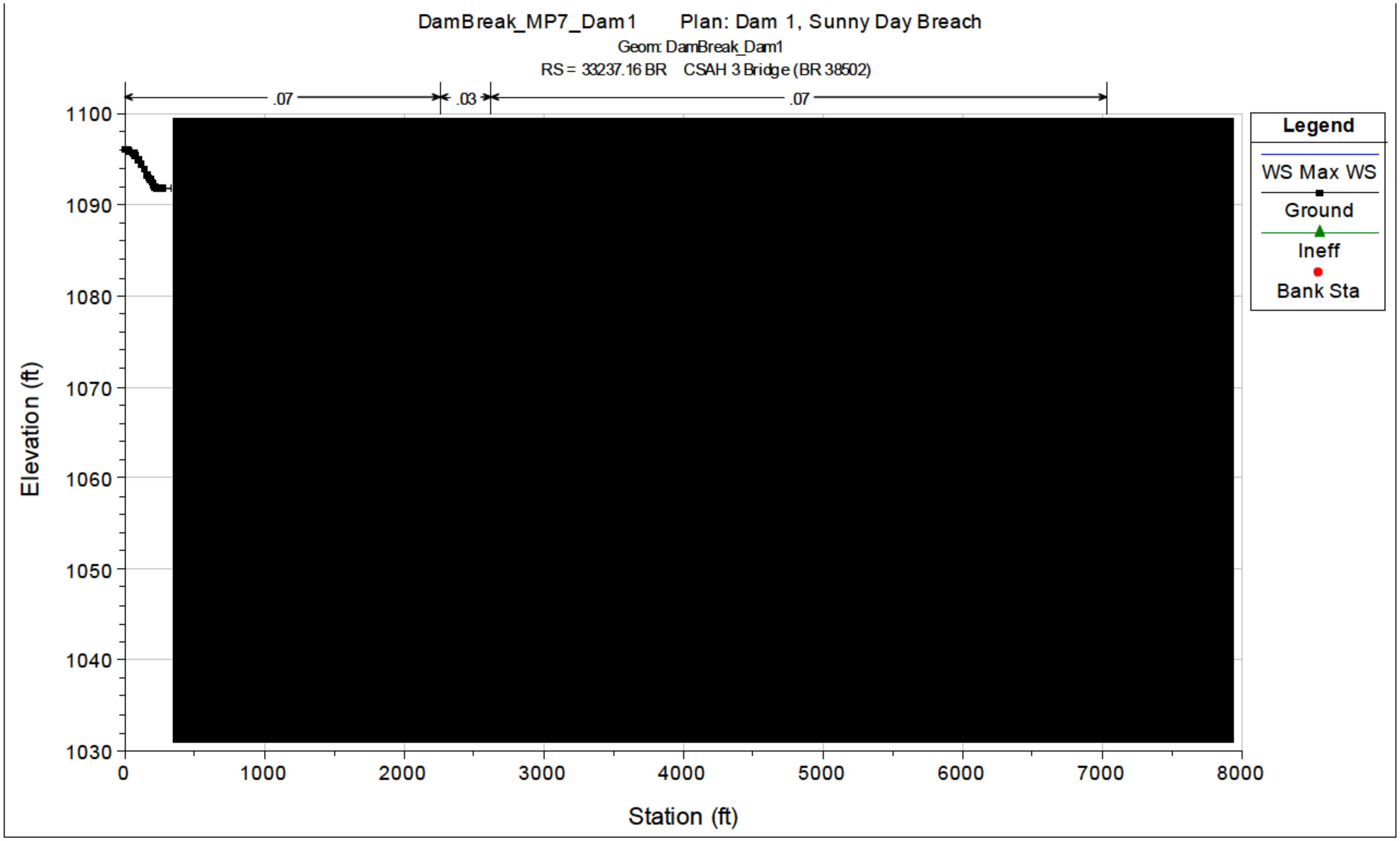


Figure E.12 Dam 1 flow path, maximum water surface elevation during breach at [redacted].

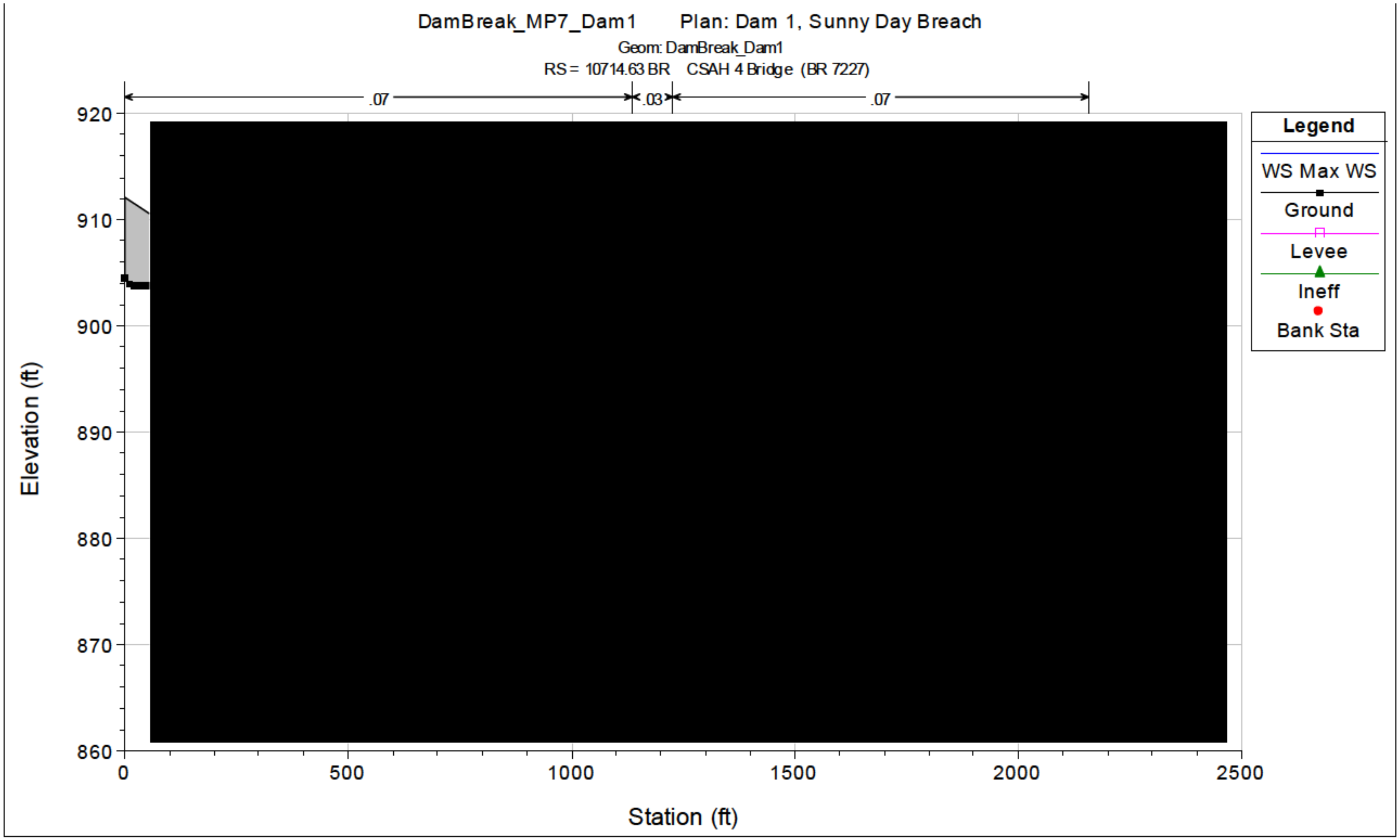


Figure E.13. Dam 1 flow path, maximum water surface elevation during breach at [redacted].

