Attachment 02.04.03-08P
TVA letter dated February 2, 2010
RAI Response

ASSOCIATED ATTACHMENTS/ENCLOSURES:

Attachment 02.04.03-8P: Dam Rating Curves, Norris

(245 Pages including Cover Sheet)

NPG CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV 0)
L58 090210 001	calculations(nuclear)	L58 091230 027

Calc Title: Dam Rating Curves, Norris

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC	GEN	CEB	CDQ000020080015	0	1	Entire calc ☒ Selected pages ☐
NEW								

ACTION					No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)
	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	

UNITS	SYSTEMS	UNIDS
N/A	N/A	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
*See Below	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
wbbondurant	901.755.7166	CEB	See Page 6	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Bryant Bondurant	12/4/09	Andrew Murr	12/4/09
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Andrew Murr	12/4/09	K.E. Spates	12/23/09

STATEMENT OF PROBLEM/ABSTRACT

Headwater rating curves for 20 dams are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations for the Tennessee River and tributaries. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents headwater rating curves for Norris Dam.

*EDCN 22404A (SQN), EDCN 54018A (WBN), Later (BFN)

This calculation contains electronic attachments and must be stored in EDMS as an Adobe .pdf file to maintain the ability to retrieve the electronic attachments.

MICROFICHE/EFICHE Yes ☐ No ☒ FICHE NUMBER(S)

☐ LOAD INTO EDMS AND DESTROY

☒ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LIBRARY. ADDRESS: LP4D-C

☐ LOAD INTO EDMS AND RETURN CALCULATION TO:

NPG CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
L58 090210 001	calculations(nuclear)	N/A

Calc Title: Dam Rating Curves, Norris

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC						Entire calc ☒
NEW	CN	NUC	GEN	CEB	CDQ000020080015	N/A	0	Selected pages ☐

ACTION	NEW ☒ REVISION ☐	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
N/A	N/A	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
N/A	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
C. SATTLER	632-6443	CEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
[signature] CLINT SATTLER	1/16/09	[signature] JANIE B. MAUTER	1/20/09
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
[signature] R.B. Williston; Andrew C. Muller; Russell B. Williston	1/20/09	[signature] K.R. Spates; K.R. Spates	2/10/09

STATEMENT OF PROBLEM/ABSTRACT

Headwater rating curves for 20 dams are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations for the Tennessee River and tributaries. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents headwater rating curves for Norris Dam.

This calculation contains electronic attachments and must be stored in EDMS as an Adobe .pdf file to maintain the ability to retrieve the electronic attachments.

MICROFICHE/EFICHE Yes ☐ No ☒ FICHE NUMBER(S):

☐ LOAD INTO EDMS AND DESTROY
☒ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LIBRARY. ADDRESS: LP4D-C
☐ LOAD INTO EDMS AND RETURN CALCULATION TO:

NPG CALCULATION COVERSHEET/CCRIS UPDATE

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	REV
	CN	NUC	GEN	CEB	CDQ000020080015	1

ALTERNATE CALCULATION IDENTIFICATION

BLDG	ROOM	ELEV	COORD/AZIM	FIRM BWSC	Print Report Yes ☐

CATEGORIES N/A

KEY NOUNS (A-add, D-delete)

ACTION (A/D)	KEY NOUN	A/D	KEY NOUN

CROSS-REFERENCES (A-add, C-change, D-delete)

ACTION (A/C/D)	XREF CODE	XREF TYPE	XREF PLANT	XREF BRANCH	XREF NUMBER	XREF REV
A	P	EN	WBN	CEB	54018	
A	P	EN	SQN	CEB	22404	
C	P	CN	NUC	CEB	CDQ000020080038	
D	S	CN	GEN	CEB	CDQ000020080054	
A	S	CN	GEN	CEB	CDQ000020080053	

CCRIS ONLY UPDATES:
Following are required only when making keyword/cross reference CCRIS updates and page 1 of form NEDP-2-1 is not included:

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE

PREPARER PHONE NO.	EDMS ACCESSION NO.

NPG CALCULATION RECORD OF REVISION	
CALCULATION IDENTIFIER CDQ000020080015	
Title	Dam Rating Curves, Norris
Revision No.	DESCRIPTION OF REVISION
0	Initial Issue 60 Pages Attachments 1, 3, 5-14, 27, 30-36 & 39-40 - 1 Page Each Attachments 2, 28 & 29 - 2 Pages Each Attachment 3 – 3 Pages
1	This calculation was revised to address the following: • PER 203951-The verification of the previous revision of this calculation was completed by personnel who had not completed the required NEDP-7 Job Performance Record (JPR). A verification JPR is now in place for all personnel engaged in verification tasks. Checking includes only changes made in this revision as the checking of the calculation was not impacted by PER 203951. The verification is inclusive of work completed prior to this revision. • PER 203872- replace NEDP-2 forms on Pages 2 through 5 and Page 7 with the forms from the NEDP-2 Revision in effect at the time of calculations issuance Significant changes in Revision 1 are noted with a left margin revision bar. Administrative changes and typos are excluded. Pages Added: 1a & 6a Pages Replaced: 1-7, 10 & 11 UVA 3.2.1 – Removed and replaced with Assumption 3.1.3 based on provided Technical Justification UVA 3.2.2 – Removed and replaced with Assumption 3.1.4 based on Reference 21 UVA 3.2.3 – Removed and replaced with Assumption 3.1.5 based on Reference 20 Total pages of calculation hard copy for Revision 1= 62

NPG CALCULATION TABLE OF CONTENTS

Calculation Identifier: CDQ000020080015 | Revision: 1

TABLE OF CONTENTS

SECTION	TITLE	PAGE
	Coversheet	1
	CCRIS Update Sheet	2
	Revision Log	3
	Table of Contents	4
	Verification Form	6
	Computer Input Sheet	7
1	Purpose	8
2	References	10
3	Assumptions & Methodology	11
4	Design Input	14
5	Special Requirements/Limiting Conditions	17
6	Calculations	18
7	Results/Conclusions	23
	Attachments	
1	General plan, Norris Dam (Ref. 1)	26
2	Tailwater Rating Curve (From Ref. 2)	27
3	Free Discharge Equation (From Ref. 3)	29
4	Sluice Discharge Tables for Maximum Sluice Opening (From Ref. 5)	30
5	Instructions for Use of Sluice Discharge Tables (From Ref. 5)	33
6	Sluice Gates (Ref. 6)	34
7	Slide Gate Outlet (Ref. 7)	35
8	Drum Gate Interior End Assembly (Ref. 8)	36
9	Drum Gate General Assembly (Ref. 9)	37
10	Model Data (From Ref. 10)	38
11	Fit to Tailwater Data (From Ref. 2)	39
12	Determination of K (From Data in Ref. 5)	40
13a	Powerhouse Generating Unit #1 (Ref. 12)	41
13b	Powerhouse Generating Unit #2 (Ref. 13)	42
14	Fit to Turbine Discharge versus Gross Head (From Refs. 12 and 13)	43
15-26	See listing of Electronic Attachments on Page 7	N/A
27	Norris Power Plant (Ref. 14)	44

NPG CALCULATION TABLE OF CONTENTS

Calculation Identifier: CDQ000020080015	Revision:	1

TABLE OF CONTENTS

SECTION		
	Attachments (Continued)	
28	Results of Stability Analysis for SSE (From Ref. 16)	45
29	Results of Stability Analysis for ½ SSE (From Ref. 16)	47
30	Figure 2.4.4-9, ½ SSE failure for Norris (From Ref. 18)	49
31	Figure 2.4.4-28, SSE Failure for Norris (From Ref. 18)	50
32	Case A Discharge Data from Model Study (From Ref. 15)	51
33	Case C Discharge Data from Model Study (From Ref. 15)	52
34	Norris Dam Failure Scenarios (From Ref. 15)	53
35	Figure 2.4-90, SSE Failure for Norris (From Ref. 17)	54
36	Figure 2.4-76, ½ SSE Failure for Norris (From Ref. 17)	55
37-38	See listing of Electronic Attachments on Page 7	N/A
39	Powerhouse, Exterior Elevation (Ref. 19)	56
40	HDC 311-2/3 (From Ref. 4)	57
Appendix A	Quantifying Effects of Tailwater Rating Curve on Sluice Flow	A1

Note: N/A indicated electronically attached file(s).

NPG CALCULATION VERIFICATION FORM

Calculation Identifier CDQ000020080015 Revision 1

Method of verification used:

1. Design Review ☒
2. Alternate Calculation ☐
3. Qualification Test ☐

Verifier Andrew Murr Date 12/4/09

Comments:

This calculation entitled, "Dam Rating Curves, Norris" was verified by independent design review. The process involved a critical review of the calculation to ensure that it is correct and complete, uses appropriate methodologies, and achieves its intended purpose. The inputs were reviewed and determined to be appropriate inputs for this calculation. The results of the calculation were reviewed and were found to be reasonable and consistent with the inputs provided. Backup files and documents were consulted as necessary to verify data and analysis details found in the calculation.

Detailed comments and editorial suggestions for the changes made in this revision were transmitted to the author by email along with a marked up copy of the calculation.

(Note: The design verification of this calculation revision is for the total calculation, not just the changes made in the revision. This complete re-verification is performed to disposition PER 203951 as described in the Calculation Revision Log on Page 3)

NPG CALCULATION VERIFICATION FORM

Calculation Identifier CDQ000020080015 Revision 0

Method of verification used:

1. Design Review ☒
2. Alternate Calculation ☐
3. Qualification Test ☐

Verifier ANDREW C. MUNN Date 1/21/08

David B Hunt for Russ Williston

Comments: DAVID B HUNT per telecon 1/21/08

NPG COMPUTER INPUT FILE
STORAGE INFORMATION SHEET

Document CDQ000020080015	Rev. 1	Plant: GEN	

Subject:
Dam Rating Curves, Norris

☐ Electronic storage of the input files for this calculation is not required. Comments:

There are no electronic input or output files associated with this calculation.

☒ Input files for this calculation have been stored electronically and sufficient identifying information is provided below for each input file. (Any retrieved file requires re-verification of its contents before use.)

Attachment 15: Excel Spreadsheet – Norris Rating Curve.xls

Attachment 16: Complete PDF copy of "Norris Dam Spillway Discharge Tables", River Operations, Tennessee Valley Authority, 2000

Attachment 17: Relevant Pages from "The Norris Project, A Comprehensive Report on the Planning, Design, Construction and Initial Operations of the Tennessee Valley Authority's First Water Control Project" (Brown Book), TVA, 1940

Attachment 18: Complete PDF copy of TVA Water Control Project Manual (Blue Book) for Norris Dam, TVA River Operations, July, 1998

Attachments 19-26, 38: High Resolution Copies of Refs. 1, 6-9, 12-14, and 19

Attachment 37: Complete PDF copy of TVA Report 2-633, "Norris Dam Discharge Ratings for Assumed Dam Failures During an Earthquake."

☐ Microfiche/eFiche

1. Purpose

Headwater rating curves for twenty dams geographically located on the Tennessee River and its tributaries above the existing Bellefonte Nuclear facility are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents headwater rating curves for Norris Dam.

TVA developed methods of analysis, procedures, and computer programs for determining design basis flood levels for nuclear plant sites in the 1970's. Determination of maximum flood levels included consideration of the most severe flood conditions that may be reasonably predicted to occur at a site as a result of both severe hydrometerological conditions and seismic activity. This process was followed to meet Nuclear Regulatory Guide 1.59. At that time, there were no computer programs available that would handle unsteady flow and dam failure analysis. As a result of this early work and method development TVA developed a runoff and stream course modeling process for the TVA reservoir system. This process provided a basis for currently licensed plants (Sequoyah Nuclear Plant, Watts Bar Nuclear Plant, and Browns Ferry Nuclear Plant). The Bellefonte Nuclear Plant (BLN) Units 1 & 2 Final Safety Analysis Report (FSAR) was also based on this process.

BLN Unit 3 & 4 Combined Operating License Application (COLA) was submitted using data and analysis that was determined for the original BLN FSAR (Unit 1 and Unit 2) and was documented in a 1998 reassessment. In 1998, the analysis process and documentation was brought under the nuclear quality assurance process for the first time. A quality assurance audit conducted by NRC staff in early 2007 raised several questions related to past work regarding design basis flood level determinations. This calculation supports a portion of the effort to improve the design basis documentation.

Preparation of all calculations supporting nuclear development and licensing are subject to TVA Standard Department Procedure NEDP-2. This standard dictates the process in which calculations are prepared, checked, verified, stored, and cross referenced in a goal to provide the highest quality nuclear design input and output possible.

Figure 1 is a plan and elevation view of Norris Dam (a portion of Reference 1). For headwaters in the normal operating range, discharge is passed through the turbines, the sluices, or the spillway. The spillway consists of three spillway bays, each with a drum gate to control discharge. The sluice discharge is controlled by vertical lift gates. During a probable maximum flood (PMF) event, headwater is not expected to rise above the top elevation of the dam, preventing discharge over any portion of the dam.
Consequently, the rating curve developed in this calculation does not include headwater elevations above the top of the dam.

Norris Dam may be operated in two different modes during a PMF event. Rating curves are provided for these two bracketing operating cases.

1. Fully Open Gates: All spillway, sluice and turbine gates will be open to the maximum setting in order to discharge the largest volume of water possible past Norris Dam. This curve is valid for rising headwaters and for falling headwaters as long as the powerhouse is not flooded (TW<866').
2. Fully Closed Gates. The spillway gates will be raised to the maximum setting and sluice gates will be closed to limit the discharge past Norris Dam. This operating mode may help prevent embankment breaches and failures downstream from Norris Dam.

As required by NRC Regulatory Guide 1.59, the most severe seismically induced floods reasonably possible should be considered for each site in addition to the floods produced by the severe hydrometeorological conditions. Also, the consideration of seismically induced floods should include the same range of seismic events as is postulated for the design of the nuclear plant. The seismic design basis for the plants requires consideration of an Operating Basis earthquake (OBE) or a 0.5 Safe Shutdown earthquake (SSE) and a full SSE.

To meet the requirement of Regulatory Guide 1.59, the flood design basis requires consideration of the following hydrological and seismic design conditions:

A). Determination of the water level at the plant during a 0.5 Probable Maximum Flood (PMF) with full reservoirs combined with the postulated failure of upstream dams during an OBE.
B). Determination of the water level at the plant during a 25-year flood with full reservoirs combined with the postulated failure of upstream dams during a 1.0 SSE.

Two of the potentially critical seismic-flood combination scenarios for the plant design basis include Norris Dam; (1) a 0.5 PMF combined with the OBE failure of Norris dam and (2) a 25-year flood combined with the SSE failure of Douglas, Cherokee and Norris dams. The OBE and SSE failure configurations used for determination of the seismic/flood dam rating curves were previously determined in Reference 16.

Because of this, two additional rating curves are provided for the seismic failure scenarios of Norris Dam. These scenarios are covered in the following cases.

3. Safe Shutdown Earthquake (SSE)
4. ½ SSE

And the final case

5. Fully Opened Gates Without Turbine Discharge. This case is valid for falling headwaters after the powerhouse has been flooded when sluice and spillway gates are fully opened.

These headwater rating curves are based on the configuration of the Norris Dam as defined on the current design drawings. The purpose of this calculation does not evaluate the design loading conditions for the dam.

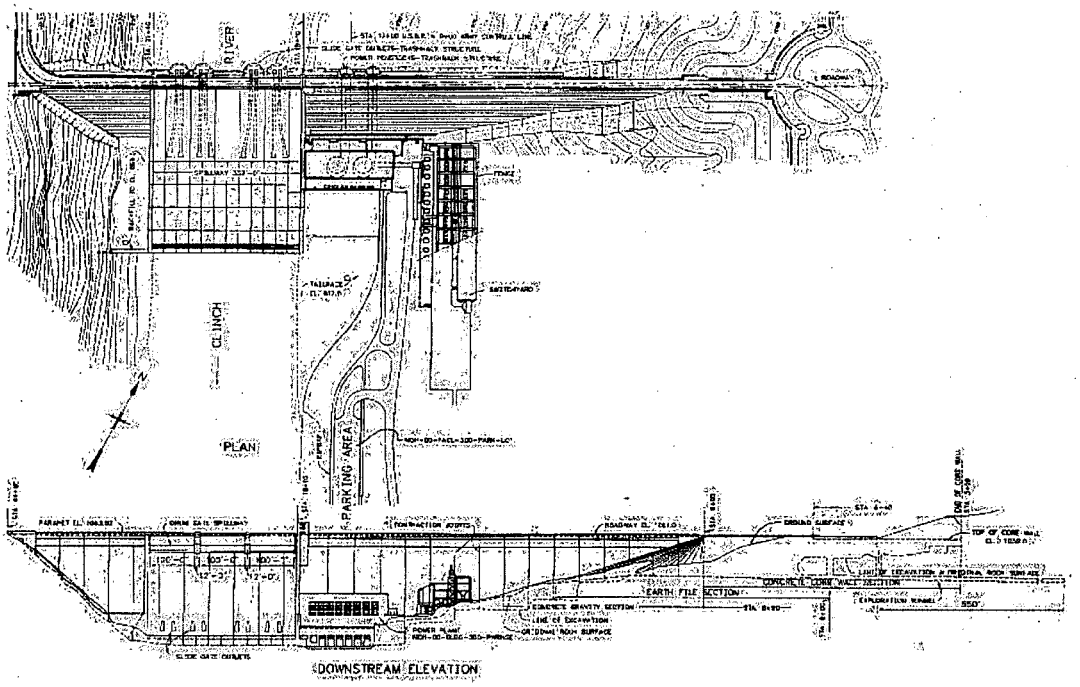


Figure 1 – Norris Dam, General Plan and Elevation (Ref. 1).

2. References

1. TVA drawing no: 10W200, R1 (Attachments 1 and 19)
2. TVA files, binder "River Scheduling: Tailwater Rating Curves by Projects"
3. "The Norris Project, A Comprehensive Report on the Planning, Design, Construction and Initial Operations of the Tennessee Valley Authority's First Water Control Project" (Brown Book), TVA, 1940 (Relevant Pages Included as Attachment 17)
4. "Hydraulic Design Criteria," USACE (U. S. Army Engineer Waterways Experiment Station), Eighteenth issue, Vicksburg, MS, 1988.
5. "Norris Dam Spillway Discharge Tables", River Operations, Tennessee Valley Authority, 2000, EDMS accession number L58 081212 811 (Attachment 16)
6. TVA drawing no: 54W100, R1 (Attachments 6 and 20)
7. TVA drawing no: 232-D-395, R2 (Attachments 7 and 21)
8. TVA drawing no: 232-D-1043, R1 (Attachments 8 and 23)
9. TVA drawing no: 232-D-1041, R1 (Attachments 9 and 22)
10. "Hydraulic Model Experiments for the Design of Norris Dam" Charles W. Thomas, Department of the Interior Bureau of Reclamation Technical Memorandum No. 406, October 15, 1934 (Relevant Page Included as Attachment 10).
11. TVA Water Control Project Manual (Blue Book) for Norris Dam, TVA River Operations, July, 1998 (Attachment 18)
12. TVA drawing no: 47K901, R1 (Attachments 13a and 24)
13. TVA drawing no: 47K902, R0 (Attachments 13b and 25)
14. TVA drawing no: 232-D-2663, R2, (Attachments 26 and 27)
15. TVA Report 2-633, "Norris Dam Discharge Ratings for Assumed Dam Failures During an Earthquake," Division of Water Control Planning, Engineering Laboratory, January 1974 (Attachment 37, select pages as Attachments 32-34)
16. "Norris Dam – Concrete Stability Analysis for SSE and ½ SSE + ½ PMF," Rev. 1, TVA Calculation, RIMS accession number B25 '88 0520 304 (Relevant Pages included as Attachments 28 and 29)
17. FSAR, Watts Bar Nuclear Plant
18. FSAR, Sequoyah Nuclear Plant
19. TVA drawing no: 232-D-1404, R6 (Attachments 38 and 39)
20. "SOCH Model Calibration, Melton Hill," CDQ000020080038 (EDMS L58 090812 001)
21. "Dam Spillway Gate/Outlet Open Configuration for Flood Analysis," Tennessee Valley Authority, May 29, 2009 (EDMS No. L58 090529 800)

3. Assumptions & Methodology

The headwater rating curves developed in these calculations will be used in simulations of probable maximum flood events. Consequently, the rating curves have been calculated well above the normal operating range of the dam.

3.1 Assumptions

3.1.1 Assumption: Power generation will continue during the PMF event until the powerhouse is flooded.
Technical Justification: Because the headwater elevation is not expected to exceed the elevation of the top of the dam [3.2.1], the powerhouse will not be overtopped. Power generation is assumed to stop when the addition of turbine discharge would cause the tailwater to reach an elevation greater than 866 feet, at which point the tailwater will flood the powerhouse through the east swinging doors and overtop the generator (Attachments 27 and 29). After the powerhouse has been flooded, the generator will not be restarted as electrical components will be wet. Accordingly, turbine discharge will only be considered in case 1, when the operating goal of the project is to discharge the largest volume of water possible past Norris Dam.

3.1.2 Assumption: Sluices will not be opened further than 8 feet.
Technical Justification: According to Attachment 5 (Ref. 5), a 1999 inspection of sluices 3 and 4 found significant cavitation damage upstream from the emergency slide gates. As a result, the sluices are not to be opened more than 8 feet, except in emergencies. Although the PMF event may be classified as an emergency, it is assumed that the integrity of the dam would not be put in jeopardy during the PMF event, during which the dam's ability to contain catastrophic floodwater is essential.

3.1. 3 Assumption: The dam will not be overtopped during a PMF event. Additionally, during a flood event coupled with a seismic failure, headwaters will not rise above 1045'.
Technical Justification: This PMF has been sufficient in all previous work. If a SOCH/TRBROUTE analysis requires a PMF Flood elevation higher than the maximum elevation considered, the change will be identified by the SOCH/TRBROUTE analyst and a revision to this dam rating curve calculation will be required.

3.1.4 Assumption: All spillway and sluice gates will remain operable, and that the headwater rating curves may be used only after all spillway and sluice gates are either fully raised or closed.
Technical Justification: For technical justification, see Reference 21, "Dam Spillway Gate/Outlet Open Configuration for Flood Anaylses".

3.1.5 Assumption: The tailwater rating curve included as Attachment 2 is acceptable for use in the headwater rating curve calculations.
Technical Justification: The final tailwater curve was verified in the unsteady SOCH Model Calibration, Melton Hill (Reference 20).

3.2 Unverified Assumptions (UVA)

None.

3.3 Methodology -- Discharge Equations

Discharges past the dam are computed as either "free" discharge or "orifice" discharge. Free discharge refers to free surface overflow, such as flow over the drum gates, and is computed using power law equation as follows (Attachment 3, Reference 3):

$$Q_f = KLH_g^n \quad (1)$$

in which Q_f = free discharge (cfs), K = free discharge coefficient (units vary with n, $ft^{3-(n+1)}$/sec, available from model data in Att. 10, and restated in Att. 17), L = length of overflowing section (ft), H_g = head on the drum gate (ft) = HW - Z_g, HW = headwater elevation (ft) Z_g = top, or crest, elevation of the drum gate (ft) and n is a dimensionless exponent (available from model data in Ref. 10 Att 10, and restated in Ref. 3 Att 17). This equation need not be modified to account for tailwater submergence, as tailwater elevation is never sufficiently high to reach the crest elevation.

Orifice discharge refers to flow passing through a contracted opening and is computed using an orifice-type equation as follows (Reference 4, Hydraulic Design Chart 311-1):

$$Q_o = CG_oB\sqrt{2g(H)} \quad (2)$$

in which Q_o = orifice discharge (cfs), C = orifice discharge coefficient (dimensionless), G_o = effective gate opening (ft), B=gate width (ft), g = acceleration of gravity, and H = head to center of gate opening (ft).

Sluice discharge is treated as orifice flow and computed using an analogous expression to Equation (2). The following equation will be used to calculate sluice flow:

$$Q_S = K\sqrt{HW - Z_{Ref}} \quad (3)$$

The coefficient K lumps the constant quantities effecting orifice flow into one parameter. It may be thought of as equal to $CA\sqrt{2g}$ in which C = discharge coefficient (dimensionless) and A = area for flow under the sluice gate (ft^2). Because the discharge is through a closed conduit, both C and A, and consequently K, are constant at a given gate opening. In Equation (3), the head differential term is defined as HW – $Z_{ref.}$, with Z_{Ref} = the elevation of the bottom of the gate in the open position (860' + 8' = 868' for maximum opening, Att. 6). The K - value for the sluice openings was determined in Attachment 12 from prototype data (for all sluices) in Reference 5.

The above equation assumes no tailwater effects. Under the conditions for which this headwater rating is developed, the tailwater may affect the sluice discharge. The following equation will be used:

$$Q_{s1} = K\sqrt{HW - TW} \quad (4)$$

where Q_{s1} = discharge affected by submergence (cfs), K = discharge coefficient ($ft^{2.5}$/sec), HW = headwater elevation (ft), and TW = tailwater elevation (ft). Equation (4) will be used to calculate discharge once the bottom of the open sluice gate is submerged by tailwater (TW = 868 feet). Because the tailwater level varies with total dam discharge, an iterative process is used to determine submerged sluice discharge. Effects of tailwater elevation on sluice flow are quantified in Appendix A.

3.4 Methodology -- Spillway Discharge Calculations

The discharge, Q_f, over a spillway crest varies with head, H_g (Reference 3). For the Norris spillway crest, the relationship $Q_f(H_g)$ is available from model test data, as are the constants K and n from Equation (1) (Ref. 3). This data is available at both gate elevations of interest to this calculation (Z_g = 1020 feet and Z_g = 1034 feet). The crest length, L, and crest elevation, Z_c, are shown on TVA drawings (e.g., Reference 1).

The physical model used to measure spillway discharge included all three bays and the piers between them. Consequently, pier contraction effects are implicitly included in the discharge coefficients derived from the model test data.

Under the assumption that all spillway gates are fully open (3.2.2), the two end bays (first and last) are the only spillway bays subject to end contraction effects. These effects, which may reduce discharge through these two bays by a few percent, are neglected in this calculation. According to Hydraulic Design Chart 111-3/2 (Attachment 40), end contraction losses effectively reduce the length of the overflowing spillway crest, L=300 ft., by $2*K_a*H_e$, in which K_a = abutment contraction coefficient (dimensionless), and $H_e = H_c$ =energy head on the crest (in ft.). The maximum possible value for K_a = 0.2 (Att. 40), which means the maximum possible impact of abutment effects (calculated at maximum H_c , 41 ft, See Section 7, maximum elevation at which free discharge occurs) is equal to:

$$\left[1-\frac{L-2K_a(H_c)}{L}\right]*100\% = \left[1-\frac{300'-2(0.2)(41')}{300'}\right]*100\% = 5.4\%$$

3.5 Methodology -- Sluice Gates Discharge Coefficient

Norris dam has eight 10 foot by 5.67 foot tunnels fitted with slide gates (Ref. 1, Att. 1 and Ref. 7 Att. 7). All sluice gates will be considered fully opened to 8 feet, the maximum gate opening preventing cavitation (Ref. 5). Attachment 5 states that sluice table "discharges are based on the results of field measurements." Therefore, the K value from Equation (3) can be back-calculated from the information in the sluice discharge tables. Reference 7 is unclear as to whether or not the sluice discharge tables reflect tailwater effects. Justification that sluice discharge does not include tailwater effects is contained in paragraph 4.8.

4. Design Input

Sect.	Input Parameter	Source	Symbol	Value
4.1	Acceleration of gravity	Common knowledge, Ref. 4, sheet. 000-1 for example	g	32.2 ft/sec^2
4.2	**Spillway crest parameters**			
4.2.1	Crest length	3 100-foot wide bays; Ref.1	L	300 feet
4.2.2	Crest elevation	Ref. 1	Z_c	1020 feet
4.3	**Spillway gate parameters (Fully Open Gate)**			
4.3.1	Gate Elevation	Refs. 8 & 1	Z_g	1020 feet
4.3.2	Discharge Coefficient	Ref. 10, Att. 10	K	2.5680 ft$^{3-(n+1)}$
4.3.3	Exponent	Ref. 10, Att. 10	n	1.6173
4.4	**Spillway gate parameters (Fully Closed Gate)**			
4.4.1	Gate Elevation	Ref. 9	Z_g	1034 feet
4.4.2	Discharge Coefficient	Ref. 10, Att. 10	K	3.985 ft$^{3-(n+1)}$
4.4.3	Exponent	Ref. 10, Att. 10	n	1.486
4.5	**Sluice gates**			
4.5.1	Discharge coefficient with or without tailwater effects	Paragraph 4.8	K	2303.7196 ft$^{2.5}$/sec
4.5.2	Bottom Elevation of sluice tunnel, directly under gate	Ref. 6	Z_{floor}	860 feet
4.5.3	Maximum Sluice Gate Opening before Cavitation	Ref. 5	Z_{cav}	8 feet
4.5.4	Elevation bottom of open sluice gate	Z_{floor}+ Z_{ref}	Z_{ref}	868 feet

4.6 Tailwater rating curve

The tailwater rating curve used in this calculation is shown in Attachment 2. Attachment 11 lists points scaled from this plot and shows a polynomial fit to the result. The polynomial indicated in Attachment 11 and repeated below is used for the headwater rating curve calculations.

$$TW = 825.23 + 0.3036*Q - 6.044x10^{-4}Q^2 + 5.59x10^{-7}Q^3 \quad (5)$$

in which Q = total discharge past the dam in cfs divided by 1000 ("1000 cfs").

Because calculated tailwater elevations (See Results Section) are less than the spillway crest elevation, tailwater effects on free discharge can be ignored. Because sluice discharge (Equation (4)) and turbine discharge (Equation (6)) are functions of tailwater elevation, which itself is a function of all discharges past the dam (Equation (5)), an iterative process will be used to calculate tailwater elevation, sluice discharge, and turbine discharge.

4.7 Upper Limit on Headwater Elevation Included in Rating Curves

The headwater rating curves need to include all headwater elevations that may occur during a PMF event. The headwater at Norris is not expected to rise past 1061 feet. According to Reference 1 (section views), the roadway elevation over the dam is 1061 feet. The curbing on either side of the roadway, also evident in the section views of Reference 1, would further act to prevent overtopping of the dam should headwaters rise to an elevation of 1061 feet.

4.8 Sluice Gate K Value

The sluice gate K value is determined from data in Attachment 4. As evident from Equation (3), if the sluice discharge, Q, is plotted versus $\sqrt{HW-868}$ the resulting slope (when the y-intercept is forced to 0) will be the K value (as y = mx) as long as the sluice data in Attachment 4 were determined without tailwater interactions. If, however, the sluice data was affected by tailwater, plotting Q versus $\sqrt{HW-TW}$ would result in a straight line with slope equal to K (see Equation (4)). Q is plotted versus $\sqrt{HW-868}$ in Attachment 12. The slope of the linear fit to the data is included on the plot in Attachment 12. Because the resulting fit to the data provides a perfect linear fit ($R^2 = 1.0$), it can be concluded that the data in the sluice discharge table was not corrected for tailwater effects. K is determined by the slope of the linear fit and is used in conjunction with Equation (4) to calculate sluice flow when it is affected by tailwater.

The K value used for calculation is K = 2303.7196 $ft^{2.5}/sec$

4.9 Discharge through Turbines

Discharge through the turbines, Q_t, was determined from Attachments 13a and 13b (Refs. 12 and 13) at 100% gate opening. Points were scaled from References 12 and 13 (100% gate curve) and a curve fit to turbine discharge versus gross head was developed in Attachment 14. The resulting polynomial is presented in Attachment 14 and repeated below.

$$Q_t = 2*\left(-0.0292(H_t)^2 + 27.518(H_t) + 662.68\right) \quad (6)$$

in which Q_t = turbine discharge in cfs, 2=number of turbines and H_t = gross head on the turbine (HW-TW) in feet. Because sluice discharge (Equation (4)) and turbine discharge (Equation (6)) are functions of tailwater elevation, which itself is a function of all discharges past the dam (Equation (5)), an iterative process will be used to calculate tailwater elevation, sluice discharge, and turbine discharge in Case 1.

4.10 Seismic Failures

Discharge rating curves for various seismic failure modes of Norris Dam were developed by TVA through model studies. The studies utilized a 1:150 scale model of Norris Dam with both upstream and downstream reaches of the Clinch River included (Ref. 15). The results of the study are contained in Reference 15.

Reference 16 serves as the basis for determining the extent of seismic failures for Safe Shutdown Earthquakes (SSE) and ½ SSE at Norris Dam. Results of these calculations (Attachments 28 and 29) were used as basis for both the Sequoyah and Watts Bar Nuclear Plant licensing (Refs. 17 and 18). Ref. 18 provides explicit drawings of failure sections expected at Norris Dam (Attachments 30 and 31, FSAR drawings included for illustrative purposes only) based on the conclusions of Reference 16.

Reference 15 contains the discharge versus headwater elevations for the model studies under consideration in this calculation (relevant pages included as Attachments 32 and 33 and the full report included as Attachment 37). Case A corresponds to the ½ SSE, in which the portion of Norris Dam between blocks 32 and 45 fails by toppling downstream of the dam (L=665'). The resulting debris field creates an obstruction to elevation 970' in the river channel (Attachments 30 and 34). Case C corresponds to the SSE, in which the portion of Norris Dam between blocks 30 and 46 topple downstream of the dam (L=833'). The resulting debris field also creates an obstruction to elevation 970' in the river channel (Attachments 31 and 34). For Norris Dam, tailwater effects and end contraction effects should be implicitly included in the headwater rating curve. Accordingly, data from Ref. 15 noted with low tailwater (Attachments 32 and 33) were excluded from this analysis as probable outliers.

5. Special Requirements/Limiting Conditions

N/A

6. Calculations

The calculations consist of computing spillway, sluice and (in Case 1) turbine discharges (from Equations 1-4 and 6) for a list of headwater elevations ranging from 20 feet below the crest elevation, up to 1061 feet, the top of the dam. The headwater rating curve is a plot of headwater elevation versus total dam discharge. Seismic events lead to failed portions of the dam in cases 3 and 4. In these cases, flow occurs over and around the debris field resulting from the failure of a portion of Norris Dam, and discharges past the debris field has been determined by model studies.

6.1 Case 1, All Gates (Spillway, Sluice and Turbine) Fully Open

Discharge passes through the sluices and turbines first, then the spillway section as headwater rises above top elevation of the drum gate (El. = 1020 for fully open gates, the crest elevation). Total discharge, given in "1000 cfs", is the sum of all discharges in cfs past the dam divided by 1000.

Figure 2 shows the spreadsheet calculations for the headwater rating curve (spreadsheet included as Attachment 15). The final result, the rating curve, is defined by the first two columns, HW vs. Total Discharge. The third column (TW) gives the tailwater elevation associated with the "Total Discharge" from the tailwater rating curve polynomial fit [4.6]. This is computed to calculate tailwater effects on the sluice discharge.

Spillway discharge is computed in the seventh column. H_g, K, L, and n are the parameters used to determine the spillway discharge, Q_f. Free discharge through the spillway occurs for all elevations above 1020 feet [4.3.1].

Sluice discharge not affected by tailwater, in cfs, is computed in the fourth column. When tailwater becomes sufficiently high to affect the sluice discharge (TW = 868 feet), the corrected sluice discharge is given in the fifth column. The corrected discharge is calculated from Equation (4). Because the tailwater level varies with total dam discharge, an iterative process is used to determine submerged sluice discharge. For the iterative process TW is assumed (red text column in Attachment 15), Q_{total} is calculated (using Q_s (or Q_{s1}) and Q_t calculated from $TW_{assumed}$), and $TW_{calculated}$ is calculated from Q_{total}. Iteration is accomplished by varying $TW_{assumed}$ until the difference between $TW_{assumed}$ and $TW_{calculated}$ is equal to 0, within convergence tolerances. The convergence tolerance was set to $1*10^{-6}$. The average difference for converged solutions is $3*10^{-8}$ feet (Attachment 15).

Norris - Dam Rating Curve, Case 1

g = 32.2 ft/s^2

Sluice Parameters

K= 2303.7196 ft^2

Z_{ref} = 868 ft

Spillway Parameters

L = 300 ft

n = 1.6173 ft

K = 2.568 ft$^{3-(n+1)}$

Z_g = 1020 ft

HW	Q Total Discharge	TW	Sluice cfs		Spillway ft	cfs	Gross Head	Turbine Discharge (100%)
feet	1000 cfs	feet	Q_s	Q_{s1}	H_g	Q_f	feet	cfs Q_t
1000	35.28	835.2123	26468	0	0.00	0	165	8809
1005	35.94	835.3878	26964	0	0.00	0	170	8980
1010	36.60	835.5597	27452	0	0.00	0	174	9149
1020	37.88	835.8936	28402	0	0.00	0	184	9478
1021	38.77	836.1247	28495	0	1.00	770	185	9504
1022	40.47	836.5651	28588	0	2.00	2364	185	9523
1023	42.77	837.1534	28681	0	3.00	4554	186	9537
1024	45.57	837.8631	28773	0	4.00	7252	186	9546
1025	48.82	838.6765	28866	0	5.00	10403	186	9552
1026	52.48	839.58	28957	0	6.00	13971	186	9556
1028	60.94	841.6138	29140	0	8.00	22248	186	9555
1030	70.78	843.8899	29322	0	10.00	31917	186	9545
1032	81.89	846.3467	29502	0	12.00	42862	186	9530
1034	94.19	848.9312	29681	0	14.00	54998	185	9511
1036	107.60	851.5969	29860	0	16.00	68256	184	9488
1037	114.71	852.9472	29948	0	17.00	75287	184	9477
1040	137.57	857.0137	30213	0	20.00	97920	183	9441
1042	154.05	859.6992	30388	0	22.00	114240	182	9418
1044	171.46	862.3346	30562	0	24.00	131502	182	9396
1046	189.79	864.9009	30735	0	26.00	149676	181	9377
1048	199.64	866.1999	30908	0	28.00	168735	182	0
1050	219.67	868.6825	0	31021	30.00	188653	181	0
1052	240.40	871.0519	0	30989	32.00	209409	181	0
1054	261.95	873.3328	0	30965	34.00	230981	181	0
1056	284.30	875.5371	0	30947	36.00	253352	180	0
1058	307.44	877.6851	0	30935	38.00	276503	180	0
1060	331.34	879.8049	0	30924	40.00	300419	180	0
1061	343.58	880.8653	0	30919	41.00	312659	180	0

Figure 2 – Calculations for Case 1

6.2 Case 2, All Gates (Spillway, Sluice and Turbine) Fully Closed

Discharge passes through the spillway section as headwater rises above top elevation of the drum gate (El. = 1034 for fully raised gates, Ref. 9). Total discharge, given in "1000 cfs", is the sum of all discharges in cfs past the dam divided by 1000.

Figure 3 shows the spreadsheet calculations for the headwater rating curve (spreadsheet included as Attachment 15). The final result, the rating curve, is defined by the first two columns, HW vs. Total Discharge. The third column (TW) gives the tailwater elevation associated with the "Total Discharge" from the tailwater rating curve polynomial fit [4.6]. This is computed to illustrate that tailwater never reaches the crest elevation to influence flow.

Spillway discharge is computed in the fifth column. H_g, K, L, and n are the parameters used to determine the spillway discharge, Q_f. Free discharge through the spillway occurs for all elevations above 1034 feet [4.4.1].

Norris - Dam Rating Curve, Case 2

$g =$ 32.2 ft/s^2

Spillway Parameters

L =	300	ft
n =	1.486	ft
K =	3.985	$ft^{3-(n+1)}$
Z_g =	1034	ft

HW feet	Q Total Discharge 1000 cfs	TW feet	Spillway ft H_g	Spillway cfs Q_f
1000	0.00	825.23	0.00	0
1005	0.00	825.23	0.00	0
1010	0.00	825.23	0.00	0
1020	0.00	825.23	0.00	0
1021	0.00	825.23	0.00	0
1022	0.00	825.23	0.00	0
1023	0.00	825.23	0.00	0
1024	0.00	825.23	0.00	0
1025	0.00	825.23	0.00	0
1026	0.00	825.23	0.00	0
1028	0.00	825.23	0.00	0
1030	0.00	825.23	0.00	0
1032	0.00	825.23	0.00	0
1034	0.00	825.23	0.00	0
1036	3.35	826.24	2.00	3349
1037	6.12	827.06	3.00	6117
1040	17.13	830.26	6.00	17135
1042	26.27	832.80	8.00	26275
1044	36.61	835.56	10.00	36606
1046	48.00	838.47	12.00	47997
1048	60.35	841.47	14.00	60353
1050	73.60	844.52	16.00	73599
1052	87.68	847.58	18.00	87677
1054	102.54	850.61	20.00	102537
1056	118.14	853.58	22.00	118138
1058	134.44	856.48	24.00	134445
1060	151.43	859.29	26.00	151426
1061	160.16	860.65	27.00	160161

Figure 3 – Calculations for Case 2

6.3 Case 3, ½ SSE & ½ PMF

Discharge passes over and around the expected debris field (Attachment 30). Total discharge, given in "1000 cfs", is the sum of all discharges in cfs past the dam divided by 1000. The headwater rating curve was generated in Ref. 15 from model data and is repeated in Figure 4.

6.4 Case 4, SSE & 25 year flood

Discharge passes over and around the expected debris field (Attachment 31). Total discharge, given in "1000 cfs", is the sum of all discharges in cfs past the dam divided by 1000. The headwater rating curve was generated in Ref. 15 from model data and is repeated in Figure 4.

6.5 Case 5, Spillway and Sluice Fully Opened with no Turbine Discharge

In this case, discharge passes through the spillway section when headwater elevation is above top elevation of the drum gate (El. = 1020 for fully open gates, the crest elevation) and the sluices. Total discharge, given in "1000 cfs", is the sum of all discharges in cfs past the dam divided by 1000.

Figure 3a shows the spreadsheet calculations for the headwater rating curve (spreadsheet included as Attachment 15). The final result, the rating curve, is defined by the first two columns, HW vs. Total Discharge. The third column (TW) gives the tailwater elevation associated with the "Total Discharge" from the tailwater rating curve polynomial fit [4.6]. This is computed to calculate tailwater effects on the sluice discharge.

Spillway discharge is computed in the seventh column. H_g, K, L, and n are the parameters used to determine the spillway discharge, Q_f. Free discharge through the spillway occurs for all elevations above 1020 feet [4.3.1].

Sluice discharge not affected by tailwater, in cfs, is computed in the fourth column. When tailwater elevation is sufficiently high as to affect the sluice discharge (TW = 868 feet), the corrected sluice discharge is given in the fifth column. The corrected discharge is calculated from Equation (4). Because the tailwater level varies with total dam discharge, an iterative process is used to determine submerged sluice discharge. For the iterative process TW is assumed (red text column in Attachment 15), Q_{total} is calculated (using Q_s (or Q_{s1}) calculated from $TW_{assumed}$), and $TW_{calculated}$ is calculated from Q_{total}. Iteration is accomplished by varying $TW_{assumed}$ until the difference between $TW_{assumed}$ and $TW_{calculated}$ is equal to 0, within convergence tolerances. The convergence tolerance was set to $1*10^{-6}$. The average difference for converged solutions is $3*10^{-8}$ feet (Attachment 15).

Norris - Dam Rating Curve, Case 5

g = 32.2 ft/s^2

Sluice Parameters

K= 2303.7196 ft^2

Z_{ref} = 868 ft

Spillway Parameters

L = 300 ft

n = 1.6173 ft

K = 2.568 ft$^{3-(n+1)}$

Z_g = 1020 ft

HW	Q Total Discharge	TW	Sluice cfs		Spillway ft	Spillway cfs
feet	1000 cfs	feet	Q_s	Q_{s1}	H_g	Q_f
1000	26.47	832.9	26468	0	0.00	0
1005	26.96	833.0	26964	0	0.00	0
1010	27.45	833.1	27452	0	0.00	0
1020	28.40	833.4	28402	0	0.00	0
1021	29.27	833.6	28495	0	1.00	770
1022	30.95	834.1	28588	0	2.00	2364
1023	33.23	834.7	28681	0	3.00	4554
1024	36.02	835.4	28773	0	4.00	7252
1025	39.27	836.3	28866	0	5.00	10403
1026	42.93	837.2	28957	0	6.00	13971
1028	51.39	839.3	29140	0	8.00	22248
1030	61.24	841.7	29322	0	10.00	31917
1032	72.36	844.2	29502	0	12.00	42862
1034	84.68	846.9	29681	0	14.00	54998
1036	98.12	849.7	29860	0	16.00	68256
1037	105.24	851.1	29948	0	17.00	75287
1040	128.13	855.4	30213	0	20.00	97920
1042	144.63	858.2	30388	0	22.00	114240
1044	162.06	860.9	30562	0	24.00	131502
1046	180.41	863.6	30735	0	26.00	149676
1048	199.64	866.2	30908	0	28.00	168735
1050	219.67	868.7	0	31021	30.00	188653
1052	240.40	871.1	0	30989	32.00	209409
1054	261.95	873.3	0	30965	34.00	230981
1056	284.30	875.5	0	30947	36.00	253352
1058	307.44	877.7	0	30935	38.00	276503
1060	331.34	879.8	0	30924	40.00	300419
1061	343.58	880.9	0	30919	41.00	312659

Figure 3a – Calculations for Case 5

7. Results/Conclusions

For convenience, the headwater rating results, separate from the calculation details provided above, are tabulated as total discharge in cfs vs. headwater elevation in feet in Figure 5. The headwater rating curves are plotted in Figures 5 and 6.

The headwater rating curves developed in this calculation provide Norris total dam discharge vs. headwater elevation for use in TVA's SOCH and TRBROUTE models for simulation conditions satisfying the assumptions in Section 3. In particular, the spillway, sluice, and turbine gates must all be fully opened in Case 1, and the spillway gates must be fully raised while the sluice and turbine gates are fully closed in Case 2. Additional curves are provided in case of seismic failure of Norris Dam.

Norris Headwater Curves

2008 Rating, Case 1		2008 Rating, Case 2		2008 Rating, Case 3		2008 Rating, Case 4		2008 Rating, Case 5	
HW feet	Total Discharge 1000 cfs	HW feet	Total Discharge 1000 cfs	HW feet	Total Discharge 1000 cfs	HW feet	Total Discharge 1000 cfs	HW feet	Total Discharge 1000 cfs
1000	35.28	1000	0.00	912.86	95.1	909.62	20.7	1000	26.47
1005	35.94	1005	0.00	925.45	141.5	930.47	57.6	1005	26.96
1010	36.60	1010	0.00	939.7	214.8	942.23	100.9	1010	27.45
1020	37.88	1020	0.00	965.42	421.8	960.11	192	1020	28.40
1021	38.77	1021	0.00	982.75	656.5	973.52	295.2	1021	29.27
1022	40.47	1022	0.00	992.97	920.3	978.62	389.8	1022	30.95
1023	42.77	1023	0.00	1001.8	1181.2	984.62	508.7	1023	33.23
1024	45.57	1024	0.00	1011.85	1520.3	991.82	692.9	1024	36.02
1025	48.82	1025	0.00	1019.65	1805.5	998.27	901.9	1025	39.27
1026	52.48	1026	0.00	1028.8	2119.4	1004.12	1103	1026	42.93
1028	60.94	1028	0.00	1030.45	2196.1	1009.67	1295	1028	51.39
1030	70.78	1030	0.00	1036.6	2436.3	1014.77	1493	1030	61.24
1032	81.89	1032	0.00	1037.03	2462.7	1019.42	1686	1032	72.36
1034	94.19	1034	0.00	1045.63	2709.4	1024.67	1889	1034	84.68
1036	107.60	1036	3.35			1029.47	2095	1036	98.12
1037	114.71	1037	6.12			1033.67	2291	1037	105.24
1040	137.57	1040	17.13			1038.5	2493	1040	128.13
1042	154.05	1042	26.27			1043.42	2703	1042	144.63
1044	171.46	1044	36.61			1045.79	2824	1044	162.06
1046	189.79	1046	48.00					1046	180.41
1048	199.64	1048	60.35					1048	199.64
1050	219.67	1050	73.60					1050	219.67
1052	240.40	1052	87.68					1052	240.40
1054	261.95	1054	102.54					1054	261.95
1056	284.30	1056	118.14					1056	284.30
1058	307.44	1058	134.44					1058	307.44
1060	331.34	1060	151.43					1060	331.34
1061	343.58	1061	160.16					1061	343.58

Figure 4 - Headwater Rating Results

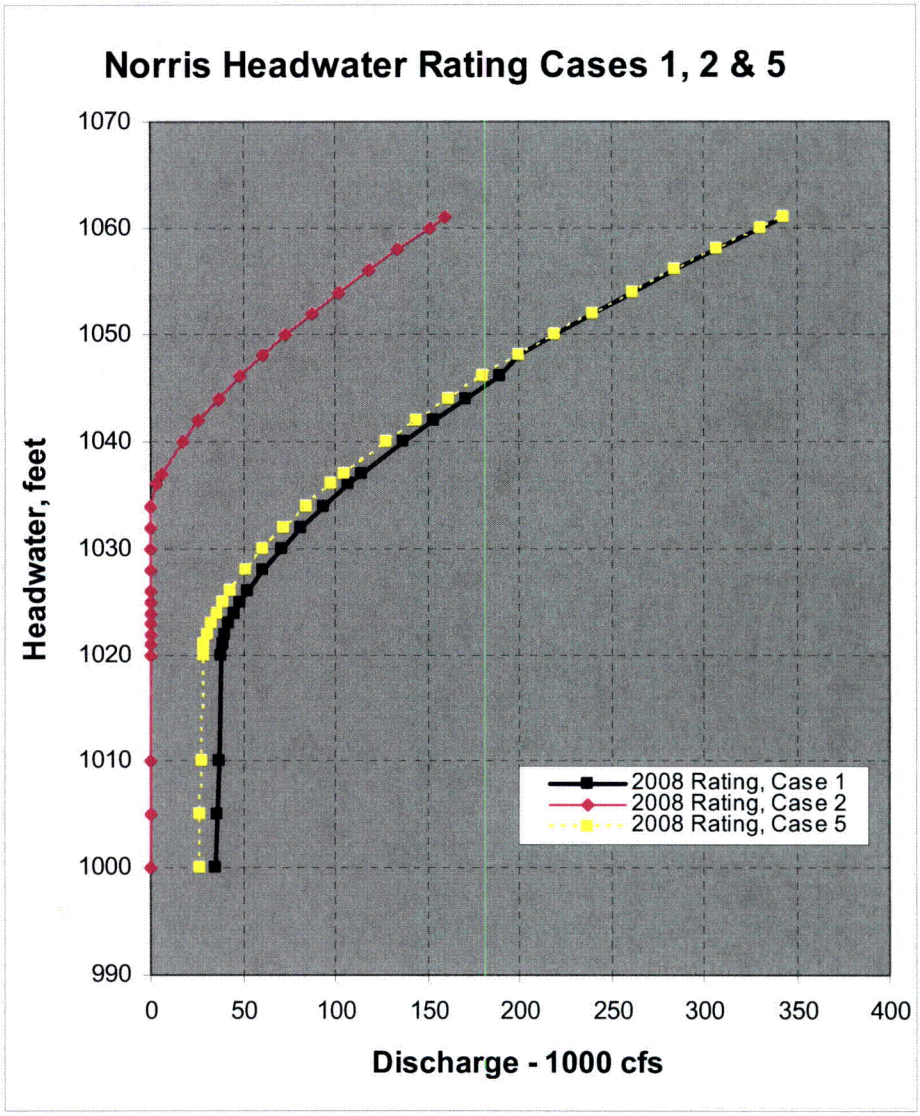


Figure 5 - Headwater Rating Curves for Cases 1, 2 and 5

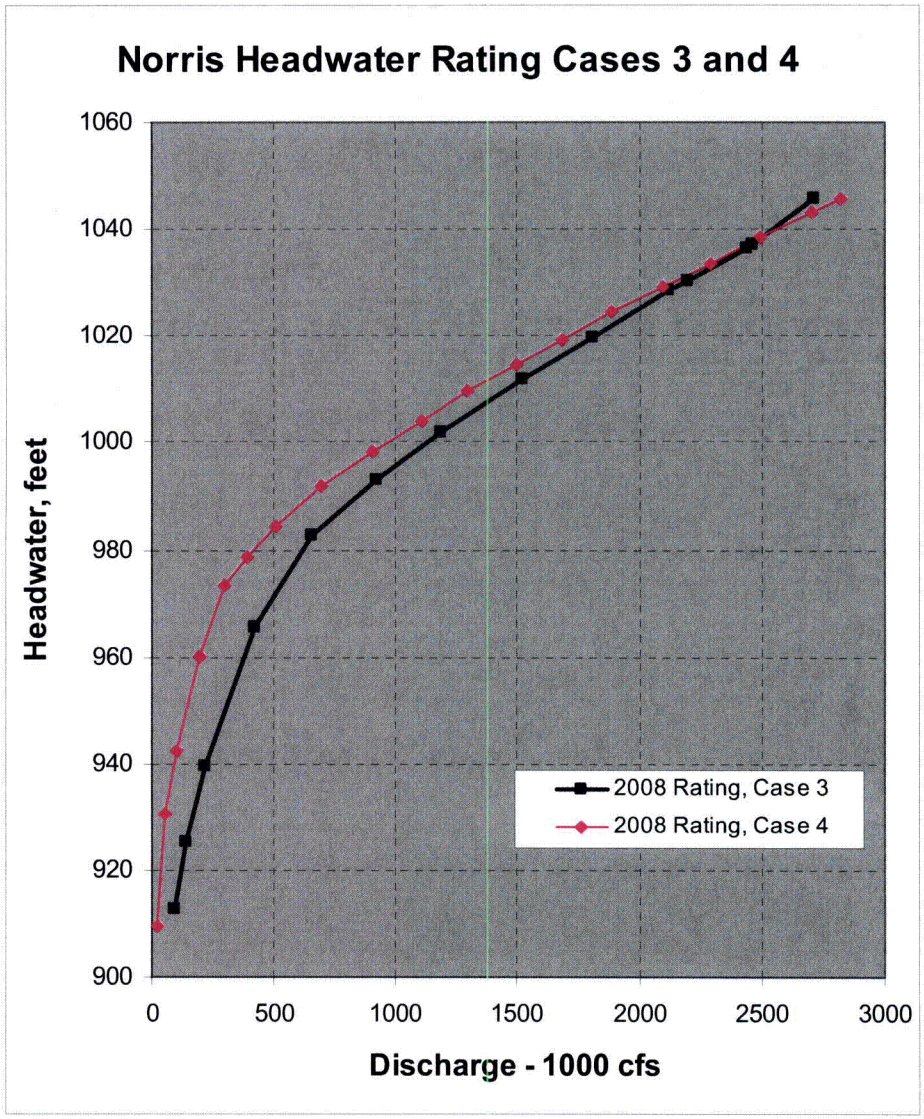
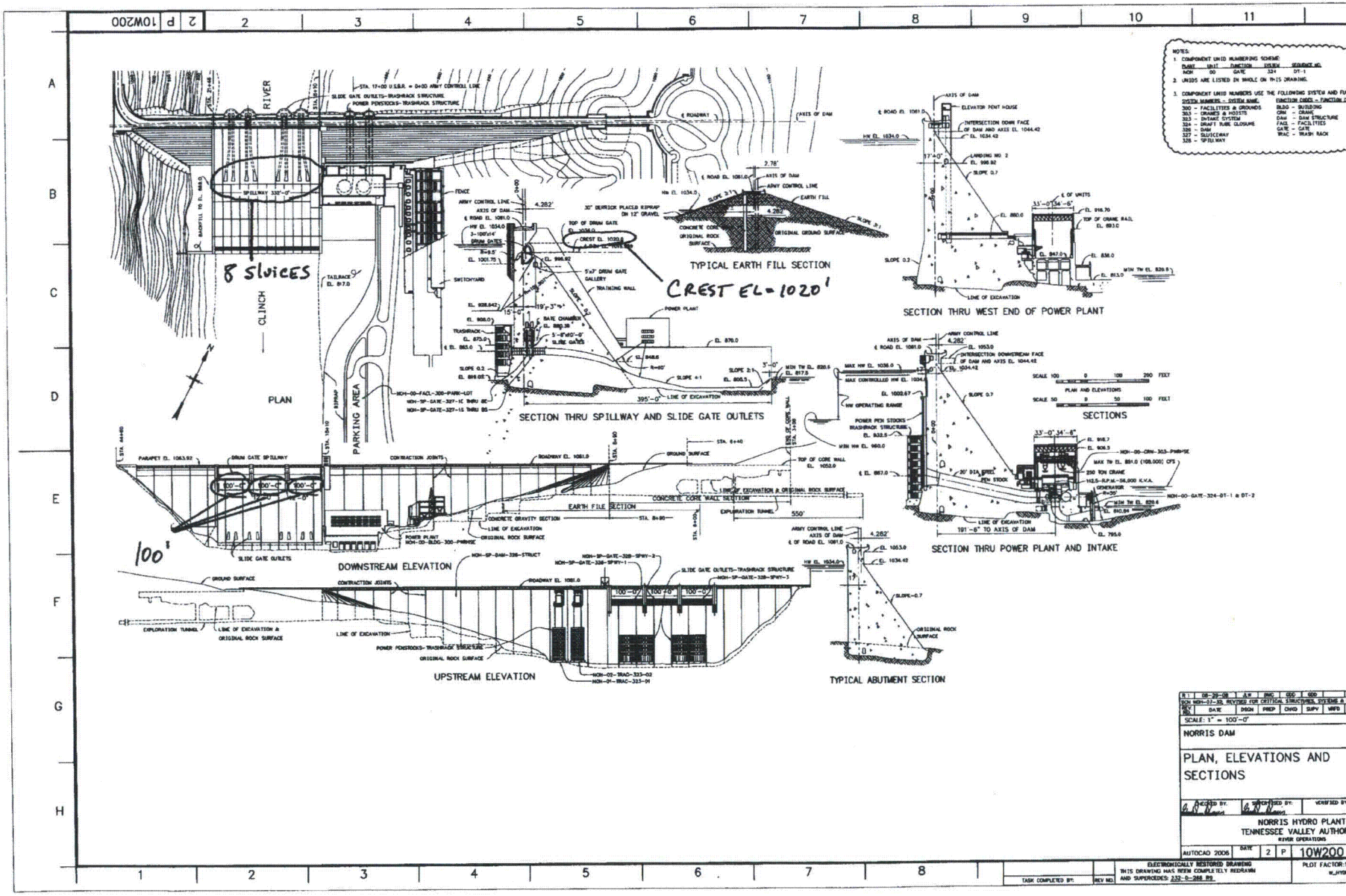


Figure 6 - Headwater Rating Curves for Cases 3 and 4


PLAN
CLINCH
RIVER
PARKING AREA
8 SLUICES
CREST EL=1020'
100'
TYPICAL EARTH FILL SECTION
SECTION THRU WEST END OF POWER PLANT
SECTION THRU SPILLWAY AND SLIDE GATE OUTLETS
SECTIONS
SECTION THRU POWER PLANT AND INTAKE
DOWNSTREAM ELEVATION
UPSTREAM ELEVATION
TYPICAL ABUTMENT SECTION
NORRIS DAM
PLAN, ELEVATIONS AND SECTIONS
NORRIS HYDRO PLANT
TENNESSEE VALLEY AUTHORITY
10W200

Norris Tailwater Rating

Riverware Rating

Q*1000	Q	Elevation
0	0	825.1
3.7	3,700	825.1
8	8,000	826.95
13.1	13,100	828.95
18.1	18,100	830.35
21.4	21,400	831.7
40	40,000	837.8
60	60,000	842.5
80	80,000	847
100	100,000	850.8
120	120,000	854
140	140,000	857.2
160	160,000	860
180	180,000	863
200	200,000	865.7
220	220,000	868.2
240	240,000	870.5
260	260,000	873
280	280,000	875
300	300,000	877.1
350	350,000	882
400	400,000	886.6
450	450,000	891
500	500,000	895

Flood Control Section 9/1948

Dicharge	Elevation
0	820
25,000	832.2
50,000	838.7
75,000	844.2
100,000	849.3
150,000	859.2
200,000	868
220,000	871

Actual data

Dicharge	Elevation
0	823.7
4690	825.5
8000	827.5
13000	829.1

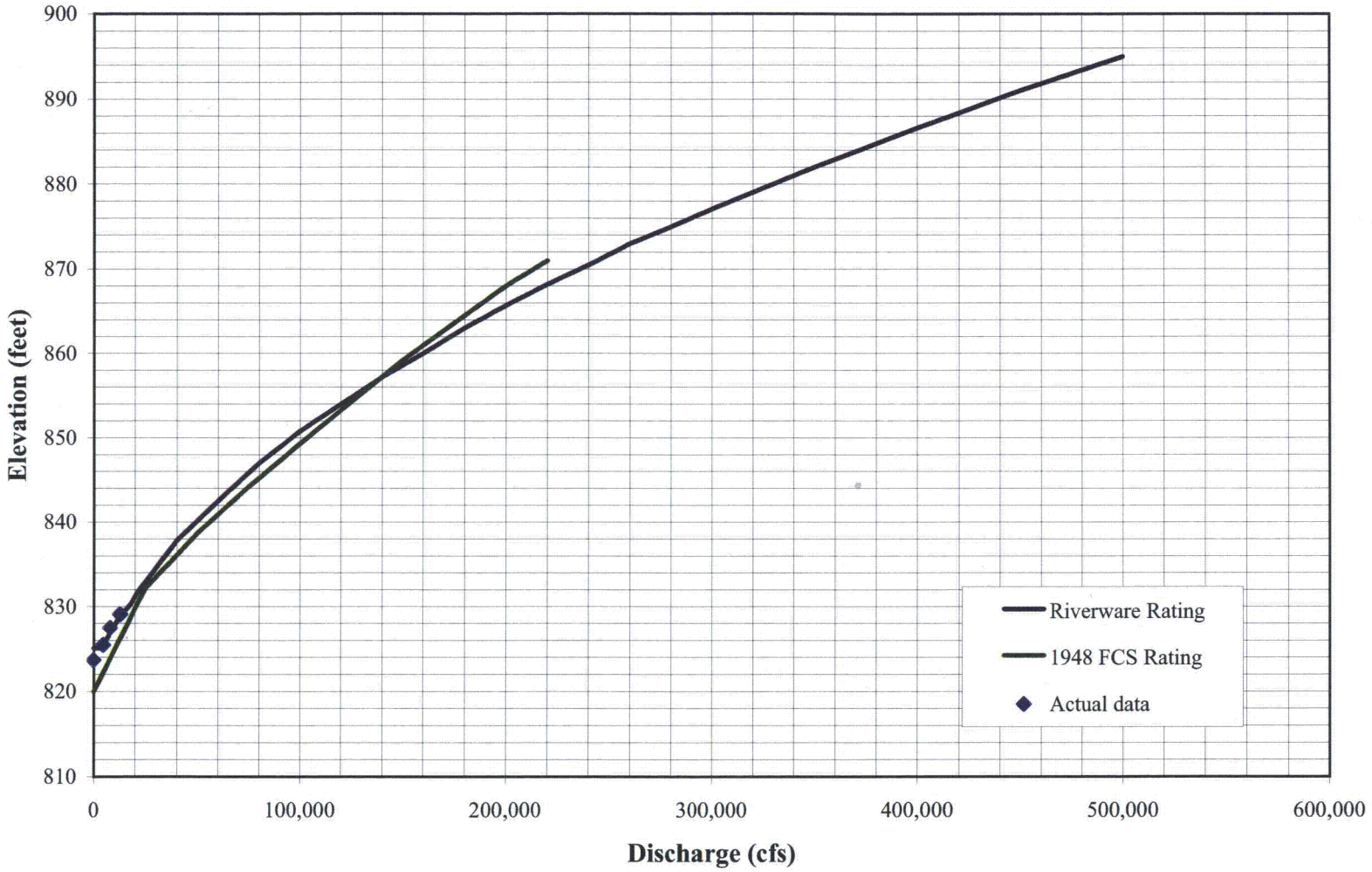
Attachment 2-2

Source: Reference 2

Calculation No: CDQ000020080015

Page 28

Norris Tailwater Rating



substituting in (5), assuming $n_p = n_m = n$

$$K_p N L_m (N H_m)^n = K_m L_m H_m{}^n N^{3/2}$$

simplifying

$$K_p = K_m N^{3/2-n} \qquad (6)$$

With the value of K_m and n for each gate setting a table of values for K_p and n were obtained and are shown in table 153. Values of K_p were calculated using equation (6) and the values of K_m and n from table 152. The values of n are the same whether model or prototype. Table 153 gives the calculated results. These data were plotted as shown on figure 337.

TABLE 153.—*Calculations of prototype coefficient of discharge from observed data*

$K_{prote} = K_{model} \times N^{1.5-n}$ where $N = 72$ and Log $N = 1.8573$

1	2	3	4	5	6	7
Gate elevation	See table 152 n	$1.5-n$	Log N× $(1.5-n)$	$N^{1.5-n}$	K Model	K Prototype
1020.00	1.618	−0.118	−0.2182	0.6050	4.244	2.568
1020.00	1.600	−.100	−.1852	.6529	4.202	2.743
1022.06	1.600	−.100	−.1839	.6548	4.097	2.683
1023.51	1.575	−.075	−.1400	.7244	4.001	2.898
1025.03	1.543	−.043	−.0797	.8324	3.960	3.296
1027.11	1.523	−.023	−.0422	.9075	3.963	3.596
1028.93	1.504	−.004	−.0076	.9826	3.909	3.841
1031.41	1.505	−.005	−.0095	.9784	3.913	3.828
1031.54	1.497	+.003	+.0061	1.0142	3.872	3.927
1031.56	1.488	+.012	+.0217	1.0513	3.847	4.044
1033.91	1.487	+.013	+.0251	1.0594	3.760	3.984

All the curves in figure 337 are interdependent. For instance, if the prototype coefficient curve is changed slightly, then the other three curves must be changed accordingly in order for the given values to check. All the plotted points are not given the same weight on the curves as there are more observations on some than on others.

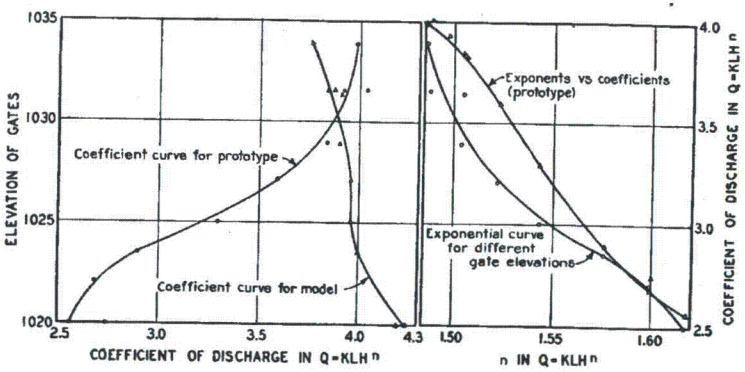


FIGURE 337.—*Coefficient (K) and exponential (n) curves for $Q = KLH^n$*

Values of K_p and n were read from these curves for each foot of gate elevation. By substituting these values in the equation $Q = K_p L H^n$, and using different values of H, the discharge table, table 154, was prepared.

Table 154 was compiled to furnish material for the construction of discharge curves. Therefore, only a sufficient number of points was calculated to fix the curves. Additional points may be calculated from the values given at the head of the column. The results in this table were plotted and are shown in figure 338. This diagram is based on having all the gate crests at the same elevation.

TABLE 154.—*Discharge table computed from the formula $Q = KLH^n$*

[Discharge (Q) for all three gates at the same elevation]

Head over gates in feet	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation
	Gate elevation 1,020 $n=1.617$ $K_p=2.568$ $K_pL=770.4$		Gate elevation 1,021 $n=1.608$ $K_p=2.617$ $K_pL=785.1$		Gate elevation 1,022 $n=1.597$ $K_p=2.696$ $K_pL=808.8$		Gate elevation 1,023 $n=1,584$ $K_p=2.809$ $K_pL=842.7$		Gate elevation 1,024 $n=1.566$ $K_p=3.002$ $K_pL=900.6$	
1	770	1,021	785	1,022	809	1,023	843	1,024	901	1,025
2	2,364	1,022	2,393	1,023	2,447	1,024	2,527	1,025	2,667	1,026
3	4,544	1,023	4,594	1,024	4,676	1,025	4,804	1,026	5,032	1,027
4	7,252	1,024	7,296	1,025	7,404	1,026	7,577	1,027	7,895	1,028
6	13,976	1,026	14,010	1,027	14,150	1,028	14,400	1,029	14,900	1,030
8	22,250	1,028	22,240	1,029	22,400	1,030	22,720	1,031	23,380	1,032
10	31,920	1,030	31,840	1,031	31,990	1,032	32,360	1,033	33,150	1,034
12	42,860	1,032	42,690	1,033	42,810	1,034	43,190	1,035	44,110	1,036
14	55,000	1,034	54,700	1,035	54,760	1,036	55,140	1,037	56,150	1,038
16	68,260	1,036	67,810	1,037	67,770	1,038	68,130	1,039	69,210	1,040
20	97,920	1,040	97,080	1,041	96,790	1,042	97,030	1,043	98,160	1,044
24	131,500	1,044	130,100	1,045	129,500	1,046	129,500	1,047	130,600	1,048
28	168,700	1,048	166,800	1,049	165,700	1,050	165,400	1,051	166,300	1,052
32	209,400	1,052	206,700	1,053	205,100	1,054	204,300	1,055		
36	253,300	1,056								
	Gate elevation 1,025 $n=1.549$ $K_p=3.220$ $K_pL=966.0$		Gate elevation 1,026 $n=1.535$ $K_p=3.410$ $K_pL=1,023$		Gate elevation 1,027 $n=1.524$ $K_p=3.574$ $K_pL=1,072$		Gate elevation 1,028 $n=1.515$ $K_p=3.704$ $K_pL=1,111$		Gate elevation 1,029 $n=1.508$ $K_p=3.796$ $K_pL=1,139$	
1	966	1,026	1,023	1,027	1,072	1,028	1,111	1,029	1,139	1,030
2	2,826	1,027	2,965	1,028	3,084	1,029	3,176	1,030	3,239	1,031
3	5,294	1,028	5,524	1,029	5,720	1,030	5,870	1,031	5,970	1,032
4	8,266	1,029	8,591	1,030	8,868	1,031	9,076	1,032	9,212	1,033
6	15,490	1,031	16,010	1,032	16,450	1,033	16,780	1,034	16,980	1,035
8	24,180	1,033	24,900	1,034	25,500	1,035	25,940	1,036	26,200	1,037
10	34,160	1,035	35,070	1,036	35,830	1,037	36,370	1,038	36,680	1,039
12	45,300	1,037	46,390	1,038	47,310	1,039	47,950	1,040	48,290	1,041
14	57,510	1,039	58,770	1,040	59,840	1,041	60,560	1,042	60,930	1,043
16	70,720	1,041	72,140	1,042	73,340	1,043	74,140	1,044	74,520	1,045
20	99,910	1,045	101,600	1,046	103,100	1,047	104,000	1,048	104,300	1,049
24	132,500	1,049	134,400	1,050	136,100	1,051	137,000	1,052	137,300	1,053
28	168,200	1,053	170,300	1,054	172,100	1,055				
	Gate elevation 1,030 $n=1.502$ $K_p=3.865$ $K_pL=1,160$		Gate elevation 1,031 $n=1.497$ $K_p=3.918$ $K_pL=1,175$		Gate elevation 1,032 $n=1.493$ $K_p=3.951$ $K_pL=1,185$		Gate elevation 1,033 $n=1.489$ $K_p=3.972$ $K_pL=1,192$		Gate elevation 1,034 $n=1.486$ $K_p=3.985$ $K_pL=1.196$	
1	1,160	1,031	1,175	1,032	1,185	1,033	1,192	1,034	1,196	1,035
2	3,284	1,032	3,318	1,033	3,336	1,034	3,345	1,035	3,349	1,036
3	6,038	1,033	6,089	1,034	6,112	1,035	6,119	1,036	6,117	1,037
4	9,302	1,034	9,367	1,035	9,391	1,036	9,392	1,037	9,380	1,038
6	17,100	1,036	17,190	1,037	17,200	1,038	17,180	1,039	17,140	1,040
8	26,350	1,038	26,440	1,039	26,430	1,040	26,370	1,041	26,280	1,042
10	36,840	1,040	36,950	1,041	36,880	1,042	36,770	1,043	36,610	1,044
12	48,440	1,042	48,520	1,043	48,420	1,044	48,230	1,045	48,000	1,046
14	61,060	1,044	61,120	1,045	60,950	1,046	60,680	1,047	60,350	1,048
16	74,620	1,046	74,640	1,047	74,400	1,048	74,030	1,049	73,600	1,050
20	104,300	1,050	104,300	1,051	103,800	1,052	103,200	1,053	102,500	1,054
24	137,200	1,054	137,000	1,055						

Attachment 3
Source: Reference 3
Calculation No: CDQ00002008015
Page 29

Attachment 4-1

Source: Reference 5

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	
6.0	17,820	17,890	17,950	18,020	18,090	18,150	18,220	18,280	18,350	18,410	18,480	18,540	18,600	18,670	18,730	18,790	18,860	18,920	18,980	19,040	19,110	6.0
6.1	18,190	18,260	18,330	18,400	18,460	18,530	18,600	18,660	18,730	18,790	18,860	18,930	18,990	19,060	19,120	19,190	19,250	19,310	19,380	19,440	19,500	6.1
6.2	18,570	18,640	18,710	18,780	18,840	18,910	18,980	19,050	19,120	19,180	19,250	19,320	19,380	19,450	19,520	19,580	19,650	19,710	19,780	19,840	19,910	6.2
6.3	18,950	19,020	19,090	19,160	19,230	19,300	19,370	19,440	19,510	19,570	19,640	19,710	19,780	19,850	19,910	19,980	20,050	20,120	20,180	20,250	20,320	6.3
6.4	19,330	19,400	19,480	19,550	19,620	19,690	19,760	19,830	19,900	19,970	20,040	20,110	20,180	20,250	20,320	20,390	20,460	20,520	20,590	20,660	20,730	6.4
6.5	19,720	19,790	19,870	19,940	20,010	20,090	20,160	20,230	20,300	20,370	20,450	20,520	20,590	20,660	20,730	20,800	20,870	20,940	21,010	21,080	21,150	6.5
6.6	20,120	20,190	20,270	20,340	20,410	20,490	20,560	20,640	20,710	20,780	20,860	20,930	21,000	21,070	21,140	21,220	21,290	21,360	21,430	21,500	21,570	6.6
6.7	20,520	20,590	20,670	20,750	20,820	20,900	20,970	21,050	21,120	21,200	21,270	21,350	21,420	21,490	21,570	21,640	21,710	21,780	21,860	21,930	22,000	6.7
6.8	20,920	21,000	21,080	21,160	21,230	21,310	21,390	21,460	21,540	21,620	21,690	21,770	21,840	21,920	21,990	22,070	22,140	22,220	22,290	22,360	22,440	6.8
6.9	21,330	21,410	21,490	21,570	21,650	21,730	21,810	21,890	21,970	22,040	22,120	22,200	22,270	22,350	22,430	22,500	22,580	22,660	22,730	22,810	22,880	6.9
7.0	21,750	21,830	21,920	22,000	22,080	22,160	22,240	22,320	22,400	22,480	22,560	22,630	22,710	22,790	22,870	22,950	23,020	23,100	23,180	23,250	23,330	7.0
7.1	22,180	22,260	22,350	22,430	22,510	22,590	22,670	22,760	22,840	22,920	23,000	23,080	23,160	23,240	23,320	23,400	23,480	23,560	23,630	23,710	23,790	7.1
7.2	22,610	22,700	22,780	22,870	22,950	23,040	23,120	23,200	23,280	23,370	23,450	23,530	23,610	23,690	23,780	23,860	23,940	24,020	24,100	24,180	24,260	7.2
7.3	23,060	23,140	23,230	23,320	23,400	23,490	23,570	23,660	23,740	23,830	23,910	23,990	24,080	24,160	24,240	24,320	24,410	24,490	24,570	24,650	24,730	7.3
7.4	23,510	23,600	23,690	23,770	23,860	23,950	24,030	24,120	24,210	24,290	24,380	24,460	24,550	24,630	24,720	24,800	24,890	24,970	25,050	25,140	25,220	7.4
7.5	23,970	24,060	24,150	24,240	24,330	24,420	24,510	24,600	24,680	24,770	24,860	24,950	25,030	25,120	25,210	25,290	25,380	25,460	25,550	25,630	25,720	7.5
7.6	24,440	24,540	24,630	24,720	24,810	24,900	24,990	25,080	25,170	25,260	25,350	25,440	25,530	25,620	25,700	25,790	25,880	25,970	26,050	26,140	26,230	7.6
7.7	24,930	25,020	25,120	25,210	25,300	25,400	25,490	25,580	25,670	25,760	25,850	25,950	26,040	26,130	26,220	26,310	26,390	26,480	26,570	26,660	26,750	7.7
7.8	25,430	25,520	25,620	25,710	25,810	25,900	26,000	26,090	26,190	26,280	26,370	26,460	26,560	26,650	26,740	26,830	26,920	27,010	27,100	27,190	27,280	7.8
7.9	25,940	26,040	26,140	26,230	26,330	26,430	26,520	26,620	26,710	26,810	26,900	27,000	27,090	27,190	27,280	27,370	27,470	27,560	27,650	27,740	27,830	7.9
8.0	26,470	26,570	26,670	26,770	26,870	26,960	27,060	27,160	27,260	27,350	27,450	27,550	27,640	27,740	27,840	27,930	28,030	28,120	28,210	28,310	28,400	8.0
WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																						
8.1	27,010	27,110	27,220	27,320	27,420	27,520	27,620	27,720	27,820	27,920	28,020	28,120	28,210	28,310	28,410	28,510	28,600	28,700	28,800	28,890	28,990	8.1
8.2	27,570	27,680	27,780	27,890	27,990	28,090	28,190	28,300	28,400	28,500	28,600	28,700	28,800	28,900	29,000	29,100	29,200	29,300	29,400	29,490	29,590	8.2
8.3	28,150	28,260	28,370	28,470	28,580	28,680	28,790	28,890	29,000	29,100	29,200	29,310	29,410	29,510	29,610	29,720	29,820	29,920	30,020	30,120	30,220	8.3
8.4	28,740	28,850	28,960	29,070	29,170	29,280	29,390	29,490	29,600	29,710	29,810	29,920	30,020	30,130	30,230	30,330	30,440	30,540	30,640	30,740	30,850	8.4
8.5	29,270	29,380	29,490	29,600	29,710	29,820	29,930	30,040	30,150	30,260	30,360	30,470	30,580	30,680	30,790	30,900	31,000	31,110	31,210	31,310	31,420	8.5
8.6	29,760	29,880	29,990	30,100	30,210	30,320	30,440	30,550	30,660	30,770	30,870	30,980	31,090	31,200	31,310	31,420	31,520	31,630	31,740	31,840	31,950	8.6
8.7	30,230	30,350	30,460	30,580	30,690	30,800	30,920	31,030	31,140	31,250	31,360	31,470	31,580	31,690	31,800	31,910	32,020	32,130	32,240	32,350	32,450	8.7
8.8	30,700	30,810	30,930	31,050	31,160	31,280	31,390	31,510	31,620	31,730	31,850	31,960	32,070	32,180	32,290	32,400	32,520	32,630	32,740	32,840	32,950	8.8
8.9	31,170	31,290	31,410	31,530	31,640	31,760	31,880	31,990	32,110	32,220	32,340	32,450	32,570	32,680	32,790	32,910	33,020	33,130	33,240	33,350	33,460	8.9
9.0	31,660	31,780	31,900	32,020	32,140	32,260	32,380	32,500	32,610	32,730	32,850	32,960	33,080	33,200	33,310	33,420	33,540	33,650	33,770	33,880	33,990	9.0
9.1	32,170	32,290	32,410	32,530	32,660	32,780	32,900	33,020	33,140	33,260	33,370	33,490	33,610	33,730	33,840	33,960	34,080	34,190	34,310	34,420	34,540	9.1
9.2	32,680	32,810	32,930	33,060	33,180	33,300	33,430	33,550	33,670	33,790	33,910	34,030	34,150	34,270	34,390	34,510	34,630	34,740	34,860	34,980	35,090	9.2
9.3	33,200	33,330	33,450	33,580	33,700	33,830	33,950	34,080	34,200	34,320	34,440	34,570	34,690	34,810	34,930	35,050	35,170	35,290	35,410	35,530	35,650	9.3
9.4	33,700	33,830	33,950	34,080	34,210	34,340	34,460	34,590	34,710	34,840	34,960	35,090	35,210	35,330	35,460	35,580	35,700	35,820	35,940	36,060	36,180	9.4
9.5*	33,820	33,940	34,070	34,200	34,330	34,460	34,580	34,710	34,840	34,960	35,090	35,210	35,340	35,460	35,580	35,700	35,830	35,950	36,070	36,190	36,310	9.5*
9.6*	33,920	34,050	34,180	34,310	34,440	34,560	34,690	34,820	34,950	35,070	35,200	35,320	35,450	35,570	35,690	35,820	35,940	36,060	36,180	36,310	36,430	9.6*
9.7*	34,020	34,150	34,270	34,400	34,530	34,660	34,790	34,920	35,040	35,170	35,290	35,420	35,540	35,670	35,790	35,920	36,040	36,160	36,290	36,410	36,530	9.7*
9.8*	34,100	34,230	34,360	34,490	34,620	34,750	34,870	35,000	35,130	35,250	35,380	35,510	35,630	35,760	35,880	36,010	36,130	36,250	36,370	36,500	36,620	9.8*
9.9*	34,170	34,300	34,430	34,560	34,690	34,820	34,950	35,070	35,200	35,330	35,460	35,580	35,710	35,830	35,960	36,080	36,200	36,330	36,450	36,570	36,700	9.9*
10.0*	34,230	34,360	34,490	34,620	34,750	34,880	35,000	35,130	35,260	35,390	35,510	35,640	35,770	35,890	36,020	36,140	36,260	36,390	36,510	36,630	36,760	10.0*