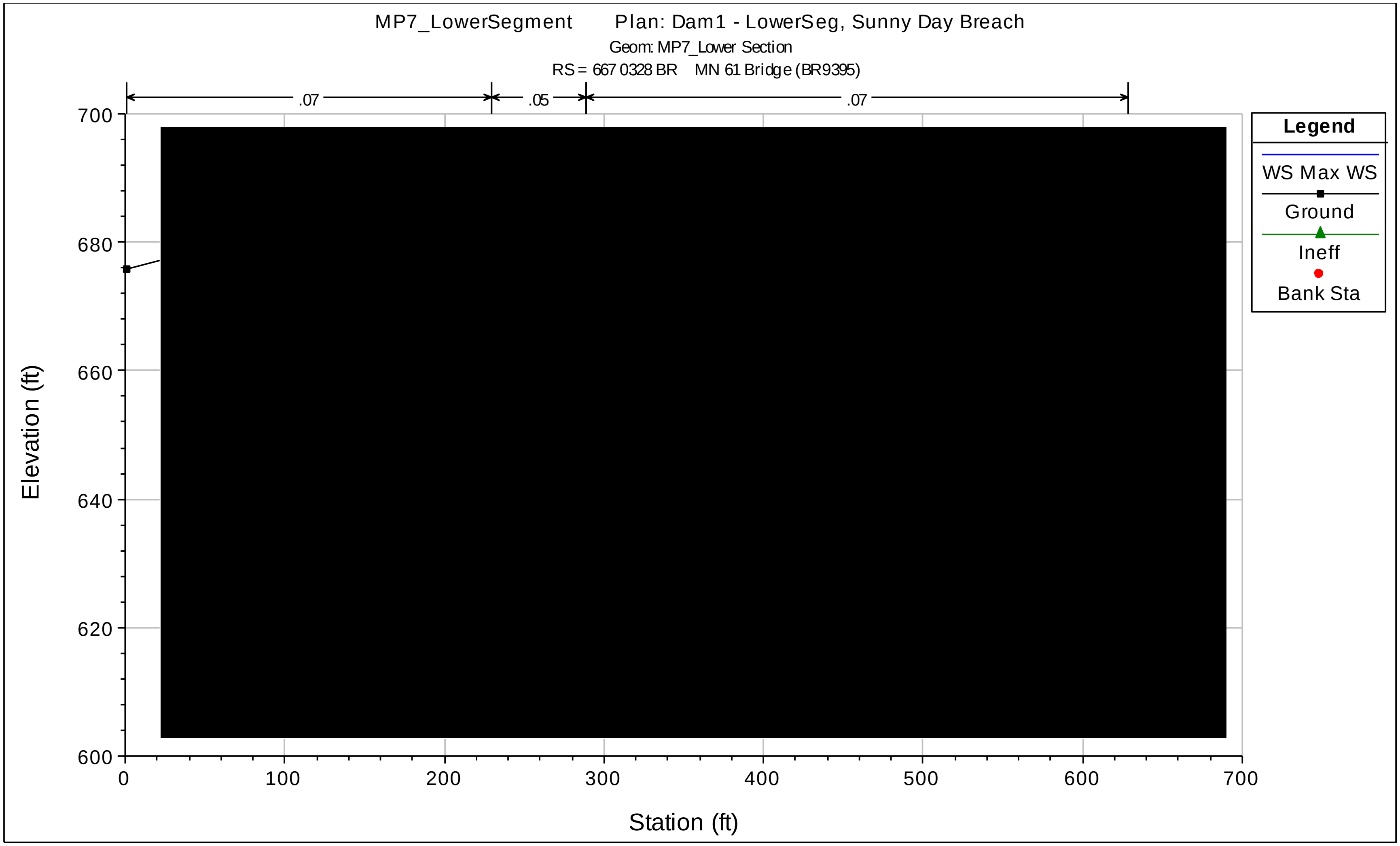


Figure E.14. Dam 1 flow path, maximum water surface elevation during breach at [redacted].

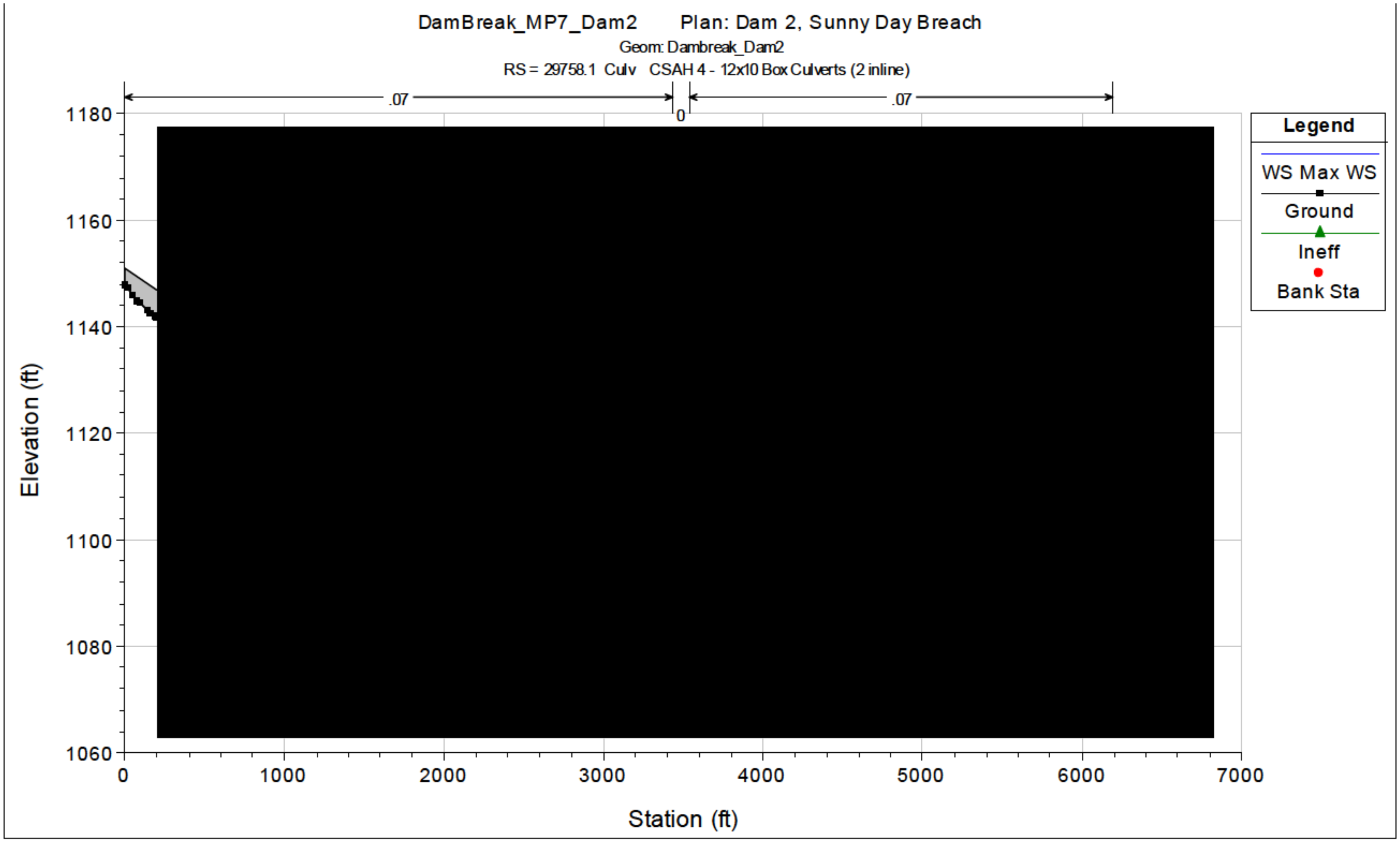


Figure E.15. Dam 2 flow path, maximum water surface elevation during breach at [redacted].

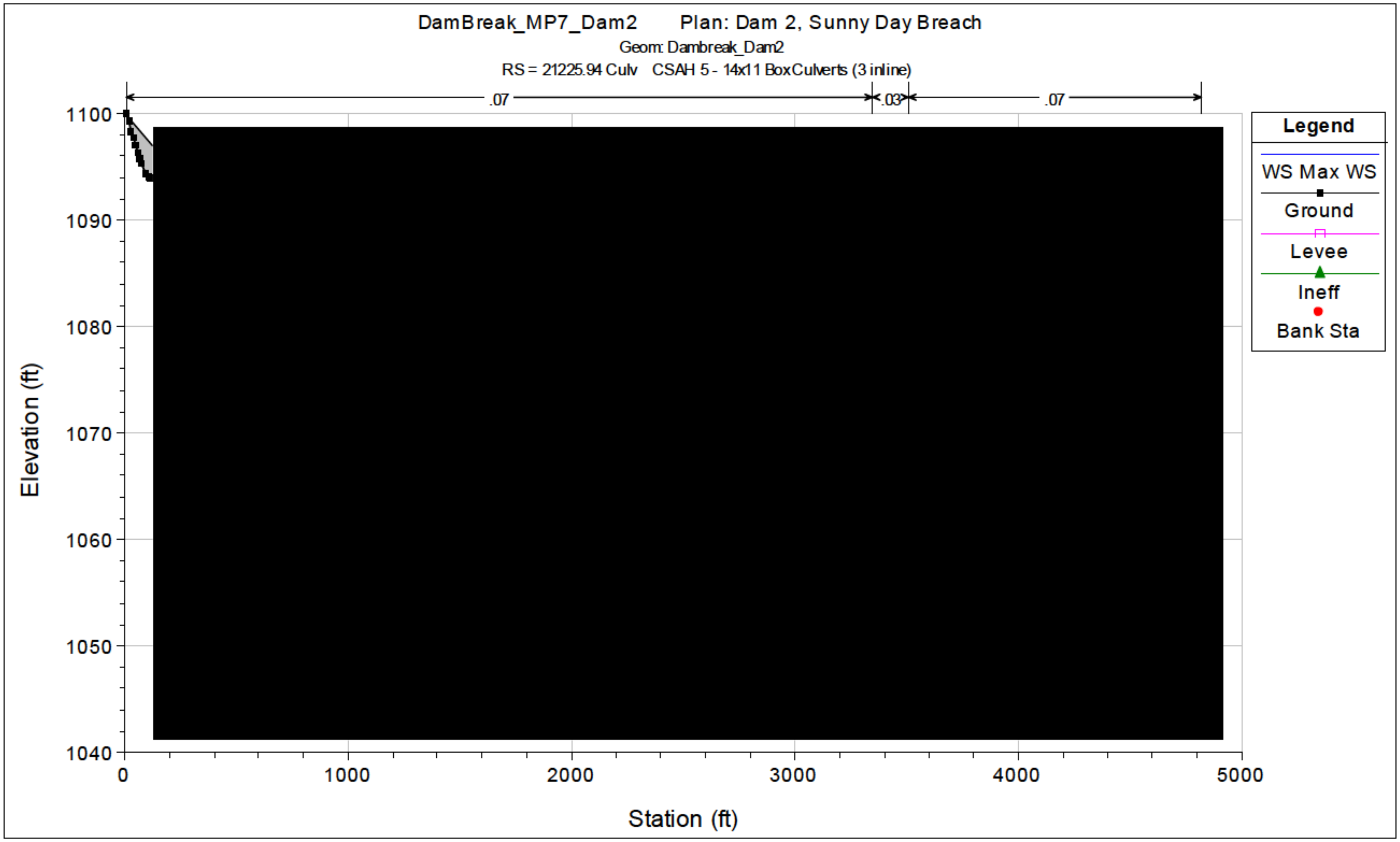


Figure E.16. Dam 2 flow path, maximum water surface elevation during breach at [redacted].

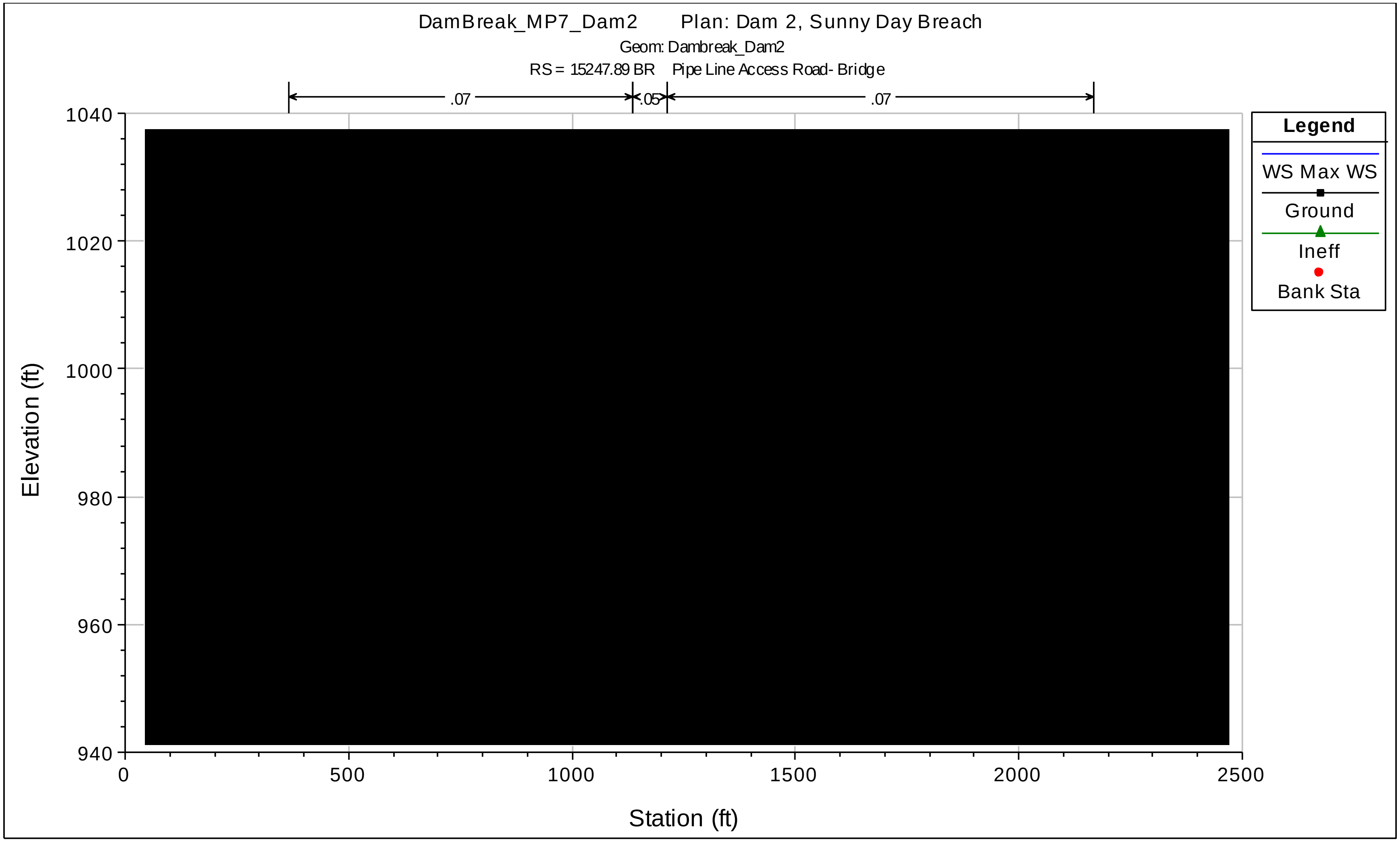


Figure E.17. Dam 2 flow path, maximum water surface elevation during breach at the [redacted].

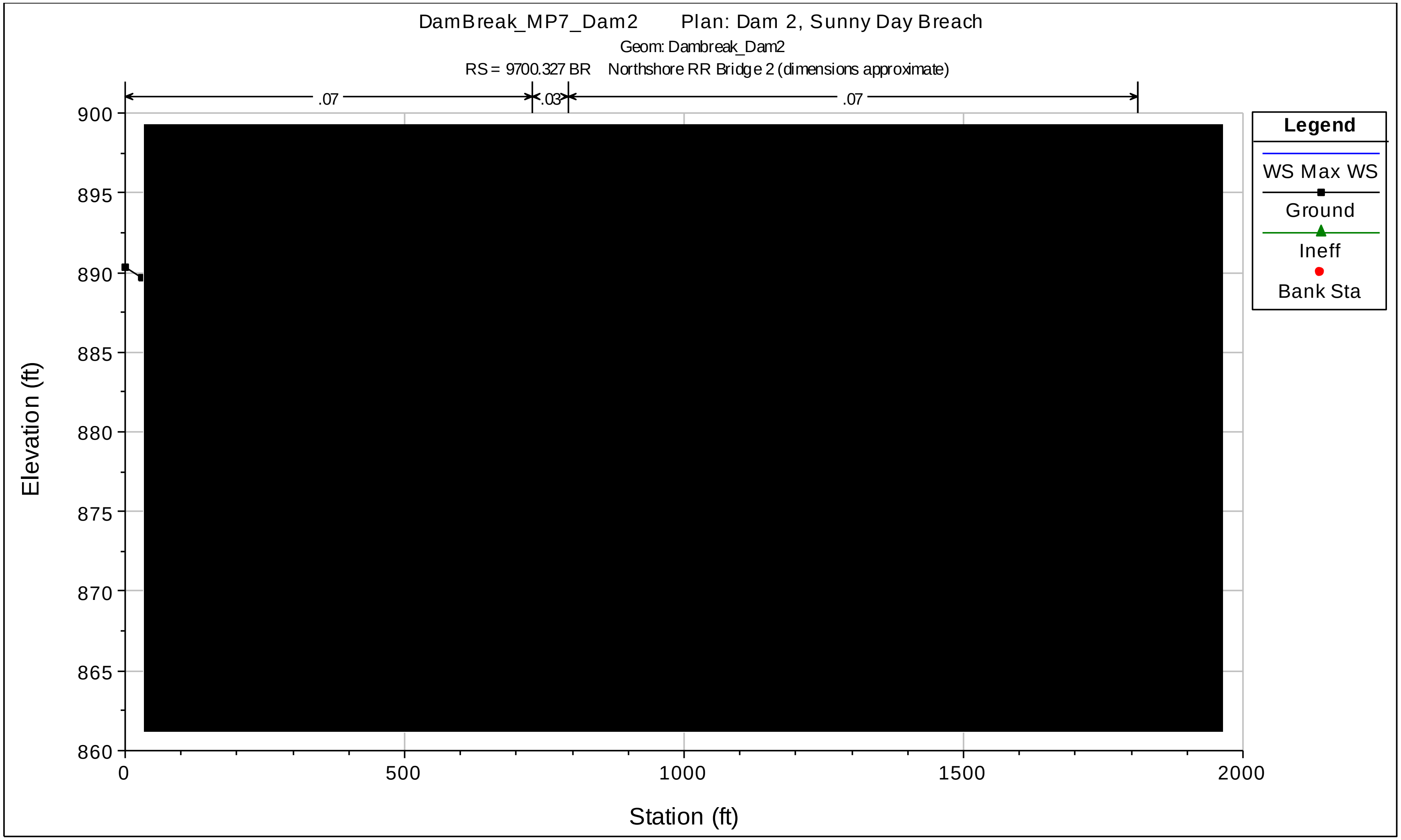


Figure E.18. Dam 2 flow path, maximum water surface elevation during breach at the [redacted]