MAY 2000

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

HEADWATER 1000 to 1020

Attachment 4-2

Source: Reference 5

Calculation No: CDQ000020080015
Page 31

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	
6.0	19, 110	19, 170	19, 230	19, 290	19, 350	19, 410	19, 470	19, 540	19, 600	19, 660	19, 720	19, 780	19, 840	19, 900	19, 960	20, 020	20, 070	20, 130	20, 190	20, 250	20, 310	6.0
6.1	19, 500	19, 570	19, 630	19, 690	19, 760	19, 820	19, 880	19, 940	20, 010	20, 070	20, 130	20, 190	20, 250	20, 310	20, 370	20, 430	20, 490	20, 550	20, 610	20, 670	20, 730	6.1
6.2	19, 910	19, 970	20, 040	20, 100	20, 160	20, 230	20, 290	20, 360	20, 420	20, 480	20, 540	20, 610	20, 670	20, 730	20, 790	20, 860	20, 920	20, 980	21, 040	21, 100	21, 160	6.2
6.3	20, 320	20, 380	20, 450	20, 510	20, 580	20, 640	20, 710	20, 770	20, 840	20, 900	20, 970	21, 030	21, 090	21, 160	21, 220	21, 280	21, 350	21, 410	21, 470	21, 530	21, 600	6.3
6.4	20, 730	20, 800	20, 860	20, 930	21, 000	21, 060	21, 130	21, 200	21, 260	21, 330	21, 390	21, 460	21, 520	21, 590	21, 650	21, 720	21, 780	21, 850	21, 910	21, 970	22, 040	6.4
6.5	21, 150	21, 220	21, 280	21, 350	21, 420	21, 490	21, 560	21, 620	21, 690	21, 760	21, 820	21, 890	21, 960	22, 020	22, 090	22, 160	22, 220	22, 290	22, 350	22, 420	22, 480	6.5
6.6	21, 570	21, 640	21, 710	21, 780	21, 850	21, 920	21, 990	22, 060	22, 130	22, 190	22, 260	22, 330	22, 400	22, 470	22, 530	22, 600	22, 670	22, 730	22, 800	22, 870	22, 930	6.6
6.7	22, 000	22, 070	22, 140	22, 210	22, 290	22, 360	22, 430	22, 500	22, 570	22, 640	22, 710	22, 780	22, 850	22, 910	22, 980	23, 050	23, 120	23, 190	23, 260	23, 320	23, 390	6.7
6.8	22, 440	22, 510	22, 580	22, 660	22, 730	22, 800	22, 870	22, 940	23, 020	23, 090	23, 160	23, 230	23, 300	23, 370	23, 440	23, 510	23, 580	23, 650	23, 720	23, 790	23, 860	6.8
6.9	22, 880	22, 960	23, 030	23, 100	23, 180	23, 250	23, 320	23, 400	23, 470	23, 540	23, 620	23, 690	23, 760	23, 830	23, 900	23, 980	24, 050	24, 120	24, 190	24, 260	24, 330	6.9
7.0	23, 330	23, 410	23, 480	23, 560	23, 630	23, 710	23, 780	23, 860	23, 930	24, 010	24, 080	24, 160	24, 230	24, 300	24, 380	24, 450	24, 520	24, 590	24, 670	24, 740	24, 810	7.0
7.1	23, 790	23, 870	23, 940	24, 020	24, 100	24, 180	24, 250	24, 330	24, 400	24, 480	24, 560	24, 630	24, 710	24, 780	24, 850	24, 930	25, 000	25, 080	25, 150	25, 220	25, 300	7.1
7.2	24, 260	24, 340	24, 410	24, 490	24, 570	24, 650	24, 730	24, 810	24, 880	24, 960	25, 040	25, 110	25, 190	25, 270	25, 340	25, 420	25, 500	25, 570	25, 650	25, 720	25, 800	7.2
7.3	24, 730	24, 810	24, 890	24, 970	25, 050	25, 130	25, 210	25, 290	25, 370	25, 450	25, 530	25, 610	25, 690	25, 760	25, 840	25, 920	26, 000	26, 070	26, 150	26, 230	26, 300	7.3
7.4	25, 220	25, 300	25, 380	25, 470	25, 550	25, 630	25, 710	25, 790	25, 870	25, 950	26, 030	26, 110	26, 190	26, 270	26, 350	26, 430	26, 510	26, 590	26, 670	26, 740	26, 820	7.4
7.5	25, 720	25, 800	25, 880	25, 970	26, 050	26, 130	26, 220	26, 300	26, 380	26, 460	26, 550	26, 630	26, 710	26, 790	26, 870	26, 950	27, 030	27, 110	27, 190	27, 270	27, 350	7.5
7.6	26, 230	26, 310	26, 400	26, 480	26, 570	26, 650	26, 740	26, 820	26, 910	26, 990	27, 070	27, 160	27, 240	27, 320	27, 400	27, 490	27, 570	27, 650	27, 730	27, 810	27, 890	7.6
7.7	26, 750	26, 840	26, 920	27, 010	27, 100	27, 180	27, 270	27, 360	27, 440	27, 530	27, 610	27, 700	27, 780	27, 870	27, 950	28, 030	28, 120	28, 200	28, 280	28, 370	28, 450	7.7
7.8	27, 280	27, 370	27, 460	27, 550	27, 640	27, 730	27, 820	27, 900	27, 990	28, 080	28, 170	28, 250	28, 340	28, 420	28, 510	28, 600	28, 680	28, 770	28, 850	28, 940	29, 020	7.8
7.9	27, 830	27, 930	28, 020	28, 110	28, 200	28, 290	28, 380	28, 470	28, 560	28, 650	28, 730	28, 820	28, 910	29, 000	29, 090	29, 170	29, 260	29, 350	29, 440	29, 520	29, 610	7.9
8.0	28, 400	28, 500	28, 590	28, 680	28, 770	28, 870	28, 960	29, 050	29, 140	29, 230	29, 320	29, 410	29, 500	29, 590	29, 680	29, 770	29, 860	29, 950	30, 040	30, 120	30, 210	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	28, 990	29, 080	29, 180	29, 270	29, 370	29, 460	29, 550	29, 650	29, 740	29, 830	29, 930	30, 020	30, 110	30, 200	30, 290	30, 380	30, 480	30, 570	30, 660	30, 750	30, 840	8.1
8.2	29, 590	29, 690	29, 790	29, 880	29, 980	30, 080	30, 170	30, 270	30, 360	30, 460	30, 550	30, 650	30, 740	30, 830	30, 930	31, 020	31, 110	31, 200	31, 300	31, 390	31, 480	8.2
8.3	30, 220	30, 320	30, 420	30, 510	30, 610	30, 710	30, 810	30, 910	31, 000	31, 100	31, 200	31, 290	31, 390	31, 490	31, 580	31, 680	31, 770	31, 870	31, 960	32, 050	32, 150	8.3
8.4	30, 850	30, 950	31, 050	31, 150	31, 250	31, 350	31, 450	31, 550	31, 650	31, 750	31, 850	31, 950	32, 040	32, 140	32, 240	32, 340	32, 430	32, 530	32, 630	32, 720	32, 820	8.4
8.5	31, 420	31, 520	31, 630	31, 730	31, 830	31, 930	32, 030	32, 140	32, 240	32, 340	32, 440	32, 540	32, 640	32, 740	32, 840	32, 940	33, 040	33, 130	33, 230	33, 330	33, 430	8.5
8.6	31, 950	32, 050	32, 160	32, 260	32, 370	32, 470	32, 570	32, 680	32, 780	32, 880	32, 990	33, 090	33, 190	33, 290	33, 390	33, 490	33, 590	33, 690	33, 790	33, 890	33, 990	8.6
8.7	32, 450	32, 560	32, 670	32, 770	32, 880	32, 990	33, 090	33, 200	33, 300	33, 400	33, 510	33, 610	33, 720	33, 820	33, 920	34, 020	34, 130	34, 230	34, 330	34, 430	34, 530	8.7
8.8	32, 950	33, 060	33, 170	33, 280	33, 390	33, 490	33, 600	33, 710	33, 810	33, 920	34, 030	34, 130	34, 240	34, 340	34, 450	34, 550	34, 650	34, 760	34, 860	34, 960	35, 070	8.8
8.9	33, 460	33, 570	33, 690	33, 790	33, 900	34, 010	34, 120	34, 230	34, 340	34, 450	34, 550	34, 660	34, 770	34, 870	34, 980	35, 090	35, 190	35, 300	35, 400	35, 510	35, 610	8.9
9.0	33, 990	34, 100	34, 220	34, 330	34, 440	34, 550	34, 660	34, 770	34, 880	34, 990	35, 100	35, 210	35, 320	35, 430	35, 530	35, 640	35, 750	35, 850	35, 960	36, 070	36, 170	9.0
9.1	34, 540	34, 650	34, 770	34, 880	34, 990	35, 110	35, 220	35, 330	35, 440	35, 550	35, 660	35, 770	35, 890	36, 000	36, 100	36, 210	36, 320	36, 430	36, 540	36, 650	36, 760	9.1
9.2	35, 090	35, 210	35, 330	35, 440	35, 560	35, 670	35, 790	35, 900	36, 010	36, 130	36, 240	36, 350	36, 460	36, 580	36, 690	36, 800	36, 910	37, 020	37, 130	37, 240	37, 350	9.2
9.3	35, 650	35, 770	35, 880	36, 000	36, 120	36, 230	36, 350	36, 470	36, 580	36, 700	36, 810	36, 930	37, 040	37, 150	37, 270	37, 380	37, 490	37, 600	37, 720	37, 830	37, 940	9.3
9.4	36, 180	36, 300	36, 420	36, 540	36, 660	36, 780	36, 900	37, 020	37, 130	37, 250	37, 370	37, 480	37, 600	37, 710	37, 830	37, 940	38, 060	38, 170	38, 290	38, 400	38, 510	9.4
9.5*	36, 310	36, 430	36, 550	36, 670	36, 790	36, 910	37, 030	37, 150	37, 270	37, 380	37, 500	37, 620	37, 730	37, 850	37, 960	38, 080	38, 190	38, 310	38, 420	38, 540	38, 650	9.5*
9.6*	36, 430	36, 550	36, 670	36, 790	36, 910	37, 030	37, 150	37, 260	37, 380	37, 500	37, 620	37, 740	37, 850	37, 970	38, 080	38, 200	38, 310	38, 430	38, 540	38, 660	38, 770	9.6*
9.7*	36, 530	36, 650	36, 770	36, 890	37, 010	37, 130	37, 250	37, 370	37, 490	37, 610	37, 720	37, 840	37, 960	38, 070	38, 190	38, 310	38, 420	38, 540	38, 650	38, 770	38, 880	9.7*
9.8*	36, 620	36, 740	36, 860	36, 980	37, 100	37, 220	37, 340	37, 460	37, 580	37, 700	37, 820	37, 930	38, 050	38, 170	38, 280	38, 400	38, 520	38, 630	38, 750	38, 860	38, 980	9.8*
9.9*	36, 700	36, 820	36, 940	37, 060	37, 180	37, 300	37, 420	37, 540	37, 660	37, 780	37, 900	38, 010	38, 130	38, 250	38, 370	38, 480	38, 600	38, 710	38, 830	38, 940	39, 060	9.9*
10.0*	36, 760	36, 880	37, 000	37, 120	37, 240	37, 360	37, 480	37, 600	37, 720	37, 840	37, 960	38, 080	38, 200	38, 310	38, 430	38, 550	38, 660	38, 780	38, 890	39, 010	39, 120	10.0*

MAY 2000

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

HEADWATER 1020 to 1040

Attachment 4-3

Source: Reference 5

NORRIS DAM

65

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	
6.0	20, 310	20, 370	20, 430	20, 480	20, 540	20, 600	20, 660	20, 710	20, 770	20, 830	20, 880	20, 940	21, 000									6.0
6.1	20, 730	20, 790	20, 850	20, 910	20, 970	21, 030	21, 090	21, 150	21, 200	21, 260	21, 320	21, 380	21, 440									6.1
6.2	21, 160	21, 220	21, 280	21, 340	21, 400	21, 460	21, 520	21, 580	21, 640	21, 700	21, 760	21, 820	21, 880									6.2
6.3	21, 600	21, 660	21, 720	21, 780	21, 840	21, 910	21, 970	22, 030	22, 090	22, 150	22, 210	22, 270	22, 330									6.3
6.4	22, 040	22, 100	22, 160	22, 230	22, 290	22, 350	22, 410	22, 480	22, 540	22, 600	22, 660	22, 720	22, 790									6.4
6.5	22, 480	22, 550	22, 610	22, 680	22, 740	22, 800	22, 870	22, 930	22, 990	23, 060	23, 120	23, 180	23, 250									6.5
6.6	22, 930	23, 000	23, 070	23, 130	23, 200	23, 260	23, 330	23, 390	23, 460	23, 520	23, 590	23, 650	23, 710									6.6
6.7	23, 390	23, 460	23, 530	23, 590	23, 660	23, 730	23, 790	23, 860	23, 930	23, 990	24, 060	24, 120	24, 190									6.7
6.8	23, 860	23, 930	23, 990	24, 060	24, 130	24, 200	24, 270	24, 330	24, 400	24, 470	24, 540	24, 600	24, 670									6.8
6.9	24, 330	24, 400	24, 470	24, 540	24, 610	24, 680	24, 750	24, 820	24, 880	24, 950	25, 020	25, 090	25, 160									6.9
7.0	24, 810	24, 880	24, 950	25, 020	25, 090	25, 170	25, 240	25, 310	25, 380	25, 450	25, 520	25, 590	25, 660									7.0
7.1	25, 300	25, 370	25, 440	25, 520	25, 590	25, 660	25, 730	25, 800	25, 880	25, 950	26, 020	26, 090	26, 160									7.1
7.2	25, 800	25, 870	25, 940	26, 020	26, 090	26, 170	26, 240	26, 310	26, 390	26, 460	26, 530	26, 600	26, 680									7.2
7.3	26, 300	26, 380	26, 450	26, 530	26, 610	26, 680	26, 760	26, 830	26, 910	26, 980	27, 050	27, 130	27, 200									7.3
7.4	26, 820	26, 900	26, 980	27, 050	27, 130	27, 210	27, 280	27, 360	27, 440	27, 510	27, 590	27, 660	27, 740									7.4
7.5	27, 350	27, 430	27, 510	27, 590	27, 670	27, 740	27, 820	27, 900	27, 980	28, 060	28, 130	28, 210	28, 290									7.5
7.6	27, 890	27, 970	28, 060	28, 140	28, 220	28, 300	28, 370	28, 450	28, 530	28, 610	28, 690	28, 770	28, 850									7.6
7.7	28, 450	28, 530	28, 610	28, 700	28, 780	28, 860	28, 940	29, 020	29, 100	29, 180	29, 260	29, 340	29, 420									7.7
7.8	29, 020	29, 110	29, 190	29, 270	29, 360	29, 440	29, 520	29, 600	29, 690	29, 770	29, 850	29, 930	30, 020									7.8
7.9	29, 610	29, 690	29, 780	29, 860	29, 950	30, 040	30, 120	30, 200	30, 290	30, 370	30, 460	30, 540	30, 620									7.9
8.0	30, 210	30, 300	30, 390	30, 480	30, 560	30, 650	30, 740	30, 820	30, 910	30, 990	31, 080	31, 160	31, 250									8.0
WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																						
8.1	30, 840	30, 930	31, 020	31, 100	31, 190	31, 280	31, 370	31, 460	31, 550	31, 630	31, 720	31, 810	31, 890									8.1
8.2	31, 480	31, 570	31, 660	31, 750	31, 850	31, 940	32, 030	32, 120	32, 210	32, 290	32, 380	32, 470	32, 560									8.2
8.3	32, 150	32, 240	32, 330	32, 430	32, 520	32, 610	32, 700	32, 800	32, 890	32, 980	33, 070	33, 160	33, 250									8.3
8.4	32, 820	32, 910	33, 010	33, 100	33, 200	33, 290	33, 390	33, 480	33, 570	33, 670	33, 760	33, 850	33, 950									8.4
8.5	33, 430	33, 530	33, 620	33, 720	33, 820	33, 910	34, 010	34, 100	34, 200	34, 290	34, 390	34, 480	34, 580									8.5
8.6	33, 990	34, 090	34, 190	34, 290	34, 390	34, 480	34, 580	34, 680	34, 780	34, 870	34, 970	35, 070	35, 160									8.6
8.7	34, 530	34, 630	34, 730	34, 830	34, 930	35, 030	35, 130	35, 230	35, 330	35, 430	35, 530	35, 620	35, 720									8.7
8.8	35, 070	35, 170	35, 270	35, 370	35, 470	35, 570	35, 680	35, 780	35, 880	35, 980	36, 080	36, 170	36, 270									8.8
8.9	35, 610	35, 710	35, 820	35, 920	36, 020	36, 130	36, 230	36, 330	36, 430	36, 530	36, 640	36, 740	36, 840									8.9
9.0	36, 170	36, 280	36, 380	36, 490	36, 590	36, 700	36, 800	36, 910	37, 010	37, 110	37, 220	37, 320	37, 420									9.0
9.1	36, 760	36, 860	36, 970	37, 080	37, 180	37, 290	37, 400	37, 500	37, 610	37, 710	37, 820	37, 920	38, 020									9.1
9.2	37, 350	37, 460	37, 570	37, 680	37, 780	37, 890	38, 000	38, 110	38, 210	38, 320	38, 430	38, 530	38, 640									9.2
9.3	37, 940	38, 050	38, 160	38, 270	38, 380	38, 490	38, 600	38, 710	38, 820	38, 930	39, 040	39, 140	39, 250									9.3
9.4	38, 510	38, 630	38, 740	38, 850	38, 960	39, 070	39, 180	39, 290	39, 410	39, 520	39, 630	39, 730	39, 840									9.4
9.5*	38, 650	38, 760	38, 880	38, 990	39, 100	39, 210	39, 320	39, 430	39, 550	39, 660	39, 770	39, 880	39, 990									9.5*
9.6*	38, 770	38, 890	39, 000	39, 110	39, 220	39, 340	39, 450	39, 560	39, 670	39, 780	39, 890	40, 000	40, 110									9.6*
9.7*	38, 880	38, 990	39, 110	39, 220	39, 330	39, 450	39, 560	39, 670	39, 780	39, 890	40, 000	40, 120	40, 230									9.7*
9.8*	38, 980	39, 090	39, 200	39, 320	39, 430	39, 540	39, 660	39, 770	39, 880	39, 990	40, 100	40, 210	40, 330									9.8*
9.9*	39, 060	39, 170	39, 290	39, 400	39, 520	39, 630	39, 740	39, 850	39, 970	40, 080	40, 190	40, 300	40, 410									9.9*
10.0*	39, 120	39, 240	39, 350	39, 470	39, 580	39, 690	39, 810	39, 920	40, 030	40, 150	40, 260	40, 370	40, 480									10.0*

MAY 2000

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

HEADWATER 1040 to 1060

INSTRUCTIONS FOR USE OF TABLES

1. Tables Update

These tables supersede the tables dated October 1961. The revised discharges were generated using the computer code SPILLQ and are only slightly different from those in the 1961 tables.

2. Purpose of Tables

These tables provide a means of setting up or determining the discharge through the sluices in Norris Dam. They give the total discharge in cubic feet per second through all eight sluices when the headwater elevation and sluice gate openings are known. The discharges are based on the results of field measurements.

The tables have been prepared to permit simultaneous operation of all eight sluices shown on page 4 except for gate openings greater than 9.4 feet (explained in following section). Past operating experience has shown that simultaneous operation should be used to minimize damage to the apron, bank, riprap, and sluice conduits.

3. Cavitation-Imposed Limits on Gate Openings

Significant cavitation damage upstream from the emergency slide gates was discovered during inspections of Sluices 3 and 4 in the Spring of 1999. An analysis determined that this damage occurred during past operations when the sluices were operated at gate openings greater than about 8.6 feet. **To avoid further cavitation damage the sluices should not be opened above 8 feet except in emergency situations.** The limit is set at 8 feet, rather than 8.6 feet, to provide a factor of safety.

Also, because past operating experience has shown that cavitation damage to the gate seals may occur if the gates are set to openings smaller than 1 foot, the minimum acceptable opening for the gates is 1 foot.

In addition, gates 2, 4, 5, 7, and 8 should never be opened more than 9.4 feet because of cavitation danger related to flow past the intake gate slots.

4. Range of Tables

The tables cover a discharge range from 0 to 40,480 cubic feet per second. Headwater elevations range from 880 feet to 1052 feet. Sluice gate openings range from 1 foot, which is the minimum acceptable opening, to maximum openings of either 9.4 feet or 10 feet.

5. Arrangement of Tables

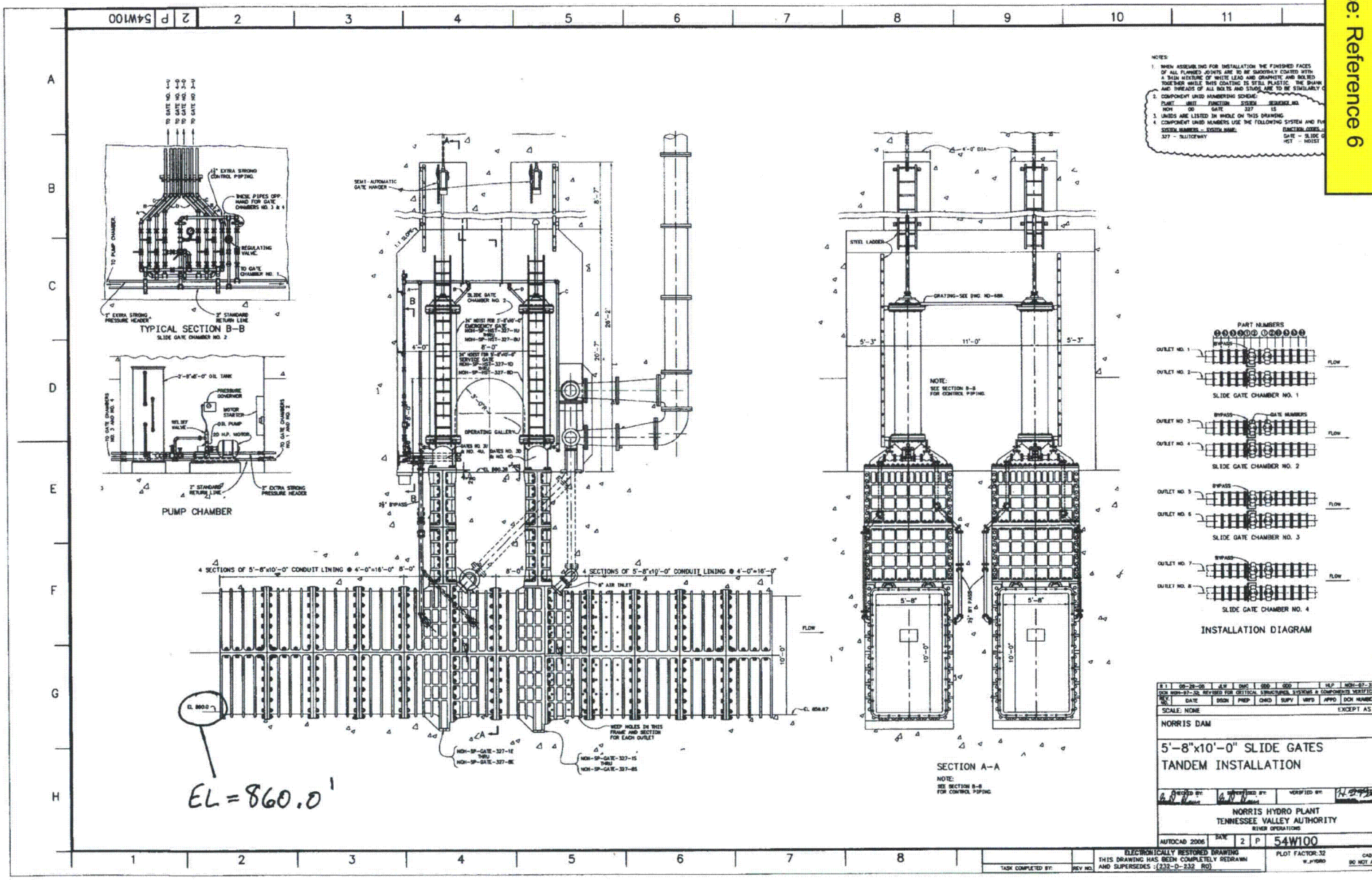
The sluice discharge tables show discharges in cubic feet per second for all sluices set at identical openings, except for openings greater than 9.4 feet as noted on each page. Gate opening positions in 0.1 foot increments are listed in the left and right columns. Headwater elevations for each foot of headwater elevation are shown at the top of each column. The headwater range is shown at the bottom of each page.

Discharges are recorded to the nearest 10 cubic feet per second since the accuracy of the field measurements does not warrant greater refinement. For this reason, there should be no interpolation between values given in these tables.

6. Use of Tables

The use of the tables is best illustrated by examples.

Example 1 -- With the headwater elevation at 991.52 feet what sluice gate settings are necessary to pass 19,000 cubic feet per second? The headwater elevation closest to 991.52 feet is 992 feet, which is found on pages 58 and 59. In the column headed 992 the discharge closest to 19,000 cubic feet per second is 19,120 cubic feet per second,


TYPICAL SECTION B-B
SLIDE GATE CHAMBER NO. 2
PUMP CHAMBER
SECTION A-A
NOTE:
SEE SECTION B-B FOR CONTROL PIPING
4 SECTIONS OF 5'-8"x10'-0" CONDUIT LINING @ 4'-0"=16'-0"
OPERATING GALLERY
STEEL LADDER
GRATING-SEE DWG. NO-688
PART NUMBERS
SLIDE GATE CHAMBER NO. 1
SLIDE GATE CHAMBER NO. 2
SLIDE GATE CHAMBER NO. 3
SLIDE GATE CHAMBER NO. 4
INSTALLATION DIAGRAM
EL=860.0'
NORRIS DAM
5'-8"x10'-0" SLIDE GATES
TANDEM INSTALLATION
NORRIS HYDRO PLANT
TENNESSEE VALLEY AUTHORITY
RIVER OPERATIONS
AUTOCAD 2006
54W100
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES :(232-D-232 R0)
PLOT FACTOR:32

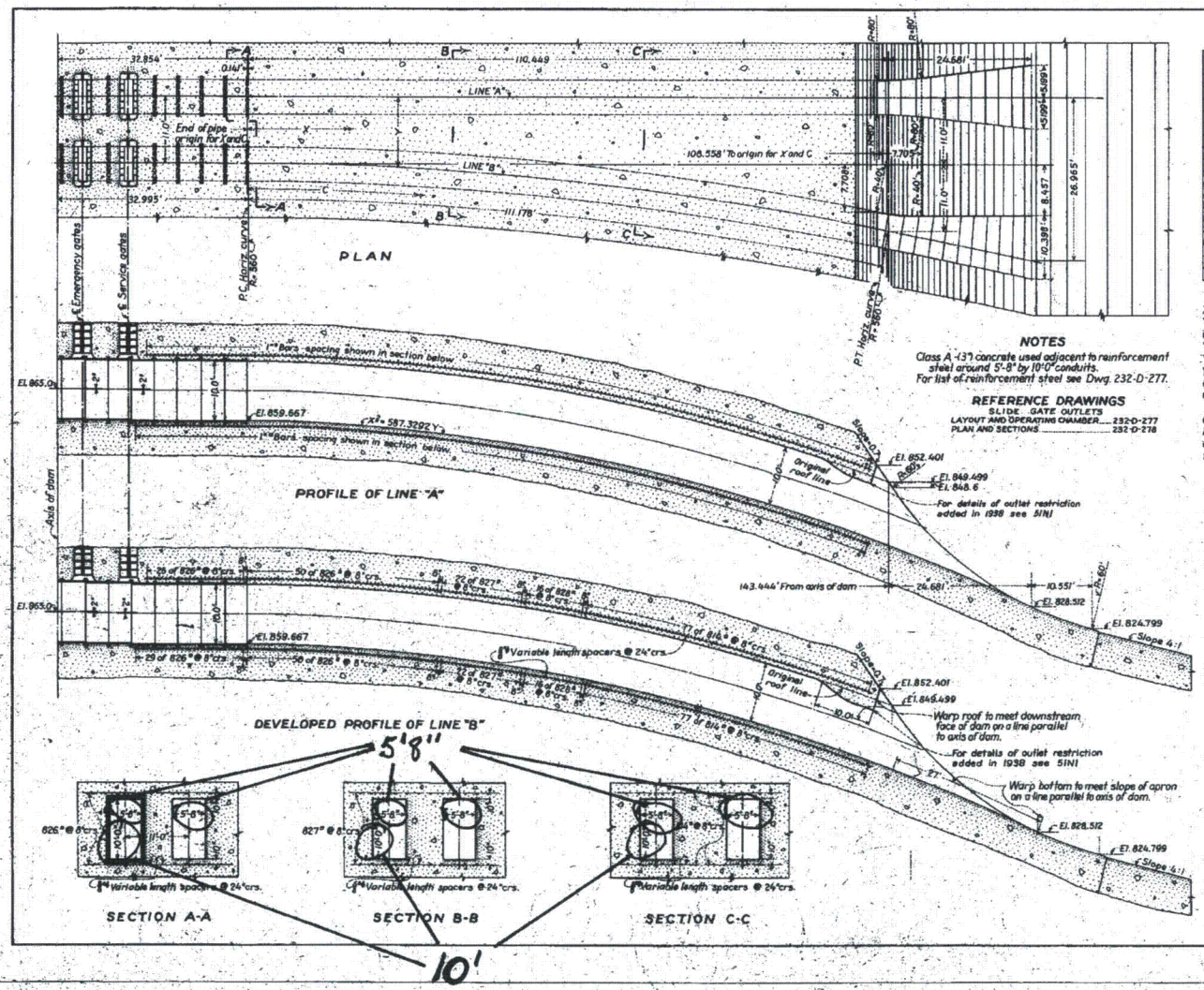


TABLE OF COORDINATES

X	Elevation of Invert ℄	Y	C	
0	859.667	11.000	0.000	
0.141	859.667	11.000	0.141	P.C. on horizontal curve (Line "B")
10.	859.496	11.087	10.001	
20.	858.986	11.352	20.004	
30.	858.134	11.797	30.014	
40.	856.943	12.420	40.034	
50.	855.410	13.224	50.066	
60.	853.537	14.208	60.115	
70.	851.324	15.375	70.182	
80.	848.770	16.724	80.273	
90.	845.876	18.257	90.390	
100.	842.641	19.975	100.537	
110	839.065	21.882	110.717	
110.590	838.843	22.000	111.319	
120	835.149	23.893	120.917	P.T. on horizontal curve (Line "B")
130	830.892	25.905	131.118	
135.271	828.512	26.965	136.494	

EXPLANATION OF TABLE

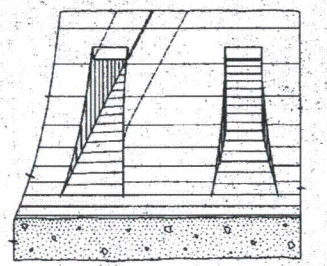
X is measured along Line "A" with origin at end of pipe
Y is measured normal to Line "A".
C is measured along Line "B" with origin at end of pipe.
Y = 11.00' from x = 0 to x = 0.141'
Y = 571.1/(313.600 - (x - 0.141)²) from x = 0.141' to x = 110.590'.
Y = 22.000 + (x - 110.590) tan. 11°22'30.20" from x = 110.590' to x = 135.271'
C = x from x = 0 to x = 0.141
C = 9.773842 (sin⁻¹ (x - 0.141)/560) + 0.141 from x = 0.141 to x = 110.590 where angle is in degrees and decimal of a degree
C = 111.319 + (x - 110.590)/cos. 11°22'30.20" from x = 110.590 to x = 135.271.
Elevation of invert ℄ = 859.667 - (x²/587.3292)
cos. 11°22'30.20" = 0.98035714
tan. 11°22'30.20" = 0.20118235

NOTES

Class A-(3") concrete used adjacent to reinforcement steel around 5'-8" by 10'-0" conduits.
For list of reinforcement steel see Dwg. 232-D-277.

REFERENCE DRAWINGS

SLIDE GATE OUTLETS
LAYOUT AND OPERATING CHAMBER 232-D-277
PLAN AND SECTIONS 232-D-278



ELEVATION
END OF SLIDE GATE OUTLETS

UNITED STATES
TENNESSEE VALLEY AUTHORITY
CLINCH RIVER PROJECT

NORRIS DAM

SLIDE GATE OUTLETS
CONDUIT PLAN AND PROFILES

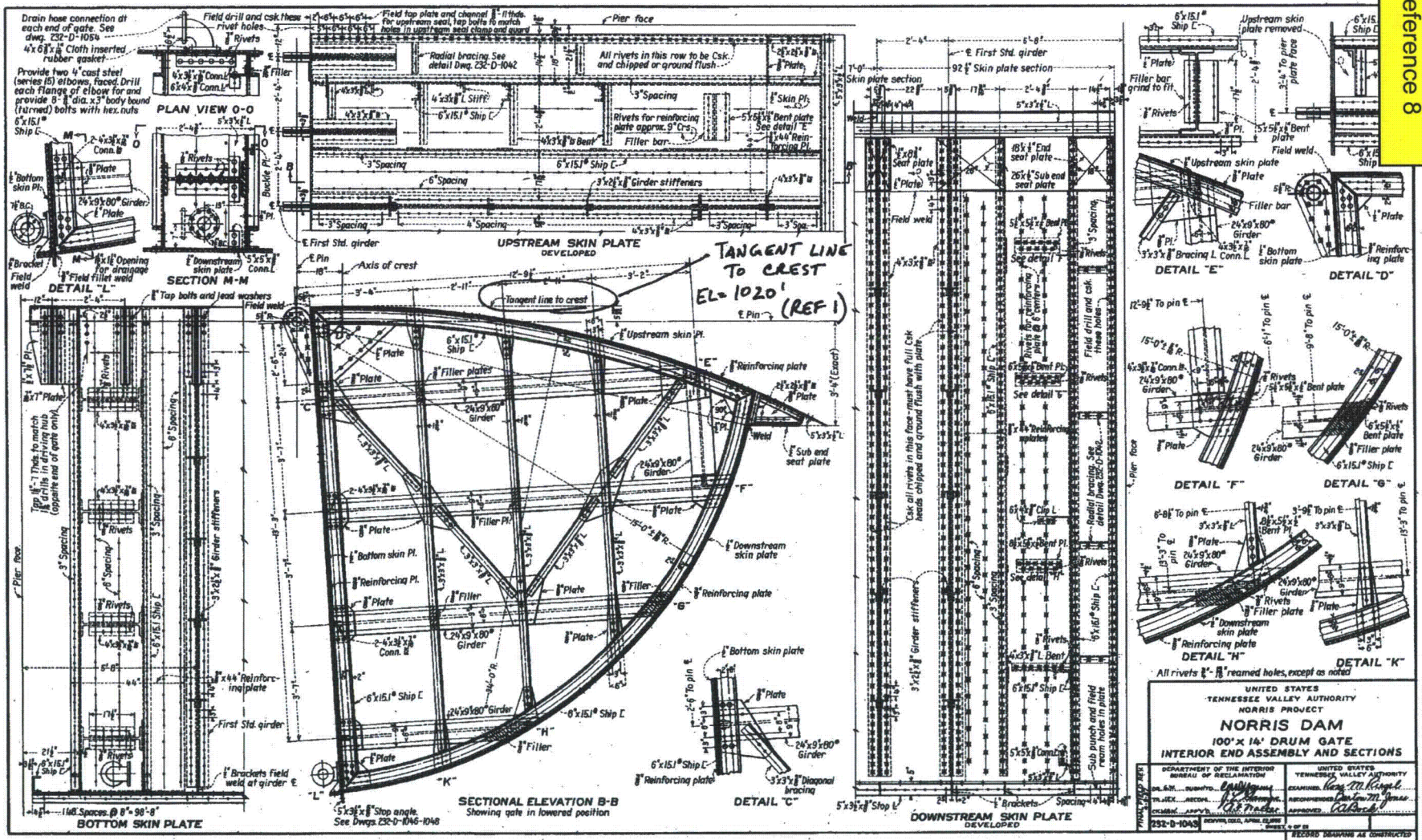
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. J.E.A. SUBMIT'D. [signature]
TR. [signature] RECOM. [signature]
CHK. [signature] APP'VD. [signature]
232-D-395 DENVER, COLO. JULY 31, 1934

UNITED STATES
TENNESSEE VALLEY AUTHORITY
EXAMINED [signature]
RECOMMENDED [signature]
APPROVED [signature]
RECORD DRAWING AS CONSTRUCTED
[signature] 1942

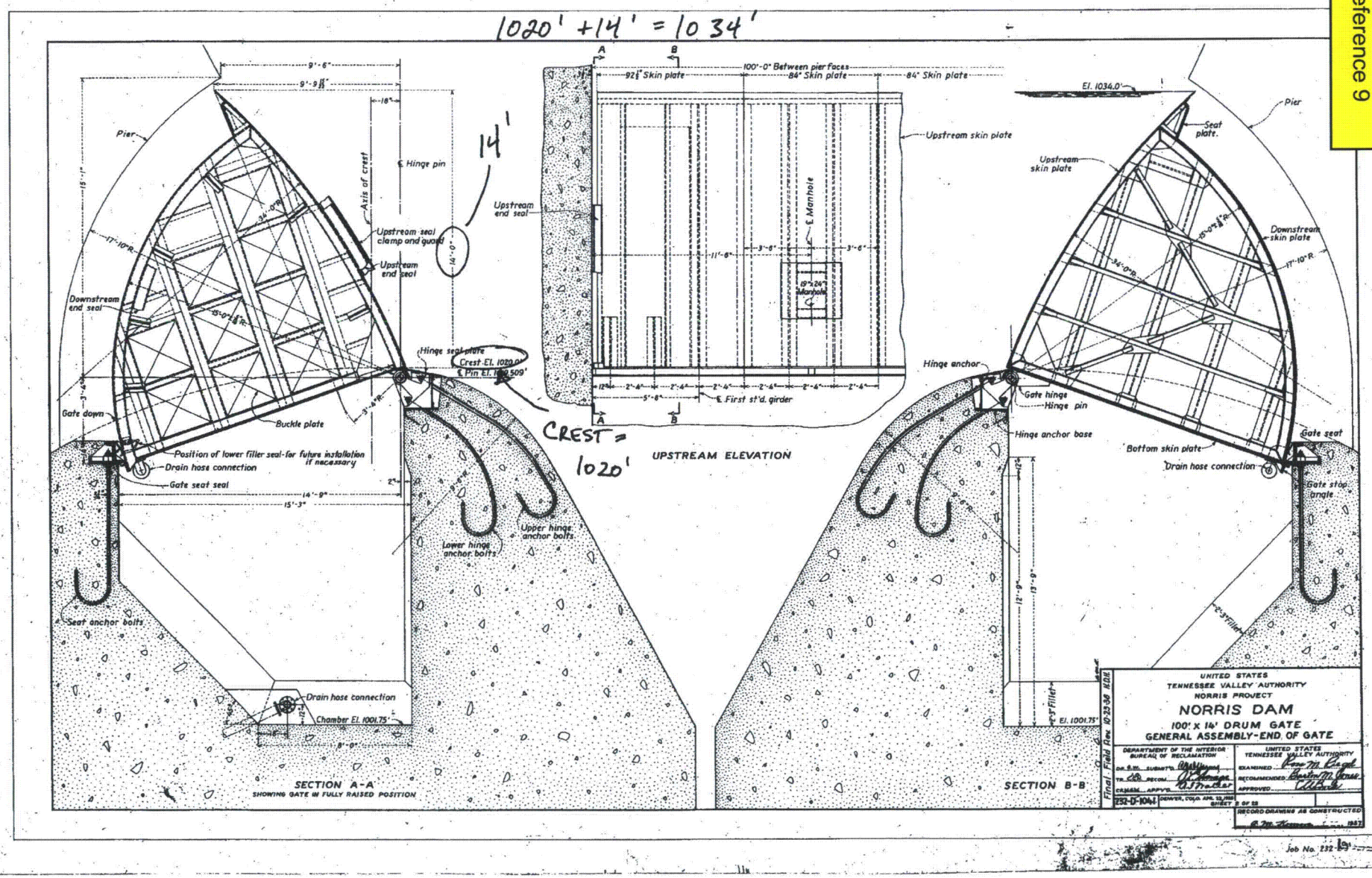
FINAL FIELD REV. 3-11-46, L.B.L.

Slide Gate Outlets
Conduit Plan & Prof.

Attachment 8
Source: Reference 8



Calculation No: CDQ0000200800015
Page 36


1020' + 14' = 1034'
14'
CREST = 1020'
UPSTREAM ELEVATION
SECTION A-A
SHOWING GATE IN FULLY RAISED POSITION
SECTION B-B
Pier
Axis of crest
℄ Hinge pin
Upstream seal clamp and guard
Upstream end seal
Downstream end seal
Hinge seal plate
Crest El. 1020.0'
Gate down
Buckle plate
Position of lower filler seal-for future installation if necessary
Drain hose connection
Gate seat seal
Lower hinge anchor bolts
Upper hinge anchor bolts
Seat anchor bolts
Chamber El. 1001.75'
100'-0" Between pier faces
92½" Skin plate
84" Skin plate
Upstream skin plate
℄ Manhole
℄ First st'd. girder
El. 1034.0'
Seat plate
Downstream skin plate
Hinge anchor
Gate hinge
Hinge pin
Hinge anchor base
Bottom skin plate
Gate seat
Gate stop angle
UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT
NORRIS DAM
100' x 14' DRUM GATE
GENERAL ASSEMBLY-END OF GATE
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
UNITED STATES
TENNESSEE VALLEY AUTHORITY
RECORD DRAWING AS CONSTRUCTED
Job No. 232-

Calculation No: CDQ0000200800015
Page 38

Attachment 10
Source: Reference 10

TABLE NO. 5

NORRIS DAM SPILLWAY

Discharge Table Computed from the Formula $Q = KLH^n$

Discharge Q for all Three Gates at the same Elevation.

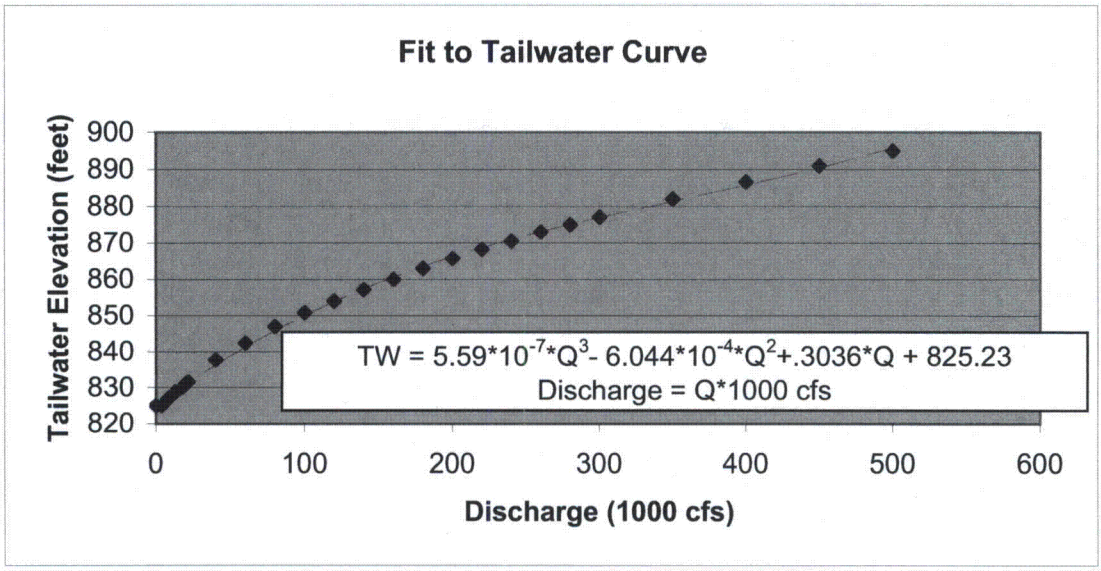
Head over Gates in Feet	Gate El. 1020 (n=1.6173, K_p=2.5680, K_pL=770.4) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1021 (n = 1.6081, K_p = 2.6170, K_pL= 785.1) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1022 (n = 1.5972, K_p = 2.6960, K_pL= 808.8) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1023 (n = 1.5843, K_p = 2.8090, K_pL= 842.7) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1024 (n = 1.5660, K_p = 3.0020, K_pL= 900.6) Quantity in c.f.s.	El. Reservoir Water Surface
1	770	1021	785	1022	809	1023	843	1024	901	1025
2	2,364	1022	2,393	1023	2,447	1024	2,527	1025	2,667	1026
3	4,554	1023	4,594	1024	4,676	1025	4,804	1026	5 032	1027
4	7,252	1024	7,296	1025	7,404	1026	7,577	1027	7,895	1028
5	10,974	1025	14,005	1027	14,148	1028	14,404	1029	14,898	1030
8	22,248	1028	22,243	1029	22,400	1030	22,722	1031	23,376	1032
10	31,917	1030	31,844	1031	31,992	1032	32,367	1033	33,154	1034
12	42,862	1032	42,693	1033	42,806	1034	43,193	1035	44,109	1036
14	54,999	1034	54,704	1035	54,757	1036	55,143	1037	56,153	1038
15	68,256	1036	67,806	1037	67,774	1038	68,133	1039	69,213	1040
20	97,918	1040	97,076	1041	96,794	1042	97,027	1043	98,163	1044
24	131,507	1044	130,149	1045	129,512	1046	129,521	1047	130,596	1048
28	168,741	1048	166,764	1049	165,671	1050	165,352	1051	166,260	1052
32	209,410	1052	206,708	1053	205,053	1054	204 307	1055	-	-
36	253,346	1056	-	-	-	-	-	-	-	-

Head over Gates in Feet	Gate El. 1025 (n = 1.5485, K_p = 3.2200, K_pL= 966.0) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1026 (n = 1.5350, K_p = 3.4100, K_pL= 1023.0) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1027 (n = 1.5240, K_p = 3.5740, K_pL= 1072.2) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1028 (n = 1.515, K_p = 3.704, K_pL= 1111.2) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1029 (n = 1.508, K_p = 3.796, K_pL= 1138.8) Quantity in c.f.s.	El. Reservoir Water Surface
1	966	1026	1,023	1027	1,072	1028	1,111	1029	1,139	1030
2	2,826	1027	2,965	1028	3,084	1029	3,176	1030	3,239	1031
3	5,294	1028	5,524	1029	5,720	1030	5,870	1031	5,970	1032
4	8,266	1029	8,591	1030	8,868	1031	9,076	1032	9,212	1033
6	15,486	1031	16,008	1032	16,450	1033	16,776	1034	16,978	1035
8	24,178	1033	24,895	1034	25 503	1035	25,940	1036	26,200	1037
10	34,157	1035	35,065	1036	35,832	1037	36,374	1038	36,682	1039
12	45,299	1037	46,389	1038	47,309	1039	47,946	1040	48,289	1041
14	57,512	1039	58,774	1040	59,838	1041	60,559	1042	60,927	1043
16	70,722	1041	72,144	1042	73,342	1043	74,137	1044	74,518	1045
20	99,913	1045	101,615	1046	103,050	1047	103,957	1048	104,328	1049
24	132,505	1049	134,430	1050	136,056	1051	137,029	1052	137,342	1053
28	168,230	1053	170,320	1054	172,079	1055	-	-	-	-

Head over Gates in Feet	Gate El. 1030 (n = 1.502, K_p = 3.865, K_pL= 1159.5) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1031 (n = 1.4972, K_p = 3.918, K_pL= 1175.4) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1032 (n = 1.493, K_p = 3.951, K_pL = 1185.3) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1033 (n = 1.4893, K_p = 3.972, K_pL = 1191.6) Quantity in c.f.s.	El. Reservoir Water Surface	Gate El. 1034 (n = 1.486, K_p = 3.985, K_pL= 1195.5) Quantity in c.f.s.	El. Reservoir Water Surface
1	1,160	1031	1,175	1032	1,185	1033	1,192	1034	1,196	1035
2	3,284	1032	3,318	1033	3,336	1034	3,345	1035	3,349	1036
3	6,038	1033	6,089	1034	6,112	1035	6,119	1036	6,117	1037
4	9,302	1034	9,367	1035	9,391	1036	9,392	1037	9,380	1038
6	17,102	1036	17,188	1037	17,203	1038	17,180	1039	17,135	1040
8	26,346	1038	26,442	1039	26,433	1040	26,370	1041	26,275	1042
10	36,836	1040	36,931	1041	36,883	1042	36,765	1043	36,606	1044
12	48,439	1042	48,522	1043	48,422	1044	48,234	1045	47,997	1046
14	61,060	1044	61,118	1045	60,954	1046	60,682	1047	60,353	1048
16	74,621	1046	74,644	1047	74,401	1048	74,033	1049	73,599	1050
20	104,332	1050	104,282	1051	103,817	1052	103,218	1053	102,537	1054
24	137,198	1054	136,973	1055	-	-	-	-	-	-

Riverware Rating

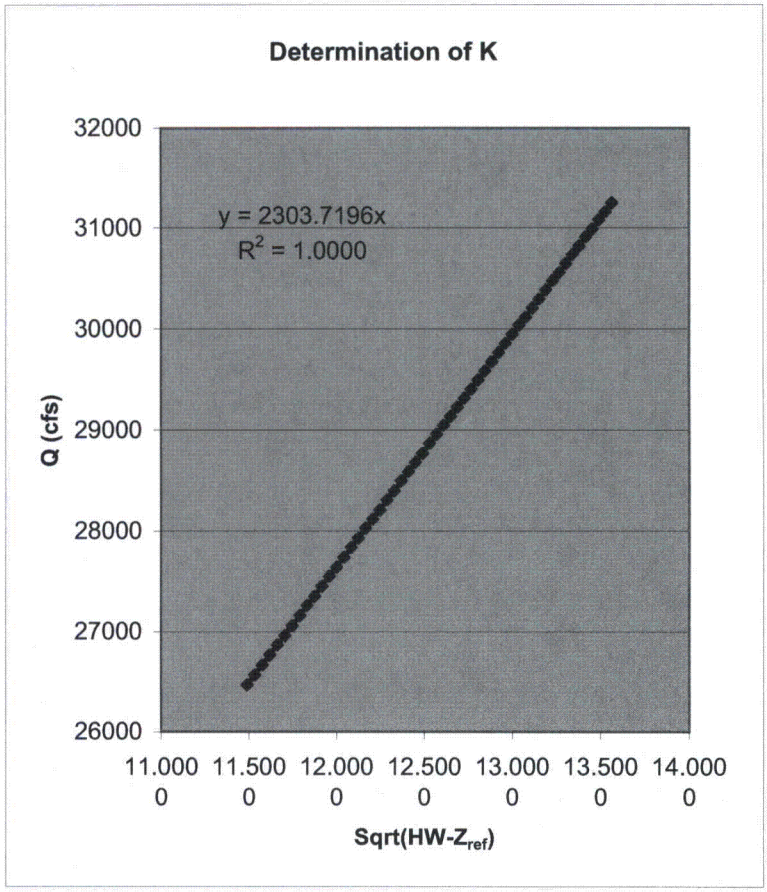
Q*1000	Q	Elevation	Elevation (fit)
0	0	825.1	825.2
3.7	3,700	825.1	826.3
8	8,000	826.95	827.6
13.1	13,100	828.95	829.1
18.1	18,100	830.35	830.5
21.4	21,400	831.7	831.5
40	40,000	837.8	836.4
60	60,000	842.5	841.4
80	80,000	847	845.9
100	100,000	850.8	850.1
120	120,000	854	853.9
140	140,000	857.2	857.4
160	160,000	860	860.6
180	180,000	863	863.6
200	200,000	865.7	866.2
220	220,000	868.2	868.7
240	240,000	870.5	871.0
260	260,000	873	873.1
280	280,000	875	875.1
300	300,000	877.1	877.0
350	350,000	882	881.4
400	400,000	886.6	885.7
450	450,000	891	890.4
500	500,000	895	895.8

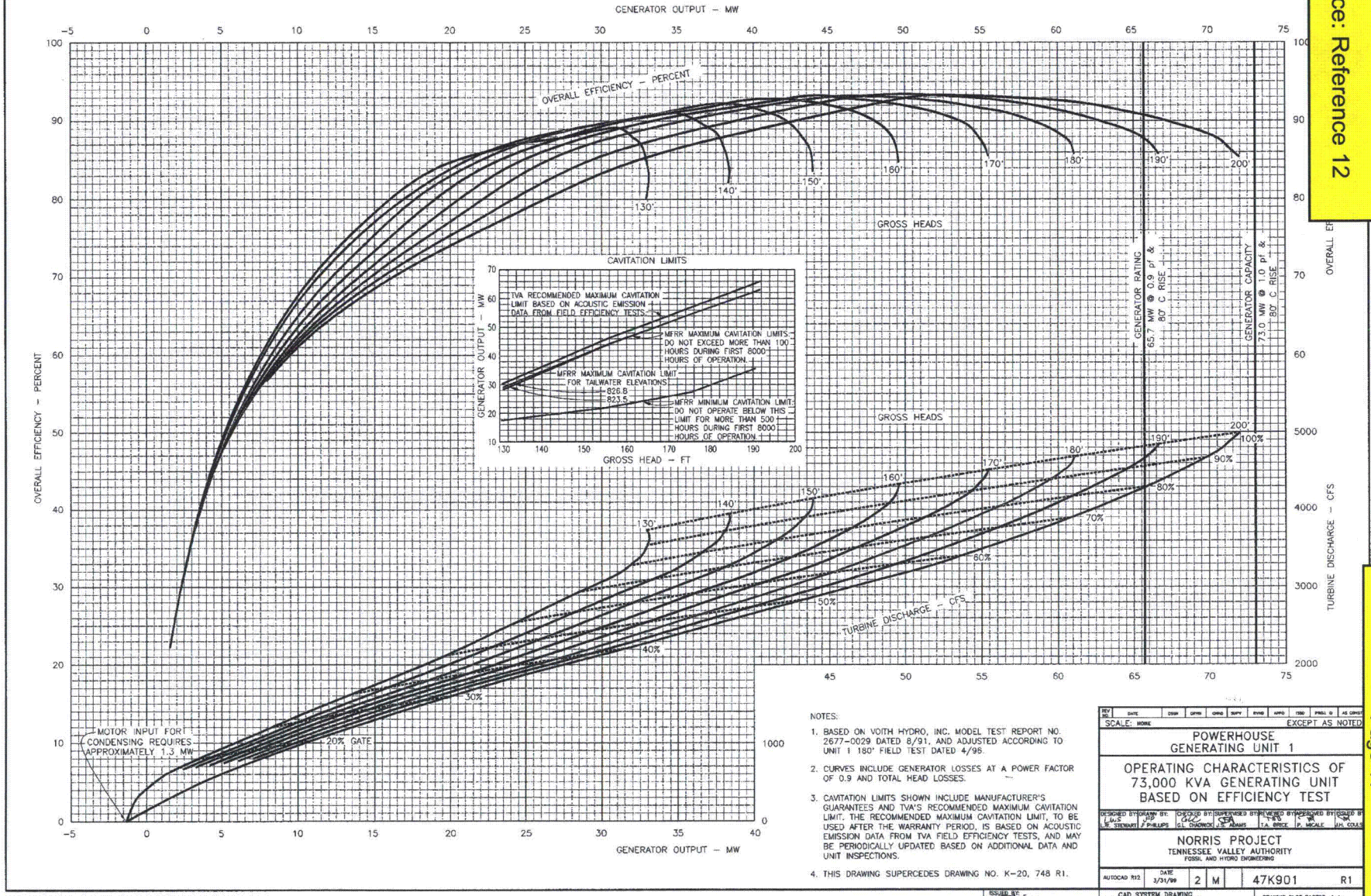


Norris Dam
Sluice Flows
From Norris Spillway Discharge Tables

Z_{ref} = 868

HW feet	Qsluice cfs	Sqrt (Hw-Zref)
1000	26470	11.4891
1001	26570	11.5326
1002	26670	11.5758
1003	26770	11.6190
1004	26870	11.6619
1005	26960	11.7047
1006	27060	11.7473
1007	27160	11.7898
1008	27260	11.8322
1009	27350	11.8743
1010	27450	11.9164
1011	27550	11.9583
1012	27640	12.0000
1013	27740	12.0416
1014	27840	12.0830
1015	27930	12.1244
1016	28030	12.1655
1017	28120	12.2066
1018	28210	12.2474
1019	28310	12.2882
1020	28400	12.3288
1021	28500	12.3693
1022	28590	12.4097
1023	28680	12.4499
1024	28770	12.4900
1025	28870	12.5300
1026	28960	12.5698
1027	29050	12.6095
1028	29140	12.6491
1029	29230	12.6886
1030	29320	12.7279
1031	29410	12.7671
1032	29500	12.8062
1033	29590	12.8452
1034	29680	12.8841
1035	29770	12.9228
1036	29860	12.9615
1037	29950	13.0000
1038	30040	13.0384
1039	30120	13.0767
1040	30210	13.1149
1041	30300	13.1529
1042	30390	13.1909
1043	30480	13.2288
1044	30560	13.2665
1045	30650	13.3041
1046	30740	13.3417
1047	30820	13.3791
1048	30910	13.4164
1049	30990	13.4536
1050	31080	13.4907
1051	31160	13.5277
1052	31250	13.5647





NOTES:

1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2677-0029 DATED 8/91, AND ADJUSTED ACCORDING TO UNIT 1 180° FIELD TEST DATED 4/96.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K-20, 748 R1.

SCALE: NONE — EXCEPT AS NOTED

POWERHOUSE
GENERATING UNIT 1

OPERATING CHARACTERISTICS OF 73,000 KVA GENERATING UNIT BASED ON EFFICIENCY TEST

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
L.W.S L.W. STEWART	JSP J. PHILLIPS	GLC G.L. CHADWICK	JEA J.E. ADAMS	T.W.S T.A. BRICE	M P. MICALE	M J.H. COLES

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12	DATE				
	3/31/99	2	M	47K901	R1

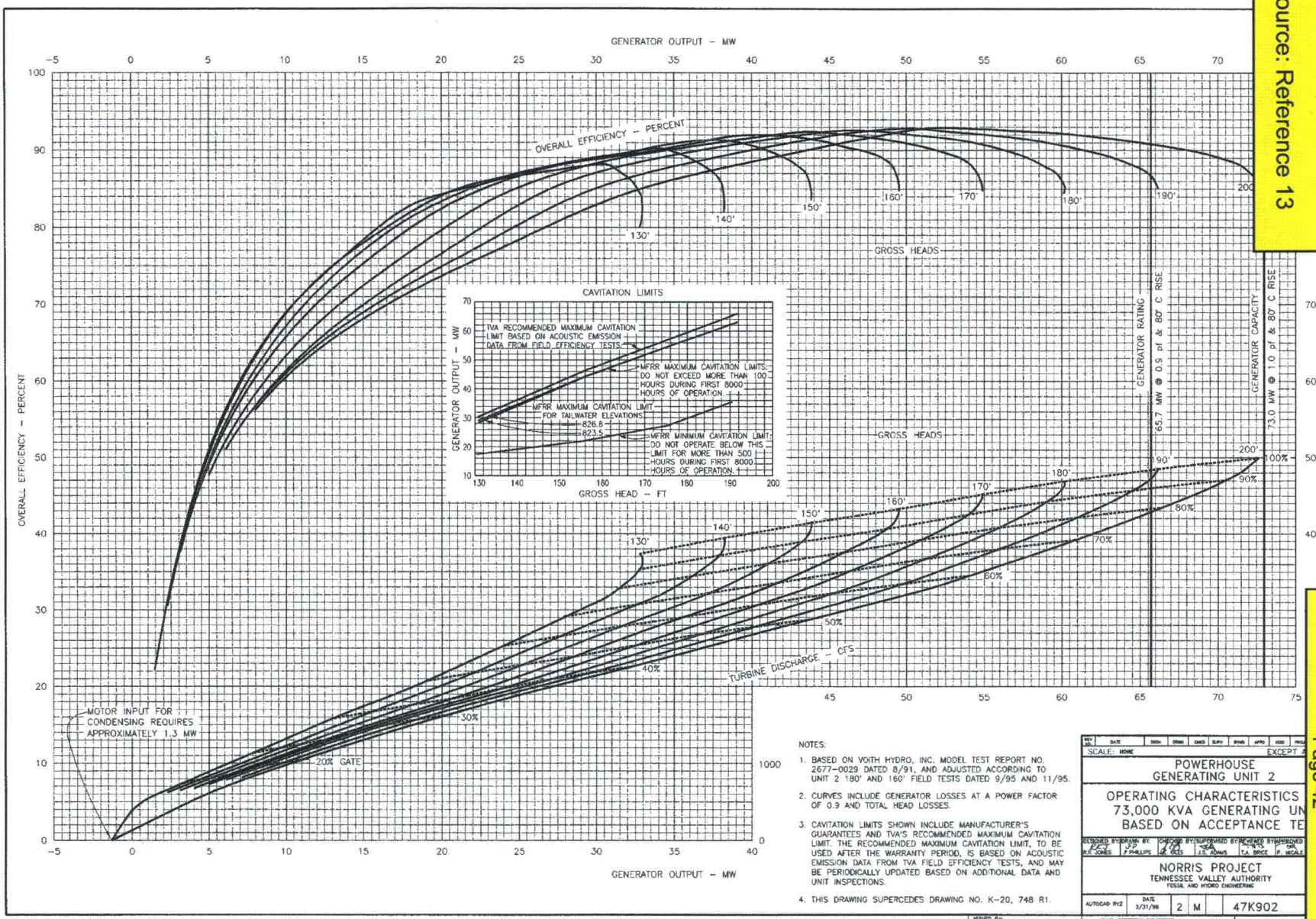
ISSUED BY: Micali

CAD SYSTEM DRAWING
DO NOT ALTER MANUALLY

DRAWING PLOT FACTOR: 1=1
INSERTED DRAWING: X=1, Y=1.13

Attachment 13a
Source: Reference 12

Calculation No: CDQ0000020080013
Page 41



NOTES:

1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2677-0029 DATED 8/91, AND ADJUSTED ACCORDING TO UNIT 2 180' AND 160' FIELD TESTS DATED 9/95 AND 11/95.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K-20, 748 R1.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJ

SCALE: NONE — EXCEPT A

POWERHOUSE
GENERATING UNIT 2

OPERATING CHARACTERISTICS
73,000 KVA GENERATING UN
BASED ON ACCEPTANCE TE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:
R.F. JONES	J.P. PHILLIPS	J.E. GEES	J.S. ADAMS	T.A. BRYCE	P. MCGLE

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12	DATE 3/31/98	2	M	47K902

ISSUED BY: [signature]

CAD SYSTEM DRAWING DO NOT ALTER MANUALLY

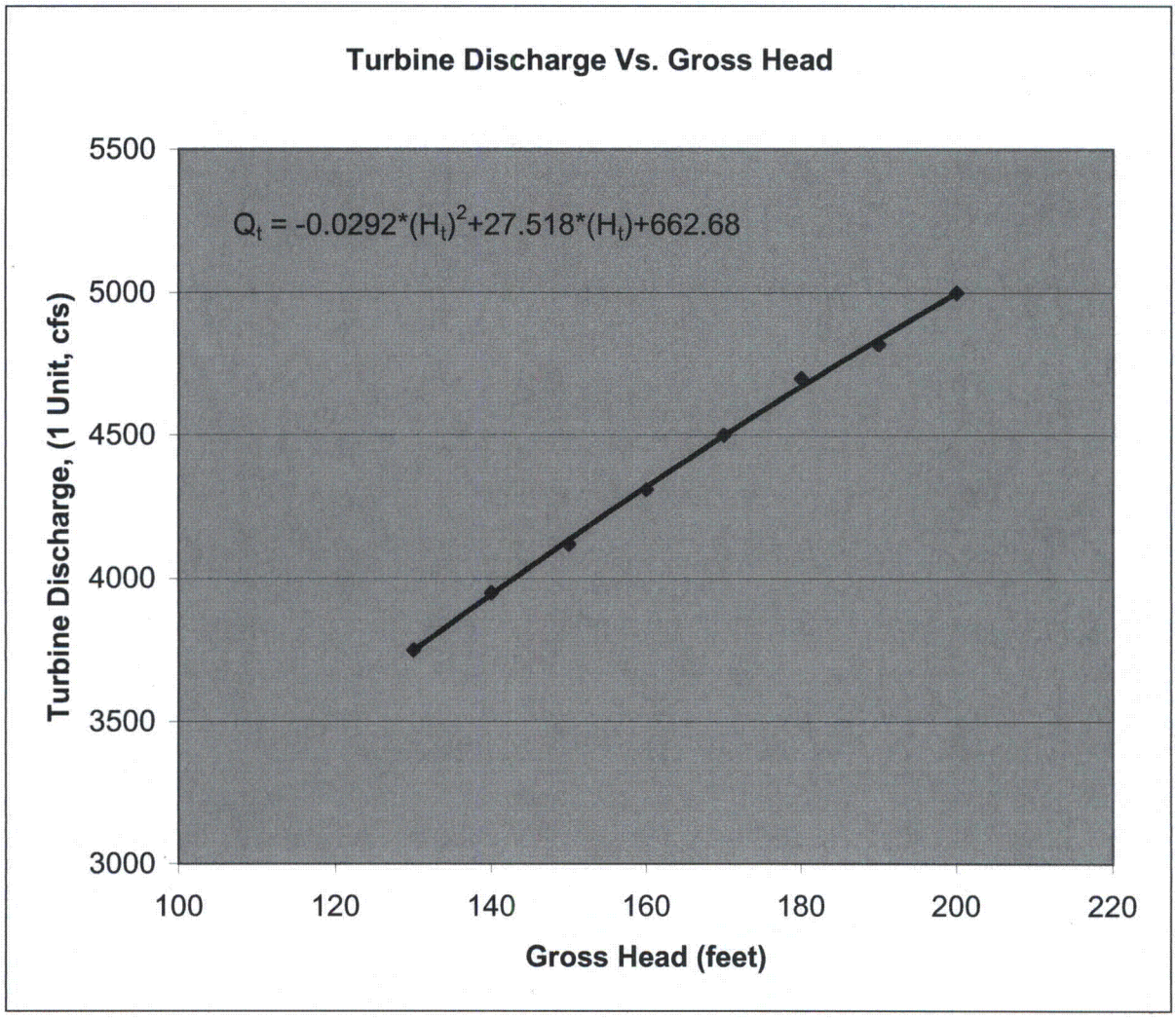
DRAWING PLOT FACTOR INSERTED DRAWING: X=

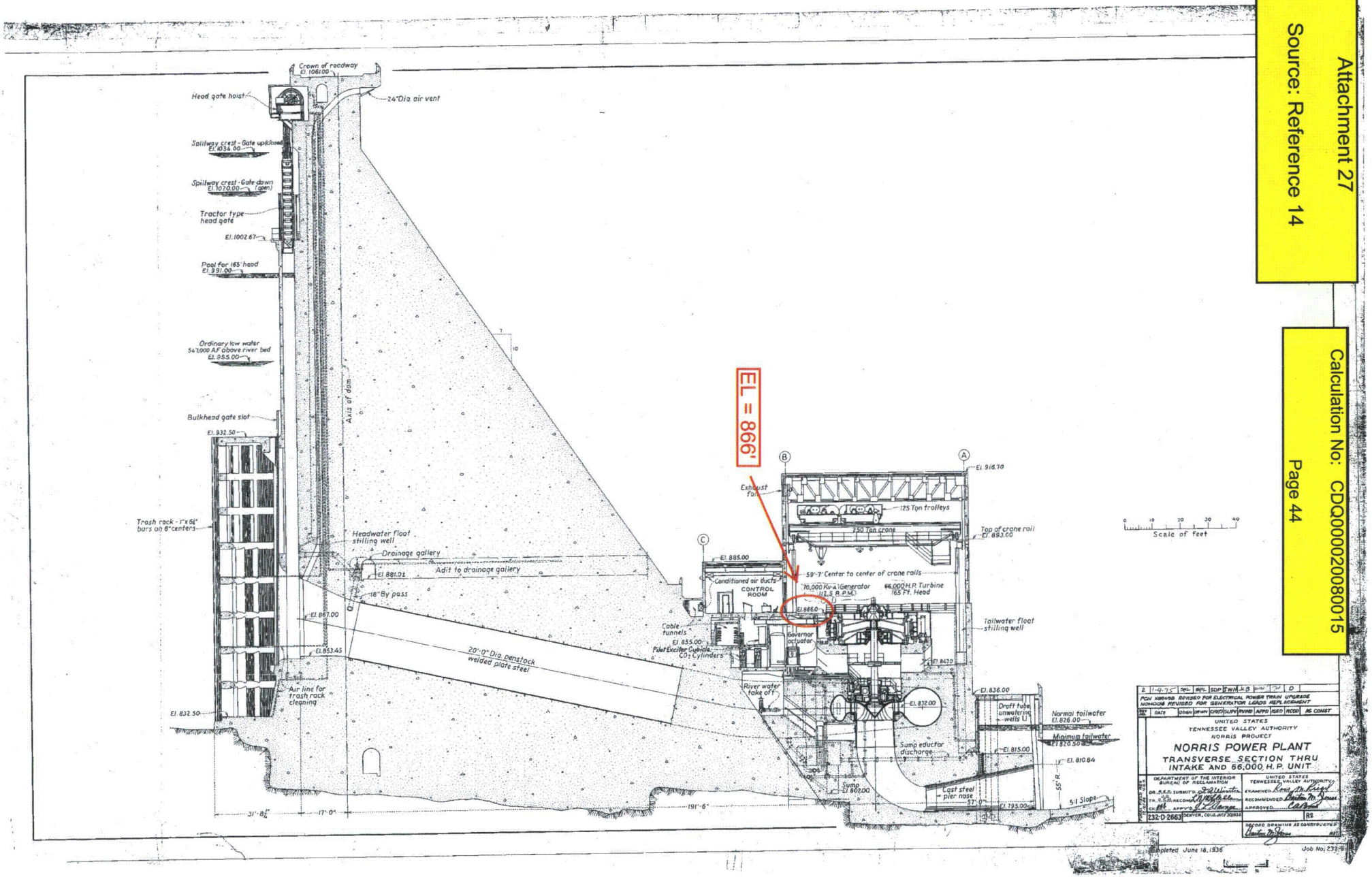
Attachment 13b
Source: Reference 13

Calculation No: CDQ0000020080015
Page 42

From Drawings
47K901 R1, and 47K902 R0
Valid for Turbines 1 and 2 (Curves are the same)

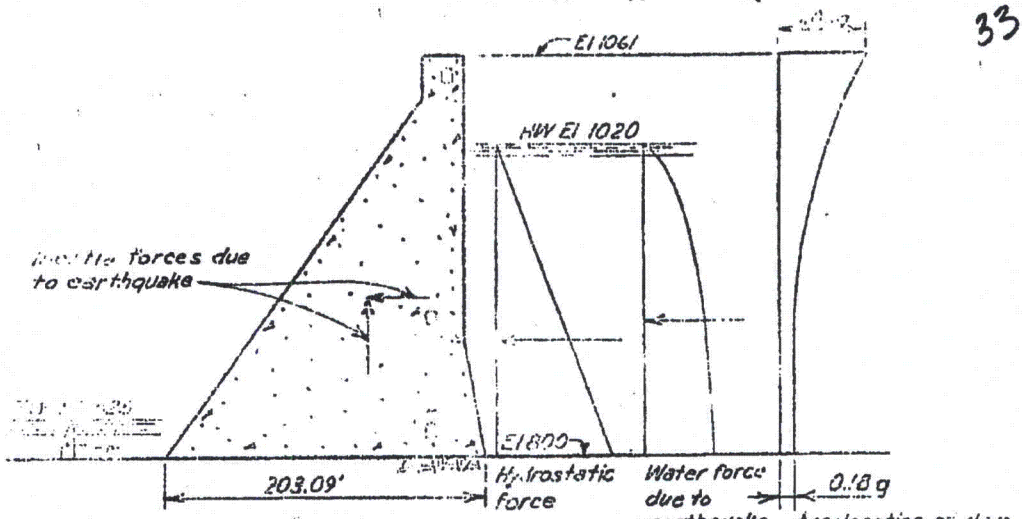
Gross Head feet	Discharge cfs	Fit
130	3750	3747
140	3950	3943
150	4120	4133
160	4310	4318
170	4500	4497
180	4700	4670
190	4820	4837
200	5000	4998




EL = 866'
Crown of roadway El. 1061.00
Head gate hoist
24"Dia. air vent
Spillway crest - Gate upclosed El. 1034.00
Spillway crest - Gate down El. 1070.00 (gen)
Tractor type head gate
El. 1002.67
Pool for 165' head El. 991.00
Ordinary low water 547,000 A.F. above river bed El. 955.00
Bulkhead gate slot
El. 932.50
Axis of dam
Trash rack - 1"x 6" bars on 6" centers
Headwater float stilling well
Drainage gallery
El. 881.01
Adit to drainage gallery
18" By pass
El. 867.00
El. 853.45
20'-0" Dia. Penstock welded plate steel
Air line for trash rack cleaning
El. 832.50
31'-8 1/4"
17'-0"
191'-6"
Exhaust fan
El. 916.70
125 Ton trolleys
750 Ton crane
Top of crane rail El. 883.00
El. 885.00
59'-7" Center to center of crane rails
Conditioned air ducts
CONTROL ROOM
70,000 Kv-A Generator 112.5 R.P.M.
66,000 H.P. Turbine 165 Ft. Head
El. 866.0
Cable tunnels
El. 855.00
Pilot Exciter Cubicle
CO2 Cylinders
Governor actuator
El. 847.0
Tailwater float stilling well
River water take off
El. 836.00
El. 832.00
Draft tube unwatering wells (3)
Normal tailwater El. 826.00
Minimum tailwater El. 820.50
Sump eductor discharge
El. 815.00
El. 810.84
Sump El. 802.00
Cast steel pier nose
57'-0"
El. 795.00
55' R.
5:1 Slope
0 10 20 30 40
Scale of feet
2 1-4-75 SKL SPL SDP EWH JLB WHW JW D
PCN X86498 REVISED FOR ELECTRICAL POWER TRAIN UPGRADE
NON-CON REVISED FOR GENERATOR LEADS REPLACEMENT
NO. DATE DRAWN CHKD SUPV REVWD APPD ISSD RCDD AS CONST
UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT
NORRIS POWER PLANT
TRANSVERSE SECTION THRU INTAKE AND 66,000 H.P. UNIT
DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION
DR. D.E.D. SUBMITTED
TR. C.S.B. RECOMMENDED
APPROVED
232-D-2663
DENVER, COLO. JULY 30, 1935
UNITED STATES TENNESSEE VALLEY AUTHORITY
EXAMINED
RECOMMENDED
APPROVED
RECORD DRAWING AS CONSTRUCTED
Completed June 18, 1936
Job No. 232-8

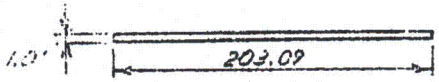
HEPE5NOHSON.WBNBLNBEN EXHIBIT 1

33

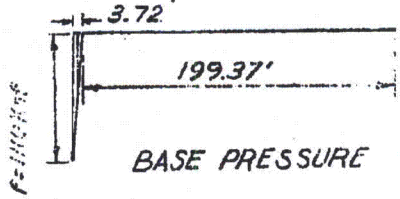


TYPICAL ABUTMENT SECTION

UPLIFT DIAGRAM EL 800
UPLIFT PRESSURE ASSUMED TO ACT ON 100 % OF BASE AREA



BASE PLAN AT EL 800



BASE PRESSURE

NOTES:
1. Vertical acceleration of dam due to earthquake assumed to be 0.12g.
2. Horizontal acceleration of bedrock assumed to be 0.18g. A dynamic analysis was run to determine amplification of bedrock acceleration due to height of dam. This analysis showed variation in acceleration from 0.18g at bedrock to 1.00g at top.
3. Results shown are based on static analysis as given in ENGINEERING FOR DAMS by Hinds, Creager & Justin, pp 279-286.

V_R	H_R	$\frac{H_R}{V_R}$	Avg Shear, S	S Reqd For Q=1 *	f_{max}	$FS=\frac{\Sigma M_R}{\Sigma M_{ot}}$
2010K	2857K	1.4	14 Ksf (97 psi)	7.4 Ksf (51.0 psi)	1110 Ksf (7700 psi)	1.005

* Shears, that is reqd for Q=1 is calculated from shear-friction formula, $Q=\frac{0.65 V_R + SA}{H_R}$. A is assumed to be entire area.

Scale 1"=100'

ABUTMENT SECTION

RESULTS OF ANALYSIS FOR DESIGN BASIS EARTHQUAKE

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

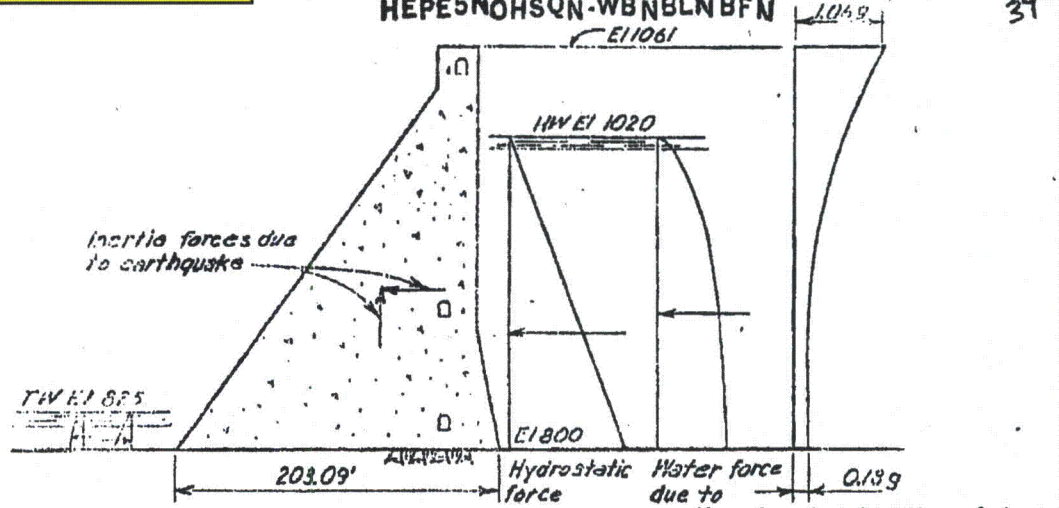
SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE

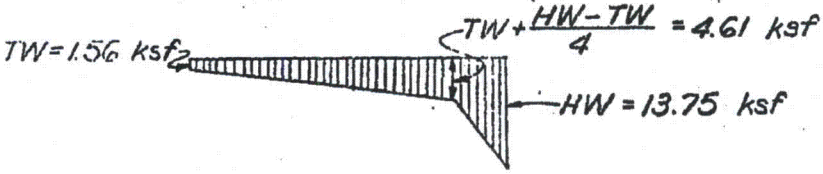
EXHIBIT 2

HEPE5NOHSQN-WBNBLNBFN

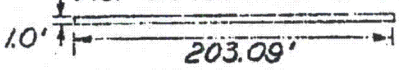
34



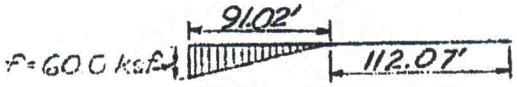
TYPICAL ABUTMENT SECTION



UPLIFT DIAGRAM EL 800**
Uplift Pressure Assumed to Act on 100% of Base Area



BASE PLAN AT EL 800



BASE PRESSURES

See Exhibit I for Notes

V_R	H_R	$\frac{H_R}{V_R}$	Avg. Shear, S	S Reqd. for Q=1*	f max	$FS=\frac{\Sigma M_R}{\Sigma M_{or}}$
1.40	28.50	1.04	14 ksf (97 psi)	5.2 ksf (36 psi)	60 ksf (416 psi)	1.185

*Shear, S, that is reqd for Q=1 is calculated from shear-friction, $Q=\frac{0.65\ V_R+SA}{H_R}$. A is assumed to be entire base area.