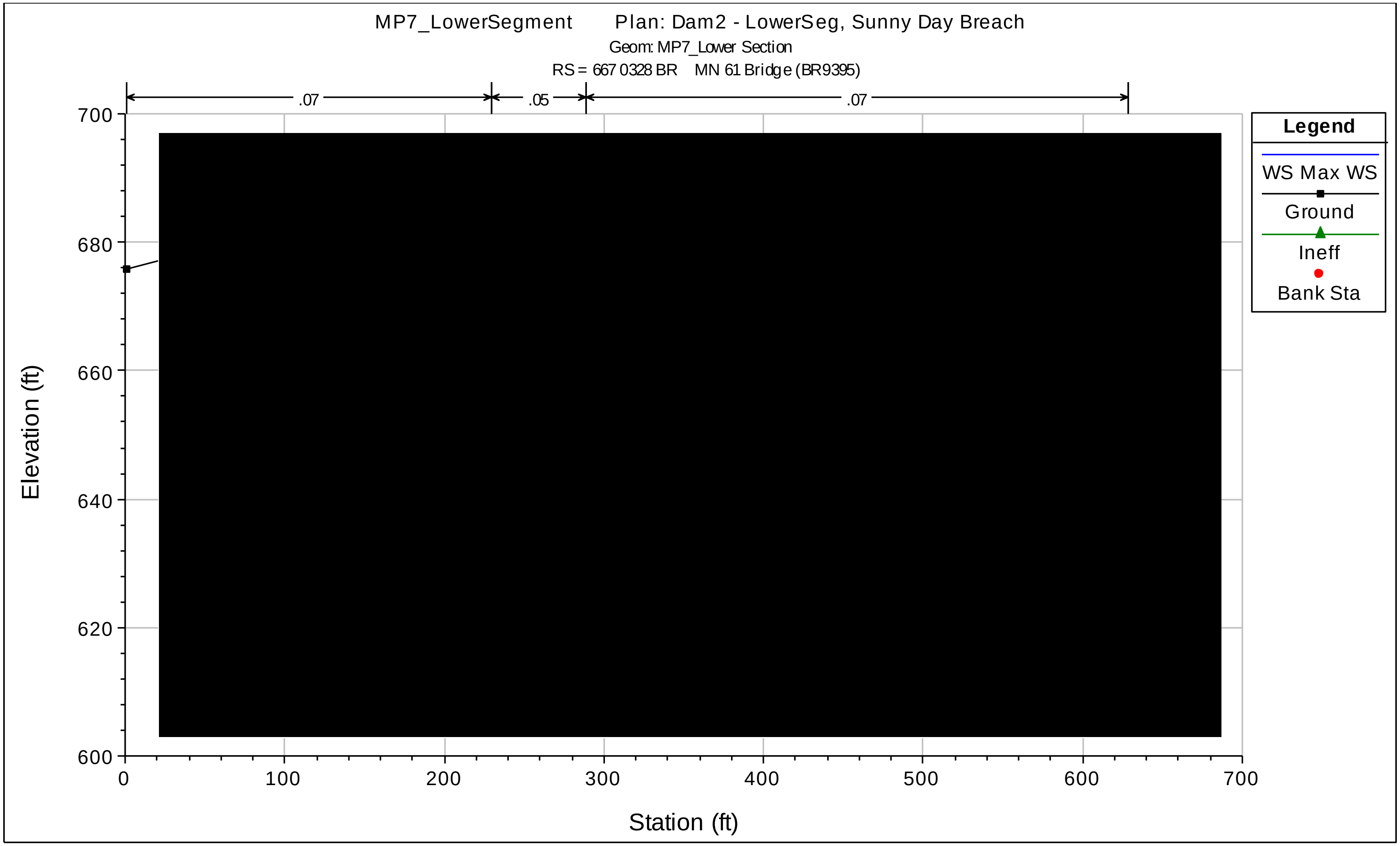


Figure E.19. Dam 2 flow path, maximum water surface elevation during breach at the [redacted].

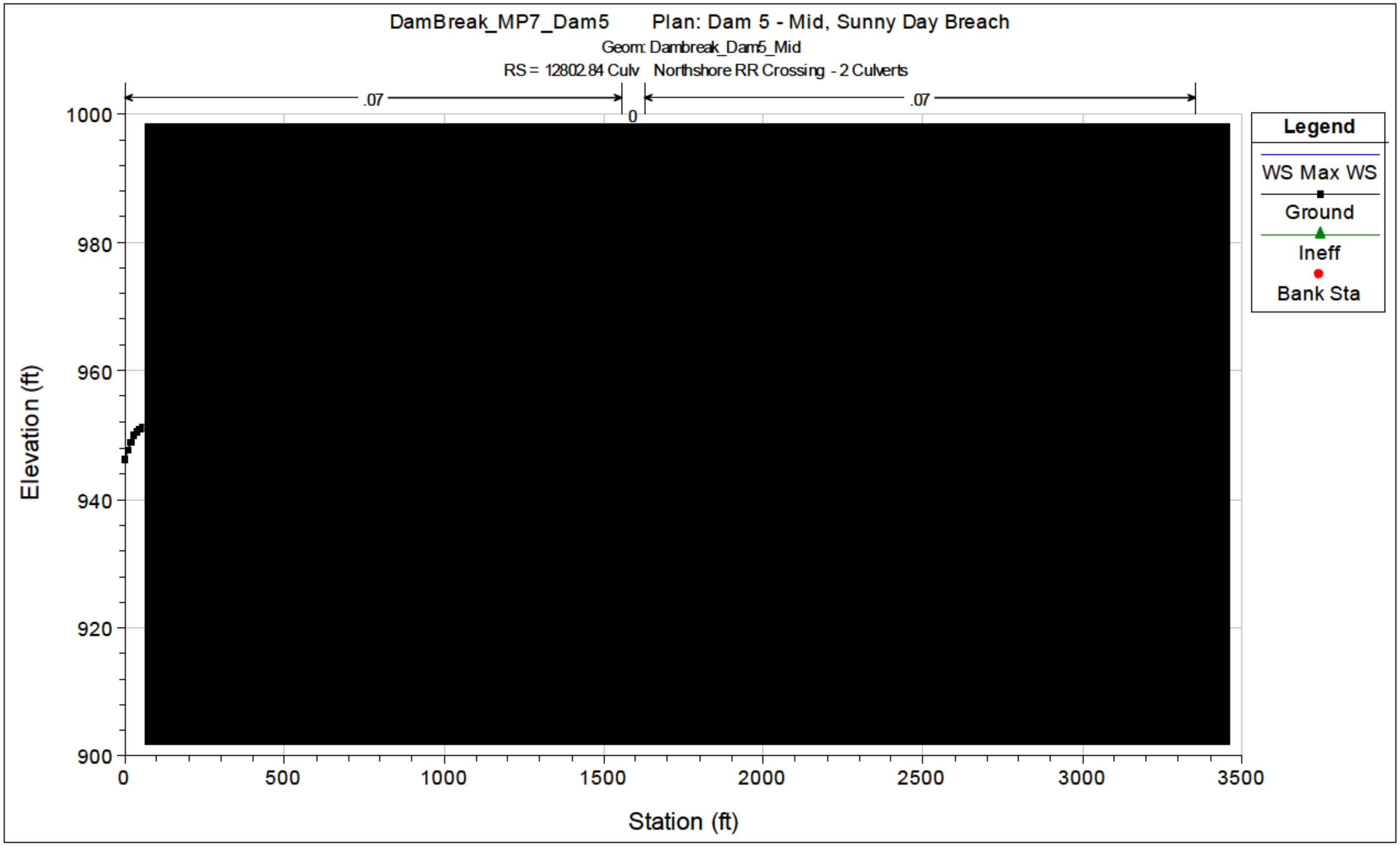


Figure E.20. Dam 5 flow path (Mid Section), maximum water surface elevation during breach [redacted].

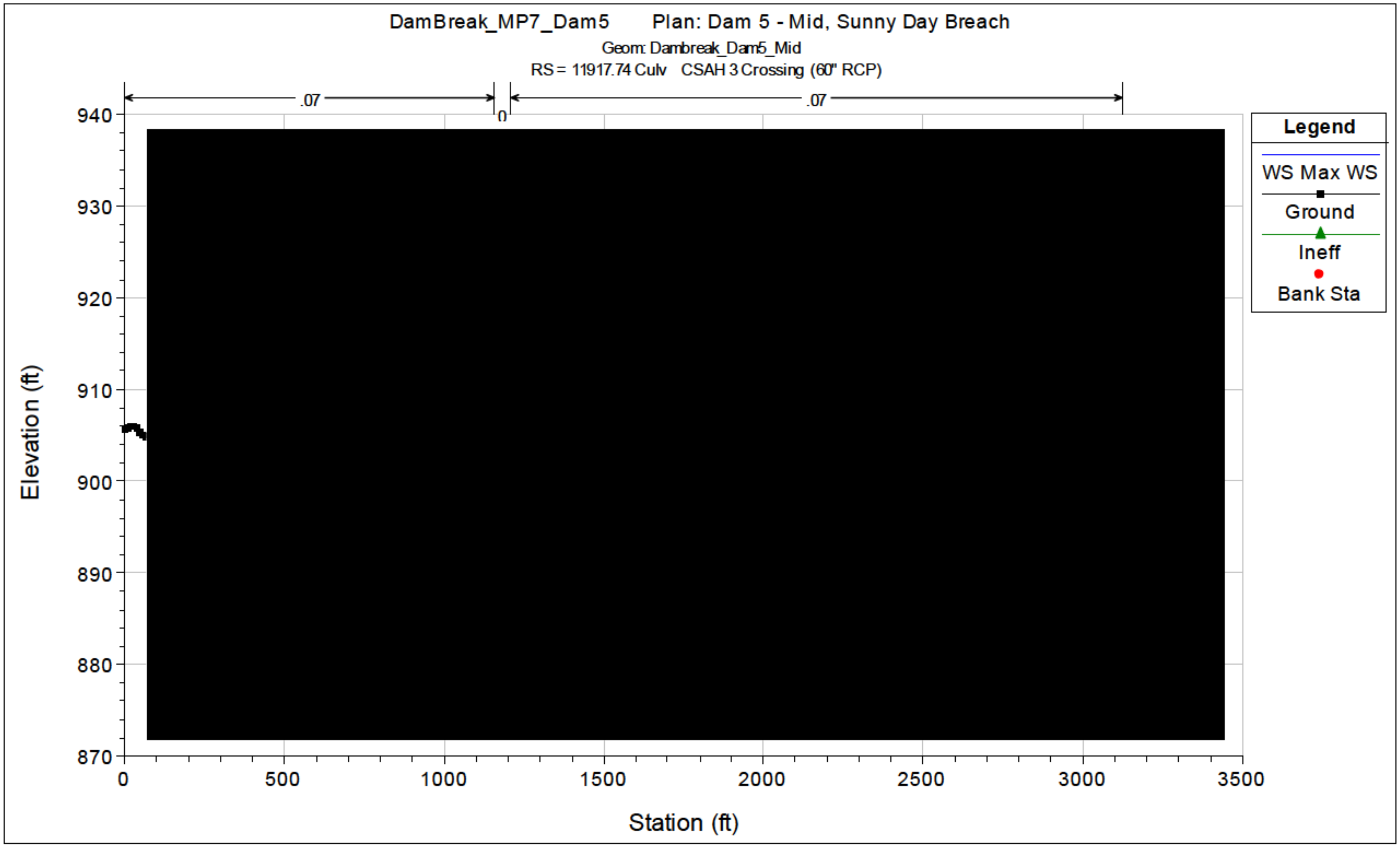


Figure E.21. Dam 5 flow path (Mid Section), maximum water surface elevation during breach [redacted].

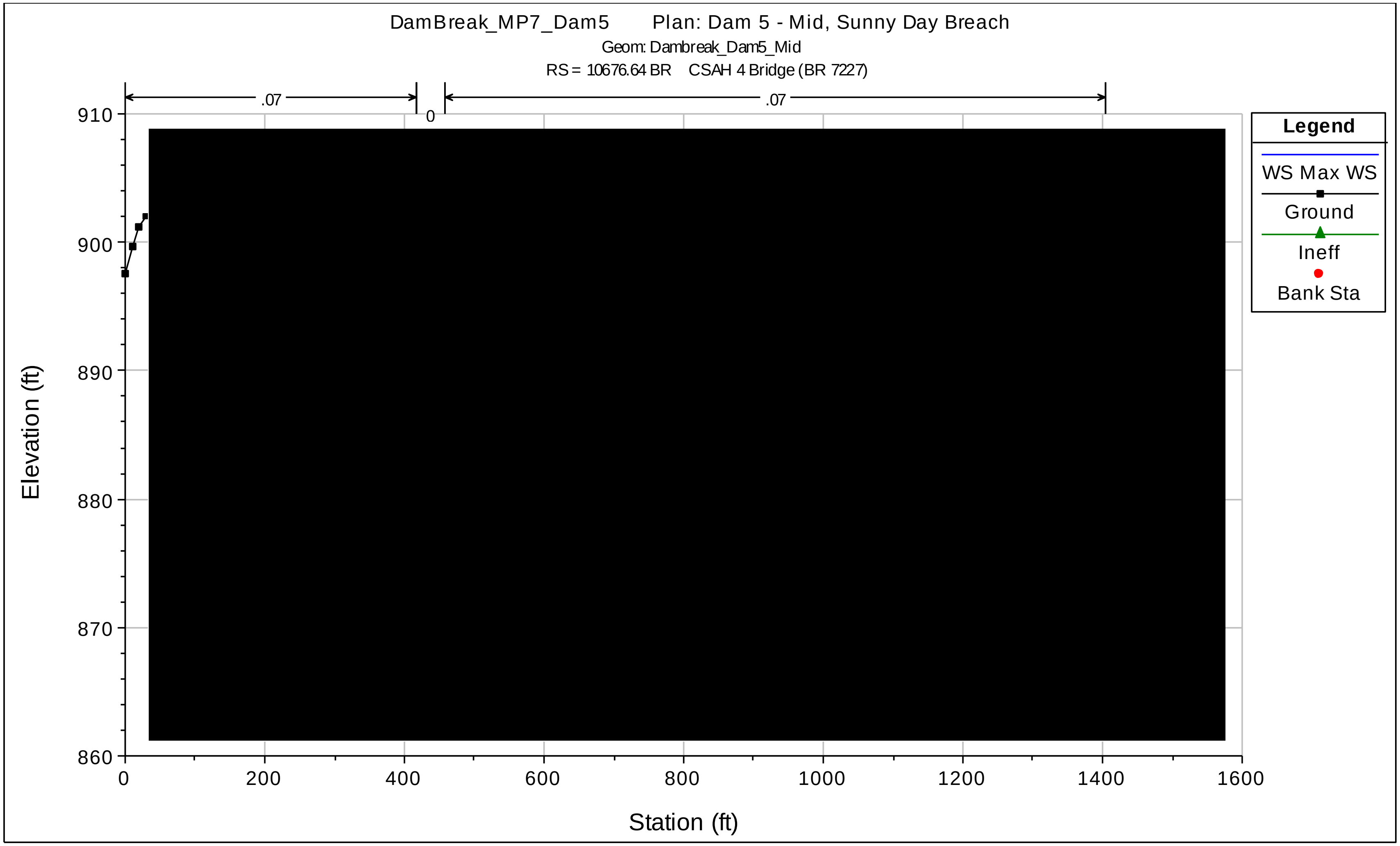


Figure E.22 Dam 5 flow path (Mid Section), maximum water surface elevation during [redacted].

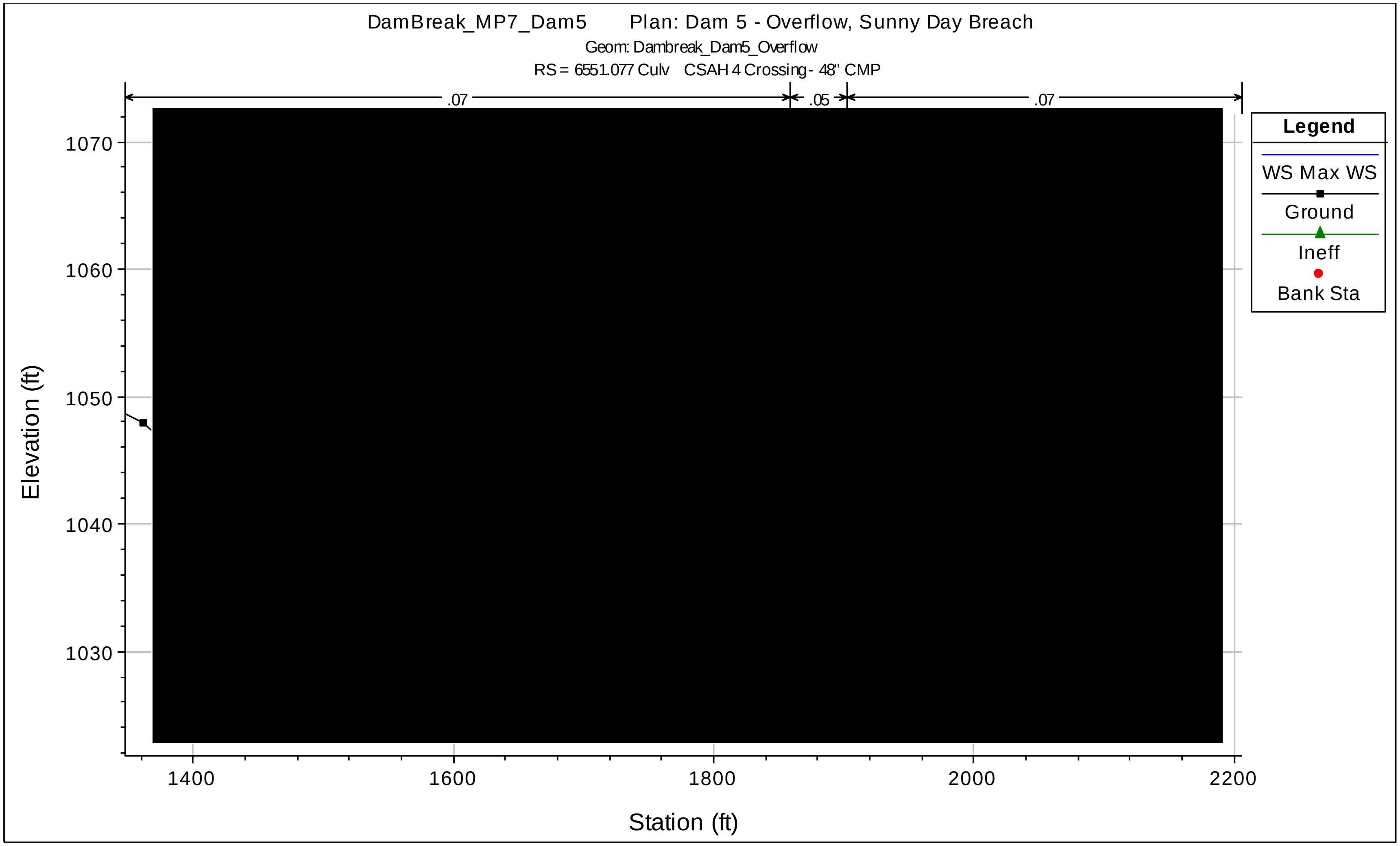


Figure E.23. Dam 5 flow path (Overflow Section), maximum water surface elevation [redacted]