**Assumed uplift diagram for drained base.

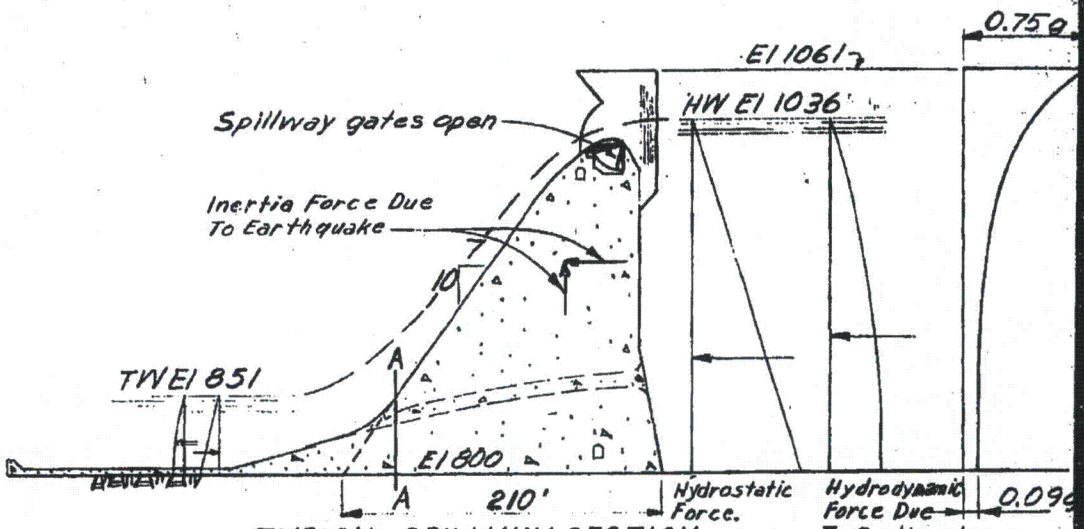
Scale 1"=100'

ABUTMENT SECTION
RESULT OF ANALYSIS FOR DESIGN BASIS EARTHQUAKE ASSUMING UPLIFT RELIEF DRAINS

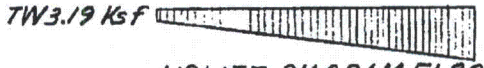
NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED | RECOMMENDED | APPROVED

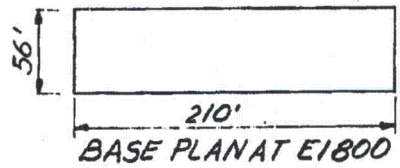
KNOXVILLE



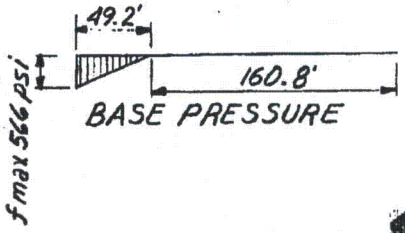
TYPICAL SPILLWAY SECTION



UPLIFT DIAGRAM El 800
UPLIFT PRESSURE ASSUMED
TO ACT ON 100 % OF BASE AREA



BASE PLAN AT El 800



BASE PRESSURE

* Shears, that is reqd
calculated from shea
formula, $Q = \frac{0.65 \Sigma V}{\Sigma H}$

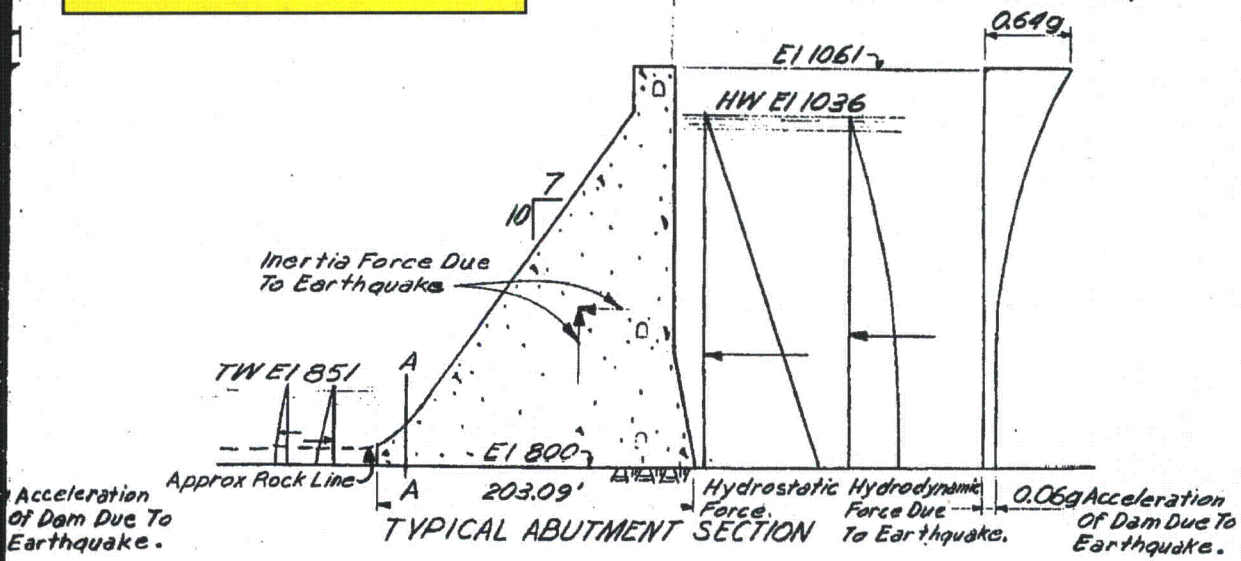
** assumed to be en
Shears, reqd for
considering portio
compression (no te
of entire base area

ΣV	ΣH	ΣH/ΣV	Avg Shears	S Reqd For Q=1	f max	FS=ΣMR/ΣMo	Vertical Shear on plane A-A
112,616 K	143,587 K	1.28	85 psi (entire base)	42 psi* (177 psi)**	566 psi	1.25	247 psi

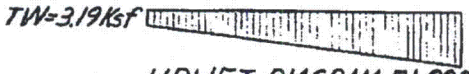
ΣV
2101

1443

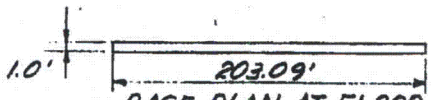
HEPE5NOHSQN-WBNBLNBFN



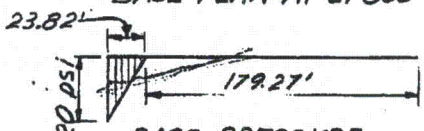
TYPICAL ABUTMENT SECTION



UPLIFT DIAGRAM El 800
UPLIFT PRESSURE ASSUMED
TO ACT ON 100 % OF BASE AREA



BASE PLAN AT El 800



BASE PRESSURE

NOTES:

1. Vertical acceleration of abutment and spillway at base assumed to be 0.06g. By dynamic analysis, amplification of acceleration above the base was determined to be 0.14g at the top for the abutment section and 0.14g at the top for the spillway.
2. Horizontal acceleration of abutment and spillway at base assumed to be 0.09g. By dynamic analysis, amplification of acceleration above the base was determined to be 0.64g at the top for the abutment section and 0.75g at the top for the spillway.
3. Spillway gates assumed open for this analysis.

for Q=1 is
r-friction
SA, A is
tire area.
Q=1
of base in
sion), instead

3

Scale 1"=100'

	ΣH	ΣH/ΣV	Avg Shear, s	S Reqd For Q=1	f max	FS=ΣMr/ΣMo	Vertical Shear on plane A-A
K	2786K	1.33	95 psi (entire base)	49 psi* (415psi)**	1220 psi	1.03	535 psi

SPILLWAY & ABUTMENT

RESULTS OF ANALYSIS FOR OPERATING BASE EARTHQUAKE

NORRIS DAM
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE

Attachment 30
Source: References 18

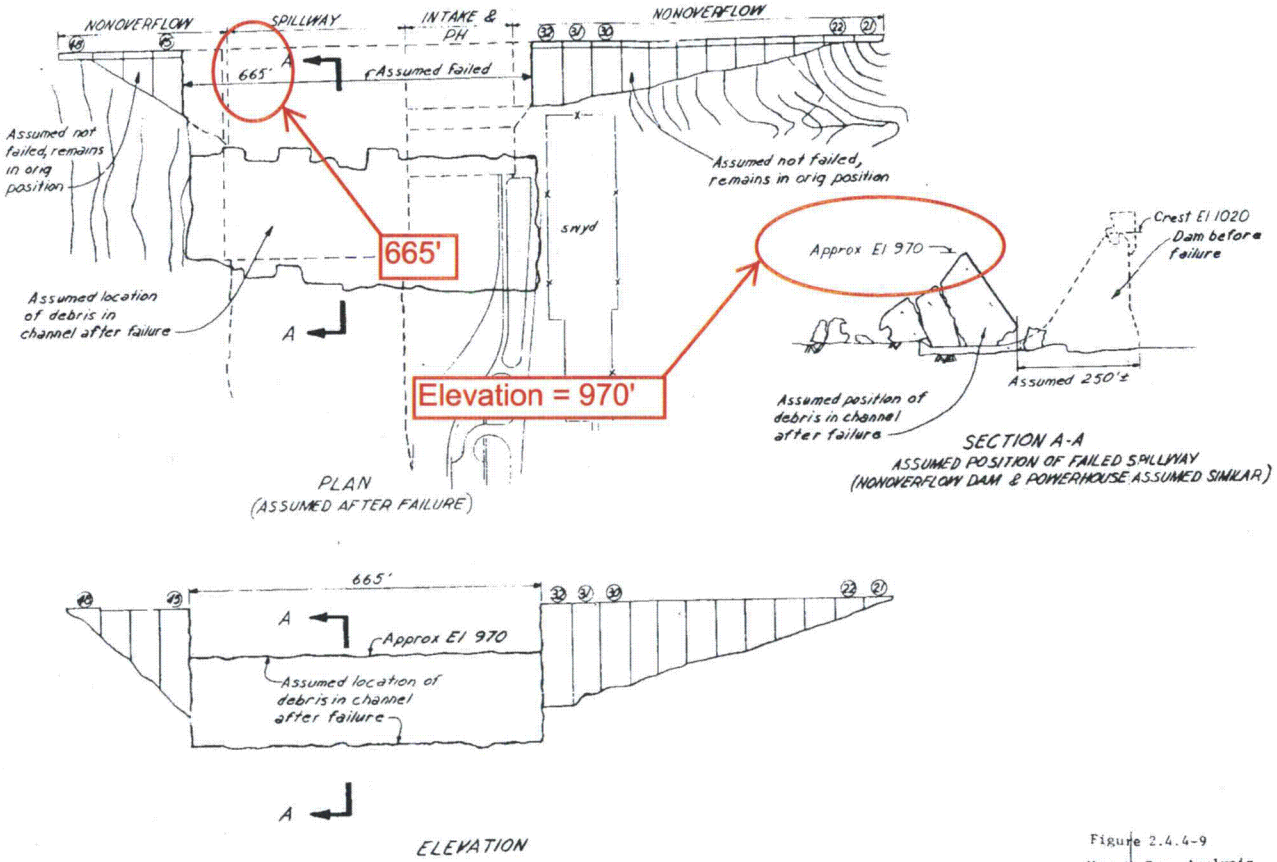


Figure 2.4.4-9
Norris Dam, Analysis for 1/2 SSE & One Half Maximum Possible Flood

Calculation No: CDQ0000200800 15
Page 49

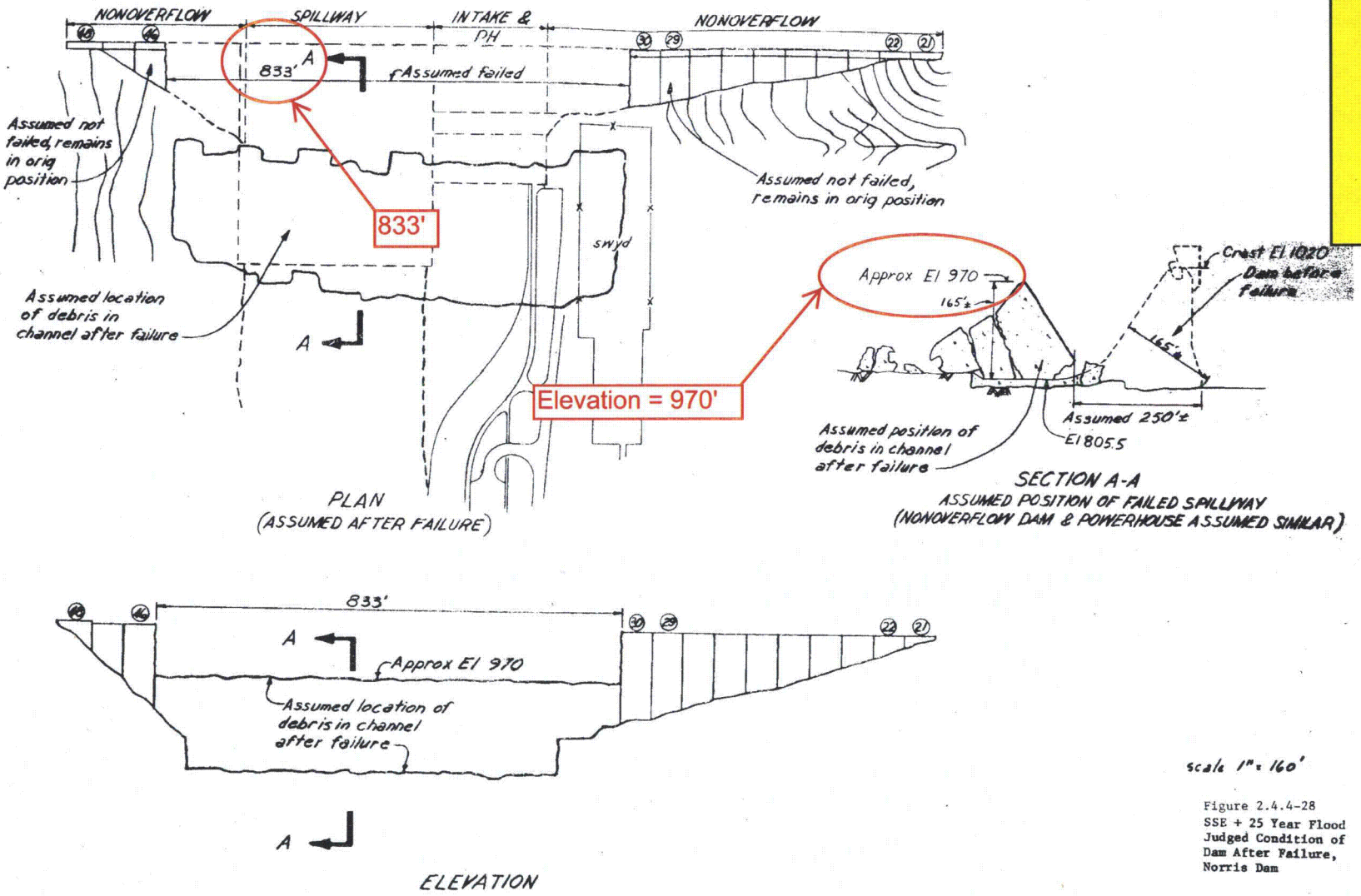


Figure 2.4.4-28
SSE + 25 Year Flood Judged Condition of Dam After Failure, Norris Dam

Attachment 32

Source: References 15

Calculation No: CDQ000020080015

TABLE 1

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE A

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
1A	965.42	421,800	
2A	982.75	656,500	
3A	992.97	920,300	919.0
4A	1001.80	1,181,200	932.5
5A	1011.85	1,520,300	948.0
6A	1019.65	1,805,500	959.5
7A	1028.80	2,119,400	970.2
8A	1036.60	2,436,300	981.5
9A	1045.63	2,709,400	990.0
10A	1040.20	2,709,400	T.W. Low
11A	1030.45	2,196,100	973.0
12A	912.86	95,100	
13A	925.45	141,500	
14A	939.70	214,800	
15A	1037.03	2,462,700	982.0

This data point is treated as an outlier

TABLE 3

NORRIS DAM FAILURE STUDY
SUMMARY OF TESTS RESULTS
DISCHARGE RATING
CASE C

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
59C	942.23	100,900	853.0
60C	960.11	192,000	864.0
61C	973.52	295,200	876.0
62C	978.62	389,800	885.0
63C	984.62	508,700	894.5
64C	991.82	692,900	906.5
65C	998.27	901,900	918.5
66C	1004.12	1,103,000	928.5
67C	1009.67	1,295,000	938.0
68C	1014.77	1,493,000	946.5
69C	1019.42	1,686,000	954.0
70C	1024.67	1,889,000	962.5
71C	1029.47	2,095,000	969.8
72C	1033.67	2,291,000	976.0
73C	1038.50	2,493,000	983.0
74C	1043.42	2,703,000	990.0
75C	1045.79	2,824,000	994.0
76C	1043.27	2,824,000	Low T.W.
77C	930.47	57,600	845.0
78C	909.62	20,700	839.0

This data point is treated as an outlier

Attachment 34
Source: Reference 15

Calculation No: CDQ0000200800 15
Page 53

665'

Elevation = 970'

832.5'

Elevation = 970'

PLAN (ASSUMED AFTER FAILURE)
(CASE A)

SECTION A-A

PLAN (ASSUMED AFTER FAILURE)
(CASE B)

SECTION A-A

PLAN (ASSUMED AFTER FAILURE)
(CASE C)

SECTION A-A

PLAN (ASSUMED AFTER FAILURE)
(CASE D)

SECTION A-A

PLAN (ASSUMED AFTER FAILURE)
(CASE E)

SECTION A-A

PLAN (ASSUMED AFTER FAILURE)
(CASE F)

SECTION A-A

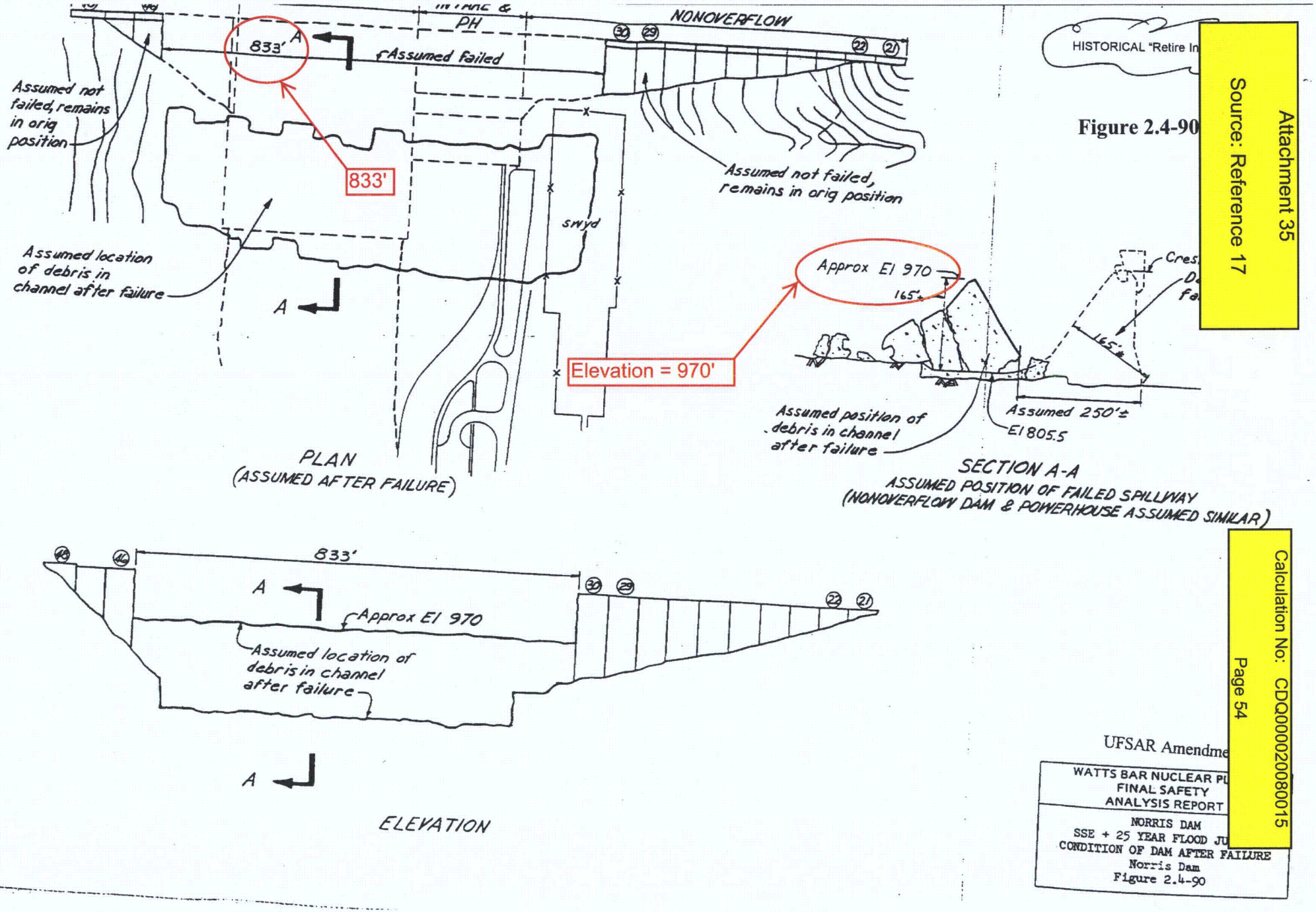
NORRIS DAM FAILURE ST

DETAILS OF

CASES A,B,C,D,E,& F

NORRIS DAM PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
ENGINEERING LABORATORY, NORRIS

12-18-73 | 2-EL-96-K-109



HISTORICAL "Retire In

Figure 2.4-90

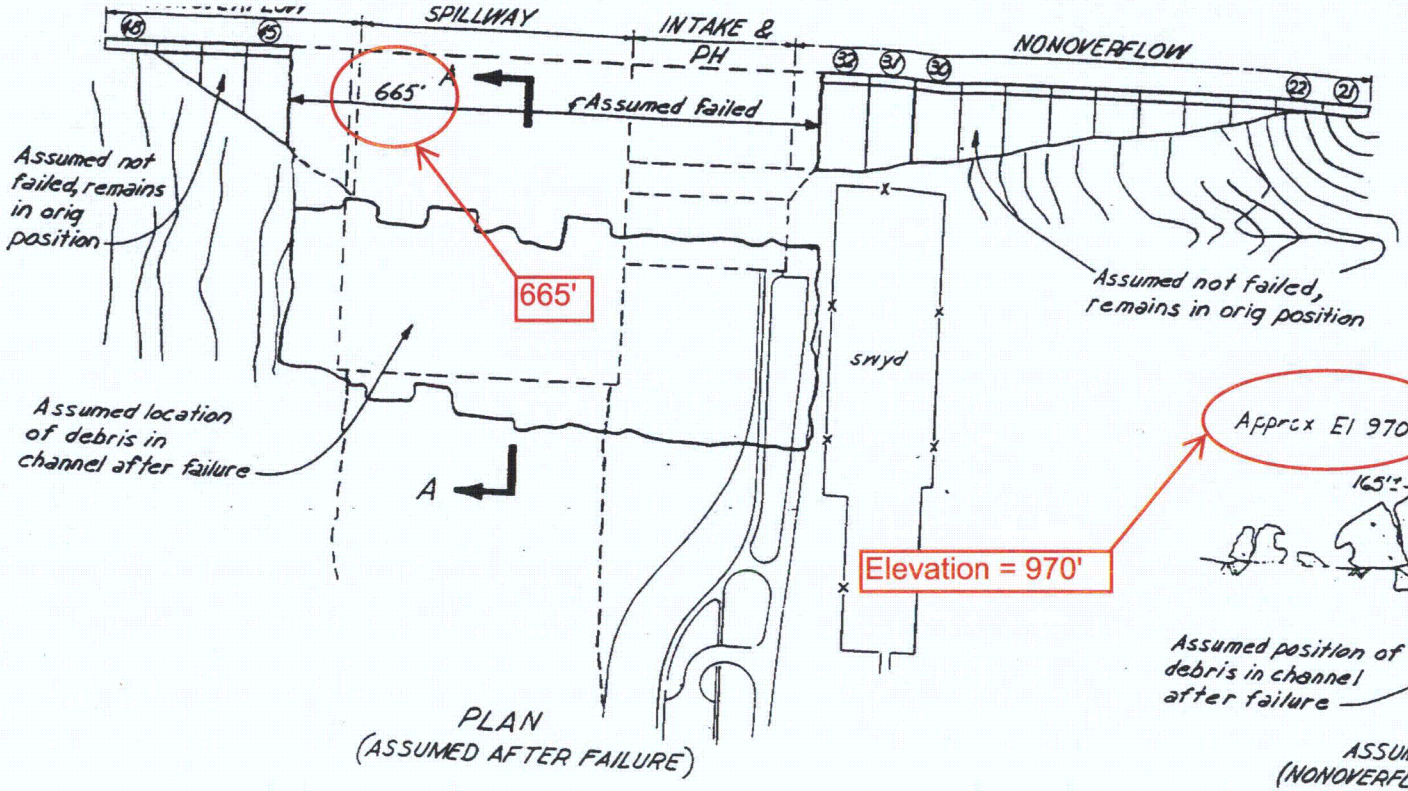
Attachment 35
Source: Reference 17

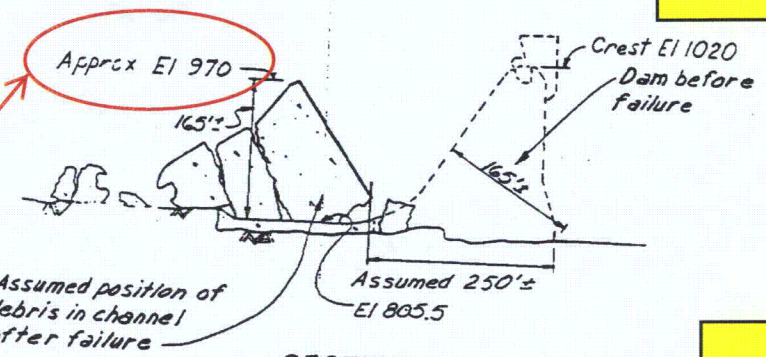
Calculation No: CDQ000020080015
Page 54

UFSAR Amendme

WATTS BAR NUCLEAR PL FINAL SAFETY ANALYSIS REPORT
NORRIS DAM SSE + 25 YEAR FLOOD JU CONDITION OF DAM AFTER FAILURE Norris Dam Figure 2.4-90

Attachment 36
Source: Reference 17





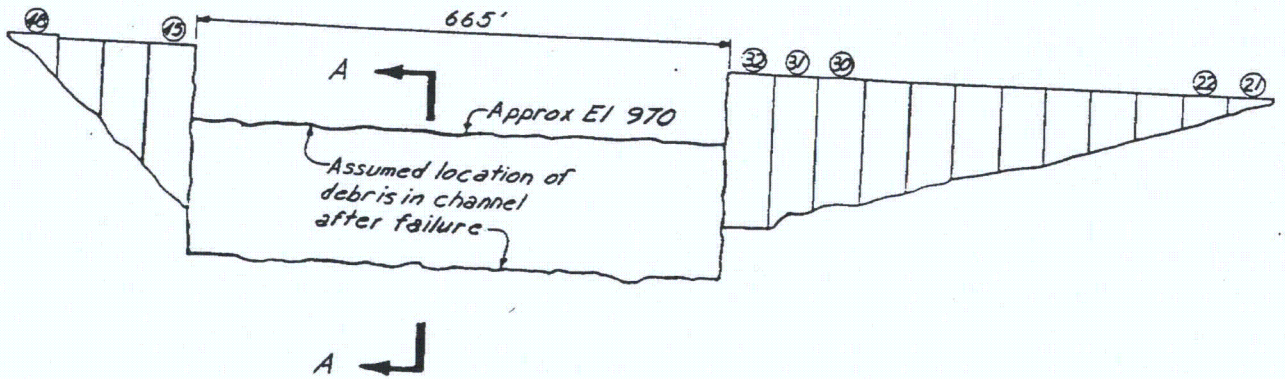


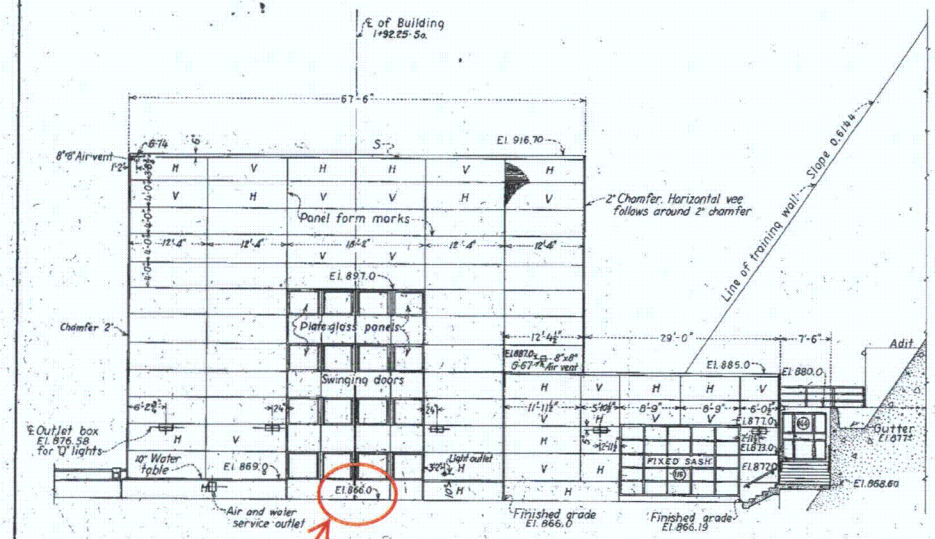
Figure 2

Calculation No: CDQ00002008001S
Page 55

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

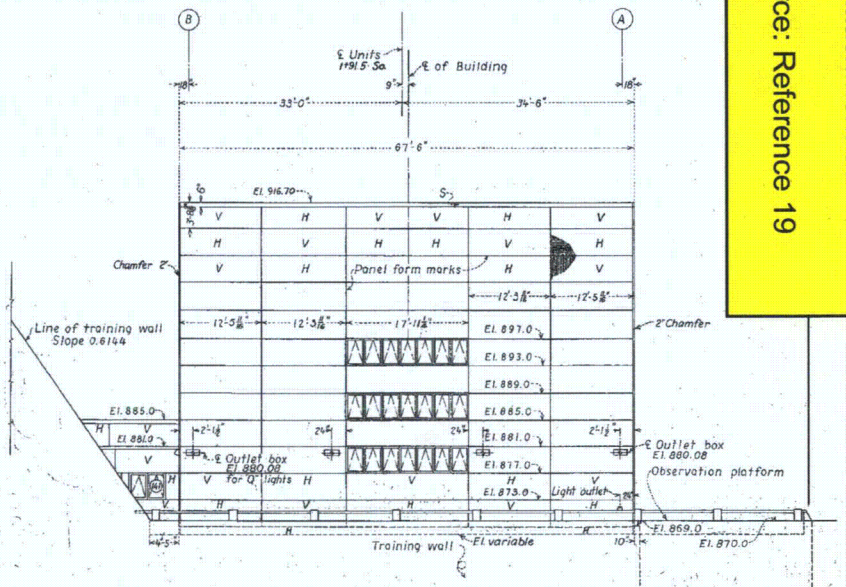
ANALYSIS FOR OBE & ½ PMF
ASSUMED CONDITION OF DAM
AFTER FAILURE
Norris Dam
Figure 2.4-76

Attachment 39
Source: Reference 19

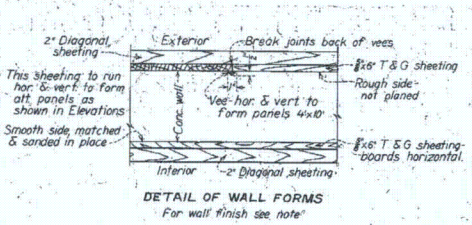


EAST ELEVATION

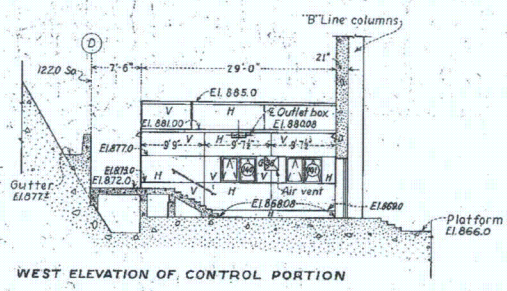
EI - 866'



WEST ELEVATION



DETAIL OF WALL FORMS
For wall finish see note



WEST ELEVATION OF CONTROL PORTION

NOTES

Outside wall finish: Forms lined with $\frac{5}{8}$"x6" T & G sheeting with rough side against concrete, with $\frac{3}{4}$"x1" vees placed horizontal and vertical to form 4'-0"x10'-0" panels (unless otherwise noted). Sheeting placed to form alternate panels of horizontal and vertical board marks as shown. All outside corners have 2" chamfer with horizontal vees following around chamfer.
Inside wall finish: Forms lined with $\frac{5}{8}$"x6" T & G sheeting, all boards horizontal; smooth side against concrete, with sheeting sanded in place. Where plaster occurs on interior walls forms were not lined with $\frac{5}{8}$" sheeting.

REFERENCE DRAWINGS

EXTERIOR NORTH ELEVATION.....232-D-1402
EXTERIOR SOUTH ELEVATION.....232-D-1403

5 0 5 10 15 10
Scale of feet

UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT

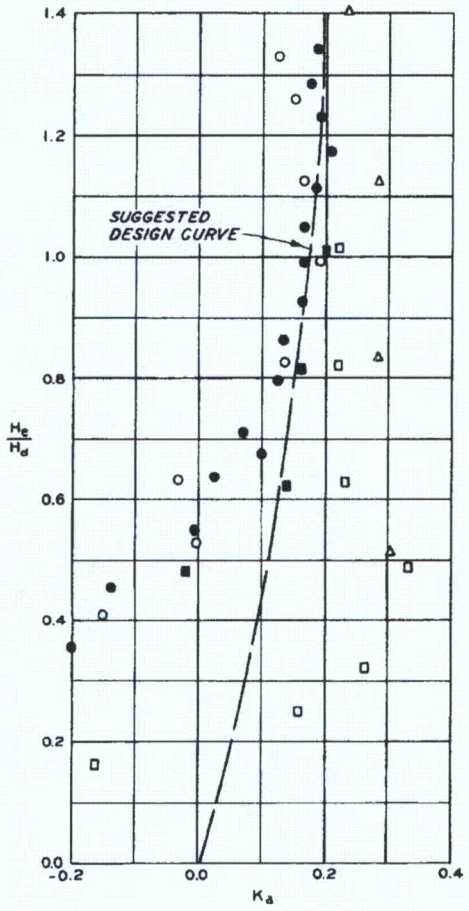
NORRIS POWER PLANT
EXTERIOR
EAST AND WEST ELEVATIONS

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. H.L.K. SUBMITTED R.A. Memmo
C.H.W.B. TR. A.D. RECOM. E.M. McCallum
CHIEF APP'V'D. A.J. Peaslee
DENVER, COLO., JUNE 11, 1935
232-D-1404

UNITED STATES
TENNESSEE VALLEY AUTH.
EXAMINED Wm. M. Kinney
RECOMMENDED Carlton M. Smith
APPROVED Arthur E. Morgan
RECORD DRAWING AS CONSTR.
R.M. Hansen

May 10, 1935

Calculation No: CDQ00002008015
Page 56



BASIC EQUATION

$$Q = C[L' - 2(NK_p + K_a)H_e]H_e^{3/2}$$

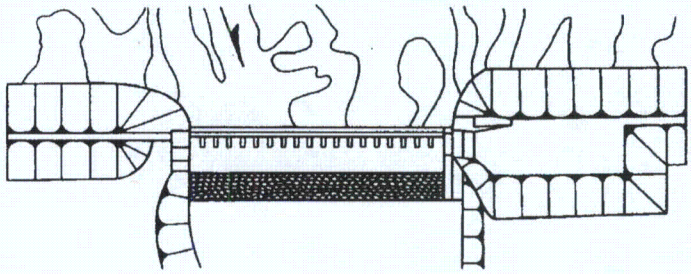
WHERE:
- Q = DISCHARGE, CFS
- C = DISCHARGE COEFFICIENT
- L' = NET LENGTH OF CREST, FT
- N = NUMBER OF PIERS
- K_p = PIER CONTRACTION COEFFICIENT
- K_a = ABUTMENT CONTRACTION COEFFICIENT
- H_e = ENERGY HEAD ON CREST, FT

LEGEND

SYMBOL	PROJECT	R	W/L	W/H
□	DORENA	2	5.60	10.7
■	DORENA	4	5.60	10.7
○	RED ROCK*	7.8	3.42	16.5
●	CARLYLE*	9	8.44	75.5
△	WALTER F. GEORGE*	4	5.44	55.3

*GATED SPILLWAY WITH PIERS

NOTE: R = RADIUS OF ABUTMENT, FT
W = WIDTH OF APPROACH REPRODUCED IN MODEL, FT
L = GROSS WIDTH OF SPILLWAY, FT
H = DEPTH OF APPROACH IN MODEL, FT
H_d = DESIGN HEAD ON CREST, FT



OVERFLOW SPILLWAY CREST WITH ADJACENT EMBANKMENT SECTIONS

ABUTMENT CONTRACTION COEFFICIENT

HYDRAULIC DESIGN CHART III-3/2

PREPARED BY U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISSISSIPPI

REV 1-64

WES 8-60

Appendix A: Quantifying Effects of Tailwater Rating Curve on Sluice Flow.

For Norris Dam, Tailwater can only affect sluices in Case 1 and 5, as sluice tunnels are either fully closed or blocked in all other cases. Also, Tailwater does not reach the bottom of the sluice gate in order to influence discharge through the sluice until the headwater rises to an elevation of 1050 feet (See Section 7, Case 1)

From Equations (3) and (4), for Case 1 and at HW=1050 feet (See Sections 4 and 7 for values of HW, Z_{Ref} and TW)

$$\frac{Q_s}{Q_{s1}} - 1 = \left(\frac{\sqrt{HW - Z_{Ref}}}{\sqrt{HW - TW}} - 1 \right) * 100\% = \left(\sqrt{\frac{1050 - 868}{1050 - 868.68}} - 1 \right) * 100\% = 0.19\%$$

Therefore, sluice flow calculated when neglecting tailwater effects is less than 1% larger than sluice flow which accounts for tailwater effects at this particular headwater elevation.

From the calculations results (See Section 7)

$$\frac{Q_{s1}}{Q} = \frac{31021}{219.67 * 1000} * 100\% = 14.12\%$$

Therefore sluice flow accounts for 14.12% of the total discharge past the dam at a headwater elevation of 1050 feet. Neglecting tailwater effects on the sluice flow would therefore result in a 0.03 % change in the total discharge past the dam (0.0019*0.1412 = 0.0003). The impact of neglecting tailwater effects on sluice flow at all relevant headwater elevations for Case 1 is contained in Table C1. Case 2 will have similar results. As evident from Table C1, the tailwater curve has negligible impact on the sluice flow for Norris Dam.

Table C1: Impact of Tailwater Rating Curve on Headwater Rating Curve Due to Sluice Discharge

HW	TW	Change in Flow ((No TW) / TW)-1	% of Total Q_{s1}/Q	Impact on Rating Curve
ft	ft	%	%	%
1050	868.68	0.19%	14.12%	0.03%
1052	871.05	0.84%	12.89%	0.11%
1054	873.33	1.47%	11.82%	0.17%
1056	875.54	2.07%	10.89%	0.22%
1058	877.69	2.65%	10.06%	0.27%
1060	879.80	3.22%	9.33%	0.30%
1061	880.87	3.51%	9.00%	0.32%

TENNESSEE VALLEY AUTHORITY
RIVER SYSTEM OPERATIONS & ENVIRONMENT
RIVER OPERATIONS

NORRIS DAM

SPILLWAY AND SLUICE DISCHARGE TABLES

MAY 2000

CONTENTS

PART 1. SPILLWAY DISCHARGE TABLES

Page

Instructions for Use of Tables 2
Location of Spillway Gates 4
Spillway Discharge Tables 5-43
Headwater Range
- 1020 - 1022 5
- 1022 - 1024 6
- 1024 - 1026 7
- 1026 - 1028 8
- 1028 - 1030 10
- 1030 - 1032 12
- 1032 - 1034 14
- 1034 - 1036 17
- 1036 - 1038 20
- 1038 - 1040 23
- 1040 - 1042 26
- 1042 - 1044 29
- 1044 - 1046 32
- 1046 - 1048 35
- 1048 - 1050 38
- 1050 - 1052 41

PART 2. SLUICE DISCHARGE TABLES

Instructions for Use of Tables 46
Location of Sluice Gates 4
Sluice Discharge Tables 48-65
Headwater Range
- 880 - 900 48
- 900 - 920 50
- 920 - 940 52
- 940 - 960 54
- 960 - 980 56
- 980 - 1000 58
- 1000 - 1020 60
- 1020 - 1040 62
- 1040 - 1052 64

PART 1

SPILLWAY DISCHARGE TABLES

MAY 2000

INSTRUCTIONS FOR USE OF TABLES

1. New Tables

These spillway tables are the first that have been prepared for the drum gate spillways at Norris Dam. The computer code SPILLQ generated the tabulated discharges, which are based on the same discharge coefficients that were used to prepare the curves of discharge vs. reservoir and top-of-gates elevations that were used before these tables existed. The discharge coefficients were determined previously in model studies.

2. Purpose of Tables

These tables provide a means of setting up or determining the discharge over the drum gate spillways at Norris Dam. It is assumed that all three gates are set to the same top elevation. The tables give total discharge in cubic feet per second over all three spillway gates when the headwater elevation is known and the common top-of-gate elevation of the gates is known.

3. Range of Tables

The tables cover a discharge range from 0 to 209,400 cubic feet per second. Headwater elevations range from 1020 feet, which is the minimum top elevation of the gates, to 1052 feet.

4. Arrangement of Tables

The tables show spillway discharges in cubic feet per second for all three drum gates set to identical top-of-gate, or "gate," elevations. Gate elevations in 0.1-foot increments are listed in the left and right columns. Headwater elevations for each 0.1 foot of headwater elevation are shown at the top of each column. The headwater range is shown at the bottom of each page.

5. Discharge Intervals

The tables have been prepared so that the incremental discharge between the tabulated values varies from 20 cubic feet per second at the lowest discharges to about 1300 cubic feet per second (about 0.6 percent) at the highest discharges. In all cases, the tabulated discharges are considered accurate enough that it will not be necessary to interpolate between values given in these tables.

When the exact headwater elevation does not appear in the tables, the discharge for the headwater elevation closest to it should be used. For example, the column headed 1031.2 should be used for actual headwater elevations between 1031.15 feet and 1031.24 feet inclusive. When the actual headwater elevation is exactly halfway between tabular values, the larger value is to be used.

6. Use of Tables

The tables can be used in two ways: (1) to determine the top-of-gates elevation needed to pass a required discharge at a given headwater elevation, and (2) to determine the discharge for a top-of-gates elevation and headwater elevation.

Example 1 -- What gate elevation is necessary to pass a discharge of 9,000 cubic feet per second with the headwater at elevation 1028.82 feet?

The first step is to find the table in which the headwater elevation appears. Referring to the contents page, we find that headwater elevations between 1028 feet and 1030 feet are found on page 10 (and continued on page 11). The headwater elevation closest to 1028.82 feet is 1028.8 feet. In the column headed 1028.8 the discharge nearest to the required 9,000 cubic feet per second is 9,040 cubic feet per second located near the bottom of the page. By tracing the horizontal line in which 9,040 cubic feet per second appears, to either side of the page, we find that all three drum gates should be set

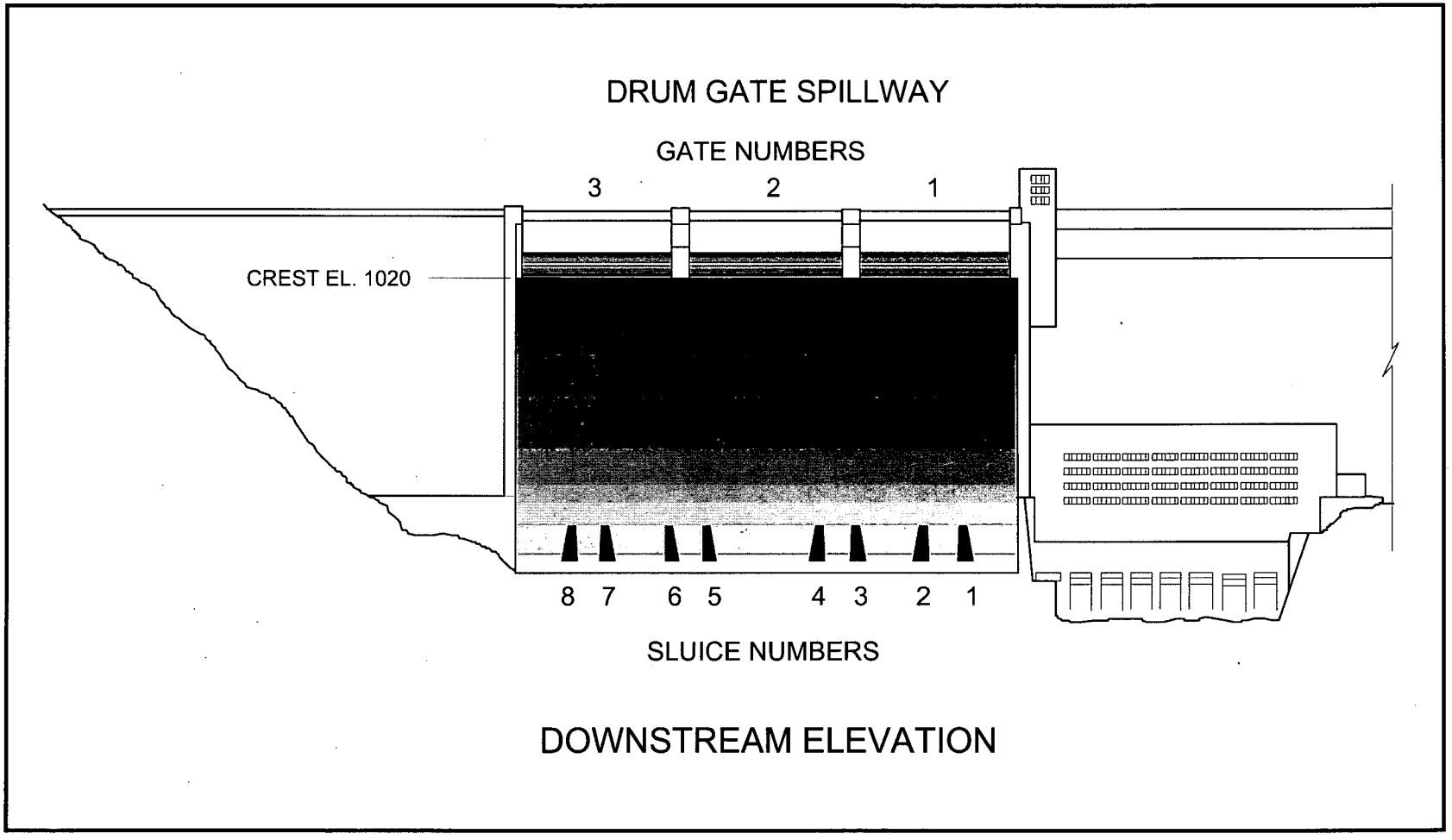
to top-of-gate elevation 1024.5 feet to pass the discharge closest to 9,000 cubic feet per second at headwater elevation 1028.82 feet.

After all the gates are set, changes in the headwater elevation may require changes in the top-of-gates elevation to maintain the desired discharge. For example, if the headwater should fall to 1028.63 feet, the discharge will be found in the column headed 1028.6. In this column the discharge closest to 9,000 cubic feet per second is 8,960 cubic feet per second for top-of-gates elevation 1024.3 feet. Therefore, to maintain the discharge nearest to 9,000 cubic feet per second the gates would be lowered to top-of-gate elevation 1024.3 feet.

Example 2 -- Suppose the operating records show that the headwater is at elevation 1031.95 feet, and the gates are set to top-of-gate elevation 1028.4 feet. The headwater is found starting on page 12 which is marked "Headwater 1030 to 1032." The elevation given is exactly halfway between elevation 1031.9 feet and 1032.0 feet. The larger value, 1032.0 feet, should be used. In the column headed 1032.0 opposite gate elevation 1028.4 feet, the discharge is found to be 7,790 cubic feet per second.

NORRIS DAM

LOCATION OF SPILLWAY AND SLUICE GATES



NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1020.0	1020.1	1020.2	1020.3	1020.4	1020.5	1020.6	1020.7	1020.8	1020.9	1021.0	1021.1	1021.2	1021.3	1021.4	1021.5	1021.6	1021.7	1021.8	1021.9	1022.0	
1021.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	1021.9
1021.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	1021.8
1021.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	120	1021.7
1021.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	120	180	1021.6
1021.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	120	180	260	1021.5
1021.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	120	180	260	350	1021.4
1021.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	110	180	260	350	450	1021.3
1021.2	0	0	0	0	0	0	0	0	0	0	0	0	0	20	60	110	180	260	350	450	550	1021.2
1021.1	0	0	0	0	0	0	0	0	0	0	0	0	20	60	110	180	260	350	440	550	660	1021.1
1021.0	0	0	0	0	0	0	0	0	0	0	0	20	60	110	180	260	350	440	550	660	790	1021.0
1020.9	0	0	0	0	0	0	0	0	0	0	20	60	110	180	260	340	440	550	660	780	910	1020.9
1020.8	0	0	0	0	0	0	0	0	0	20	60	110	180	260	340	440	550	660	780	910	1, 050	1020.8
1020.7	0	0	0	0	0	0	0	0	20	60	110	180	260	340	440	540	660	780	910	1, 050	1, 190	1020.7
1020.6	0	0	0	0	0	0	0	20	60	110	180	250	340	440	540	660	780	910	1, 050	1, 190	1, 340	1020.6
1020.5	0	0	0	0	0	0	20	60	110	180	250	340	440	540	660	780	910	1, 040	1, 190	1, 340	1, 500	1020.5
1020.4	0	0	0	0	0	20	60	110	180	250	340	440	540	650	780	910	1, 040	1, 190	1, 340	1, 490	1, 660	1020.4
1020.3	0	0	0	0	20	60	110	180	250	340	440	540	650	770	900	1, 040	1, 180	1, 330	1, 490	1, 650	1, 820	1020.3
1020.2	0	0	0	20	55	110	180	250	340	430	540	650	770	900	1, 040	1, 180	1, 330	1, 490	1, 650	1, 820	2, 000	1020.2
1020.1	0	0	20	55	110	180	250	340	430	540	650	770	900	1, 040	1, 180	1, 330	1, 490	1, 650	1, 820	2, 000	2, 180	1020.1
1020.0	0	20	55	110	180	250	340	430	540	650	770	900	1, 030	1, 180	1, 330	1, 480	1, 650	1, 820	1, 990	2, 180	2, 360	1020.0