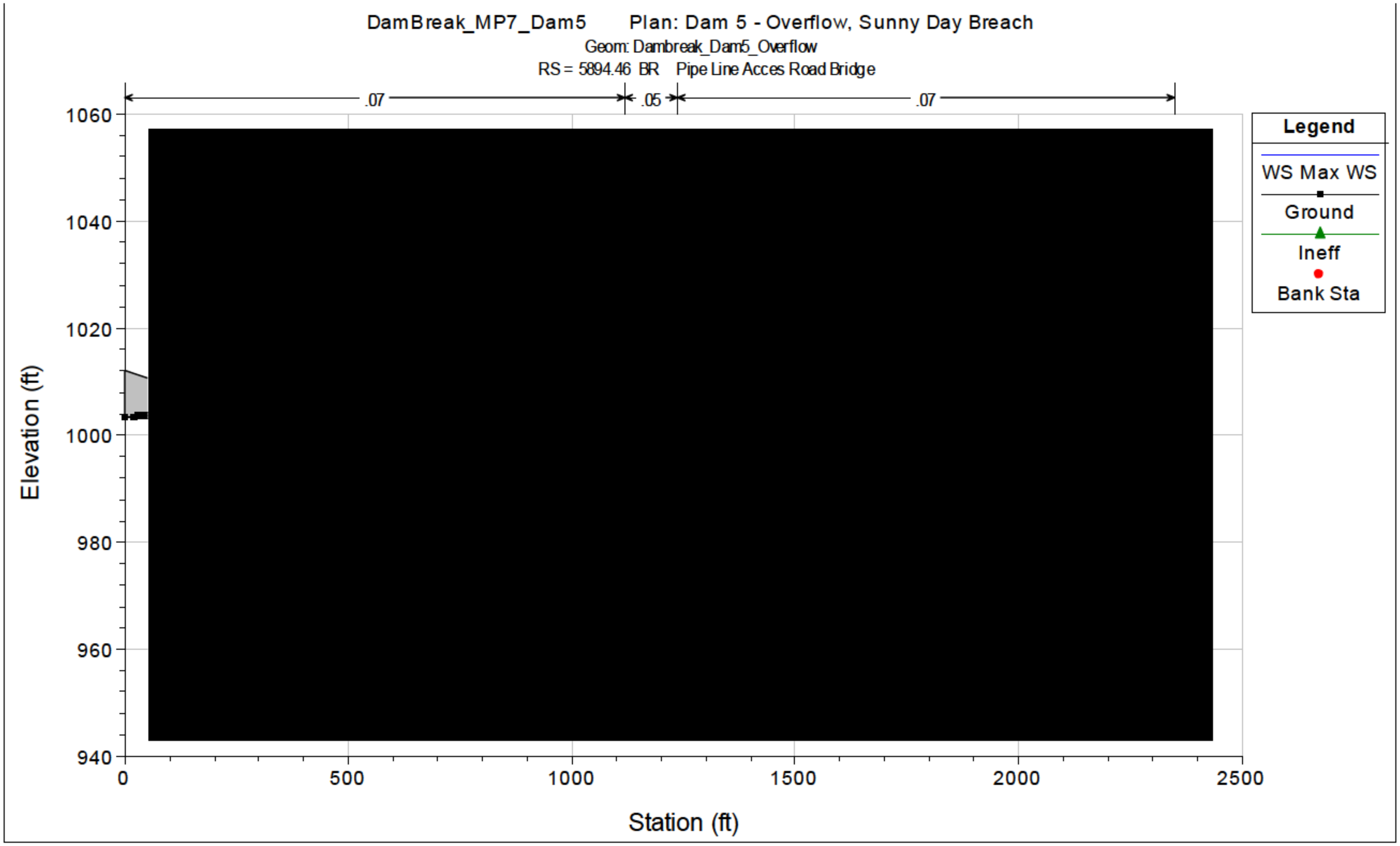


Figure E.24. Dam 5 flow path (Overflow Section), maximum water surface elevation during breach [redacted]

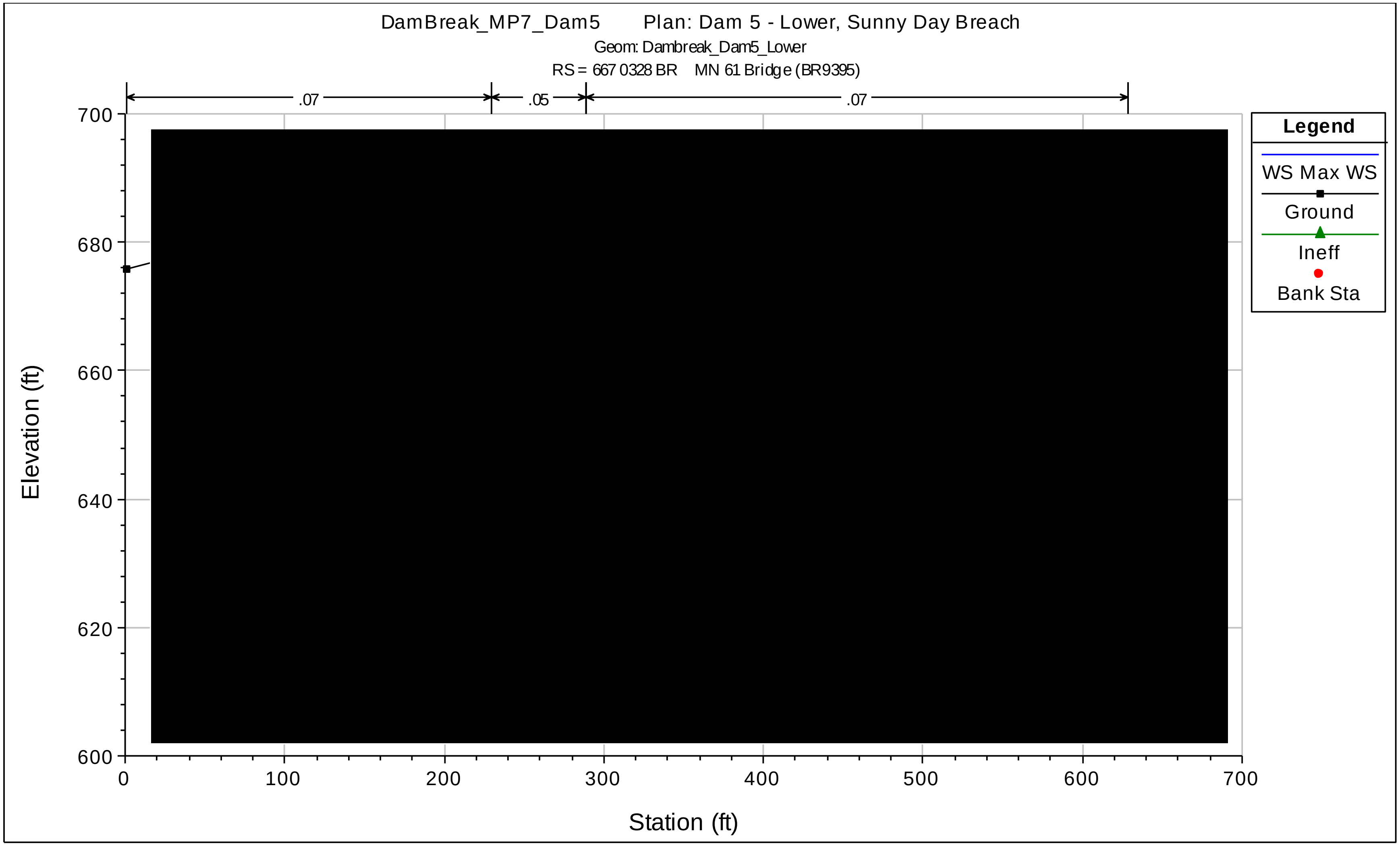


Figure E.25. Dam 5 flow path (Lower Section), maximum water surface elevation during breach [redacted]

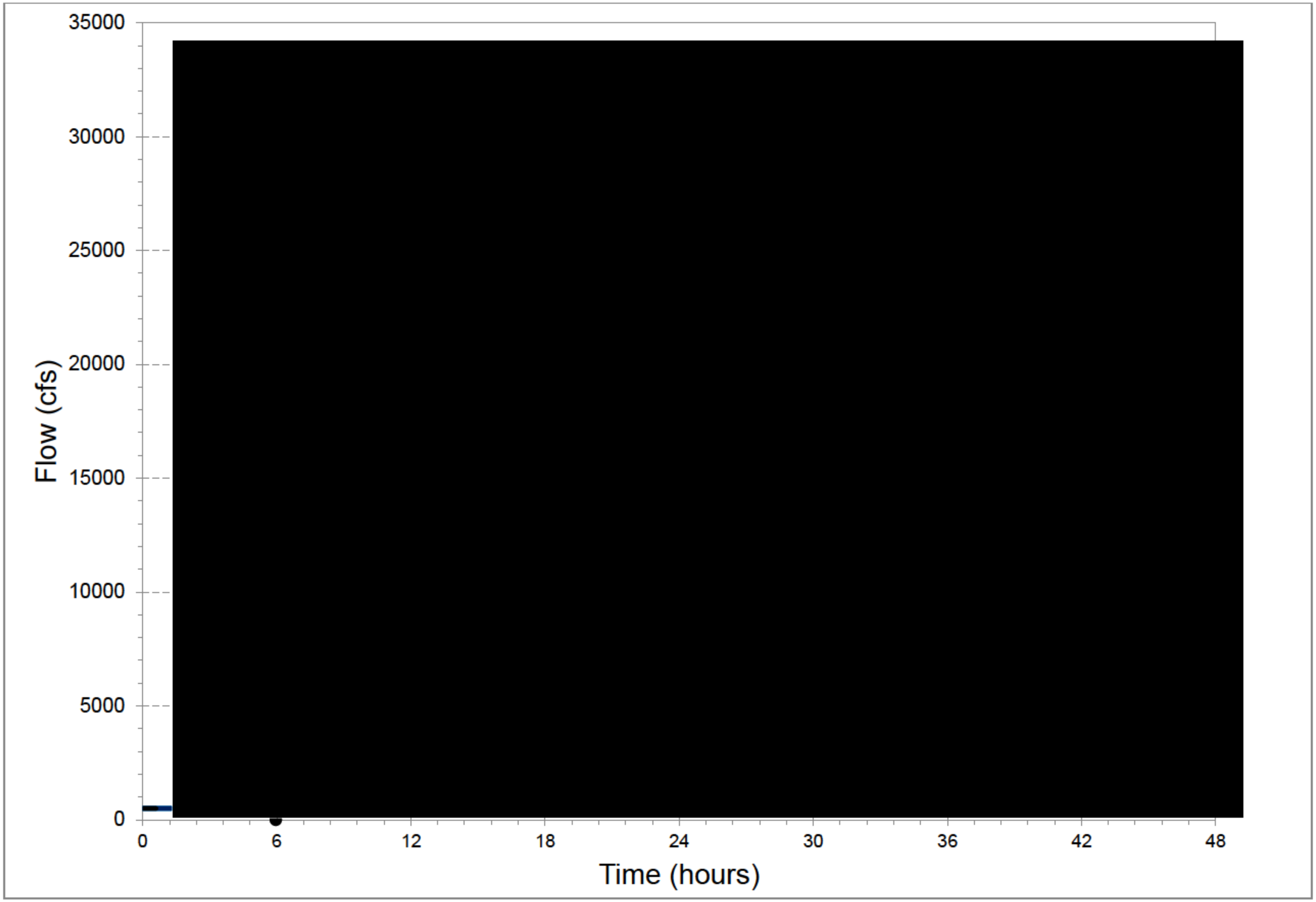
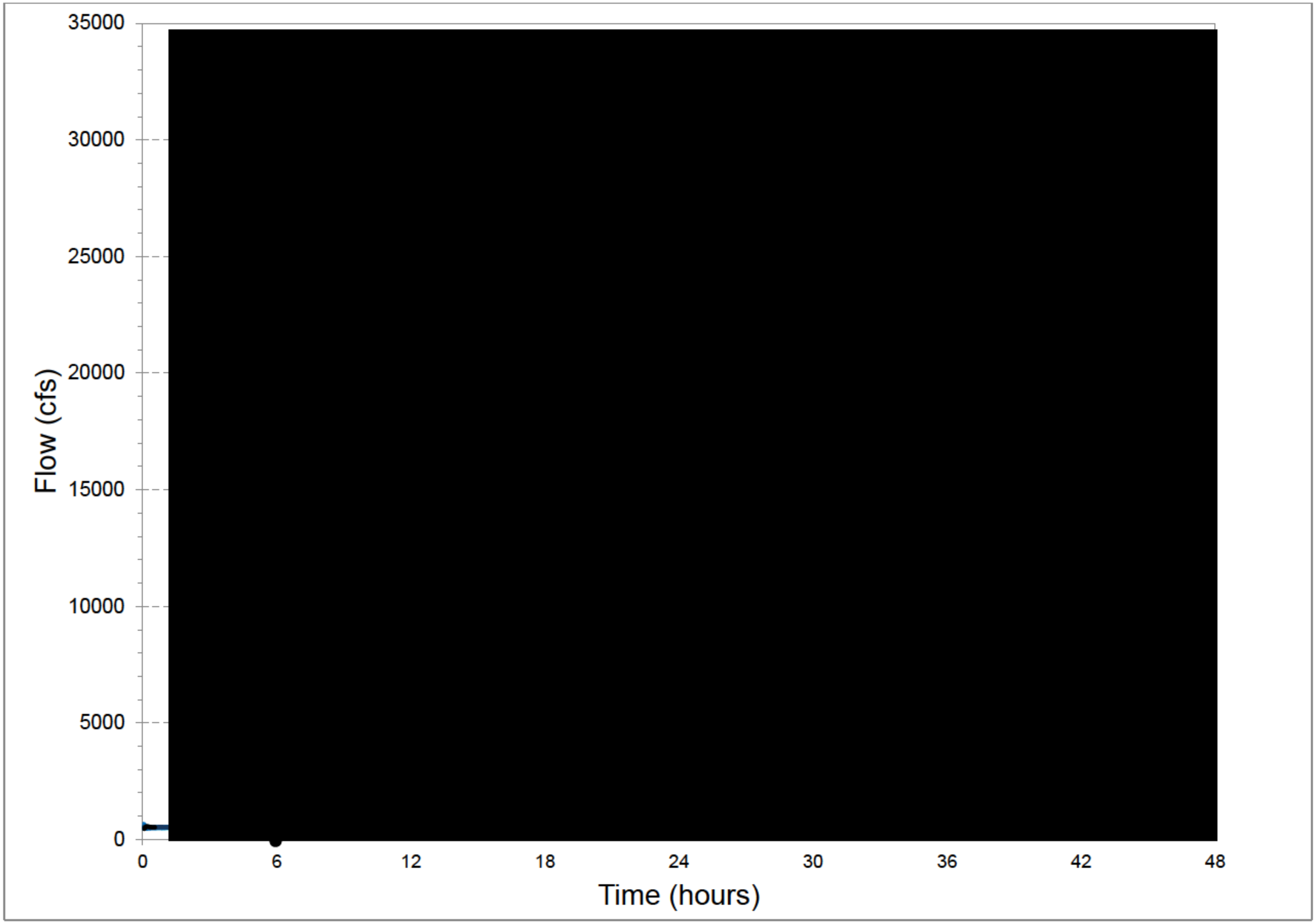


Figure E.26. Dam 1 breach flood hydrograph [redacted].



[redacted]

Figure E.27. Dam 2 breach flood hydrograph [redacted].