MAY 2000

HEADWATER 1020 to 1022

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																				GATE ELEVATION IN FEET
	1022.0	1022.1	1022.2	1022.3	1022.4	1022.5	1022.6	1022.7	1022.8	1022.9	1023.0	1023.1	1023.2	1023.3	1023.4	1023.5	1023.6	1023.7	1023.8	1023.9	1024.0	
1023.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	1023.9
1023.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	1023.8
1023.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	130	1023.7
1023.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	130	210	1023.6
1023.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	130	210	290	1023.5
1023.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	130	200	290	390	1023.4
1023.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	70	130	200	290	380	490	1023.3
1023.2	0	0	0	0	0	0	0	0	0	0	0	0	0	20	65	130	200	290	380	490	600	1023.2
1023.1	0	0	0	0	0	0	0	0	0	0	0	0	20	65	130	200	280	380	480	600	720	1023.1
1023.0	0	0	0	0	0	0	0	0	0	0	0	20	65	130	200	280	380	480	590	710	840	1023.0
1022.9	0	0	0	0	0	0	0	0	0	0	20	65	120	200	280	370	480	590	710	840	980	1022.9
1022.8	0	0	0	0	0	0	0	0	0	20	65	120	200	280	370	470	590	710	840	970	1, 120	1022.8
1022.7	0	0	0	0	0	0	0	0	20	65	120	190	280	370	470	580	700	830	970	1, 110	1, 260	1022.7
1022.6	0	0	0	0	0	0	0	20	65	120	190	280	370	470	580	700	830	960	1, 110	1, 260	1, 420	1022.6
1022.5	0	0	0	0	0	0	20	65	120	190	270	370	470	580	700	830	960	1, 100	1, 250	1, 410	1, 570	1022.5
1022.4	0	0	0	0	0	20	65	120	190	270	360	470	580	700	820	960	1, 100	1, 250	1, 410	1, 570	1, 740	1022.4
1022.3	0	0	0	0	20	65	120	190	270	360	460	570	690	820	950	1, 100	1, 240	1, 400	1, 560	1, 730	1, 910	1022.3
1022.2	0	0	0	20	65	120	190	270	360	460	570	690	820	950	1, 090	1, 240	1, 390	1, 560	1, 730	1, 900	2, 080	1022.2
1022.1	0	0	20	60	120	190	270	360	460	570	690	810	950	1, 090	1, 230	1, 390	1, 550	1, 720	1, 890	2, 080	2, 260	1022.1
1022.0	0	20	60	120	190	270	360	460	570	680	810	940	1, 080	1, 230	1, 380	1, 550	1, 710	1, 890	2, 070	2, 250	2, 450	1022.0
1021.9	20	60	120	190	270	360	460	560	680	810	940	1, 080	1, 230	1, 380	1, 540	1, 710	1, 880	2, 060	2, 250	2, 440	2, 640	1021.9
1021.8	60	120	190	270	360	450	560	680	800	940	1, 080	1, 220	1, 380	1, 540	1, 710	1, 880	2, 060	2, 240	2, 440	2, 630	2, 840	1021.8
1021.7	120	180	260	350	450	560	680	800	930	1, 070	1, 220	1, 370	1, 530	1, 700	1, 870	2, 050	2, 240	2, 430	2, 630	2, 830	3, 040	1021.7
1021.6	180	260	350	450	560	680	800	930	1, 070	1, 220	1, 370	1, 530	1, 700	1, 870	2, 050	2, 230	2, 430	2, 620	2, 830	3, 030	3, 250	1021.6
1021.5	260	350	450	560	670	800	930	1, 070	1, 210	1, 370	1, 530	1, 690	1, 870	2, 040	2, 230	2, 420	2, 620	2, 820	3, 030	3, 240	3, 460	1021.5
1021.4	350	450	560	670	790	930	1, 060	1, 210	1, 360	1, 520	1, 690	1, 860	2, 040	2, 220	2, 410	2, 610	2, 810	3, 020	3, 230	3, 450	3, 680	1021.4
1021.3	450	550	670	790	920	1, 060	1, 210	1, 360	1, 520	1, 680	1, 860	2, 030	2, 220	2, 410	2, 610	2, 810	3, 020	3, 230	3, 450	3, 670	3, 900	1021.3
1021.2	550	670	790	920	1, 060	1, 200	1, 360	1, 510	1, 680	1, 850	2, 030	2, 210	2, 400	2, 600	2, 800	3, 010	3, 220	3, 440	3, 660	3, 890	4, 130	1021.2
1021.1	660	790	920	1, 060	1, 200	1, 350	1, 510	1, 680	1, 850	2, 030	2, 210	2, 400	2, 590	2, 800	3, 000	3, 220	3, 430	3, 660	3, 890	4, 120	4, 360	1021.1
1021.0	790	920	1, 050	1, 200	1, 350	1, 510	1, 670	1, 840	2, 020	2, 200	2, 390	2, 590	2, 790	3, 000	3, 210	3, 430	3, 650	3, 880	4, 110	4, 350	4, 590	1021.0
1020.9	910	1, 050	1, 200	1, 350	1, 500	1, 670	1, 840	2, 020	2, 200	2, 390	2, 590	2, 790	2, 990	3, 210	3, 420	3, 650	3, 870	4, 110	4, 350	4, 590	4, 840	1020.9
1020.8	1, 050	1, 190	1, 340	1, 500	1, 670	1, 840	2, 010	2, 200	2, 390	2, 580	2, 780	2, 990	3, 200	3, 420	3, 640	3, 870	4, 100	4, 340	4, 590	4, 830	5, 090	1020.8
1020.7	1, 190	1, 340	1, 500	1, 660	1, 840	2, 010	2, 200	2, 380	2, 580	2, 780	2, 990	3, 200	3, 420	3, 640	3, 870	4, 100	4, 340	4, 580	4, 830	5, 080	5, 340	1020.7
1020.6	1, 340	1, 500	1, 660	1, 830	2, 010	2, 190	2, 380	2, 580	2, 780	2, 980	3, 190	3, 410	3, 630	3, 860	4, 100	4, 330	4, 580	4, 830	5, 080	5, 340	5, 600	1020.6
1020.5	1, 500	1, 660	1, 830	2, 010	2, 190	2, 380	2, 570	2, 770	2, 980	3, 190	3, 410	3, 630	3, 860	4, 090	4, 330	4, 570	4, 820	5, 080	5, 330	5, 600	5, 860	1020.5
1020.4	1, 660	1, 830	2, 000	2, 190	2, 380	2, 570	2, 770	2, 980	3, 190	3, 410	3, 630	3, 860	4, 090	4, 330	4, 570	4, 820	5, 070	5, 330	5, 590	5, 860	6, 130	1020.4
1020.3	1, 820	2, 000	2, 180	2, 370	2, 570	2, 770	2, 970	3, 180	3, 400	3, 620	3, 850	4, 080	4, 320	4, 570	4, 810	5, 070	5, 330	5, 590	5, 860	6, 130	6, 410	1020.3
1020.2	2, 000	2, 180	2, 370	2, 560	2, 760	2, 970	3, 180	3, 400	3, 620	3, 850	4, 080	4, 320	4, 560	4, 810	5, 060	5, 320	5, 580	5, 850	6, 120	6, 400	6, 680	1020.2
1020.1	2, 180	2, 370	2, 560	2, 760	2, 970	3, 180	3, 390	3, 620	3, 840	4, 080	4, 310	4, 560	4, 810	5, 060	5, 320	5, 580	5, 850	6, 120	6, 400	6, 680	6, 970	1020.1
1020.0	2, 360	2, 560	2, 760	2, 960	3, 170	3, 390	3, 610	3, 840	4, 070	4, 310	4, 550	4, 800	5, 050	5, 310	5, 580	5, 840	6, 120	6, 390	6, 670	6, 960	7, 250	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1024.0	1024.1	1024.2	1024.3	1024.4	1024.5	1024.6	1024.7	1024.8	1024.9	1025.0	1025.1	1025.2	1025.3	1025.4	1025.5	1025.6	1025.7	1025.8	1025.9	1026.0	
1025.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	1025.9
1025.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	85	1025.8
1025.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	85	160	1025.7
1025.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	85	160	240	1025.6
1025.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	85	160	240	340	1025.5
1025.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	85	150	240	340	450	1025.4
1025.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	80	150	240	340	450	570	1025.3
1025.2	0	0	0	0	0	0	0	0	0	0	0	0	0	30	80	150	240	330	440	560	690	1025.2
1025.1	0	0	0	0	0	0	0	0	0	0	0	0	30	80	150	240	330	440	560	690	830	1025.1
1025.0	0	0	0	0	0	0	0	0	0	0	0	25	80	150	230	330	440	560	680	820	970	1025.0
1024.9	0	0	0	0	0	0	0	0	0	0	25	80	150	230	330	430	550	680	810	960	1, 110	1024.9
1024.8	0	0	0	0	0	0	0	0	0	25	80	150	230	330	430	550	670	810	950	1, 100	1, 260	1024.8
1024.7	0	0	0	0	0	0	0	0	25	80	150	230	320	430	540	670	800	950	1, 100	1, 260	1, 420	1024.7
1024.6	0	0	0	0	0	0	0	25	75	140	230	320	420	540	660	800	940	1, 090	1, 250	1, 410	1, 590	1024.6
1024.5	0	0	0	0	0	0	25	75	140	220	320	420	540	660	790	930	1, 080	1, 240	1, 400	1, 580	1, 750	1024.5
1024.4	0	0	0	0	0	25	75	140	220	310	420	530	650	790	930	1, 080	1, 230	1, 390	1, 570	1, 740	1, 930	1024.4
1024.3	0	0	0	0	25	75	140	220	310	410	530	650	780	920	1, 070	1, 220	1, 390	1, 560	1, 730	1, 920	2, 110	1024.3
1024.2	0	0	0	25	75	140	220	310	410	520	640	780	910	1, 060	1, 210	1, 380	1, 550	1, 720	1, 900	2, 090	2, 290	1024.2
1024.1	0	0	25	75	140	220	310	410	520	640	770	910	1, 050	1, 210	1, 370	1, 540	1, 710	1, 890	2, 080	2, 270	2, 480	1024.1
1024.0	0	25	70	140	210	300	400	520	630	760	900	1, 050	1, 200	1, 360	1, 530	1, 700	1, 880	2, 070	2, 260	2, 460	2, 670	1024.0
1023.9	25	70	140	210	300	400	510	630	760	890	1, 040	1, 190	1, 350	1, 520	1, 690	1, 870	2, 060	2, 250	2, 450	2, 650	2, 860	1023.9
1023.8	70	130	210	300	400	510	630	750	890	1, 030	1, 180	1, 340	1, 510	1, 680	1, 860	2, 040	2, 240	2, 430	2, 640	2, 850	3, 060	1023.8
1023.7	130	210	300	400	500	620	750	880	1, 030	1, 180	1, 330	1, 500	1, 670	1, 850	2, 030	2, 220	2, 420	2, 620	2, 830	3, 050	3, 270	1023.7
1023.6	210	290	390	500	620	740	880	1, 020	1, 170	1, 330	1, 490	1, 660	1, 840	2, 020	2, 210	2, 410	2, 610	2, 820	3, 030	3, 250	3, 480	1023.6
1023.5	290	390	500	610	740	870	1, 010	1, 160	1, 320	1, 480	1, 650	1, 830	2, 010	2, 200	2, 400	2, 600	2, 800	3, 020	3, 240	3, 460	3, 690	1023.5
1023.4	390	490	610	730	870	1, 010	1, 150	1, 310	1, 470	1, 640	1, 820	2, 000	2, 190	2, 380	2, 580	2, 790	3, 000	3, 220	3, 440	3, 670	3, 910	1023.4
1023.3	490	600	730	860	1, 000	1, 150	1, 300	1, 460	1, 630	1, 810	1, 990	2, 180	2, 370	2, 570	2, 770	2, 990	3, 200	3, 430	3, 650	3, 890	4, 130	1023.3
1023.2	600	720	850	990	1, 140	1, 290	1, 450	1, 620	1, 800	1, 980	2, 160	2, 360	2, 550	2, 760	2, 970	3, 190	3, 410	3, 640	3, 870	4, 110	4, 350	1023.2
1023.1	720	850	990	1, 130	1, 290	1, 450	1, 610	1, 790	1, 960	2, 150	2, 340	2, 540	2, 740	2, 950	3, 170	3, 390	3, 620	3, 850	4, 090	4, 330	4, 570	1023.1
1023.0	840	980	1, 120	1, 280	1, 440	1, 600	1, 770	1, 950	2, 140	2, 330	2, 530	2, 730	2, 940	3, 150	3, 370	3, 600	3, 830	4, 070	4, 310	4, 550	4, 800	1023.0
1022.9	980	1, 120	1, 270	1, 430	1, 600	1, 770	1, 950	2, 130	2, 320	2, 520	2, 720	2, 930	3, 140	3, 360	3, 590	3, 820	4, 050	4, 290	4, 540	4, 790	5, 050	1022.9
1022.8	1, 120	1, 270	1, 430	1, 590	1, 760	1, 940	2, 120	2, 310	2, 510	2, 710	2, 920	3, 130	3, 350	3, 580	3, 810	4, 040	4, 280	4, 530	4, 780	5, 030	5, 290	1022.8
1022.7	1, 260	1, 420	1, 590	1, 760	1, 930	2, 120	2, 310	2, 500	2, 700	2, 910	3, 130	3, 340	3, 570	3, 800	4, 030	4, 270	4, 520	4, 770	5, 020	5, 280	5, 540	1022.7
1022.6	1, 420	1, 580	1, 750	1, 930	2, 110	2, 300	2, 490	2, 700	2, 900	3, 120	3, 330	3, 560	3, 790	4, 020	4, 260	4, 500	4, 750	5, 010	5, 270	5, 530	5, 800	1022.6
1022.5	1, 570	1, 740	1, 920	2, 100	2, 290	2, 490	2, 690	2, 890	3, 110	3, 320	3, 550	3, 780	4, 010	4, 250	4, 490	4, 740	4, 990	5, 250	5, 520	5, 780	6, 060	1022.5
1022.4	1, 740	1, 910	2, 100	2, 280	2, 480	2, 680	2, 890	3, 100	3, 310	3, 540	3, 760	4, 000	4, 240	4, 480	4, 730	4, 980	5, 240	5, 500	5, 770	6, 040	6, 320	1022.4
1022.3	1, 910	2, 090	2, 280	2, 470	2, 670	2, 880	3, 090	3, 300	3, 530	3, 750	3, 990	4, 220	4, 470	4, 710	4, 970	5, 230	5, 490	5, 750	6, 030	6, 300	6, 580	1022.3
1022.2	2, 080	2, 270	2, 460	2, 660	2, 870	3, 080	3, 290	3, 520	3, 740	3, 970	4, 210	4, 450	4, 700	4, 950	5, 210	5, 470	5, 740	6, 010	6, 290	6, 570	6, 850	1022.2
1022.1	2, 260	2, 460	2, 650	2, 860	3, 070	3, 280	3, 510	3, 730	3, 960	4, 200	4, 440	4, 690	4, 940	5, 200	5, 460	5, 730	6, 000	6, 270	6, 550	6, 840	7, 130	1022.1
1022.0	2, 450	2, 650	2, 850	3, 060	3, 270	3, 490	3, 720	3, 950	4, 190	4, 430	4, 680	4, 930	5, 180	5, 450	5, 710	5, 980	6, 260	6, 540	6, 820	7, 110	7, 400	1022.0
1021.9	2, 640	2, 840	3, 050	3, 270	3, 490	3, 710	3, 940	4, 180	4, 420	4, 670	4, 920	5, 180	5, 440	5, 700	5, 970	6, 250	6, 530	6, 810	7, 100	7, 390	7, 690	1021.9
1021.8	2, 840	3, 050	3, 260	3, 480	3, 710	3, 940	4, 170	4, 410	4, 660	4, 910	5, 170	5, 430	5, 690	5, 960	6, 240	6, 520	6, 800	7, 090	7, 380	7, 680	7, 980	1021.8
1021.7	3, 040	3, 250	3, 470	3, 700	3, 930	4, 170	4, 410	4, 650	4, 900	5, 160	5, 420	5, 680	5, 950	6, 230	6, 510	6, 790	7, 080	7, 370	7, 670	7, 970	8, 280	1021.7
1021.6	3, 250	3, 470	3, 690	3, 920	4, 160	4, 400	4, 640	4, 890	5, 150	5, 410	5, 670	5, 940	6, 220	6, 500	6, 780	7, 070	7, 360	7, 660	7, 960	8, 260	8, 570	1021.6
1021.5	3, 460	3, 690	3, 910	4, 150	4, 390	4, 640	4, 890	5, 140	5, 400	5, 660	5, 930	6, 210	6, 490	6, 770	7, 060	7, 350	7, 650	7, 950	8, 250	8, 560	8, 880	1021.5
1021.4	3, 680	3, 910	4, 140	4, 380	4, 630	4, 880	5, 130	5, 390	5, 660	5, 920	6, 200	6, 480	6, 760	7, 050	7, 340	7, 640	7, 940	8, 240	8, 550	8, 870	9, 180	1021.4
1021.3	3, 900	4, 130	4, 370	4, 620	4, 870	5, 120	5, 380	5, 650	5, 910	6, 190	6, 470	6, 750	7, 040	7, 330	7, 620	7, 930	8, 230	8, 540	8, 850	9, 170	9, 490	1021.3
1021.2	4, 130	4, 370	4, 610	4, 860	5, 110	5, 370	5, 640	5, 910	6, 180	6, 460	6, 740	7, 030	7, 320	7, 610	7, 910	8, 220	8, 530	8, 840	9, 160	9, 480	9, 810	1021.2
1021.1	4, 360	4, 600	4, 850	5, 110	5, 360	5, 630	5, 900	6, 170	6, 450	6, 730	7, 020	7, 310	7, 600	7, 900	8, 210	8, 520	8, 830	9, 150	9, 470	9, 790	10, 120	1021.1
1021.0	4, 590	4, 840	5, 100	5, 350	5, 620	5, 890	6, 160	6, 440	6, 720	7, 010	7, 300	7, 590	7, 890	8, 200	8, 500	8, 820	9, 130	9, 460	9, 780	10, 110	10, 450	1021.0
1020.9	4, 840	5, 090	5, 350	5, 610	5, 880	6, 150	6, 430	6, 710	7, 000	7, 290	7, 590	7, 890	8, 190	8, 500	8, 810	9, 130	9, 450	9, 780	10, 110	10, 440	10, 780	1020.9
1020.8	5, 090	5, 350	5, 610	5, 880	6, 150	6, 430	6, 710	7, 000	7, 290	7, 580	7, 880	8, 190	8, 500	8, 810	9, 130	9, 450	9, 770	10, 100	10, 440	10, 780	11, 120	1020.8
1020.7	5, 340	5, 610	5, 870	6, 150	6, 420	6, 710	6, 990	7, 280	7, 580	7, 880	8, 180	8, 490	8, 800	9, 120	9, 440	9, 770	10, 100	10, 430	10, 770	11, 110	11, 460	1020.7
1020.6	5, 600	5, 870	6, 140	6, 420	6, 700	6, 990	7, 280	7, 570	7, 870	8, 180	8, 490	8, 800	9, 120	9, 440	9, 760	10, 090	10, 430	10, 770	11, 110	11, 460	11, 810	1020.6
1020.5	5, 860	6, 140	6, 410	6, 700	6, 980	7, 270	7, 570	7, 870	8, 170	8, 480	8, 800	9, 110	9, 430	9, 760	10, 090	10, 420	10, 760	11, 110	11, 450	11, 800	12, 160	1020.5
1020.4	6, 130	6, 410	6, 690	6, 980	7, 270	7, 560	7, 860	8, 170	8, 480	8, 790	9, 110	9, 430	9, 760	10, 090	10, 420	10, 760	11, 100	11, 450	11, 800	12, 150	12, 510	1020.4
1020.3	6, 410	6, 690	6, 970	7, 260	7, 560	7, 860	8, 160	8, 470	8, 790	9, 100	9, 430	9, 750	10, 080	10, 420	10, 750	11, 100	11, 440	11, 790	12, 150	12, 510	12, 870	1020.3
1020.2	6, 680	6, 970	7, 260	7, 560	7, 860	8, 160	8, 470	8, 780	9, 100	9, 420	9, 750	10, 080	10, 410	10, 750	11, 090	11, 440	11, 790	12, 140	12, 500	12, 870	13, 230	1020.2
1020.1	6, 970	7, 260	7, 550	7, 850	8, 160	8, 460	8, 780	9, 100	9, 420	9, 740	10, 070	10, 410	10, 750	11, 090	11, 440	11, 790	12, 140	12, 500	12, 860	13, 230	13, 600	1020.1
1020.0	7, 250	7, 550	7, 850	8, 150	8, 460	8, 770	9, 090	9, 410	9, 740	10, 070	10, 400	10, 740	11, 080	11, 430	11, 780	12, 140	12, 500	12, 860	13, 230	13, 600	13, 970	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																				GATE ELEVATION IN FEET
	1026.0	1026.1	1026.2	1026.3	1026.4	1026.5	1026.6	1026.7	1026.8	1026.9	1027.0	1027.1	1027.2	1027.3	1027.4	1027.5	1027.6	1027.7	1027.8	1027.9	1028.0	
1027.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	1027.9
1027.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	1027.8
1027.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	180	1027.7
1027.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	180	270	1027.6
1027.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	180	270	380	1027.5
1027.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	170	270	380	500	1027.4
1027.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	95	170	270	380	500	630	1027.3
1027.2	0	0	0	0	0	0	0	0	0	0	0	0	0	30	95	170	270	380	500	630	770	1027.2
1027.1	0	0	0	0	0	0	0	0	0	0	0	0	30	95	170	270	370	490	630	770	920	1027.1
1027.0	0	0	0	0	0	0	0	0	0	0	0	30	90	170	270	370	490	620	760	910	1, 070	1027.0
1026.9	0	0	0	0	0	0	0	0	0	0	30	90	170	260	370	490	620	760	910	1, 070	1, 230	1026.9
1026.8	0	0	0	0	0	0	0	0	0	30	90	170	260	370	490	620	760	900	1, 060	1, 230	1, 400	1026.8
1026.7	0	0	0	0	0	0	0	0	30	90	170	260	370	480	610	750	900	1, 060	1, 220	1, 400	1, 580	1026.7
1026.6	0	0	0	0	0	0	0	30	90	170	260	360	480	610	750	900	1, 050	1, 220	1, 390	1, 570	1, 760	1026.6
1026.5	0	0	0	0	0	0	30	90	170	260	360	480	610	740	890	1, 050	1, 210	1, 380	1, 560	1, 750	1, 950	1026.5
1026.4	0	0	0	0	0	30	90	170	260	360	480	600	740	890	1, 040	1, 210	1, 380	1, 560	1, 750	1, 940	2, 140	1026.4
1026.3	0	0	0	0	30	90	160	260	360	470	600	740	880	1, 040	1, 200	1, 370	1, 550	1, 740	1, 930	2, 130	2, 340	1026.3
1026.2	0	0	0	30	90	160	250	360	470	600	730	880	1, 030	1, 200	1, 370	1, 540	1, 730	1, 920	2, 120	2, 330	2, 540	1026.2
1026.1	0	0	30	85	160	250	350	470	590	730	870	1, 030	1, 190	1, 360	1, 540	1, 720	1, 910	2, 110	2, 320	2, 530	2, 750	1026.1
1026.0	0	30	85	160	250	350	470	590	730	870	1, 020	1, 180	1, 350	1, 530	1, 710	1, 910	2, 100	2, 310	2, 520	2, 740	2, 960	1026.0
1025.9	30	85	160	250	350	460	590	720	870	1, 020	1, 180	1, 350	1, 520	1, 710	1, 900	2, 090	2, 300	2, 510	2, 730	2, 950	3, 180	1025.9
1025.8	85	160	250	350	460	580	720	860	1, 010	1, 170	1, 340	1, 510	1, 700	1, 890	2, 080	2, 290	2, 500	2, 710	2, 940	3, 170	3, 400	1025.8
1025.7	160	250	350	460	580	710	860	1, 010	1, 160	1, 330	1, 510	1, 690	1, 880	2, 070	2, 280	2, 490	2, 700	2, 920	3, 150	3, 380	3, 620	1025.7
1025.6	240	340	460	580	710	850	1, 000	1, 160	1, 320	1, 500	1, 680	1, 870	2, 060	2, 260	2, 470	2, 690	2, 910	3, 140	3, 370	3, 610	3, 850	1025.6
1025.5	340	450	570	710	850	990	1, 150	1, 320	1, 490	1, 670	1, 860	2, 050	2, 250	2, 460	2, 670	2, 900	3, 120	3, 350	3, 590	3, 830	4, 080	1025.5
1025.4	450	570	700	840	990	1, 150	1, 310	1, 480	1, 660	1, 850	2, 040	2, 240	2, 450	2, 660	2, 880	3, 110	3, 340	3, 570	3, 820	4, 070	4, 320	1025.4
1025.3	570	700	840	980	1, 140	1, 300	1, 470	1, 650	1, 840	2, 030	2, 230	2, 440	2, 650	2, 870	3, 090	3, 320	3, 560	3, 800	4, 050	4, 300	4, 560	1025.3
1025.2	690	830	980	1, 130	1, 300	1, 470	1, 640	1, 830	2, 020	2, 220	2, 420	2, 640	2, 850	3, 080	3, 310	3, 540	3, 780	4, 030	4, 280	4, 540	4, 800	1025.2
1025.1	830	970	1, 130	1, 290	1, 460	1, 640	1, 820	2, 010	2, 210	2, 410	2, 620	2, 840	3, 060	3, 290	3, 520	3, 760	4, 010	4, 260	4, 520	4, 780	5, 050	1025.1
1025.0	970	1, 120	1, 280	1, 450	1, 630	1, 810	2, 000	2, 200	2, 400	2, 610	2, 830	3, 050	3, 280	3, 510	3, 750	3, 990	4, 240	4, 500	4, 760	5, 020	5, 290	1025.0
1024.9	1, 110	1, 270	1, 440	1, 620	1, 800	1, 990	2, 180	2, 390	2, 590	2, 810	3, 030	3, 260	3, 490	3, 730	3, 970	4, 220	4, 470	4, 730	5, 000	5, 270	5, 540	1024.9
1024.8	1, 260	1, 430	1, 610	1, 790	1, 980	2, 170	2, 370	2, 580	2, 790	3, 010	3, 240	3, 470	3, 710	3, 950	4, 200	4, 450	4, 710	4, 970	5, 240	5, 520	5, 790	1024.8
1024.7	1, 420	1, 600	1, 780	1, 960	2, 160	2, 360	2, 570	2, 780	3, 000	3, 220	3, 450	3, 690	3, 930	4, 180	4, 430	4, 690	4, 950	5, 220	5, 490	5, 770	6, 050	1024.7
1024.6	1, 590	1, 770	1, 950	2, 150	2, 340	2, 550	2, 760	2, 980	3, 200	3, 430	3, 670	3, 910	4, 150	4, 400	4, 660	4, 920	5, 190	5, 460	5, 740	6, 020	6, 300	1024.6
1024.5	1, 750	1, 940	2, 130	2, 330	2, 540	2, 750	2, 960	3, 190	3, 410	3, 650	3, 890	4, 130	4, 380	4, 640	4, 900	5, 160	5, 430	5, 710	5, 990	6, 270	6, 560	1024.5
1024.4	1, 930	2, 120	2, 320	2, 520	2, 730	2, 950	3, 170	3, 390	3, 630	3, 870	4, 110	4, 360	4, 610	4, 870	5, 140	5, 410	5, 680	5, 960	6, 240	6, 530	6, 830	1024.4
1024.3	2, 110	2, 300	2, 510	2, 710	2, 930	3, 150	3, 380	3, 610	3, 840	4, 090	4, 340	4, 590	4, 850	5, 110	5, 380	5, 650	5, 930	6, 210	6, 500	6, 790	7, 090	1024.3
1024.2	2, 290	2, 490	2, 700	2, 910	3, 130	3, 360	3, 590	3, 820	4, 070	4, 310	4, 560	4, 820	5, 080	5, 350	5, 620	5, 900	6, 180	6, 470	6, 760	7, 060	7, 360	1024.2
1024.1	2, 480	2, 680	2, 900	3, 110	3, 340	3, 570	3, 800	4, 040	4, 290	4, 540	4, 800	5, 060	5, 320	5, 600	5, 870	6, 150	6, 440	6, 730	7, 020	7, 320	7, 620	1024.1
1024.0	2, 670	2, 880	3, 100	3, 320	3, 550	3, 780	4, 020	4, 270	4, 520	4, 770	5, 030	5, 300	5, 570	5, 840	6, 120	6, 410	6, 690	6, 990	7, 290	7, 590	7, 900	1024.0
1023.9	2, 860	3, 080	3, 300	3, 530	3, 760	4, 000	4, 250	4, 500	4, 750	5, 010	5, 270	5, 540	5, 820	6, 090	6, 380	6, 670	6, 960	7, 260	7, 560	7, 860	8, 170	1023.9
1023.8	3, 060	3, 290	3, 510	3, 750	3, 980	4, 230	4, 470	4, 730	4, 990	5, 250	5, 520	5, 790	6, 070	6, 350	6, 640	6, 930	7, 230	7, 530	7, 830	8, 140	8, 450	1023.8
1023.7	3, 270	3, 500	3, 730	3, 960	4, 210	4, 450	4, 710	4, 960	5, 230	5, 490	5, 770	6, 040	6, 320	6, 610	6, 900	7, 200	7, 500	7, 800	8, 110	8, 420	8, 740	1023.7
1023.6	3, 480	3, 710	3, 940	4, 190	4, 430	4, 680	4, 940	5, 200	5, 470	5, 740	6, 020	6, 300	6, 580	6, 870	7, 170	7, 460	7, 770	8, 080	8, 390	8, 700	9, 020	1023.6
1023.5	3, 690	3, 930	4, 170	4, 410	4, 660	4, 920	5, 180	5, 440	5, 710	5, 990	6, 270	6, 550	6, 840	7, 140	7, 430	7, 740	8, 040	8, 350	8, 670	8, 990	9, 310	1023.5
1023.4	3, 910	4, 150	4, 390	4, 640	4, 890	5, 150	5, 420	5, 690	5, 960	6, 240	6, 530	6, 810	7, 110	7, 400	7, 700	8, 010	8, 320	8, 640	8, 950	9, 280	9, 600	1023.4
1023.3	4, 130	4, 370	4, 620	4, 870	5, 130	5, 390	5, 660	5, 940	6, 210	6, 500	6, 780	7, 080	7, 370	7, 670	7, 980	8, 290	8, 600	8, 920	9, 240	9, 570	9, 900	1023.3
1023.2	4, 350	4, 600	4, 850	5, 110	5, 370	5, 640	5, 910	6, 190	6, 470	6, 760	7, 050	7, 340	7, 640	7, 940	8, 250	8, 570	8, 880	9, 200	9, 530	9, 860	10, 190	1023.2
1023.1	4, 570	4, 830	5, 080	5, 350	5, 610	5, 880	6, 160	6, 440	6, 730	7, 020	7, 310	7, 610	7, 910	8, 220	8, 530	8, 850	9, 170	9, 490	9, 820	10, 150	10, 490	1023.1
1023.0	4, 800	5, 060	5, 320	5, 590	5, 860	6, 130	6, 410	6, 700	6, 990	7, 280	7, 580	7, 880	8, 190	8, 500	8, 810	9, 130	9, 460	9, 780	10, 110	10, 450	10, 790	1023.0
1022.9	5, 050	5, 310	5, 570	5, 840	6, 120	6, 400	6, 680	6, 970	7, 260	7, 560	7, 860	8, 170	8, 480	8, 790	9, 110	9, 440	9, 760	10, 090	10, 430	10, 770	11, 110	1022.9
1022.8	5, 290	5, 560	5, 830	6, 100	6, 380	6, 660	6, 950	7, 250	7, 540	7, 840	8, 150	8, 460	8, 770	9, 090	9, 420	9, 740	10, 070	10, 410	10, 750	11, 090	11, 440	1022.8
1022.7	5, 540	5, 810	6, 090	6, 370	6, 650	6, 940	7, 230	7, 530	7, 830	8, 130	8, 440	8, 760	9, 070	9, 400	9, 720	10, 050	10, 390	10, 730	11, 070	11, 420	11, 770	1022.7
1022.6	5, 800	6, 070	6, 350	6, 630	6, 920	7, 210	7, 510	7, 810	8, 110	8, 420	8, 740	9, 050	9, 380	9, 700	10, 030	10, 370	10, 700	11, 050	11, 390	11, 740	12, 100	1022.6
1022.5	6, 060	6, 330	6, 620	6, 900	7, 190	7, 490	7, 790	8, 100	8, 400	8, 720	9, 030	9, 360	9, 680	10, 010	10, 340	10, 680	11, 020	11, 370	11, 720	12, 070	12, 430	1022.5
1022.4	6, 320	6, 600	6, 890	7, 180	7, 470	7, 770	8, 080	8, 390	8, 700	9, 010	9, 340	9, 660	9, 990	10, 320	10, 660	11, 000	11, 350	11, 700	12, 050	12, 410	12, 770	1022.4
1022.3	6, 580	6, 870	7, 160	7, 460	7, 750	8, 060	8, 370	8, 680	8, 990	9, 320	9, 640	9, 970	10, 300	10, 640	10, 980	11, 330	11, 670	12, 030	12, 380	12, 740	13, 110	1022.3
1022.2	6, 850	7, 140	7, 440	7, 740	8, 040	8, 350	8, 660	8, 980	9, 300	9, 620	9, 950	10, 280	10, 620	10, 960	11, 300	11, 650	12, 000	12, 360	12, 720	13, 080	13, 450	1022.2
1022.1	7, 130	7, 420	7, 720	8, 020	8, 330	8, 640	8, 960	9, 280	9, 600	9, 930	10, 260	10, 600	10, 940	11, 280	11, 630	11, 980	12, 340	12, 700	13, 060	13, 430	13, 800	1022.1
1022.0	7, 400	7, 700	8, 000	8, 310	8, 620	8, 940	9, 260	9, 580	9, 910	10, 240	10, 570	10, 910	11, 260	11, 610	11, 960	12, 310	12, 670	13, 040	13, 400	13, 770	14, 150	1022.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1026.0	1026.1	1026.2	1026.3	1026.4	1026.5	1026.6	1026.7	1026.8	1026.9	1027.0	1027.1	1027.2	1027.3	1027.4	1027.5	1027.6	1027.7	1027.8	1027.9	1028.0	
1021.9	7,690	7,990	8,300	8,610	8,920	9,240	9,570	9,890	10,230	10,560	10,900	11,240	11,590	11,940	12,300	12,660	13,020	13,390	13,760	14,130	14,510	1021.9
1021.8	7,980	8,290	8,600	8,910	9,230	9,550	9,880	10,210	10,550	10,890	11,230	11,580	11,930	12,290	12,640	13,010	13,370	13,750	14,120	14,500	14,880	1021.8
1021.7	8,280	8,590	8,900	9,220	9,540	9,870	10,200	10,540	10,870	11,220	11,570	11,920	12,270	12,630	12,990	13,360	13,730	14,110	14,480	14,870	15,250	1021.7
1021.6	8,570	8,890	9,210	9,530	9,860	10,190	10,520	10,860	11,200	11,550	11,900	12,260	12,620	12,980	13,350	13,720	14,090	14,470	14,850	15,240	15,630	1021.6
1021.5	8,880	9,200	9,520	9,840	10,170	10,510	10,850	11,190	11,540	11,890	12,240	12,600	12,970	13,330	13,700	14,080	14,450	14,840	15,220	15,610	16,000	1021.5
1021.4	9,180	9,510	9,830	10,160	10,500	10,840	11,180	11,530	11,880	12,230	12,590	12,950	13,320	13,690	14,060	14,440	14,820	15,210	15,600	15,990	16,380	1021.4
1021.3	9,490	9,820	10,150	10,480	10,820	11,170	11,510	11,860	12,220	12,580	12,940	13,300	13,670	14,050	14,430	14,810	15,190	15,580	15,970	16,370	16,770	1021.3
1021.2	9,810	10,140	10,470	10,810	11,150	11,500	11,850	12,200	12,560	12,920	13,290	13,660	14,030	14,410	14,790	15,180	15,570	15,960	16,350	16,750	17,160	1021.2
1021.1	10,120	10,460	10,800	11,140	11,490	11,840	12,190	12,550	12,910	13,280	13,650	14,020	14,400	14,780	15,160	15,550	15,940	16,340	16,740	17,140	17,550	1021.1
1021.0	10,450	10,780	11,130	11,470	11,820	12,180	12,530	12,900	13,260	13,630	14,000	14,380	14,760	15,150	15,540	15,930	16,320	16,720	17,130	17,530	17,940	1021.0
1020.9	10,780	11,120	11,470	11,820	12,170	12,530	12,890	13,260	13,630	14,000	14,380	14,760	15,140	15,530	15,930	16,320	16,720	17,120	17,530	17,940	18,360	1020.9
1020.8	11,120	11,460	11,810	12,170	12,530	12,890	13,250	13,620	14,000	14,380	14,760	15,140	15,530	15,920	16,320	16,720	17,120	17,530	17,940	18,360	18,770	1020.8
1020.7	11,460	11,810	12,160	12,520	12,880	13,250	13,620	13,990	14,370	14,750	15,140	15,530	15,920	16,320	16,720	17,120	17,530	17,940	18,350	18,770	19,190	1020.7
1020.6	11,810	12,160	12,520	12,880	13,250	13,620	13,990	14,370	14,750	15,140	15,520	15,920	16,310	16,710	17,120	17,530	17,940	18,350	18,770	19,190	19,620	1020.6
1020.5	12,160	12,510	12,880	13,240	13,610	13,990	14,370	14,750	15,130	15,520	15,910	16,310	16,710	17,120	17,520	17,940	18,350	18,770	19,190	19,620	20,050	1020.5
1020.4	12,510	12,870	13,240	13,610	13,980	14,360	14,740	15,130	15,520	15,910	16,310	16,710	17,110	17,520	17,930	18,350	18,770	19,190	19,620	20,050	20,480	1020.4
1020.3	12,870	13,240	13,610	13,980	14,360	14,740	15,130	15,520	15,910	16,310	16,710	17,110	17,520	17,930	18,350	18,770	19,190	19,610	20,040	20,480	20,910	1020.3
1020.2	13,230	13,600	13,980	14,360	14,740	15,120	15,510	15,910	16,300	16,710	17,110	17,520	17,930	18,350	18,760	19,190	19,610	20,040	20,480	20,910	21,360	1020.2
1020.1	13,600	13,970	14,350	14,730	15,120	15,510	15,900	16,300	16,700	17,110	17,520	17,930	18,340	18,760	19,190	19,610	20,040	20,480	20,910	21,360	21,800	1020.1
1020.0	13,970	14,350	14,730	15,120	15,510	15,900	16,300	16,700	17,110	17,510	17,930	18,340	18,760	19,190	19,610	20,040	20,480	20,910	21,360	21,800	22,250	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																				GATE ELEVATION IN FEET
	1028.0	1028.1	1028.2	1028.3	1028.4	1028.5	1028.6	1028.7	1028.8	1028.9	1029.0	1029.1	1029.2	1029.3	1029.4	1029.5	1029.6	1029.7	1029.8	1029.9	1030.0	
1029.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	1029.9
1029.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	1029.8
1029.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	1029.7
1029.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	1029.6
1029.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	1029.5
1029.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	530	1029.4
1029.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	530	670	1029.3
1029.2	0	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	530	670	820	1029.2
1029.1	0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	530	670	810	970	1029.1
1029.0	0	0	0	0	0	0	0	0	0	0	0	35	100	190	290	400	530	670	810	970	1, 140	1029.0
1028.9	0	0	0	0	0	0	0	0	0	0	35	100	180	290	400	530	660	810	970	1, 140	1, 310	1028.9
1028.8	0	0	0	0	0	0	0	0	0	35	100	180	280	400	520	660	810	970	1, 130	1, 310	1, 490	1028.8
1028.7	0	0	0	0	0	0	0	0	35	100	180	280	400	520	660	810	960	1, 130	1, 310	1, 490	1, 680	1028.7
1028.6	0	0	0	0	0	0	0	35	100	180	280	400	520	660	810	960	1, 130	1, 300	1, 490	1, 680	1, 870	1028.6
1028.5	0	0	0	0	0	0	35	100	180	280	390	520	660	800	960	1, 120	1, 300	1, 480	1, 670	1, 870	2, 080	1028.5
1028.4	0	0	0	0	0	35	100	180	280	390	520	650	800	960	1, 120	1, 300	1, 480	1, 670	1, 870	2, 070	2, 280	1028.4
1028.3	0	0	0	0	35	100	180	280	390	520	650	800	950	1, 120	1, 290	1, 480	1, 660	1, 860	2, 070	2, 280	2, 500	1028.3
1028.2	0	0	0	35	100	180	280	390	520	650	800	950	1, 120	1, 290	1, 470	1, 660	1, 860	2, 060	2, 270	2, 490	2, 720	1028.2
1028.1	0	0	35	95	180	280	390	510	650	790	950	1, 110	1, 290	1, 470	1, 660	1, 850	2, 060	2, 270	2, 490	2, 710	2, 940	1028.1
1028.0	0	35	95	180	280	390	510	650	790	950	1, 110	1, 280	1, 460	1, 650	1, 850	2, 050	2, 260	2, 480	2, 710	2, 940	3, 180	1028.0
1027.9	35	95	180	280	390	510	640	790	940	1, 110	1, 280	1, 460	1, 650	1, 840	2, 050	2, 260	2, 480	2, 700	2, 930	3, 170	3, 410	1027.9
1027.8	95	180	270	390	510	640	790	940	1, 100	1, 280	1, 450	1, 640	1, 840	2, 040	2, 250	2, 470	2, 690	2, 920	3, 160	3, 400	3, 650	1027.8
1027.7	180	270	380	510	640	780	940	1, 100	1, 270	1, 450	1, 640	1, 830	2, 030	2, 240	2, 460	2, 680	2, 910	3, 150	3, 390	3, 640	3, 890	1027.7
1027.6	270	380	500	640	780	930	1, 100	1, 270	1, 450	1, 630	1, 830	2, 030	2, 240	2, 450	2, 670	2, 900	3, 140	3, 380	3, 630	3, 880	4, 140	1027.6
1027.5	380	500	630	780	930	1, 090	1, 260	1, 440	1, 630	1, 820	2, 020	2, 230	2, 440	2, 670	2, 900	3, 130	3, 370	3, 620	3, 870	4, 130	4, 390	1027.5
1027.4	500	630	770	930	1, 090	1, 260	1, 440	1, 620	1, 810	2, 010	2, 220	2, 440	2, 660	2, 890	3, 120	3, 360	3, 610	3, 860	4, 120	4, 380	4, 650	1027.4
1027.3	630	770	920	1, 080	1, 250	1, 430	1, 620	1, 810	2, 010	2, 220	2, 430	2, 650	2, 880	3, 110	3, 350	3, 600	3, 850	4, 110	4, 370	4, 640	4, 910	1027.3
1027.2	770	920	1, 080	1, 250	1, 430	1, 610	1, 800	2, 000	2, 210	2, 420	2, 640	2, 870	3, 100	3, 340	3, 590	3, 840	4, 090	4, 360	4, 620	4, 900	5, 180	1027.2
1027.1	920	1, 080	1, 240	1, 420	1, 600	1, 800	2, 000	2, 200	2, 410	2, 630	2, 860	3, 090	3, 330	3, 580	3, 830	4, 080	4, 340	4, 610	4, 880	5, 160	5, 450	1027.1
1027.0	1, 070	1, 240	1, 420	1, 600	1, 790	1, 990	2, 190	2, 410	2, 630	2, 850	3, 080	3, 320	3, 570	3, 820	4, 070	4, 330	4, 600	4, 870	5, 150	5, 430	5, 720	1027.0
1026.9	1, 230	1, 410	1, 590	1, 780	1, 980	2, 190	2, 400	2, 620	2, 840	3, 070	3, 310	3, 550	3, 800	4, 060	4, 320	4, 580	4, 850	5, 130	5, 410	5, 700	5, 990	1026.9
1026.8	1, 400	1, 590	1, 780	1, 970	2, 180	2, 390	2, 610	2, 830	3, 060	3, 300	3, 540	3, 790	4, 040	4, 300	4, 570	4, 840	5, 110	5, 390	5, 680	5, 970	6, 270	1026.8
1026.7	1, 580	1, 770	1, 960	2, 170	2, 380	2, 590	2, 820	3, 050	3, 280	3, 530	3, 770	4, 030	4, 290	4, 550	4, 820	5, 100	5, 380	5, 660	5, 950	6, 250	6, 550	1026.7
1026.6	1, 760	1, 960	2, 160	2, 370	2, 580	2, 810	3, 040	3, 270	3, 510	3, 760	4, 010	4, 270	4, 530	4, 800	5, 080	5, 360	5, 640	5, 930	6, 230	6, 530	6, 830	1026.6
1026.5	1, 950	2, 150	2, 360	2, 570	2, 800	3, 020	3, 260	3, 500	3, 740	4, 000	4, 250	4, 520	4, 790	5, 060	5, 340	5, 620	5, 910	6, 210	6, 500	6, 810	7, 120	1026.5
1026.4	2, 140	2, 350	2, 560	2, 780	3, 010	3, 250	3, 490	3, 730	3, 980	4, 240	4, 500	4, 770	5, 040	5, 320	5, 600	5, 890	6, 180	6, 480	6, 790	7, 090	7, 410	1026.4
1026.3	2, 340	2, 550	2, 770	3, 000	3, 230	3, 470	3, 720	3, 970	4, 220	4, 480	4, 750	5, 020	5, 300	5, 580	5, 870	6, 160	6, 460	6, 760	7, 070	7, 380	7, 700	1026.3
1026.2	2, 540	2, 760	2, 990	3, 220	3, 460	3, 700	3, 950	4, 210	4, 470	4, 730	5, 000	5, 280	5, 560	5, 850	6, 140	6, 440	6, 740	7, 050	7, 360	7, 670	7, 990	1026.2
1026.1	2, 750	2, 980	3, 210	3, 440	3, 690	3, 940	4, 190	4, 450	4, 720	4, 990	5, 260	5, 540	5, 830	6, 120	6, 420	6, 720	7, 020	7, 330	7, 650	7, 970	8, 290	1026.1
1026.0	2, 960	3, 200	3, 430	3, 670	3, 920	4, 180	4, 430	4, 700	4, 970	5, 240	5, 520	5, 810	6, 100	6, 390	6, 690	7, 000	7, 310	7, 620	7, 940	8, 260	8, 590	1026.0
1025.9	3, 180	3, 420	3, 660	3, 900	4, 160	4, 420	4, 680	4, 950	5, 220	5, 500	5, 790	6, 070	6, 370	6, 670	6, 970	7, 280	7, 590	7, 910	8, 230	8, 560	8, 890	1025.9
1025.8	3, 400	3, 640	3, 890	4, 140	4, 400	4, 660	4, 930	5, 200	5, 480	5, 760	6, 050	6, 340	6, 640	6, 940	7, 250	7, 560	7, 880	8, 200	8, 530	8, 860	9, 190	1025.8
1025.7	3, 620	3, 870	4, 120	4, 380	4, 640	4, 910	5, 180	5, 460	5, 740	6, 020	6, 320	6, 610	6, 920	7, 220	7, 530	7, 850	8, 170	8, 490	8, 820	9, 160	9, 490	1025.7
1025.6	3, 850	4, 100	4, 360	4, 620	4, 880	5, 160	5, 430	5, 710	6, 000	6, 290	6, 590	6, 890	7, 190	7, 500	7, 820	8, 140	8, 460	8, 790	9, 120	9, 460	9, 800	1025.6
1025.5	4, 080	4, 340	4, 600	4, 860	5, 130	5, 410	5, 690	5, 970	6, 270	6, 560	6, 860	7, 160	7, 470	7, 790	8, 110	8, 430	8, 760	9, 090	9, 420	9, 760	10, 110	1025.5
1025.4	4, 320	4, 580	4, 840	5, 110	5, 390	5, 670	5, 950	6, 240	6, 530	6, 830	7, 140	7, 440	7, 760	8, 070	8, 400	8, 720	9, 050	9, 390	9, 730	10, 070	10, 420	1025.4
1025.3	4, 560	4, 820	5, 090	5, 360	5, 640	5, 930	6, 210	6, 510	6, 800	7, 110	7, 410	7, 730	8, 040	8, 360	8, 690	9, 020	9, 350	9, 690	10, 030	10, 380	10, 730	1025.3
1025.2	4, 800	5, 070	5, 340	5, 620	5, 900	6, 190	6, 480	6, 780	7, 080	7, 380	7, 700	8, 010	8, 330	8, 650	8, 980	9, 320	9, 650	9, 990	10, 340	10, 690	11, 040	1025.2
1025.1	5, 050	5, 320	5, 590	5, 880	6, 160	6, 450	6, 750	7, 050	7, 360	7, 660	7, 980	8, 300	8, 620	8, 950	9, 280	9, 620	9, 960	10, 300	10, 650	11, 000	11, 360	1025.1
1025.0	5, 290	5, 570	5, 850	6, 140	6, 430	6, 720	7, 020	7, 330	7, 630	7, 950	8, 270	8, 590	8, 910	9, 240	9, 580	9, 920	10, 260	10, 610	10, 960	11, 320	11, 680	1025.0
1024.9	5, 540	5, 820	6, 110	6, 400	6, 690	6, 990	7, 290	7, 600	7, 910	8, 230	8, 550	8, 870	9, 200	9, 540	9, 880	10, 220	10, 570	10, 920	11, 270	11, 630	11, 990	1024.9
1024.8	5, 790	6, 080	6, 370	6, 660	6, 960	7, 260	7, 560	7, 880	8, 190	8, 510	8, 840	9, 160	9, 500	9, 830	10, 180	10, 520	10, 870	11, 220	11, 580	11, 940	12, 310	1024.8
1024.7	6, 050	6, 330	6, 630	6, 920	7, 220	7, 530	7, 840	8, 150	8, 470	8, 800	9, 120	9, 460	9, 790	10, 130	10, 480	10, 820	11, 180	11, 530	11, 890	12, 260	12, 630	1024.7
1024.6	6, 300	6, 600	6, 890	7, 190	7, 490	7, 800	8, 120	8, 440	8, 760	9, 080	9, 410	9, 750	10, 090	10, 430	10, 780	11, 130	11, 490	11, 840	12, 210	12, 570	12, 950	1024.6
1024.5	6, 560	6, 860	7, 160	7, 460	7, 770	8, 080	8, 400	8, 720	9, 040	9, 370	9, 710	10, 040	10, 390	10, 730	11, 080	11, 440	11, 800	12, 160	12, 520	12, 890	13, 270	1024.5
1024.4	6, 830	7, 120	7, 430	7, 730	8, 040	8, 360	8, 680	9, 000	9, 330	9, 660	10, 000	10, 340	10, 690	11, 040	11, 390	11, 750	12, 110	12, 470	12, 840	13, 210	13, 590	1024.4
1024.3	7, 090	7, 390	7, 700	8, 010	8, 320	8, 640	8, 960	9, 290	9, 620	9, 960	10, 300	10, 640	10, 990	11, 340	11, 700	12, 060	12, 420	12, 790	13, 160	13, 540	13, 910	1024.3
1024.2	7, 360	7, 660	7, 970	8, 280	8, 600	8, 920	9, 250	9, 580	9, 910	10, 250	10, 600	10, 940	11, 290	11, 650	12, 010	12, 370	12, 740	13, 110	13, 480	13, 860	14, 240	1024.2
1024.1	7, 620	7, 930	8, 240	8, 560	8, 880	9, 210	9, 540	9, 870	10, 210	10, 550	10, 900	11, 250	11, 600	11, 960	12, 320	12, 680	13, 050	13, 430	13, 800	14, 180	14, 570	1024.1
1024.0	7, 900	8, 210	8, 520	8, 840	9, 170	9, 490	9, 830	10, 160	10, 500	10, 850	11, 200	11, 550	11, 910	12, 270	12, 630	13, 000	13, 370	13, 750	14, 130	14, 510	14, 900	1024.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1028.0	1028.1	1028.2	1028.3	1028.4	1028.5	1028.6	1028.7	1028.8	1028.9	1029.0	1029.1	1029.2	1029.3	1029.4	1029.5	1029.6	1029.7	1029.8	1029.9	1030.0	
1023.9	8,170	8,490	8,810	9,130	9,460	9,790	10,130	10,470	10,810	11,160	11,510	11,860	12,220	12,590	12,950	13,330	13,700	14,080	14,460	14,850	15,240	1023.9
1023.8	8,450	8,770	9,100	9,420	9,750	10,090	10,430	10,770	11,120	11,470	11,820	12,180	12,540	12,910	13,280	13,650	14,030	14,410	14,800	15,190	15,580	1023.8
1023.7	8,740	9,060	9,390	9,720	10,050	10,390	10,730	11,080	11,430	11,780	12,140	12,500	12,860	13,230	13,610	13,980	14,370	14,750	15,140	15,530	15,920	1023.7
1023.6	9,020	9,350	9,680	10,010	10,350	10,690	11,030	11,380	11,740	12,090	12,460	12,820	13,190	13,560	13,940	14,320	14,700	15,090	15,480	15,870	16,270	1023.6
1023.5	9,310	9,640	9,970	10,310	10,650	10,990	11,340	11,690	12,050	12,410	12,770	13,140	13,510	13,890	14,270	14,650	15,040	15,430	15,820	16,220	16,620	1023.5
1023.4	9,600	9,940	10,270	10,610	10,950	11,300	11,650	12,010	12,370	12,730	13,100	13,470	13,840	14,220	14,600	14,990	15,380	15,770	16,170	16,570	16,970	1023.4
1023.3	9,900	10,230	10,570	10,910	11,260	11,610	11,960	12,320	12,680	13,050	13,420	13,790	14,170	14,550	14,940	15,330	15,720	16,110	16,510	16,920	17,320	1023.3
1023.2	10,190	10,530	10,870	11,220	11,570	11,920	12,280	12,640	13,000	13,370	13,750	14,120	14,500	14,890	15,270	15,670	16,060	16,460	16,860	17,270	17,680	1023.2
1023.1	10,490	10,830	11,180	11,520	11,880	12,230	12,590	12,960	13,330	13,700	14,070	14,450	14,840	15,220	15,610	16,010	16,410	16,810	17,210	17,620	18,030	1023.1
1023.0	10,790	11,130	11,480	11,830	12,190	12,550	12,910	13,280	13,650	14,030	14,400	14,790	15,170	15,560	15,960	16,350	16,750	17,160	17,560	17,970	18,390	1023.0
1022.9	11,110	11,460	11,810	12,170	12,530	12,890	13,260	13,630	14,000	14,380	14,760	15,150	15,540	15,930	16,320	16,720	17,130	17,540	17,950	18,360	18,780	1022.9
1022.8	11,440	11,790	12,140	12,500	12,860	13,230	13,600	13,980	14,350	14,730	15,120	15,510	15,900	16,300	16,700	17,100	17,510	17,920	18,330	18,750	19,170	1022.8
1022.7	11,770	12,120	12,480	12,840	13,210	13,580	13,950	14,330	14,710	15,090	15,480	15,870	16,270	16,670	17,070	17,480	17,890	18,300	18,720	19,140	19,560	1022.7
1022.6	12,100	12,450	12,820	13,180	13,550	13,930	14,300	14,680	15,070	15,460	15,850	16,240	16,640	17,040	17,450	17,860	18,270	18,690	19,110	19,530	19,960	1022.6
1022.5	12,430	12,790	13,160	13,530	13,900	14,280	14,660	15,040	15,430	15,820	16,210	16,610	17,020	17,420	17,830	18,240	18,660	19,080	19,500	19,930	20,360	1022.5
1022.4	12,770	13,130	13,500	13,870	14,250	14,630	15,010	15,400	15,790	16,190	16,590	16,990	17,390	17,800	18,210	18,630	19,050	19,470	19,900	20,330	20,760	1022.4
1022.3	13,110	13,480	13,850	14,230	14,600	14,990	15,380	15,770	16,160	16,560	16,960	17,360	17,770	18,190	18,600	19,020	19,440	19,870	20,300	20,730	21,170	1022.3
1022.2	13,450	13,820	14,200	14,580	14,960	15,350	15,740	16,130	16,530	16,930	17,340	17,740	18,160	18,570	18,990	19,410	19,840	20,270	20,700	21,140	21,580	1022.2
1022.1	13,800	14,170	14,550	14,940	15,320	15,710	16,110	16,500	16,900	17,310	17,720	18,130	18,540	18,960	19,380	19,810	20,240	20,670	21,110	21,540	21,990	1022.1
1022.0	14,150	14,530	14,910	15,290	15,680	16,080	16,470	16,880	17,280	17,690	18,100	18,510	18,930	19,350	19,780	20,210	20,640	21,070	21,510	21,950	22,400	1022.0
1021.9	14,510	14,890	15,280	15,670	16,060	16,460	16,860	17,260	17,670	18,080	18,500	18,920	19,340	19,760	20,190	20,620	21,060	21,500	21,940	22,380	22,830	1021.9
1021.8	14,880	15,270	15,650	16,050	16,440	16,840	17,250	17,660	18,070	18,480	18,900	19,320	19,750	20,180	20,610	21,040	21,480	21,920	22,370	22,820	23,270	1021.8
1021.7	15,250	15,640	16,030	16,430	16,830	17,230	17,640	18,050	18,470	18,880	19,310	19,730	20,160	20,590	21,030	21,470	21,910	22,350	22,800	23,250	23,710	1021.7
1021.6	15,630	16,020	16,410	16,810	17,220	17,630	18,040	18,450	18,870	19,290	19,720	20,140	20,580	21,010	21,450	21,890	22,340	22,790	23,240	23,690	24,150	1021.6
1021.5	16,000	16,400	16,800	17,200	17,610	18,020	18,440	18,850	19,270	19,700	20,130	20,560	21,000	21,430	21,880	22,320	22,770	23,220	23,680	24,140	24,600	1021.5
1021.4	16,380	16,780	17,190	17,600	18,010	18,420	18,840	19,260	19,680	20,110	20,540	20,980	21,420	21,860	22,310	22,750	23,210	23,660	24,120	24,580	25,050	1021.4
1021.3	16,770	17,170	17,580	17,990	18,400	18,820	19,240	19,670	20,100	20,530	20,960	21,400	21,840	22,290	22,740	23,190	23,650	24,110	24,570	25,030	25,500	1021.3
1021.2	17,160	17,560	17,980	18,390	18,810	19,230	19,650	20,080	20,510	20,950	21,390	21,830	22,270	22,720	23,180	23,630	24,090	24,550	25,020	25,490	25,960	1021.2
1021.1	17,550	17,960	18,370	18,790	19,210	19,640	20,070	20,500	20,930	21,370	21,810	22,260	22,710	23,160	23,610	24,070	24,540	25,000	25,470	25,940	26,420	1021.1
1021.0	17,940	18,360	18,780	19,200	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,140	23,600	24,060	24,520	24,990	25,450	25,930	26,400	26,880	1021.0
1020.9	18,360	18,770	19,200	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,140	23,600	24,060	24,520	24,990	25,460	25,930	26,410	26,880	27,370	1020.9
1020.8	18,770	19,190	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,150	23,600	24,060	24,520	24,990	25,460	25,930	26,410	26,890	27,370	27,860	1020.8
1020.7	19,190	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,150	23,600	24,060	24,530	24,990	25,460	25,940	26,410	26,890	27,370	27,860	28,350	1020.7
1020.6	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,150	23,600	24,060	24,530	24,990	25,460	25,940	26,410	26,890	27,380	27,860	28,350	28,850	1020.6
1020.5	20,050	20,480	20,920	21,360	21,800	22,250	22,700	23,150	23,610	24,070	24,530	25,000	25,470	25,940	26,420	26,900	27,380	27,870	28,360	28,850	29,350	1020.5
1020.4	20,480	20,920	21,360	21,800	22,250	22,700	23,150	23,610	24,070	24,530	25,000	25,470	25,940	26,420	26,900	27,390	27,870	28,360	28,860	29,350	29,850	1020.4
1020.3	20,910	21,360	21,800	22,250	22,700	23,150	23,610	24,070	24,530	25,000	25,470	25,950	26,420	26,910	27,390	27,880	28,370	28,860	29,360	29,860	30,360	1020.3
1020.2	21,360	21,800	22,250	22,700	23,150	23,610	24,070	24,540	25,000	25,470	25,950	26,430	26,910	27,390	27,880	28,370	28,870	29,370	29,870	30,370	30,880	1020.2
1020.1	21,800	22,250	22,700	23,150	23,610	24,070	24,540	25,010	25,480	25,950	26,430	26,910	27,400	27,890	28,380	28,870	29,370	29,870	30,380	30,880	31,400	1020.1
1020.0	22,250	22,700	23,150	23,610	24,070	24,540	25,010	25,480	25,960	26,430	26,920	27,400	27,890	28,380	28,880	29,380	29,880	30,380	30,890	31,400	31,920	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1030.0	1030.1	1030.2	1030.3	1030.4	1030.5	1030.6	1030.7	1030.8	1030.9	1031.0	1031.1	1031.2	1031.3	1031.4	1031.5	1031.6	1031.7	1031.8	1031.9	1032.0	
1031.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1031.9
1031.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	1031.8
1031.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	1031.7
1031.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	300	1031.6
1031.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	300	420	1031.5
1031.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	190	300	420	550	1031.4
1031.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	190	300	420	550	690	1031.3
1031.2	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	190	300	420	550	690	840	1031.2
1031.1	0	0	0	0	0	0	0	0	0	0	0	0	35	110	190	300	420	550	690	840	1, 000	1031.1
1031.0	0	0	0	0	0	0	0	0	0	0	0	35	110	190	300	420	550	690	840	1, 000	1, 180	1031.0
1030.9	0	0	0	0	0	0	0	0	0	0	35	110	190	300	420	550	690	840	1, 000	1, 170	1, 350	1030.9
1030.8	0	0	0	0	0	0	0	0	0	35	110	190	300	410	550	690	840	1, 000	1, 170	1, 350	1, 540	1030.8
1030.7	0	0	0	0	0	0	0	0	35	100	190	300	410	540	690	840	1, 000	1, 170	1, 350	1, 540	1, 730	1030.7
1030.6	0	0	0	0	0	0	0	35	100	190	300	410	540	680	840	1, 000	1, 170	1, 350	1, 540	1, 730	1, 940	1030.6
1030.5	0	0	0	0	0	0	35	100	190	300	410	540	680	840	1, 000	1, 170	1, 350	1, 530	1, 730	1, 930	2, 140	1030.5
1030.4	0	0	0	0	0	35	100	190	290	410	540	680	830	1, 000	1, 170	1, 350	1, 530	1, 730	1, 930	2, 140	2, 360	1030.4
1030.3	0	0	0	0	35	100	190	290	410	540	680	830	990	1, 160	1, 340	1, 530	1, 730	1, 930	2, 140	2, 360	2, 580	1030.3
1030.2	0	0	0	35	100	190	290	410	540	680	830	990	1, 160	1, 340	1, 530	1, 720	1, 930	2, 140	2, 350	2, 580	2, 810	1030.2
1030.1	0	0	35	100	190	290	410	540	680	830	990	1, 160	1, 340	1, 530	1, 720	1, 920	2, 130	2, 350	2, 580	2, 810	3, 040	1030.1
1030.0	0	35	100	190	290	410	540	680	830	990	1, 160	1, 340	1, 520	1, 720	1, 920	2, 130	2, 350	2, 570	2, 800	3, 040	3, 280	1030.0
1029.9	35	100	190	290	410	540	680	830	990	1, 160	1, 340	1, 520	1, 720	1, 920	2, 130	2, 350	2, 570	2, 800	3, 040	3, 280	3, 530	1029.9
1029.8	100	190	290	410	540	680	830	990	1, 160	1, 330	1, 520	1, 710	1, 920	2, 130	2, 340	2, 570	2, 800	3, 030	3, 280	3, 520	3, 780	1029.8
1029.7	190	290	410	530	670	820	980	1, 150	1, 330	1, 520	1, 710	1, 910	2, 120	2, 340	2, 560	2, 790	3, 030	3, 270	3, 520	3, 770	4, 040	1029.7
1029.6	290	410	530	670	820	980	1, 150	1, 330	1, 510	1, 710	1, 910	2, 120	2, 330	2, 560	2, 790	3, 020	3, 270	3, 510	3, 770	4, 030	4, 300	1029.6
1029.5	400	530	670	820	980	1, 150	1, 330	1, 510	1, 710	1, 910	2, 120	2, 330	2, 550	2, 780	3, 020	3, 260	3, 510	3, 760	4, 030	4, 290	4, 560	1029.5
1029.4	530	670	820	980	1, 150	1, 320	1, 510	1, 700	1, 900	2, 110	2, 330	2, 550	2, 780	3, 010	3, 260	3, 510	3, 760	4, 020	4, 290	4, 560	4, 830	1029.4
1029.3	670	820	980	1, 150	1, 320	1, 510	1, 700	1, 900	2, 110	2, 320	2, 550	2, 780	3, 010	3, 250	3, 500	3, 750	4, 010	4, 280	4, 550	4, 830	5, 110	1029.3
1029.2	820	980	1, 140	1, 320	1, 500	1, 700	1, 900	2, 110	2, 320	2, 540	2, 770	3, 010	3, 250	3, 500	3, 750	4, 010	4, 270	4, 550	4, 820	5, 110	5, 390	1029.2
1029.1	970	1, 140	1, 320	1, 500	1, 690	1, 890	2, 100	2, 320	2, 540	2, 770	3, 000	3, 240	3, 490	3, 740	4, 000	4, 270	4, 540	4, 820	5, 100	5, 390	5, 680	1029.1
1029.0	1, 140	1, 310	1, 500	1, 690	1, 890	2, 100	2, 310	2, 530	2, 760	3, 000	3, 240	3, 490	3, 740	4, 000	4, 260	4, 530	4, 810	5, 090	5, 380	5, 670	5, 970	1029.0
1028.9	1, 310	1, 500	1, 690	1, 890	2, 090	2, 310	2, 530	2, 760	2, 990	3, 230	3, 480	3, 730	3, 990	4, 260	4, 530	4, 800	5, 080	5, 370	5, 660	5, 960	6, 260	1028.9
1028.8	1, 490	1, 680	1, 880	2, 090	2, 300	2, 520	2, 750	2, 990	3, 230	3, 470	3, 730	3, 980	4, 250	4, 520	4, 790	5, 070	5, 360	5, 650	5, 950	6, 250	6, 560	1028.8
1028.7	1, 680	1, 880	2, 090	2, 300	2, 520	2, 750	2, 980	3, 220	3, 470	3, 720	3, 980	4, 240	4, 510	4, 790	5, 070	5, 350	5, 640	5, 940	6, 240	6, 550	6, 860	1028.7
1028.6	1, 870	2, 080	2, 290	2, 510	2, 740	2, 970	3, 210	3, 460	3, 710	3, 970	4, 230	4, 500	4, 780	5, 060	5, 340	5, 630	5, 930	6, 230	6, 540	6, 850	7, 160	1028.6
1028.5	2, 080	2, 290	2, 510	2, 740	2, 970	3, 210	3, 450	3, 700	3, 960	4, 230	4, 490	4, 770	5, 050	5, 330	5, 620	5, 920	6, 220	6, 530	6, 840	7, 150	7, 470	1028.5
1028.4	2, 280	2, 500	2, 730	2, 960	3, 200	3, 450	3, 700	3, 950	4, 220	4, 490	4, 760	5, 040	5, 320	5, 610	5, 910	6, 210	6, 520	6, 830	7, 140	7, 460	7, 790	1028.4
1028.3	2, 500	2, 720	2, 960	3, 190	3, 440	3, 690	3, 950	4, 210	4, 480	4, 750	5, 030	5, 320	5, 600	5, 900	6, 200	6, 500	6, 810	7, 130	7, 450	7, 770	8, 100	1028.3
1028.2	2, 720	2, 950	3, 190	3, 430	3, 680	3, 940	4, 200	4, 470	4, 740	5, 020	5, 310	5, 600	5, 890	6, 190	6, 490	6, 800	7, 120	7, 440	7, 760	8, 090	8, 420	1028.2
1028.1	2, 940	3, 180	3, 430	3, 680	3, 930	4, 190	4, 460	4, 730	5, 010	5, 300	5, 590	5, 880	6, 180	6, 480	6, 790	7, 110	7, 430	7, 750	8, 080	8, 410	8, 750	1028.1
1028.0	3, 180	3, 420	3, 670	3, 920	4, 190	4, 450	4, 730	5, 000	5, 290	5, 580	5, 870	6, 170	6, 470	6, 780	7, 100	7, 410	7, 740	8, 070	8, 400	8, 730	9, 080	1028.0
1027.9	3, 410	3, 660	3, 910	4, 170	4, 440	4, 710	4, 990	5, 270	5, 560	5, 850	6, 150	6, 460	6, 770	7, 080	7, 400	7, 720	8, 050	8, 380	8, 710	9, 060	9, 400	1027.9
1027.8	3, 650	3, 900	4, 160	4, 430	4, 700	4, 980	5, 260	5, 550	5, 840	6, 140	6, 440	6, 750	7, 060	7, 380	7, 700	8, 030	8, 360	8, 690	9, 030	9, 380	9, 730	1027.8
1027.7	3, 890	4, 150	4, 420	4, 690	4, 960	5, 250	5, 530	5, 820	6, 120	6, 420	6, 730	7, 040	7, 360	7, 680	8, 010	8, 340	8, 670	9, 010	9, 360	9, 710	10, 060	1027.7
1027.6	4, 140	4, 400	4, 680	4, 950	5, 230	5, 520	5, 810	6, 110	6, 410	6, 710	7, 030	7, 340	7, 660	7, 990	8, 320	8, 650	8, 990	9, 340	9, 680	10, 040	10, 390	1027.6
1027.5	4, 390	4, 660	4, 940	5, 220	5, 500	5, 800	6, 090	6, 390	6, 700	7, 010	7, 320	7, 640	7, 970	8, 300	8, 630	8, 970	9, 320	9, 660	10, 010	10, 370	10, 730	1027.5
1027.4	4, 650	4, 920	5, 200	5, 490	5, 780	6, 080	6, 380	6, 680	6, 990	7, 310	7, 630	7, 950	8, 280	8, 610	8, 950	9, 290	9, 640	9, 990	10, 350	10, 710	11, 070	1027.4
1027.3	4, 910	5, 190	5, 480	5, 770	6, 060	6, 360	6, 660	6, 970	7, 290	7, 610	7, 930	8, 260	8, 590	8, 930	9, 270	9, 620	9, 970	10, 320	10, 680	11, 050	11, 410	1027.3
1027.2	5, 180	5, 460	5, 750	6, 040	6, 340	6, 650	6, 960	7, 270	7, 590	7, 910	8, 240	8, 570	8, 910	9, 250	9, 600	9, 950	10, 300	10, 660	11, 020	11, 390	11, 760	1027.2
1027.1	5, 450	5, 740	6, 030	6, 330	6, 630	6, 940	7, 250	7, 570	7, 890	8, 220	8, 550	8, 890	9, 230	9, 570	9, 920	10, 280	10, 640	11, 000	11, 360	11, 730	12, 110	1027.1
1027.0	5, 720	6, 010	6, 310	6, 610	6, 920	7, 230	7, 550	7, 870	8, 200	8, 530	8, 870	9, 210	9, 550	9, 900	10, 250	10, 610	10, 970	11, 340	11, 710	12, 080	12, 460	1027.0
1026.9	5, 990	6, 290	6, 590	6, 900	7, 210	7, 530	7, 850	8, 170	8, 510	8, 840	9, 180	9, 520	9, 870	10, 220	10, 580	10, 940	11, 300	11, 670	12, 050	12, 420	12, 800	1026.9
1026.8	6, 270	6, 570	6, 880	7, 190	7, 500	7, 820	8, 150	8, 480	8, 810	9, 150	9, 490	9, 840	10, 190	10, 550	10, 910	11, 270	11, 640	12, 010	12, 390	12, 770	13, 150	1026.8
1026.7	6, 550	6, 850	7, 160	7, 480	7, 800	8, 120	8, 450	8, 780	9, 120	9, 460	9, 810	10, 160	10, 520	10, 870	11, 240	11, 610	11, 980	12, 350	12, 730	13, 110	13, 500	1026.7
1026.6	6, 830	7, 140	7, 450	7, 770	8, 100	8, 420	8, 760	9, 090	9, 430	9, 780	10, 130	10, 480	10, 840	11, 200	11, 570	11, 940	12, 320	12, 690	13, 080	13, 460	13, 850	1026.6
1026.5	7, 120	7, 430	7, 750	8, 070	8, 400	8, 730	9, 070	9, 410	9, 750	10, 100	10, 450	10, 810	11, 170	11, 540	11, 910	12, 280	12, 660	13, 040	13, 420	13, 810	14, 210	1026.5
1026.4	7, 410	7, 720	8, 040	8, 370	8, 700	9, 040	9, 380	9, 720	10, 070	10, 420	10, 780	11, 140	11, 500	11, 870	12, 240	12, 620	13, 000	13, 390	13, 770	14, 170	14, 560	1026.4
1026.3	7, 700	8, 020	8, 340	8, 670	9, 010	9, 350	9, 690	10, 040	10, 390	10, 740	11, 100	11, 470	11, 840	12, 210	12, 580	12, 960	13, 350	13, 740	14, 130	14, 520	14, 920	1026.3
1026.2	7, 990	8, 320	8, 650	8, 980	9, 320	9, 660	10, 010	10, 360	10, 710	11, 070	11, 430	11, 800	12, 170	12, 550	12, 930	13, 310	13, 700	14, 090	14, 480	14, 880	15, 280	1026.2
1026.1	8, 290	8, 620	8, 950	9, 290	9, 630	9, 980	10, 330	10, 680	11, 040	11, 400	11, 770	12, 140	12, 510	12, 890	13, 270	13, 660	14, 050	14, 440	14, 840	15, 240	15, 640	1026.1
1026.0	8, 590	8, 920	9, 260	9, 600	9, 940	10, 290	10, 650	11, 000	11, 370	11, 730	12, 100	12, 470	12, 850	13, 230	13, 620	14, 010	14, 400	14, 800	15, 200	15, 600	16, 010	1026.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1030.0	1030.1	1030.2	1030.3	1030.4	1030.5	1030.6	1030.7	1030.8	1030.9	1031.0	1031.1	1031.2	1031.3	1031.4	1031.5	1031.6	1031.7	1031.8	1031.9	1032.0	
1025.9	8,890	9,220	9,560	9,910	10,260	10,610	10,960	11,320	11,690	12,060	12,430	12,810	13,190	13,570	13,960	14,350	14,750	15,150	15,550	15,960	16,370	1025.9
1025.8	9,190	9,530	9,870	10,220	10,570	10,930	11,280	11,650	12,020	12,390	12,760	13,140	13,530	13,910	14,300	14,700	15,100	15,500	15,900	16,310	16,730	1025.8
1025.7	9,490	9,840	10,180	10,530	10,890	11,240	11,610	11,970	12,340	12,720	13,100	13,480	13,860	14,250	14,650	15,050	15,450	15,850	16,260	16,670	17,090	1025.7
1025.6	9,800	10,140	10,490	10,850	11,200	11,570	11,930	12,300	12,670	13,050	13,430	13,820	14,210	14,600	15,000	15,400	15,800	16,210	16,620	17,030	17,450	1025.6
1025.5	10,110	10,450	10,810	11,160	11,520	11,890	12,260	12,630	13,010	13,390	13,770	14,160	14,550	14,950	15,340	15,750	16,150	16,560	16,980	17,390	17,820	1025.5
1025.4	10,420	10,770	11,120	11,480	11,850	12,210	12,590	12,960	13,340	13,720	14,110	14,500	14,900	15,290	15,690	16,100	16,510	16,920	17,340	17,760	18,180	1025.4
1025.3	10,730	11,080	11,440	11,800	12,170	12,540	12,920	13,290	13,680	14,060	14,450	14,840	15,240	15,640	16,050	16,460	16,870	17,280	17,700	18,120	18,550	1025.3
1025.2	11,040	11,400	11,760	12,130	12,500	12,870	13,250	13,630	14,010	14,400	14,790	15,190	15,590	15,990	16,400	16,810	17,230	17,640	18,070	18,490	18,920	1025.2
1025.1	11,360	11,720	12,080	12,450	12,820	13,200	13,580	13,970	14,350	14,740	15,140	15,540	15,940	16,350	16,760	17,170	17,590	18,010	18,430	18,860	19,290	1025.1
1025.0	11,680	12,040	12,410	12,780	13,150	13,530	13,920	14,300	14,690	15,090	15,490	15,890	16,290	16,700	17,110	17,530	17,950	18,370	18,800	19,230	19,660	1025.0
1024.9	11,990	12,360	12,730	13,100	13,480	13,860	14,250	14,640	15,030	15,430	15,830	16,230	16,640	17,050	17,470	17,880	18,310	18,730	19,160	19,590	20,030	1024.9
1024.8	12,310	12,680	13,050	13,430	13,810	14,190	14,580	14,970	15,370	15,770	16,170	16,580	16,990	17,400	17,820	18,240	18,660	19,090	19,520	19,960	20,390	1024.8
1024.7	12,630	13,000	13,370	13,750	14,140	14,520	14,920	15,310	15,710	16,110	16,520	16,920	17,340	17,750	18,170	18,600	19,020	19,450	19,890	20,320	20,760	1024.7
1024.6	12,950	13,320	13,700	14,080	14,470	14,860	15,250	15,650	16,050	16,450	16,860	17,270	17,690	18,110	18,530	18,950	19,380	19,820	20,250	20,690	21,130	1024.6
1024.5	13,270	13,640	14,030	14,410	14,800	15,190	15,590	15,990	16,390	16,800	17,210	17,620	18,040	18,460	18,890	19,310	19,740	20,180	20,620	21,060	21,500	1024.5
1024.4	13,590	13,970	14,350	14,740	15,130	15,530	15,930	16,330	16,730	17,140	17,560	17,970	18,390	18,820	19,240	19,670	20,110	20,540	20,980	21,430	21,880	1024.4
1024.3	13,910	14,300	14,680	15,070	15,470	15,870	16,270	16,670	17,080	17,490	17,910	18,330	18,750	19,170	19,600	20,040	20,470	20,910	21,350	21,800	22,250	1024.3
1024.2	14,240	14,630	15,020	15,410	15,800	16,200	16,610	17,020	17,430	17,840	18,260	18,680	19,100	19,530	19,960	20,400	20,840	21,280	21,720	22,170	22,620	1024.2
1024.1	14,570	14,960	15,350	15,740	16,140	16,550	16,950	17,360	17,770	18,190	18,610	19,030	19,460	19,890	20,330	20,760	21,200	21,650	22,090	22,550	23,000	1024.1
1024.0	14,900	15,290	15,680	16,080	16,480	16,890	17,300	17,710	18,120	18,540	18,970	19,390	19,820	20,250	20,690	21,130	21,570	22,020	22,470	22,920	23,380	1024.0
1023.9	15,240	15,630	16,030	16,430	16,830	17,240	17,650	18,070	18,490	18,910	19,330	19,760	20,190	20,630	21,070	21,510	21,950	22,400	22,860	23,310	23,770	1023.9
1023.8	15,580	15,980	16,380	16,780	17,190	17,600	18,010	18,430	18,850	19,270	19,700	20,130	20,570	21,010	21,450	21,890	22,340	22,790	23,250	23,700	24,160	1023.8
1023.7	15,920	16,320	16,730	17,130	17,540	17,960	18,370	18,790	19,220	19,640	20,070	20,510	20,940	21,380	21,830	22,280	22,730	23,180	23,640	24,100	24,560	1023.7
1023.6	16,270	16,670	17,080	17,490	17,900	18,320	18,730	19,160	19,580	20,010	20,450	20,880	21,320	21,770	22,210	22,660	23,110	23,570	24,030	24,490	24,960	1023.6
1023.5	16,620	17,020	17,430	17,840	18,260	18,680	19,100	19,520	19,950	20,390	20,820	21,260	21,700	22,150	22,600	23,050	23,500	23,960	24,420	24,890	25,360	1023.5
1023.4	16,970	17,380	17,790	18,200	18,620	19,040	19,470	19,890	20,320	20,760	21,200	21,640	22,080	22,530	22,980	23,440	23,900	24,360	24,820	25,290	25,760	1023.4
1023.3	17,320	17,730	18,150	18,560	18,980	19,410	19,830	20,260	20,700	21,140	21,580	22,020	22,470	22,920	23,370	23,830	24,290	24,750	25,220	25,690	26,160	1023.3
1023.2	17,680	18,090	18,500	18,920	19,350	19,770	20,200	20,640	21,070	21,510	21,960	22,400	22,850	23,310	23,760	24,220	24,680	25,150	25,620	26,090	26,570	1023.2
1023.1	18,030	18,450	18,870	19,290	19,710	20,140	20,570	21,010	21,450	21,890	22,340	22,790	23,240	23,700	24,150	24,620	25,080	25,550	26,020	26,500	26,970	1023.1
1023.0	18,390	18,810	19,230	19,650	20,080	20,510	20,950	21,390	21,830	22,270	22,720	23,170	23,630	24,090	24,550	25,010	25,480	25,950	26,430	26,900	27,380	1023.0
1022.9	18,780	19,200	19,620	20,050	20,480	20,920	21,360	21,800	22,240	22,690	23,140	23,600	24,050	24,510	24,980	25,450	25,920	26,390	26,870	27,350	27,830	1022.9
1022.8	19,170	19,590	20,020	20,450	20,890	21,320	21,770	22,210	22,660	23,110	23,560	24,020	24,480	24,950	25,410	25,880	26,360	26,830	27,310	27,800	28,280	1022.8
1022.7	19,560	19,990	20,420	20,860	21,290	21,730	22,180	22,630	23,080	23,530	23,990	24,450	24,910	25,380	25,850	26,320	26,800	27,280	27,760	28,250	28,740	1022.7
1022.6	19,960	20,390	20,820	21,260	21,700	22,150	22,590	23,040	23,500	23,950	24,410	24,880	25,350	25,820	26,290	26,760	27,240	27,730	28,210	28,700	29,190	1022.6
1022.5	20,360	20,790	21,230	21,670	22,110	22,560	23,010	23,460	23,920	24,380	24,850	25,310	25,780	26,250	26,730	27,210	27,690	28,180	28,670	29,160	29,650	1022.5
1022.4	20,760	21,200	21,640	22,080	22,530	22,980	23,430	23,890	24,350	24,810	25,280	25,750	26,220	26,700	27,180	27,660	28,140	28,630	29,120	29,620	30,120	1022.4
1022.3	21,170	21,610	22,050	22,500	22,950	23,400	23,860	24,320	24,780	25,240	25,710	26,190	26,660	27,140	27,620	28,110	28,600	29,090	29,580	30,080	30,580	1022.3
1022.2	21,580	22,020	22,460	22,910	23,370	23,820	24,280	24,740	25,210	25,680	26,150	26,630	27,110	27,590	28,070	28,560	29,050	29,550	30,040	30,540	31,050	1022.2
1022.1	21,990	22,430	22,880	23,330	23,790	24,250	24,710	25,180	25,650	26,120	26,590	27,070	27,550	28,040	28,530	29,020	29,510	30,010	30,510	31,010	31,520	1022.1
1022.0	22,400	22,850	23,300	23,760	24,220	24,680	25,140	25,610	26,080	26,560	27,040	27,520	28,000	28,490	28,980	29,480	29,970	30,470	30,980	31,480	31,990	1022.0
1021.9	22,830	23,290	23,740	24,200	24,660	25,130	25,600	26,070	26,540	27,020	27,500	27,990	28,480	28,970	29,460	29,960	30,460	30,960	31,470	31,980	32,490	1021.9
1021.8	23,270	23,730	24,180	24,650	25,110	25,580	26,050	26,530	27,010	27,490	27,970	28,460	28,950	29,440	29,940	30,440	30,950	31,450	31,960	32,480	32,990	1021.8
1021.7	23,710	24,170	24,630	25,100	25,560	26,040	26,510	26,990	27,470	27,960	28,440	28,940	29,430	29,930	30,430	30,930	31,440	31,950	32,460	32,980	33,500	1021.7
1021.6	24,150	24,610	25,080	25,550	26,020	26,500	26,970	27,460	27,940	28,430	28,920	29,410	29,910	30,410	30,920	31,420	31,930	32,450	32,960	33,480	34,000	1021.6
1021.5	24,600	25,060	25,530	26,010	26,480	26,960	27,440	27,930	28,410	28,900	29,400	29,900	30,400	30,900	31,410	31,920	32,430	32,950	33,470	33,990	34,510	1021.5
1021.4	25,050	25,520	25,990	26,460	26,940	27,420	27,910	28,400	28,890	29,380	29,880	30,380	30,890	31,390	31,900	32,420	32,930	33,450	33,970	34,500	35,030	1021.4
1021.3	25,500	25,970	26,450	26,930	27,410	27,890	28,380	28,870	29,370	29,870	30,370	30,870	31,380	31,890	32,400	32,920	33,440	33,960	34,490	35,010	35,550	1021.3
1021.2	25,960	26,430	26,910	27,390	27,880	28,370	28,860	29,350	29,850	30,350	30,860	31,360	31,870	32,390	32,900	33,420	33,950	34,470	35,000	35,530	36,070	1021.2
1021.1	26,420	26,900	27,380	27,860	28,350	28,840	29,340	29,840	30,340	30,840	31,350	31,860	32,370	32,890	33,410	33,930	34,460	34,990	35,520	36,050	36,590	1021.1
1021.0	26,880	27,360	27,850	28,340	28,830	29,320	29,820	30,320	30,830	31,330	31,840	32,360	32,870	33,390	33,920	34,440	34,970	35,500	36,040	36,580	37,120	1021.0
1020.9	27,370	27,850	28,340	28,830	29,330	29,830	30,330	30,830	31,340	31,850	32,370	32,880	33,400	33,930	34,450	34,980	35,510	36,050	36,590	37,130	37,670	1020.9
1020.8	27,860	28,350	28,840	29,330	29,830	30,330	30,840	31,350	31,860	32,370	32,890	33,410	33,930	34,460	34,990	35,520	36,060	36,600	37,140	37,690	38,240	1020.8
1020.7	28,350	28,840	29,340	29,840	30,340	30,850	31,350	31,870	32,380	32,900	33,420	33,940	34,470	35,000	35,530	36,070	36,610	37,150	37,700	38,250	38,800	1020.7
1020.6	28,850	29,340	29,840	30,350	30,850	31,360	31,870	32,390	32,910	33,430	33,950	34,480	35,010	35,550	36,080	36,620	37,170	37,710	38,260	38,810	39,370	1020.6
1020.5	29,350	29,850	30,350	30,860	31,370	31,880	32,400	32,910	33,440	33,960	34,490	35,020	35,560	36,090	36,630	37,180	37,720	38,270	38,830	39,380	39,940	1020.5
1020.4	29,850	30,360	30,860	31,370	31,890	32,400	32,920	33,450	33,970	34,500	35,030	35,570	36,100	36,640	37,190	37,740	38,290	38,840	39,400	39,950	40,520	1020.4
1020.3	30,360	30,870	31,380	31,890	32,410	32,930	33,450	33,980	34,510	35,040	35,580	36,110	36,660	37,200	37,750	38,300	38,850	39,410	39,970	40,530	41,100	1020.3
1020.2	30,880	31,390	31,900	32,420	32,940	33,460	33,990	34,520	35,050	35,590	36,130	36,670	37,210	37,760	38,310	38,870	39,420	39,980	40,550	41,110	41,680	1020.2
1020.1	31,400	31,910	32,430	32,950	33,470	34,000	34,530	35,060	35,600	36,140	36,680	37,220	37,770	38,320	38,880	39,440	40,000	40,560	41,130	41,700	42,270	1020.1
1020.0	31,920	32,430	32,960	33,480	34,010	34,540	35,070	35,610	36,150	36,690	37,240	37,780	38,340	38,890	39,450	40,010	40,580	41,140	41,710	42,290	42,860	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																				GATE ELEVATION IN FEET
	1032.0	1032.1	1032.2	1032.3	1032.4	1032.5	1032.6	1032.7	1032.8	1032.9	1033.0	1033.1	1033.2	1033.3	1033.4	1033.5	1033.6	1033.7	1033.8	1033.9	1034.0	
1033.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	1033.9
1033.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	1033.8
1033.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	1033.7
1033.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	310	1033.6
1033.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	310	430	1033.5
1033.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	310	430	560	1033.4
1033.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	310	430	560	700	1033.3
1033.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	860	1033.2
1033.1	0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	860	1, 020	1033.1
1033.0	0	0	0	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	850	1, 020	1, 190	1033.0
1032.9	0	0	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	850	1, 020	1, 190	1, 370	1032.9
1032.8	0	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	850	1, 020	1, 190	1, 370	1, 560	1032.8
1032.7	0	0	0	0	0	0	0	0	40	110	200	300	420	560	700	850	1, 020	1, 190	1, 370	1, 560	1, 760	1032.7
1032.6	0	0	0	0	0	0	0	40	110	200	300	420	560	700	850	1, 020	1, 190	1, 370	1, 560	1, 760	1, 960	1032.6
1032.5	0	0	0	0	0	0	40	110	200	300	420	550	700	850	1, 020	1, 190	1, 370	1, 560	1, 760	1, 960	2, 180	1032.5
1032.4	0	0	0	0	0	40	110	200	300	420	550	700	850	1, 020	1, 190	1, 370	1, 560	1, 760	1, 960	2, 170	2, 390	1032.4
1032.3	0	0	0	0	40	110	200	300	420	550	700	850	1, 010	1, 190	1, 370	1, 560	1, 760	1, 960	2, 170	2, 390	2, 620	1032.3
1032.2	0	0	0	40	110	200	300	420	550	700	850	1, 010	1, 190	1, 370	1, 560	1, 760	1, 960	2, 170	2, 390	2, 620	2, 850	1032.2
1032.1	0	0	40	110	200	300	420	550	700	850	1, 010	1, 190	1, 370	1, 560	1, 750	1, 960	2, 170	2, 390	2, 620	2, 850	3, 090	1032.1
1032.0	0	40	110	200	300	420	550	700	850	1, 010	1, 190	1, 370	1, 560	1, 750	1, 960	2, 170	2, 390	2, 620	2, 850	3, 090	3, 340	1032.0
1031.9	40	110	200	300	420	550	700	850	1, 010	1, 180	1, 370	1, 550	1, 750	1, 960	2, 170	2, 390	2, 620	2, 850	3, 090	3, 330	3, 590	1031.9
1031.8	110	200	300	420	550	690	850	1, 010	1, 180	1, 360	1, 550	1, 750	1, 960	2, 170	2, 390	2, 610	2, 850	3, 090	3, 330	3, 580	3, 840	1031.8
1031.7	200	300	420	550	690	850	1, 010	1, 180	1, 360	1, 550	1, 750	1, 950	2, 170	2, 390	2, 610	2, 850	3, 090	3, 330	3, 580	3, 840	4, 100	1031.7
1031.6	300	420	550	690	850	1, 010	1, 180	1, 360	1, 550	1, 750	1, 950	2, 170	2, 380	2, 610	2, 840	3, 080	3, 330	3, 580	3, 840	4, 100	4, 370	1031.6
1031.5	420	550	690	850	1, 010	1, 180	1, 360	1, 550	1, 750	1, 950	2, 160	2, 380	2, 610	2, 840	3, 080	3, 330	3, 580	3, 840	4, 100	4, 370	4, 640	1031.5
1031.4	550	690	840	1, 010	1, 180	1, 360	1, 550	1, 750	1, 950	2, 160	2, 380	2, 610	2, 840	3, 080	3, 330	3, 580	3, 830	4, 100	4, 370	4, 640	4, 920	1031.4
1031.3	690	840	1, 010	1, 180	1, 360	1, 550	1, 740	1, 950	2, 160	2, 380	2, 610	2, 840	3, 080	3, 320	3, 580	3, 830	4, 100	4, 370	4, 640	4, 920	5, 210	1031.3
1031.2	840	1, 010	1, 180	1, 360	1, 550	1, 740	1, 950	2, 160	2, 380	2, 600	2, 840	3, 080	3, 320	3, 570	3, 830	4, 090	4, 360	4, 640	4, 920	5, 200	5, 500	1031.2
1031.1	1, 000	1, 180	1, 360	1, 550	1, 740	1, 950	2, 160	2, 380	2, 600	2, 840	3, 070	3, 320	3, 570	3, 830	4, 090	4, 360	4, 640	4, 920	5, 200	5, 490	5, 790	1031.1
1031.0	1, 180	1, 360	1, 540	1, 740	1, 950	2, 160	2, 380	2, 600	2, 830	3, 070	3, 320	3, 570	3, 830	4, 090	4, 360	4, 630	4, 910	5, 200	5, 490	5, 790	6, 090	1031.0
1030.9	1, 350	1, 540	1, 740	1, 940	2, 150	2, 370	2, 600	2, 830	3, 070	3, 310	3, 570	3, 820	4, 090	4, 360	4, 630	4, 910	5, 200	5, 490	5, 780	6, 080	6, 390	1030.9
1030.8	1, 540	1, 740	1, 940	2, 150	2, 370	2, 600	2, 830	3, 070	3, 310	3, 560	3, 820	4, 080	4, 350	4, 630	4, 910	5, 190	5, 480	5, 780	6, 080	6, 380	6, 700	1030.8
1030.7	1, 730	1, 940	2, 150	2, 370	2, 590	2, 820	3, 060	3, 310	3, 560	3, 820	4, 080	4, 350	4, 620	4, 900	5, 190	5, 480	5, 770	6, 070	6, 380	6, 690	7, 010	1030.7
1030.6	1, 940	2, 150	2, 360	2, 590	2, 820	3, 060	3, 300	3, 560	3, 810	4, 070	4, 340	4, 620	4, 900	5, 180	5, 470	5, 770	6, 070	6, 370	6, 690	7, 000	7, 320	1030.6
1030.5	2, 140	2, 360	2, 590	2, 820	3, 060	3, 300	3, 550	3, 810	4, 070	4, 340	4, 610	4, 890	5, 180	5, 470	5, 760	6, 060	6, 370	6, 680	7, 000	7, 320	7, 640	1030.5
1030.4	2, 360	2, 580	2, 820	3, 050	3, 300	3, 550	3, 800	4, 070	4, 330	4, 610	4, 890	5, 170	5, 460	5, 760	6, 060	6, 360	6, 670	6, 990	7, 310	7, 630	7, 960	1030.4
1030.3	2, 580	2, 810	3, 050	3, 290	3, 540	3, 800	4, 060	4, 330	4, 600	4, 880	5, 170	5, 460	5, 750	6, 050	6, 360	6, 670	6, 980	7, 300	7, 630	7, 960	8, 290	1030.3
1030.2	2, 810	3, 050	3, 290	3, 540	3, 800	4, 060	4, 330	4, 600	4, 880	5, 160	5, 450	5, 750	6, 050	6, 350	6, 660	6, 980	7, 300	7, 620	7, 950	8, 290	8, 620	1030.2
1030.1	3, 040	3, 290	3, 540	3, 790	4, 060	4, 320	4, 600	4, 870	5, 160	5, 450	5, 740	6, 040	6, 350	6, 660	6, 970	7, 290	7, 620	7, 950	8, 280	8, 620	8, 960	1030.1
1030.0	3, 280	3, 530	3, 790	4, 050	4, 320	4, 590	4, 870	5, 150	5, 440	5, 740	6, 040	6, 340	6, 650	6, 970	7, 290	7, 610	7, 940	8, 270	8, 610	8, 950	9, 300	1030.0
1029.9	3, 530	3, 780	4, 050	4, 310	4, 590	4, 860	5, 150	5, 440	5, 730	6, 030	6, 340	6, 650	6, 960	7, 280	7, 600	7, 930	8, 270	8, 600	8, 950	9, 290	9, 640	1029.9
1029.8	3, 780	4, 040	4, 310	4, 580	4, 860	5, 140	5, 430	5, 730	6, 020	6, 330	6, 640	6, 950	7, 270	7, 600	7, 920	8, 260	8, 590	8, 940	9, 280	9, 630	9, 990	1029.8
1029.7	4, 040	4, 300	4, 570	4, 850	5, 140	5, 420	5, 720	6, 020	6, 320	6, 630	6, 940	7, 260	7, 590	7, 920	8, 250	8, 590	8, 930	9, 270	9, 630	9, 980	10, 340	1029.7
1029.6	4, 300	4, 570	4, 850	5, 130	5, 420	5, 710	6, 010	6, 310	6, 620	6, 940	7, 260	7, 580	7, 910	8, 240	8, 580	8, 920	9, 270	9, 620	9, 970	10, 330	10, 690	1029.6
1029.5	4, 560	4, 840	5, 120	5, 410	5, 710	6, 000	6, 310	6, 620	6, 930	7, 250	7, 570	7, 900	8, 230	8, 570	8, 910	9, 260	9, 610	9, 960	10, 320	10, 680	11, 050	1029.5
1029.4	4, 830	5, 120	5, 410	5, 700	6, 000	6, 300	6, 610	6, 920	7, 240	7, 560	7, 890	8, 220	8, 560	8, 900	9, 250	9, 600	9, 950	10, 310	10, 670	11, 040	11, 410	1029.4
1029.3	5, 110	5, 400	5, 690	5, 990	6, 290	6, 600	6, 910	7, 230	7, 560	7, 880	8, 220	8, 550	8, 890	9, 240	9, 590	9, 940	10, 300	10, 670	11, 030	11, 400	11, 780	1029.3
1029.2	5, 390	5, 690	5, 980	6, 290	6, 590	6, 910	7, 230	7, 550	7, 880	8, 210	8, 540	8, 880	9, 230	9, 580	9, 930	10, 290	10, 660	11, 020	11, 390	11, 770	12, 150	1029.2
1029.1	5, 680	5, 980	6, 280	6, 590	6, 900	7, 220	7, 540	7, 870	8, 200	8, 530	8, 880	9, 220	9, 570	9, 920	10, 280	10, 650	11, 010	11, 380	11, 760	12, 140	12, 520	1029.1
1029.0	5, 970	6, 270	6, 580	6, 890	7, 210	7, 530	7, 860	8, 190	8, 530	8, 870	9, 210	9, 560	9, 920	10, 270	10, 640	11, 000	11, 370	11, 750	12, 130	12, 510	12, 900	1029.0
1028.9	6, 260	6, 570	6, 880	7, 200	7, 520	7, 850	8, 180	8, 510	8, 850	9, 200	9, 550	9, 900	10, 260	10, 620	10, 990	11, 360	11, 730	12, 110	12, 490	12, 880	13, 270	1028.9
1028.8	6, 560	6, 870	7, 190	7, 510	7, 830	8, 170	8, 500	8, 840	9, 180	9, 530	9, 890	10, 240	10, 610	10, 970	11, 340	11, 720	12, 090	12, 480	12, 860	13, 250	13, 650	1028.8
1028.7	6, 860	7, 180	7, 500	7, 820	8, 150	8, 490	8, 830	9, 170	9, 520	9, 870	10, 230	10, 590	10, 960	11, 330	11, 700	12, 080	12, 460	12, 850	13, 240	13, 630	14, 030	1028.7
1028.6	7, 160	7, 480	7, 810	8, 140	8, 470	8, 810	9, 160	9, 510	9, 860	10, 220	10, 580	10, 940	11, 310	11, 680	12, 060	12, 440	12, 830	13, 220	13, 610	14, 010	14, 410	1028.6
1028.5	7, 470	7, 800	8, 130	8, 460	8, 800	9, 140	9, 490	9, 840	10, 200	10, 560	10, 930	11, 300	11, 670	12, 050	12, 430	12, 810	13, 200	13, 590	13, 990	14, 390	14, 800	1028.5
1028.4	7, 790	8, 120	8, 450	8, 790	9, 130	9, 480	9, 830	10, 190	10, 550	10, 910	11, 280	11, 650	12, 030	12, 410	12, 800	13, 180	13, 580	13, 970	14, 370	14, 780	15, 190	1028.4
1028.3	8, 100	8, 440	8, 770	9, 120	9, 460	9, 820	10, 170	10, 530	10, 900	11, 260	11, 640	12, 010	12, 390	12, 780	13, 170	13, 560	13, 960	14, 360	14, 760	15, 170	15, 580	1028.3
1028.2	8, 420	8, 760	9, 100	9, 450	9, 800	10, 160	10, 520	10, 880	11, 250	11, 620	12, 000	12, 380	12, 760	13, 150	13, 540	13, 940	14, 340	14, 740	15, 150	15, 560	15, 980	1028.2
1028.1	8, 750	9, 090	9, 440	9, 790	10, 140	10, 500	10, 860	11, 230	11, 600	11, 980	12, 360	12, 740	13, 130	13, 520	13, 920	14, 320	14, 720	15, 130	15, 540	15, 960	16, 370	1028.1
1028.0	9, 080	9, 420	9, 770	10, 130	10, 490	10, 850	11, 220	11, 590	11, 960	12, 340	12, 730	13, 110	13, 510	13, 900	14, 300	14, 700	15, 110	15, 520	15, 940	16, 350	16, 780	1028.0