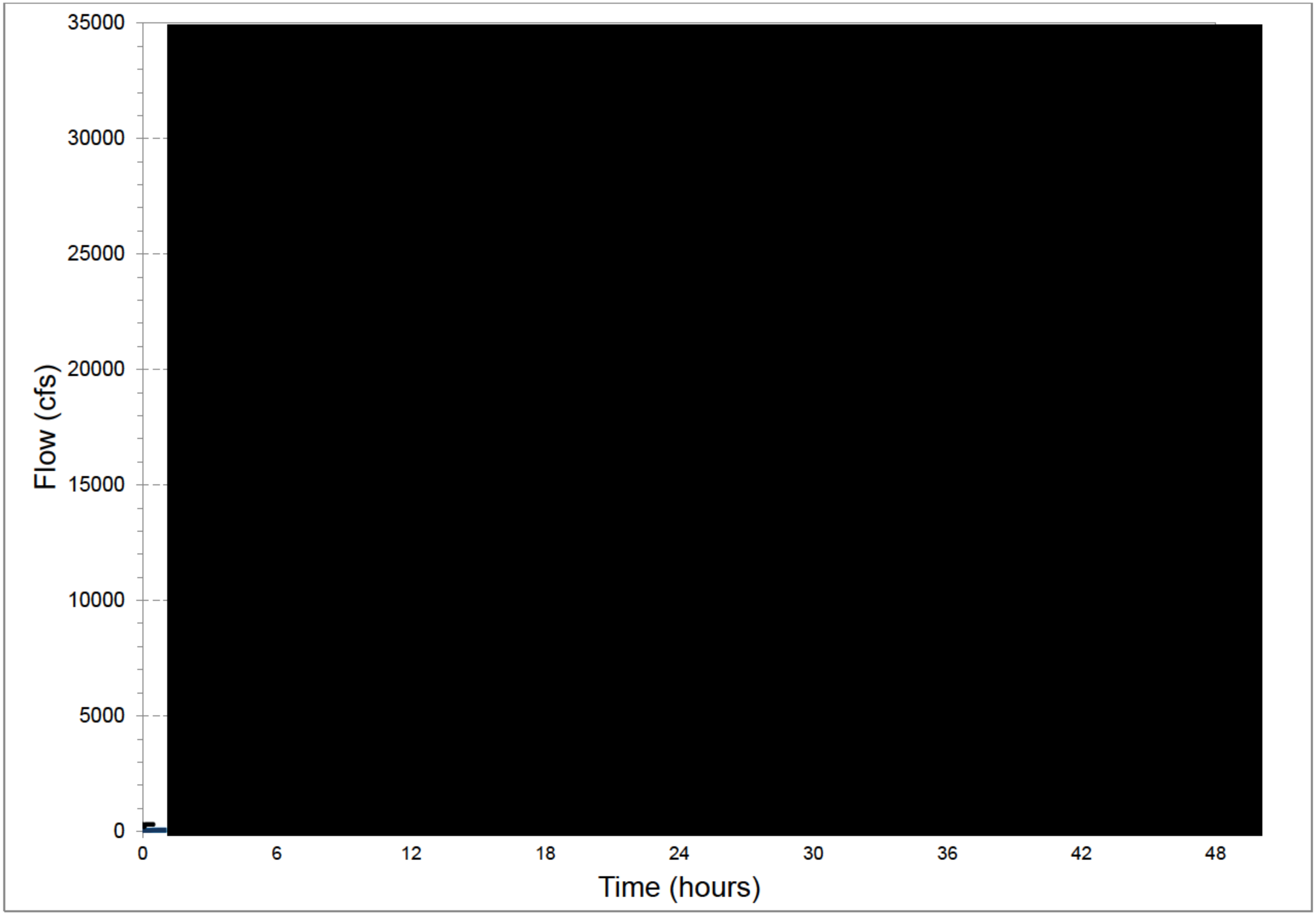


Figure E.28. Dam 5 breach flood hydrograph at [redacted]

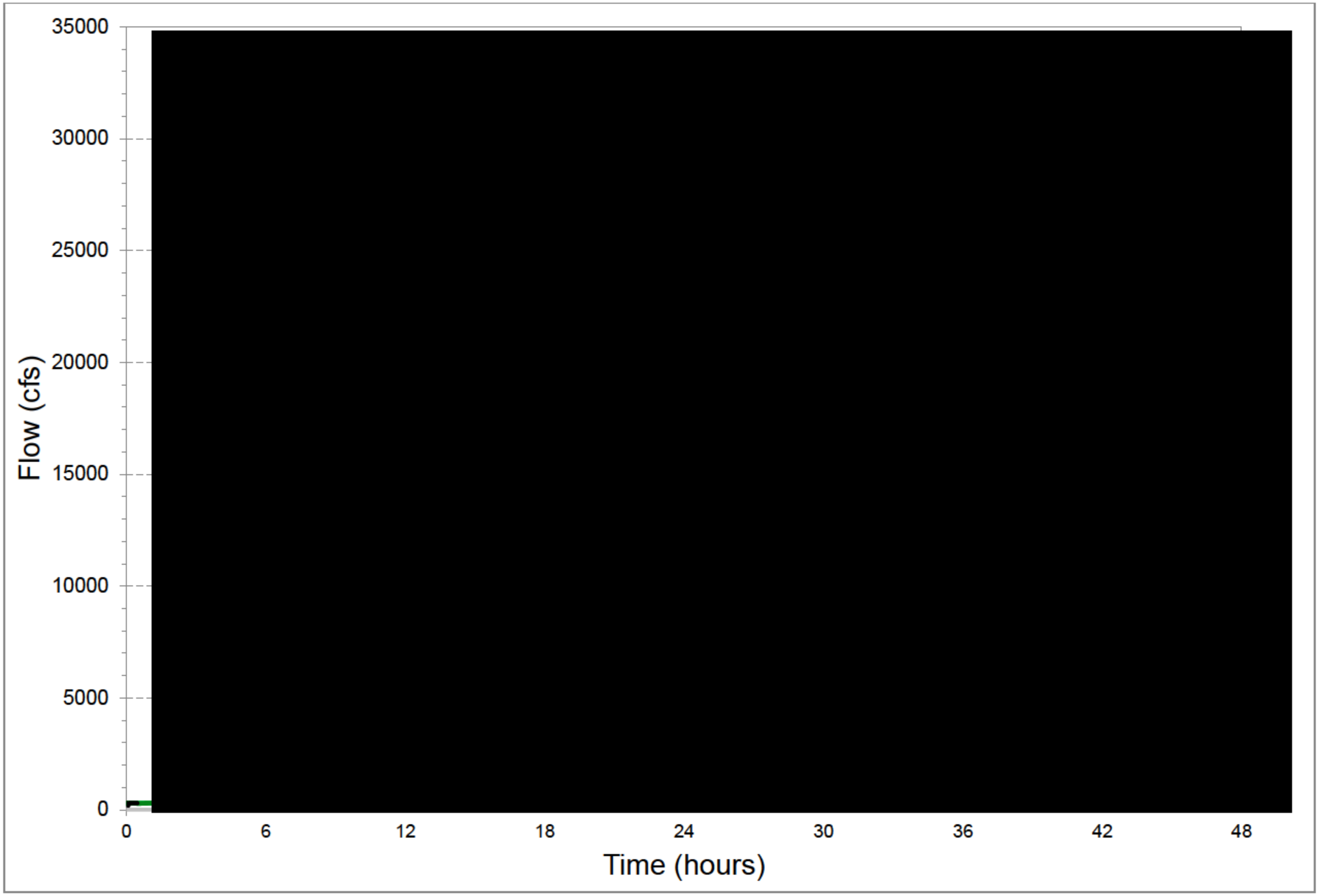


Figure E.29. Dam 5 breach flood hydrograph [redacted]

[redacted]

Surveyed Properties

Structure Outside Inundation Area

Structure Within Inundated Area

Modeled Structures

Dam

Floodwave Below Road Elevation

Floodwave Above Road Elevation

Inundation Extents

Current Water Surface Elevation

Maximum Water Surface Elevation

Ultimate Basin Extents

Beaver Bay Municipal Boundary

N

Miles

0.25 0 0.25 0.5

Figure E.30

DAM 1 BREACH INUNDATION AREA
MAXIMUM AND CURRENT
BASIN WATER SURFACE ELEVATIONS
MP7 Dambreak Analysis
Near Silver Bay, MN

Appendix F

Emergency Action Plan Review, Updating Training, and Testing

Appendix F

Emergency Action Plan Review, Updating, Training, and Testing

F.1 Emergency Action Plan Review and Updating

Review and update of the Emergency Action Plan (EAP) should be accomplished every 5 years as part of the 5 year operating plan updates. Review and updating should also include adjustments that are found to be necessary through experience gained as a result of practice sessions or emergencies that occur at other sites. The telephone numbers and persons listed in the Notification Flowchart are of primary importance.

F.2 Training

Anyone assuming significant responsibilities in the EAP, and their alternates, must review the elements of the EAP and conduct appropriate training every 3 years.

F.3 Testing

Testing of the EAP may be carried out as a part of the training session. Testing the EAP familiarizes the responsible parties with the EAP, gives the community a good idea of the real time needed for evacuation, and helps make evident any EAP deficiencies. Simulation drills may be conducted as a means of preparation, training, and testing the EAP.

Appendix G

Emergency Action Plan Distribution

Appendix G

Emergency Action Plan Storage Location and Distribution Lists

The storage location and distribution lists are provided to insure that each participant has a copy of the EAP and to ensure that copies of the EAP are easily accessible. The lists will also assist with distribution of updated EAPs when necessary.

A copy of the EAP document will be stored in the following locations:

- [redacted]

In addition to the NSM and Cliffs Technology Group staff listed in the emergency notification contact list, the following is a distribution list for the EAP document.

BJ Kohlstedt
Coordinator
Lake County Emergency Management
99 Edison Blvd
Silver Bay, MN 55647

Jason Boyle
State Dam Safety Engineer
Minnesota Department of Natural Resources
Division of Ecological and Water Resources
500 Lafayette Rd.
St. Paul, Minnesota 55155-4032
jason.boyle@dnr.state.mn.us

Joe Rokala
Region 2 Contact
DNR Lands and Minerals
1201 East Hwy 2
Grand Rapids, MN 55744

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Minnesota Duty Officer
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Diane Cooper
Service Hydrologist
National Weather Service Forecast Office
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Aaron Grosser
Senior Geotechnical Engineer
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