HEADWATER 1032 to 1034

MAY 2000

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1032.0	1032.1	1032.2	1032.3	1032.4	1032.5	1032.6	1032.7	1032.8	1032.9	1033.0	1033.1	1033.2	1033.3	1033.4	1033.5	1033.6	1033.7	1033.8	1033.9	1034.0	
1027.9	9,400	9,750	10,100	10,460	10,830	11,190	11,560	11,940	12,320	12,700	13,090	13,480	13,870	14,270	14,670	15,080	15,490	15,900	16,320	16,740	17,170	1027.9
1027.8	9,730	10,080	10,440	10,800	11,170	11,540	11,910	12,290	12,670	13,060	13,450	13,840	14,240	14,640	15,050	15,460	15,870	16,290	16,710	17,140	17,560	1027.8
1027.7	10,060	10,420	10,780	11,140	11,510	11,890	12,270	12,650	13,030	13,420	13,820	14,210	14,620	15,020	15,430	15,840	16,260	16,680	17,100	17,530	17,960	1027.7
1027.6	10,390	10,750	11,120	11,490	11,860	12,240	12,620	13,010	13,390	13,790	14,180	14,590	14,990	15,400	15,810	16,230	16,650	17,070	17,500	17,930	18,360	1027.6
1027.5	10,730	11,090	11,460	11,840	12,210	12,590	12,980	13,370	13,760	14,160	14,560	14,960	15,370	15,780	16,190	16,610	17,040	17,460	17,890	18,330	18,760	1027.5
1027.4	11,070	11,440	11,810	12,190	12,570	12,950	13,340	13,730	14,130	14,530	14,930	15,340	15,750	16,160	16,580	17,000	17,430	17,860	18,290	18,730	19,170	1027.4
1027.3	11,410	11,780	12,160	12,540	12,920	13,310	13,700	14,100	14,500	14,900	15,310	15,720	16,130	16,550	16,970	17,390	17,820	18,260	18,690	19,130	19,570	1027.3
1027.2	11,760	12,130	12,510	12,900	13,280	13,670	14,070	14,470	14,870	15,280	15,680	16,100	16,520	16,940	17,360	17,790	18,220	18,660	19,090	19,540	19,980	1027.2
1027.1	12,110	12,490	12,870	13,260	13,650	14,040	14,440	14,840	15,240	15,650	16,070	16,480	16,900	17,330	17,750	18,190	18,620	19,060	19,500	19,940	20,390	1027.1
1027.0	12,460	12,840	13,230	13,620	14,010	14,410	14,810	15,210	15,620	16,030	16,450	16,870	17,290	17,720	18,150	18,580	19,020	19,460	19,910	20,360	20,810	1027.0
1026.9	12,800	13,190	13,580	13,970	14,370	14,770	15,170	15,580	15,990	16,410	16,830	17,250	17,670	18,100	18,540	18,970	19,410	19,860	20,300	20,750	21,210	1026.9
1026.8	13,150	13,540	13,930	14,330	14,730	15,130	15,540	15,950	16,360	16,780	17,200	17,630	18,060	18,490	18,920	19,360	19,810	20,250	20,700	21,150	21,610	1026.8
1026.7	13,500	13,890	14,290	14,690	15,090	15,490	15,900	16,320	16,730	17,160	17,580	18,010	18,440	18,870	19,310	19,760	20,200	20,650	21,100	21,560	22,020	1026.7
1026.6	13,850	14,250	14,640	15,050	15,450	15,860	16,270	16,690	17,110	17,530	17,960	18,390	18,830	19,260	19,700	20,150	20,600	21,050	21,500	21,960	22,420	1026.6
1026.5	14,210	14,600	15,000	15,410	15,820	16,230	16,640	17,060	17,490	17,910	18,340	18,780	19,210	19,650	20,100	20,540	20,990	21,450	21,910	22,370	22,830	1026.5
1026.4	14,560	14,960	15,370	15,770	16,190	16,600	17,020	17,440	17,870	18,290	18,730	19,160	19,600	20,050	20,490	20,940	21,390	21,850	22,310	22,770	23,240	1026.4
1026.3	14,920	15,320	15,730	16,140	16,550	16,970	17,390	17,820	18,250	18,680	19,110	19,550	19,990	20,440	20,890	21,340	21,800	22,250	22,720	23,180	23,650	1026.3
1026.2	15,280	15,690	16,100	16,510	16,930	17,350	17,770	18,200	18,630	19,060	19,500	19,940	20,390	20,830	21,290	21,740	22,200	22,660	23,130	23,590	24,060	1026.2
1026.1	15,640	16,050	16,460	16,880	17,300	17,720	18,150	18,580	19,010	19,450	19,890	20,330	20,780	21,230	21,690	22,140	22,600	23,070	23,540	24,010	24,480	1026.1
1026.0	16,010	16,420	16,830	17,250	17,680	18,100	18,530	18,960	19,400	19,840	20,280	20,730	21,180	21,630	22,090	22,550	23,010	23,480	23,950	24,420	24,900	1026.0
1025.9	16,370	16,780	17,200	17,620	18,040	18,470	18,900	19,340	19,780	20,220	20,660	21,110	21,570	22,020	22,480	22,940	23,410	23,880	24,350	24,820	25,300	1025.9
1025.8	16,730	17,140	17,560	17,990	18,410	18,840	19,280	19,720	20,160	20,600	21,050	21,500	21,960	22,410	22,870	23,340	23,810	24,280	24,750	25,230	25,710	1025.8
1025.7	17,090	17,510	17,930	18,360	18,790	19,220	19,660	20,100	20,540	20,990	21,440	21,890	22,350	22,810	23,270	23,740	24,210	24,680	25,160	25,640	26,120	1025.7
1025.6	17,450	17,870	18,300	18,730	19,160	19,590	20,030	20,480	20,920	21,370	21,820	22,280	22,740	23,200	23,670	24,140	24,610	25,080	25,560	26,040	26,530	1025.6
1025.5	17,820	18,240	18,670	19,100	19,530	19,970	20,410	20,860	21,310	21,760	22,210	22,670	23,130	23,600	24,070	24,540	25,010	25,490	25,970	26,450	26,940	1025.5
1025.4	18,180	18,610	19,040	19,470	19,910	20,350	20,790	21,240	21,690	22,150	22,600	23,060	23,530	23,990	24,460	24,940	25,410	25,890	26,380	26,860	27,350	1025.4
1025.3	18,550	18,980	19,410	19,850	20,290	20,730	21,180	21,630	22,080	22,540	22,990	23,460	23,920	24,390	24,870	25,340	25,820	26,300	26,790	27,280	27,770	1025.3
1025.2	18,920	19,350	19,790	20,220	20,670	21,110	21,560	22,010	22,470	22,930	23,390	23,850	24,320	24,790	25,270	25,750	26,230	26,710	27,200	27,690	28,180	1025.2
1025.1	19,290	19,720	20,160	20,600	21,050	21,490	21,950	22,400	22,860	23,320	23,780	24,250	24,720	25,190	25,670	26,150	26,630	27,120	27,610	28,100	28,600	1025.1
1025.0	19,660	20,100	20,540	20,980	21,430	21,880	22,330	22,790	23,250	23,710	24,180	24,650	25,120	25,600	26,070	26,560	27,040	27,530	28,020	28,520	29,010	1025.0
1024.9	20,030	20,470	20,910	21,350	21,800	22,260	22,710	23,170	23,630	24,100	24,570	25,040	25,510	25,990	26,470	26,960	27,440	27,930	28,430	28,920	29,420	1024.9
1024.8	20,390	20,840	21,280	21,730	22,180	22,630	23,090	23,550	24,020	24,480	24,960	25,430	25,910	26,390	26,870	27,360	27,850	28,340	28,830	29,330	29,830	1024.8
1024.7	20,760	21,210	21,650	22,100	22,560	23,010	23,470	23,940	24,400	24,870	25,350	25,820	26,300	26,780	27,270	27,760	28,250	28,740	29,240	29,740	30,250	1024.7
1024.6	21,130	21,580	22,030	22,480	22,940	23,390	23,860	24,320	24,790	25,260	25,740	26,220	26,700	27,180	27,670	28,160	28,650	29,150	29,650	30,150	30,660	1024.6
1024.5	21,500	21,950	22,400	22,860	23,320	23,780	24,240	24,710	25,180	25,650	26,130	26,610	27,090	27,580	28,070	28,560	29,060	29,560	30,060	30,560	31,070	1024.5
1024.4	21,880	22,330	22,780	23,240	23,700	24,160	24,630	25,100	25,570	26,050	26,520	27,010	27,490	27,980	28,470	28,970	29,460	29,970	30,470	30,980	31,490	1024.4
1024.3	22,250	22,700	23,160	23,620	24,080	24,540	25,010	25,480	25,960	26,440	26,920	27,400	27,890	28,380	28,880	29,370	29,870	30,380	30,880	31,390	31,900	1024.3
1024.2	22,620	23,080	23,540	24,000	24,460	24,930	25,400	25,870	26,350	26,830	27,320	27,800	28,290	28,780	29,280	29,780	30,280	30,790	31,290	31,800	32,320	1024.2
1024.1	23,000	23,460	23,920	24,380	24,850	25,320	25,790	26,270	26,740	27,230	27,710	28,200	28,690	29,190	29,690	30,190	30,690	31,200	31,710	32,220	32,740	1024.1
1024.0	23,380	23,840	24,300	24,760	25,230	25,700	26,180	26,660	27,140	27,620	28,110	28,600	29,100	29,590	30,090	30,590	31,100	31,610	32,120	32,640	33,150	1024.0
1023.9	23,770	24,230	24,700	25,160	25,630	26,110	26,590	27,070	27,550	28,040	28,530	29,020	29,520	30,020	30,520	31,020	31,530	32,040	32,560	33,070	33,590	1023.9
1023.8	24,160	24,630	25,100	25,570	26,040	26,520	27,000	27,480	27,970	28,450	28,950	29,440	29,940	30,440	30,950	31,450	31,960	32,480	32,990	33,510	34,040	1023.8
1023.7	24,560	25,030	25,500	25,970	26,450	26,920	27,410	27,890	28,380	28,870	29,370	29,870	30,370	30,870	31,380	31,890	32,400	32,910	33,430	33,960	34,480	1023.7
1023.6	24,960	25,430	25,900	26,370	26,850	27,330	27,820	28,310	28,800	29,290	29,790	30,290	30,790	31,300	31,810	32,320	32,840	33,350	33,870	34,400	34,920	1023.6
1023.5	25,360	25,830	26,300	26,780	27,260	27,750	28,230	28,720	29,220	29,710	30,210	30,720	31,220	31,730	32,240	32,760	33,270	33,790	34,320	34,840	35,370	1023.5
1023.4	25,760	26,230	26,710	27,190	27,670	28,160	28,650	29,140	29,640	30,140	30,640	31,140	31,650	32,160	32,680	33,190	33,710	34,230	34,760	35,290	35,820	1023.4
1023.3	26,160	26,640	27,120	27,600	28,090	28,580	29,070	29,560	30,060	30,560	31,070	31,570	32,080	32,600	33,110	33,630	34,150	34,680	35,210	35,740	36,270	1023.3
1023.2	26,570	27,050	27,530	28,010	28,500	28,990	29,490	29,980	30,480	30,990	31,490	32,000	32,520	33,030	33,550	34,070	34,600	35,120	35,650	36,190	36,720	1023.2
1023.1	26,970	27,460	27,940	28,430	28,920	29,410	29,910	30,410	30,910	31,420	31,930	32,440	32,950	33,470	33,990	34,510	35,040	35,570	36,100	36,640	37,180	1023.1
1023.0	27,380	27,870	28,350	28,840	29,340	29,830	30,330	30,830	31,340	31,850	32,360	32,870	33,390	33,910	34,430	34,960	35,490	36,020	36,550	37,090	37,630	1023.0
1022.9	27,830	28,320	28,810	29,300	29,800	30,300	30,800	31,300	31,810	32,320	32,830	33,350	33,870	34,390	34,920	35,450	35,980	36,520	37,050	37,590	38,140	1022.9
1022.8	28,280	28,770	29,270	29,760	30,260	30,760	31,270	31,770	32,280	32,800	33,310	33,830	34,360	34,880	35,410	35,940	36,480	37,020	37,560	38,100	38,640	1022.8
1022.7	28,740	29,230	29,720	30,220	30,720	31,230	31,740	32,250	32,760	33,280	33,800	34,320	34,850	35,370	35,910	36,440	36,980	37,520	38,060	38,610	39,160	1022.7
1022.6	29,190	29,690	30,190	30,690	31,190	31,700	32,210	32,720	33,240	33,760	34,280	34,810	35,340	35,870	36,400	36,940	37,480	38,020	38,570	39,120	39,670	1022.6
1022.5	29,650	30,150	30,650	31,160	31,660	32,170	32,690	33,200	33,720	34,250	34,770	35,300	35,830	36,360	36,900	37,440	37,980	38,530	39,080	39,630	40,190	1022.5
1022.4	30,120	30,620	31,120	31,630	32,140	32,650	33,170	33,690	34,210	34,730	35,260	35,790	36,330	36,860	37,400	37,950	38,490	39,040	39,590	40,150	40,700	1022.4
1022.3	30,580	31,080	31,590	32,100	32,610	33,130	33,650	34,170	34,700	35,220	35,760	36,290	36,830	37,370	37,910	38,450	39,000	39,550	40,110	40,670	41,230	1022.3
1022.2	31,050	31,560	32,070	32,580	33,090	33,610	34,130	34,660	35,190	35,720	36,250	36,790	37,330	37,870	38,420	38,960	39,520	40,070	40,630	41,190	41,750	1022.2
1022.1	31,520	32,030	32,540	33,060	33,580	34,100	34,620	35,150	35,680	36,210	36,750	37,290	37,830	38,380	38,930	39,480	40,030	40,590	41,150	41,710	42,280	1022.1
1022.0	31,990	32,500	33,020	33,540	34,060	34,580	35,110	35,640	36,180	36,710	37,250	37,790	38,340	38,890	39,440	39,990	40,550	41,110	41,670	42,240	42,810	1022.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1032.0	1032.1	1032.2	1032.3	1032.4	1032.5	1032.6	1032.7	1032.8	1032.9	1033.0	1033.1	1033.2	1033.3	1033.4	1033.5	1033.6	1033.7	1033.8	1033.9	1034.0	
1021.9	32,490	33,010	33,520	34,050	34,570	35,100	35,630	36,160	36,700	37,240	37,780	38,330	38,880	39,430	39,980	40,540	41,100	41,660	42,230	42,800	43,370	1021.9
1021.8	32,990	33,510	34,030	34,560	35,080	35,620	36,150	36,690	37,230	37,770	38,310	38,860	39,410	39,970	40,530	41,090	41,650	42,210	42,780	43,360	43,930	1021.8
1021.7	33,500	34,020	34,540	35,070	35,600	36,140	36,670	37,210	37,760	38,300	38,850	39,400	39,960	40,510	41,070	41,640	42,200	42,770	43,340	43,920	44,500	1021.7
1021.6	34,000	34,530	35,060	35,590	36,120	36,660	37,200	37,740	38,290	38,840	39,390	39,940	40,500	41,060	41,630	42,190	42,760	43,330	43,910	44,490	45,070	1021.6
1021.5	34,510	35,040	35,570	36,110	36,650	37,190	37,730	38,270	38,820	39,380	39,930	40,490	41,050	41,610	42,180	42,750	43,320	43,900	44,480	45,060	45,640	1021.5
1021.4	35,030	35,560	36,090	36,630	37,170	37,720	38,260	38,810	39,360	39,920	40,480	41,040	41,600	42,170	42,740	43,310	43,890	44,460	45,050	45,630	46,220	1021.4
1021.3	35,550	36,080	36,620	37,160	37,700	38,250	38,800	39,350	39,910	40,460	41,030	41,590	42,160	42,730	43,300	43,880	44,450	45,040	45,620	46,210	46,800	1021.3
1021.2	36,070	36,600	37,150	37,690	38,240	38,790	39,340	39,890	40,450	41,010	41,580	42,150	42,720	43,290	43,860	44,440	45,030	45,610	46,200	46,790	47,380	1021.2
1021.1	36,590	37,130	37,680	38,220	38,770	39,330	39,880	40,440	41,000	41,570	42,130	42,700	43,280	43,850	44,430	45,010	45,600	46,190	46,780	47,370	47,970	1021.1
1021.0	37,120	37,660	38,210	38,760	39,310	39,870	40,430	40,990	41,550	42,120	42,690	43,270	43,840	44,420	45,000	45,590	46,180	46,770	47,360	47,960	48,560	1021.0
1020.9	37,670	38,220	38,770	39,330	39,880	40,440	41,000	41,570	42,140	42,710	43,280	43,860	44,440	45,020	45,610	46,200	46,790	47,380	47,980	48,580	49,180	1020.9
1020.8	38,240	38,790	39,340	39,900	40,460	41,020	41,590	42,160	42,730	43,300	43,880	44,460	45,040	45,630	46,220	46,810	47,410	48,000	48,600	49,210	49,810	1020.8
1020.7	38,800	39,350	39,910	40,470	41,040	41,600	42,170	42,740	43,320	43,900	44,480	45,060	45,650	46,240	46,830	47,430	48,030	48,630	49,230	49,840	50,450	1020.7
1020.6	39,370	39,930	40,490	41,050	41,620	42,190	42,760	43,340	43,920	44,500	45,080	45,670	46,260	46,850	47,450	48,050	48,650	49,250	49,860	50,470	51,080	1020.6
1020.5	39,940	40,500	41,070	41,630	42,200	42,780	43,350	43,930	44,520	45,100	45,690	46,280	46,870	47,470	48,070	48,670	49,280	49,890	50,500	51,110	51,730	1020.5
1020.4	40,520	41,080	41,650	42,220	42,790	43,370	43,950	44,530	45,120	45,710	46,300	46,890	47,490	48,090	48,690	49,300	49,910	50,520	51,140	51,750	52,370	1020.4
1020.3	41,100	41,670	42,240	42,810	43,390	43,970	44,550	45,140	45,730	46,320	46,920	47,510	48,110	48,720	49,320	49,930	50,550	51,160	51,780	52,400	53,020	1020.3
1020.2	41,680	42,250	42,830	43,410	43,990	44,570	45,160	45,750	46,340	46,940	47,530	48,140	48,740	49,350	49,960	50,570	51,190	51,800	52,430	53,050	53,680	1020.2
1020.1	42,270	42,850	43,420	44,010	44,590	45,180	45,770	46,360	46,960	47,560	48,160	48,760	49,370	49,980	50,600	51,210	51,830	52,450	53,080	53,710	54,340	1020.1
1020.0	42,860	43,440	44,020	44,610	45,200	45,790	46,380	46,980	47,580	48,180	48,790	49,390	50,010	50,620	51,240	51,860	52,480	53,100	53,730	54,360	55,000	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1034.0	1034.1	1034.2	1034.3	1034.4	1034.5	1034.6	1034.7	1034.8	1034.9	1035.0	1035.1	1035.2	1035.3	1035.4	1035.5	1035.6	1035.7	1035.8	1035.9	1036.0	
1034.0	0	40	110	200	310	430	560	700	860	1,020	1,200	1,380	1,570	1,770	1,970	2,180	2,400	2,630	2,860	3,100	3,350	1034.0
1033.9	40	110	200	310	430	560	700	860	1,020	1,200	1,380	1,570	1,770	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	1033.9
1033.8	110	200	310	430	560	700	860	1,020	1,190	1,380	1,570	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	1033.8
1033.7	200	310	430	560	700	860	1,020	1,190	1,380	1,570	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	1033.7
1033.6	310	430	560	700	860	1,020	1,190	1,380	1,570	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	1033.6
1033.5	430	560	700	860	1,020	1,190	1,380	1,570	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	1033.5
1033.4	560	700	860	1,020	1,190	1,370	1,570	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	4,950	1033.4
1033.3	700	860	1,020	1,190	1,370	1,560	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	4,940	5,230	1033.3
1033.2	860	1,020	1,190	1,370	1,560	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	4,940	5,230	5,520	1033.2
1033.1	1,020	1,190	1,370	1,560	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	4,940	5,230	5,520	5,820	1033.1
1033.0	1,190	1,370	1,560	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,350	3,600	3,860	4,120	4,390	4,660	4,940	5,230	5,520	5,820	6,120	1033.0
1032.9	1,370	1,560	1,760	1,970	2,180	2,400	2,630	2,860	3,100	3,340	3,600	3,850	4,120	4,390	4,660	4,940	5,230	5,520	5,820	6,120	6,420	1032.9
1032.8	1,560	1,760	1,970	2,180	2,400	2,620	2,860	3,100	3,340	3,600	3,850	4,120	4,390	4,660	4,940	5,230	5,520	5,820	6,120	6,420	6,740	1032.8
1032.7	1,760	1,960	2,180	2,400	2,620	2,860	3,100	3,340	3,590	3,850	4,120	4,390	4,660	4,940	5,230	5,520	5,820	6,120	6,420	6,730	7,050	1032.7
1032.6	1,960	2,180	2,400	2,620	2,860	3,100	3,340	3,590	3,850	4,120	4,390	4,660	4,940	5,230	5,520	5,810	6,120	6,420	6,730	7,050	7,370	1032.6
1032.5	2,180	2,400	2,620	2,860	3,090	3,340	3,590	3,850	4,120	4,380	4,660	4,940	5,230	5,520	5,810	6,120	6,420	6,730	7,050	7,370	7,700	1032.5
1032.4	2,390	2,620	2,850	3,090	3,340	3,590	3,850	4,110	4,380	4,660	4,940	5,230	5,520	5,810	6,110	6,420	6,730	7,050	7,370	7,700	8,030	1032.4
1032.3	2,620	2,850	3,090	3,340	3,590	3,850	4,110	4,380	4,660	4,940	5,220	5,520	5,810	6,110	6,420	6,730	7,050	7,370	7,700	8,030	8,360	1032.3
1032.2	2,850	3,090	3,340	3,590	3,850	4,110	4,380	4,660	4,940	5,220	5,520	5,810	6,110	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,700	1032.2
1032.1	3,090	3,340	3,590	3,850	4,110	4,380	4,660	4,940	5,220	5,510	5,810	6,110	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,700	9,040	1032.1
1032.0	3,340	3,590	3,850	4,110	4,380	4,660	4,940	5,220	5,510	5,810	6,110	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,700	9,040	9,390	1032.0
1031.9	3,590	3,840	4,110	4,380	4,650	4,930	5,220	5,510	5,810	6,110	6,420	6,730	7,040	7,370	7,690	8,020	8,360	8,700	9,040	9,390	9,740	1031.9
1031.8	3,840	4,110	4,380	4,650	4,930	5,220	5,510	5,810	6,110	6,410	6,730	7,040	7,360	7,690	8,020	8,350	8,690	9,040	9,390	9,740	10,100	1031.8
1031.7	4,100	4,370	4,650	4,930	5,220	5,510	5,800	6,100	6,410	6,720	7,040	7,360	7,690	8,020	8,350	8,690	9,040	9,380	9,740	10,090	10,450	1031.7
1031.6	4,370	4,650	4,930	5,210	5,500	5,800	6,100	6,410	6,720	7,040	7,360	7,680	8,010	8,350	8,690	9,030	9,380	9,730	10,090	10,450	10,820	1031.6
1031.5	4,640	4,930	5,210	5,500	5,800	6,100	6,410	6,720	7,030	7,360	7,680	8,010	8,350	8,690	9,030	9,380	9,730	10,090	10,450	10,820	11,180	1031.5
1031.4	4,920	5,210	5,500	5,800	6,100	6,400	6,720	7,030	7,350	7,680	8,010	8,340	8,680	9,030	9,380	9,730	10,090	10,450	10,810	11,180	11,560	1031.4
1031.3	5,210	5,500	5,790	6,100	6,400	6,710	7,030	7,350	7,680	8,010	8,340	8,680	9,030	9,370	9,730	10,080	10,450	10,810	11,180	11,550	11,930	1031.3
1031.2	5,500	5,790	6,090	6,400	6,710	7,030	7,350	7,670	8,000	8,340	8,680	9,020	9,370	9,720	10,080	10,440	10,810	11,180	11,550	11,930	12,310	1031.2
1031.1	5,790	6,090	6,400	6,710	7,030	7,350	7,670	8,000	8,340	8,680	9,020	9,370	9,720	10,080	10,440	10,810	11,180	11,550	11,930	12,310	12,690	1031.1
1031.0	6,090	6,400	6,710	7,020	7,340	7,670	8,000	8,330	8,670	9,020	9,370	9,720	10,080	10,440	10,800	11,170	11,550	11,920	12,310	12,690	13,080	1031.0
1030.9	6,390	6,700	7,020	7,340	7,660	7,990	8,330	8,670	9,010	9,360	9,710	10,070	10,430	10,800	11,170	11,540	11,920	12,300	12,680	13,070	13,470	1030.9
1030.8	6,700	7,010	7,330	7,660	7,990	8,320	8,660	9,010	9,350	9,710	10,060	10,420	10,790	11,160	11,530	11,910	12,290	12,680	13,070	13,460	13,860	1030.8
1030.7	7,010	7,330	7,650	7,980	8,320	8,660	9,000	9,350	9,700	10,060	10,420	10,780	11,150	11,530	11,900	12,280	12,670	13,060	13,450	13,850	14,250	1030.7
1030.6	7,320	7,650	7,980	8,310	8,650	8,990	9,340	9,690	10,050	10,410	10,780	11,140	11,520	11,900	12,280	12,660	13,050	13,440	13,840	14,240	14,650	1030.6
1030.5	7,640	7,970	8,300	8,640	8,990	9,330	9,690	10,040	10,400	10,770	11,140	11,510	11,890	12,270	12,650	13,040	13,440	13,830	14,230	14,640	15,050	1030.5
1030.4	7,960	8,300	8,640	8,980	9,330	9,680	10,040	10,400	10,760	11,130	11,500	11,880	12,260	12,650	13,040	13,430	13,830	14,230	14,630	15,040	15,450	1030.4
1030.3	8,290	8,630	8,970	9,320	9,670	10,030	10,390	10,750	11,120	11,500	11,870	12,250	12,640	13,030	13,420	13,820	14,220	14,620	15,030	15,440	15,860	1030.3
1030.2	8,620	8,970	9,310	9,670	10,020	10,380	10,750	11,120	11,490	11,870	12,250	12,630	13,020	13,410	13,810	14,210	14,620	15,020	15,440	15,850	16,270	1030.2
1030.1	8,960	9,310	9,660	10,020	10,380	10,740	11,110	11,480	11,860	12,240	12,620	13,010	13,410	13,800	14,200	14,610	15,020	15,430	15,840	16,260	16,680	1030.1
1030.0	9,300	9,650	10,010	10,370	10,730	11,100	11,470	11,850	12,230	12,620	13,010	13,400	13,790	14,190	14,600	15,010	15,420	15,830	16,250	16,680	17,100	1030.0
1029.9	9,640	10,000	10,360	10,720	11,090	11,460	11,840	12,220	12,610	12,990	13,390	13,780	14,180	14,590	15,000	15,410	15,820	16,240	16,660	17,090	17,520	1029.9
1029.8	9,990	10,350	10,710	11,080	11,450	11,830	12,210	12,600	12,980	13,380	13,770	14,170	14,580	14,980	15,400	15,810	16,230	16,650	17,080	17,510	17,940	1029.8
1029.7	10,340	10,700	11,070	11,440	11,820	12,200	12,580	12,970	13,370	13,760	14,160	14,560	14,970	15,380	15,800	16,220	16,640	17,070	17,490	17,930	18,360	1029.7
1029.6	10,690	11,060	11,430	11,810	12,190	12,570	12,960	13,350	13,750	14,150	14,550	14,960	15,370	15,790	16,200	16,630	17,050	17,480	17,920	18,350	18,790	1029.6
1029.5	11,050	11,420	11,800	12,180	12,560	12,950	13,340	13,740	14,140	14,540	14,950	15,360	15,770	16,190	16,610	17,040	17,470	17,900	18,340	18,780	19,220	1029.5
1029.4	11,410	11,790	12,170	12,550	12,940	13,330	13,730	14,130	14,530	14,940	15,350	15,760	16,180	16,600	17,030	17,460	17,890	18,330	18,770	19,210	19,660	1029.4
1029.3	11,780	12,160	12,540	12,930	13,320	13,720	14,120	14,520	14,930	15,340	15,750	16,170	16,590	17,020	17,440	17,880	18,310	18,750	19,200	19,640	20,090	1029.3
1029.2	12,150	12,530	12,920	13,310	13,710	14,100	14,510	14,910	15,320	15,740	16,160	16,580	17,000	17,430	17,860	18,300	18,740	19,180	19,630	20,080	20,530	1029.2
1029.1	12,520	12,910	13,300	13,690	14,090	14,500	14,900	15,310	15,730	16,140	16,570	16,990	17,420	17,850	18,290	18,730	19,170	19,620	20,070	20,520	20,980	1029.1
1029.0	12,900	13,290	13,680	14,080	14,480	14,890	15,300	15,710	16,130	16,550	16,980	17,410	17,840	18,270	18,710	19,160	19,600	20,050	20,510	20,960	21,420	1029.0
1028.9	13,270	13,670	14,060	14,470	14,870	15,280	15,700	16,110	16,530	16,960	17,390	17,820	18,250	18,690	19,130	19,580	20,030	20,480	20,940	21,400	21,860	1028.9
1028.8	13,650	14,050	14,450	14,850	15,260	15,680	16,090	16,510	16,940	17,370	17,800	18,230	18,670	19,110	19,560	20,010	20,460	20,920	21,380	21,840	22,300	1028.8
1028.7	14,030	14,430	14,830	15,240	15,660	16,070	16,490	16,920	17,350	17,780	18,210	18,650	19,090	19,540	19,990	20,440	20,890	21,350	21,810	22,280	22,750	1028.7
1028.6	14,410	14,820	15,220	15,640	16,050	16,470	16,900	17,320	17,760	18,190	18,630	19,070	19,510	19,960	20,410	20,870	21,330	21,790	22,260	22,720	23,200	1028.6
1028.5	14,800	15,210	15,620	16,030	16,450	16,880	17,300	17,730	18,170	18,610	19,050	19,490	19,940	20,390	20,850	21,310	21,770	22,230	22,700	23,170	23,650	1028.5
1028.4	15,190	15,600	16,010	16,430	16,860	17,280	17,710	18,150	18,590	19,030	19,470	19,920	20,370	20,820	21,280	21,740	22,210	22,680	23,150	23,620	24,100	1028.4
1028.3	15,580	16,000	16,410	16,840	17,260	17,690	18,130	18,560	19,000	19,450	19,900	20,350	20,800	21,260	21,720	22,180	22,650	23,120	23,600	24,080	24,560	1028.3
1028.2	15,980	16,390	16,820	17,240	17,670	18,110	18,540	18,980	19,430	19,870	20,320	20,780	21,240	21,700	22,160	22,630	23,100	23,570	24,050	24,530	25,020	1028.2
1028.1	16,370	16,800	17,220	17,650	18,080	18,520	18,960	19,400	19,850	20,300	20,760	21,210	21,670	22,140	22,600	23,070	23,550	24,030	24,510	24,990	25,480	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1034.0	1034.1	1034.2	1034.3	1034.4	1034.5	1034.6	1034.7	1034.8	1034.9	1035.0	1035.1	1035.2	1035.3	1035.4	1035.5	1035.6	1035.7	1035.8	1035.9	1036.0	
1028.0	16, 780	17, 200	17, 630	18, 060	18, 500	18, 940	19, 380	19, 830	20, 280	20, 730	21, 190	21, 650	22, 110	22, 580	23, 050	23, 520	24, 000	24, 480	24, 960	25, 450	25, 940	1028.0
1027.9	17, 170	17, 600	18, 030	18, 460	18, 900	19, 350	19, 790	20, 240	20, 690	21, 150	21, 610	22, 070	22, 540	23, 010	23, 480	23, 960	24, 440	24, 920	25, 410	25, 900	26, 390	1027.9
1027.8	17, 560	17, 990	18, 430	18, 870	19, 310	19, 760	20, 200	20, 660	21, 110	21, 570	22, 030	22, 500	22, 970	23, 440	23, 920	24, 400	24, 880	25, 360	25, 850	26, 340	26, 840	1027.8
1027.7	17, 960	18, 390	18, 830	19, 270	19, 720	20, 170	20, 620	21, 070	21, 530	22, 000	22, 460	22, 930	23, 400	23, 880	24, 350	24, 840	25, 320	25, 810	26, 300	26, 790	27, 290	1027.7
1027.6	18, 360	18, 800	19, 240	19, 680	20, 130	20, 580	21, 040	21, 490	21, 960	22, 420	22, 890	23, 360	23, 830	24, 310	24, 790	25, 280	25, 770	26, 260	26, 750	27, 250	27, 750	1027.6
1027.5	18, 760	19, 200	19, 650	20, 090	20, 540	21, 000	21, 460	21, 920	22, 380	22, 850	23, 320	23, 790	24, 270	24, 750	25, 230	25, 720	26, 210	26, 700	27, 200	27, 700	28, 200	1027.5
1027.4	19, 170	19, 610	20, 060	20, 510	20, 960	21, 420	21, 880	22, 340	22, 810	23, 280	23, 750	24, 230	24, 710	25, 190	25, 680	26, 170	26, 660	27, 160	27, 650	28, 160	28, 660	1027.4
1027.3	19, 570	20, 020	20, 470	20, 920	21, 380	21, 840	22, 300	22, 770	23, 240	23, 710	24, 190	24, 670	25, 150	25, 630	26, 120	26, 620	27, 110	27, 610	28, 110	28, 620	29, 120	1027.3
1027.2	19, 980	20, 430	20, 880	21, 340	21, 800	22, 260	22, 730	23, 200	23, 670	24, 140	24, 620	25, 100	25, 590	26, 080	26, 570	27, 070	27, 560	28, 060	28, 570	29, 080	29, 590	1027.2
1027.1	20, 390	20, 850	21, 300	21, 760	22, 220	22, 690	23, 150	23, 630	24, 100	24, 580	25, 060	25, 550	26, 030	26, 530	27, 020	27, 520	28, 020	28, 520	29, 030	29, 540	30, 050	1027.1
1027.0	20, 810	21, 260	21, 720	22, 180	22, 650	23, 110	23, 580	24, 060	24, 540	25, 020	25, 500	25, 990	26, 480	26, 970	27, 470	27, 970	28, 470	28, 980	29, 490	30, 000	30, 520	1027.0
1026.9	21, 210	21, 670	22, 130	22, 590	23, 060	23, 530	24, 000	24, 480	24, 960	25, 440	25, 930	26, 420	26, 910	27, 410	27, 910	28, 410	28, 910	29, 420	29, 930	30, 450	30, 970	1026.9
1026.8	21, 610	22, 070	22, 530	23, 000	23, 470	23, 940	24, 420	24, 900	25, 380	25, 870	26, 360	26, 850	27, 340	27, 840	28, 340	28, 850	29, 360	29, 870	30, 380	30, 900	31, 420	1026.8
1026.7	22, 020	22, 480	22, 940	23, 410	23, 880	24, 360	24, 840	25, 320	25, 810	26, 290	26, 780	27, 280	27, 780	28, 280	28, 780	29, 290	29, 800	30, 310	30, 830	31, 350	31, 870	1026.7
1026.6	22, 420	22, 890	23, 360	23, 830	24, 300	24, 780	25, 260	25, 740	26, 230	26, 720	27, 220	27, 710	28, 210	28, 710	29, 220	29, 730	30, 240	30, 760	31, 270	31, 800	32, 320	1026.6
1026.5	22, 830	23, 300	23, 770	24, 240	24, 720	25, 200	25, 680	26, 170	26, 660	27, 150	27, 650	28, 150	28, 650	29, 150	29, 660	30, 170	30, 690	31, 200	31, 720	32, 250	32, 770	1026.5
1026.4	23, 240	23, 710	24, 180	24, 660	25, 140	25, 620	26, 110	26, 600	27, 090	27, 580	28, 080	28, 580	29, 090	29, 590	30, 100	30, 620	31, 130	31, 650	32, 180	32, 700	33, 230	1026.4
1026.3	23, 650	24, 120	24, 600	25, 080	25, 560	26, 040	26, 530	27, 020	27, 520	28, 020	28, 520	29, 020	29, 530	30, 040	30, 550	31, 060	31, 580	32, 100	32, 630	33, 160	33, 690	1026.3
1026.2	24, 060	24, 540	25, 020	25, 500	25, 980	26, 470	26, 960	27, 450	27, 950	28, 450	28, 950	29, 460	29, 970	30, 480	30, 990	31, 510	32, 030	32, 560	33, 080	33, 610	34, 140	1026.2
1026.1	24, 480	24, 960	25, 440	25, 920	26, 410	26, 900	27, 390	27, 880	28, 380	28, 880	29, 390	29, 900	30, 410	30, 920	31, 440	31, 960	32, 480	33, 010	33, 540	34, 070	34, 600	1026.1
1026.0	24, 900	25, 370	25, 860	26, 340	26, 830	27, 320	27, 820	28, 320	28, 820	29, 320	29, 830	30, 340	30, 850	31, 370	31, 890	32, 410	32, 940	33, 460	33, 990	34, 530	35, 070	1026.0
1025.9	25, 300	25, 780	26, 270	26, 760	27, 250	27, 740	28, 240	28, 740	29, 240	29, 750	30, 260	30, 770	31, 280	31, 800	32, 320	32, 850	33, 380	33, 910	34, 440	34, 970	35, 510	1025.9
1025.8	25, 710	26, 190	26, 680	27, 170	27, 660	28, 160	28, 660	29, 160	29, 670	30, 170	30, 690	31, 200	31, 720	32, 240	32, 760	33, 290	33, 820	34, 350	34, 880	35, 420	35, 960	1025.8
1025.7	26, 120	26, 600	27, 090	27, 590	28, 080	28, 580	29, 080	29, 580	30, 090	30, 600	31, 120	31, 630	32, 150	32, 670	33, 200	33, 730	34, 260	34, 790	35, 330	35, 870	36, 410	1025.7
1025.6	26, 530	27, 020	27, 510	28, 000	28, 500	29, 000	29, 500	30, 010	30, 520	31, 030	31, 550	32, 070	32, 590	33, 110	33, 640	34, 170	34, 700	35, 240	35, 780	36, 320	36, 860	1025.6
1025.5	26, 940	27, 430	27, 920	28, 420	28, 920	29, 420	29, 930	30, 440	30, 950	31, 460	31, 980	32, 500	33, 020	33, 550	34, 080	34, 610	35, 150	35, 680	36, 220	36, 770	37, 310	1025.5
1025.4	27, 350	27, 850	28, 340	28, 840	29, 340	29, 850	30, 350	30, 860	31, 380	31, 890	32, 410	32, 940	33, 460	33, 990	34, 520	35, 050	35, 590	36, 130	36, 670	37, 220	37, 770	1025.4
1025.3	27, 770	28, 260	28, 760	29, 260	29, 760	30, 270	30, 780	31, 290	31, 810	32, 330	32, 850	33, 370	33, 900	34, 430	34, 960	35, 500	36, 040	36, 580	37, 120	37, 670	38, 220	1025.3
1025.2	28, 180	28, 680	29, 180	29, 680	30, 190	30, 690	31, 210	31, 720	32, 240	32, 760	33, 280	33, 810	34, 340	34, 870	35, 410	35, 940	36, 480	37, 030	37, 570	38, 120	38, 680	1025.2
1025.1	28, 600	29, 100	29, 600	30, 100	30, 610	31, 120	31, 630	32, 150	32, 670	33, 190	33, 720	34, 250	34, 780	35, 310	35, 850	36, 390	36, 930	37, 480	38, 030	38, 580	39, 130	1025.1
1025.0	29, 010	29, 520	30, 020	30, 530	31, 040	31, 550	32, 060	32, 580	33, 100	33, 630	34, 160	34, 690	35, 220	35, 760	36, 300	36, 840	37, 380	37, 930	38, 480	39, 030	39, 590	1025.0
1024.9	29, 420	29, 930	30, 430	30, 940	31, 450	31, 970	32, 490	33, 010	33, 530	34, 060	34, 590	35, 120	35, 650	36, 190	36, 730	37, 280	37, 820	38, 370	38, 920	39, 480	40, 040	1024.9
1024.8	29, 830	30, 340	30, 850	31, 360	31, 870	32, 390	32, 910	33, 430	33, 960	34, 480	35, 020	35, 550	36, 090	36, 630	37, 170	37, 720	38, 260	38, 820	39, 370	39, 930	40, 490	1024.8
1024.7	30, 250	30, 750	31, 260	31, 780	32, 290	32, 810	33, 330	33, 860	34, 380	34, 910	35, 450	35, 980	36, 520	37, 060	37, 610	38, 160	38, 710	39, 260	39, 820	40, 370	40, 940	1024.7
1024.6	30, 660	31, 170	31, 680	32, 190	32, 710	33, 230	33, 760	34, 280	34, 810	35, 340	35, 880	36, 420	36, 960	37, 500	38, 050	38, 600	39, 150	39, 700	40, 260	40, 820	41, 390	1024.6
1024.5	31, 070	31, 580	32, 100	32, 610	33, 130	33, 660	34, 180	34, 710	35, 240	35, 770	36, 310	36, 850	37, 390	37, 940	38, 490	39, 040	39, 590	40, 150	40, 710	41, 270	41, 840	1024.5
1024.4	31, 490	32, 000	32, 510	33, 030	33, 550	34, 080	34, 610	35, 140	35, 670	36, 210	36, 750	37, 290	37, 830	38, 380	38, 930	39, 480	40, 040	40, 600	41, 160	41, 720	42, 290	1024.4
1024.3	31, 900	32, 420	32, 930	33, 450	33, 980	34, 500	35, 030	35, 570	36, 100	36, 640	37, 180	37, 720	38, 270	38, 820	39, 370	39, 930	40, 480	41, 050	41, 610	42, 170	42, 740	1024.3
1024.2	32, 320	32, 830	33, 350	33, 880	34, 400	34, 930	35, 460	36, 000	36, 530	37, 070	37, 620	38, 160	38, 710	39, 260	39, 820	40, 370	40, 930	41, 490	42, 060	42, 630	43, 200	1024.2
1024.1	32, 740	33, 250	33, 780	34, 300	34, 830	35, 360	35, 890	36, 430	36, 970	37, 510	38, 050	38, 600	39, 150	39, 700	40, 260	40, 820	41, 380	41, 940	42, 510	43, 080	43, 650	1024.1
1024.0	33, 150	33, 670	34, 200	34, 720	35, 250	35, 790	36, 320	36, 860	37, 400	37, 940	38, 490	39, 040	39, 590	40, 150	40, 700	41, 270	41, 830	42, 390	42, 960	43, 530	44, 110	1024.0
1023.9	33, 590	34, 120	34, 640	35, 170	35, 700	36, 240	36, 780	37, 320	37, 860	38, 400	38, 950	39, 500	40, 060	40, 620	41, 180	41, 740	42, 300	42, 870	43, 440	44, 020	44, 590	1023.9
1023.8	34, 040	34, 560	35, 090	35, 620	36, 150	36, 690	37, 230	37, 770	38, 320	38, 870	39, 420	39, 970	40, 530	41, 090	41, 650	42, 210	42, 780	43, 350	43, 930	44, 500	45, 080	1023.8
1023.7	34, 480	35, 010	35, 540	36, 070	36, 610	37, 150	37, 690	38, 230	38, 780	39, 330	39, 880	40, 440	41, 000	41, 560	42, 120	42, 690	43, 260	43, 830	44, 410	44, 990	45, 570	1023.7
1023.6	34, 920	35, 450	35, 990	36, 520	37, 060	37, 600	38, 150	38, 690	39, 240	39, 800	40, 350	40, 910	41, 470	42, 030	42, 600	43, 170	43, 740	44, 320	44, 900	45, 480	46, 060	1023.6
1023.5	35, 370	35, 900	36, 440	36, 980	37, 520	38, 060	38, 610	39, 160	39, 710	40, 260	40, 820	41, 380	41, 950	42, 510	43, 080	43, 650	44, 230	44, 800	45, 380	45, 970	46, 550	1023.5
1023.4	35, 820	36, 350	36, 890	37, 430	37, 980	38, 520	39, 070	39, 620	40, 180	40, 730	41, 290	41, 860	42, 420	42, 990	43, 560	44, 130	44, 710	45, 290	45, 870	46, 460	47, 040	1023.4
1023.3	36, 270	36, 810	37, 350	37, 890	38, 430	38, 980	39, 530	40, 090	40, 640	41, 200	41, 770	42, 330	42, 900	43, 470	44, 040	44, 620	45, 200	45, 780	46, 360	46, 950	47, 540	1023.3
1023.2	36, 720	37, 260	37, 800	38, 350	38, 900	39, 450	40, 000	40, 550	41, 110	41, 680	42, 240	42, 810	43, 380	43, 950	44, 520	45, 100	45, 680	46, 270	46, 850	47, 440	48, 040	1023.2
1023.1	37, 180	37, 720	38, 260	38, 810	39, 360	39, 910	40, 470	41, 020	41, 590	42, 150	42, 720	43, 290	43, 860	44, 430	45, 010	45, 590	46, 170	46, 760	47, 350	47, 940	48, 530	1023.1
1023.0	37, 630	38, 170	38, 720	39, 270	39, 820	40, 380	40, 930	41, 500	42, 060	42, 620	43, 190	43, 770	44, 340	44, 920	45, 500	46, 080	46, 660	47, 250	47, 840	48, 440	49, 030	1023.0
1022.9	38, 140	38, 680	39, 230	39, 780	40, 340	40, 900	41, 460	42, 020	42, 590	43, 150	43, 730	44, 300	44, 880	45, 460	46, 040	46, 630	47, 210	47, 800	48, 400	48, 990	49, 590	1022.9
1022.8	38, 640	39, 190	39, 750	40, 300	40, 860	41, 420	41, 980	42, 550	43, 120	43, 690	44, 260	44, 840	45, 420	46, 000	46, 590	47, 180	47, 770	48, 360	48, 960	49, 550	50, 160	1022.8
1022.7	39, 160	39, 710	40, 260	40, 820	41, 380	41, 940	42, 510	43, 080	43, 650	44, 220	44, 800	45, 380	45, 960	46, 550	47, 140	47, 730	48, 320	48, 920	49, 520	50, 120	50, 720	1022.7
1022.6	39, 670	40, 220	40, 780	41, 340	41, 900	42, 470	43, 040	43, 610	44, 180	44, 760	45, 340	45, 920	46, 510	47, 100	47, 690	48, 280	48, 880	49, 480	50, 080	50, 680	51, 290	1022.6
1022.5	40, 190	40, 740	41, 300	41, 870	42, 430	43, 000	43, 570	44, 150	44, 720	45, 300	45, 880	46, 470	47, 060	47, 650	48, 240	48, 840	49, 440	50, 040	50, 640	51, 250	51, 860	1022.5
1022.4	40, 700	41, 260	41, 830	42, 390	42, 960	43, 530	44, 110	44, 680	45, 260	45, 850	46, 430	47, 020	47, 610	48, 200	48, 800	49, 400	50, 000	50, 610	51, 210	51, 820	52, 430	1022.4
1022.3	41, 230	41, 790	42, 350	42, 920	43, 490	44, 070	44, 640	45, 220	45, 810	46, 390	46, 980	47, 570	48, 160	48, 760	49, 360	49, 960	50, 570	51, 170	51, 780	52, 400	53, 010	1022.3
1022.2	41, 750	42, 320	42, 880	43, 460	44, 030	44, 610	45, 190	45, 770	46, 350	46, 940	47, 530	48, 130	48, 720	49, 320	49, 920	50, 530	51, 130	51, 740	52, 360	52, 970	53, 590	1022.2
1022.1	42, 280	42, 850	43, 420	43, 990	44, 570	45, 150	45, 730	46, 310	46, 900	47, 490	48, 090	48, 680	49, 280	49, 880	50, 490	51, 100	51, 710	52, 320	52, 930	53, 550	54, 170	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1034.0	1034.1	1034.2	1034.3	1034.4	1034.5	1034.6	1034.7	1034.8	1034.9	1035.0	1035.1	1035.2	1035.3	1035.4	1035.5	1035.6	1035.7	1035.8	1035.9	1036.0	
1022.0	42,810	43,380	43,950	44,530	45,110	45,690	46,280	46,860	47,450	48,050	48,640	49,240	49,850	50,450	51,060	51,670	52,280	52,890	53,510	54,130	54,760	1022.0
1021.9	43,370	43,940	44,520	45,100	45,680	46,270	46,850	47,450	48,040	48,640	49,230	49,840	50,440	51,050	51,660	52,270	52,890	53,510	54,130	54,750	55,380	1021.9
1021.8	43,930	44,510	45,090	45,670	46,260	46,840	47,440	48,030	48,630	49,230	49,830	50,430	51,040	51,650	52,270	52,880	53,500	54,120	54,750	55,370	56,000	1021.8
1021.7	44,500	45,080	45,660	46,250	46,840	47,430	48,020	48,620	49,220	49,820	50,430	51,030	51,650	52,260	52,880	53,490	54,120	54,740	55,370	56,000	56,630	1021.7
1021.6	45,070	45,650	46,240	46,830	47,420	48,010	48,610	49,210	49,810	50,420	51,030	51,640	52,250	52,870	53,490	54,110	54,740	55,360	55,990	56,630	57,260	1021.6
1021.5	45,640	46,230	46,820	47,410	48,000	48,600	49,200	49,800	50,410	51,020	51,630	52,250	52,860	53,480	54,100	54,730	55,360	55,990	56,620	57,260	57,900	1021.5
1021.4	46,220	46,810	47,400	47,990	48,590	49,190	49,800	50,400	51,010	51,620	52,240	52,860	53,480	54,100	54,720	55,350	55,980	56,620	57,250	57,890	58,530	1021.4
1021.3	46,800	47,390	47,990	48,580	49,180	49,790	50,400	51,000	51,620	52,230	52,850	53,470	54,090	54,720	55,350	55,980	56,610	57,250	57,890	58,530	59,180	1021.3
1021.2	47,380	47,980	48,570	49,180	49,780	50,390	51,000	51,610	52,230	52,840	53,460	54,090	54,710	55,340	55,970	56,610	57,250	57,890	58,530	59,170	59,820	1021.2
1021.1	47,970	48,570	49,170	49,770	50,380	50,990	51,600	52,220	52,840	53,460	54,080	54,710	55,340	55,970	56,600	57,240	57,880	58,530	59,170	59,820	60,470	1021.1
1021.0	48,560	49,160	49,760	50,370	50,980	51,600	52,210	52,830	53,450	54,080	54,700	55,330	55,970	56,600	57,240	57,880	58,520	59,170	59,820	60,470	61,120	1021.0
1020.9	49,180	49,790	50,400	51,010	51,620	52,240	52,860	53,480	54,110	54,730	55,360	56,000	56,630	57,270	57,910	58,560	59,200	59,850	60,500	61,160	61,820	1020.9
1020.8	49,810	50,420	51,030	51,650	52,270	52,890	53,510	54,130	54,760	55,390	56,030	56,660	57,300	57,950	58,590	59,240	59,890	60,540	61,200	61,850	62,510	1020.8
1020.7	50,450	51,060	51,670	52,290	52,910	53,540	54,160	54,790	55,420	56,060	56,700	57,340	57,980	58,620	59,270	59,920	60,580	61,230	61,890	62,550	63,220	1020.7
1020.6	51,080	51,700	52,320	52,940	53,560	54,190	54,820	55,450	56,090	56,730	57,370	58,010	58,660	59,310	59,960	60,610	61,270	61,930	62,590	63,260	63,920	1020.6
1020.5	51,730	52,350	52,970	53,590	54,220	54,850	55,480	56,120	56,760	57,400	58,040	58,690	59,340	59,990	60,650	61,310	61,970	62,630	63,300	63,960	64,640	1020.5
1020.4	52,370	53,000	53,620	54,250	54,880	55,510	56,150	56,790	57,430	58,080	58,730	59,380	60,030	60,680	61,340	62,000	62,670	63,330	64,000	64,680	65,350	1020.4
1020.3	53,020	53,650	54,280	54,910	55,540	56,180	56,820	57,460	58,110	58,760	59,410	60,060	60,720	61,380	62,040	62,710	63,370	64,040	64,720	65,390	66,070	1020.3
1020.2	53,680	54,310	54,940	55,570	56,210	56,850	57,500	58,140	58,790	59,440	60,100	60,760	61,420	62,080	62,750	63,410	64,080	64,760	65,430	66,110	66,790	1020.2
1020.1	54,340	54,970	55,600	56,240	56,890	57,530	58,180	58,830	59,480	60,130	60,790	61,450	62,120	62,780	63,450	64,120	64,800	65,480	66,160	66,840	67,520	1020.1
1020.0	55,000	55,640	56,270	56,920	57,560	58,210	58,860	59,510	60,170	60,830	61,490	62,150	62,820	63,490	64,160	64,840	65,520	66,200	66,880	67,570	68,260	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1036.0	1036.1	1036.2	1036.3	1036.4	1036.5	1036.6	1036.7	1036.8	1036.9	1037.0	1037.1	1037.2	1037.3	1037.4	1037.5	1037.6	1037.7	1037.8	1037.9	1038.0	
1034.0	3,350	3,600	3,860	4,120	4,390	4,670	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,690	8,020	8,350	8,690	9,030	9,380	1034.0
1033.9	3,600	3,860	4,120	4,390	4,670	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,690	8,020	8,350	8,690	9,030	9,380	9,730	1033.9
1033.8	3,860	4,120	4,390	4,670	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,690	9,040	9,380	9,730	10,090	1033.8
1033.7	4,120	4,390	4,670	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,690	9,040	9,380	9,730	10,090	10,450	1033.7
1033.6	4,390	4,660	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,690	8,020	8,360	8,700	9,040	9,390	9,740	10,090	10,450	10,810	1033.6
1033.5	4,660	4,950	5,230	5,520	5,820	6,120	6,420	6,730	7,050	7,370	7,700	8,020	8,360	8,700	9,040	9,390	9,740	10,090	10,450	10,820	11,180	1033.5
1033.4	4,950	5,230	5,520	5,820	6,120	6,420	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,090	10,450	10,820	11,190	11,560	1033.4
1033.3	5,230	5,520	5,820	6,120	6,420	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,820	11,190	11,560	11,940	1033.3
1033.2	5,520	5,820	6,120	6,430	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,820	11,190	11,560	11,940	12,320	1033.2
1033.1	5,820	6,120	6,430	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,820	11,190	11,560	11,940	12,320	12,700	1033.1
1033.0	6,120	6,430	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,820	11,190	11,570	11,940	12,320	12,710	13,100	1033.0
1032.9	6,420	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,190	11,570	11,940	12,320	12,710	13,100	13,490	1032.9
1032.8	6,740	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,190	11,570	11,940	12,320	12,710	13,100	13,490	13,880	1032.8
1032.7	7,050	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,190	11,570	11,940	12,320	12,710	13,100	13,490	13,890	14,290	1032.7
1032.6	7,370	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,190	11,570	11,940	12,330	12,710	13,100	13,490	13,890	14,290	14,690	1032.6
1032.5	7,700	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,190	11,570	11,940	12,330	12,710	13,100	13,490	13,890	14,290	14,690	15,100	1032.5
1032.4	8,030	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,200	11,570	11,950	12,330	12,710	13,100	13,490	13,890	14,290	14,690	15,100	15,510	1032.4
1032.3	8,360	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,200	11,570	11,950	12,330	12,710	13,100	13,490	13,890	14,290	14,700	15,100	15,510	15,930	1032.3
1032.2	8,700	9,040	9,390	9,740	10,100	10,460	10,830	11,200	11,570	11,950	12,330	12,710	13,100	13,490	13,890	14,290	14,700	15,100	15,520	15,930	16,350	1032.2
1032.1	9,040	9,390	9,740	10,100	10,460	10,830	11,200	11,570	11,950	12,330	12,710	13,100	13,500	13,890	14,290	14,700	15,110	15,520	15,930	16,350	16,770	1032.1
1032.0	9,390	9,740	10,100	10,460	10,830	11,200	11,570	11,950	12,330	12,710	13,100	13,500	13,890	14,290	14,700	15,110	15,520	15,930	16,350	16,780	17,200	1032.0
1031.9	9,740	10,100	10,460	10,820	11,190	11,570	11,950	12,330	12,710	13,100	13,490	13,890	14,290	14,700	15,110	15,520	15,930	16,350	16,780	17,200	17,630	1031.9
1031.8	10,100	10,460	10,820	11,190	11,570	11,940	12,320	12,710	13,100	13,490	13,890	14,290	14,700	15,100	15,520	15,930	16,350	16,770	17,200	17,630	18,060	1031.8
1031.7	10,450	10,820	11,190	11,560	11,940	12,320	12,710	13,100	13,490	13,890	14,290	14,690	15,100	15,510	15,930	16,350	16,770	17,200	17,630	18,060	18,500	1031.7
1031.6	10,820	11,190	11,560	11,940	12,320	12,710	13,100	13,490	13,890	14,290	14,690	15,100	15,510	15,930	16,350	16,770	17,200	17,630	18,060	18,500	18,940	1031.6
1031.5	11,180	11,560	11,940	12,320	12,700	13,090	13,490	13,880	14,280	14,690	15,100	15,510	15,930	16,350	16,770	17,200	17,630	18,060	18,500	18,940	19,380	1031.5
1031.4	11,560	11,930	12,320	12,700	13,090	13,480	13,880	14,280	14,690	15,100	15,510	15,920	16,340	16,770	17,190	17,620	18,060	18,500	18,940	19,380	19,830	1031.4
1031.3	11,930	12,310	12,700	13,090	13,480	13,880	14,280	14,690	15,090	15,510	15,920	16,340	16,770	17,190	17,620	18,060	18,490	18,940	19,380	19,830	20,280	1031.3
1031.2	12,310	12,700	13,090	13,480	13,880	14,280	14,680	15,090	15,510	15,920	16,340	16,760	17,190	17,620	18,060	18,490	18,930	19,380	19,830	20,280	20,730	1031.2
1031.1	12,690	13,080	13,480	13,880	14,280	14,680	15,090	15,500	15,920	16,340	16,760	17,190	17,620	18,050	18,490	18,930	19,380	19,830	20,280	20,730	21,190	1031.1
1031.0	13,080	13,480	13,870	14,270	14,680	15,090	15,500	15,920	16,340	16,760	17,190	17,620	18,050	18,490	18,930	19,380	19,820	20,280	20,730	21,190	21,650	1031.0
1030.9	13,470	13,870	14,270	14,670	15,080	15,490	15,910	16,330	16,750	17,180	17,610	18,040	18,480	18,920	19,370	19,820	20,270	20,720	21,180	21,640	22,110	1030.9
1030.8	13,860	14,260	14,660	15,070	15,480	15,900	16,320	16,740	17,170	17,600	18,040	18,470	18,910	19,360	19,810	20,260	20,710	21,170	21,630	22,100	22,560	1030.8
1030.7	14,250	14,660	15,060	15,480	15,890	16,310	16,740	17,160	17,590	18,030	18,460	18,910	19,350	19,800	20,250	20,700	21,160	21,620	22,090	22,560	23,030	1030.7
1030.6	14,650	15,060	15,470	15,880	16,300	16,730	17,150	17,580	18,020	18,460	18,900	19,340	19,790	20,240	20,690	21,150	21,610	22,080	22,550	23,020	23,490	1030.6
1030.5	15,050	15,460	15,880	16,300	16,720	17,150	17,580	18,010	18,450	18,890	19,330	19,780	20,230	20,690	21,140	21,600	22,070	22,540	23,010	23,480	23,960	1030.5
1030.4	15,450	15,870	16,290	16,710	17,140	17,570	18,000	18,440	18,880	19,320	19,770	20,220	20,680	21,130	21,590	22,060	22,530	23,000	23,470	23,950	24,430	1030.4
1030.3	15,860	16,280	16,700	17,130	17,560	17,990	18,430	18,870	19,310	19,760	20,210	20,670	21,120	21,590	22,050	22,520	22,990	23,460	23,940	24,420	24,900	1030.3
1030.2	16,270	16,690	17,120	17,550	17,980	18,420	18,860	19,310	19,750	20,200	20,660	21,120	21,580	22,040	22,510	22,980	23,450	23,930	24,410	24,900	25,380	1030.2
1030.1	16,680	17,110	17,540	17,970	18,410	18,850	19,300	19,740	20,190	20,650	21,110	21,570	22,030	22,500	22,970	23,440	23,920	24,400	24,890	25,370	25,860	1030.1
1030.0	17,100	17,530	17,970	18,400	18,840	19,290	19,730	20,190	20,640	21,100	21,560	22,020	22,490	22,960	23,430	23,910	24,390	24,880	25,360	25,850	26,350	1030.0
1029.9	17,520	17,950	18,390	18,830	19,270	19,720	20,170	20,630	21,080	21,540	22,010	22,480	22,950	23,420	23,900	24,380	24,860	25,350	25,840	26,330	26,830	1029.9
1029.8	17,940	18,380	18,820	19,260	19,710	20,160	20,610	21,070	21,530	21,990	22,460	22,930	23,410	23,880	24,360	24,850	25,330	25,820	26,320	26,810	27,310	1029.8
1029.7	18,360	18,800	19,250	19,690	20,150	20,600	21,060	21,520	21,980	22,450	22,920	23,390	23,870	24,350	24,830	25,320	25,810	26,300	26,800	27,300	27,800	1029.7
1029.6	18,790	19,230	19,680	20,130	20,590	21,040	21,500	21,970	22,430	22,900	23,380	23,860	24,340	24,820	25,310	25,790	26,290	26,780	27,280	27,780	28,290	1029.6
1029.5	19,220	19,670	20,120	20,570	21,030	21,490	21,950	22,420	22,890	23,360	23,840	24,320	24,800	25,290	25,780	26,270	26,770	27,270	27,770	28,270	28,780	1029.5
1029.4	19,660	20,110	20,560	21,020	21,480	21,940	22,410	22,880	23,350	23,830	24,310	24,790	25,280	25,770	26,260	26,750	27,250	27,760	28,260	28,770	29,280	1029.4
1029.3	20,090	20,550	21,000	21,460	21,930	22,390	22,860	23,340	23,810	24,290	24,780	25,260	25,750	26,240	26,740	27,240	27,740	28,250	28,750	29,260	29,780	1029.3
1029.2	20,530	20,990	21,450	21,910	22,380	22,850	23,320	23,800	24,280	24,760	25,250	25,740	26,230	26,730	27,220	27,730	28,230	28,740	29,250	29,760	30,280	1029.2
1029.1	20,980	21,440	21,900	22,370	22,840	23,310	23,780	24,260	24,750	25,230	25,720	26,210	26,710	27,210	27,710	28,220	28,720	29,230	29,750	30,270	30,790	1029.1
1029.0	21,420	21,880	22,350	22,820	23,290	23,770	24,250	24,730	25,220	25,710	26,200	26,700	27,190	27,700	28,200	28,710	29,220	29,730	30,250	30,770	31,290	1029.0
1028.9	21,860	22,330	22,800	23,270	23,750	24,230	24,710	25,190	25,680	26,170	26,670	27,170	27,670	28,170	28,680	29,190	29,710	30,220	30,740	31,260	31,790	1028.9
1028.8	22,300	22,770	23,250	23,720	24,200	24,680	25,170	25,660	26,150	26,640	27,140	27,640	28,150	28,650	29,160	29,680	30,190	30,710	31,240	31,760	32,290	1028.8
1028.7	22,750	23,220	23,700	24,180	24,660	25,140	25,630	26,120	26,620	27,110	27,620	28,120	28,630	29,140	29,650	30,170	30,690	31,210	31,730	32,260	32,790	1028.7
1028.6	23,200	23,670	24,150	24,630	25,120	25,610	26,100	26,590	27,090	27,590	28,090	28,600	29,110	29,620	30,140	30,660	31,180	31,700	32,230	32,760	33,300	1028.6
1028.5	23,650	24,130	24,610	25,090	25,580	26,070	26,560	27,060	27,560	28,070	28,570	29,080	29,590	30,110	30,630	31,150	31,670	32,200	32,730	33,270	33,800	1028.5
1028.4	24,100	24,580	25,070	25,550	26,040	26,540	27,040	27,540	28,040	28,540	29,050	29,570	30,080	30,600	31,120	31,650	32,170	32,700	33,240	33,770	34,310	1028.4
1028.3	24,560	25,040	25,530	26,020	26,510	27,010	27,510	28,010	28,520	29,030	29,540	30,050	30,570	31,090	31,620	32,140	32,670	33,210	33,740	34,280	34,820	1028.3
1028.2	25,020	25,500	25,990	26,490	26,980	27,480	27,980	28,490	29,000	29,510	30,030	30,540	31,060	31,590	32,120	32,650	33,180	33,710	34,250	34,790	35,340	1028.2
1028.1	25,480	25,970	26,460	26,960	27,450	27,960	28,460	28,970	29,480	30,000	30,520	31,040	31,560	32,090	32,620	33,150	33,680	34,220	34,760	35,310	35,850	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1036.0	1036.1	1036.2	1036.3	1036.4	1036.5	1036.6	1036.7	1036.8	1036.9	1037.0	1037.1	1037.2	1037.3	1037.4	1037.5	1037.6	1037.7	1037.8	1037.9	1038.0	
1028.0	25, 940	26, 430	26, 930	27, 430	27, 930	28, 440	28, 940	29, 460	29, 970	30, 490	31, 010	31, 530	32, 060	32, 590	33, 120	33, 650	34, 190	34, 730	35, 280	35, 820	36, 370	1028.0
1027.9	26, 390	26, 880	27, 380	27, 880	28, 390	28, 900	29, 410	29, 920	30, 440	30, 960	31, 480	32, 010	32, 540	33, 070	33, 600	34, 140	34, 680	35, 220	35, 770	36, 320	36, 870	1027.9
1027.8	26, 840	27, 340	27, 840	28, 340	28, 850	29, 360	29, 870	30, 390	30, 910	31, 430	31, 960	32, 490	33, 020	33, 550	34, 090	34, 630	35, 170	35, 720	36, 270	36, 820	37, 370	1027.8
1027.7	27, 290	27, 790	28, 300	28, 800	29, 310	29, 830	30, 340	30, 860	31, 380	31, 910	32, 440	32, 970	33, 500	34, 040	34, 580	35, 120	35, 660	36, 210	36, 760	37, 320	37, 870	1027.7
1027.6	27, 750	28, 250	28, 760	29, 270	29, 780	30, 290	30, 810	31, 330	31, 860	32, 380	32, 910	33, 450	33, 980	34, 520	35, 060	35, 610	36, 160	36, 710	37, 260	37, 820	38, 380	1027.6
1027.5	28, 200	28, 710	29, 220	29, 730	30, 240	30, 760	31, 280	31, 810	32, 330	32, 860	33, 400	33, 930	34, 470	35, 010	35, 560	36, 100	36, 650	37, 210	37, 760	38, 320	38, 880	1027.5
1027.4	28, 660	29, 170	29, 680	30, 200	30, 710	31, 230	31, 760	32, 280	32, 810	33, 340	33, 880	34, 420	34, 960	35, 500	36, 050	36, 600	37, 150	37, 710	38, 260	38, 820	39, 390	1027.4
1027.3	29, 120	29, 630	30, 150	30, 660	31, 180	31, 710	32, 230	32, 760	33, 290	33, 830	34, 370	34, 910	35, 450	35, 990	36, 540	37, 100	37, 650	38, 210	38, 770	39, 330	39, 900	1027.3
1027.2	29, 590	30, 100	30, 620	31, 130	31, 660	32, 180	32, 710	33, 240	33, 780	34, 310	34, 850	35, 400	35, 940	36, 490	37, 040	37, 590	38, 150	38, 710	39, 270	39, 840	40, 410	1027.2
1027.1	30, 050	30, 570	31, 080	31, 610	32, 130	32, 660	33, 190	33, 720	34, 260	34, 800	35, 340	35, 890	36, 430	36, 990	37, 540	38, 100	38, 650	39, 220	39, 780	40, 350	40, 920	1027.1
1027.0	30, 520	31, 040	31, 560	32, 080	32, 610	33, 140	33, 670	34, 210	34, 750	35, 290	35, 830	36, 380	36, 930	37, 480	38, 040	38, 600	39, 160	39, 720	40, 290	40, 860	41, 430	1027.0
1026.9	30, 970	31, 490	32, 010	32, 540	33, 070	33, 600	34, 130	34, 670	35, 210	35, 760	36, 300	36, 850	37, 400	37, 960	38, 520	39, 080	39, 640	40, 210	40, 780	41, 350	41, 920	1026.9
1026.8	31, 420	31, 940	32, 460	32, 990	33, 520	34, 060	34, 600	35, 140	35, 680	36, 220	36, 770	37, 330	37, 880	38, 440	39, 000	39, 560	40, 130	40, 690	41, 270	41, 840	42, 420	1026.8
1026.7	31, 870	32, 390	32, 920	33, 450	33, 980	34, 520	35, 060	35, 600	36, 150	36, 700	37, 250	37, 800	38, 360	38, 920	39, 480	40, 040	40, 610	41, 180	41, 750	42, 330	42, 910	1026.7
1026.6	32, 320	32, 850	33, 380	33, 910	34, 450	34, 980	35, 530	36, 070	36, 620	37, 170	37, 720	38, 280	38, 830	39, 400	39, 960	40, 530	41, 100	41, 670	42, 240	42, 820	43, 400	1026.6
1026.5	32, 770	33, 300	33, 840	34, 370	34, 910	35, 450	35, 990	36, 540	37, 090	37, 640	38, 200	38, 750	39, 310	39, 880	40, 440	41, 010	41, 580	42, 160	42, 730	43, 310	43, 900	1026.5
1026.4	33, 230	33, 760	34, 300	34, 830	35, 370	35, 910	36, 460	37, 010	37, 560	38, 110	38, 670	39, 230	39, 790	40, 360	40, 930	41, 500	42, 070	42, 650	43, 230	43, 810	44, 390	1026.4
1026.3	33, 690	34, 220	34, 760	35, 300	35, 840	36, 380	36, 930	37, 480	38, 030	38, 590	39, 150	39, 710	40, 280	40, 840	41, 410	41, 990	42, 560	43, 140	43, 720	44, 300	44, 890	1026.3
1026.2	34, 140	34, 680	35, 220	35, 760	36, 300	36, 850	37, 400	37, 950	38, 510	39, 070	39, 630	40, 190	40, 760	41, 330	41, 900	42, 470	43, 050	43, 630	44, 220	44, 800	45, 390	1026.2
1026.1	34, 600	35, 140	35, 680	36, 230	36, 770	37, 320	37, 870	38, 430	38, 980	39, 550	40, 110	40, 670	41, 240	41, 810	42, 390	42, 960	43, 540	44, 130	44, 710	45, 300	45, 890	1026.1
1026.0	35, 070	35, 600	36, 150	36, 690	37, 240	37, 790	38, 350	38, 900	39, 460	40, 020	40, 590	41, 160	41, 730	42, 300	42, 880	43, 460	44, 040	44, 620	45, 210	45, 800	46, 390	1026.0
1025.9	35, 510	36, 050	36, 600	37, 150	37, 700	38, 250	38, 810	39, 360	39, 930	40, 490	41, 060	41, 630	42, 200	42, 770	43, 350	43, 930	44, 510	45, 100	45, 690	46, 280	46, 870	1025.9
1025.8	35, 960	36, 510	37, 050	37, 600	38, 150	38, 710	39, 270	39, 830	40, 390	40, 960	41, 520	42, 100	42, 670	43, 250	43, 830	44, 410	44, 990	45, 580	46, 170	46, 760	47, 360	1025.8
1025.7	36, 410	36, 960	37, 510	38, 060	38, 610	39, 170	39, 730	40, 290	40, 850	41, 420	41, 990	42, 570	43, 140	43, 720	44, 300	44, 890	45, 470	46, 060	46, 650	47, 250	47, 850	1025.7
1025.6	36, 860	37, 410	37, 960	38, 510	39, 070	39, 630	40, 190	40, 750	41, 320	41, 890	42, 460	43, 040	43, 620	44, 200	44, 780	45, 360	45, 950	46, 540	47, 140	47, 730	48, 330	1025.6
1025.5	37, 310	37, 860	38, 420	38, 970	39, 530	40, 090	40, 650	41, 220	41, 790	42, 360	42, 930	43, 510	44, 090	44, 670	45, 260	45, 840	46, 430	47, 030	47, 620	48, 220	48, 820	1025.5
1025.4	37, 770	38, 320	38, 870	39, 430	39, 990	40, 550	41, 120	41, 680	42, 250	42, 830	43, 400	43, 980	44, 560	45, 150	45, 740	46, 320	46, 920	47, 510	48, 110	48, 710	49, 310	1025.4
1025.3	38, 220	38, 770	39, 330	39, 890	40, 450	41, 010	41, 580	42, 150	42, 720	43, 300	43, 880	44, 460	45, 040	45, 630	46, 210	46, 810	47, 400	48, 000	48, 600	49, 200	49, 800	1025.3
1025.2	38, 680	39, 230	39, 790	40, 350	40, 910	41, 480	42, 050	42, 620	43, 190	43, 770	44, 350	44, 930	45, 520	46, 100	46, 700	47, 290	47, 880	48, 480	49, 080	49, 690	50, 290	1025.2
1025.1	39, 130	39, 690	40, 250	40, 810	41, 380	41, 940	42, 510	43, 090	43, 660	44, 240	44, 820	45, 410	45, 990	46, 580	47, 180	47, 770	48, 370	48, 970	49, 570	50, 180	50, 780	1025.1
1025.0	39, 590	40, 150	40, 710	41, 270	41, 840	42, 410	42, 980	43, 560	44, 140	44, 720	45, 300	45, 880	46, 470	47, 060	47, 660	48, 250	48, 850	49, 460	50, 060	50, 670	51, 280	1025.0
1024.9	40, 040	40, 600	41, 160	41, 730	42, 300	42, 870	43, 440	44, 020	44, 600	45, 180	45, 770	46, 350	46, 940	47, 540	48, 130	48, 730	49, 330	49, 930	50, 540	51, 150	51, 760	1024.9
1024.8	40, 490	41, 050	41, 610	42, 180	42, 750	43, 320	43, 900	44, 480	45, 060	45, 650	46, 230	46, 820	47, 410	48, 010	48, 610	49, 210	49, 810	50, 410	51, 020	51, 630	52, 240	1024.8
1024.7	40, 940	41, 500	42, 070	42, 640	43, 210	43, 780	44, 360	44, 940	45, 530	46, 110	46, 700	47, 290	47, 880	48, 480	49, 080	49, 680	50, 290	50, 890	51, 500	52, 120	52, 730	1024.7
1024.6	41, 390	41, 950	42, 520	43, 090	43, 670	44, 240	44, 820	45, 410	45, 990	46, 580	47, 170	47, 760	48, 360	48, 960	49, 560	50, 160	50, 770	51, 370	51, 990	52, 600	53, 220	1024.6
1024.5	41, 840	42, 410	42, 980	43, 550	44, 130	44, 700	45, 290	45, 870	46, 460	47, 050	47, 640	48, 230	48, 830	49, 430	50, 030	50, 640	51, 250	51, 860	52, 470	53, 080	53, 700	1024.5
1024.4	42, 290	42, 860	43, 430	44, 010	44, 590	45, 170	45, 750	46, 330	46, 920	47, 510	48, 110	48, 710	49, 300	49, 910	50, 510	51, 120	51, 730	52, 340	52, 950	53, 570	54, 190	1024.4
1024.3	42, 740	43, 320	43, 890	44, 470	45, 050	45, 630	46, 210	46, 800	47, 390	47, 980	48, 580	49, 180	49, 780	50, 380	50, 990	51, 600	52, 210	52, 820	53, 440	54, 060	54, 680	1024.3
1024.2	43, 200	43, 770	44, 350	44, 930	45, 510	46, 090	46, 680	47, 270	47, 860	48, 450	49, 050	49, 650	50, 260	50, 860	51, 470	52, 080	52, 690	53, 310	53, 930	54, 550	55, 170	1024.2
1024.1	43, 650	44, 230	44, 810	45, 390	45, 970	46, 560	47, 140	47, 740	48, 330	48, 930	49, 530	50, 130	50, 730	51, 340	51, 950	52, 560	53, 180	53, 790	54, 410	55, 040	55, 660	1024.1
1024.0	44, 110	44, 690	45, 270	45, 850	46, 430	47, 020	47, 610	48, 200	48, 800	49, 400	50, 000	50, 600	51, 210	51, 820	52, 430	53, 040	53, 660	54, 280	54, 900	55, 530	56, 150	1024.0
1023.9	44, 590	45, 170	45, 760	46, 340	46, 930	47, 520	48, 110	48, 700	49, 300	49, 900	50, 510	51, 110	51, 720	52, 330	52, 940	53, 560	54, 180	54, 800	55, 420	56, 050	56, 680	1023.9
1023.8	45, 080	45, 660	46, 250	46, 830	47, 420	48, 010	48, 610	49, 210	49, 810	50, 410	51, 010	51, 620	52, 230	52, 850	53, 460	54, 080	54, 700	55, 320	55, 950	56, 580	57, 210	1023.8
1023.7	45, 570	46, 150	46, 740	47, 330	47, 920	48, 510	49, 110	49, 710	50, 310	50, 920	51, 520	52, 130	52, 750	53, 360	53, 980	54, 600	55, 220	55, 850	56, 480	57, 110	57, 740	1023.7
1023.6	46, 060	46, 640	47, 230	47, 820	48, 420	49, 010	49, 610	50, 210	50, 820	51, 430	52, 040	52, 650	53, 260	53, 880	54, 500	55, 120	55, 750	56, 380	57, 010	57, 640	58, 270	1023.6
1023.5	46, 550	47, 140	47, 730	48, 320	48, 920	49, 520	50, 120	50, 720	51, 330	51, 940	52, 550	53, 160	53, 780	54, 400	55, 020	55, 650	56, 270	56, 900	57, 540	58, 170	58, 810	1023.5
1023.4	47, 040	47, 630	48, 230	48, 820	49, 420	50, 020	50, 620	51, 230	51, 840	52, 450	53, 060	53, 680	54, 300	54, 920	55, 550	56, 170	56, 800	57, 430	58, 070	58, 710	59, 350	1023.4
1023.3	47, 540	48, 130	48, 730	49, 320	49, 920	50, 530	51, 130	51, 740	52, 350	52, 970	53, 580	54, 200	54, 820	55, 450	56, 070	56, 700	57, 330	57, 970	58, 600	59, 240	59, 880	1023.3
1023.2	48, 040	48, 630	49, 230	49, 830	50, 430	51, 030	51, 640	52, 250	52, 870	53, 480	54, 100	54, 720	55, 340	55, 970	56, 600	57, 230	57, 860	58, 500	59, 140	59, 780	60, 430	1023.2
1023.1	48, 530	49, 130	49, 730	50, 330	50, 940	51, 540	52, 150	52, 770	53, 380	54, 000	54, 620	55, 240	55, 870	56, 500	57, 130	57, 760	58, 400	59, 040	59, 680	60, 320	60, 970	1023.1
1023.0	49, 030	49, 630	50, 230	50, 840	51, 450	52, 050	52, 670	53, 280	53, 900	54, 520	55, 140	55, 770	56, 400	57, 030	57, 660	58, 290	58, 930	59, 570	60, 220	60, 860	61, 510	1023.0
1022.9	49, 590	50, 200	50, 800	51, 410	52, 020	52, 630	53, 240	53, 860	54, 480	55, 100	55, 730	56, 360	56, 990	57, 620	58, 260	58, 890	59, 540	60, 180	60, 830	61, 470	62, 120	1022.9
1022.8	50, 160	50, 760	51, 370	51, 980	52, 590	53, 200	53, 820	54, 440	55, 070	55, 690	56, 320	56, 950	57, 580	58, 220	58, 860	59, 500	60, 140	60, 790	61, 440	62, 090	62, 740	1022.8
1022.7	50, 720	51, 330	51, 940	52, 550	53, 170	53, 780	54, 400	55, 030	55, 650	56, 280	56, 910	57, 540	58, 180	58, 820	59, 460	60, 100	60, 750	61, 400	62, 050	62, 700	63, 360	1022.7
1022.6	51, 290	51, 900	52, 510	53, 130	53, 740	54, 360	54, 990	55, 610	56, 240	56, 870	57, 510	58, 140	58, 780	59, 420	60, 070	60, 710	61, 360	62, 010	62, 670	63, 320	63, 980	1022.6
1022.5	51, 860	52, 470	53, 090	53, 710	54, 330	54, 950	55, 580	56, 200	56, 830	57, 470	58, 100	58, 740	59, 380	60, 030	60, 670	61, 320	61, 980	62, 630	63, 290	63, 950	64, 610	1022.5
1022.4	52, 430	53, 050	53, 670	54, 290	54, 910	55, 540	56, 160	56, 800	57, 430	58, 070	58, 700	59, 350	59, 990	60, 640	61, 290	61, 940	62, 590	63, 250	63, 910	64, 570	65, 230	1022.4
1022.3	53, 010	53, 630	54, 250	54, 870	55, 500	56, 130	56, 760	57, 390	58, 030	58, 670	59, 310	59, 950	60, 600	61, 250	61, 900	62, 550	63, 210	63, 870	64, 530	65, 200	65, 870	1022.3
1022.2	53, 590	54, 210	54, 830	55, 460	56, 090	56, 720	57, 350	57, 990	58, 630	59, 270	59, 910	60, 560	61, 210	61, 860	62, 520	63, 170	63, 830	64, 500	65, 160	65, 830	66, 500	1022.2
1022.1	54, 170	54, 800	55, 420	56, 050	56, 680	57, 310	57, 950	58, 590	59, 230	59, 880	60, 520	61, 170	61, 830	62, 480	63, 140	63, 800	64, 460	65, 120	65, 790	66, 460	67, 130	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																				GATE ELEVATION IN FEET
	1036.0	1036.1	1036.2	1036.3	1036.4	1036.5	1036.6	1036.7	1036.8	1036.9	1037.0	1037.1	1037.2	1037.3	1037.4	1037.5	1037.6	1037.7	1037.8	1037.9	1038.0	
1022.0	54,760	55,380	56,010	56,640	57,280	57,910	58,550	59,190	59,840	60,490	61,140	61,790	62,440	63,100	63,760	64,420	65,090	65,760	66,430	67,100	67,770	1022.0
1021.9	55,380	56,010	56,640	57,270	57,910	58,550	59,190	59,840	60,480	61,130	61,790	62,440	63,100	63,760	64,420	65,090	65,760	66,430	67,100	67,780	68,460	1021.9
1021.8	56,000	56,630	57,270	57,910	58,550	59,190	59,830	60,480	61,130	61,790	62,440	63,100	63,760	64,420	65,090	65,760	66,430	67,100	67,780	68,460	69,140	1021.8
1021.7	56,630	57,270	57,900	58,540	59,190	59,830	60,480	61,130	61,790	62,440	63,100	63,760	64,430	65,090	65,760	66,430	67,110	67,780	68,460	69,140	69,830	1021.7
1021.6	57,260	57,900	58,540	59,180	59,830	60,480	61,130	61,780	62,440	63,100	63,760	64,430	65,090	65,760	66,430	67,110	67,790	68,470	69,150	69,830	70,520	1021.6
1021.5	57,900	58,540	59,180	59,830	60,480	61,130	61,780	62,440	63,100	63,760	64,430	65,090	65,760	66,440	67,110	67,790	68,470	69,150	69,840	70,530	71,220	1021.5
1021.4	58,530	59,180	59,830	60,480	61,130	61,780	62,440	63,100	63,760	64,430	65,100	65,770	66,440	67,120	67,790	68,470	69,160	69,840	70,530	71,220	71,920	1021.4
1021.3	59,180	59,820	60,470	61,130	61,780	62,440	63,100	63,760	64,430	65,100	65,770	66,440	67,120	67,800	68,480	69,160	69,850	70,540	71,230	71,920	72,620	1021.3
1021.2	59,820	60,470	61,120	61,780	62,440	63,100	63,760	64,430	65,100	65,770	66,440	67,120	67,800	68,480	69,170	69,850	70,540	71,230	71,930	72,630	73,330	1021.2
1021.1	60,470	61,120	61,780	62,440	63,100	63,760	64,430	65,100	65,770	66,450	67,120	67,800	68,490	69,170	69,860	70,550	71,240	71,940	72,630	73,330	74,040	1021.1
1021.0	61,120	61,780	62,440	63,100	63,760	64,430	65,100	65,770	66,450	67,130	67,810	68,490	69,170	69,860	70,550	71,250	71,940	72,640	73,340	74,040	74,750	1021.0
1020.9	61,820	62,480	63,140	63,800	64,470	65,140	65,820	66,490	67,170	67,850	68,530	69,220	69,910	70,600	71,300	71,990	72,690	73,390	74,100	74,800	75,510	1020.9
1020.8	62,510	63,180	63,840	64,510	65,180	65,860	66,540	67,210	67,900	68,580	69,270	69,960	70,650	71,340	72,040	72,740	73,440	74,150	74,860	75,570	76,280	1020.8
1020.7	63,220	63,880	64,550	65,230	65,900	66,580	67,260	67,940	68,630	69,310	70,000	70,700	71,390	72,090	72,790	73,500	74,200	74,910	75,620	76,340	77,050	1020.7
1020.6	63,920	64,590	65,270	65,940	66,620	67,300	67,990	68,670	69,360	70,050	70,750	71,440	72,140	72,840	73,550	74,260	74,960	75,680	76,390	77,110	77,830	1020.6
1020.5	64,640	65,310	65,990	66,660	67,350	68,030	68,720	69,410	70,100	70,790	71,490	72,190	72,900	73,600	74,310	75,020	75,730	76,450	77,170	77,890	78,610	1020.5
1020.4	65,350	66,030	66,710	67,390	68,080	68,760	69,450	70,150	70,840	71,540	72,240	72,950	73,650	74,360	75,070	75,790	76,500	77,220	77,940	78,670	79,390	1020.4
1020.3	66,070	66,750	67,430	68,120	68,810	69,500	70,200	70,890	71,590	72,290	73,000	73,700	74,410	75,130	75,840	76,560	77,280	78,000	78,730	79,450	80,180	1020.3
1020.2	66,790	67,480	68,170	68,860	69,550	70,240	70,940	71,640	72,340	73,050	73,760	74,470	75,180	75,900	76,610	77,330	78,060	78,780	79,510	80,240	80,980	1020.2
1020.1	67,520	68,210	68,900	69,590	70,290	70,990	71,690	72,390	73,100	73,810	74,520	75,230	75,950	76,670	77,390	78,120	78,840	79,570	80,300	81,040	81,780	1020.1
1020.0	68,260	68,950	69,640	70,340	71,040	71,740	72,440	73,150	73,860	74,570	75,290	76,000	76,720	77,450	78,170	78,900	79,630	80,360	81,100	81,840	82,580	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1038.0	1038.1	1038.2	1038.3	1038.4	1038.5	1038.6	1038.7	1038.8	1038.9	1039.0	1039.1	1039.2	1039.3	1039.4	1039.5	1039.6	1039.7	1039.8	1039.9	1040.0	
1034.0	9,380	9,730	10,090	10,440	10,810	11,170	11,550	11,920	12,300	12,680	13,070	13,460	13,850	14,250	14,650	15,060	15,470	15,880	16,290	16,710	17,130	1034.0
1033.9	9,730	10,090	10,450	10,810	11,180	11,550	11,920	12,300	12,680	13,070	13,460	13,860	14,250	14,660	15,060	15,470	15,880	16,300	16,720	17,140	17,570	1033.9
1033.8	10,090	10,450	10,810	11,180	11,550	11,920	12,300	12,690	13,070	13,460	13,860	14,260	14,660	15,060	15,470	15,890	16,300	16,720	17,140	17,570	18,000	1033.8
1033.7	10,450	10,810	11,180	11,550	11,930	12,310	12,690	13,080	13,470	13,860	14,260	14,660	15,070	15,480	15,890	16,310	16,730	17,150	17,580	18,010	18,440	1033.7
1033.6	10,810	11,180	11,550	11,930	12,310	12,690	13,080	13,470	13,860	14,260	14,670	15,070	15,480	15,890	16,310	16,730	17,150	17,580	18,010	18,440	18,880	1033.6
1033.5	11,180	11,560	11,930	12,310	12,690	13,080	13,470	13,870	14,270	14,670	15,070	15,480	15,900	16,310	16,730	17,160	17,580	18,020	18,450	18,890	19,330	1033.5
1033.4	11,560	11,930	12,310	12,700	13,080	13,480	13,870	14,270	14,670	15,080	15,490	15,900	16,320	16,740	17,160	17,590	18,020	18,450	18,890	19,330	19,780	1033.4
1033.3	11,940	12,320	12,700	13,090	13,480	13,870	14,270	14,680	15,080	15,490	15,900	16,320	16,740	17,170	17,590	18,030	18,460	18,900	19,340	19,780	20,230	1033.3
1033.2	12,320	12,700	13,090	13,480	13,880	14,280	14,680	15,090	15,500	15,910	16,330	16,750	17,170	17,600	18,030	18,460	18,900	19,340	19,790	20,240	20,690	1033.2
1033.1	12,700	13,090	13,480	13,880	14,280	14,680	15,090	15,500	15,910	16,330	16,750	17,180	17,600	18,040	18,470	18,910	19,350	19,790	20,240	20,690	21,150	1033.1
1033.0	13,100	13,490	13,880	14,280	14,690	15,090	15,500	15,920	16,330	16,760	17,180	17,610	18,040	18,480	18,910	19,360	19,800	20,250	20,700	21,160	21,610	1033.0
1032.9	13,490	13,880	14,280	14,690	15,090	15,500	15,920	16,340	16,760	17,180	17,610	18,040	18,480	18,920	19,360	19,800	20,250	20,700	21,160	21,620	22,080	1032.9
1032.8	13,880	14,280	14,690	15,100	15,510	15,920	16,340	16,760	17,180	17,610	18,050	18,480	18,920	19,360	19,810	20,260	20,710	21,160	21,620	22,080	22,550	1032.8
1032.7	14,290	14,690	15,100	15,510	15,920	16,340	16,760	17,190	17,620	18,050	18,480	18,920	19,360	19,810	20,260	20,710	21,170	21,630	22,090	22,550	23,020	1032.7
1032.6	14,690	15,100	15,510	15,920	16,340	16,760	17,190	17,620	18,050	18,490	18,930	19,370	19,810	20,260	20,720	21,170	21,630	22,090	22,560	23,030	23,500	1032.6
1032.5	15,100	15,510	15,930	16,340	16,770	17,190	17,620	18,050	18,490	18,930	19,370	19,820	20,270	20,720	21,180	21,630	22,100	22,560	23,030	23,500	23,980	1032.5
1032.4	15,510	15,930	16,350	16,770	17,190	17,620	18,060	18,490	18,930	19,370	19,820	20,270	20,720	21,180	21,640	22,100	22,570	23,040	23,510	23,980	24,460	1032.4
1032.3	15,930	16,350	16,770	17,200	17,630	18,060	18,490	18,930	19,380	19,820	20,270	20,730	21,180	21,640	22,110	22,570	23,040	23,510	23,990	24,470	24,950	1032.3
1032.2	16,350	16,770	17,200	17,630	18,060	18,500	18,940	19,380	19,830	20,280	20,730	21,190	21,650	22,110	22,580	23,050	23,520	23,990	24,470	24,960	25,440	1032.2
1032.1	16,770	17,200	17,630	18,060	18,500	18,940	19,380	19,830	20,280	20,730	21,190	21,650	22,110	22,580	23,050	23,520	24,000	24,480	24,960	25,450	25,930	1032.1
1032.0	17,200	17,630	18,070	18,500	18,940	19,390	19,830	20,280	20,740	21,190	21,660	22,120	22,590	23,060	23,530	24,000	24,480	24,970	25,450	25,940	26,430	1032.0
1031.9	17,630	18,060	18,500	18,940	19,390	19,830	20,280	20,740	21,190	21,650	22,120	22,590	23,060	23,530	24,000	24,480	24,970	25,450	25,940	26,430	26,930	1031.9
1031.8	18,060	18,500	18,940	19,380	19,830	20,280	20,740	21,190	21,650	22,120	22,580	23,060	23,530	24,000	24,480	24,970	25,450	25,940	26,430	26,930	27,430	1031.8
1031.7	18,500	18,940	19,380	19,830	20,280	20,740	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,480	24,970	25,450	25,940	26,440	26,930	27,430	27,930	1031.7
1031.6	18,940	19,380	19,830	20,280	20,740	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,450	25,940	26,440	26,930	27,430	27,930	28,440	1031.6
1031.5	19,380	19,830	20,280	20,730	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,940	26,440	26,930	27,430	27,930	28,440	28,950	1031.5
1031.4	19,830	20,280	20,730	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,950	26,440	26,930	27,430	27,930	28,440	28,950	29,460	1031.4
1031.3	20,280	20,730	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,950	26,440	26,940	27,430	27,940	28,440	28,950	29,460	29,970	1031.3
1031.2	20,730	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,950	26,440	26,940	27,440	27,940	28,440	28,950	29,460	29,980	30,490	1031.2
1031.1	21,190	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,950	26,440	26,940	27,440	27,940	28,440	28,950	29,460	29,980	30,500	31,020	1031.1
1031.0	21,650	22,120	22,580	23,050	23,530	24,010	24,490	24,970	25,460	25,950	26,440	26,940	27,440	27,940	28,450	28,950	29,470	29,980	30,500	31,020	31,540	1031.0
1030.9	22,110	22,570	23,040	23,520	24,000	24,480	24,960	25,450	25,940	26,430	26,930	27,430	27,930	28,440	28,940	29,460	29,970	30,490	31,010	31,530	32,060	1030.9
1030.8	22,560	23,040	23,510	23,990	24,470	24,950	25,440	25,930	26,420	26,920	27,420	27,920	28,430	28,930	29,450	29,960	30,480	31,000	31,520	32,050	32,580	1030.8
1030.7	23,030	23,500	23,980	24,460	24,940	25,430	25,920	26,410	26,910	27,410	27,910	28,420	28,930	29,440	29,950	30,470	30,990	31,510	32,040	32,570	33,100	1030.7
1030.6	23,490	23,970	24,450	24,930	25,420	25,910	26,400	26,900	27,400	27,900	28,410	28,920	29,430	29,940	30,460	30,980	31,500	32,030	32,560	33,090	33,620	1030.6
1030.5	23,960	24,440	24,920	25,410	25,900	26,390	26,890	27,390	27,890	28,400	28,910	29,420	29,930	30,450	30,970	31,490	32,020	32,550	33,080	33,610	34,150	1030.5
1030.4	24,430	24,910	25,400	25,890	26,380	26,880	27,380	27,880	28,390	28,900	29,410	29,920	30,440	30,960	31,480	32,010	32,540	33,070	33,610	34,140	34,680	1030.4
1030.3	24,900	25,390	25,880	26,370	26,870	27,370	27,870	28,380	28,890	29,400	29,910	30,430	30,950	31,470	32,000	32,530	33,060	33,600	34,130	34,670	35,220	1030.3
1030.2	25,380	25,870	26,370	26,860	27,360	27,860	28,370	28,880	29,390	29,900	30,420	30,940	31,460	31,990	32,520	33,050	33,590	34,120	34,660	35,210	35,750	1030.2
1030.1	25,860	26,360	26,850	27,350	27,850	28,360	28,870	29,380	29,890	30,410	30,930	31,450	31,980	32,510	33,040	33,580	34,110	34,650	35,200	35,740	36,290	1030.1
1030.0	26,350	26,840	27,340	27,840	28,350	28,860	29,370	29,880	30,400	30,920	31,440	31,970	32,500	33,030	33,570	34,100	34,650	35,190	35,730	36,280	36,840	1030.0
1029.9	26,830	27,330	27,830	28,330	28,840	29,350	29,870	30,390	30,910	31,430	31,960	32,480	33,020	33,550	34,090	34,630	35,170	35,720	36,270	36,820	37,380	1029.9
1029.8	27,310	27,810	28,320	28,830	29,340	29,850	30,370	30,890	31,410	31,940	32,470	33,000	33,540	34,070	34,610	35,160	35,700	36,250	36,800	37,360	37,920	1029.8
1029.7	27,800	28,300	28,810	29,320	29,840	30,360	30,880	31,400	31,930	32,450	32,990	33,520	34,060	34,600	35,140	35,690	36,240	36,790	37,340	37,900	38,460	1029.7
1029.6	28,290	28,800	29,310	29,820	30,340	30,860	31,380	31,910	32,440	32,970	33,510	34,040	34,580	35,130	35,670	36,220	36,770	37,330	37,890	38,450	39,010	1029.6
1029.5	28,780	29,290	29,810	30,330	30,850	31,370	31,890	32,420	32,960	33,490	34,030	34,570	35,110	35,660	36,210	36,760	37,310	37,870	38,430	38,990	39,560	1029.5
1029.4	29,280	29,790	30,310	30,830	31,350	31,880	32,410	32,940	33,470	34,010	34,550	35,100	35,640	36,190	36,740	37,300	37,860	38,420	38,980	39,540	40,110	1029.4
1029.3	29,780	30,300	30,820	31,340	31,860	32,390	32,920	33,460	34,000	34,540	35,080	35,630	36,180	36,730	37,280	37,840	38,400	38,960	39,530	40,100	40,670	1029.3
1029.2	30,280	30,800	31,320	31,850	32,380	32,910	33,440	33,980	34,520	35,070	35,610	36,160	36,710	37,270	37,820	38,380	38,950	39,510	40,080	40,650	41,230	1029.2
1029.1	30,790	31,310	31,830	32,360	32,890	33,430	33,970	34,510	35,050	35,600	36,150	36,700	37,250	37,810	38,370	38,930	39,500	40,070	40,640	41,210	41,790	1029.1
1029.0	31,290	31,820	32,350	32,880	33,410	33,950	34,490	35,030	35,580	36,130	36,680	37,240	37,790	38,350	38,920	39,480	40,050	40,620	41,200	41,770	42,350	1029.0
1028.9	31,790	32,320	32,850	33,380	33,920	34,460	35,000	35,550	36,100	36,650	37,210	37,760	38,320	38,880	39,450	40,020	40,590	41,160	41,740	42,320	42,900	1028.9
1028.8	32,290	32,820	33,350	33,890	34,430	34,970	35,520	36,070	36,620	37,170	37,730	38,290	38,850	39,420	39,990	40,560	41,130	41,710	42,290	42,870	43,450	1028.8
1028.7	32,790	33,330	33,860	34,400	34,940	35,490	36,040	36,590	37,140	37,700	38,260	38,820	39,390	39,950	40,530	41,100	41,670	42,250	42,830	43,420	44,010	1028.7
1028.6	33,300	33,830	34,370	34,910	35,460	36,010	36,560	37,110	37,670	38,230	38,790	39,360	39,920	40,490	41,070	41,640	42,220	42,800	43,390	43,970	44,560	1028.6
1028.5	33,800	34,340	34,880	35,430	35,980	36,530	37,080	37,640	38,200	38,760	39,320	39,890	40,460	41,030	41,610	42,190	42,770	43,350	43,940	44,530	45,120	1028.5
1028.4	34,310	34,850	35,400	35,950	36,500	37,050	37,610	38,170	38,730	39,290	39,860	40,430	41,000	41,580	42,160	42,740	43,320	43,910	44,490	45,090	45,680	1028.4
1028.3	34,820	35,370	35,920	36,470	37,020	37,580	38,130	38,700	39,260	39,830	40,400	40,970	41,540	42,120	42,700	43,290	43,870	44,460	45,050	45,650	46,240	1028.3
1028.2	35,340	35,890	36,440	36,990	37,540	38,100	38,660	39,230	39,790	40,360	40,940	41,510	42,090	42,670	43,250	43,840	44,430	45,020	45,610	46,210	46,810	1028.2
1028.1	35,850	36,400	36,960	37,510	38,070	38,630	39,200	39,760	40,330	40,900	41,480	42,060	42,640	43,220	43,810	44,390	44,990	45,580	46,180	46,770	47,380	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1038.0	1038.1	1038.2	1038.3	1038.4	1038.5	1038.6	1038.7	1038.8	1038.9	1039.0	1039.1	1039.2	1039.3	1039.4	1039.5	1039.6	1039.7	1039.8	1039.9	1040.0	
1028.0	36,370	36,930	37,480	38,040	38,600	39,160	39,730	40,300	40,870	41,450	42,020	42,600	43,190	43,770	44,360	44,950	45,550	46,140	46,740	47,340	47,950	1028.0
1027.9	36,870	37,430	37,980	38,540	39,110	39,670	40,240	40,810	41,390	41,970	42,550	43,130	43,710	44,300	44,890	45,480	46,080	46,680	47,280	47,880	48,490	1027.9
1027.8	37,370	37,930	38,490	39,050	39,620	40,190	40,760	41,330	41,910	42,490	43,070	43,650	44,240	44,830	45,420	46,020	46,620	47,220	47,820	48,420	49,030	1027.8
1027.7	37,870	38,430	38,990	39,560	40,130	40,700	41,270	41,850	42,430	43,010	43,590	44,180	44,770	45,360	45,950	46,550	47,150	47,750	48,360	48,970	49,580	1027.7
1027.6	38,380	38,940	39,500	40,070	40,640	41,210	41,790	42,370	42,950	43,530	44,120	44,710	45,300	45,890	46,490	47,090	47,690	48,300	48,900	49,510	50,130	1027.6
1027.5	38,880	39,450	40,010	40,580	41,150	41,730	42,310	42,890	43,470	44,060	44,650	45,240	45,830	46,430	47,030	47,630	48,230	48,840	49,450	50,060	50,680	1027.5
1027.4	39,390	39,950	40,520	41,100	41,670	42,250	42,830	43,410	44,000	44,580	45,170	45,770	46,360	46,960	47,560	48,170	48,770	49,380	50,000	50,610	51,230	1027.4
1027.3	39,900	40,470	41,040	41,610	42,190	42,770	43,350	43,930	44,520	45,110	45,710	46,300	46,900	47,500	48,100	48,710	49,320	49,930	50,540	51,160	51,780	1027.3
1027.2	40,410	40,980	41,550	42,130	42,710	43,290	43,870	44,460	45,050	45,640	46,240	46,840	47,440	48,040	48,650	49,250	49,860	50,480	51,090	51,710	52,330	1027.2
1027.1	40,920	41,490	42,070	42,650	43,230	43,810	44,400	44,990	45,580	46,180	46,770	47,370	47,980	48,580	49,190	49,800	50,410	51,030	51,650	52,270	52,890	1027.1
1027.0	41,430	42,010	42,590	43,170	43,750	44,340	44,930	45,520	46,110	46,710	47,310	47,910	48,520	49,120	49,730	50,350	50,960	51,580	52,200	52,820	53,450	1027.0
1026.9	41,920	42,500	43,080	43,660	44,250	44,840	45,430	46,020	46,620	47,220	47,820	48,420	49,030	49,640	50,250	50,860	51,480	52,100	52,720	53,350	53,980	1026.9
1026.8	42,420	43,000	43,580	44,160	44,750	45,340	45,930	46,530	47,130	47,730	48,330	48,940	49,540	50,150	50,770	51,380	52,000	52,620	53,250	53,880	54,500	1026.8
1026.7	42,910	43,490	44,070	44,660	45,250	45,840	46,440	47,030	47,630	48,240	48,840	49,450	50,060	50,670	51,290	51,910	52,530	53,150	53,770	54,400	55,030	1026.7
1026.6	43,400	43,990	44,570	45,160	45,750	46,340	46,940	47,540	48,140	48,750	49,350	49,960	50,580	51,190	51,810	52,430	53,050	53,670	54,300	54,930	55,560	1026.6
1026.5	43,900	44,480	45,070	45,660	46,250	46,850	47,450	48,050	48,650	49,260	49,870	50,480	51,090	51,710	52,330	52,950	53,570	54,200	54,830	55,460	56,100	1026.5
1026.4	44,390	44,980	45,570	46,160	46,760	47,360	47,960	48,560	49,160	49,770	50,380	51,000	51,610	52,230	52,850	53,470	54,100	54,730	55,360	55,990	56,630	1026.4
1026.3	44,890	45,480	46,070	46,670	47,260	47,860	48,460	49,070	49,680	50,290	50,900	51,510	52,130	52,750	53,370	54,000	54,630	55,260	55,890	56,530	57,160	1026.3
1026.2	45,390	45,980	46,570	47,170	47,770	48,370	48,970	49,580	50,190	50,800	51,420	52,030	52,650	53,270	53,900	54,530	55,160	55,790	56,420	57,060	57,700	1026.2
1026.1	45,890	46,480	47,080	47,670	48,280	48,880	49,480	50,090	50,700	51,320	51,930	52,550	53,170	53,800	54,420	55,050	55,690	56,320	56,960	57,590	58,240	1026.1
1026.0	46,390	46,980	47,580	48,180	48,780	49,390	50,000	50,610	51,220	51,840	52,450	53,070	53,700	54,320	54,950	55,580	56,220	56,850	57,490	58,130	58,770	1026.0
1025.9	46,870	47,470	48,070	48,670	49,280	49,880	50,490	51,100	51,720	52,340	52,960	53,580	54,200	54,830	55,460	56,090	56,730	57,370	58,010	58,650	59,290	1025.9
1025.8	47,360	47,960	48,560	49,160	49,770	50,380	50,990	51,600	52,220	52,840	53,460	54,080	54,710	55,340	55,970	56,600	57,240	57,880	58,520	59,170	59,810	1025.8
1025.7	47,850	48,450	49,050	49,650	50,260	50,870	51,490	52,100	52,720	53,340	53,960	54,590	55,220	55,850	56,480	57,120	57,750	58,400	59,040	59,680	60,330	1025.7
1025.6	48,330	48,940	49,540	50,150	50,760	51,370	51,980	52,600	53,220	53,840	54,470	55,090	55,720	56,360	56,990	57,630	58,270	58,910	59,560	60,200	60,850	1025.6
1025.5	48,820	49,430	50,030	50,640	51,250	51,870	52,480	53,100	53,720	54,350	54,970	55,600	56,230	56,870	57,500	58,140	58,780	59,430	60,070	60,720	61,370	1025.5
1025.4	49,310	49,920	50,520	51,130	51,750	52,360	52,980	53,600	54,220	54,850	55,480	56,110	56,740	57,380	58,020	58,660	59,300	59,950	60,590	61,240	61,900	1025.4
1025.3	49,800	50,410	51,020	51,630	52,240	52,860	53,480	54,100	54,730	55,360	55,990	56,620	57,250	57,890	58,530	59,170	59,820	60,460	61,110	61,770	62,420	1025.3
1025.2	50,290	50,900	51,510	52,130	52,740	53,360	53,980	54,610	55,230	55,860	56,490	57,130	57,760	58,400	59,040	59,690	60,340	60,980	61,640	62,290	62,950	1025.2
1025.1	50,780	51,390	52,010	52,620	53,240	53,860	54,480	55,110	55,740	56,370	57,000	57,640	58,280	58,920	59,560	60,210	60,850	61,500	62,160	62,810	63,470	1025.1
1025.0	51,280	51,890	52,500	53,120	53,740	54,360	54,990	55,610	56,240	56,880	57,510	58,150	58,790	59,430	60,080	60,720	61,370	62,030	62,680	63,340	64,000	1025.0
1024.9	51,760	52,370	52,990	53,610	54,230	54,850	55,480	56,110	56,740	57,380	58,010	58,650	59,290	59,940	60,580	61,230	61,880	62,540	63,190	63,850	64,510	1024.9
1024.8	52,240	52,860	53,480	54,100	54,720	55,350	55,980	56,610	57,240	57,880	58,510	59,150	59,800	60,440	61,090	61,740	62,400	63,050	63,710	64,370	65,030	1024.8
1024.7	52,730	53,350	53,970	54,590	55,210	55,840	56,470	57,100	57,740	58,380	59,020	59,660	60,300	60,950	61,600	62,250	62,910	63,570	64,220	64,890	65,550	1024.7
1024.6	53,220	53,830	54,460	55,080	55,710	56,340	56,970	57,600	58,240	58,880	59,520	60,160	60,810	61,460	62,110	62,760	63,420	64,080	64,740	65,410	66,070	1024.6
1024.5	53,700	54,320	54,950	55,570	56,200	56,830	57,470	58,100	58,740	59,380	60,020	60,670	61,320	61,970	62,620	63,280	63,940	64,600	65,260	65,920	66,590	1024.5
1024.4	54,190	54,810	55,440	56,070	56,700	57,330	57,960	58,600	59,240	59,880	60,530	61,180	61,830	62,480	63,130	63,790	64,450	65,110	65,780	66,450	67,110	1024.4
1024.3	54,680	55,300	55,930	56,560	57,190	57,830	58,460	59,100	59,740	60,390	61,040	61,680	62,340	62,990	63,650	64,310	64,970	65,630	66,300	66,970	67,640	1024.3
1024.2	55,170	55,800	56,420	57,060	57,690	58,320	58,960	59,600	60,250	60,890	61,540	62,190	62,850	63,500	64,160	64,820	65,480	66,150	66,820	67,490	68,160	1024.2
1024.1	55,660	56,290	56,920	57,550	58,190	58,820	59,460	60,110	60,750	61,400	62,050	62,700	63,360	64,020	64,680	65,340	66,000	66,670	67,340	68,010	68,690	1024.1
1024.0	56,150	56,780	57,410	58,050	58,690	59,320	59,970	60,610	61,260	61,910	62,560	63,210	63,870	64,530	65,190	65,860	66,520	67,190	67,860	68,540	69,210	1024.0
1023.9	56,680	57,310	57,950	58,580	59,220	59,860	60,510	61,150	61,800	62,450	63,110	63,760	64,420	65,090	65,750	66,420	67,080	67,760	68,430	69,100	69,780	1023.9
1023.8	57,210	57,840	58,480	59,120	59,760	60,400	61,050	61,700	62,350	63,000	63,660	64,320	64,980	65,640	66,310	66,980	67,650	68,320	69,000	69,670	70,360	1023.8
1023.7	57,740	58,380	59,020	59,660	60,300	60,950	61,590	62,240	62,900	63,550	64,210	64,870	65,540	66,200	66,870	67,540	68,210	68,890	69,570	70,250	70,930	1023.7
1023.6	58,270	58,910	59,550	60,200	60,840	61,490	62,140	62,790	63,450	64,110	64,770	65,430	66,100	66,760	67,430	68,110	68,780	69,460	70,140	70,820	71,510	1023.6
1023.5	58,810	59,450	60,090	60,740	61,390	62,040	62,690	63,340	64,000	64,660	65,320	65,990	66,660	67,330	68,000	68,670	69,350	70,030	70,710	71,400	72,080	1023.5
1023.4	59,350	59,990	60,630	61,280	61,930	62,580	63,240	63,890	64,550	65,220	65,880	66,550	67,220	67,890	68,570	69,240	69,920	70,600	71,290	71,970	72,660	1023.4
1023.3	59,880	60,530	61,180	61,830	62,480	63,130	63,790	64,450	65,110	65,770	66,440	67,110	67,780	68,460	69,130	69,810	70,490	71,180	71,860	72,550	73,240	1023.3
1023.2	60,430	61,070	61,720	62,370	63,030	63,680	64,340	65,000	65,670	66,330	67,000	67,680	68,350	69,030	69,700	70,390	71,070	71,760	72,440	73,140	73,830	1023.2
1023.1	60,970	61,620	62,270	62,920	63,580	64,240	64,900	65,560	66,230	66,900	67,570	68,240	68,920	69,600	70,280	70,960	71,650	72,330	73,030	73,720	74,410	1023.1
1023.0	61,510	62,160	62,820	63,470	64,130	64,790	65,450	66,120	66,790	67,460	68,130	68,810	69,490	70,170	70,850	71,540	72,230	72,920	73,610	74,300	75,000	1023.0
1022.9	62,120	62,780	63,430	64,090	64,750	65,420	66,080	66,750	67,420	68,100	68,770	69,450	70,130	70,820	71,500	72,190	72,880	73,570	74,270	74,970	75,670	1022.9
1022.8	62,740	63,400	64,060	64,720	65,380	66,050	66,720	67,390	68,060	68,740	69,420	70,100	70,780	71,470	72,160	72,850	73,540	74,240	74,930	75,640	76,340	1022.8
1022.7	63,360	64,020	64,680	65,340	66,010	66,680	67,350	68,030	68,700	69,380	70,060	70,750	71,430	72,120	72,810	73,510	74,200	74,900	75,600	76,310	77,010	1022.7
1022.6	63,980	64,640	65,310	65,970	66,640	67,320	67,990	68,670	69,350	70,030	70,710	71,400	72,090	72,780	73,470	74,170	74,870	75,570	76,270	76,980	77,690	1022.6
1022.5	64,610	65,270	65,940	66,610	67,280	67,950	68,630	69,310	69,990	70,680	71,360	72,050	72,740	73,440	74,130	74,830	75,530	76,240	76,940	77,650	78,360	1022.5
1022.4	65,230	65,900	66,570	67,240	67,920	68,590	69,270	69,960	70,640	71,330	72,020	72,710	73,400	74,100	74,800	75,500	76,210	76,910	77,620	78,330	79,050	1022.4
1022.3	65,870	66,530	67,210	67,880	68,560	69,240	69,920	70,610	71,290	71,980	72,670	73,370	74,070	74,770	75,470	76,170	76,880	77,590	78,300	79,010	79,730	1022.3
1022.2	66,500	67,170	67,850	68,520	69,200	69,890	70,570	71,260	71,950	72,640	73,330	74,030	74,730	75,430	76,140	76,850	77,560	78,270	78,980	79,700	80,420	1022.2
1022.1	67,130	67,810	68,490	69,170	69,850	70,540	71,220	71,910	72,610	73,300	74,000	74,700	75,400	76,110	76,810	77,520	78,240	78,950	79,670	80,390	81,110	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1038.0	1038.1	1038.2	1038.3	1038.4	1038.5	1038.6	1038.7	1038.8	1038.9	1039.0	1039.1	1039.2	1039.3	1039.4	1039.5	1039.6	1039.7	1039.8	1039.9	1040.0	
1022.0	67,770	68,450	69,130	69,810	70,500	71,190	71,880	72,570	73,270	73,960	74,660	75,370	76,070	76,780	77,490	78,200	78,920	79,640	80,350	81,080	81,800	1022.0
1021.9	68,460	69,140	69,820	70,510	71,190	71,880	72,580	73,270	73,970	74,670	75,380	76,080	76,790	77,500	78,210	78,930	79,650	80,370	81,090	81,820	82,540	1021.9
1021.8	69,140	69,820	70,510	71,200	71,890	72,580	73,280	73,980	74,680	75,390	76,090	76,800	77,510	78,230	78,940	79,660	80,380	81,100	81,830	82,560	83,290	1021.8
1021.7	69,830	70,520	71,210	71,900	72,590	73,290	73,990	74,690	75,390	76,100	76,810	77,520	78,240	78,950	79,670	80,390	81,120	81,850	82,570	83,310	84,040	1021.7
1021.6	70,520	71,210	71,900	72,600	73,300	74,000	74,700	75,400	76,110	76,820	77,530	78,250	78,970	79,690	80,410	81,130	81,860	82,590	83,320	84,060	84,790	1021.6
1021.5	71,220	71,910	72,610	73,300	74,000	74,710	75,410	76,120	76,830	77,540	78,260	78,980	79,700	80,420	81,150	81,870	82,600	83,340	84,070	84,810	85,550	1021.5
1021.4	71,920	72,610	73,310	74,010	74,720	75,420	76,130	76,840	77,560	78,270	78,990	79,710	80,430	81,160	81,890	82,620	83,350	84,090	84,830	85,570	86,310	1021.4
1021.3	72,620	73,320	74,020	74,720	75,430	76,140	76,850	77,570	78,280	79,000	79,720	80,450	81,170	81,900	82,630	83,370	84,100	84,840	85,580	86,330	87,070	1021.3
1021.2	73,330	74,030	74,730	75,440	76,150	76,860	77,580	78,290	79,010	79,740	80,460	81,190	81,920	82,650	83,380	84,120	84,860	85,600	86,350	87,090	87,840	1021.2
1021.1	74,040	74,740	75,450	76,160	76,870	77,590	78,310	79,030	79,750	80,470	81,200	81,930	82,660	83,400	84,140	84,880	85,620	86,360	87,110	87,860	88,610	1021.1
1021.0	74,750	75,460	76,170	76,880	77,600	78,320	79,040	79,760	80,490	81,220	81,950	82,680	83,420	84,150	84,890	85,640	86,380	87,130	87,880	88,630	89,390	1021.0
1020.9	75,510	76,220	76,940	77,660	78,380	79,100	79,820	80,550	81,280	82,010	82,740	83,480	84,220	84,960	85,710	86,450	87,200	87,950	88,710	89,460	90,220	1020.9
1020.8	76,280	77,000	77,710	78,430	79,160	79,880	80,610	81,340	82,070	82,810	83,550	84,290	85,030	85,770	86,520	87,270	88,020	88,780	89,540	90,300	91,060	1020.8
1020.7	77,050	77,770	78,490	79,220	79,940	80,670	81,400	82,140	82,870	83,610	84,350	85,100	85,840	86,590	87,340	88,100	88,850	89,610	90,370	91,130	91,900	1020.7
1020.6	77,830	78,550	79,280	80,000	80,730	81,460	82,200	82,940	83,680	84,420	85,160	85,910	86,660	87,410	88,170	88,920	89,680	90,450	91,210	91,980	92,750	1020.6
1020.5	78,610	79,330	80,060	80,790	81,530	82,260	83,000	83,740	84,480	85,230	85,980	86,730	87,480	88,240	89,000	89,760	90,520	91,290	92,050	92,820	93,600	1020.5
1020.4	79,390	80,120	80,850	81,590	82,330	83,070	83,810	84,550	85,300	86,050	86,800	87,550	88,310	89,070	89,830	90,600	91,360	92,130	92,900	93,680	94,450	1020.4
1020.3	80,180	80,920	81,650	82,390	83,130	83,870	84,620	85,370	86,120	86,870	87,620	88,380	89,140	89,900	90,670	91,440	92,210	92,980	93,760	94,530	95,310	1020.3
1020.2	80,980	81,710	82,450	83,190	83,940	84,680	85,430	86,180	86,940	87,690	88,450	89,210	89,980	90,740	91,510	92,280	93,060	93,830	94,610	95,390	96,180	1020.2
1020.1	81,780	82,520	83,260	84,000	84,750	85,500	86,250	87,010	87,760	88,520	89,290	90,050	90,820	91,590	92,360	93,140	93,910	94,690	95,470	96,260	97,050	1020.1
1020.0	82,580	83,320	84,070	84,820	85,570	86,320	87,080	87,830	88,600	89,360	90,120	90,890	91,660	92,440	93,210	93,990	94,770	95,560	96,340	97,130	97,920	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1040.0	1040.1	1040.2	1040.3	1040.4	1040.5	1040.6	1040.7	1040.8	1040.9	1041.0	1041.1	1041.2	1041.3	1041.4	1041.5	1041.6	1041.7	1041.8	1041.9	1042.0	
1034.0	17, 130	17, 560	17, 990	18, 420	18, 860	19, 300	19, 740	20, 190	20, 640	21, 090	21, 550	22, 000	22, 470	22, 930	23, 400	23, 870	24, 350	24, 820	25, 300	25, 790	26, 270	1034.0
1033.9	17, 570	18, 000	18, 430	18, 870	19, 300	19, 750	20, 190	20, 640	21, 100	21, 550	22, 010	22, 470	22, 940	23, 410	23, 880	24, 350	24, 830	25, 310	25, 800	26, 280	26, 770	1033.9
1033.8	18, 000	18, 430	18, 870	19, 310	19, 750	20, 200	20, 650	21, 100	21, 560	22, 020	22, 480	22, 950	23, 420	23, 890	24, 360	24, 840	25, 320	25, 810	26, 290	26, 780	27, 280	1033.8
1033.7	18, 440	18, 880	19, 320	19, 760	20, 210	20, 660	21, 110	21, 570	22, 030	22, 490	22, 950	23, 420	23, 900	24, 370	24, 850	25, 330	25, 820	26, 300	26, 790	27, 290	27, 780	1033.7
1033.6	18, 880	19, 320	19, 770	20, 210	20, 660	21, 120	21, 570	22, 030	22, 500	22, 960	23, 430	23, 900	24, 380	24, 860	25, 340	25, 830	26, 310	26, 800	27, 300	27, 790	28, 290	1033.6
1033.5	19, 330	19, 770	20, 220	20, 670	21, 120	21, 580	22, 040	22, 500	22, 970	23, 440	23, 910	24, 390	24, 870	25, 350	25, 830	26, 320	26, 810	27, 310	27, 800	28, 300	28, 810	1033.5
1033.4	19, 780	20, 220	20, 680	21, 130	21, 590	22, 050	22, 510	22, 980	23, 450	23, 920	24, 400	24, 880	25, 360	25, 840	26, 330	26, 820	27, 320	27, 810	28, 310	28, 820	29, 320	1033.4
1033.3	20, 230	20, 680	21, 140	21, 590	22, 050	22, 520	22, 990	23, 460	23, 930	24, 410	24, 880	25, 370	25, 850	26, 340	26, 830	27, 330	27, 820	28, 330	28, 830	29, 330	29, 840	1033.3
1033.2	20, 690	21, 140	21, 600	22, 060	22, 530	22, 990	23, 460	23, 940	24, 410	24, 890	25, 380	25, 860	26, 350	26, 840	27, 340	27, 830	28, 340	28, 840	29, 350	29, 860	30, 370	1033.2
1033.1	21, 150	21, 610	22, 070	22, 530	23, 000	23, 470	23, 940	24, 420	24, 900	25, 380	25, 870	26, 360	26, 850	27, 350	27, 850	28, 350	28, 850	29, 360	29, 870	30, 380	30, 890	1033.1
1033.0	21, 610	22, 080	22, 540	23, 010	23, 480	23, 950	24, 430	24, 910	25, 390	25, 880	26, 370	26, 860	27, 360	27, 860	28, 360	28, 860	29, 370	29, 880	30, 390	30, 910	31, 430	1033.0
1032.9	22, 080	22, 540	23, 010	23, 480	23, 960	24, 440	24, 920	25, 400	25, 890	26, 380	26, 870	27, 360	27, 860	28, 360	28, 870	29, 380	29, 890	30, 400	30, 920	31, 430	31, 960	1032.9
1032.8	22, 550	23, 020	23, 490	23, 960	24, 440	24, 920	25, 410	25, 890	26, 380	26, 880	27, 370	27, 870	28, 370	28, 880	29, 380	29, 890	30, 410	30, 920	31, 440	31, 970	32, 490	1032.8
1032.7	23, 020	23, 490	23, 970	24, 450	24, 930	25, 410	25, 900	26, 390	26, 880	27, 380	27, 880	28, 380	28, 880	29, 390	29, 900	30, 420	30, 930	31, 450	31, 970	32, 500	33, 030	1032.7
1032.6	23, 500	23, 970	24, 450	24, 930	25, 420	25, 900	26, 390	26, 890	27, 380	27, 880	28, 390	28, 890	29, 400	29, 910	30, 420	30, 940	31, 460	31, 980	32, 510	33, 040	33, 570	1032.6
1032.5	23, 980	24, 460	24, 940	25, 420	25, 910	26, 400	26, 890	27, 390	27, 890	28, 390	28, 900	29, 410	29, 920	30, 430	30, 950	31, 470	31, 990	32, 520	33, 050	33, 580	34, 110	1032.5
1032.4	24, 460	24, 940	25, 430	25, 920	26, 410	26, 900	27, 400	27, 900	28, 400	28, 910	29, 420	29, 930	30, 440	30, 960	31, 480	32, 000	32, 530	33, 060	33, 590	34, 120	34, 660	1032.4
1032.3	24, 950	25, 430	25, 920	26, 410	26, 910	27, 400	27, 910	28, 410	28, 910	29, 420	29, 930	30, 450	30, 970	31, 490	32, 010	32, 540	33, 070	33, 600	34, 130	34, 670	35, 210	1032.3
1032.2	25, 440	25, 930	26, 420	26, 910	27, 410	27, 910	28, 420	28, 920	29, 430	29, 940	30, 460	30, 980	31, 500	32, 020	32, 550	33, 080	33, 610	34, 140	34, 680	35, 220	35, 760	1032.2
1032.1	25, 930	26, 430	26, 920	27, 420	27, 920	28, 420	28, 930	29, 440	29, 950	30, 470	30, 980	31, 510	32, 030	32, 560	33, 090	33, 620	34, 150	34, 690	35, 230	35, 780	36, 320	1032.1
1032.0	26, 430	26, 930	27, 430	27, 930	28, 430	28, 940	29, 450	29, 960	30, 470	30, 990	31, 510	32, 040	32, 570	33, 100	33, 630	34, 160	34, 700	35, 240	35, 790	36, 330	36, 880	1032.0
1031.9	26, 930	27, 430	27, 930	28, 430	28, 940	29, 450	29, 960	30, 480	31, 000	31, 520	32, 040	32, 570	33, 100	33, 630	34, 170	34, 710	35, 250	35, 790	36, 340	36, 890	37, 440	1031.9
1031.8	27, 430	27, 930	28, 430	28, 940	29, 450	29, 960	30, 480	31, 000	31, 520	32, 040	32, 570	33, 100	33, 640	34, 170	34, 710	35, 250	35, 800	36, 340	36, 890	37, 450	38, 000	1031.8
1031.7	27, 930	28, 430	28, 940	29, 450	29, 970	30, 480	31, 000	31, 520	32, 050	32, 580	33, 110	33, 640	34, 180	34, 710	35, 260	35, 800	36, 350	36, 900	37, 450	38, 010	38, 560	1031.7
1031.6	28, 440	28, 940	29, 450	29, 970	30, 480	31, 000	31, 530	32, 050	32, 580	33, 110	33, 640	34, 180	34, 720	35, 260	35, 800	36, 350	36, 900	37, 460	38, 010	38, 570	39, 130	1031.6
1031.5	28, 950	29, 460	29, 970	30, 490	31, 010	31, 530	32, 050	32, 580	33, 110	33, 650	34, 180	34, 720	35, 260	35, 810	36, 360	36, 910	37, 460	38, 020	38, 570	39, 140	39, 700	1031.5
1031.4	29, 460	29, 970	30, 490	31, 010	31, 530	32, 060	32, 580	33, 120	33, 650	34, 190	34, 730	35, 270	35, 810	36, 360	36, 910	37, 460	38, 020	38, 580	39, 140	39, 710	40, 270	1031.4
1031.3	29, 970	30, 490	31, 010	31, 530	32, 060	32, 590	33, 120	33, 650	34, 190	34, 730	35, 270	35, 820	36, 370	36, 920	37, 470	38, 030	38, 590	39, 150	39, 710	40, 280	40, 850	1031.3
1031.2	30, 490	31, 010	31, 540	32, 060	32, 590	33, 120	33, 660	34, 190	34, 730	35, 280	35, 820	36, 370	36, 920	37, 470	38, 030	38, 590	39, 150	39, 720	40, 280	40, 850	41, 430	1031.2
1031.1	31, 020	31, 540	32, 060	32, 590	33, 120	33, 660	34, 200	34, 740	35, 280	35, 830	36, 370	36, 930	37, 480	38, 040	38, 600	39, 160	39, 720	40, 290	40, 860	41, 430	42, 010	1031.1
1031.0	31, 540	32, 070	32, 600	33, 130	33, 660	34, 200	34, 740	35, 280	35, 830	36, 380	36, 930	37, 480	38, 040	38, 600	39, 160	39, 730	40, 300	40, 870	41, 440	42, 020	42, 600	1031.0
1030.9	32, 060	32, 590	33, 120	33, 650	34, 190	34, 730	35, 270	35, 820	36, 370	36, 920	37, 480	38, 030	38, 590	39, 150	39, 720	40, 290	40, 860	41, 430	42, 010	42, 590	43, 170	1030.9
1030.8	32, 580	33, 110	33, 640	34, 180	34, 720	35, 270	35, 810	36, 360	36, 910	37, 470	38, 020	38, 580	39, 150	39, 710	40, 280	40, 850	41, 420	42, 000	42, 580	43, 160	43, 740	1030.8
1030.7	33, 100	33, 630	34, 170	34, 710	35, 260	35, 800	36, 350	36, 900	37, 460	38, 010	38, 570	39, 140	39, 700	40, 270	40, 840	41, 410	41, 990	42, 570	43, 150	43, 730	44, 320	1030.7
1030.6	33, 620	34, 160	34, 700	35, 250	35, 790	36, 340	36, 890	37, 450	38, 000	38, 560	39, 130	39, 690	40, 260	40, 830	41, 400	41, 980	42, 560	43, 140	43, 720	44, 310	44, 900	1030.6
1030.5	34, 150	34, 690	35, 240	35, 780	36, 330	36, 880	37, 440	37, 990	38, 550	39, 120	39, 680	40, 250	40, 820	41, 400	41, 970	42, 550	43, 130	43, 720	44, 300	44, 890	45, 480	1030.5
1030.4	34, 680	35, 230	35, 770	36, 320	36, 870	37, 430	37, 990	38, 550	39, 110	39, 670	40, 240	40, 810	41, 390	41, 960	42, 540	43, 120	43, 710	44, 290	44, 880	45, 470	46, 070	1030.4
1030.3	35, 220	35, 760	36, 310	36, 860	37, 420	37, 980	38, 540	39, 100	39, 660	40, 230	40, 800	41, 380	41, 950	42, 530	43, 110	43, 700	44, 280	44, 870	45, 470	46, 060	46, 660	1030.3
1030.2	35, 750	36, 300	36, 850	37, 410	37, 970	38, 530	39, 090	39, 660	40, 220	40, 790	41, 370	41, 940	42, 520	43, 100	43, 690	44, 280	44, 870	45, 460	46, 050	46, 650	47, 250	1030.2
1030.1	36, 290	36, 850	37, 400	37, 960	38, 520	39, 080	39, 650	40, 210	40, 790	41, 360	41, 940	42, 510	43, 100	43, 680	44, 270	44, 860	45, 450	46, 040	46, 640	47, 240	47, 840	1030.1
1030.0	36, 840	37, 390	37, 950	38, 510	39, 070	39, 640	40, 210	40, 780	41, 350	41, 930	42, 510	43, 090	43, 670	44, 260	44, 850	45, 440	46, 030	46, 630	47, 230	47, 830	48, 440	1030.0
1029.9	37, 380	37, 930	38, 490	39, 060	39, 620	40, 190	40, 760	41, 330	41, 910	42, 490	43, 070	43, 660	44, 240	44, 830	45, 420	46, 020	46, 620	47, 220	47, 820	48, 420	49, 030	1029.9
1029.8	37, 920	38, 480	39, 040	39, 610	40, 170	40, 750	41, 320	41, 900	42, 470	43, 060	43, 640	44, 230	44, 820	45, 410	46, 000	46, 600	47, 200	47, 800	48, 410	49, 020	49, 630	1029.8
1029.7	38, 460	39, 020	39, 590	40, 160	40, 730	41, 300	41, 880	42, 460	43, 040	43, 630	44, 210	44, 800	45, 390	45, 990	46, 590	47, 190	47, 790	48, 390	49, 000	49, 610	50, 230	1029.7
1029.6	39, 010	39, 570	40, 140	40, 710	41, 290	41, 860	42, 440	43, 030	43, 610	44, 200	44, 790	45, 380	45, 970	46, 570	47, 170	47, 770	48, 380	48, 990	49, 600	50, 210	50, 830	1029.6
1029.5	39, 560	40, 130	40, 700	41, 270	41, 850	42, 430	43, 010	43, 590	44, 180	44, 770	45, 360	45, 960	46, 560	47, 160	47, 760	48, 360	48, 970	49, 580	50, 200	50, 810	51, 430	1029.5
1029.4	40, 110	40, 680	41, 260	41, 830	42, 410	42, 990	43, 580	44, 170	44, 760	45, 350	45, 940	46, 540	47, 140	47, 740	48, 350	48, 960	49, 570	50, 180	50, 800	51, 410	52, 030	1029.4
1029.3	40, 670	41, 240	41, 820	42, 400	42, 980	43, 560	44, 150	44, 740	45, 330	45, 930	46, 530	47, 130	47, 730	48, 330	48, 940	49, 550	50, 170	50, 780	51, 400	52, 020	52, 640	1029.3
1029.2	41, 230	41, 800	42, 380	42, 960	43, 550	44, 140	44, 730	45, 320	45, 910	46, 510	47, 110	47, 710	48, 320	48, 930	49, 540	50, 150	50, 770	51, 390	52, 010	52, 630	53, 250	1029.2
1029.1	41, 790	42, 370	42, 950	43, 530	44, 120	44, 710	45, 300	45, 900	46, 500	47, 100	47, 700	48, 300	48, 910	49, 520	50, 140	50, 750	51, 370	51, 990	52, 610	53, 240	53, 870	1029.1
1029.0	42, 350	42, 930	43, 520	44, 110	44, 700	45, 290	45, 880	46, 480	47, 080	47, 680	48, 290	48, 900	49, 510	50, 120	50, 740	51, 360	51, 980	52, 600	53, 230	53, 850	54, 480	1029.0
1028.9	42, 900	43, 480	44, 070	44, 660	45, 250	45, 850	46, 450	47, 050	47, 650	48, 260	48, 860	49, 470	50, 090	50, 700	51, 320	51, 940	52, 560	53, 190	53, 820	54, 450	55, 080	1028.9
1028.8	43, 450	44, 040	44, 630	45, 220	45, 820	46, 410	47, 010	47, 620	48, 220	48, 830	49, 440	50, 050	50, 670	51, 290	51, 910	52, 530	53, 150	53, 780	54, 410	55, 050	55, 680	1028.8
1028.7	44, 010	44, 590	45, 190	45, 780	46, 380	46, 980	47, 580	48, 190	48, 790	49, 400	50, 020	50, 630	51, 250	51, 870	52, 490	53, 120	53, 750	54, 380	55, 010	55, 650	56, 280	1028.7
1028.6	44, 560	45, 150	45, 750	46, 350	46, 940	47, 550	48, 150	48, 760	49, 370	49, 980	50, 600	51, 220	51, 840	52, 460	53, 080	53, 710	54, 340	54, 970	55, 610	56, 250	56, 890	1028.6
1028.5	45, 120	45, 710	46, 310	46, 910	47, 510	48, 120	48, 730	49, 340	49, 950	50, 560	51, 180	51, 800	52, 420	53, 050	53, 680	54, 310	54, 940	55, 570	56, 210	56, 850	57, 490	1028.5
1028.4	45, 680	46, 280	46, 880	47, 480	48, 080	48, 690	49, 300	49, 910	50, 530	51, 150	51, 770	52, 390	53, 010	53, 640	54, 270	54, 900	55, 540	56, 180	56, 820	57, 460	58, 100	1028.4
1028.3	46, 240	46, 840	47, 440	48, 050	48, 660	49, 270	49, 880	50, 490	51, 110	51, 730	52, 350	52, 980	53, 600	54, 230	54, 870	55, 500	56, 140	56, 780	57, 420	58, 070	58, 710	1028.3
1028.2	46, 810	47, 410	48, 010	48, 620	49, 230	49, 840	50, 460	51, 070	51, 690	52, 320	52, 940	53, 570	54, 200	54, 830	55, 470	56, 100	56, 740	57, 380	58, 030	58, 680	59, 330	1028.2
1028.1	47, 380	47, 980	48, 590	49, 200	49, 810	50, 420	51, 040	51, 660	52, 280	52, 910	53, 530	54, 160	54, 800	55, 430	56, 070	56, 710	57, 350	57, 990	58, 640	59, 290	59, 940	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1040.0	1040.1	1040.2	1040.3	1040.4	1040.5	1040.6	1040.7	1040.8	1040.9	1041.0	1041.1	1041.2	1041.3	1041.4	1041.5	1041.6	1041.7	1041.8	1041.9	1042.0	
1028.0	47,950	48,550	49,160	49,770	50,390	51,000	51,620	52,250	52,870	53,500	54,130	54,760	55,390	56,030	56,670	57,310	57,960	58,600	59,250	59,900	60,560	1028.0
1027.9	48,490	49,100	49,710	50,320	50,940	51,560	52,180	52,800	53,430	54,060	54,690	55,330	55,960	56,600	57,240	57,890	58,530	59,180	59,830	60,490	61,140	1027.9
1027.8	49,030	49,640	50,260	50,870	51,490	52,110	52,740	53,360	53,990	54,620	55,260	55,890	56,530	57,170	57,820	58,460	59,110	59,760	60,410	61,070	61,730	1027.8
1027.7	49,580	50,190	50,810	51,430	52,050	52,670	53,300	53,920	54,550	55,190	55,820	56,460	57,100	57,750	58,390	59,040	59,690	60,340	61,000	61,660	62,320	1027.7
1027.6	50,130	50,740	51,360	51,980	52,600	53,230	53,860	54,490	55,120	55,750	56,390	57,030	57,670	58,320	58,970	59,620	60,270	60,930	61,580	62,240	62,900	1027.6
1027.5	50,680	51,290	51,910	52,530	53,160	53,790	54,420	55,050	55,680	56,320	56,960	57,600	58,250	58,900	59,550	60,200	60,850	61,510	62,170	62,830	63,500	1027.5
1027.4	51,230	51,850	52,470	53,090	53,720	54,350	54,980	55,620	56,250	56,890	57,530	58,180	58,830	59,470	60,130	60,780	61,440	62,100	62,760	63,420	64,090	1027.4
1027.3	51,780	52,400	53,020	53,650	54,280	54,910	55,550	56,180	56,820	57,460	58,110	58,750	59,400	60,050	60,710	61,360	62,020	62,680	63,350	64,010	64,680	1027.3
1027.2	52,330	52,960	53,580	54,210	54,840	55,480	56,110	56,750	57,390	58,040	58,680	59,330	59,980	60,640	61,290	61,950	62,610	63,270	63,940	64,610	65,280	1027.2
1027.1	52,890	53,520	54,140	54,770	55,410	56,040	56,680	57,320	57,970	58,610	59,260	59,910	60,560	61,220	61,880	62,540	63,200	63,860	64,530	65,200	65,870	1027.1
1027.0	53,450	54,080	54,710	55,340	55,970	56,610	57,250	57,890	58,540	59,190	59,840	60,490	61,150	61,800	62,460	63,120	63,790	64,460	65,130	65,800	66,470	1027.0
1026.9	53,980	54,600	55,240	55,870	56,510	57,150	57,790	58,430	59,080	59,730	60,380	61,040	61,690	62,350	63,020	63,680	64,350	65,010	65,690	66,360	67,030	1026.9
1026.8	54,500	55,140	55,770	56,410	57,040	57,690	58,330	58,980	59,620	60,280	60,930	61,590	62,240	62,910	63,570	64,230	64,900	65,570	66,250	66,920	67,600	1026.8
1026.7	55,030	55,670	56,300	56,940	57,580	58,220	58,870	59,520	60,170	60,820	61,480	62,140	62,800	63,460	64,120	64,790	65,460	66,130	66,810	67,480	68,160	1026.7
1026.6	55,560	56,200	56,840	57,480	58,120	58,760	59,410	60,060	60,710	61,370	62,030	62,690	63,350	64,010	64,680	65,350	66,020	66,690	67,370	68,050	68,730	1026.6
1026.5	56,100	56,730	57,370	58,010	58,660	59,310	59,950	60,610	61,260	61,920	62,580	63,240	63,900	64,570	65,230	65,910	66,580	67,250	67,930	68,610	69,300	1026.5
1026.4	56,630	57,270	57,910	58,550	59,200	59,850	60,500	61,150	61,810	62,470	63,130	63,790	64,450	65,120	65,790	66,470	67,140	67,820	68,500	69,180	69,860	1026.4
1026.3	57,160	57,800	58,450	59,090	59,740	60,390	61,040	61,700	62,360	63,020	63,680	64,340	65,010	65,680	66,350	67,030	67,700	68,380	69,060	69,750	70,430	1026.3
1026.2	57,700	58,340	58,990	59,630	60,280	60,930	61,590	62,250	62,910	63,570	64,230	64,900	65,570	66,240	66,910	67,590	68,260	68,950	69,630	70,310	71,000	1026.2
1026.1	58,240	58,880	59,530	60,180	60,830	61,480	62,140	62,790	63,460	64,120	64,780	65,450	66,120	66,800	67,470	68,150	68,830	69,510	70,200	70,880	71,570	1026.1
1026.0	58,770	59,420	60,070	60,720	61,370	62,030	62,680	63,340	64,010	64,670	65,340	66,010	66,680	67,360	68,030	68,710	69,390	70,080	70,760	71,450	72,140	1026.0
1025.9	59,290	59,940	60,590	61,240	61,900	62,550	63,210	63,870	64,540	65,210	65,870	66,550	67,220	67,900	68,570	69,250	69,940	70,620	71,310	72,000	72,690	1025.9
1025.8	59,810	60,460	61,110	61,770	62,420	63,080	63,740	64,400	65,070	65,740	66,410	67,080	67,760	68,440	69,120	69,800	70,480	71,170	71,860	72,550	73,250	1025.8
1025.7	60,330	60,980	61,640	62,290	62,950	63,610	64,270	64,940	65,600	66,270	66,950	67,620	68,300	68,980	69,660	70,340	71,030	71,720	72,410	73,100	73,800	1025.7
1025.6	60,850	61,510	62,160	62,820	63,480	64,140	64,800	65,470	66,140	66,810	67,480	68,160	68,840	69,520	70,200	70,890	71,580	72,270	72,960	73,650	74,350	1025.6
1025.5	61,370	62,030	62,680	63,340	64,000	64,670	65,330	66,000	66,670	67,350	68,020	68,700	69,380	70,060	70,750	71,430	72,120	72,810	73,510	74,200	74,900	1025.5
1025.4	61,900	62,550	63,210	63,870	64,530	65,200	65,870	66,540	67,210	67,880	68,560	69,240	69,920	70,600	71,290	71,980	72,670	73,360	74,060	74,760	75,460	1025.4
1025.3	62,420	63,080	63,740	64,400	65,060	65,730	66,400	67,070	67,740	68,420	69,100	69,780	70,460	71,150	71,840	72,530	73,220	73,910	74,610	75,310	76,010	1025.3
1025.2	62,950	63,600	64,260	64,930	65,590	66,260	66,930	67,610	68,280	68,960	69,640	70,320	71,010	71,690	72,380	73,080	73,770	74,470	75,160	75,870	76,570	1025.2
1025.1	63,470	64,130	64,790	65,460	66,130	66,800	67,470	68,140	68,820	69,500	70,180	70,860	71,550	72,240	72,930	73,620	74,320	75,020	75,720	76,420	77,130	1025.1
1025.0	64,000	64,660	65,320	65,990	66,660	67,330	68,000	68,680	69,360	70,040	70,720	71,410	72,100	72,790	73,480	74,170	74,870	75,570	76,270	76,980	77,680	1025.0
1024.9	64,510	65,180	65,840	66,510	67,180	67,860	68,530	69,210	69,890	70,570	71,260	71,940	72,630	73,330	74,020	74,720	75,410	76,120	76,820	77,530	78,230	1024.9
1024.8	65,030	65,700	66,360	67,030	67,710	68,380	69,060	69,740	70,420	71,100	71,790	72,480	73,170	73,860	74,560	75,260	75,960	76,660	77,370	78,080	78,780	1024.8
1024.7	65,550	66,220	66,890	67,560	68,230	68,910	69,590	70,270	70,950	71,640	72,330	73,020	73,710	74,410	75,100	75,800	76,510	77,210	77,920	78,630	79,340	1024.7
1024.6	66,070	66,740	67,410	68,080	68,760	69,440	70,120	70,800	71,490	72,170	72,860	73,560	74,250	74,950	75,650	76,350	77,050	77,760	78,470	79,180	79,890	1024.6
1024.5	66,590	67,260	67,940	68,610	69,290	69,970	70,650	71,330	72,020	72,710	73,400	74,100	74,790	75,490	76,190	76,890	77,600	78,310	79,020	79,730	80,440	1024.5
1024.4	67,110	67,790	68,460	69,140	69,820	70,500	71,180	71,870	72,560	73,250	73,940	74,640	75,330	76,030	76,740	77,440	78,150	78,860	79,570	80,280	81,000	1024.4
1024.3	67,640	68,310	68,990	69,670	70,350	71,030	71,710	72,400	73,090	73,790	74,480	75,180	75,880	76,580	77,280	77,990	78,700	79,410	80,120	80,840	81,560	1024.3
1024.2	68,160	68,840	69,510	70,190	70,880	71,560	72,250	72,940	73,630	74,320	75,020	75,720	76,420	77,120	77,830	78,540	79,250	79,960	80,680	81,390	82,110	1024.2
1024.1	68,690	69,360	70,040	70,720	71,410	72,090	72,780	73,470	74,170	74,860	75,560	76,260	76,970	77,670	78,380	79,090	79,800	80,520	81,230	81,950	82,670	1024.1
1024.0	69,210	69,890	70,570	71,260	71,940	72,630	73,320	74,010	74,710	75,410	76,110	76,810	77,510	78,220	78,930	79,640	80,350	81,070	81,790	82,510	83,230	1024.0
1023.9	69,780	70,460	71,150	71,830	72,520	73,210	73,900	74,600	75,300	75,990	76,700	77,400	78,110	78,820	79,530	80,240	80,960	81,680	82,400	83,120	83,840	1023.9
1023.8	70,360	71,040	71,720	72,410	73,100	73,790	74,490	75,190	75,880	76,590	77,290	78,000	78,710	79,420	80,130	80,850	81,560	82,280	83,010	83,730	84,460	1023.8
1023.7	70,930	71,610	72,300	72,990	73,680	74,380	75,080	75,770	76,480	77,180	77,890	78,590	79,310	80,020	80,730	81,450	82,170	82,900	83,620	84,350	85,080	1023.7
1023.6	71,510	72,190	72,880	73,570	74,270	74,960	75,660	76,370	77,070	77,780	78,480	79,190	79,910	80,620	81,340	82,060	82,780	83,510	84,240	84,960	85,700	1023.6
1023.5	72,080	72,770	73,460	74,160	74,850	75,550	76,250	76,960	77,660	78,370	79,080	79,800	80,510	81,230	81,950	82,670	83,400	84,120	84,850	85,580	86,320	1023.5
1023.4	72,660	73,350	74,050	74,740	75,440	76,140	76,850	77,550	78,260	78,970	79,680	80,400	81,120	81,840	82,560	83,280	84,010	84,740	85,470	86,200	86,940	1023.4
1023.3	73,240	73,940	74,630	75,330	76,030	76,740	77,440	78,150	78,860	79,570	80,290	81,010	81,730	82,450	83,170	83,900	84,630	85,360	86,090	86,830	87,570	1023.3
1023.2	73,830	74,520	75,220	75,920	76,630	77,330	78,040	78,750	79,460	80,180	80,890	81,610	82,340	83,060	83,790	84,510	85,250	85,980	86,710	87,450	88,190	1023.2
1023.1	74,410	75,110	75,810	76,520	77,220	77,930	78,640	79,350	80,070	80,780	81,500	82,220	82,950	83,670	84,400	85,130	85,870	86,600	87,340	88,080	88,820	1023.1
1023.0	75,000	75,700	76,400	77,110	77,820	78,530	79,240	79,950	80,670	81,390	82,110	82,830	83,560	84,290	85,020	85,750	86,490	87,230	87,970	88,710	89,450	1023.0
1022.9	75,670	76,370	77,080	77,780	78,490	79,210	79,920	80,640	81,360	82,080	82,800	83,530	84,260	84,990	85,720	86,460	87,200	87,940	88,680	89,430	90,170	1022.9
1022.8	76,340	77,040	77,750	78,460	79,170	79,890	80,610	81,330	82,050	82,770	83,500	84,230	84,960	85,700	86,430	87,170	87,910	88,650	89,400	90,150	90,900	1022.8
1022.7	77,010	77,720	78,430	79,140	79,860	80,580	81,300	82,020	82,740	83,470	84,200	84,930	85,670	86,400	87,140	87,880	88,630	89,370	90,120	90,870	91,620	1022.7
1022.6	77,690	78,400	79,110	79,830	80,540	81,260	81,990	82,710	83,440	84,170	84,900	85,640	86,370	87,110	87,850	88,600	89,340	90,090	90,840	91,600	92,350	1022.6
1022.5	78,360	79,080	79,790	80,510	81,230	81,960	82,680	83,410	84,140	84,870	85,610	86,340	87,080	87,830	88,570	89,320	90,070	90,820	91,570	92,330	93,090	1022.5
1022.4	79,050	79,760	80,480	81,200	81,930	82,650	83,380	84,110	84,840	85,580	86,320	87,060	87,800	88,540	89,290	90,040	90,790	91,540	92,300	93,060	93,820	1022.4
1022.3	79,730	80,450	81,170	81,890	82,620	83,350	84,080	84,810	85,550	86,290	87,030	87,770	88,510	89,260	90,010	90,760	91,520	92,280	93,030	93,800	94,560	1022.3
1022.2	80,420	81,140	81,860	82,590	83,320	84,050	84,780	85,520	86,260	87,000	87,740	88,490	89,230	89,980	90,740	91,490	92,250	93,010	93,770	94,530	95,300	1022.2
1022.1	81,110	81,830	82,560	83,290	84,020	84,750	85,490	86,230	86,970	87,710	88,460	89,210	89,960	90,710	91,470	92,220	92,980	93,750	94,510	95,280	96,050	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1040.0	1040.1	1040.2	1040.3	1040.4	1040.5	1040.6	1040.7	1040.8	1040.9	1041.0	1041.1	1041.2	1041.3	1041.4	1041.5	1041.6	1041.7	1041.8	1041.9	1042.0	
1022.0	81,800	82,530	83,260	83,990	84,720	85,460	86,200	86,940	87,690	88,430	89,180	89,930	90,680	91,440	92,200	92,960	93,720	94,480	95,250	96,020	96,790	1022.0
1021.9	82,540	83,270	84,010	84,740	85,480	86,220	86,960	87,700	88,450	89,200	89,950	90,710	91,460	92,220	92,980	93,750	94,510	95,280	96,050	96,820	97,600	1021.9
1021.8	83,290	84,020	84,760	85,500	86,240	86,980	87,720	88,470	89,220	89,970	90,730	91,490	92,240	93,010	93,770	94,540	95,310	96,080	96,850	97,630	98,400	1021.8
1021.7	84,040	84,780	85,510	86,250	87,000	87,740	88,490	89,240	90,000	90,750	91,510	92,270	93,030	93,800	94,560	95,330	96,100	96,880	97,650	98,430	99,210	1021.7
1021.6	84,790	85,530	86,270	87,020	87,760	88,510	89,260	90,020	90,770	91,530	92,290	93,060	93,820	94,590	95,360	96,130	96,910	97,680	98,460	99,240	100,000	1021.6
1021.5	85,550	86,290	87,040	87,780	88,530	89,280	90,040	90,800	91,550	92,320	93,080	93,850	94,610	95,390	96,160	96,930	97,710	98,490	99,280	100,100	100,800	1021.5
1021.4	86,310	87,060	87,800	88,550	89,310	90,060	90,820	91,580	92,340	93,100	93,870	94,640	95,410	96,190	96,960	97,740	98,520	99,310	100,100	100,900	101,700	1021.4
1021.3	87,070	87,820	88,570	89,330	90,080	90,840	91,600	92,360	93,130	93,900	94,670	95,440	96,210	96,990	97,770	98,550	99,340	100,100	100,900	101,700	102,500	1021.3
1021.2	87,840	88,590	89,350	90,100	90,860	91,620	92,390	93,150	93,920	94,690	95,470	96,240	97,020	97,800	98,580	99,370	100,200	100,900	101,700	102,500	103,300	1021.2
1021.1	88,610	89,370	90,130	90,890	91,650	92,410	93,180	93,950	94,720	95,490	96,270	97,050	97,830	98,610	99,400	100,200	101,000	101,800	102,600	103,400	104,200	1021.1
1021.0	89,390	90,150	90,910	91,670	92,440	93,200	93,970	94,740	95,520	96,300	97,080	97,860	98,640	99,430	100,200	101,000	101,800	102,600	103,400	104,200	105,000	1021.0
1020.9	90,220	90,980	91,750	92,510	93,280	94,050	94,830	95,600	96,380	97,160	97,940	98,730	99,520	100,300	101,100	101,900	102,700	103,500	104,300	105,100	105,900	1020.9
1020.8	91,060	91,820	92,590	93,360	94,130	94,910	95,680	96,460	97,240	98,030	98,820	99,600	100,400	101,200	102,000	102,800	103,600	104,400	105,200	106,000	106,800	1020.8
1020.7	91,900	92,670	93,440	94,210	94,990	95,770	96,550	97,330	98,110	98,900	99,690	100,500	101,300	102,100	102,900	103,700	104,500	105,300	106,100	106,900	107,700	1020.7
1020.6	92,750	93,520	94,290	95,070	95,850	96,630	97,410	98,200	98,990	99,780	100,600	101,400	102,200	103,000	103,800	104,600	105,400	106,200	107,000	107,800	108,600	1020.6
1020.5	93,600	94,370	95,150	95,930	96,710	97,500	98,290	99,080	99,870	100,700	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,600	1020.5
1020.4	94,450	95,230	96,010	96,800	97,580	98,370	99,160	99,960	100,800	101,500	102,300	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,700	110,500	1020.4
1020.3	95,310	96,090	96,880	97,670	98,460	99,250	100,000	100,800	101,600	102,400	103,200	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,800	110,600	111,400	1020.3
1020.2	96,180	96,960	97,750	98,540	99,340	100,100	100,900	101,700	102,500	103,300	104,100	105,000	105,800	106,600	107,400	108,200	109,000	109,900	110,700	111,500	112,400	1020.2
1020.1	97,050	97,840	98,630	99,420	100,200	101,000	101,800	102,600	103,400	104,200	105,100	105,900	106,700	107,500	108,300	109,100	110,000	110,800	111,600	112,500	113,300	1020.1
1020.0	97,920	98,710	99,510	100,300	101,100	101,900	102,700	103,500	104,300	105,100	106,000	106,800	107,600	108,400	109,200	110,100	110,900	111,700	112,600	113,400	114,200	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1042.0	1042.1	1042.2	1042.3	1042.4	1042.5	1042.6	1042.7	1042.8	1042.9	1043.0	1043.1	1043.2	1043.3	1043.4	1043.5	1043.6	1043.7	1043.8	1043.9	1044.0	
1034.0	26,270	26,760	27,260	27,750	28,250	28,750	29,260	29,760	30,270	30,790	31,300	31,820	32,340	32,860	33,390	33,920	34,450	34,990	35,520	36,060	36,610	1034.0
1033.9	26,770	27,270	27,760	28,260	28,760	29,270	29,770	30,280	30,800	31,310	31,830	32,350	32,880	33,400	33,930	34,470	35,000	35,540	36,080	36,620	37,170	1033.9
1033.8	27,280	27,770	28,270	28,770	29,280	29,790	30,300	30,810	31,330	31,840	32,370	32,890	33,420	33,950	34,480	35,020	35,550	36,090	36,640	37,180	37,730	1033.8
1033.7	27,780	28,280	28,780	29,290	29,800	30,310	30,820	31,340	31,860	32,380	32,900	33,430	33,960	34,490	35,030	35,570	36,110	36,650	37,200	37,750	38,300	1033.7
1033.6	28,290	28,800	29,300	29,810	30,320	30,830	31,350	31,870	32,390	32,920	33,450	33,980	34,510	35,050	35,580	36,130	36,670	37,220	37,770	38,320	38,870	1033.6
1033.5	28,810	29,310	29,820	30,330	30,850	31,360	31,880	32,410	32,930	33,460	33,990	34,520	35,060	35,600	36,140	36,690	37,230	37,780	38,330	38,890	39,450	1033.5
1033.4	29,320	29,830	30,340	30,860	31,380	31,900	32,420	32,940	33,470	34,000	34,540	35,070	35,610	36,160	36,700	37,250	37,800	38,350	38,910	39,460	40,030	1033.4
1033.3	29,840	30,360	30,870	31,390	31,910	32,430	32,960	33,490	34,020	34,550	35,090	35,630	36,170	36,720	37,260	37,820	38,370	38,920	39,480	40,040	40,610	1033.3
1033.2	30,370	30,880	31,400	31,920	32,450	32,970	33,500	34,030	34,570	35,100	35,640	36,190	36,730	37,280	37,830	38,390	38,940	39,500	40,060	40,630	41,190	1033.2
1033.1	30,890	31,410	31,930	32,460	32,980	33,510	34,050	34,580	35,120	35,660	36,200	36,750	37,300	37,850	38,400	38,960	39,520	40,080	40,640	41,210	41,780	1033.1
1033.0	31,430	31,950	32,470	33,000	33,530	34,060	34,600	35,130	35,670	36,220	36,760	37,310	37,870	38,420	38,980	39,540	40,100	40,660	41,230	41,800	42,370	1033.0
1032.9	31,960	32,480	33,010	33,540	34,070	34,610	35,150	35,690	36,230	36,780	37,330	37,880	38,430	38,990	39,550	40,110	40,680	41,240	41,810	42,390	42,960	1032.9
1032.8	32,490	33,020	33,550	34,080	34,620	35,160	35,700	36,240	36,790	37,340	37,890	38,440	39,000	39,560	40,130	40,690	41,260	41,830	42,400	42,980	43,560	1032.8
1032.7	33,030	33,560	34,090	34,630	35,170	35,710	36,250	36,800	37,350	37,900	38,460	39,020	39,580	40,140	40,700	41,270	41,840	42,420	42,990	43,570	44,150	1032.7
1032.6	33,570	34,100	34,640	35,180	35,720	36,260	36,810	37,360	37,920	38,470	39,030	39,590	40,150	40,720	41,290	41,860	42,430	43,010	43,590	44,170	44,750	1032.6
1032.5	34,110	34,650	35,190	35,730	36,280	36,820	37,370	37,930	38,480	39,040	39,600	40,170	40,730	41,300	41,870	42,450	43,020	43,600	44,190	44,770	45,360	1032.5
1032.4	34,660	35,200	35,740	36,290	36,840	37,390	37,940	38,500	39,050	39,620	40,180	40,750	41,320	41,890	42,460	43,040	43,620	44,200	44,790	45,370	45,960	1032.4
1032.3	35,210	35,750	36,300	36,850	37,400	37,950	38,510	39,070	39,630	40,190	40,760	41,330	41,900	42,480	43,060	43,640	44,220	44,800	45,390	45,980	46,570	1032.3
1032.2	35,760	36,310	36,860	37,410	37,960	38,520	39,080	39,640	40,210	40,780	41,350	41,920	42,490	43,070	43,650	44,230	44,820	45,410	46,000	46,590	47,190	1032.2
1032.1	36,320	36,870	37,420	37,980	38,530	39,090	39,660	40,220	40,790	41,360	41,930	42,510	43,090	43,670	44,250	44,840	45,420	46,020	46,610	47,200	47,800	1032.1
1032.0	36,880	37,440	37,990	38,550	39,110	39,670	40,240	40,800	41,370	41,950	42,520	43,100	43,680	44,270	44,850	45,440	46,030	46,630	47,220	47,820	48,420	1032.0
1031.9	37,440	38,000	38,550	39,110	39,680	40,240	40,810	41,380	41,950	42,530	43,110	43,690	44,270	44,860	45,450	46,040	46,640	47,230	47,830	48,430	49,040	1031.9
1031.8	38,000	38,560	39,120	39,680	40,250	40,820	41,390	41,960	42,540	43,120	43,700	44,280	44,870	45,460	46,050	46,640	47,240	47,840	48,440	49,050	49,650	1031.8
1031.7	38,560	39,120	39,690	40,250	40,820	41,390	41,970	42,540	43,120	43,710	44,290	44,880	45,470	46,060	46,650	47,250	47,850	48,450	49,060	49,660	50,270	1031.7
1031.6	39,130	39,690	40,260	40,830	41,400	41,980	42,550	43,130	43,710	44,300	44,890	45,480	46,070	46,660	47,260	47,860	48,460	49,070	49,670	50,280	50,900	1031.6
1031.5	39,700	40,270	40,840	41,410	41,980	42,560	43,140	43,720	44,310	44,890	45,480	46,080	46,670	47,270	47,870	48,470	49,080	49,680	50,290	50,910	51,520	1031.5
1031.4	40,270	40,840	41,410	41,990	42,570	43,150	43,730	44,310	44,900	45,490	46,090	46,680	47,280	47,880	48,480	49,090	49,700	50,310	50,920	51,530	52,150	1031.4
1031.3	40,850	41,420	42,000	42,570	43,150	43,740	44,320	44,910	45,500	46,090	46,690	47,290	47,890	48,490	49,100	49,710	50,320	50,930	51,550	52,160	52,780	1031.3
1031.2	41,430	42,000	42,580	43,160	43,740	44,330	44,920	45,510	46,100	46,700	47,300	47,900	48,500	49,110	49,720	50,330	50,940	51,560	52,180	52,800	53,420	1031.2
1031.1	42,010	42,590	43,170	43,750	44,340	44,930	45,520	46,110	46,710	47,310	47,910	48,510	49,120	49,730	50,340	50,950	51,570	52,190	52,810	53,430	54,060	1031.1
1031.0	42,600	43,180	43,760	44,350	44,930	45,530	46,120	46,720	47,320	47,920	48,520	49,130	49,740	50,350	50,960	51,580	52,200	52,820	53,440	54,070	54,700	1031.0
1030.9	43,170	43,750	44,340	44,930	45,520	46,110	46,710	47,310	47,910	48,510	49,120	49,730	50,340	50,960	51,570	52,190	52,810	53,440	54,060	54,690	55,320	1030.9
1030.8	43,740	44,330	44,920	45,510	46,100	46,700	47,300	47,900	48,510	49,110	49,720	50,330	50,950	51,560	52,180	52,810	53,430	54,060	54,680	55,320	55,950	1030.8
1030.7	44,320	44,910	45,500	46,090	46,690	47,290	47,890	48,500	49,100	49,710	50,330	50,940	51,560	52,180	52,800	53,420	54,050	54,680	55,310	55,940	56,580	1030.7
1030.6	44,900	45,490	46,090	46,680	47,280	47,880	48,490	49,100	49,710	50,320	50,930	51,550	52,170	52,790	53,410	54,040	54,670	55,300	55,940	56,570	57,210	1030.6
1030.5	45,480	46,080	46,670	47,270	47,880	48,480	49,090	49,700	50,310	50,920	51,540	52,160	52,780	53,410	54,030	54,660	55,300	55,930	56,570	57,210	57,850	1030.5
1030.4	46,070	46,670	47,270	47,870	48,470	49,080	49,690	50,300	50,920	51,530	52,150	52,780	53,400	54,030	54,660	55,290	55,920	56,560	57,200	57,840	58,480	1030.4
1030.3	46,660	47,260	47,860	48,460	49,070	49,680	50,290	50,910	51,530	52,150	52,770	53,390	54,020	54,650	55,280	55,920	56,550	57,190	57,830	58,480	59,120	1030.3
1030.2	47,250	47,850	48,460	49,060	49,670	50,290	50,900	51,520	52,140	52,760	53,390	54,010	54,640	55,270	55,910	56,550	57,190	57,830	58,470	59,120	59,770	1030.2
1030.1	47,840	48,450	49,060	49,670	50,280	50,890	51,510	52,130	52,750	53,380	54,010	54,630	55,270	55,900	56,540	57,180	57,820	58,460	59,110	59,760	60,410	1030.1
1030.0	48,440	49,050	49,660	50,270	50,890	51,500	52,120	52,750	53,370	54,000	54,630	55,260	55,890	56,530	57,170	57,810	58,460	59,110	59,750	60,410	61,060	1030.0
1029.9	49,030	49,640	50,260	50,870	51,490	52,110	52,730	53,360	53,980	54,610	55,250	55,880	56,520	57,160	57,800	58,440	59,090	59,740	60,390	61,050	61,700	1029.9
1029.8	49,630	50,240	50,860	51,470	52,090	52,720	53,340	53,970	54,600	55,230	55,870	56,500	57,140	57,790	58,430	59,080	59,730	60,380	61,030	61,690	62,350	1029.8
1029.7	50,230	50,840	51,460	52,080	52,700	53,330	53,950	54,580	55,220	55,850	56,490	57,130	57,770	58,420	59,060	59,710	60,370	61,020	61,680	62,340	63,000	1029.7
1029.6	50,830	51,440	52,060	52,690	53,310	53,940	54,570	55,200	55,840	56,480	57,120	57,760	58,400	59,050	59,700	60,350	61,010	61,660	62,320	62,980	63,650	1029.6
1029.5	51,430	52,050	52,670	53,300	53,930	54,560	55,190	55,820	56,460	57,100	57,740	58,390	59,040	59,690	60,340	60,990	61,650	62,310	62,970	63,630	64,300	1029.5
1029.4	52,030	52,660	53,280	53,910	54,540	55,170	55,810	56,450	57,090	57,730	58,380	59,020	59,670	60,330	60,980	61,640	62,300	62,960	63,620	64,290	64,960	1029.4
1029.3	52,640	53,270	53,900	54,530	55,160	55,800	56,430	57,070	57,720	58,360	59,010	59,660	60,310	60,970	61,620	62,280	62,950	63,610	64,280	64,940	65,620	1029.3
1029.2	53,250	53,880	54,510	55,150	55,780	56,420	57,060	57,700	58,350	59,000	59,650	60,300	60,950	61,610	62,270	62,930	63,600	64,260	64,930	65,600	66,280	1029.2
1029.1	53,870	54,500	55,130	55,770	56,410	57,050	57,690	58,330	58,980	59,630	60,290	60,940	61,600	62,260	62,920	63,580	64,250	64,920	65,590	66,260	66,940	1029.1
1029.0	54,480	55,120	55,750	56,390	57,030	57,680	58,320	58,970	59,620	60,270	60,930	61,580	62,240	62,910	63,570	64,240	64,910	65,580	66,250	66,930	67,610	1029.0
1028.9	55,080	55,720	56,360	57,000	57,640	58,280	58,930	59,580	60,240	60,890	61,550	62,210	62,870	63,530	64,200	64,870	65,540	66,220	66,890	67,570	68,250	1028.9
1028.8	55,680	56,320	56,960	57,600	58,250	58,900	59,550	60,200	60,850	61,510	62,170	62,830	63,500	64,160	64,830	65,500	66,180	66,850	67,530	68,210	68,900	1028.8
1028.7	56,280	56,920	57,570	58,210	58,860	59,510	60,160	60,820	61,470	62,130	62,800	63,460	64,130	64,800	65,470	66,140	66,820	67,490	68,180	68,860	69,540	1028.7
1028.6	56,890	57,530	58,180	58,820	59,470	60,120	60,780	61,440	62,100	62,760	63,420	64,090	64,760	65,430	66,100	66,780	67,460	68,140	68,820	69,510	70,190	1028.6
1028.5	57,490	58,140	58,790	59,440	60,090	60,740	61,400	62,060	62,720	63,390	64,050	64,720	65,390	66,070	66,740	67,420	68,100	68,780	69,470	70,160	70,840	1028.5
1028.4	58,100	58,750	59,400	60,050	60,710	61,360	62,020	62,680	63,350	64,010	64,680	65,350	66,030	66,700	67,380	68,060	68,740	69,430	70,120	70,810	71,500	1028.4
1028.3	58,710	59,360	60,010	60,670	61,330	61,990	62,650	63,310	63,980	64,650	65,320	65,990	66,670	67,340	68,020	68,710	69,390	70,080	70,770	71,460	72,160	1028.3
1028.2	59,330	59,980	60,630	61,290	61,950	62,610	63,270	63,940	64,610	65,280	65,950	66,630	67,310	67,990	68,670	69,350	70,040	70,730	71,420	72,120	72,810	1028.2
1028.1	59,940	60,600	61,250	61,910	62,570	63,240	63,900	64,570	65,240	65,920	66,590	67,270	67,950	68,630	69,320	70,000	70,690	71,380	72,080	72,780	73,470	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1042.0	1042.1	1042.2	1042.3	1042.4	1042.5	1042.6	1042.7	1042.8	1042.9	1043.0	1043.1	1043.2	1043.3	1043.4	1043.5	1043.6	1043.7	1043.8	1043.9	1044.0	
1028.0	60,560	61,220	61,870	62,540	63,200	63,870	64,530	65,200	65,880	66,550	67,230	67,910	68,590	69,280	69,970	70,660	71,350	72,040	72,740	73,440	74,140	1028.0
1027.9	61,140	61,800	62,460	63,130	63,790	64,460	65,130	65,800	66,480	67,160	67,840	68,520	69,200	69,890	70,580	71,270	71,960	72,660	73,360	74,060	74,760	1027.9
1027.8	61,730	62,390	63,050	63,720	64,380	65,050	65,730	66,400	67,080	67,760	68,440	69,120	69,810	70,500	71,190	71,880	72,580	73,280	73,980	74,680	75,390	1027.8
1027.7	62,320	62,980	63,640	64,310	64,980	65,650	66,330	67,000	67,680	68,360	69,050	69,730	70,420	71,110	71,810	72,500	73,200	73,900	74,600	75,300	76,010	1027.7
1027.6	62,900	63,570	64,240	64,910	65,580	66,250	66,930	67,610	68,290	68,970	69,660	70,340	71,030	71,730	72,420	73,120	73,820	74,520	75,220	75,930	76,640	1027.6
1027.5	63,500	64,160	64,830	65,500	66,180	66,850	67,530	68,210	68,890	69,580	70,270	70,960	71,650	72,340	73,040	73,740	74,440	75,140	75,850	76,560	77,270	1027.5
1027.4	64,090	64,760	65,430	66,100	66,780	67,450	68,130	68,820	69,500	70,190	70,880	71,570	72,260	72,960	73,660	74,360	75,060	75,770	76,480	77,190	77,900	1027.4
1027.3	64,680	65,350	66,020	66,700	67,380	68,060	68,740	69,420	70,110	70,800	71,490	72,190	72,880	73,580	74,280	74,980	75,690	76,400	77,110	77,820	78,530	1027.3
1027.2	65,280	65,950	66,620	67,300	67,980	68,660	69,350	70,030	70,720	71,410	72,110	72,800	73,500	74,200	74,900	75,610	76,320	77,030	77,740	78,450	79,170	1027.2
1027.1	65,870	66,550	67,220	67,900	68,590	69,270	69,960	70,640	71,340	72,030	72,720	73,420	74,120	74,820	75,530	76,240	76,940	77,660	78,370	79,090	79,800	1027.1
1027.0	66,470	67,150	67,830	68,510	69,190	69,880	70,570	71,260	71,950	72,640	73,340	74,040	74,740	75,450	76,150	76,860	77,570	78,290	79,000	79,720	80,440	1027.0
1026.9	67,030	67,710	68,390	69,080	69,760	70,450	71,140	71,830	72,530	73,220	73,920	74,620	75,330	76,030	76,740	77,450	78,160	78,880	79,600	80,320	81,040	1026.9
1026.8	67,600	68,280	68,960	69,640	70,330	71,020	71,710	72,410	73,100	73,800	74,500	75,200	75,910	76,620	77,330	78,040	78,750	79,470	80,190	80,910	81,630	1026.8
1026.7	68,160	68,840	69,530	70,210	70,900	71,590	72,290	72,980	73,680	74,380	75,080	75,790	76,490	77,200	77,920	78,630	79,340	80,060	80,780	81,510	82,230	1026.7
1026.6	68,730	69,410	70,100	70,790	71,480	72,170	72,860	73,560	74,260	74,960	75,670	76,370	77,080	77,790	78,500	79,220	79,940	80,660	81,380	82,100	82,830	1026.6
1026.5	69,300	69,980	70,670	71,360	72,050	72,740	73,440	74,140	74,840	75,540	76,250	76,960	77,670	78,380	79,090	79,810	80,530	81,250	81,970	82,700	83,430	1026.5
1026.4	69,860	70,550	71,240	71,930	72,620	73,320	74,020	74,720	75,420	76,130	76,830	77,540	78,250	78,970	79,680	80,400	81,120	81,850	82,570	83,300	84,030	1026.4
1026.3	70,430	71,120	71,810	72,500	73,200	73,900	74,600	75,300	76,000	76,710	77,420	78,130	78,840	79,560	80,280	81,000	81,720	82,440	83,170	83,900	84,630	1026.3
1026.2	71,000	71,690	72,380	73,080	73,780	74,470	75,180	75,880	76,590	77,290	78,000	78,720	79,430	80,150	80,870	81,590	82,310	83,040	83,770	84,500	85,230	1026.2
1026.1	71,570	72,260	72,960	73,650	74,350	75,050	75,760	76,460	77,170	77,880	78,590	79,310	80,020	80,740	81,460	82,190	82,910	83,640	84,370	85,100	85,840	1026.1
1026.0	72,140	72,840	73,530	74,230	74,930	75,630	76,340	77,050	77,750	78,470	79,180	79,900	80,610	81,330	82,060	82,780	83,510	84,240	84,970	85,700	86,440	1026.0
1025.9	72,690	73,390	74,090	74,790	75,490	76,190	76,900	77,610	78,320	79,030	79,750	80,460	81,180	81,910	82,630	83,360	84,080	84,820	85,550	86,280	87,020	1025.9
1025.8	73,250	73,940	74,640	75,340	76,040	76,750	77,460	78,170	78,880	79,600	80,310	81,030	81,750	82,480	83,200	83,930	84,660	85,390	86,130	86,860	87,600	1025.8
1025.7	73,800	74,500	75,200	75,900	76,600	77,310	78,020	78,730	79,440	80,160	80,880	81,600	82,320	83,050	83,780	84,500	85,240	85,970	86,710	87,440	88,190	1025.7
1025.6	74,350	75,050	75,750	76,460	77,160	77,870	78,580	79,290	80,010	80,730	81,450	82,170	82,890	83,620	84,350	85,080	85,810	86,550	87,290	88,030	88,770	1025.6
1025.5	74,900	75,600	76,310	77,010	77,720	78,430	79,140	79,860	80,580	81,290	82,020	82,740	83,470	84,190	84,920	85,660	86,390	87,130	87,870	88,610	89,350	1025.5
1025.4	75,460	76,160	76,870	77,570	78,280	78,990	79,710	80,420	81,140	81,860	82,590	83,310	84,040	84,770	85,500	86,230	86,970	87,710	88,450	89,190	89,940	1025.4
1025.3	76,010	76,720	77,420	78,130	78,840	79,560	80,270	80,990	81,710	82,430	83,160	83,880	84,610	85,340	86,080	86,810	87,550	88,290	89,030	89,780	90,520	1025.3
1025.2	76,570	77,270	77,980	78,690	79,410	80,120	80,840	81,560	82,280	83,000	83,730	84,460	85,190	85,920	86,650	87,390	88,130	88,870	89,620	90,360	91,110	1025.2
1025.1	77,130	77,830	78,540	79,250	79,970	80,680	81,400	82,120	82,850	83,570	84,300	85,030	85,760	86,500	87,230	87,970	88,710	89,450	90,200	90,950	91,700	1025.1
1025.0	77,680	78,390	79,100	79,820	80,530	81,250	81,970	82,690	83,420	84,140	84,870	85,600	86,340	87,070	87,810	88,550	89,290	90,040	90,780	91,530	92,280	1025.0
1024.9	78,230	78,940	79,660	80,370	81,090	81,810	82,530	83,250	83,980	84,710	85,440	86,170	86,910	87,640	88,380	89,130	89,870	90,620	91,360	92,110	92,870	1024.9
1024.8	78,780	79,500	80,210	80,930	81,650	82,370	83,090	83,820	84,540	85,270	86,010	86,740	87,480	88,220	88,960	89,700	90,450	91,190	91,940	92,700	93,450	1024.8
1024.7	79,340	80,050	80,770	81,480	82,210	82,930	83,650	84,380	85,110	85,840	86,580	87,310	88,050	88,790	89,530	90,280	91,030	91,770	92,530	93,280	94,040	1024.7
1024.6	79,890	80,610	81,320	82,040	82,770	83,490	84,220	84,940	85,680	86,410	87,140	87,880	88,620	89,360	90,110	90,860	91,600	92,360	93,110	93,860	94,620	1024.6
1024.5	80,440	81,160	81,880	82,600	83,330	84,050	84,780	85,510	86,240	86,980	87,720	88,460	89,200	89,940	90,690	91,430	92,190	92,940	93,690	94,450	95,210	1024.5
1024.4	81,000	81,720	82,440	83,160	83,890	84,620	85,350	86,080	86,810	87,550	88,290	89,030	89,770	90,520	91,270	92,020	92,770	93,520	94,280	95,040	95,800	1024.4
1024.3	81,560	82,280	83,000	83,720	84,450	85,180	85,910	86,650	87,380	88,120	88,860	89,600	90,350	91,100	91,840	92,600	93,350	94,110	94,860	95,620	96,390	1024.3
1024.2	82,110	82,840	83,560	84,290	85,010	85,750	86,480	87,210	87,950	88,690	89,430	90,180	90,930	91,670	92,430	93,180	93,930	94,690	95,450	96,210	96,980	1024.2
1024.1	82,670	83,400	84,120	84,850	85,580	86,310	87,050	87,780	88,520	89,270	90,010	90,760	91,500	92,250	93,010	93,760	94,520	95,280	96,040	96,800	97,570	1024.1
1024.0	83,230	83,960	84,680	85,410	86,150	86,880	87,620	88,360	89,100	89,840	90,590	91,330	92,080	92,840	93,590	94,350	95,110	95,870	96,630	97,390	98,160	1024.0
1023.9	83,840	84,570	85,300	86,030	86,770	87,500	88,240	88,980	89,730	90,470	91,220	91,970	92,720	93,480	94,230	94,990	95,750	96,520	97,280	98,050	98,820	1023.9
1023.8	84,460	85,190	85,920	86,660	87,390	88,130	88,870	89,610	90,360	91,110	91,860	92,610	93,360	94,120	94,880	95,640	96,400	97,170	97,940	98,710	99,480	1023.8
1023.7	85,080	85,810	86,540	87,280	88,020	88,760	89,500	90,250	90,990	91,740	92,500	93,250	94,010	94,770	95,530	96,290	97,050	97,820	98,590	99,360	100,100	1023.7
1023.6	85,700	86,430	87,170	87,900	88,650	89,390	90,130	90,880	91,630	92,380	93,140	93,890	94,650	95,410	96,180	96,940	97,710	98,480	99,250	100,000	100,800	1023.6
1023.5	86,320	87,050	87,790	88,530	89,280	90,020	90,770	91,520	92,270	93,020	93,780	94,540	95,300	96,060	96,830	97,590	98,360	99,140	99,910	100,700	101,500	1023.5
1023.4	86,940	87,680	88,420	89,160	89,910	90,650	91,400	92,160	92,910	93,670	94,420	95,190	95,950	96,710	97,480	98,250	99,020	99,800	100,600	101,400	102,100	1023.4
1023.3	87,570	88,310	89,050	89,790	90,540	91,290	92,040	92,800	93,550	94,310	95,070	95,840	96,600	97,370	98,140	98,910	99,680	100,500	101,200	102,000	102,800	1023.3
1023.2	88,190	88,940	89,680	90,430	91,180	91,930	92,680	93,440	94,200	94,960	95,720	96,490	97,250	98,020	98,800	99,570	100,300	101,100	101,900	102,700	103,500	1023.2
1023.1	88,820	89,570	90,310	91,060	91,820	92,570	93,330	94,080	94,850	95,610	96,370	97,140	97,910	98,680	99,460	100,200	101,000	101,800	102,600	103,400	104,100	1023.1
1023.0	89,450	90,200	90,950	91,700	92,460	93,210	93,970	94,730	95,490	96,260	97,030	97,800	98,570	99,340	100,100	100,900	101,700	102,500	103,200	104,000	104,800	1023.0
1022.9	90,170	90,920	91,680	92,430	93,190	93,950	94,710	95,470	96,240	97,000	97,770	98,550	99,320	100,100	100,900	101,700	102,400	103,200	104,000	104,800	105,600	1022.9
1022.8	90,900	91,650	92,400	93,160	93,920	94,680	95,450	96,210	96,980	97,750	98,520	99,300	100,100	100,900	101,600	102,400	103,200	104,000	104,800	105,600	106,400	1022.8
1022.7	91,620	92,380	93,140	93,900	94,660	95,420	96,190	96,960	97,730	98,500	99,280	100,100	100,800	101,600	102,400	103,200	104,000	104,800	105,600	106,400	107,200	1022.7
1022.6	92,350	93,110	93,870	94,630	95,400	96,160	96,930	97,710	98,480	99,260	100,000	100,800	101,600	102,400	103,200	104,000	104,800	105,500	106,300	107,100	107,900	1022.6
1022.5	93,090	93,850	94,610	95,370	96,140	96,910	97,680	98,460	99,230	100,000	100,800	101,600	102,400	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	1022.5
1022.4	93,820	94,580	95,350	96,120	96,890	97,660	98,430	99,210	99,990	100,800	101,600	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	1022.4
1022.3	94,560	95,320	96,090	96,860	97,640	98,410	99,190	99,970	100,800	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	1022.3
1022.2	95,300	96,070	96,840	97,610	98,390	99,170	99,950	100,700	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	1022.2
1022.1	96,050	96,820	97,590	98,370	99,140	99,930	100,700	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1042.0	1042.1	1042.2	1042.3	1042.4	1042.5	1042.6	1042.7	1042.8	1042.9	1043.0	1043.1	1043.2	1043.3	1043.4	1043.5	1043.6	1043.7	1043.8	1043.9	1044.0	
1022.0	96,790	97,570	98,340	99,120	99,900	100,700	101,500	102,300	103,100	103,800	104,600	105,400	106,200	107,000	107,800	108,600	109,500	110,300	111,100	111,900	112,700	1022.0
1021.9	97,600	98,370	99,150	99,940	100,700	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,800	113,600	1021.9
1021.8	98,400	99,180	99,970	100,800	101,500	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,200	112,000	112,800	113,600	114,400	1021.8
1021.7	99,210	100,000	100,800	101,600	102,400	103,200	103,900	104,700	105,500	106,300	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,700	114,500	115,300	1021.7
1021.6	100,000	100,800	101,600	102,400	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,100	112,900	113,700	114,500	115,400	116,200	1021.6
1021.5	100,800	101,600	102,400	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,700	110,500	111,300	112,100	112,900	113,800	114,600	115,400	116,200	117,100	1021.5
1021.4	101,700	102,500	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,200	113,000	113,800	114,600	115,500	116,300	117,100	118,000	1021.4
1021.3	102,500	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,600	111,400	112,200	113,000	113,800	114,700	115,500	116,300	117,200	118,000	118,800	1021.3
1021.2	103,300	104,100	104,900	105,700	106,500	107,300	108,200	109,000	109,800	110,600	111,400	112,200	113,100	113,900	114,700	115,600	116,400	117,200	118,100	118,900	119,700	1021.2
1021.1	104,200	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,500	112,300	113,100	113,900	114,800	115,600	116,400	117,300	118,100	118,900	119,800	120,600	1021.1
1021.0	105,000	105,800	106,600	107,400	108,200	109,000	109,900	110,700	111,500	112,300	113,200	114,000	114,800	115,600	116,500	117,300	118,200	119,000	119,800	120,700	121,500	1021.0
1020.9	105,900	106,700	107,500	108,300	109,200	110,000	110,800	111,600	112,400	113,300	114,100	114,900	115,800	116,600	117,400	118,300	119,100	120,000	120,800	121,700	122,500	1020.9
1020.8	106,800	107,600	108,400	109,300	110,100	110,900	111,700	112,500	113,400	114,200	115,000	115,900	116,700	117,500	118,400	119,200	120,100	120,900	121,800	122,600	123,500	1020.8
1020.7	107,700	108,500	109,400	110,200	111,000	111,800	112,700	113,500	114,300	115,100	116,000	116,800	117,700	118,500	119,400	120,200	121,100	121,900	122,800	123,600	124,500	1020.7
1020.6	108,600	109,500	110,300	111,100	111,900	112,800	113,600	114,400	115,300	116,100	116,900	117,800	118,600	119,500	120,300	121,200	122,000	122,900	123,700	124,600	125,500	1020.6
1020.5	109,600	110,400	111,200	112,000	112,900	113,700	114,500	115,400	116,200	117,000	117,900	118,700	119,600	120,400	121,300	122,100	123,000	123,900	124,700	125,600	126,500	1020.5
1020.4	110,500	111,300	112,100	113,000	113,800	114,600	115,500	116,300	117,200	118,000	118,900	119,700	120,600	121,400	122,300	123,100	124,000	124,900	125,700	126,600	127,500	1020.4
1020.3	111,400	112,200	113,100	113,900	114,800	115,600	116,400	117,300	118,100	119,000	119,800	120,700	121,500	122,400	123,300	124,100	125,000	125,800	126,700	127,600	128,500	1020.3
1020.2	112,400	113,200	114,000	114,900	115,700	116,500	117,400	118,200	119,100	119,900	120,800	121,700	122,500	123,400	124,200	125,100	126,000	126,800	127,700	128,600	129,500	1020.2
1020.1	113,300	114,100	115,000	115,800	116,700	117,500	118,400	119,200	120,100	120,900	121,800	122,600	123,500	124,400	125,200	126,100	127,000	127,800	128,700	129,600	130,500	1020.1
1020.0	114,200	115,100	115,900	116,800	117,600	118,500	119,300	120,200	121,000	121,900	122,800	123,600	124,500	125,400	126,200	127,100	128,000	128,900	129,700	130,600	131,500	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1044.0	1044.1	1044.2	1044.3	1044.4	1044.5	1044.6	1044.7	1044.8	1044.9	1045.0	1045.1	1045.2	1045.3	1045.4	1045.5	1045.6	1045.7	1045.8	1045.9	1046.0	
1034.0	36,610	37,150	37,700	38,250	38,800	39,360	39,920	40,480	41,040	41,610	42,180	42,750	43,320	43,900	44,470	45,060	45,640	46,220	46,810	47,400	48,000	1034.0
1033.9	37,170	37,720	38,270	38,820	39,380	39,930	40,500	41,060	41,630	42,200	42,770	43,340	43,920	44,500	45,080	45,660	46,250	46,840	47,430	48,020	48,620	1033.9
1033.8	37,730	38,280	38,840	39,390	39,950	40,510	41,080	41,650	42,210	42,790	43,360	43,940	44,520	45,100	45,680	46,270	46,860	47,450	48,040	48,640	49,240	1033.8
1033.7	38,300	38,850	39,410	39,970	40,530	41,100	41,660	42,230	42,810	43,380	43,960	44,540	45,120	45,700	46,290	46,880	47,470	48,070	48,660	49,260	49,870	1033.7
1033.6	38,870	39,430	39,990	40,550	41,120	41,680	42,250	42,830	43,400	43,980	44,560	45,140	45,730	46,310	46,900	47,500	48,090	48,690	49,290	49,890	50,500	1033.6
1033.5	39,450	40,010	40,570	41,140	41,700	42,270	42,850	43,420	44,000	44,580	45,160	45,750	46,340	46,930	47,520	48,120	48,710	49,310	49,920	50,520	51,130	1033.5
1033.4	40,030	40,590	41,150	41,720	42,290	42,870	43,440	44,020	44,600	45,190	45,770	46,360	46,950	47,540	48,140	48,740	49,340	49,940	50,550	51,150	51,760	1033.4
1033.3	40,610	41,170	41,740	42,310	42,890	43,460	44,040	44,620	45,210	45,790	46,380	46,970	47,570	48,160	48,760	49,360	49,970	50,570	51,180	51,790	52,400	1033.3
1033.2	41,190	41,760	42,330	42,910	43,480	44,060	44,640	45,230	45,820	46,400	47,000	47,590	48,190	48,790	49,390	49,990	50,600	51,210	51,820	52,430	53,050	1033.2
1033.1	41,780	42,350	42,930	43,500	44,080	44,670	45,250	45,840	46,430	47,020	47,610	48,210	48,810	49,410	50,020	50,620	51,230	51,840	52,460	53,070	53,690	1033.1
1033.0	42,370	42,950	43,520	44,100	44,690	45,270	45,860	46,450	47,040	47,640	48,230	48,830	49,440	50,040	50,650	51,260	51,870	52,480	53,100	53,720	54,340	1033.0
1032.9	42,960	43,540	44,120	44,700	45,290	45,880	46,470	47,060	47,660	48,250	48,850	49,460	50,060	50,670	51,280	51,890	52,510	53,120	53,740	54,360	54,990	1032.9
1032.8	43,560	44,140	44,720	45,310	45,890	46,480	47,080	47,670	48,270	48,870	49,480	50,080	50,690	51,300	51,910	52,530	53,140	53,760	54,390	55,010	55,640	1032.8
1032.7	44,150	44,740	45,320	45,910	46,500	47,100	47,690	48,290	48,890	49,500	50,100	50,710	51,320	51,930	52,550	53,170	53,790	54,410	55,030	55,660	56,290	1032.7
1032.6	44,750	45,340	45,930	46,520	47,110	47,710	48,310	48,910	49,510	50,120	50,730	51,340	51,950	52,570	53,190	53,810	54,430	55,060	55,690	56,320	56,950	1032.6
1032.5	45,360	45,950	46,540	47,130	47,730	48,330	48,930	49,530	50,140	50,750	51,360	51,980	52,590	53,210	53,830	54,450	55,080	55,710	56,340	56,970	57,610	1032.5
1032.4	45,960	46,560	47,150	47,750	48,350	48,950	49,550	50,160	50,770	51,380	52,000	52,610	53,230	53,850	54,480	55,100	55,730	56,360	57,000	57,630	58,270	1032.4
1032.3	46,570	47,170	47,770	48,370	48,970	49,570	50,180	50,790	51,400	52,020	52,630	53,250	53,880	54,500	55,130	55,760	56,390	57,020	57,660	58,300	58,940	1032.3
1032.2	47,190	47,780	48,380	48,990	49,590	50,200	50,810	51,420	52,040	52,660	53,280	53,900	54,520	55,150	55,780	56,410	57,050	57,680	58,320	58,960	59,610	1032.2
1032.1	47,800	48,400	49,010	49,610	50,220	50,830	51,440	52,060	52,680	53,300	53,920	54,550	55,170	55,800	56,440	57,070	57,710	58,350	58,990	59,630	60,280	1032.1
1032.0	48,420	49,030	49,630	50,240	50,850	51,470	52,080	52,700	53,320	53,940	54,570	55,200	55,830	56,460	57,090	57,730	58,370	59,010	59,660	60,300	60,950	1032.0
1031.9	49,040	49,640	50,250	50,860	51,480	52,090	52,710	53,330	53,960	54,580	55,210	55,840	56,470	57,110	57,750	58,390	59,030	59,670	60,320	60,970	61,620	1031.9
1031.8	49,650	50,260	50,870	51,490	52,100	52,720	53,350	53,970	54,600	55,220	55,850	56,490	57,120	57,760	58,400	59,040	59,690	60,340	60,990	61,640	62,290	1031.8
1031.7	50,270	50,890	51,500	52,120	52,740	53,360	53,980	54,610	55,240	55,870	56,500	57,140	57,780	58,420	59,060	59,710	60,350	61,000	61,650	62,310	62,970	1031.7
1031.6	50,900	51,510	52,130	52,750	53,370	53,990	54,620	55,250	55,880	56,520	57,150	57,790	58,430	59,080	59,720	60,370	61,020	61,670	62,330	62,980	63,640	1031.6
1031.5	51,520	52,140	52,760	53,380	54,010	54,630	55,260	55,900	56,530	57,170	57,810	58,450	59,090	59,740	60,380	61,040	61,690	62,340	63,000	63,660	64,320	1031.5
1031.4	52,150	52,770	53,390	54,020	54,650	55,280	55,910	56,540	57,180	57,820	58,460	59,110	59,750	60,400	61,050	61,710	62,360	63,020	63,680	64,340	65,010	1031.4
1031.3	52,780	53,410	54,030	54,660	55,290	55,920	56,560	57,200	57,830	58,480	59,120	59,770	60,420	61,070	61,720	62,380	63,040	63,700	64,360	65,030	65,690	1031.3
1031.2	53,420	54,050	54,670	55,300	55,940	56,570	57,210	57,850	58,490	59,140	59,780	60,430	61,090	61,740	62,400	63,050	63,720	64,380	65,040	65,710	66,380	1031.2
1031.1	54,060	54,690	55,320	55,950	56,590	57,220	57,860	58,510	59,150	59,800	60,450	61,100	61,760	62,410	63,070	63,730	64,400	65,060	65,730	66,400	67,070	1031.1
1031.0	54,700	55,330	55,960	56,600	57,240	57,880	58,520	59,170	59,820	60,470	61,120	61,770	62,430	63,090	63,750	64,410	65,080	65,750	66,420	67,090	67,770	1031.0
1030.9	55,320	55,960	56,590	57,230	57,870	58,520	59,160	59,810	60,460	61,110	61,770	62,420	63,080	63,750	64,410	65,080	65,740	66,420	67,090	67,760	68,440	1030.9
1030.8	55,950	56,590	57,230	57,870	58,510	59,160	59,800	60,450	61,110	61,760	62,420	63,080	63,740	64,400	65,070	65,740	66,410	67,080	67,760	68,440	69,120	1030.8
1030.7	56,580	57,220	57,860	58,500	59,150	59,800	60,450	61,100	61,760	62,410	63,070	63,740	64,400	65,070	65,740	66,410	67,080	67,760	68,430	69,110	69,800	1030.7
1030.6	57,210	57,850	58,500	59,140	59,790	60,440	61,090	61,750	62,410	63,070	63,730	64,390	65,060	65,730	66,400	67,080	67,750	68,430	69,110	69,790	70,480	1030.6
1030.5	57,850	58,490	59,140	59,780	60,440	61,090	61,740	62,400	63,060	63,720	64,390	65,060	65,730	66,400	67,070	67,750	68,430	69,110	69,790	70,470	71,160	1030.5
1030.4	58,480	59,130	59,780	60,430	61,080	61,740	62,400	63,060	63,720	64,380	65,050	65,720	66,390	67,070	67,740	68,420	69,100	69,780	70,470	71,160	71,850	1030.4
1030.3	59,120	59,770	60,420	61,080	61,730	62,390	63,050	63,710	64,380	65,050	65,720	66,390	67,060	67,740	68,420	69,100	69,780	70,470	71,160	71,850	72,540	1030.3
1030.2	59,770	60,420	61,070	61,730	62,390	63,050	63,710	64,370	65,040	65,710	66,380	67,060	67,740	68,410	69,100	69,780	70,460	71,150	71,840	72,530	73,230	1030.2
1030.1	60,410	61,070	61,720	62,380	63,040	63,700	64,370	65,040	65,710	66,380	67,050	67,730	68,410	69,090	69,780	70,460	71,150	71,840	72,530	73,230	73,920	1030.1
1030.0	61,060	61,720	62,370	63,040	63,700	64,360	65,030	65,700	66,370	67,050	67,730	68,410	69,090	69,770	70,460	71,150	71,840	72,530	73,220	73,920	74,620	1030.0
1029.9	61,700	62,360	63,020	63,690	64,350	65,020	65,690	66,360	67,040	67,710	68,390	69,080	69,760	70,450	71,130	71,830	72,520	73,210	73,910	74,610	75,310	1029.9
1029.8	62,350	63,010	63,670	64,340	65,010	65,680	66,350	67,030	67,700	68,380	69,060	69,750	70,430	71,120	71,810	72,510	73,200	73,900	74,600	75,300	76,010	1029.8
1029.7	63,000	63,660	64,330	64,990	65,670	66,340	67,010	67,690	68,370	69,050	69,740	70,420	71,110	71,800	72,500	73,190	73,890	74,590	75,290	76,000	76,700	1029.7
1029.6	63,650	64,310	64,980	65,650	66,330	67,000	67,680	68,360	69,040	69,730	70,410	71,100	71,790	72,490	73,180	73,880	74,580	75,280	75,990	76,690	77,400	1029.6
1029.5	64,300	64,970	65,640	66,310	66,990	67,670	68,350	69,030	69,710	70,400	71,090	71,780	72,470	73,170	73,870	74,570	75,270	75,980	76,680	77,390	78,100	1029.5
1029.4	64,960	65,630	66,300	66,980	67,660	68,340	69,020	69,700	70,390	71,080	71,770	72,460	73,160	73,860	74,560	75,260	75,970	76,670	77,380	78,090	78,810	1029.4
1029.3	65,620	66,290	66,960	67,640	68,320	69,010	69,690	70,380	71,070	71,760	72,450	73,150	73,850	74,550	75,250	75,960	76,660	77,370	78,090	78,800	79,520	1029.3
1029.2	66,280	66,950	67,630	68,310	68,990	69,680	70,370	71,060	71,750	72,440	73,140	73,840	74,540	75,240	75,950	76,650	77,360	78,080	78,790	79,510	80,220	1029.2
1029.1	66,940	67,620	68,300	68,980	69,670	70,360	71,050	71,740	72,430	73,130	73,830	74,530	75,230	75,940	76,640	77,350	78,070	78,780	79,500	80,220	80,940	1029.1
1029.0	67,610	68,290	68,970	69,660	70,340	71,030	71,730	72,420	73,120	73,820	74,520	75,220	75,930	76,630	77,340	78,060	78,770	79,490	80,210	80,930	81,650	1029.0
1028.9	68,250	68,930	69,620	70,310	71,000	71,690	72,380	73,080	73,780	74,480	75,180	75,890	76,600	77,310	78,020	78,730	79,450	80,170	80,890	81,610	82,340	1028.9
1028.8	68,900	69,580	70,270	70,960	71,650	72,340	73,040	73,740	74,440	75,150	75,850	76,560	77,270	77,980	78,700	79,410	80,130	80,850	81,570	82,300	83,030	1028.8
1028.7	69,540	70,230	70,920	71,610	72,310	73,000	73,700	74,400	75,110	75,810	76,520	77,230	77,940	78,660	79,370	80,090	80,810	81,540	82,260	82,990	83,720	1028.7
1028.6	70,190	70,880	71,570	72,270	72,970	73,660	74,370	75,070	75,770	76,480	77,190	77,900	78,620	79,340	80,050	80,780	81,500	82,220	82,950	83,680	84,410	1028.6
1028.5	70,840	71,540	72,230	72,930	73,630	74,330	75,030	75,740	76,440	77,150	77,870	78,580	79,300	80,020	80,740	81,460	82,190	82,910	83,640	84,370	85,110	1028.5
1028.4	71,500	72,190	72,890	73,590	74,290	74,990	75,700	76,410	77,120	77,830	78,540	79,260	79,980	80,700	81,420	82,150	82,870	83,600	84,340	85,070	85,810	1028.4
1028.3	72,160	72,850	73,550	74,250	74,950	75,660	76,370	77,080	77,790	78,500	79,220	79,940	80,660	81,380	82,110	82,840	83,570	84,300	85,030	85,770	86,510	1028.3
1028.2	72,810	73,510	74,210	74,920	75,620	76,330	77,040	77,750	78,470	79,180	79,900	80,620	81,350	82,070	82,800	83,530	84,260	84,990	85,730	86,470	87,210	1028.2
1028.1	73,470	74,170	74,880	75,580	76,290	77,000	77,710	78,430	79,140	79,860	80,580	81,310	82,030	82,760	83,490	84,220	84,960	85,690	86,430	87,170	87,910	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1044.0	1044.1	1044.2	1044.3	1044.4	1044.5	1044.6	1044.7	1044.8	1044.9	1045.0	1045.1	1045.2	1045.3	1045.4	1045.5	1045.6	1045.7	1045.8	1045.9	1046.0	
1028.0	74,140	74,840	75,550	76,250	76,960	77,670	78,390	79,110	79,820	80,550	81,270	81,990	82,720	83,450	84,180	84,920	85,650	86,390	87,130	87,870	88,620	1028.0
1027.9	74,760	75,470	76,170	76,880	77,590	78,310	79,020	79,740	80,460	81,190	81,910	82,640	83,370	84,100	84,830	85,570	86,310	87,050	87,790	88,530	89,280	1027.9
1027.8	75,390	76,090	76,800	77,510	78,230	78,940	79,660	80,380	81,100	81,830	82,550	83,280	84,020	84,750	85,480	86,220	86,960	87,700	88,450	89,190	89,940	1027.8
1027.7	76,010	76,720	77,430	78,140	78,860	79,580	80,300	81,020	81,740	82,470	83,200	83,930	84,660	85,400	86,140	86,880	87,620	88,360	89,110	89,860	90,610	1027.7
1027.6	76,640	77,350	78,060	78,780	79,500	80,220	80,940	81,660	82,390	83,120	83,850	84,580	85,320	86,050	86,790	87,530	88,280	89,020	89,770	90,520	91,270	1027.6
1027.5	77,270	77,980	78,700	79,410	80,130	80,850	81,580	82,300	83,030	83,760	84,500	85,230	85,970	86,710	87,450	88,190	88,940	89,680	90,430	91,190	91,940	1027.5
1027.4	77,900	78,620	79,330	80,050	80,770	81,500	82,220	82,950	83,680	84,410	85,150	85,880	86,620	87,360	88,110	88,850	89,600	90,350	91,100	91,850	92,610	1027.4
1027.3	78,530	79,250	79,970	80,690	81,410	82,140	82,870	83,600	84,330	85,060	85,800	86,540	87,280	88,020	88,760	89,510	90,260	91,010	91,770	92,520	93,280	1027.3
1027.2	79,170	79,890	80,610	81,330	82,050	82,780	83,510	84,240	84,980	85,710	86,450	87,190	87,930	88,680	89,430	90,170	90,930	91,680	92,430	93,190	93,950	1027.2
1027.1	79,800	80,520	81,250	81,970	82,700	83,430	84,160	84,890	85,630	86,370	87,110	87,850	88,590	89,340	90,090	90,840	91,590	92,350	93,100	93,860	94,630	1027.1
1027.0	80,440	81,160	81,890	82,610	83,340	84,070	84,810	85,540	86,280	87,020	87,760	88,510	89,250	90,000	90,750	91,510	92,260	93,020	93,780	94,540	95,300	1027.0
1026.9	81,040	81,760	82,490	83,220	83,950	84,680	85,410	86,150	86,890	87,630	88,370	89,120	89,870	90,620	91,370	92,120	92,880	93,640	94,400	95,160	95,930	1026.9
1026.8	81,630	82,360	83,090	83,820	84,550	85,280	86,020	86,760	87,500	88,240	88,990	89,730	90,480	91,230	91,990	92,740	93,500	94,260	95,020	95,790	96,560	1026.8
1026.7	82,230	82,960	83,690	84,420	85,150	85,890	86,630	87,370	88,110	88,850	89,600	90,350	91,100	91,850	92,610	93,370	94,130	94,890	95,650	96,420	97,180	1026.7
1026.6	82,830	83,560	84,290	85,020	85,760	86,490	87,230	87,980	88,720	89,470	90,210	90,960	91,720	92,470	93,230	93,990	94,750	95,510	96,280	97,040	97,810	1026.6
1026.5	83,430	84,160	84,890	85,630	86,360	87,100	87,840	88,590	89,330	90,080	90,830	91,580	92,340	93,090	93,850	94,610	95,370	96,140	96,910	97,670	98,450	1026.5
1026.4	84,030	84,760	85,500	86,230	86,970	87,710	88,450	89,200	89,950	90,690	91,450	92,200	92,960	93,710	94,470	95,230	96,000	96,770	97,530	98,300	99,080	1026.4
1026.3	84,630	85,360	86,100	86,840	87,580	88,320	89,060	89,810	90,560	91,310	92,060	92,820	93,580	94,330	95,100	95,860	96,630	97,390	98,160	98,940	99,710	1026.3
1026.2	85,230	85,970	86,710	87,440	88,190	88,930	89,680	90,420	91,170	91,930	92,680	93,440	94,200	94,960	95,720	96,490	97,250	98,020	98,790	99,570	100,300	1026.2
1026.1	85,840	86,570	87,310	88,050	88,800	89,540	90,290	91,040	91,790	92,540	93,300	94,060	94,820	95,580	96,350	97,110	97,880	98,650	99,430	100,200	101,000	1026.1
1026.0	86,440	87,180	87,920	88,660	89,410	90,150	90,900	91,650	92,410	93,160	93,920	94,680	95,440	96,210	96,970	97,740	98,510	99,280	100,100	100,800	101,600	1026.0
1025.9	87,020	87,760	88,500	89,250	89,990	90,740	91,490	92,250	93,000	93,760	94,520	95,280	96,040	96,810	97,570	98,340	99,120	99,890	100,700	101,400	102,200	1025.9
1025.8	87,600	88,340	89,090	89,830	90,580	91,330	92,080	92,840	93,590	94,350	95,110	95,880	96,640	97,410	98,180	98,950	99,720	100,500	101,300	102,100	102,800	1025.8
1025.7	88,190	88,930	89,670	90,420	91,170	91,920	92,670	93,430	94,190	94,950	95,710	96,470	97,240	98,010	98,780	99,550	100,300	101,100	101,900	102,700	103,400	1025.7
1025.6	88,770	89,510	90,260	91,010	91,760	92,510	93,270	94,020	94,780	95,540	96,310	97,070	97,840	98,610	99,380	100,200	100,900	101,700	102,500	103,300	104,100	1025.6
1025.5	89,350	90,100	90,850	91,600	92,350	93,100	93,860	94,620	95,380	96,140	96,910	97,670	98,440	99,210	99,990	100,800	101,500	102,300	103,100	103,900	104,700	1025.5
1025.4	89,940	90,680	91,430	92,190	92,940	93,690	94,450	95,210	95,980	96,740	97,510	98,270	99,050	99,820	100,600	101,400	102,200	102,900	103,700	104,500	105,300	1025.4
1025.3	90,520	91,270	92,020	92,780	93,530	94,290	95,050	95,810	96,570	97,340	98,110	98,880	99,650	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	1025.3
1025.2	91,110	91,860	92,610	93,370	94,120	94,880	95,640	96,410	97,170	97,940	98,710	99,480	100,300	101,000	101,800	102,600	103,400	104,200	104,900	105,700	106,500	1025.2
1025.1	91,700	92,450	93,200	93,960	94,720	95,480	96,240	97,000	97,770	98,540	99,310	100,100	100,900	101,600	102,400	103,200	104,000	104,800	105,600	106,300	107,100	1025.1
1025.0	92,280	93,040	93,790	94,550	95,310	96,070	96,840	97,600	98,370	99,140	99,910	100,700	101,500	102,200	103,000	103,800	104,600	105,400	106,200	107,000	107,800	1025.0
1024.9	92,870	93,620	94,380	95,140	95,900	96,660	97,430	98,200	98,970	99,740	100,500	101,300	102,100	102,800	103,600	104,400	105,200	106,000	106,800	107,600	108,400	1024.9
1024.8	93,450	94,210	94,970	95,730	96,490	97,250	98,020	98,790	99,560	100,300	101,100	101,900	102,700	103,500	104,200	105,000	105,800	106,600	107,400	108,200	109,000	1024.8
1024.7	94,040	94,790	95,550	96,320	97,080	97,850	98,620	99,390	100,200	100,900	101,700	102,500	103,300	104,100	104,800	105,600	106,400	107,200	108,000	108,800	109,600	1024.7
1024.6	94,620	95,380	96,140	96,910	97,670	98,440	99,210	99,990	100,800	101,500	102,300	103,100	103,900	104,700	105,500	106,200	107,000	107,800	108,600	109,400	110,200	1024.6
1024.5	95,210	95,970	96,730	97,500	98,270	99,040	99,810	100,600	101,400	102,100	102,900	103,700	104,500	105,300	106,100	106,900	107,600	108,400	109,200	110,000	110,800	1024.5
1024.4	95,800	96,560	97,330	98,090	98,860	99,630	100,400	101,200	102,000	102,700	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	1024.4
1024.3	96,390	97,150	97,920	98,690	99,460	100,200	101,000	101,800	102,600	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	1024.3
1024.2	96,980	97,740	98,510	99,280	100,100	100,800	101,600	102,400	103,200	104,000	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	1024.2
1024.1	97,570	98,340	99,110	99,880	100,700	101,400	102,200	103,000	103,800	104,600	105,300	106,100	106,900	107,700	108,500	109,300	110,100	110,900	111,700	112,500	113,300	1024.1
1024.0	98,160	98,930	99,700	100,500	101,300	102,000	102,800	103,600	104,400	105,200	106,000	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,200	114,000	1024.0
1023.9	98,820	99,590	100,400	101,100	101,900	102,700	103,500	104,300	105,100	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,900	114,700	1023.9
1023.8	99,480	100,300	101,000	101,800	102,600	103,400	104,200	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,600	115,400	1023.8
1023.7	100,100	100,900	101,700	102,500	103,300	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,300	116,100	1023.7
1023.6	100,800	101,600	102,400	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	113,500	114,300	115,100	116,000	116,800	1023.6
1023.5	101,500	102,200	103,000	103,800	104,600	105,400	106,200	107,000	107,800	108,600	109,400	110,200	111,000	111,800	112,600	113,400	114,200	115,000	115,800	116,700	117,500	1023.5
1023.4	102,100	102,900	103,700	104,500	105,300	106,100	106,900	107,700	108,500	109,300	110,100	110,900	111,700	112,500	113,300	114,100	114,900	115,700	116,600	117,400	118,200	1023.4
1023.3	102,800	103,600	104,400	105,200	106,000	106,800	107,500	108,300	109,100	109,900	110,800	111,600	112,400	113,200	114,000	114,800	115,600	116,400	117,300	118,100	118,900	1023.3
1023.2	103,500	104,300	105,100	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	1023.2
1023.1	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	113,000	113,800	114,600	115,400	116,200	117,000	117,900	118,700	119,500	120,400	1023.1
1023.0	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,700	114,500	115,300	116,100	116,900	117,800	118,600	119,400	120,200	121,100	1023.0
1022.9	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,500	115,300	116,100	116,900	117,700	118,600	119,400	120,200	121,100	121,900	1022.9
1022.8	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,300	116,100	116,900	117,700	118,600	119,400	120,200	121,100	121,900	122,700	1022.8
1022.7	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,300	116,100	116,900	117,700	118,600	119,400	120,200	121,100	121,900	122,700	123,600	1022.7
1022.6	107,900	108,700	109,500	110,400	111,200	112,000	112,800	113,600	114,400	115,200	116,100	116,900	117,700	118,500	119,400	120,200	121,000	121,900	122,700	123,600	124,400	1022.6
1022.5	108,700	109,500	110,300	111,100	112,000	112,800	113,600	114,400	115,200	116,100	116,900	117,700	118,500	119,400	120,200	121,000	121,900	122,700	123,600	124,400	125,300	1022.5
1022.4	109,500	110,300	111,100	111,900	112,800	113,600	114,400	115,200	116,000	116,900	117,700	118,500	119,400	120,200	121,000	121,900	122,700	123,600	124,400	125,200	126,100	1022.4
1022.3	110,300	111,100	111,900	112,700	113,600	114,400	115,200	116,000	116,900	117,700	118,500	119,300	120,200	121,000	121,900	122,700	123,500	124,400	125,200	126,100	126,900	1022.3
1022.2	111,100	111,900	112,700	113,600	114,400	115,200	116,000	116,800	117,700	118,500	119,300	120,200	121,000	121,900	122,700	123,500	124,400	125,200	126,100	126,900	127,800	1022.2
1022.1	111,900	112,700	113,500	114,400	115,200	116,000	116,800	117,700	118,500	119,300	120,200	121,000	121,900	122,700	123,500	124,400	125,200	126,100	126,900	127,800	128,700	1022.1

NORRIS DAM
DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS
IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1044.0	1044.1	1044.2	1044.3	1044.4	1044.5	1044.6	1044.7	1044.8	1044.9	1045.0	1045.1	1045.2	1045.3	1045.4	1045.5	1045.6	1045.7	1045.8	1045.9	1046.0	
1022.0	112, 700	113, 500	114, 300	115, 200	116, 000	116, 800	117, 700	118, 500	119, 300	120, 200	121, 000	121, 800	122, 700	123, 500	124, 400	125, 200	126, 100	126, 900	127, 800	128, 700	129, 500	1022.0
1021.9	113, 600	114, 400	115, 200	116, 000	116, 900	117, 700	118, 500	119, 400	120, 200	121, 100	121, 900	122, 700	123, 600	124, 400	125, 300	126, 100	127, 000	127, 900	128, 700	129, 600	130, 400	1021.9
1021.8	114, 400	115, 300	116, 100	116, 900	117, 800	118, 600	119, 400	120, 300	121, 100	122, 000	122, 800	123, 600	124, 500	125, 300	126, 200	127, 100	127, 900	128, 800	129, 600	130, 500	131, 400	1021.8
1021.7	115, 300	116, 100	117, 000	117, 800	118, 600	119, 500	120, 300	121, 200	122, 000	122, 900	123, 700	124, 600	125, 400	126, 300	127, 100	128, 000	128, 800	129, 700	130, 600	131, 400	132, 300	1021.7
1021.6	116, 200	117, 000	117, 900	118, 700	119, 500	120, 400	121, 200	122, 100	122, 900	123, 800	124, 600	125, 500	126, 300	127, 200	128, 000	128, 900	129, 800	130, 600	131, 500	132, 400	133, 200	1021.6
1021.5	117, 100	117, 900	118, 700	119, 600	120, 400	121, 300	122, 100	123, 000	123, 800	124, 700	125, 500	126, 400	127, 200	128, 100	129, 000	129, 800	130, 700	131, 600	132, 400	133, 300	134, 200	1021.5
1021.4	118, 000	118, 800	119, 600	120, 500	121, 300	122, 200	123, 000	123, 900	124, 700	125, 600	126, 400	127, 300	128, 200	129, 000	129, 900	130, 800	131, 600	132, 500	133, 400	134, 300	135, 100	1021.4
1021.3	118, 800	119, 700	120, 500	121, 400	122, 200	123, 100	123, 900	124, 800	125, 600	126, 500	127, 400	128, 200	129, 100	130, 000	130, 800	131, 700	132, 600	133, 500	134, 300	135, 200	136, 100	1021.3
1021.2	119, 700	120, 600	121, 400	122, 300	123, 100	124, 000	124, 800	125, 700	126, 600	127, 400	128, 300	129, 200	130, 000	130, 900	131, 800	132, 600	133, 500	134, 400	135, 300	136, 200	137, 100	1021.2
1021.1	120, 600	121, 500	122, 300	123, 200	124, 000	124, 900	125, 800	126, 600	127, 500	128, 300	129, 200	130, 100	131, 000	131, 800	132, 700	133, 600	134, 500	135, 400	136, 200	137, 100	138, 000	1021.1
1021.0	121, 500	122, 400	123, 200	124, 100	125, 000	125, 800	126, 700	127, 500	128, 400	129, 300	130, 100	131, 000	131, 900	132, 800	133, 700	134, 500	135, 400	136, 300	137, 200	138, 100	139, 000	1021.0
1020.9	122, 500	123, 400	124, 200	125, 100	125, 900	126, 800	127, 700	128, 500	129, 400	130, 300	131, 200	132, 000	132, 900	133, 800	134, 700	135, 600	136, 500	137, 300	138, 200	139, 100	140, 000	1020.9
1020.8	123, 500	124, 400	125, 200	126, 100	126, 900	127, 800	128, 700	129, 500	130, 400	131, 300	132, 200	133, 100	133, 900	134, 800	135, 700	136, 600	137, 500	138, 400	139, 300	140, 200	141, 100	1020.8
1020.7	124, 500	125, 300	126, 200	127, 100	127, 900	128, 800	129, 700	130, 600	131, 400	132, 300	133, 200	134, 100	135, 000	135, 900	136, 700	137, 600	138, 500	139, 400	140, 300	141, 200	142, 100	1020.7
1020.6	125, 500	126, 300	127, 200	128, 100	128, 900	129, 800	130, 700	131, 600	132, 500	133, 300	134, 200	135, 100	136, 000	136, 900	137, 800	138, 700	139, 600	140, 500	141, 400	142, 300	143, 200	1020.6
1020.5	126, 500	127, 300	128, 200	129, 100	129, 900	130, 800	131, 700	132, 600	133, 500	134, 400	135, 200	136, 100	137, 000	137, 900	138, 800	139, 700	140, 600	141, 500	142, 400	143, 400	144, 300	1020.5
1020.4	127, 500	128, 300	129, 200	130, 100	131, 000	131, 800	132, 700	133, 600	134, 500	135, 400	136, 300	137, 200	138, 100	139, 000	139, 900	140, 800	141, 700	142, 600	143, 500	144, 400	145, 300	1020.4
1020.3	128, 500	129, 300	130, 200	131, 100	132, 000	132, 900	133, 800	134, 600	135, 500	136, 400	137, 300	138, 200	139, 100	140, 000	140, 900	141, 800	142, 800	143, 700	144, 600	145, 500	146, 400	1020.3
1020.2	129, 500	130, 300	131, 200	132, 100	133, 000	133, 900	134, 800	135, 700	136, 600	137, 500	138, 400	139, 300	140, 200	141, 100	142, 000	142, 900	143, 800	144, 700	145, 700	146, 600	147, 500	1020.2
1020.1	130, 500	131, 400	132, 300	133, 100	134, 000	134, 900	135, 800	136, 700	137, 600	138, 500	139, 400	140, 300	141, 200	142, 100	143, 100	144, 000	144, 900	145, 800	146, 700	147, 700	148, 600	1020.1
1020.0	131, 500	132, 400	133, 300	134, 200	135, 100	136, 000	136, 900	137, 800	138, 700	139, 600	140, 500	141, 400	142, 300	143, 200	144, 100	145, 000	146, 000	146, 900	147, 800	148, 700	149, 700	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1046.0	1046.1	1046.2	1046.3	1046.4	1046.5	1046.6	1046.7	1046.8	1046.9	1047.0	1047.1	1047.2	1047.3	1047.4	1047.5	1047.6	1047.7	1047.8	1047.9	1048.0	
1034.0	48,000	48,590	49,190	49,790	50,390	51,000	51,610	52,220	52,830	53,440	54,060	54,680	55,300	55,920	56,550	57,180	57,810	58,440	59,080	59,710	60,350	1034.0
1033.9	48,620	49,210	49,820	50,420	51,020	51,630	52,240	52,860	53,470	54,090	54,710	55,330	55,950	56,580	57,210	57,840	58,470	59,110	59,750	60,390	61,030	1033.9
1033.8	49,240	49,840	50,440	51,050	51,660	52,270	52,880	53,500	54,120	54,740	55,360	55,980	56,610	57,240	57,870	58,500	59,140	59,780	60,420	61,060	61,710	1033.8
1033.7	49,870	50,470	51,080	51,690	52,300	52,910	53,530	54,140	54,760	55,390	56,010	56,640	57,270	57,900	58,540	59,170	59,810	60,450	61,090	61,740	62,390	1033.7
1033.6	50,500	51,100	51,710	52,320	52,940	53,550	54,170	54,790	55,420	56,040	56,670	57,300	57,930	58,570	59,200	59,840	60,480	61,130	61,770	62,420	63,070	1033.6
1033.5	51,130	51,740	52,350	52,960	53,580	54,200	54,820	55,450	56,070	56,700	57,330	57,960	58,600	59,240	59,880	60,520	61,160	61,810	62,460	63,110	63,760	1033.5
1033.4	51,760	52,380	52,990	53,610	54,230	54,850	55,470	56,100	56,730	57,360	57,990	58,630	59,270	59,910	60,550	61,190	61,840	62,490	63,140	63,800	64,450	1033.4
1033.3	52,400	53,020	53,640	54,260	54,880	55,500	56,130	56,760	57,390	58,020	58,660	59,300	59,940	60,580	61,230	61,880	62,530	63,180	63,830	64,490	65,150	1033.3
1033.2	53,050	53,660	54,280	54,910	55,530	56,160	56,790	57,420	58,060	58,690	59,330	59,970	60,620	61,260	61,910	62,560	63,210	63,870	64,520	65,180	65,840	1033.2
1033.1	53,690	54,310	54,940	55,560	56,190	56,820	57,450	58,090	58,720	59,360	60,010	60,650	61,300	61,940	62,590	63,250	63,900	64,560	65,220	65,880	66,540	1033.1
1033.0	54,340	54,960	55,590	56,220	56,850	57,480	58,120	58,760	59,400	60,040	60,680	61,330	61,980	62,630	63,280	63,940	64,600	65,260	65,920	66,580	67,250	1033.0
1032.9	54,990	55,610	56,240	56,870	57,510	58,140	58,780	59,420	60,060	60,710	61,360	62,010	62,660	63,310	63,970	64,630	65,290	65,950	66,610	67,280	67,950	1032.9
1032.8	55,640	56,270	56,900	57,530	58,170	58,810	59,450	60,090	60,740	61,380	62,030	62,690	63,340	64,000	64,660	65,320	65,980	66,640	67,310	67,980	68,650	1032.8
1032.7	56,290	56,920	57,560	58,190	58,830	59,470	60,120	60,760	61,410	62,060	62,710	63,370	64,030	64,690	65,350	66,010	66,680	67,340	68,010	68,690	69,360	1032.7
1032.6	56,950	57,580	58,220	58,860	59,500	60,140	60,790	61,440	62,090	62,740	63,400	64,060	64,710	65,380	66,040	66,710	67,380	68,050	68,720	69,390	70,070	1032.6
1032.5	57,610	58,240	58,880	59,530	60,170	60,820	61,470	62,120	62,770	63,430	64,080	64,740	65,410	66,070	66,740	67,410	68,080	68,750	69,430	70,110	70,790	1032.5
1032.4	58,270	58,910	59,550	60,200	60,840	61,490	62,150	62,800	63,460	64,110	64,770	65,440	66,100	66,770	67,440	68,110	68,780	69,460	70,140	70,820	71,500	1032.4
1032.3	58,940	59,580	60,220	60,870	61,520	62,170	62,830	63,480	64,140	64,800	65,470	66,130	66,800	67,470	68,140	68,820	69,490	70,170	70,850	71,540	72,220	1032.3
1032.2	59,610	60,250	60,900	61,550	62,200	62,860	63,510	64,170	64,830	65,500	66,160	66,830	67,500	68,180	68,850	69,530	70,210	70,890	71,570	72,260	72,950	1032.2
1032.1	60,280	60,930	61,580	62,230	62,890	63,540	64,200	64,860	65,530	66,200	66,860	67,530	68,210	68,880	69,560	70,240	70,920	71,610	72,290	72,980	73,670	1032.1
1032.0	60,950	61,600	62,260	62,910	63,570	64,230	64,890	65,560	66,230	66,900	67,570	68,240	68,920	69,590	70,270	70,960	71,640	72,330	73,020	73,710	74,400	1032.0
1031.9	61,620	62,280	62,930	63,590	64,250	64,910	65,580	66,250	66,920	67,590	68,260	68,940	69,620	70,300	70,980	71,660	72,350	73,040	73,730	74,430	75,120	1031.9
1031.8	62,290	62,950	63,610	64,270	64,930	65,600	66,260	66,930	67,610	68,280	68,960	69,640	70,320	71,000	71,690	72,370	73,060	73,760	74,450	75,150	75,840	1031.8
1031.7	62,970	63,630	64,290	64,950	65,620	66,280	66,950	67,630	68,300	68,980	69,660	70,340	71,020	71,710	72,400	73,090	73,780	74,470	75,170	75,870	76,570	1031.7
1031.6	63,640	64,310	64,970	65,640	66,300	66,970	67,650	68,320	69,000	69,680	70,360	71,050	71,730	72,420	73,110	73,800	74,500	75,200	75,890	76,600	77,300	1031.6
1031.5	64,320	64,990	65,650	66,320	66,990	67,670	68,340	69,020	69,700	70,380	71,070	71,750	72,440	73,130	73,830	74,520	75,220	75,920	76,620	77,330	78,030	1031.5
1031.4	65,010	65,670	66,340	67,010	67,690	68,360	69,040	69,720	70,410	71,090	71,780	72,470	73,160	73,850	74,550	75,240	75,940	76,650	77,350	78,060	78,770	1031.4
1031.3	65,690	66,360	67,030	67,710	68,380	69,060	69,740	70,430	71,110	71,800	72,490	73,180	73,870	74,570	75,270	75,970	76,670	77,380	78,080	78,790	79,500	1031.3
1031.2	66,380	67,050	67,730	68,410	69,080	69,770	70,450	71,130	71,820	72,510	73,200	73,900	74,600	75,290	75,990	76,700	77,400	78,110	78,820	79,530	80,250	1031.2
1031.1	67,070	67,750	68,430	69,110	69,790	70,470	71,160	71,840	72,540	73,230	73,920	74,620	75,320	76,020	76,720	77,430	78,140	78,850	79,560	80,270	80,990	1031.1
1031.0	67,770	68,450	69,130	69,810	70,490	71,180	71,870	72,560	73,250	73,950	74,640	75,340	76,050	76,750	77,460	78,160	78,870	79,590	80,300	81,020	81,740	1031.0
1030.9	68,440	69,120	69,800	70,490	71,180	71,860	72,560	73,250	73,940	74,640	75,340	76,040	76,750	77,450	78,160	78,870	79,590	80,300	81,020	81,740	82,460	1030.9
1030.8	69,120	69,800	70,490	71,170	71,860	72,550	73,250	73,940	74,640	75,340	76,040	76,750	77,450	78,160	78,870	79,580	80,300	81,020	81,740	82,460	83,180	1030.8
1030.7	69,800	70,480	71,170	71,860	72,550	73,240	73,940	74,640	75,340	76,040	76,740	77,450	78,160	78,870	79,580	80,300	81,020	81,740	82,460	83,180	83,910	1030.7
1030.6	70,480	71,170	71,850	72,550	73,240	73,940	74,630	75,330	76,040	76,740	77,450	78,160	78,870	79,580	80,300	81,020	81,740	82,460	83,180	83,910	84,640	1030.6
1030.5	71,160	71,850	72,540	73,240	73,930	74,630	75,330	76,040	76,740	77,450	78,160	78,870	79,580	80,300	81,020	81,740	82,460	83,180	83,910	84,640	85,370	1030.5
1030.4	71,850	72,540	73,230	73,930	74,630	75,330	76,030	76,740	77,450	78,160	78,870	79,580	80,300	81,010	81,740	82,460	83,180	83,910	84,640	85,370	86,100	1030.4
1030.3	72,540	73,230	73,930	74,630	75,330	76,030	76,740	77,440	78,150	78,870	79,580	80,300	81,010	81,730	82,460	83,180	83,910	84,640	85,370	86,100	86,840	1030.3
1030.2	73,230	73,930	74,630	75,330	76,030	76,740	77,440	78,150	78,870	79,580	80,300	81,010	81,730	82,460	83,180	83,910	84,640	85,370	86,100	86,840	87,580	1030.2
1030.1	73,920	74,620	75,320	76,030	76,730	77,440	78,150	78,860	79,580	80,300	81,010	81,730	82,460	83,180	83,910	84,640	85,370	86,100	86,840	87,580	88,320	1030.1
1030.0	74,620	75,320	76,030	76,730	77,440	78,150	78,860	79,580	80,290	81,010	81,730	82,460	83,180	83,910	84,640	85,370	86,110	86,840	87,580	88,320	89,060	1030.0
1029.9	75,310	76,020	76,720	77,430	78,140	78,850	79,570	80,290	81,000	81,730	82,450	83,180	83,900	84,630	85,360	86,100	86,830	87,570	88,310	89,060	89,800	1029.9
1029.8	76,010	76,710	77,420	78,130	78,840	79,560	80,280	81,000	81,720	82,440	83,170	83,900	84,630	85,360	86,090	86,830	87,570	88,310	89,050	89,790	90,540	1029.8
1029.7	76,700	77,410	78,120	78,840	79,550	80,270	80,990	81,710	82,430	83,160	83,890	84,620	85,350	86,080	86,820	87,560	88,300	89,040	89,790	90,540	91,280	1029.7
1029.6	77,400	78,110	78,830	79,540	80,260	80,980	81,700	82,430	83,150	83,880	84,610	85,340	86,080	86,810	87,550	88,290	89,040	89,780	90,530	91,280	92,030	1029.6
1029.5	78,100	78,820	79,530	80,250	80,970	81,690	82,420	83,140	83,870	84,600	85,340	86,070	86,810	87,550	88,290	89,030	89,780	90,520	91,270	92,030	92,780	1029.5
1029.4	78,810	79,520	80,240	80,960	81,680	82,410	83,140	83,860	84,600	85,330	86,060	86,800	87,540	88,280	89,030	89,770	90,520	91,270	92,020	92,770	93,530	1029.4
1029.3	79,520	80,230	80,950	81,680	82,400	83,130	83,860	84,590	85,320	86,060	86,790	87,530	88,280	89,020	89,770	90,510	91,260	92,020	92,770	93,530	94,280	1029.3
1029.2	80,220	80,950	81,670	82,390	83,120	83,850	84,580	85,310	86,050	86,790	87,530	88,270	89,010	89,760	90,510	91,260	92,010	92,770	93,520	94,280	95,040	1029.2
1029.1	80,940	81,660	82,380	83,110	83,840	84,570	85,310	86,040	86,780	87,520	88,260	89,010	89,750	90,500	91,250	92,010	92,760	93,520	94,280	95,040	95,800	1029.1
1029.0	81,650	82,380	83,100	83,830	84,570	85,300	86,040	86,770	87,510	88,260	89,000	89,750	90,500	91,250	92,000	92,760	93,510	94,270	95,030	95,800	96,560	1029.0
1028.9	82,340	83,070	83,800	84,530	85,260	86,000	86,740	87,480	88,220	88,960	89,710	90,460	91,210	91,960	92,720	93,480	94,230	95,000	95,760	96,520	97,290	1028.9
1028.8	83,030	83,760	84,490	85,220	85,960	86,700	87,440	88,180	88,930	89,670	90,420	91,170	91,920	92,680	93,440	94,200	94,960	95,720	96,490	97,250	98,020	1028.8
1028.7	83,720	84,450	85,190	85,920	86,660	87,400	88,140	88,890	89,630	90,380	91,130	91,890	92,640	93,400	94,160	94,920	95,680	96,450	97,220	97,990	98,760	1028.7
1028.6	84,410	85,150	85,880	86,620	87,360	88,100	88,850	89,600	90,340	91,100	91,850	92,600	93,360	94,120	94,880	95,650	96,410	97,180	97,950	98,720	99,490	1028.6
1028.5	85,110	85,840	86,580	87,320	88,070	88,810	89,560	90,310	91,060	91,810	92,570	93,320	94,080	94,840	95,610	96,370	97,140	97,910	98,680	99,460	100,200	1028.5
1028.4	85,810	86,540	87,290	88,030	88,770	89,520	90,270	91,020	91,770	92,530	93,290	94,040	94,810	95,570	96,340	97,100	97,870	98,640	99,420	100,200	101,000	1028.4
1028.3	86,510	87,250	87,990	88,730	89,480	90,230	90,980	91,730	92,490	93,250	94,010	94,770	95,530	96,300	97,070	97,840	98,610	99,380	100,200	100,900	101,700	1028.3
1028.2	87,210	87,950	88,700	89,440	90,190	90,940	91,700	92,450	93,210	93,970	94,730	95,490	96,260	97,030	97,800	98,570	99,340	100,100	100,900	101,700	102,500	1028.2
1028.1	87,910	88,660	89,400	90,150	90,910	91,660	92,410	93,170	93,930	94,690	95,460	96,220	96,990	97,760	98,530	99,310	100,100	100,900	101,600	102,400	103,200	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1046.0	1046.1	1046.2	1046.3	1046.4	1046.5	1046.6	1046.7	1046.8	1046.9	1047.0	1047.1	1047.2	1047.3	1047.4	1047.5	1047.6	1047.7	1047.8	1047.9	1048.0	
1028.0	88,620	89,370	90,120	90,870	91,620	92,380	93,130	93,890	94,650	95,420	96,180	96,950	97,720	98,490	99,270	100,000	100,800	101,600	102,400	103,200	104,000	1028.0
1027.9	89,280	90,030	90,780	91,530	92,290	93,050	93,810	94,570	95,330	96,100	96,860	97,630	98,410	99,180	99,960	100,700	101,500	102,300	103,100	103,900	104,700	1027.9
1027.8	89,940	90,690	91,450	92,200	92,960	93,720	94,480	95,240	96,010	96,780	97,540	98,320	99,090	99,870	100,600	101,400	102,200	103,000	103,800	104,600	105,400	1027.8
1027.7	90,610	91,360	92,110	92,870	93,630	94,390	95,150	95,920	96,690	97,460	98,230	99,000	99,780	100,600	101,300	102,100	102,900	103,700	104,500	105,300	106,100	1027.7
1027.6	91,270	92,030	92,780	93,540	94,300	95,070	95,830	96,600	97,370	98,140	98,910	99,690	100,500	101,200	102,000	102,800	103,600	104,400	105,200	106,000	106,800	1027.6
1027.5	91,940	92,700	93,450	94,220	94,980	95,740	96,510	97,280	98,050	98,820	99,600	100,400	101,200	101,900	102,700	103,500	104,300	105,100	105,900	106,700	107,500	1027.5
1027.4	92,610	93,370	94,130	94,890	95,650	96,420	97,190	97,960	98,730	99,510	100,300	101,100	101,800	102,600	103,400	104,200	105,000	105,800	106,600	107,400	108,200	1027.4
1027.3	93,280	94,040	94,800	95,570	96,330	97,100	97,870	98,640	99,420	100,200	101,000	101,800	102,500	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	1027.3
1027.2	93,950	94,710	95,480	96,240	97,010	97,780	98,550	99,330	100,100	100,900	101,700	102,400	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	1027.2
1027.1	94,630	95,390	96,150	96,920	97,690	98,460	99,240	100,000	100,800	101,600	102,400	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	1027.1
1027.0	95,300	96,070	96,830	97,600	98,380	99,150	99,920	100,700	101,500	102,300	103,000	103,800	104,600	105,400	106,200	107,000	107,800	108,600	109,400	110,200	111,000	1027.0
1026.9	95,930	96,690	97,460	98,230	99,010	99,780	100,600	101,300	102,100	102,900	103,700	104,500	105,300	106,100	106,900	107,700	108,400	109,200	110,100	110,900	111,700	1026.9
1026.8	96,560	97,320	98,090	98,870	99,640	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	1026.8
1026.7	97,180	97,950	98,730	99,500	100,300	101,100	101,800	102,600	103,400	104,200	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	1026.7
1026.6	97,810	98,590	99,360	100,100	100,900	101,700	102,500	103,300	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	1026.6
1026.5	98,450	99,220	99,990	100,800	101,600	102,300	103,100	103,900	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	113,500	114,300	1026.5
1026.4	99,080	99,850	100,600	101,400	102,200	103,000	103,800	104,500	105,300	106,100	106,900	107,700	108,500	109,300	110,100	110,900	111,700	112,500	113,300	114,100	115,000	1026.4
1026.3	99,710	100,500	101,300	102,000	102,800	103,600	104,400	105,200	106,000	106,800	107,600	108,400	109,200	110,000	110,800	111,600	112,400	113,200	114,000	114,800	115,600	1026.3
1026.2	100,300	101,100	101,900	102,700	103,500	104,300	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,700	115,500	116,300	1026.2
1026.1	101,000	101,800	102,500	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,500	115,300	116,100	117,000	1026.1
1026.0	101,600	102,400	103,200	104,000	104,800	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	113,500	114,400	115,200	116,000	116,800	117,600	1026.0
1025.9	102,200	103,000	103,800	104,600	105,400	106,200	107,000	107,700	108,500	109,300	110,100	110,900	111,700	112,600	113,400	114,200	115,000	115,800	116,600	117,400	118,300	1025.9
1025.8	102,800	103,600	104,400	105,200	106,000	106,800	107,600	108,400	109,200	110,000	110,800	111,600	112,400	113,200	114,000	114,800	115,600	116,400	117,300	118,100	118,900	1025.8
1025.7	103,400	104,200	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	116,300	117,100	117,900	118,700	119,500	1025.7
1025.6	104,100	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,300	116,100	116,900	117,700	118,500	119,400	120,200	1025.6
1025.5	104,700	105,500	106,300	107,000	107,800	108,600	109,400	110,200	111,000	111,800	112,600	113,500	114,300	115,100	115,900	116,700	117,500	118,400	119,200	120,000	120,800	1025.5
1025.4	105,300	106,100	106,900	107,700	108,500	109,300	110,100	110,900	111,700	112,500	113,300	114,100	114,900	115,700	116,500	117,300	118,200	119,000	119,800	120,600	121,500	1025.4
1025.3	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,500	121,300	122,100	1025.3
1025.2	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,500	115,400	116,200	117,000	117,800	118,600	119,400	120,300	121,100	121,900	122,800	1025.2
1025.1	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	113,500	114,400	115,200	116,000	116,800	117,600	118,400	119,300	120,100	120,900	121,700	122,600	123,400	1025.1
1025.0	107,800	108,500	109,300	110,100	110,900	111,800	112,600	113,400	114,200	115,000	115,800	116,600	117,400	118,300	119,100	119,900	120,700	121,600	122,400	123,200	124,100	1025.0
1024.9	108,400	109,200	110,000	110,800	111,600	112,400	113,200	114,000	114,800	115,600	116,400	117,300	118,100	118,900	119,700	120,500	121,400	122,200	123,000	123,900	124,700	1024.9
1024.8	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	116,300	117,100	117,900	118,700	119,500	120,400	121,200	122,000	122,800	123,700	124,500	125,400	1024.8
1024.7	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,300	116,100	116,900	117,700	118,500	119,300	120,200	121,000	121,800	122,700	123,500	124,300	125,200	126,000	1024.7
1024.6	110,200	111,000	111,800	112,600	113,400	114,300	115,100	115,900	116,700	117,500	118,300	119,200	120,000	120,800	121,600	122,500	123,300	124,100	125,000	125,800	126,700	1024.6
1024.5	110,800	111,600	112,500	113,300	114,100	114,900	115,700	116,500	117,300	118,200	119,000	119,800	120,600	121,500	122,300	123,100	124,000	124,800	125,600	126,500	127,300	1024.5
1024.4	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	118,000	118,800	119,600	120,400	121,300	122,100	122,900	123,800	124,600	125,400	126,300	127,100	128,000	1024.4
1024.3	112,100	112,900	113,700	114,500	115,300	116,100	117,000	117,800	118,600	119,400	120,300	121,100	121,900	122,700	123,600	124,400	125,200	126,100	126,900	127,800	128,600	1024.3
1024.2	112,700	113,500	114,300	115,100	116,000	116,800	117,600	118,400	119,200	120,100	120,900	121,700	122,600	123,400	124,200	125,100	125,900	126,700	127,600	128,400	129,300	1024.2
1024.1	113,300	114,100	115,000	115,800	116,600	117,400	118,200	119,100	119,900	120,700	121,500	122,400	123,200	124,000	124,900	125,700	126,600	127,400	128,200	129,100	129,900	1024.1
1024.0	114,000	114,800	115,600	116,400	117,200	118,000	118,900	119,700	120,500	121,300	122,200	123,000	123,800	124,700	125,500	126,400	127,200	128,100	128,900	129,700	130,600	1024.0
1023.9	114,700	115,500	116,300	117,100	117,900	118,800	119,600	120,400	121,200	122,100	122,900	123,700	124,600	125,400	126,300	127,100	127,900	128,800	129,600	130,500	131,300	1023.9
1023.8	115,400	116,200	117,000	117,800	118,600	119,500	120,300	121,100	122,000	122,800	123,600	124,500	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	1023.8
1023.7	116,100	116,900	117,700	118,500	119,400	120,200	121,000	121,800	122,700	123,500	124,400	125,200	126,000	126,900	127,700	128,600	129,400	130,300	131,100	132,000	132,800	1023.7
1023.6	116,800	117,600	118,400	119,200	120,100	120,900	121,700	122,600	123,400	124,200	125,100	125,900	126,800	127,600	128,500	129,300	130,200	131,000	131,900	132,700	133,600	1023.6
1023.5	117,500	118,300	119,100	120,000	120,800	121,600	122,500	123,300	124,100	125,000	125,800	126,700	127,500	128,400	129,200	130,100	130,900	131,800	132,600	133,500	134,400	1023.5
1023.4	118,200	119,000	119,900	120,700	121,500	122,400	123,200	124,000	124,900	125,700	126,600	127,400	128,200	129,100	130,000	130,800	131,700	132,500	133,400	134,200	135,100	1023.4
1023.3	118,900	119,700	120,600	121,400	122,200	123,100	123,900	124,800	125,600	126,400	127,300	128,100	129,000	129,800	130,700	131,600	132,400	133,300	134,100	135,000	135,900	1023.3
1023.2	119,600	120,500	121,300	122,100	123,000	123,800	124,600	125,500	126,300	127,200	128,000	128,900	129,700	130,600	131,500	132,300	133,200	134,000	134,900	135,800	136,600	1023.2
1023.1	120,400	121,200	122,000	122,900	123,700	124,500	125,400	126,200	127,100	127,900	128,800	129,600	130,500	131,300	132,200	133,100	133,900	134,800	135,700	136,500	137,400	1023.1
1023.0	121,100	121,900	122,700	123,600	124,400	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	1023.0
1022.9	121,900	122,700	123,600	124,400	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,100	1022.9
1022.8	122,700	123,600	124,400	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,100	139,900	1022.8
1022.7	123,600	124,400	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,100	140,000	140,800	1022.7
1022.6	124,400	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,100	140,000	140,800	141,700	1022.6
1022.5	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,300	138,200	139,100	140,000	140,900	141,700	142,600	1022.5
1022.4	126,100	126,900	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,300	138,200	139,100	140,000	140,900	141,800	142,600	143,500	1022.4
1022.3	126,900	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,300	138,200	139,100	140,000	140,900	141,800	142,700	143,500	144,400	1022.3
1022.2	127,800	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,400	138,200	139,100	140,000	140,900	141,800	142,700	143,600	144,400	145,300	1022.2
1022.1	128,700	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,400	138,200	139,100	140,000	140,900	141,800	142,700	143,600	144,500	145,400	146,300	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1046.0	1046.1	1046.2	1046.3	1046.4	1046.5	1046.6	1046.7	1046.8	1046.9	1047.0	1047.1	1047.2	1047.3	1047.4	1047.5	1047.6	1047.7	1047.8	1047.9	1048.0	
1022.0	129,500	130,400	131,200	132,100	133,000	133,800	134,700	135,600	136,500	137,400	138,200	139,100	140,000	140,900	141,800	142,700	143,600	144,500	145,400	146,300	147,200	1022.0
1021.9	130,400	131,300	132,200	133,000	133,900	134,800	135,700	136,500	137,400	138,300	139,200	140,100	141,000	141,900	142,800	143,700	144,600	145,500	146,400	147,300	148,200	1021.9
1021.8	131,400	132,200	133,100	134,000	134,900	135,700	136,600	137,500	138,400	139,300	140,200	141,100	141,900	142,800	143,700	144,600	145,500	146,400	147,300	148,300	149,200	1021.8
1021.7	132,300	133,200	134,100	134,900	135,800	136,700	137,600	138,500	139,300	140,200	141,100	142,000	142,900	143,800	144,700	145,600	146,500	147,400	148,300	149,300	150,200	1021.7
1021.6	133,200	134,100	135,000	135,900	136,800	137,600	138,500	139,400	140,300	141,200	142,100	143,000	143,900	144,800	145,700	146,600	147,500	148,400	149,300	150,300	151,200	1021.6
1021.5	134,200	135,100	136,000	136,800	137,700	138,600	139,500	140,400	141,300	142,200	143,100	144,000	144,900	145,800	146,700	147,600	148,500	149,400	150,300	151,300	152,200	1021.5
1021.4	135,100	136,000	136,900	137,800	138,700	139,600	140,500	141,400	142,300	143,200	144,100	145,000	145,900	146,800	147,700	148,600	149,500	150,400	151,300	152,300	153,200	1021.4
1021.3	136,100	137,000	137,900	138,800	139,600	140,500	141,400	142,300	143,200	144,100	145,000	146,000	146,900	147,800	148,700	149,600	150,500	151,400	152,400	153,300	154,200	1021.3
1021.2	137,100	137,900	138,800	139,700	140,600	141,500	142,400	143,300	144,200	145,100	146,000	146,900	147,900	148,800	149,700	150,600	151,500	152,500	153,400	154,300	155,200	1021.2
1021.1	138,000	138,900	139,800	140,700	141,600	142,500	143,400	144,300	145,200	146,100	147,000	147,900	148,900	149,800	150,700	151,600	152,500	153,500	154,400	155,300	156,300	1021.1
1021.0	139,000	139,900	140,800	141,700	142,600	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,900	150,800	151,700	152,600	153,600	154,500	155,400	156,400	157,300	1021.0
1020.9	140,000	140,900	141,800	142,700	143,600	144,500	145,500	146,400	147,300	148,200	149,100	150,000	151,000	151,900	152,800	153,700	154,700	155,600	156,500	157,500	158,400	1020.9
1020.8	141,100	142,000	142,900	143,800	144,700	145,600	146,500	147,400	148,400	149,300	150,200	151,100	152,000	153,000	153,900	154,800	155,800	156,700	157,700	158,600	159,500	1020.8
1020.7	142,100	143,000	143,900	144,900	145,800	146,700	147,600	148,500	149,400	150,400	151,300	152,200	153,200	154,100	155,000	156,000	156,900	157,800	158,800	159,700	160,700	1020.7
1020.6	143,200	144,100	145,000	145,900	146,800	147,800	148,700	149,600	150,500	151,500	152,400	153,300	154,300	155,200	156,100	157,100	158,000	159,000	159,900	160,900	161,800	1020.6
1020.5	144,300	145,200	146,100	147,000	147,900	148,900	149,800	150,700	151,600	152,600	153,500	154,400	155,400	156,300	157,200	158,200	159,100	160,100	161,000	162,000	162,900	1020.5
1020.4	145,300	146,300	147,200	148,100	149,000	149,900	150,900	151,800	152,700	153,700	154,600	155,500	156,500	157,400	158,400	159,300	160,300	161,200	162,200	163,100	164,100	1020.4
1020.3	146,400	147,300	148,300	149,200	150,100	151,000	152,000	152,900	153,800	154,800	155,700	156,700	157,600	158,600	159,500	160,500	161,400	162,400	163,300	164,300	165,200	1020.3
1020.2	147,500	148,400	149,300	150,300	151,200	152,100	153,100	154,000	155,000	155,900	156,800	157,800	158,700	159,700	160,600	161,600	162,600	163,500	164,500	165,400	166,400	1020.2
1020.1	148,600	149,500	150,400	151,400	152,300	153,200	154,200	155,100	156,100	157,000	158,000	158,900	159,900	160,800	161,800	162,700	163,700	164,700	165,600	166,600	167,600	1020.1
1020.0	149,700	150,600	151,500	152,500	153,400	154,400	155,300	156,200	157,200	158,100	159,100	160,100	161,000	162,000	162,900	163,900	164,900	165,800	166,800	167,800	168,700	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1048.0	1048.1	1048.2	1048.3	1048.4	1048.5	1048.6	1048.7	1048.8	1048.9	1049.0	1049.1	1049.2	1049.3	1049.4	1049.5	1049.6	1049.7	1049.8	1049.9	1050.0	
1034.0	60,350	60,990	61,640	62,280	62,930	63,580	64,240	64,890	65,550	66,210	66,870	67,530	68,200	68,870	69,540	70,210	70,880	71,560	72,240	72,920	73,600	1034.0
1033.9	61,030	61,670	62,320	62,970	63,620	64,270	64,930	65,580	66,240	66,910	67,570	68,240	68,900	69,580	70,250	70,920	71,600	72,280	72,960	73,640	74,330	1033.9
1033.8	61,710	62,350	63,000	63,650	64,310	64,960	65,620	66,280	66,940	67,610	68,280	68,940	69,620	70,290	70,960	71,640	72,320	73,000	73,690	74,370	75,060	1033.8
1033.7	62,390	63,040	63,690	64,340	65,000	65,660	66,320	66,980	67,650	68,310	68,980	69,660	70,330	71,010	71,680	72,360	73,050	73,730	74,420	75,100	75,790	1033.7
1033.6	63,070	63,720	64,380	65,040	65,700	66,360	67,020	67,690	68,350	69,020	69,700	70,370	71,050	71,720	72,410	73,090	73,770	74,460	75,150	75,840	76,530	1033.6
1033.5	63,760	64,420	65,070	65,730	66,390	67,060	67,720	68,390	69,060	69,740	70,410	71,090	71,770	72,450	73,130	73,820	74,500	75,190	75,880	76,580	77,270	1033.5
1033.4	64,450	65,110	65,770	66,430	67,100	67,760	68,430	69,100	69,780	70,450	71,130	71,810	72,490	73,170	73,860	74,550	75,240	75,930	76,620	77,320	78,020	1033.4
1033.3	65,150	65,810	66,470	67,130	67,800	68,470	69,140	69,820	70,490	71,170	71,850	72,530	73,220	73,900	74,590	75,280	75,970	76,670	77,370	78,070	78,770	1033.3
1033.2	65,840	66,510	67,170	67,840	68,510	69,180	69,860	70,530	71,210	71,890	72,570	73,260	73,950	74,640	75,330	76,020	76,720	77,410	78,110	78,810	79,520	1033.2
1033.1	66,540	67,210	67,880	68,550	69,220	69,900	70,570	71,250	71,930	72,620	73,300	73,990	74,680	75,370	76,060	76,760	77,460	78,160	78,860	79,560	80,270	1033.1
1033.0	67,250	67,920	68,590	69,260	69,940	70,610	71,290	71,980	72,660	73,350	74,030	74,720	75,420	76,110	76,810	77,500	78,210	78,910	79,610	80,320	81,030	1033.0
1032.9	67,950	68,620	69,290	69,970	70,650	71,330	72,010	72,690	73,380	74,070	74,760	75,450	76,150	76,850	77,540	78,250	78,950	79,650	80,360	81,070	81,780	1032.9
1032.8	68,650	69,330	70,000	70,680	71,360	72,050	72,730	73,420	74,110	74,800	75,490	76,190	76,880	77,580	78,290	78,990	79,690	80,400	81,110	81,820	82,540	1032.8
1032.7	69,360	70,040	70,720	71,400	72,080	72,770	73,450	74,140	74,840	75,530	76,230	76,920	77,620	78,330	79,030	79,740	80,440	81,150	81,870	82,580	83,300	1032.7
1032.6	70,070	70,750	71,430	72,120	72,800	73,490	74,180	74,870	75,570	76,260	76,960	77,660	78,370	79,070	79,780	80,490	81,200	81,910	82,630	83,340	84,060	1032.6
1032.5	70,790	71,470	72,150	72,840	73,530	74,220	74,910	75,600	76,300	77,000	77,700	78,410	79,110	79,820	80,530	81,240	81,950	82,670	83,390	84,110	84,830	1032.5
1032.4	71,500	72,190	72,870	73,560	74,250	74,950	75,640	76,340	77,040	77,740	78,450	79,150	79,860	80,570	81,280	82,000	82,710	83,430	84,150	84,870	85,600	1032.4
1032.3	72,220	72,910	73,600	74,290	74,980	75,680	76,380	77,080	77,780	78,490	79,190	79,900	80,610	81,320	82,040	82,750	83,470	84,190	84,920	85,640	86,370	1032.3
1032.2	72,950	73,640	74,330	75,020	75,720	76,420	77,120	77,820	78,530	79,230	79,940	80,650	81,370	82,080	82,800	83,520	84,240	84,960	85,690	86,420	87,140	1032.2
1032.1	73,670	74,360	75,060	75,760	76,460	77,160	77,860	78,560	79,270	79,980	80,690	81,410	82,120	82,840	83,560	84,280	85,010	85,730	86,460	87,190	87,920	1032.1
1032.0	74,400	75,100	75,790	76,490	77,200	77,900	78,600	79,310	80,020	80,740	81,450	82,170	82,880	83,600	84,330	85,050	85,780	86,510	87,240	87,970	88,710	1032.0
1031.9	75,120	75,820	76,520	77,220	77,930	78,630	79,340	80,050	80,760	81,480	82,190	82,910	83,630	84,360	85,080	85,810	86,540	87,270	88,000	88,740	89,480	1031.9
1031.8	75,840	76,540	77,250	77,950	78,660	79,370	80,080	80,790	81,510	82,220	82,940	83,660	84,390	85,110	85,840	86,570	87,300	88,040	88,770	89,510	90,250	1031.8
1031.7	76,570	77,270	77,980	78,690	79,390	80,110	80,820	81,540	82,250	82,970	83,690	84,420	85,140	85,870	86,600	87,340	88,070	88,810	89,540	90,280	91,030	1031.7
1031.6	77,300	78,000	78,710	79,420	80,130	80,850	81,560	82,280	83,000	83,720	84,450	85,180	85,900	86,630	87,370	88,100	88,840	89,580	90,320	91,060	91,810	1031.6
1031.5	78,030	78,740	79,450	80,160	80,880	81,590	82,310	83,030	83,750	84,480	85,210	85,940	86,670	87,400	88,130	88,870	89,610	90,350	91,100	91,840	92,590	1031.5
1031.4	78,770	79,480	80,190	80,900	81,620	82,340	83,060	83,780	84,510	85,240	85,970	86,700	87,430	88,170	88,910	89,650	90,390	91,130	91,880	92,620	93,370	1031.4
1031.3	79,500	80,220	80,930	81,650	82,370	83,090	83,810	84,540	85,270	86,000	86,730	87,460	88,200	88,940	89,680	90,420	91,170	91,910	92,660	93,410	94,160	1031.3
1031.2	80,250	80,960	81,680	82,400	83,120	83,850	84,570	85,300	86,030	86,760	87,500	88,230	88,970	89,710	90,460	91,200	91,950	92,700	93,450	94,200	94,950	1031.2
1031.1	80,990	81,710	82,430	83,150	83,880	84,600	85,330	86,060	86,790	87,530	88,270	89,010	89,750	90,490	91,240	91,980	92,730	93,480	94,240	94,990	95,750	1031.1
1031.0	81,740	82,460	83,180	83,910	84,630	85,360	86,090	86,830	87,560	88,300	89,040	89,780	90,520	91,270	92,020	92,770	93,520	94,270	95,030	95,790	96,550	1031.0
1030.9	82,460	83,180	83,910	84,630	85,360	86,090	86,830	87,560	88,300	89,040	89,780	90,530	91,270	92,020	92,770	93,520	94,280	95,030	95,790	96,550	97,310	1030.9
1030.8	83,180	83,910	84,630	85,360	86,100	86,830	87,570	88,300	89,040	89,790	90,530	91,280	92,020	92,770	93,530	94,280	95,040	95,800	96,560	97,320	98,080	1030.8
1030.7	83,910	84,630	85,360	86,100	86,830	87,570	88,310	89,050	89,790	90,530	91,280	92,030	92,780	93,530	94,290	95,040	95,800	96,560	97,320	98,090	98,860	1030.7
1030.6	84,640	85,370	86,100	86,830	87,570	88,310	89,050	89,790	90,540	91,280	92,030	92,780	93,530	94,290	95,050	95,810	96,570	97,330	98,090	98,860	99,630	1030.6
1030.5	85,370	86,100	86,830	87,570	88,310	89,050	89,790	90,540	91,290	92,030	92,790	93,540	94,290	95,050	95,810	96,570	97,330	98,100	98,870	99,640	100,400	1030.5
1030.4	86,100	86,840	87,570	88,310	89,050	89,800	90,540	91,290	92,040	92,790	93,540	94,300	95,060	95,810	96,580	97,340	98,110	98,870	99,640	100,400	101,200	1030.4
1030.3	86,840	87,570	88,310	89,050	89,800	90,540	91,290	92,040	92,790	93,550	94,300	95,060	95,820	96,580	97,340	98,110	98,880	99,650	100,400	101,200	102,000	1030.3
1030.2	87,580	88,320	89,060	89,800	90,550	91,290	92,040	92,800	93,550	94,310	95,060	95,820	96,590	97,350	98,120	98,880	99,650	100,400	101,200	102,000	102,800	1030.2
1030.1	88,320	89,060	89,800	90,550	91,300	92,050	92,800	93,550	94,310	95,070	95,830	96,590	97,360	98,120	98,890	99,660	100,400	101,200	102,000	102,800	103,500	1030.1
1030.0	89,060	89,810	90,550	91,300	92,050	92,800	93,560	94,310	95,070	95,830	96,600	97,360	98,130	98,900	99,670	100,400	101,200	102,000	102,800	103,500	104,300	1030.0
1029.9	89,800	90,550	91,300	92,050	92,800	93,550	94,310	95,070	95,830	96,590	97,360	98,120	98,890	99,660	100,400	101,200	102,000	102,800	103,500	104,300	105,100	1029.9
1029.8	90,540	91,290	92,040	92,790	93,550	94,310	95,060	95,830	96,590	97,350	98,120	98,890	99,660	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	1029.8
1029.7	91,280	92,040	92,790	93,540	94,300	95,060	95,820	96,590	97,350	98,120	98,890	99,660	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	1029.7
1029.6	92,030	92,780	93,540	94,300	95,060	95,820	96,580	97,350	98,120	98,890	99,660	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	1029.6
1029.5	92,780	93,540	94,290	95,050	95,820	96,580	97,350	98,110	98,880	99,660	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	1029.5
1029.4	93,530	94,290	95,050	95,810	96,580	97,340	98,110	98,880	99,650	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	1029.4
1029.3	94,280	95,050	95,810	96,570	97,340	98,110	98,880	99,650	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	1029.3
1029.2	95,040	95,800	96,570	97,340	98,100	98,880	99,650	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	1029.2
1029.1	95,800	96,570	97,330	98,100	98,870	99,650	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	1029.1
1029.0	96,560	97,330	98,100	98,870	99,640	100,400	101,200	102,000	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	1029.0
1028.9	97,290	98,060	98,830	99,610	100,400	101,200	101,900	102,700	103,500	104,300	105,100	105,900	106,700	107,500	108,200	109,000	109,800	110,600	111,500	112,300	113,100	1028.9
1028.8	98,020	98,800	99,570	100,300	101,100	101,900	102,700	103,500	104,300	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	1028.8
1028.7	98,760	99,530	100,300	101,100	101,900	102,600	103,400	104,200	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	1028.7
1028.6	99,490	100,300	101,000	101,800	102,600	103,400	104,200	105,000	105,800	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	113,000	113,800	114,600	115,400	1028.6
1028.5	100,200	101,000	101,800	102,600	103,400	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,500	115,400	116,200	1028.5
1028.4	101,000	101,800	102,500	103,300	104,100	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,500	115,300	116,100	117,000	1028.4
1028.3	101,700	102,500	103,300	104,100	104,900	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,700	114,500	115,300	116,100	116,900	117,700	1028.3
1028.2	102,500	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,200	116,100	116,900	117,700	118,500	1028.2
1028.1	103,200	104,000	104,800	105,600	106,400	107,200	108,000	108,800	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,200	116,000	116,800	117,700	118,500	119,300	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1048.0	1048.1	1048.2	1048.3	1048.4	1048.5	1048.6	1048.7	1048.8	1048.9	1049.0	1049.1	1049.2	1049.3	1049.4	1049.5	1049.6	1049.7	1049.8	1049.9	1050.0	
1028.0	104,000	104,700	105,500	106,300	107,100	107,900	108,700	109,500	110,300	111,100	111,900	112,700	113,600	114,400	115,200	116,000	116,800	117,600	118,500	119,300	120,100	1028.0
1027.9	104,700	105,400	106,200	107,000	107,800	108,600	109,400	110,200	111,000	111,800	112,600	113,500	114,300	115,100	115,900	116,700	117,500	118,400	119,200	120,000	120,800	1027.9
1027.8	105,400	106,100	106,900	107,700	108,500	109,300	110,100	110,900	111,700	112,600	113,400	114,200	115,000	115,800	116,600	117,400	118,300	119,100	119,900	120,700	121,600	1027.8
1027.7	106,100	106,800	107,600	108,400	109,200	110,000	110,800	111,700	112,500	113,300	114,100	114,900	115,700	116,500	117,400	118,200	119,000	119,800	120,600	121,500	122,300	1027.7
1027.6	106,800	107,600	108,300	109,100	110,000	110,800	111,600	112,400	113,200	114,000	114,800	115,600	116,400	117,300	118,100	118,900	119,700	120,600	121,400	122,200	123,000	1027.6
1027.5	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,500	121,300	122,100	123,000	123,800	1027.5
1027.4	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	116,200	117,100	117,900	118,700	119,500	120,400	121,200	122,000	122,900	123,700	124,500	1027.4
1027.3	108,900	109,700	110,500	111,300	112,100	112,900	113,700	114,500	115,300	116,200	117,000	117,800	118,600	119,400	120,300	121,100	121,900	122,800	123,600	124,400	125,300	1027.3
1027.2	109,600	110,400	111,200	112,000	112,800	113,600	114,400	115,200	116,100	116,900	117,700	118,500	119,300	120,200	121,000	121,800	122,700	123,500	124,300	125,200	126,000	1027.2
1027.1	110,300	111,100	111,900	112,700	113,500	114,300	115,200	116,000	116,800	117,600	118,400	119,300	120,100	120,900	121,700	122,600	123,400	124,200	125,100	125,900	126,800	1027.1
1027.0	111,000	111,800	112,600	113,400	114,200	115,100	115,900	116,700	117,500	118,300	119,200	120,000	120,800	121,600	122,500	123,300	124,100	125,000	125,800	126,700	127,500	1027.0
1026.9	111,700	112,500	113,300	114,100	114,900	115,700	116,500	117,400	118,200	119,000	119,800	120,700	121,500	122,300	123,200	124,000	124,800	125,700	126,500	127,400	128,200	1026.9
1026.8	112,300	113,100	113,900	114,800	115,600	116,400	117,200	118,000	118,900	119,700	120,500	121,300	122,200	123,000	123,800	124,700	125,500	126,400	127,200	128,000	128,900	1026.8
1026.7	113,000	113,800	114,600	115,400	116,200	117,100	117,900	118,700	119,500	120,400	121,200	122,000	122,800	123,700	124,500	125,400	126,200	127,000	127,900	128,700	129,600	1026.7
1026.6	113,600	114,500	115,300	116,100	116,900	117,700	118,500	119,400	120,200	121,000	121,900	122,700	123,500	124,400	125,200	126,000	126,900	127,700	128,600	129,400	130,300	1026.6
1026.5	114,300	115,100	115,900	116,700	117,600	118,400	119,200	120,000	120,900	121,700	122,500	123,400	124,200	125,000	125,900	126,700	127,600	128,400	129,300	130,100	131,000	1026.5
1026.4	115,000	115,800	116,600	117,400	118,200	119,100	119,900	120,700	121,500	122,400	123,200	124,000	124,900	125,700	126,600	127,400	128,300	129,100	129,900	130,800	131,700	1026.4
1026.3	115,600	116,400	117,300	118,100	118,900	119,700	120,600	121,400	122,200	123,100	123,900	124,700	125,600	126,400	127,200	128,100	128,900	129,800	130,600	131,500	132,300	1026.3
1026.2	116,300	117,100	117,900	118,800	119,600	120,400	121,200	122,100	122,900	123,700	124,600	125,400	126,200	127,100	127,900	128,800	129,600	130,500	131,300	132,200	133,000	1026.2
1026.1	117,000	117,800	118,600	119,400	120,200	121,100	121,900	122,700	123,600	124,400	125,200	126,100	126,900	127,800	128,600	129,500	130,300	131,200	132,000	132,900	133,700	1026.1
1026.0	117,600	118,400	119,300	120,100	120,900	121,800	122,600	123,400	124,300	125,100	125,900	126,800	127,600	128,500	129,300	130,200	131,000	131,900	132,700	133,600	134,400	1026.0
1025.9	118,300	119,100	119,900	120,700	121,600	122,400	123,200	124,100	124,900	125,700	126,600	127,400	128,300	129,100	130,000	130,800	131,700	132,500	133,400	134,200	135,100	1025.9
1025.8	118,900	119,700	120,600	121,400	122,200	123,000	123,900	124,700	125,600	126,400	127,200	128,100	128,900	129,800	130,600	131,500	132,300	133,200	134,000	134,900	135,800	1025.8
1025.7	119,500	120,400	121,200	122,000	122,900	123,700	124,500	125,400	126,200	127,000	127,900	128,700	129,600	130,400	131,300	132,100	133,000	133,900	134,700	135,600	136,400	1025.7
1025.6	120,200	121,000	121,800	122,700	123,500	124,300	125,200	126,000	126,900	127,700	128,500	129,400	130,200	131,100	131,900	132,800	133,700	134,500	135,400	136,200	137,100	1025.6
1025.5	120,800	121,700	122,500	123,300	124,200	125,000	125,800	126,700	127,500	128,400	129,200	130,100	130,900	131,800	132,600	133,500	134,300	135,200	136,000	136,900	137,800	1025.5
1025.4	121,500	122,300	123,100	124,000	124,800	125,600	126,500	127,300	128,200	129,000	129,900	130,700	131,600	132,400	133,300	134,100	135,000	135,900	136,700	137,600	138,500	1025.4
1025.3	122,100	122,900	123,800	124,600	125,500	126,300	127,100	128,000	128,800	129,700	130,500	131,400	132,200	133,100	133,900	134,800	135,700	136,500	137,400	138,300	139,100	1025.3
1025.2	122,800	123,600	124,400	125,300	126,100	126,900	127,800	128,600	129,500	130,300	131,200	132,000	132,900	133,700	134,600	135,500	136,300	137,200	138,100	138,900	139,800	1025.2
1025.1	123,400	124,200	125,100	125,900	126,800	127,600	128,400	129,300	130,100	131,000	131,800	132,700	133,600	134,400	135,300	136,100	137,000	137,900	138,700	139,600	140,500	1025.1
1025.0	124,100	124,900	125,700	126,600	127,400	128,300	129,100	129,900	130,800	131,700	132,500	133,400	134,200	135,100	135,900	136,800	137,700	138,500	139,400	140,300	141,200	1025.0
1024.9	124,700	125,500	126,400	127,200	128,100	128,900	129,800	130,600	131,500	132,300	133,200	134,000	134,900	135,700	136,600	137,500	138,300	139,200	140,100	141,000	141,800	1024.9
1024.8	125,400	126,200	127,000	127,900	128,700	129,600	130,400	131,300	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,000	139,900	140,800	141,600	142,500	1024.8
1024.7	126,000	126,800	127,700	128,500	129,400	130,200	131,100	131,900	132,800	133,600	134,500	135,400	136,200	137,100	138,000	138,800	139,700	140,600	141,400	142,300	143,200	1024.7
1024.6	126,700	127,500	128,300	129,200	130,000	130,900	131,700	132,600	133,500	134,300	135,200	136,000	136,900	137,800	138,600	139,500	140,400	141,300	142,100	143,000	143,900	1024.6
1024.5	127,300	128,200	129,000	129,800	130,700	131,600	132,400	133,300	134,100	135,000	135,800	136,700	137,600	138,400	139,300	140,200	141,100	141,900	142,800	143,700	144,600	1024.5
1024.4	128,000	128,800	129,700	130,500	131,400	132,200	133,100	133,900	134,800	135,700	136,500	137,400	138,300	139,100	140,000	140,900	141,700	142,600	143,500	144,400	145,300	1024.4
1024.3	128,600	129,500	130,300	131,200	132,000	132,900	133,700	134,600	135,500	136,300	137,200	138,100	138,900	139,800	140,700	141,600	142,400	143,300	144,200	145,100	146,000	1024.3
1024.2	129,300	130,100	131,000	131,800	132,700	133,500	134,400	135,300	136,100	137,000	137,900	138,700	139,600	140,500	141,400	142,200	143,100	144,000	144,900	145,800	146,700	1024.2
1024.1	129,900	130,800	131,600	132,500	133,400	134,200	135,100	135,900	136,800	137,700	138,500	139,400	140,300	141,200	142,000	142,900	143,800	144,700	145,600	146,500	147,300	1024.1
1024.0	130,600	131,500	132,300	133,200	134,000	134,900	135,700	136,600	137,500	138,400	139,200	140,100	141,000	141,800	142,700	143,600	144,500	145,400	146,300	147,100	148,000	1024.0
1023.9	131,300	132,200	133,100	133,900	134,800	135,600	136,500	137,400	138,200	139,100	140,000	140,900	141,700	142,600	143,500	144,400	145,300	146,200	147,000	147,900	148,800	1023.9
1023.8	132,100	133,000	133,800	134,700	135,500	136,400	137,300	138,100	139,000	139,900	140,800	141,600	142,500	143,400	144,300	145,200	146,100	146,900	147,800	148,700	149,600	1023.8
1023.7	132,800	133,700	134,600	135,400	136,300	137,200	138,000	138,900	139,800	140,700	141,500	142,400	143,300	144,200	145,100	146,000	146,800	147,700	148,600	149,500	150,400	1023.7
1023.6	133,600	134,500	135,300	136,200	137,100	137,900	138,800	139,700	140,600	141,400	142,300	143,200	144,100	145,000	145,900	146,700	147,600	148,500	149,400	150,300	151,200	1023.6
1023.5	134,400	135,200	136,100	137,000	137,800	138,700	139,600	140,400	141,300	142,200	143,100	144,000	144,900	145,800	146,600	147,500	148,400	149,300	150,200	151,100	152,000	1023.5
1023.4	135,100	136,000	136,800	137,700	138,600	139,500	140,300	141,200	142,100	143,000	143,900	144,800	145,700	146,500	147,400	148,300	149,200	150,100	151,000	151,900	152,800	1023.4
1023.3	135,900	136,700	137,600	138,500	139,400	140,200	141,100	142,000	142,900	143,800	144,700	145,500	146,400	147,300	148,200	149,100	150,000	150,900	151,800	152,700	153,600	1023.3
1023.2	136,600	137,500	138,400	139,300	140,100	141,000	141,900	142,800	143,700	144,600	145,400	146,300	147,200	148,100	149,000	149,900	150,800	151,700	152,600	153,500	154,500	1023.2
1023.1	137,400	138,300	139,200	140,000	140,900	141,800	142,700	143,600	144,500	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,500	154,400	155,300	1023.1
1023.0	138,200	139,100	139,900	140,800	141,700	142,600	143,500	144,400	145,200	146,100	147,000	147,900	148,800	149,700	150,600	151,500	152,400	153,400	154,300	155,200	156,100	1023.0
1022.9	139,100	139,900	140,800	141,700	142,600	143,500	144,400	145,300	146,200	147,000	147,900	148,800	149,700	150,700	151,600	152,500	153,400	154,300	155,200	156,100	157,000	1022.9
1022.8	139,900	140,800	141,700	142,600	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,400	154,300	155,200	156,100	157,100	158,000	1022.8
1022.7	140,800	141,700	142,600	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,400	154,300	155,200	156,200	157,100	158,000	158,900	1022.7
1022.6	141,700	142,600	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,400	154,300	155,300	156,200	157,100	158,000	159,000	159,900	1022.6
1022.5	142,600	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,500	154,400	155,300	156,200	157,100	158,100	159,000	159,900	160,800	1022.5
1022.4	143,500	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,600	153,500	154,400	155,300	156,200	157,200	158,100	159,000	159,900	160,900	161,800	1022.4
1022.3	144,400	145,300	146,200	147,100	148,000	148,900	149,800	150,800	151,700	152,600	153,500	154,400	155,400	156,300	157,200	158,100	159,000	160,000	160,900	161,800	162,800	1022.3
1022.2	145,300	146,200	147,100	148,100	149,000	149,900	150,800	151,700	152,600	153,500	154,400	155,400	156,300	157,200	158,100	159,100	160,000	160,900	161,900	162,800	163,700	1022.2
1022.1	146,300	147,200	148,100	149,000	149,900	150,800	151,700	152,600	153,500	154,500	155,400	156,300	157,200	158,100	159,100	160,000	160,900	161,900	162,800	163,800	164,700	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1048.0	1048.1	1048.2	1048.3	1048.4	1048.5	1048.6	1048.7	1048.8	1048.9	1049.0	1049.1	1049.2	1049.3	1049.4	1049.5	1049.6	1049.7	1049.8	1049.9	1050.0	
1022.0	147,200	148,100	149,000	149,900	150,800	151,700	152,600	153,600	154,500	155,400	156,300	157,200	158,200	159,100	160,000	161,000	161,900	162,800	163,800	164,700	165,700	1022.0
1021.9	148,200	149,100	150,000	150,900	151,800	152,700	153,600	154,600	155,500	156,400	157,300	158,300	159,200	160,100	161,100	162,000	162,900	163,900	164,800	165,800	166,700	1021.9
1021.8	149,200	150,100	151,000	151,900	152,800	153,700	154,700	155,600	156,500	157,400	158,400	159,300	160,200	161,200	162,100	163,100	164,000	164,900	165,900	166,800	167,800	1021.8
1021.7	150,200	151,100	152,000	152,900	153,800	154,800	155,700	156,600	157,500	158,500	159,400	160,300	161,300	162,200	163,200	164,100	165,000	166,000	166,900	167,900	168,900	1021.7
1021.6	151,200	152,100	153,000	153,900	154,900	155,800	156,700	157,600	158,600	159,500	160,400	161,400	162,300	163,300	164,200	165,200	166,100	167,100	168,000	169,000	169,900	1021.6
1021.5	152,200	153,100	154,000	154,900	155,900	156,800	157,700	158,700	159,600	160,500	161,500	162,400	163,400	164,300	165,300	166,200	167,200	168,100	169,100	170,000	171,000	1021.5
1021.4	153,200	154,100	155,000	156,000	156,900	157,800	158,800	159,700	160,600	161,600	162,500	163,500	164,400	165,400	166,300	167,300	168,200	169,200	170,200	171,100	172,100	1021.4
1021.3	154,200	155,100	156,100	157,000	157,900	158,900	159,800	160,700	161,700	162,600	163,600	164,500	165,500	166,400	167,400	168,300	169,300	170,300	171,200	172,200	173,200	1021.3
1021.2	155,200	156,200	157,100	158,000	159,000	159,900	160,900	161,800	162,700	163,700	164,600	165,600	166,500	167,500	168,500	169,400	170,400	171,300	172,300	173,300	174,300	1021.2
1021.1	156,300	157,200	158,100	159,100	160,000	161,000	161,900	162,800	163,800	164,700	165,700	166,700	167,600	168,600	169,500	170,500	171,500	172,400	173,400	174,400	175,300	1021.1
1021.0	157,300	158,200	159,200	160,100	161,100	162,000	162,900	163,900	164,900	165,800	166,800	167,700	168,700	169,600	170,600	171,600	172,500	173,500	174,500	175,500	176,400	1021.0
1020.9	158,400	159,400	160,300	161,200	162,200	163,100	164,100	165,000	166,000	167,000	167,900	168,900	169,800	170,800	171,800	172,800	173,700	174,700	175,700	176,700	177,600	1020.9
1020.8	159,500	160,500	161,400	162,400	163,300	164,300	165,200	166,200	167,200	168,100	169,100	170,100	171,000	172,000	173,000	173,900	174,900	175,900	176,900	177,900	178,800	1020.8
1020.7	160,700	161,600	162,600	163,500	164,500	165,400	166,400	167,400	168,300	169,300	170,300	171,200	172,200	173,200	174,100	175,100	176,100	177,100	178,100	179,100	180,000	1020.7
1020.6	161,800	162,800	163,700	164,700	165,600	166,600	167,600	168,500	169,500	170,500	171,400	172,400	173,400	174,400	175,300	176,300	177,300	178,300	179,300	180,300	181,300	1020.6
1020.5	162,900	163,900	164,900	165,800	166,800	167,700	168,700	169,700	170,700	171,600	172,600	173,600	174,600	175,500	176,500	177,500	178,500	179,500	180,500	181,500	182,500	1020.5
1020.4	164,100	165,100	166,000	167,000	167,900	168,900	169,900	170,900	171,800	172,800	173,800	174,800	175,800	176,700	177,700	178,700	179,700	180,700	181,700	182,700	183,700	1020.4
1020.3	165,200	166,200	167,200	168,100	169,100	170,100	171,100	172,000	173,000	174,000	175,000	176,000	177,000	177,900	178,900	179,900	180,900	181,900	182,900	183,900	184,900	1020.3
1020.2	166,400	167,400	168,300	169,300	170,300	171,300	172,200	173,200	174,200	175,200	176,200	177,200	178,200	179,200	180,100	181,100	182,100	183,100	184,200	185,200	186,200	1020.2
1020.1	167,600	168,500	169,500	170,500	171,500	172,400	173,400	174,400	175,400	176,400	177,400	178,400	179,400	180,400	181,400	182,400	183,400	184,400	185,400	186,400	187,400	1020.1
1020.0	168,700	169,700	170,700	171,700	172,700	173,600	174,600	175,600	176,600	177,600	178,600	179,600	180,600	181,600	182,600	183,600	184,600	185,600	186,600	187,600	188,700	1020.0

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1050.0	1050.1	1050.2	1050.3	1050.4	1050.5	1050.6	1050.7	1050.8	1050.9	1051.0	1051.1	1051.2	1051.3	1051.4	1051.5	1051.6	1051.7	1051.8	1051.9	1052.0	
1034.0	73,600	74,280	74,970	75,660	76,350	77,040	77,740	78,430	79,130	79,830	80,540	81,240	81,950	82,660	83,370	84,080	84,800	85,510	86,230	86,950	87,680	1034.0
1033.9	74,330	75,010	75,700	76,400	77,090	77,780	78,480	79,180	79,880	80,590	81,290	82,000	82,710	83,420	84,130	84,850	85,570	86,290	87,010	87,730	88,460	1033.9
1033.8	75,060	75,750	76,440	77,140	77,830	78,530	79,230	79,930	80,640	81,340	82,050	82,760	83,470	84,190	84,900	85,620	86,340	87,060	87,790	88,510	89,240	1033.8
1033.7	75,790	76,490	77,180	77,880	78,580	79,280	79,980	80,680	81,390	82,100	82,810	83,520	84,240	84,960	85,670	86,390	87,120	87,840	88,570	89,300	90,030	1033.7
1033.6	76,530	77,230	77,920	78,620	79,330	80,030	80,730	81,440	82,150	82,860	83,580	84,290	85,010	85,730	86,450	87,170	87,900	88,620	89,350	90,090	90,820	1033.6
1033.5	77,270	77,970	78,670	79,370	80,080	80,780	81,490	82,200	82,910	83,630	84,340	85,060	85,780	86,500	87,230	87,950	88,680	89,410	90,140	90,880	91,610	1033.5
1033.4	78,020	78,720	79,420	80,130	80,830	81,540	82,250	82,960	83,680	84,390	85,110	85,830	86,560	87,280	88,010	88,740	89,470	90,200	90,930	91,670	92,410	1033.4
1033.3	78,770	79,470	80,170	80,880	81,590	82,300	83,010	83,730	84,450	85,170	85,890	86,610	87,340	88,060	88,790	89,520	90,260	90,990	91,730	92,470	93,210	1033.3
1033.2	79,520	80,220	80,930	81,640	82,350	83,070	83,780	84,500	85,220	85,940	86,660	87,390	88,120	88,850	89,580	90,310	91,050	91,790	92,530	93,270	94,010	1033.2
1033.1	80,270	80,980	81,690	82,400	83,120	83,830	84,550	85,270	85,990	86,720	87,440	88,170	88,900	89,640	90,370	91,110	91,840	92,580	93,330	94,070	94,820	1033.1
1033.0	81,030	81,740	82,450	83,170	83,880	84,600	85,320	86,050	86,770	87,500	88,230	88,960	89,690	90,430	91,160	91,900	92,640	93,390	94,130	94,880	95,630	1033.0
1032.9	81,780	82,500	83,210	83,930	84,650	85,370	86,090	86,820	87,550	88,280	89,010	89,740	90,480	91,210	91,950	92,690	93,440	94,180	94,930	95,680	96,430	1032.9
1032.8	82,540	83,250	83,970	84,690	85,420	86,140	86,870	87,590	88,320	89,060	89,790	90,530	91,260	92,000	92,750	93,490	94,240	94,980	95,730	96,490	97,240	1032.8
1032.7	83,300	84,020	84,740	85,460	86,190	86,910	87,640	88,370	89,100	89,840	90,580	91,310	92,050	92,800	93,540	94,290	95,040	95,790	96,540	97,290	98,050	1032.7
1032.6	84,060	84,780	85,510	86,230	86,960	87,690	88,420	89,150	89,890	90,620	91,360	92,110	92,850	93,590	94,340	95,090	95,840	96,590	97,350	98,110	98,860	1032.6
1032.5	84,830	85,550	86,280	87,010	87,730	88,470	89,200	89,940	90,670	91,410	92,160	92,900	93,650	94,390	95,140	95,890	96,650	97,400	98,160	98,920	99,680	1032.5
1032.4	85,600	86,320	87,050	87,780	88,510	89,250	89,990	90,720	91,460	92,210	92,950	93,700	94,450	95,200	95,950	96,700	97,460	98,220	98,980	99,740	100,500	1032.4
1032.3	86,370	87,100	87,830	88,560	89,300	90,030	90,770	91,510	92,260	93,000	93,750	94,500	95,250	96,000	96,760	97,510	98,270	99,030	99,800	100,600	101,300	1032.3
1032.2	87,140	87,880	88,610	89,350	90,080	90,820	91,560	92,310	93,050	93,800	94,550	95,300	96,060	96,810	97,570	98,330	99,090	99,850	100,600	101,400	102,200	1032.2
1032.1	87,920	88,660	89,390	90,130	90,870	91,610	92,360	93,100	93,850	94,600	95,360	96,110	96,870	97,620	98,380	99,140	99,910	100,700	101,400	102,200	103,000	1032.1
1032.0	88,710	89,440	90,180	90,920	91,660	92,410	93,160	93,900	94,660	95,410	96,160	96,920	97,680	98,440	99,200	99,970	100,700	101,500	102,300	103,000	103,800	1032.0
1031.9	89,480	90,220	90,960	91,700	92,450	93,190	93,940	94,690	95,450	96,200	96,960	97,720	98,480	99,240	100,000	100,800	101,500	102,300	103,100	103,900	104,600	1031.9
1031.8	90,250	90,990	91,740	92,480	93,230	93,980	94,730	95,480	96,240	97,000	97,760	98,520	99,280	100,000	100,800	101,600	102,400	103,100	103,900	104,700	105,500	1031.8
1031.7	91,030	91,770	92,520	93,260	94,020	94,770	95,520	96,280	97,040	97,800	98,560	99,320	100,100	100,900	101,600	102,400	103,200	103,900	104,700	105,500	106,300	1031.7
1031.6	91,810	92,550	93,300	94,050	94,800	95,560	96,320	97,070	97,840	98,600	99,360	100,100	100,900	101,700	102,400	103,200	104,000	104,800	105,500	106,300	107,100	1031.6
1031.5	92,590	93,340	94,090	94,840	95,600	96,350	97,110	97,870	98,640	99,400	100,200	100,900	101,700	102,500	103,300	104,000	104,800	105,600	106,400	107,200	107,900	1031.5
1031.4	93,370	94,130	94,880	95,640	96,390	97,150	97,910	98,680	99,440	100,200	101,000	101,800	102,500	103,300	104,100	104,900	105,600	106,400	107,200	108,000	108,800	1031.4
1031.3	94,160	94,920	95,670	96,430	97,190	97,950	98,720	99,480	100,300	101,000	101,800	102,600	103,300	104,100	104,900	105,700	106,500	107,300	108,000	108,800	109,600	1031.3
1031.2	94,950	95,710	96,470	97,230	97,990	98,760	99,520	100,300	101,100	101,800	102,600	103,400	104,200	104,900	105,700	106,500	107,300	108,100	108,900	109,700	110,500	1031.2
1031.1	95,750	96,510	97,270	98,030	98,800	99,560	100,300	101,100	101,900	102,700	103,400	104,200	105,000	105,800	106,600	107,300	108,100	108,900	109,700	110,500	111,300	1031.1
1031.0	96,550	97,310	98,070	98,840	99,610	100,400	101,100	101,900	102,700	103,500	104,300	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	1031.0
1030.9	97,310	98,080	98,840	99,610	100,400	101,200	101,900	102,700	103,500	104,300	105,000	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	1030.9
1030.8	98,080	98,850	99,620	100,400	101,200	101,900	102,700	103,500	104,300	105,100	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	1030.8
1030.7	98,860	99,620	100,400	101,200	101,900	102,700	103,500	104,300	105,100	105,800	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	1030.7
1030.6	99,630	100,400	101,200	101,900	102,700	103,500	104,300	105,100	105,900	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	1030.6
1030.5	100,400	101,200	102,000	102,700	103,500	104,300	105,100	105,900	106,600	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	116,200	1030.5
1030.4	101,200	102,000	102,700	103,500	104,300	105,100	105,900	106,700	107,400	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,400	116,300	117,100	1030.4
1030.3	102,000	102,700	103,500	104,300	105,100	105,900	106,700	107,500	108,200	109,000	109,800	110,600	111,400	112,200	113,000	113,800	114,600	115,500	116,300	117,100	117,900	1030.3
1030.2	102,800	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,000	109,800	110,600	111,400	112,200	113,000	113,900	114,700	115,500	116,300	117,100	117,900	118,700	1030.2
1030.1	103,500	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	117,900	118,700	119,600	1030.1
1030.0	104,300	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	117,900	118,700	119,600	120,400	1030.0
1029.9	105,100	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	117,900	118,800	119,600	120,400	121,200	1029.9
1029.8	105,900	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	117,900	118,800	119,600	120,400	121,200	122,100	1029.8
1029.7	106,700	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	117,900	118,800	119,600	120,400	121,200	122,100	122,900	1029.7
1029.6	107,500	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	118,000	118,800	119,600	120,400	121,200	122,100	122,900	123,700	1029.6
1029.5	108,300	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	118,000	118,800	119,600	120,400	121,200	122,100	122,900	123,700	124,600	1029.5
1029.4	109,100	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,100	118,000	118,800	119,600	120,400	121,300	122,100	122,900	123,700	124,600	125,400	1029.4
1029.3	109,900	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,400	121,300	122,100	122,900	123,700	124,600	125,400	126,300	1029.3
1029.2	110,700	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,400	121,300	122,100	122,900	123,800	124,600	125,400	126,300	127,100	1029.2
1029.1	111,500	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,400	121,300	122,100	122,900	123,800	124,600	125,400	126,300	127,100	128,000	1029.1
1029.0	112,300	113,100	113,900	114,700	115,500	116,300	117,200	118,000	118,800	119,600	120,500	121,300	122,100	122,900	123,800	124,600	125,400	126,300	127,100	128,000	128,800	1029.0
1028.9	113,100	113,900	114,700	115,500	116,300	117,100	118,000	118,800	119,600	120,400	121,200	122,100	122,900	123,700	124,600	125,400	126,200	127,100	127,900	128,800	129,600	1028.9
1028.8	113,800	114,600	115,500	116,300	117,100	117,900	118,700	119,600	120,400	121,200	122,000	122,900	123,700	124,500	125,400	126,200	127,100	127,900	128,700	129,600	130,400	1028.8
1028.7	114,600	115,400	116,200	117,100	117,900	118,700	119,500	120,300	121,200	122,000	122,800	123,700	124,500	125,300	126,200	127,000	127,900	128,700	129,600	130,400	131,200	1028.7
1028.6	115,400	116,200	117,000	117,800	118,700	119,500	120,300	121,100	122,000	122,800	123,600	124,500	125,300	126,100	127,000	127,800	128,700	129,500	130,400	131,200	132,100	1028.6
1028.5	116,200	117,000	117,800	118,600	119,500	120,300	121,100	121,900	122,800	123,600	124,400	125,300	126,100	127,000	127,800	128,600	129,500	130,300	131,200	132,000	132,900	1028.5
1028.4	117,000	117,800	118,600	119,400	120,200	121,100	121,900	122,700	123,600	124,400	125,200	126,100	126,900	127,800	128,600	129,500	130,300	131,200	132,000	132,900	133,700	1028.4
1028.3	117,700	118,600	119,400	120,200	121,000	121,900	122,700	123,500	124,400	125,200	126,000	126,900	127,700	128,600	129,400	130,300	131,100	132,000	132,800	133,700	134,500	1028.3
1028.2	118,500	119,300	120,200	121,000	121,800	122,700	123,500	124,300	125,200	126,000	126,900	127,700	128,500	129,400	130,200	131,100	131,900	132,800	133,600	134,500	135,400	1028.2
1028.1	119,300	120,100	121,000	121,800	122,600	123,500	124,300	125,100	126,000	126,800	127,700	128,500	129,400	130,200	131,100	131,900	132,800	133,600	134,500	135,300	136,200	1028.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1050.0	1050.1	1050.2	1050.3	1050.4	1050.5	1050.6	1050.7	1050.8	1050.9	1051.0	1051.1	1051.2	1051.3	1051.4	1051.5	1051.6	1051.7	1051.8	1051.9	1052.0	
1028.0	120,100	120,900	121,800	122,600	123,400	124,300	125,100	125,900	126,800	127,600	128,500	129,300	130,200	131,000	131,900	132,700	133,600	134,400	135,300	136,200	137,000	1028.0
1027.9	120,800	121,700	122,500	123,300	124,200	125,000	125,800	126,700	127,500	128,400	129,200	130,100	130,900	131,800	132,600	133,500	134,300	135,200	136,100	136,900	137,800	1027.9
1027.8	121,600	122,400	123,200	124,100	124,900	125,800	126,600	127,400	128,300	129,100	130,000	130,800	131,700	132,500	133,400	134,200	135,100	136,000	136,800	137,700	138,600	1027.8
1027.7	122,300	123,100	124,000	124,800	125,700	126,500	127,300	128,200	129,000	129,900	130,700	131,600	132,400	133,300	134,200	135,000	135,900	136,700	137,600	138,500	139,300	1027.7
1027.6	123,000	123,900	124,700	125,600	126,400	127,200	128,100	128,900	129,800	130,600	131,500	132,300	133,200	134,100	134,900	135,800	136,600	137,500	138,400	139,200	140,100	1027.6
1027.5	123,800	124,600	125,500	126,300	127,100	128,000	128,800	129,700	130,500	131,400	132,200	133,100	134,000	134,800	135,700	136,500	137,400	138,300	139,100	140,000	140,900	1027.5
1027.4	124,500	125,400	126,200	127,100	127,900	128,700	129,600	130,400	131,300	132,100	133,000	133,900	134,700	135,600	136,400	137,300	138,200	139,000	139,900	140,800	141,700	1027.4
1027.3	125,300	126,100	127,000	127,800	128,600	129,500	130,300	131,200	132,100	132,900	133,800	134,600	135,500	136,300	137,200	138,100	138,900	139,800	140,700	141,600	142,400	1027.3
1027.2	126,000	126,900	127,700	128,500	129,400	130,200	131,100	132,000	132,800	133,700	134,500	135,400	136,300	137,100	138,000	138,900	139,700	140,600	141,500	142,300	143,200	1027.2
1027.1	126,800	127,600	128,500	129,300	130,200	131,000	131,900	132,700	133,600	134,400	135,300	136,200	137,000	137,900	138,800	139,600	140,500	141,400	142,200	143,100	144,000	1027.1
1027.0	127,500	128,400	129,200	130,100	130,900	131,800	132,600	133,500	134,300	135,200	136,100	136,900	137,800	138,700	139,500	140,400	141,300	142,100	143,000	143,900	144,800	1027.0
1026.9	128,200	129,000	129,900	130,700	131,600	132,500	133,300	134,200	135,000	135,900	136,800	137,600	138,500	139,400	140,200	141,100	142,000	142,900	143,700	144,600	145,500	1026.9
1026.8	128,900	129,700	130,600	131,400	132,300	133,200	134,000	134,900	135,700	136,600	137,500	138,300	139,200	140,100	140,900	141,800	142,700	143,600	144,500	145,300	146,200	1026.8
1026.7	129,600	130,400	131,300	132,100	133,000	133,800	134,700	135,600	136,400	137,300	138,200	139,000	139,900	140,800	141,700	142,500	143,400	144,300	145,200	146,100	146,900	1026.7
1026.6	130,300	131,100	132,000	132,800	133,700	134,500	135,400	136,300	137,100	138,000	138,900	139,700	140,600	141,500	142,400	143,200	144,100	145,000	145,900	146,800	147,700	1026.6
1026.5	131,000	131,800	132,700	133,500	134,400	135,200	136,100	137,000	137,800	138,700	139,600	140,400	141,300	142,200	143,100	144,000	144,800	145,700	146,600	147,500	148,400	1026.5
1026.4	131,700	132,500	133,400	134,200	135,100	135,900	136,800	137,700	138,500	139,400	140,300	141,200	142,000	142,900	143,800	144,700	145,600	146,400	147,300	148,200	149,100	1026.4
1026.3	132,300	133,200	134,100	134,900	135,800	136,600	137,500	138,400	139,200	140,100	141,000	141,900	142,700	143,600	144,500	145,400	146,300	147,200	148,000	148,900	149,800	1026.3
1026.2	133,000	133,900	134,800	135,600	136,500	137,300	138,200	139,100	140,000	140,800	141,700	142,600	143,500	144,300	145,200	146,100	147,000	147,900	148,800	149,700	150,600	1026.2
1026.1	133,700	134,600	135,500	136,300	137,200	138,000	138,900	139,800	140,700	141,500	142,400	143,300	144,200	145,100	145,900	146,800	147,700	148,600	149,500	150,400	151,300	1026.1
1026.0	134,400	135,300	136,200	137,000	137,900	138,800	139,600	140,500	141,400	142,200	143,100	144,000	144,900	145,800	146,700	147,500	148,400	149,300	150,200	151,100	152,000	1026.0
1025.9	135,100	136,000	136,800	137,700	138,600	139,400	140,300	141,200	142,000	142,900	143,800	144,700	145,600	146,500	147,300	148,200	149,100	150,000	150,900	151,800	152,700	1025.9
1025.8	135,800	136,600	137,500	138,400	139,200	140,100	141,000	141,900	142,700	143,600	144,500	145,400	146,300	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,400	1025.8
1025.7	136,400	137,300	138,200	139,000	139,900	140,800	141,700	142,500	143,400	144,300	145,200	146,100	146,900	147,800	148,700	149,600	150,500	151,400	152,300	153,200	154,100	1025.7
1025.6	137,100	138,000	138,800	139,700	140,600	141,500	142,300	143,200	144,100	145,000	145,900	146,700	147,600	148,500	149,400	150,300	151,200	152,100	153,000	153,900	154,800	1025.6
1025.5	137,800	138,600	139,500	140,400	141,300	142,100	143,000	143,900	144,800	145,700	146,500	147,400	148,300	149,200	150,100	151,000	151,900	152,800	153,700	154,600	155,500	1025.5
1025.4	138,500	139,300	140,200	141,100	141,900	142,800	143,700	144,600	145,500	146,300	147,200	148,100	149,000	149,900	150,800	151,700	152,600	153,500	154,400	155,300	156,200	1025.4
1025.3	139,100	140,000	140,900	141,700	142,600	143,500	144,400	145,300	146,100	147,000	147,900	148,800	149,700	150,600	151,500	152,400	153,300	154,200	155,100	156,000	156,900	1025.3
1025.2	139,800	140,700	141,500	142,400	143,300	144,200	145,100	145,900	146,800	147,700	148,600	149,500	150,400	151,300	152,200	153,100	154,000	154,900	155,800	156,700	157,600	1025.2
1025.1	140,500	141,300	142,200	143,100	144,000	144,900	145,700	146,600	147,500	148,400	149,300	150,200	151,100	152,000	152,900	153,800	154,700	155,600	156,500	157,400	158,300	1025.1
1025.0	141,200	142,000	142,900	143,800	144,700	145,500	146,400	147,300	148,200	149,100	150,000	150,900	151,800	152,700	153,600	154,500	155,400	156,300	157,200	158,100	159,000	1025.0
1024.9	141,800	142,700	143,600	144,500	145,400	146,200	147,100	148,000	148,900	149,800	150,700	151,600	152,500	153,400	154,300	155,200	156,100	157,000	157,900	158,800	159,700	1024.9
1024.8	142,500	143,400	144,300	145,200	146,000	146,900	147,800	148,700	149,600	150,500	151,400	152,300	153,200	154,100	155,000	155,900	156,800	157,700	158,600	159,500	160,500	1024.8
1024.7	143,200	144,100	145,000	145,800	146,700	147,600	148,500	149,400	150,300	151,200	152,100	153,000	153,900	154,800	155,700	156,600	157,500	158,400	159,300	160,300	161,200	1024.7
1024.6	143,900	144,800	145,700	146,500	147,400	148,300	149,200	150,100	151,000	151,900	152,800	153,700	154,600	155,500	156,400	157,300	158,200	159,100	160,100	161,000	161,900	1024.6
1024.5	144,600	145,500	146,300	147,200	148,100	149,000	149,900	150,800	151,700	152,600	153,500	154,400	155,300	156,200	157,100	158,000	158,900	159,900	160,800	161,700	162,600	1024.5
1024.4	145,300	146,200	147,000	147,900	148,800	149,700	150,600	151,500	152,400	153,300	154,200	155,100	156,000	156,900	157,800	158,800	159,700	160,600	161,500	162,400	163,300	1024.4
1024.3	146,000	146,800	147,700	148,600	149,500	150,400	151,300	152,200	153,100	154,000	154,900	155,800	156,700	157,600	158,600	159,500	160,400	161,300	162,200	163,100	164,100	1024.3
1024.2	146,700	147,500	148,400	149,300	150,200	151,100	152,000	152,900	153,800	154,700	155,600	156,500	157,400	158,400	159,300	160,200	161,100	162,000	162,900	163,900	164,800	1024.2
1024.1	147,300	148,200	149,100	150,000	150,900	151,800	152,700	153,600	154,500	155,400	156,300	157,200	158,200	159,100	160,000	160,900	161,800	162,800	163,700	164,600	165,500	1024.1
1024.0	148,000	148,900	149,800	150,700	151,600	152,500	153,400	154,300	155,200	156,100	157,100	158,000	158,900	159,800	160,700	161,600	162,600	163,500	164,400	165,300	166,300	1024.0
1023.9	148,800	149,700	150,600	151,500	152,400	153,300	154,200	155,100	156,000	157,000	157,900	158,800	159,700	160,600	161,500	162,500	163,400	164,300	165,200	166,200	167,100	1023.9
1023.8	149,600	150,500	151,400	152,300	153,200	154,100	155,000	156,000	156,900	157,800	158,700	159,600	160,500	161,400	162,400	163,300	164,200	165,100	166,100	167,000	167,900	1023.8
1023.7	150,400	151,300	152,200	153,100	154,000	154,900	155,900	156,800	157,700	158,600	159,500	160,400	161,400	162,300	163,200	164,100	165,100	166,000	166,900	167,900	168,800	1023.7
1023.6	151,200	152,100	153,000	153,900	154,800	155,800	156,700	157,600	158,500	159,400	160,300	161,300	162,200	163,100	164,000	165,000	165,900	166,800	167,800	168,700	169,600	1023.6
1023.5	152,000	152,900	153,800	154,800	155,700	156,600	157,500	158,400	159,300	160,200	161,200	162,100	163,000	163,900	164,900	165,800	166,700	167,700	168,600	169,600	170,500	1023.5
1023.4	152,800	153,700	154,700	155,600	156,500	157,400	158,300	159,200	160,100	161,100	162,000	162,900	163,900	164,800	165,700	166,600	167,600	168,500	169,500	170,400	171,300	1023.4
1023.3	153,600	154,600	155,500	156,400	157,300	158,200	159,100	160,100	161,000	161,900	162,800	163,800	164,700	165,600	166,600	167,500	168,400	169,400	170,300	171,300	172,200	1023.3
1023.2	154,500	155,400	156,300	157,200	158,100	159,000	160,000	160,900	161,800	162,700	163,700	164,600	165,500	166,500	167,400	168,300	169,300	170,200	171,200	172,100	173,100	1023.2
1023.1	155,300	156,200	157,100	158,000	158,900	159,900	160,800	161,700	162,600	163,600	164,500	165,400	166,400	167,300	168,300	169,200	170,100	171,100	172,000	173,000	173,900	1023.1
1023.0	156,100	157,000	157,900	158,800	159,800	160,700	161,600	162,600	163,500	164,400	165,400	166,300	167,200	168,200	169,100	170,100	171,000	171,900	172,900	173,800	174,800	1023.0
1022.9	157,000	158,000	158,900	159,800	160,800	161,700	162,600	163,500	164,400	165,400	166,300	167,300	168,200	169,100	170,100	171,000	172,000	172,900	173,900	174,800	175,800	1022.9
1022.8	158,000	158,900	159,800	160,800	161,700	162,600	163,500	164,500	165,400	166,400	167,300	168,200	169,200	170,100	171,100	172,000	173,000	173,900	174,900	175,800	176,800	1022.8
1022.7	158,900	159,900	160,800	161,700	162,600	163,600	164,500	165,400	166,400	167,300	168,300	169,200	170,200	171,100	172,100	173,000	174,000	174,900	175,900	176,800	177,800	1022.7
1022.6	159,900	160,800	161,700	162,700	163,600	164,500	165,500	166,400	167,400	168,300	169,300	170,200	171,100	172,100	173,100	174,000	175,000	175,900	176,900	177,900	178,800	1022.6
1022.5	160,800	161,800	162,700	163,600	164,600	165,500	166,500	167,400	168,300	169,300	170,200	171,200	172,100	173,100	174,100	175,000	176,000	176,900	177,900	178,900	179,800	1022.5
1022.4	161,800	162,700	163,700	164,600	165,500	166,500	167,400	168,400	169,300	170,300	171,200	172,200	173,100	174,100	175,100	176,000	177,000	177,900	178,900	179,900	180,900	1022.4
1022.3	162,800	163,700	164,600	165,600	166,500	167,500	168,400	169,400	170,300	171,300	172,200	173,200	174,100	175,100	176,100	177,000	178,000	179,000	179,900	180,900	181,900	1022.3
1022.2	163,700	164,700	165,600	166,500	167,500	168,400	169,400	170,300	171,300	172,300	173,200	174,200	175,100	176,100	177,100	178,000	179,000	180,000	181,000	181,900	182,900	1022.2
1022.1	164,700	165,600	166,600	167,500	168,500	169,400	170,400	171,300	172,300	173,300	174,200	175,200	176,100	177,100	178,100	179,100	180,000	181,000	182,000	183,000	183,900	1022.1

NORRIS DAM

DISCHARGE FOR ALL SPILLWAYS AT IDENTICAL ELEVATIONS

IN CUBIC FEET PER SECOND

GATE ELEVATION IN FEET	HEADWATER ELEVATION																					GATE ELEVATION IN FEET
	1050.0	1050.1	1050.2	1050.3	1050.4	1050.5	1050.6	1050.7	1050.8	1050.9	1051.0	1051.1	1051.2	1051.3	1051.4	1051.5	1051.6	1051.7	1051.8	1051.9	1052.0	
1022.0	165,700	166,600	167,600	168,500	169,500	170,400	171,400	172,300	173,300	174,300	175,200	176,200	177,200	178,100	179,100	180,100	181,000	182,000	183,000	184,000	185,000	1022.0
1021.9	166,700	167,700	168,600	169,600	170,500	171,500	172,500	173,400	174,400	175,300	176,300	177,300	178,300	179,200	180,200	181,200	182,200	183,100	184,100	185,100	186,100	1021.9
1021.8	167,800	168,700	169,700	170,700	171,600	172,600	173,500	174,500	175,500	176,400	177,400	178,400	179,400	180,300	181,300	182,300	183,300	184,300	185,200	186,200	187,200	1021.8
1021.7	168,900	169,800	170,800	171,700	172,700	173,700	174,600	175,600	176,600	177,500	178,500	179,500	180,500	181,400	182,400	183,400	184,400	185,400	186,400	187,400	188,400	1021.7
1021.6	169,900	170,900	171,800	172,800	173,800	174,700	175,700	176,700	177,700	178,600	179,600	180,600	181,600	182,600	183,500	184,500	185,500	186,500	187,500	188,500	189,500	1021.6
1021.5	171,000	172,000	172,900	173,900	174,900	175,800	176,800	177,800	178,800	179,700	180,700	181,700	182,700	183,700	184,700	185,600	186,600	187,600	188,600	189,600	190,600	1021.5
1021.4	172,100	173,000	174,000	175,000	176,000	176,900	177,900	178,900	179,900	180,800	181,800	182,800	183,800	184,800	185,800	186,800	187,800	188,800	189,800	190,800	191,800	1021.4
1021.3	173,200	174,100	175,100	176,100	177,100	178,000	179,000	180,000	181,000	182,000	182,900	183,900	184,900	185,900	186,900	187,900	188,900	189,900	190,900	191,900	192,900	1021.3
1021.2	174,300	175,200	176,200	177,200	178,200	179,100	180,100	181,100	182,100	183,100	184,100	185,100	186,100	187,100	188,100	189,100	190,100	191,100	192,100	193,100	194,100	1021.2
1021.1	175,300	176,300	177,300	178,300	179,300	180,200	181,200	182,200	183,200	184,200	185,200	186,200	187,200	188,200	189,200	190,200	191,200	192,200	193,200	194,200	195,300	1021.1
1021.0	176,400	177,400	178,400	179,400	180,400	181,400	182,400	183,300	184,300	185,300	186,300	187,300	188,300	189,300	190,300	191,300	192,400	193,400	194,400	195,400	196,400	1021.0
1020.9	177,600	178,600	179,600	180,600	181,600	182,600	183,600	184,600	185,600	186,600	187,600	188,600	189,600	190,600	191,600	192,600	193,600	194,600	195,700	196,700	197,700	1020.9
1020.8	178,800	179,800	180,800	181,800	182,800	183,800	184,800	185,800	186,800	187,800	188,800	189,800	190,800	191,800	192,800	193,900	194,900	195,900	196,900	197,900	199,000	1020.8
1020.7	180,000	181,000	182,000	183,000	184,000	185,000	186,000	187,000	188,000	189,000	190,000	191,100	192,100	193,100	194,100	195,100	196,100	197,200	198,200	199,200	200,300	1020.7
1020.6	181,300	182,300	183,300	184,300	185,300	186,300	187,300	188,300	189,300	190,300	191,300	192,300	193,300	194,400	195,400	196,400	197,400	198,500	199,500	200,500	201,500	1020.6
1020.5	182,500	183,500	184,500	185,500	186,500	187,500	188,500	189,500	190,500	191,500	192,600	193,600	194,600	195,600	196,600	197,700	198,700	199,700	200,800	201,800	202,800	1020.5
1020.4	183,700	184,700	185,700	186,700	187,700	188,700	189,700	190,800	191,800	192,800	193,800	194,800	195,900	196,900	197,900	199,000	200,000	201,000	202,100	203,100	204,100	1020.4
1020.3	184,900	185,900	186,900	188,000	189,000	190,000	191,000	192,000	193,000	194,100	195,100	196,100	197,100	198,200	199,200	200,200	201,300	202,300	203,400	204,400	205,500	1020.3
1020.2	186,200	187,200	188,200	189,200	190,200	191,200	192,300	193,300	194,300	195,300	196,400	197,400	198,400	199,500	200,500	201,500	202,600	203,600	204,700	205,700	206,800	1020.2
1020.1	187,400	188,400	189,400	190,500	191,500	192,500	193,500	194,500	195,600	196,600	197,600	198,700	199,700	200,800	201,800	202,800	203,900	204,900	206,000	207,000	208,100	1020.1
1020.0	188,700	189,700	190,700	191,700	192,700	193,800	194,800	195,800	196,900	197,900	198,900	200,000	201,000	202,100	203,100	204,100	205,200	206,200	207,300	208,400	209,400	1020.0

THIS PAGE WAS
INTENTIONALLY
LEFT BLANK

PART 2

SLUICE DISCHARGE TABLES

MAY 2000

INSTRUCTIONS FOR USE OF TABLES

1. Tables Update

These tables supersede the tables dated October 1961. The revised discharges were generated using the computer code SPILLQ and are only slightly different from those in the 1961 tables.

2. Purpose of Tables

These tables provide a means of setting up or determining the discharge through the sluices in Norris Dam. They give the total discharge in cubic feet per second through all eight sluices when the headwater elevation and sluice gate openings are known. The discharges are based on the results of field measurements.

The tables have been prepared to permit simultaneous operation of all eight sluices shown on page 4 except for gate openings greater than 9.4 feet (explained in following section). Past operating experience has shown that simultaneous operation should be used to minimize damage to the apron, bank, riprap, and sluice conduits.

3. Cavitation-Imposed Limits on Gate Openings

Significant cavitation damage upstream from the emergency slide gates was discovered during inspections of Sluices 3 and 4 in the Spring of 1999. An analysis determined that this damage occurred during past operations when the sluices were operated at gate openings greater than about 8.6 feet. **To avoid further cavitation damage the sluices should not be opened above 8 feet except in emergency situations.** The limit is set at 8 feet, rather than 8.6 feet, to provide a factor of safety.

Also, because past operating experience has shown that cavitation damage to the gate seals may occur if the gates are set to openings smaller than 1 foot, the minimum acceptable opening for the gates is 1 foot.

In addition, gates 2, 4, 5, 7, and 8 should never be opened more than 9.4 feet because of cavitation danger related to flow past the intake gate slots.

4. Range of Tables

The tables cover a discharge range from 0 to 40,480 cubic feet per second. Headwater elevations range from 880 feet to 1052 feet. Sluice gate openings range from 1 foot, which is the minimum acceptable opening, to maximum openings of either 9.4 feet or 10 feet.

5. Arrangement of Tables

The sluice discharge tables show discharges in cubic feet per second for all sluices set at identical openings, except for openings greater than 9.4 feet as noted on each page. Gate opening positions in 0.1 foot increments are listed in the left and right columns. Headwater elevations for each foot of headwater elevation are shown at the top of each column. The headwater range is shown at the bottom of each page.

Discharges are recorded to the nearest 10 cubic feet per second since the accuracy of the field measurements does not warrant greater refinement. For this reason, there should be no interpolation between values given in these tables.

6. Use of Tables

The use of the tables is best illustrated by examples.

Example 1 -- With the headwater elevation at 991.52 feet what sluice gate settings are necessary to pass 19,000 cubic feet per second? The headwater elevation closest to 991.52 feet is 992 feet, which is found on pages 58 and 59. In the column headed 992 the discharge closest to 19,000 cubic feet per second is 19,120 cubic feet per second,

which is found near the middle of the column on page 59. By following the horizontal line containing this discharge to the left or right columns of the page, it is found that all eight sluice gates should be opened to position 6.5 feet.

Suppose the headwater elevation should rise from elevation 991.52 feet to 992.86 feet. The headwater elevation closest to 992.86 feet is 993 feet. In the column headed 993 the discharge is found to be 19,200 cubic feet per second.

Example 2 – With the headwater elevation at 979.21 feet what sluice gate settings are necessary to pass 31,000 cubic feet per second? The headwater elevation closest to 979.21 feet is 979 feet, which is found on pages 56 and 57. In the column headed 979 the discharge closest to 31,000 cubic feet per second is 30,980 cubic feet per second, which is found near the bottom of the column on page 57. This discharge is located below the warning that operating the sluices with gate openings above 8 feet may result in significant cavitation damage to the sluice conduit. Consequently, unless this is an emergency and no other options are available, all eight sluices should be opened to 8 feet, which will provide a discharge of 24,270 cubic feet per second. If this is an emergency, then by following the horizontal line containing the 30,980 cubic feet per second discharge to the left or right columns of the page, it is found that sluice gates 1, 3, and 6 should be opened to position 9.5 feet. The asterisks (*) in the left and right columns refer to the note at the bottom of the page, which indicates that gates 2, 4, 5, 7, and 8 should be opened only to position 9.4 feet.

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	1,140	1,170	1,190	1,220	1,250	1,280	1,300	1,330	1,350	1,380	1,400	1,430	1,450	1,470	1,500	1,520	1,540	1,560	1,590	1,610	1,630	1.0
1.1	1,240	1,270	1,300	1,330	1,360	1,390	1,420	1,450	1,480	1,500	1,530	1,560	1,580	1,610	1,630	1,660	1,680	1,710	1,730	1,750	1,780	1.1
1.2	1,340	1,370	1,410	1,440	1,470	1,500	1,540	1,570	1,600	1,630	1,660	1,680	1,710	1,740	1,770	1,790	1,820	1,850	1,870	1,900	1,920	1.2
1.3	1,440	1,470	1,510	1,550	1,580	1,620	1,650	1,680	1,720	1,750	1,780	1,810	1,840	1,870	1,900	1,930	1,960	1,980	2,010	2,040	2,060	1.3
1.4	1,530	1,570	1,610	1,650	1,690	1,730	1,760	1,800	1,830	1,870	1,900	1,930	1,960	2,000	2,030	2,060	2,090	2,120	2,150	2,180	2,210	1.4
1.5	1,630	1,670	1,710	1,750	1,790	1,830	1,870	1,910	1,950	1,980	2,020	2,050	2,090	2,120	2,160	2,190	2,220	2,250	2,290	2,320	2,350	1.5
1.6	1,720	1,770	1,810	1,860	1,900	1,940	1,980	2,020	2,060	2,100	2,140	2,170	2,210	2,250	2,280	2,320	2,350	2,390	2,420	2,450	2,490	1.6
1.7	1,810	1,860	1,910	1,960	2,000	2,050	2,090	2,130	2,170	2,210	2,250	2,290	2,330	2,370	2,410	2,450	2,480	2,520	2,550	2,590	2,620	1.7
1.8	1,900	1,960	2,010	2,060	2,100	2,150	2,200	2,240	2,280	2,330	2,370	2,410	2,450	2,490	2,530	2,570	2,610	2,650	2,690	2,720	2,760	1.8
1.9	1,990	2,050	2,100	2,150	2,200	2,250	2,300	2,350	2,400	2,440	2,490	2,530	2,570	2,610	2,660	2,700	2,740	2,780	2,820	2,860	2,890	1.9
2.0	2,080	2,140	2,200	2,250	2,300	2,360	2,410	2,460	2,500	2,550	2,600	2,650	2,690	2,740	2,780	2,820	2,860	2,910	2,950	2,990	3,030	2.0
2.1	2,170	2,230	2,290	2,350	2,400	2,460	2,510	2,560	2,610	2,660	2,710	2,760	2,810	2,860	2,900	2,950	2,990	3,030	3,080	3,120	3,160	2.1
2.2	2,260	2,320	2,380	2,440	2,500	2,560	2,610	2,670	2,720	2,770	2,830	2,880	2,930	2,970	3,020	3,070	3,120	3,160	3,210	3,250	3,300	2.2
2.3	2,350	2,410	2,480	2,540	2,600	2,660	2,720	2,770	2,830	2,890	2,940	2,990	3,040	3,090	3,140	3,190	3,240	3,290	3,340	3,380	3,430	2.3
2.4	2,440	2,500	2,570	2,640	2,700	2,760	2,820	2,880	2,940	3,000	3,050	3,110	3,160	3,210	3,260	3,320	3,370	3,420	3,460	3,510	3,560	2.4
2.5	2,520	2,590	2,660	2,730	2,800	2,860	2,920	2,990	3,050	3,110	3,160	3,220	3,280	3,330	3,390	3,440	3,490	3,540	3,590	3,640	3,690	2.5
2.6	2,610	2,680	2,760	2,830	2,890	2,960	3,030	3,090	3,150	3,210	3,280	3,330	3,390	3,450	3,510	3,560	3,620	3,670	3,720	3,770	3,830	2.6
2.7	2,700	2,770	2,850	2,920	2,990	3,060	3,130	3,200	3,260	3,320	3,390	3,450	3,510	3,570	3,630	3,680	3,740	3,800	3,850	3,910	3,960	2.7
2.8	2,780	2,860	2,940	3,020	3,090	3,160	3,230	3,300	3,370	3,440	3,500	3,560	3,630	3,690	3,750	3,810	3,870	3,920	3,980	4,040	4,090	2.8
2.9	2,870	2,950	3,030	3,110	3,190	3,260	3,340	3,410	3,480	3,550	3,610	3,680	3,740	3,810	3,870	3,930	3,990	4,050	4,110	4,170	4,230	2.9
3.0	2,960	3,040	3,130	3,210	3,290	3,360	3,440	3,510	3,590	3,660	3,730	3,790	3,860	3,930	3,990	4,060	4,120	4,180	4,240	4,300	4,360	3.0
3.1	3,040	3,130	3,220	3,300	3,380	3,460	3,540	3,620	3,690	3,770	3,840	3,910	3,980	4,050	4,120	4,180	4,250	4,310	4,370	4,440	4,500	3.1
3.2	3,130	3,220	3,310	3,400	3,480	3,570	3,650	3,730	3,800	3,880	3,950	4,030	4,100	4,170	4,240	4,310	4,370	4,440	4,510	4,570	4,630	3.2
3.3	3,220	3,310	3,410	3,500	3,580	3,670	3,750	3,830	3,910	3,990	4,070	4,140	4,220	4,290	4,360	4,430	4,500	4,570	4,640	4,700	4,770	3.3
3.4	3,310	3,400	3,500	3,590	3,680	3,770	3,860	3,940	4,020	4,110	4,180	4,260	4,340	4,410	4,490	4,560	4,630	4,700	4,770	4,840	4,910	3.4
3.5	3,390	3,500	3,590	3,690	3,780	3,870	3,960	4,050	4,140	4,220	4,300	4,380	4,460	4,540	4,610	4,690	4,760	4,840	4,910	4,980	5,050	3.5
3.6	3,480	3,590	3,690	3,790	3,880	3,980	4,070	4,160	4,250	4,330	4,420	4,500	4,580	4,660	4,740	4,820	4,890	4,970	5,040	5,120	5,190	3.6
3.7	3,570	3,680	3,780	3,890	3,990	4,080	4,180	4,270	4,360	4,450	4,540	4,620	4,710	4,790	4,870	4,950	5,030	5,100	5,180	5,260	5,330	3.7
3.8	3,660	3,770	3,880	3,990	4,090	4,190	4,290	4,380	4,470	4,570	4,660	4,740	4,830	4,920	5,000	5,080	5,160	5,240	5,320	5,400	5,470	3.8
3.9	3,750	3,870	3,980	4,090	4,190	4,290	4,390	4,490	4,590	4,680	4,780	4,870	4,960	5,040	5,130	5,210	5,300	5,380	5,460	5,540	5,620	3.9
4.0	3,840	3,960	4,070	4,190	4,290	4,400	4,500	4,610	4,700	4,800	4,900	4,990	5,080	5,170	5,260	5,350	5,430	5,520	5,600	5,680	5,760	4.0
4.1	3,930	4,050	4,170	4,290	4,400	4,510	4,620	4,720	4,820	4,920	5,020	5,120	5,210	5,300	5,390	5,480	5,570	5,660	5,740	5,830	5,910	4.1
4.2	4,020	4,150	4,270	4,390	4,500	4,620	4,730	4,830	4,940	5,040	5,140	5,240	5,340	5,430	5,530	5,620	5,710	5,800	5,890	5,970	6,060	4.2
4.3	4,120	4,250	4,370	4,490	4,610	4,730	4,840	4,950	5,060	5,160	5,270	5,370	5,470	5,570	5,660	5,760	5,850	5,940	6,030	6,120	6,210	4.3
4.4	4,210	4,340	4,470	4,600	4,720	4,840	4,950	5,070	5,180	5,290	5,390	5,500	5,600	5,700	5,800	5,890	5,990	6,080	6,180	6,270	6,360	4.4
4.5	4,300	4,440	4,570	4,700	4,830	4,950	5,070	5,180	5,300	5,410	5,520	5,630	5,730	5,830	5,940	6,040	6,130	6,230	6,320	6,420	6,510	4.5
4.6	4,400	4,540	4,670	4,810	4,930	5,060	5,180	5,300	5,420	5,530	5,650	5,760	5,860	5,970	6,070	6,180	6,280	6,380	6,470	6,570	6,670	4.6
4.7	4,490	4,630	4,770	4,910	5,040	5,170	5,300	5,420	5,540	5,660	5,770	5,890	6,000	6,110	6,210	6,320	6,420	6,520	6,620	6,720	6,820	4.7
4.8	4,590	4,730	4,880	5,020	5,150	5,290	5,420	5,540	5,660	5,790	5,900	6,020	6,130	6,250	6,360	6,460	6,570	6,670	6,780	6,880	6,980	4.8
4.9	4,680	4,830	4,980	5,120	5,260	5,400	5,530	5,660	5,790	5,910	6,030	6,150	6,270	6,390	6,500	6,610	6,720	6,820	6,930	7,030	7,140	4.9
5.0	4,780	4,930	5,090	5,230	5,380	5,520	5,650	5,780	5,910	6,040	6,170	6,290	6,410	6,530	6,640	6,760	6,870	6,980	7,080	7,190	7,300	5.0
5.1	4,870	5,030	5,190	5,340	5,490	5,630	5,770	5,910	6,040	6,170	6,300	6,420	6,550	6,670	6,790	6,900	7,020	7,130	7,240	7,350	7,460	5.1
5.2	4,970	5,130	5,290	5,450	5,600	5,750	5,890	6,030	6,170	6,300	6,430	6,560	6,690	6,810	6,930	7,050	7,170	7,280	7,400	7,510	7,620	5.2
5.3	5,070	5,240	5,400	5,560	5,710	5,870	6,010	6,160	6,300	6,430	6,570	6,700	6,830	6,960	7,080	7,200	7,320	7,440	7,560	7,670	7,780	5.3
5.4	5,160	5,340	5,510	5,670	5,830	5,980	6,130	6,280	6,430	6,570	6,700	6,840	6,970	7,100	7,230	7,350	7,480	7,600	7,720	7,840	7,950	5.4
5.5	5,260	5,440	5,610	5,780	5,940	6,100	6,260	6,410	6,560	6,700	6,840	6,980	7,110	7,250	7,380	7,510	7,630	7,760	7,880	8,000	8,120	5.5
5.6	5,360	5,540	5,720	5,890	6,060	6,220	6,380	6,540	6,690	6,830	6,980	7,120	7,260	7,400	7,530	7,660	7,790	7,920	8,040	8,170	8,290	5.6
5.7	5,460	5,650	5,830	6,010	6,180	6,340	6,510	6,660	6,820	6,970	7,120	7,260	7,410	7,550	7,680	7,820	7,950	8,080	8,210	8,330	8,460	5.7
5.8	5,560	5,750	5,940	6,120	6,290	6,470	6,630	6,790	6,950	7,110	7,260	7,410	7,550	7,700	7,840	7,970	8,110	8,240	8,370	8,500	8,630	5.8
5.9	5,660	5,860	6,050	6,230	6,410	6,590	6,760	6,920	7,090	7,240	7,400	7,550	7,700	7,850	7,990	8,130	8,270	8,410	8,540	8,670	8,800	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	
6.0	5,760	5,960	6,160	6,350	6,530	6,710	6,890	7,060	7,220	7,380	7,540	7,700	7,850	8,000	8,150	8,290	8,430	8,570	8,710	8,840	8,980	6.0
6.1	5,860	6,070	6,270	6,460	6,650	6,840	7,010	7,190	7,360	7,520	7,690	7,850	8,000	8,150	8,300	8,450	8,600	8,740	8,880	9,020	9,150	6.1
6.2	5,960	6,180	6,380	6,580	6,770	6,960	7,140	7,320	7,490	7,660	7,830	7,990	8,150	8,310	8,460	8,610	8,760	8,910	9,050	9,190	9,330	6.2
6.3	6,070	6,280	6,490	6,700	6,890	7,090	7,270	7,460	7,630	7,810	7,980	8,140	8,310	8,470	8,620	8,780	8,930	9,080	9,230	9,370	9,510	6.3
6.4	6,170	6,390	6,610	6,810	7,020	7,210	7,400	7,590	7,770	7,950	8,130	8,300	8,460	8,630	8,790	8,940	9,100	9,250	9,400	9,550	9,690	6.4
6.5	6,270	6,500	6,720	6,930	7,140	7,340	7,540	7,730	7,910	8,100	8,270	8,450	8,620	8,790	8,950	9,110	9,270	9,430	9,580	9,730	9,880	6.5
6.6	6,380	6,610	6,830	7,050	7,260	7,470	7,670	7,870	8,060	8,240	8,420	8,600	8,780	8,950	9,120	9,280	9,440	9,600	9,760	9,910	10,070	6.6
6.7	6,480	6,720	6,950	7,170	7,390	7,600	7,810	8,010	8,200	8,390	8,580	8,760	8,940	9,110	9,280	9,450	9,620	9,780	9,940	10,100	10,250	6.7
6.8	6,590	6,830	7,070	7,300	7,520	7,730	7,940	8,150	8,350	8,540	8,730	8,920	9,100	9,280	9,450	9,630	9,800	9,960	10,130	10,290	10,440	6.8
6.9	6,690	6,940	7,190	7,420	7,650	7,870	8,080	8,290	8,490	8,690	8,890	9,080	9,260	9,450	9,630	9,800	9,980	10,150	10,310	10,480	10,640	6.9
7.0	6,800	7,060	7,310	7,540	7,780	8,000	8,220	8,440	8,640	8,850	9,050	9,240	9,430	9,620	9,800	9,980	10,160	10,330	10,500	10,670	10,840	7.0
7.1	6,910	7,170	7,430	7,670	7,910	8,140	8,360	8,580	8,800	9,000	9,210	9,410	9,600	9,790	9,980	10,160	10,340	10,520	10,690	10,870	11,040	7.1
7.2	7,020	7,290	7,550	7,800	8,040	8,280	8,510	8,730	8,950	9,160	9,370	9,570	9,770	9,970	10,160	10,350	10,530	10,710	10,890	11,070	11,240	7.2
7.3	7,130	7,410	7,670	7,930	8,180	8,420	8,660	8,880	9,110	9,320	9,540	9,740	9,950	10,150	10,340	10,530	10,720	10,910	11,090	11,270	11,450	7.3
7.4	7,250	7,530	7,800	8,060	8,320	8,560	8,800	9,040	9,270	9,490	9,710	9,920	10,130	10,330	10,530	10,730	10,920	11,110	11,290	11,480	11,660	7.4
7.5	7,360	7,650	7,930	8,200	8,460	8,710	8,960	9,200	9,430	9,660	9,880	10,100	10,310	10,520	10,720	10,920	11,120	11,310	11,500	11,690	11,870	7.5
7.6	7,480	7,780	8,060	8,340	8,600	8,860	9,110	9,360	9,600	9,830	10,050	10,280	10,490	10,710	10,920	11,120	11,320	11,520	11,710	11,900	12,090	7.6
7.7	7,600	7,900	8,200	8,480	8,750	9,010	9,270	9,520	9,770	10,000	10,240	10,460	10,680	10,900	11,120	11,320	11,530	11,730	11,930	12,130	12,320	7.7
7.8	7,720	8,030	8,330	8,620	8,900	9,170	9,430	9,690	9,940	10,180	10,420	10,650	10,880	11,100	11,320	11,530	11,740	11,950	12,150	12,350	12,550	7.8
7.9	7,850	8,170	8,470	8,770	9,060	9,330	9,600	9,860	10,120	10,370	10,610	10,850	11,080	11,310	11,530	11,750	11,960	12,170	12,380	12,590	12,790	7.9
8.0	7,980	8,310	8,620	8,920	9,210	9,500	9,770	10,040	10,300	10,560	10,810	11,050	11,290	11,520	11,750	11,970	12,190	12,410	12,620	12,830	13,030	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	8,110	8,450	8,770	9,080	9,380	9,670	9,950	10,220	10,490	10,750	11,010	11,250	11,500	11,740	11,970	12,200	12,420	12,640	12,860	13,070	13,280	8.1
8.2	8,250	8,590	8,920	9,240	9,550	9,840	10,130	10,410	10,690	10,950	11,210	11,470	11,720	11,960	12,200	12,430	12,660	12,890	13,110	13,330	13,540	8.2
8.3	8,390	8,740	9,080	9,410	9,720	10,030	10,320	10,610	10,890	11,160	11,430	11,690	11,940	12,190	12,440	12,680	12,910	13,140	13,370	13,590	13,810	8.3
8.4	8,530	8,890	9,240	9,570	9,900	10,210	10,510	10,800	11,090	11,370	11,640	11,910	12,170	12,430	12,680	12,920	13,160	13,400	13,630	13,860	14,080	8.4
8.5	8,660	9,020	9,380	9,720	10,050	10,370	10,680	10,980	11,270	11,560	11,840	12,110	12,370	12,630	12,890	13,140	13,390	13,630	13,860	14,100	14,330	8.5
8.6	8,770	9,140	9,500	9,850	10,190	10,510	10,830	11,140	11,440	11,730	12,010	12,290	12,560	12,830	13,090	13,340	13,590	13,840	14,080	14,320	14,550	8.6
8.7	8,870	9,250	9,620	9,980	10,320	10,650	10,970	11,290	11,590	11,890	12,180	12,460	12,740	13,010	13,270	13,530	13,790	14,040	14,280	14,520	14,760	8.7
8.8	8,970	9,360	9,740	10,100	10,450	10,790	11,110	11,430	11,740	12,050	12,340	12,630	12,910	13,180	13,450	13,720	13,980	14,230	14,480	14,730	14,970	8.8
8.9	9,070	9,470	9,850	10,220	10,580	10,920	11,260	11,580	11,900	12,210	12,510	12,800	13,080	13,360	13,640	13,910	14,170	14,430	14,690	14,940	15,180	8.9
9.0	9,170	9,580	9,970	10,350	10,710	11,070	11,410	11,740	12,060	12,370	12,680	12,970	13,270	13,550	13,830	14,110	14,370	14,640	14,900	15,150	15,400	9.0
9.1	9,280	9,700	10,100	10,480	10,850	11,210	11,560	11,900	12,220	12,540	12,850	13,160	13,450	13,750	14,030	14,310	14,580	14,850	15,110	15,370	15,630	9.1
9.2	9,390	9,820	10,220	10,620	10,990	11,360	11,710	12,060	12,390	12,720	13,030	13,340	13,650	13,940	14,230	14,520	14,790	15,070	15,340	15,600	15,860	9.2
9.3	9,500	9,930	10,350	10,750	11,130	11,510	11,870	12,220	12,560	12,890	13,210	13,530	13,840	14,140	14,430	14,720	15,000	15,280	15,560	15,830	16,090	9.3
9.4	9,600	10,040	10,470	10,870	11,270	11,650	12,010	12,370	12,720	13,050	13,380	13,700	14,020	14,320	14,620	14,920	15,210	15,490	15,770	16,040	16,310	9.4
9.5*	9,620	10,060	10,490	10,900	11,290	11,680	12,040	12,400	12,750	13,090	13,420	13,740	14,060	14,370	14,670	14,960	15,250	15,540	15,820	16,090	16,360	9.5*
9.6*	9,630	10,080	10,510	10,920	11,320	11,700	12,070	12,430	12,780	13,120	13,450	13,780	14,090	14,400	14,700	15,000	15,290	15,580	15,860	16,130	16,400	9.6*
9.7*	9,640	10,090	10,520	10,940	11,330	11,720	12,090	12,450	12,800	13,150	13,480	13,800	14,120	14,430	14,740	15,030	15,330	15,610	15,890	16,170	16,440	9.7*
9.8*	9,650	10,100	10,530	10,950	11,350	11,740	12,110	12,470	12,820	13,170	13,500	13,830	14,150	14,460	14,760	15,060	15,350	15,640	15,920	16,200	16,470	9.8*
9.9*	9,660	10,110	10,540	10,960	11,360	11,750	12,120	12,490	12,840	13,180	13,520	13,850	14,170	14,480	14,780	15,080	15,380	15,670	15,950	16,230	16,500	9.9*
10.0*	9,660	10,110	10,540	10,960	11,370	11,750	12,130	12,490	12,850	13,190	13,530	13,860	14,180	14,490	14,800	15,100	15,390	15,680	15,970	16,250	16,520	10.0*

MAY 2000

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

HEADWATER 880 to 900

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	1,630	1,650	1,670	1,690	1,710	1,730	1,750	1,770	1,790	1,810	1,820	1,840	1,860	1,880	1,900	1,920	1,930	1,950	1,970	1,990	2,000	1.0
1.1	1,780	1,800	1,820	1,840	1,860	1,890	1,910	1,930	1,950	1,970	1,990	2,010	2,030	2,050	2,070	2,090	2,110	2,130	2,150	2,170	2,180	1.1
1.2	1,920	1,950	1,970	1,990	2,020	2,040	2,060	2,090	2,110	2,130	2,150	2,180	2,200	2,220	2,240	2,260	2,280	2,300	2,320	2,340	2,370	1.2
1.3	2,060	2,090	2,120	2,140	2,170	2,190	2,220	2,240	2,270	2,290	2,320	2,340	2,360	2,390	2,410	2,430	2,450	2,480	2,500	2,520	2,540	1.3
1.4	2,210	2,240	2,260	2,290	2,320	2,350	2,370	2,400	2,420	2,450	2,480	2,500	2,530	2,550	2,580	2,600	2,620	2,650	2,670	2,700	2,720	1.4
1.5	2,350	2,380	2,410	2,440	2,470	2,490	2,520	2,550	2,580	2,610	2,630	2,660	2,690	2,710	2,740	2,770	2,790	2,820	2,840	2,870	2,890	1.5
1.6	2,490	2,520	2,550	2,580	2,610	2,640	2,670	2,700	2,730	2,760	2,790	2,820	2,850	2,880	2,900	2,930	2,960	2,990	3,010	3,040	3,070	1.6
1.7	2,620	2,660	2,690	2,720	2,760	2,790	2,820	2,850	2,880	2,910	2,950	2,980	3,010	3,040	3,060	3,090	3,120	3,150	3,180	3,210	3,240	1.7
1.8	2,760	2,790	2,830	2,870	2,900	2,930	2,970	3,000	3,030	3,070	3,100	3,130	3,160	3,190	3,230	3,260	3,290	3,320	3,350	3,380	3,410	1.8
1.9	2,890	2,930	2,970	3,010	3,040	3,080	3,110	3,150	3,180	3,220	3,250	3,290	3,320	3,350	3,380	3,420	3,450	3,480	3,510	3,540	3,570	1.9
2.0	3,030	3,070	3,110	3,150	3,180	3,220	3,260	3,300	3,330	3,370	3,400	3,440	3,470	3,510	3,540	3,580	3,610	3,640	3,680	3,710	3,740	2.0
2.1	3,160	3,200	3,240	3,280	3,320	3,360	3,400	3,440	3,480	3,520	3,550	3,590	3,630	3,660	3,700	3,740	3,770	3,810	3,840	3,870	3,910	2.1
2.2	3,300	3,340	3,380	3,420	3,470	3,510	3,550	3,590	3,630	3,670	3,710	3,740	3,780	3,820	3,860	3,890	3,930	3,970	4,000	4,040	4,070	2.2
2.3	3,430	3,470	3,520	3,560	3,610	3,650	3,690	3,730	3,770	3,820	3,860	3,900	3,940	3,980	4,010	4,050	4,090	4,130	4,170	4,200	4,240	2.3
2.4	3,560	3,610	3,650	3,700	3,750	3,790	3,830	3,880	3,920	3,960	4,010	4,050	4,090	4,130	4,170	4,210	4,250	4,290	4,330	4,370	4,410	2.4
2.5	3,690	3,740	3,790	3,840	3,890	3,930	3,980	4,020	4,070	4,110	4,160	4,200	4,240	4,290	4,330	4,370	4,410	4,450	4,490	4,530	4,570	2.5
2.6	3,830	3,880	3,930	3,980	4,030	4,070	4,120	4,170	4,220	4,260	4,310	4,350	4,400	4,440	4,490	4,530	4,570	4,610	4,660	4,700	4,740	2.6
2.7	3,960	4,010	4,060	4,120	4,170	4,220	4,270	4,320	4,360	4,410	4,460	4,510	4,550	4,600	4,640	4,690	4,730	4,780	4,820	4,860	4,910	2.7
2.8	4,090	4,150	4,200	4,250	4,310	4,360	4,410	4,460	4,510	4,560	4,610	4,660	4,710	4,750	4,800	4,850	4,890	4,940	4,990	5,030	5,080	2.8
2.9	4,230	4,280	4,340	4,390	4,450	4,500	4,560	4,610	4,660	4,710	4,760	4,810	4,860	4,910	4,960	5,010	5,060	5,100	5,150	5,200	5,240	2.9
3.0	4,360	4,420	4,480	4,540	4,590	4,650	4,700	4,760	4,810	4,860	4,920	4,970	5,020	5,070	5,120	5,170	5,220	5,270	5,320	5,370	5,410	3.0
3.1	4,500	4,560	4,620	4,680	4,730	4,790	4,850	4,910	4,960	5,020	5,070	5,120	5,180	5,230	5,280	5,330	5,380	5,440	5,490	5,540	5,580	3.1
3.2	4,630	4,700	4,760	4,820	4,880	4,940	5,000	5,050	5,110	5,170	5,220	5,280	5,340	5,390	5,440	5,500	5,550	5,600	5,650	5,710	5,760	3.2
3.3	4,770	4,830	4,900	4,960	5,020	5,080	5,150	5,210	5,260	5,320	5,380	5,440	5,500	5,550	5,610	5,660	5,720	5,770	5,820	5,880	5,930	3.3
3.4	4,910	4,980	5,040	5,110	5,170	5,230	5,300	5,360	5,420	5,480	5,540	5,600	5,660	5,710	5,770	5,830	5,880	5,940	6,000	6,050	6,100	3.4
3.5	5,050	5,120	5,180	5,250	5,320	5,380	5,450	5,510	5,570	5,640	5,700	5,760	5,820	5,880	5,940	6,000	6,050	6,110	6,170	6,220	6,280	3.5
3.6	5,190	5,260	5,330	5,400	5,470	5,530	5,600	5,670	5,730	5,790	5,860	5,920	5,980	6,040	6,100	6,170	6,220	6,280	6,340	6,400	6,460	3.6
3.7	5,330	5,400	5,470	5,550	5,620	5,680	5,750	5,820	5,890	5,950	6,020	6,080	6,150	6,210	6,270	6,340	6,400	6,460	6,520	6,580	6,640	3.7
3.8	5,470	5,550	5,620	5,690	5,770	5,840	5,910	5,980	6,050	6,120	6,180	6,250	6,310	6,380	6,440	6,510	6,570	6,630	6,700	6,760	6,820	3.8
3.9	5,620	5,690	5,770	5,850	5,920	5,990	6,070	6,140	6,210	6,280	6,350	6,420	6,480	6,550	6,620	6,680	6,750	6,810	6,880	6,940	7,000	3.9
4.0	5,760	5,840	5,920	6,000	6,070	6,150	6,220	6,300	6,370	6,440	6,510	6,580	6,650	6,720	6,790	6,860	6,930	6,990	7,060	7,120	7,190	4.0
4.1	5,910	5,990	6,070	6,150	6,230	6,310	6,380	6,460	6,530	6,610	6,680	6,750	6,830	6,900	6,970	7,040	7,100	7,170	7,240	7,310	7,370	4.1
4.2	6,060	6,140	6,220	6,310	6,390	6,470	6,550	6,620	6,700	6,780	6,850	6,930	7,000	7,070	7,140	7,220	7,290	7,360	7,430	7,490	7,560	4.2
4.3	6,210	6,290	6,380	6,460	6,550	6,630	6,710	6,790	6,870	6,950	7,020	7,100	7,170	7,250	7,320	7,400	7,470	7,540	7,610	7,680	7,750	4.3
4.4	6,360	6,450	6,530	6,620	6,710	6,790	6,870	6,960	7,040	7,120	7,200	7,270	7,350	7,430	7,510	7,580	7,660	7,730	7,800	7,870	7,950	4.4
4.5	6,510	6,600	6,690	6,780	6,870	6,950	7,040	7,120	7,210	7,290	7,370	7,450	7,530	7,610	7,690	7,770	7,840	7,920	7,990	8,070	8,140	4.5
4.6	6,670	6,760	6,850	6,940	7,030	7,120	7,210	7,290	7,380	7,460	7,550	7,630	7,710	7,790	7,870	7,950	8,030	8,110	8,190	8,260	8,340	4.6
4.7	6,820	6,920	7,010	7,100	7,200	7,290	7,380	7,470	7,550	7,640	7,730	7,810	7,900	7,980	8,060	8,140	8,220	8,300	8,380	8,460	8,540	4.7
4.8	6,980	7,080	7,170	7,270	7,360	7,460	7,550	7,640	7,730	7,820	7,910	7,990	8,080	8,170	8,250	8,330	8,420	8,500	8,580	8,660	8,740	4.8
4.9	7,140	7,240	7,340	7,440	7,530	7,630	7,720	7,820	7,910	8,000	8,090	8,180	8,270	8,350	8,440	8,530	8,610	8,690	8,780	8,860	8,940	4.9
5.0	7,300	7,400	7,500	7,600	7,700	7,800	7,900	7,990	8,090	8,180	8,270	8,360	8,460	8,540	8,630	8,720	8,810	8,890	8,980	9,060	9,150	5.0
5.1	7,460	7,560	7,670	7,770	7,870	7,970	8,070	8,170	8,270	8,360	8,460	8,550	8,650	8,740	8,830	8,920	9,010	9,090	9,180	9,270	9,350	5.1
5.2	7,620	7,730	7,840	7,940	8,050	8,150	8,250	8,350	8,450	8,550	8,650	8,740	8,840	8,930	9,020	9,120	9,210	9,300	9,390	9,480	9,560	5.2
5.3	7,780	7,900	8,010	8,110	8,220	8,330	8,430	8,530	8,640	8,740	8,840	8,930	9,030	9,130	9,220	9,320	9,410	9,500	9,590	9,680	9,770	5.3
5.4	7,950	8,060	8,180	8,290	8,400	8,510	8,610	8,720	8,820	8,930	9,030	9,130	9,230	9,330	9,420	9,520	9,610	9,710	9,800	9,900	9,990	5.4
5.5	8,120	8,230	8,350	8,460	8,580	8,690	8,800	8,900	9,010	9,120	9,220	9,320	9,420	9,530	9,630	9,720	9,820	9,920	10,010	10,110	10,200	5.5
5.6	8,290	8,410	8,520	8,640	8,760	8,870	8,980	9,090	9,200	9,310	9,410	9,520	9,620	9,730	9,830	9,930	10,030	10,130	10,230	10,320	10,420	5.6
5.7	8,460	8,580	8,700	8,820	8,940	9,050	9,170	9,280	9,390	9,500	9,610	9,720	9,830	9,930	10,040	10,140	10,240	10,340	10,440	10,540	10,640	5.7
5.8	8,630	8,750	8,880	9,000	9,120	9,240	9,360	9,470	9,590	9,700	9,810	9,920	10,030	10,140	10,240	10,350	10,450	10,560	10,660	10,760	10,860	5.8
5.9	8,800	8,930	9,060	9,180	9,300	9,430	9,550	9,660	9,780	9,900	10,010	10,120	10,230	10,350	10,450	10,560	10,670	10,780	10,880	10,980	11,090	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	
6.0	8,980	9,110	9,240	9,370	9,490	9,610	9,740	9,860	9,980	10,100	10,210	10,330	10,440	10,560	10,670	10,780	10,890	11,000	11,100	11,210	11,310	6.0
6.1	9,150	9,290	9,420	9,550	9,680	9,810	9,930	10,050	10,180	10,300	10,420	10,540	10,650	10,770	10,880	10,990	11,110	11,220	11,330	11,440	11,540	6.1
6.2	9,330	9,470	9,600	9,740	9,870	10,000	10,130	10,250	10,380	10,500	10,620	10,740	10,860	10,980	11,100	11,210	11,330	11,440	11,550	11,660	11,770	6.2
6.3	9,510	9,650	9,790	9,930	10,060	10,190	10,320	10,450	10,580	10,710	10,830	10,960	11,080	11,200	11,320	11,440	11,550	11,670	11,780	11,900	12,010	6.3
6.4	9,690	9,840	9,980	10,120	10,260	10,390	10,520	10,660	10,790	10,920	11,040	11,170	11,290	11,420	11,540	11,660	11,780	11,900	12,010	12,130	12,240	6.4
6.5	9,880	10,030	10,170	10,310	10,450	10,590	10,730	10,860	11,000	11,130	11,260	11,390	11,510	11,640	11,760	11,890	12,010	12,130	12,250	12,370	12,480	6.5
6.6	10,070	10,210	10,360	10,510	10,650	10,790	10,930	11,070	11,210	11,340	11,470	11,600	11,730	11,860	11,990	12,120	12,240	12,360	12,490	12,610	12,730	6.6
6.7	10,250	10,410	10,560	10,710	10,850	11,000	11,140	11,280	11,420	11,560	11,690	11,830	11,960	12,090	12,220	12,350	12,480	12,600	12,730	12,850	12,970	6.7
6.8	10,440	10,600	10,750	10,910	11,060	11,200	11,350	11,490	11,640	11,780	11,910	12,050	12,190	12,320	12,450	12,590	12,720	12,840	12,970	13,100	13,220	6.8
6.9	10,640	10,800	10,960	11,110	11,260	11,410	11,560	11,710	11,850	12,000	12,140	12,280	12,420	12,560	12,690	12,820	12,960	13,090	13,220	13,350	13,470	6.9
7.0	10,840	11,000	11,160	11,320	11,470	11,630	11,780	11,930	12,080	12,220	12,370	12,510	12,650	12,790	12,930	13,070	13,200	13,340	13,470	13,600	13,730	7.0
7.1	11,040	11,200	11,370	11,530	11,690	11,840	12,000	12,150	12,300	12,450	12,600	12,750	12,890	13,030	13,180	13,320	13,450	13,590	13,730	13,860	13,990	7.1
7.2	11,240	11,410	11,580	11,740	11,900	12,060	12,220	12,380	12,530	12,690	12,840	12,990	13,130	13,280	13,420	13,570	13,710	13,850	13,990	14,120	14,260	7.2
7.3	11,450	11,620	11,790	11,960	12,130	12,290	12,450	12,610	12,770	12,920	13,080	13,230	13,380	13,530	13,680	13,820	13,970	14,110	14,250	14,390	14,530	7.3
7.4	11,660	11,830	12,010	12,180	12,350	12,520	12,680	12,850	13,010	13,170	13,320	13,480	13,630	13,790	13,940	14,090	14,230	14,380	14,520	14,670	14,810	7.4
7.5	11,870	12,050	12,230	12,410	12,580	12,750	12,920	13,090	13,250	13,420	13,580	13,730	13,890	14,050	14,200	14,350	14,500	14,650	14,800	14,940	15,090	7.5
7.6	12,090	12,280	12,460	12,640	12,820	12,990	13,160	13,330	13,500	13,670	13,830	14,000	14,160	14,310	14,470	14,630	14,780	14,930	15,080	15,230	15,380	7.6
7.7	12,320	12,510	12,690	12,880	13,060	13,240	13,410	13,590	13,760	13,930	14,100	14,260	14,430	14,590	14,750	14,910	15,060	15,220	15,370	15,520	15,670	7.7
7.8	12,550	12,740	12,930	13,120	13,310	13,490	13,670	13,850	14,020	14,200	14,370	14,540	14,700	14,870	15,030	15,190	15,350	15,510	15,670	15,820	15,980	7.8
7.9	12,790	12,980	13,180	13,370	13,560	13,750	13,930	14,110	14,290	14,470	14,640	14,820	14,990	15,160	15,320	15,490	15,650	15,810	15,970	16,130	16,290	7.9
8.0	13,030	13,230	13,430	13,630	13,820	14,010	14,200	14,390	14,570	14,750	14,930	15,110	15,280	15,450	15,620	15,790	15,960	16,130	16,290	16,450	16,610	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	13,280	13,490	13,690	13,890	14,090	14,290	14,480	14,670	14,860	15,040	15,220	15,400	15,580	15,760	15,930	16,110	16,280	16,450	16,610	16,780	16,940	8.1
8.2	13,540	13,760	13,960	14,170	14,370	14,570	14,770	14,960	15,150	15,340	15,530	15,710	15,900	16,080	16,250	16,430	16,610	16,780	16,950	17,120	17,290	8.2
8.3	13,810	14,030	14,240	14,450	14,660	14,860	15,060	15,260	15,460	15,650	15,840	16,030	16,220	16,400	16,590	16,770	16,940	17,120	17,300	17,470	17,640	8.3
8.4	14,080	14,300	14,520	14,740	14,950	15,160	15,360	15,570	15,770	15,960	16,160	16,350	16,540	16,730	16,920	17,100	17,280	17,470	17,640	17,820	18,000	8.4
8.5	14,330	14,550	14,770	14,990	15,210	15,420	15,630	15,840	16,040	16,240	16,440	16,640	16,840	17,030	17,220	17,410	17,590	17,780	17,960	18,140	18,320	8.5
8.6	14,550	14,780	15,010	15,230	15,450	15,670	15,880	16,090	16,300	16,500	16,710	16,910	17,110	17,300	17,490	17,690	17,880	18,060	18,250	18,430	18,610	8.6
8.7	14,760	14,990	15,230	15,450	15,680	15,900	16,110	16,330	16,540	16,750	16,960	17,160	17,360	17,560	17,760	17,950	18,150	18,340	18,530	18,710	18,900	8.7
8.8	14,970	15,210	15,440	15,670	15,900	16,120	16,350	16,560	16,780	16,990	17,200	17,410	17,610	17,820	18,020	18,220	18,410	18,610	18,800	18,990	19,180	8.8
8.9	15,180	15,420	15,660	15,900	16,130	16,360	16,580	16,800	17,020	17,240	17,450	17,660	17,870	18,080	18,280	18,480	18,680	18,880	19,080	19,270	19,460	8.9
9.0	15,400	15,650	15,890	16,130	16,370	16,600	16,830	17,050	17,280	17,500	17,710	17,930	18,140	18,350	18,560	18,760	18,960	19,170	19,360	19,560	19,760	9.0
9.1	15,630	15,880	16,130	16,370	16,610	16,850	17,080	17,310	17,540	17,760	17,980	18,200	18,420	18,630	18,840	19,050	19,250	19,460	19,660	19,860	20,060	9.1
9.2	15,860	16,120	16,370	16,610	16,860	17,100	17,340	17,570	17,800	18,030	18,250	18,480	18,700	18,910	19,130	19,340	19,550	19,760	19,960	20,170	20,370	9.2
9.3	16,090	16,350	16,610	16,860	17,110	17,350	17,590	17,830	18,060	18,300	18,530	18,750	18,980	19,200	19,410	19,630	19,840	20,060	20,260	20,470	20,680	9.3
9.4	16,310	16,580	16,840	17,090	17,340	17,590	17,840	18,080	18,320	18,560	18,790	19,020	19,250	19,470	19,690	19,910	20,130	20,340	20,560	20,770	20,970	9.4
9.5*	16,360	16,630	16,890	17,140	17,400	17,650	17,890	18,140	18,380	18,610	18,850	19,080	19,310	19,530	19,760	19,980	20,190	20,410	20,620	20,830	21,040	9.5*
9.6*	16,400	16,670	16,930	17,190	17,450	17,700	17,940	18,190	18,430	18,670	18,900	19,130	19,360	19,590	19,810	20,030	20,250	20,470	20,680	20,900	21,100	9.6*
9.7*	16,440	16,710	16,970	17,230	17,490	17,740	17,990	18,230	18,470	18,710	18,950	19,180	19,410	19,640	19,860	20,080	20,300	20,520	20,740	20,950	21,160	9.7*
9.8*	16,470	16,740	17,010	17,270	17,520	17,780	18,020	18,270	18,510	18,750	18,990	19,220	19,450	19,680	19,900	20,130	20,350	20,570	20,780	20,990	21,210	9.8*
9.9*	16,500	16,770	17,040	17,300	17,550	17,810	18,060	18,300	18,540	18,780	19,020	19,260	19,490	19,710	19,940	20,160	20,380	20,600	20,820	21,030	21,240	9.9*
10.0*	16,520	16,790	17,060	17,320	17,570	17,830	18,080	18,330	18,570	18,810	19,050	19,280	19,510	19,740	19,970	20,190	20,410	20,630	20,850	21,060	21,270	10.0*

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	2,000	2,020	2,040	2,050	2,070	2,090	2,100	2,120	2,130	2,150	2,170	2,180	2,200	2,210	2,230	2,240	2,260	2,270	2,290	2,300	2,320	1.0
1.1	2,180	2,200	2,220	2,240	2,260	2,280	2,290	2,310	2,330	2,350	2,360	2,380	2,400	2,410	2,430	2,450	2,460	2,480	2,500	2,510	2,530	1.1
1.2	2,370	2,390	2,410	2,420	2,440	2,460	2,480	2,500	2,520	2,540	2,560	2,580	2,600	2,610	2,630	2,650	2,670	2,690	2,700	2,720	2,740	1.2
1.3	2,540	2,560	2,590	2,610	2,630	2,650	2,670	2,690	2,710	2,730	2,750	2,770	2,790	2,810	2,830	2,850	2,870	2,890	2,910	2,930	2,940	1.3
1.4	2,720	2,740	2,760	2,790	2,810	2,830	2,850	2,880	2,900	2,920	2,940	2,960	2,980	3,010	3,030	3,050	3,070	3,090	3,110	3,130	3,150	1.4
1.5	2,890	2,920	2,940	2,970	2,990	3,010	3,040	3,060	3,080	3,110	3,130	3,150	3,180	3,200	3,220	3,240	3,260	3,290	3,310	3,330	3,350	1.5
1.6	3,070	3,090	3,120	3,140	3,170	3,190	3,220	3,240	3,270	3,290	3,320	3,340	3,370	3,390	3,410	3,440	3,460	3,480	3,510	3,530	3,550	1.6
1.7	3,240	3,260	3,290	3,320	3,350	3,370	3,400	3,420	3,450	3,480	3,500	3,530	3,550	3,580	3,600	3,630	3,650	3,680	3,700	3,730	3,750	1.7
1.8	3,410	3,430	3,460	3,490	3,520	3,550	3,580	3,600	3,630	3,660	3,690	3,710	3,740	3,770	3,790	3,820	3,850	3,870	3,900	3,920	3,950	1.8
1.9	3,570	3,600	3,630	3,660	3,690	3,720	3,750	3,780	3,810	3,840	3,870	3,900	3,930	3,950	3,980	4,010	4,040	4,060	4,090	4,120	4,140	1.9
2.0	3,740	3,770	3,810	3,840	3,870	3,900	3,930	3,960	3,990	4,020	4,050	4,080	4,110	4,140	4,170	4,200	4,230	4,250	4,280	4,310	4,340	2.0
2.1	3,910	3,940	3,980	4,010	4,040	4,070	4,110	4,140	4,170	4,200	4,230	4,260	4,290	4,320	4,360	4,390	4,420	4,450	4,470	4,500	4,530	2.1
2.2	4,070	4,110	4,140	4,180	4,210	4,250	4,280	4,310	4,350	4,380	4,410	4,450	4,480	4,510	4,540	4,570	4,600	4,640	4,670	4,700	4,730	2.2
2.3	4,240	4,280	4,310	4,350	4,390	4,420	4,460	4,490	4,530	4,560	4,590	4,630	4,660	4,690	4,730	4,760	4,790	4,830	4,860	4,890	4,920	2.3
2.4	4,410	4,450	4,480	4,520	4,560	4,590	4,630	4,670	4,700	4,740	4,770	4,810	4,840	4,880	4,910	4,950	4,980	5,020	5,050	5,080	5,120	2.4
2.5	4,570	4,610	4,650	4,690	4,730	4,770	4,810	4,840	4,880	4,920	4,960	4,990	5,030	5,060	5,100	5,140	5,170	5,210	5,240	5,280	5,310	2.5
2.6	4,740	4,780	4,820	4,860	4,900	4,940	4,980	5,020	5,060	5,100	5,140	5,170	5,210	5,250	5,290	5,320	5,360	5,400	5,430	5,470	5,500	2.6
2.7	4,910	4,950	4,990	5,030	5,080	5,120	5,160	5,200	5,240	5,280	5,320	5,360	5,400	5,440	5,470	5,510	5,550	5,590	5,630	5,660	5,700	2.7
2.8	5,080	5,120	5,160	5,210	5,250	5,290	5,340	5,380	5,420	5,460	5,500	5,540	5,580	5,620	5,660	5,700	5,740	5,780	5,820	5,860	5,900	2.8
2.9	5,240	5,290	5,340	5,380	5,420	5,470	5,510	5,560	5,600	5,640	5,680	5,730	5,770	5,810	5,850	5,890	5,930	5,970	6,010	6,050	6,090	2.9
3.0	5,410	5,460	5,510	5,550	5,600	5,650	5,690	5,740	5,780	5,830	5,870	5,910	5,960	6,000	6,040	6,080	6,130	6,170	6,210	6,250	6,290	3.0
3.1	5,580	5,630	5,680	5,730	5,780	5,820	5,870	5,920	5,960	6,010	6,060	6,100	6,150	6,190	6,230	6,280	6,320	6,360	6,410	6,450	6,490	3.1
3.2	5,760	5,810	5,860	5,910	5,960	6,000	6,050	6,100	6,150	6,200	6,240	6,290	6,340	6,380	6,430	6,470	6,520	6,560	6,610	6,650	6,690	3.2
3.3	5,930	5,980	6,030	6,080	6,140	6,190	6,240	6,280	6,330	6,380	6,430	6,480	6,530	6,570	6,620	6,670	6,710	6,760	6,810	6,850	6,900	3.3
3.4	6,100	6,160	6,210	6,260	6,320	6,370	6,420	6,470	6,520	6,570	6,620	6,670	6,720	6,770	6,820	6,870	6,910	6,960	7,010	7,050	7,100	3.4
3.5	6,280	6,340	6,390	6,440	6,500	6,550	6,610	6,660	6,710	6,760	6,810	6,860	6,920	6,970	7,020	7,060	7,110	7,160	7,210	7,260	7,310	3.5
3.6	6,460	6,520	6,570	6,630	6,680	6,740	6,790	6,850	6,900	6,950	7,010	7,060	7,110	7,160	7,220	7,270	7,320	7,370	7,420	7,470	7,520	3.6
3.7	6,640	6,700	6,750	6,810	6,870	6,930	6,980	7,040	7,090	7,150	7,200	7,260	7,310	7,360	7,420	7,470	7,520	7,570	7,630	7,680	7,730	3.7
3.8	6,820	6,880	6,940	7,000	7,060	7,120	7,170	7,230	7,290	7,340	7,400	7,460	7,510	7,570	7,620	7,670	7,730	7,780	7,830	7,890	7,940	3.8
3.9	7,000	7,060	7,130	7,190	7,250	7,310	7,370	7,430	7,480	7,540	7,600	7,660	7,710	7,770	7,830	7,880	7,940	7,990	8,050	8,100	8,150	3.9
4.0	7,190	7,250	7,310	7,380	7,440	7,500	7,560	7,620	7,680	7,740	7,800	7,860	7,920	7,980	8,040	8,090	8,150	8,210	8,260	8,320	8,370	4.0
4.1	7,370	7,440	7,500	7,570	7,630	7,700	7,760	7,820	7,880	7,950	8,010	8,070	8,130	8,190	8,250	8,300	8,360	8,420	8,480	8,540	8,590	4.1
4.2	7,560	7,630	7,700	7,760	7,830	7,890	7,960	8,020	8,090	8,150	8,210	8,270	8,340	8,400	8,460	8,520	8,580	8,640	8,700	8,760	8,810	4.2
4.3	7,750	7,820	7,890	7,960	8,030	8,090	8,160	8,230	8,290	8,360	8,420	8,480	8,550	8,610	8,670	8,740	8,800	8,860	8,920	8,980	9,040	4.3
4.4	7,950	8,020	8,090	8,160	8,230	8,300	8,360	8,430	8,500	8,570	8,630	8,700	8,760	8,830	8,890	8,950	9,020	9,080	9,140	9,200	9,270	4.4
4.5	8,140	8,210	8,290	8,360	8,430	8,500	8,570	8,640	8,710	8,780	8,840	8,910	8,980	9,040	9,110	9,180	9,240	9,300	9,370	9,430	9,500	4.5
4.6	8,340	8,410	8,490	8,560	8,630	8,710	8,780	8,850	8,920	8,990	9,060	9,130	9,200	9,260	9,330	9,400	9,470	9,530	9,600	9,660	9,730	4.6
4.7	8,540	8,610	8,690	8,770	8,840	8,910	8,990	9,060	9,130	9,210	9,280	9,350	9,420	9,490	9,560	9,630	9,690	9,760	9,830	9,900	9,960	4.7
4.8	8,740	8,820	8,890	8,970	9,050	9,130	9,200	9,280	9,350	9,420	9,500	9,570	9,640	9,710	9,780	9,850	9,920	9,990	10,060	10,130	10,200	4.8
4.9	8,940	9,020	9,100	9,180	9,260	9,340	9,420	9,490	9,570	9,640	9,720	9,790	9,870	9,940	10,010	10,090	10,160	10,230	10,300	10,370	10,440	4.9
5.0	9,150	9,230	9,310	9,390	9,470	9,550	9,630	9,710	9,790	9,870	9,940	10,020	10,090	10,170	10,240	10,320	10,390	10,460	10,540	10,610	10,680	5.0
5.1	9,350	9,440	9,520	9,610	9,690	9,770	9,850	9,930	10,010	10,090	10,170	10,250	10,330	10,400	10,480	10,550	10,630	10,700	10,780	10,850	10,930	5.1
5.2	9,560	9,650	9,740	9,820	9,910	9,990	10,070	10,160	10,240	10,320	10,400	10,480	10,560	10,640	10,720	10,790	10,870	10,950	11,020	11,100	11,170	5.2
5.3	9,770	9,860	9,950	10,040	10,130	10,210	10,300	10,380	10,460	10,550	10,630	10,710	10,790	10,870	10,950	11,030	11,110	11,190	11,270	11,350	11,420	5.3
5.4	9,990	10,080	10,170	10,260	10,350	10,440	10,520	10,610	10,690	10,780	10,860	10,950	11,030	11,110	11,200	11,280	11,360	11,440	11,520	11,600	11,670	5.4
5.5	10,200	10,300	10,390	10,480	10,570	10,660	10,750	10,840	10,930	11,010	11,100	11,190	11,270	11,360	11,440	11,520	11,600	11,690	11,770	11,850	11,930	5.5
5.6	10,420	10,520	10,610	10,700	10,800	10,890	10,980	11,070	11,160	11,250	11,340	11,430	11,510	11,600	11,690	11,770	11,850	11,940	12,020	12,100	12,190	5.6
5.7	10,640	10,740	10,840	10,930	11,030	11,120	11,210	11,310	11,400	11,490	11,580	11,670	11,760	11,850	11,930	12,020	12,110	12,190	12,280	12,360	12,450	5.7
5.8	10,860	10,960	11,060	11,160	11,260	11,350	11,450	11,540	11,640	11,730	11,820	11,910	12,010	12,100	12,190	12,270	12,360	12,450	12,540	12,620	12,710	5.8
5.9	11,090	11,190	11,290	11,390	11,490	11,590	11,690	11,780	11,880	11,970	12,070	12,160	12,260	12,350	12,440	12,530	12,620	12,710	12,800	12,890	12,980	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	
6.0	11,310	11,420	11,520	11,620	11,730	11,830	11,930	12,020	12,120	12,220	12,320	12,410	12,510	12,600	12,700	12,790	12,880	12,970	13,060	13,150	13,240	6.0
6.1	11,540	11,650	11,750	11,860	11,960	12,070	12,170	12,270	12,370	12,470	12,570	12,670	12,760	12,860	12,960	13,050	13,140	13,240	13,330	13,420	13,520	6.1
6.2	11,770	11,880	11,990	12,100	12,200	12,310	12,410	12,520	12,620	12,720	12,820	12,920	13,020	13,120	13,220	13,310	13,410	13,510	13,600	13,700	13,790	6.2
6.3	12,010	12,120	12,230	12,340	12,450	12,550	12,660	12,770	12,870	12,980	13,080	13,180	13,280	13,380	13,480	13,580	13,680	13,780	13,880	13,970	14,070	6.3
6.4	12,240	12,360	12,470	12,580	12,690	12,800	12,910	13,020	13,130	13,230	13,340	13,440	13,550	13,650	13,750	13,850	13,950	14,050	14,150	14,250	14,350	6.4
6.5	12,480	12,600	12,720	12,830	12,940	13,050	13,170	13,280	13,390	13,490	13,600	13,710	13,810	13,920	14,020	14,130	14,230	14,330	14,430	14,530	14,630	6.5
6.6	12,730	12,850	12,960	13,080	13,190	13,310	13,420	13,540	13,650	13,760	13,870	13,980	14,080	14,190	14,300	14,400	14,510	14,610	14,720	14,820	14,920	6.6
6.7	12,970	13,090	13,210	13,330	13,450	13,570	13,680	13,800	13,910	14,030	14,140	14,250	14,360	14,470	14,580	14,690	14,790	14,900	15,000	15,110	15,210	6.7
6.8	13,220	13,350	13,470	13,590	13,710	13,830	13,950	14,060	14,180	14,300	14,410	14,520	14,640	14,750	14,860	14,970	15,080	15,190	15,300	15,400	15,510	6.8
6.9	13,470	13,600	13,730	13,850	13,970	14,090	14,220	14,340	14,450	14,570	14,690	14,800	14,920	15,030	15,150	15,260	15,370	15,480	15,590	15,700	15,810	6.9
7.0	13,730	13,860	13,990	14,120	14,240	14,360	14,490	14,610	14,730	14,850	14,970	15,090	15,210	15,320	15,440	15,550	15,670	15,780	15,890	16,000	16,120	7.0
7.1	13,990	14,120	14,260	14,380	14,510	14,640	14,770	14,890	15,010	15,140	15,260	15,380	15,500	15,620	15,740	15,850	15,970	16,090	16,200	16,310	16,430	7.1
7.2	14,260	14,390	14,530	14,660	14,790	14,920	15,050	15,170	15,300	15,430	15,550	15,670	15,800	15,920	16,040	16,160	16,280	16,390	16,510	16,630	16,740	7.2
7.3	14,530	14,670	14,800	14,940	15,070	15,200	15,330	15,460	15,590	15,720	15,850	15,970	16,100	16,220	16,350	16,470	16,590	16,710	16,830	16,950	17,070	7.3
7.4	14,810	14,950	15,090	15,220	15,360	15,490	15,630	15,760	15,890	16,020	16,150	16,280	16,410	16,540	16,660	16,790	16,910	17,030	17,150	17,270	17,400	7.4
7.5	15,090	15,230	15,370	15,510	15,650	15,790	15,930	16,060	16,200	16,330	16,460	16,590	16,720	16,850	16,980	17,110	17,240	17,360	17,490	17,610	17,730	7.5
7.6	15,380	15,520	15,670	15,810	15,950	16,100	16,230	16,370	16,510	16,650	16,780	16,920	17,050	17,180	17,310	17,440	17,570	17,700	17,820	17,950	18,080	7.6
7.7	15,670	15,820	15,970	16,120	16,260	16,410	16,550	16,690	16,830	16,970	17,110	17,240	17,380	17,510	17,650	17,780	17,910	18,040	18,170	18,300	18,430	7.7
7.8	15,980	16,130	16,280	16,430	16,580	16,730	16,870	17,020	17,160	17,300	17,440	17,580	17,720	17,860	17,990	18,130	18,260	18,400	18,530	18,660	18,790	7.8
7.9	16,290	16,450	16,600	16,750	16,900	17,050	17,200	17,350	17,500	17,640	17,790	17,930	18,070	18,210	18,350	18,490	18,620	18,760	18,900	19,030	19,160	7.9
8.0	16,610	16,770	16,930	17,080	17,240	17,390	17,540	17,700	17,840	17,990	18,140	18,290	18,430	18,570	18,720	18,860	19,000	19,140	19,270	19,410	19,550	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	16,940	17,110	17,270	17,430	17,580	17,740	17,900	18,050	18,200	18,350	18,500	18,650	18,800	18,950	19,090	19,240	19,380	19,520	19,660	19,800	19,940	8.1
8.2	17,290	17,450	17,620	17,780	17,940	18,100	18,260	18,420	18,570	18,730	18,880	19,030	19,180	19,330	19,480	19,630	19,780	19,920	20,070	20,210	20,350	8.2
8.3	17,640	17,810	17,980	18,140	18,310	18,470	18,640	18,800	18,960	19,110	19,270	19,430	19,580	19,730	19,890	20,040	20,190	20,330	20,480	20,630	20,770	8.3
8.4	18,000	18,170	18,340	18,510	18,680	18,850	19,010	19,180	19,340	19,500	19,660	19,820	19,980	20,140	20,290	20,450	20,600	20,750	20,900	21,050	21,200	8.4
8.5	18,320	18,500	18,670	18,840	19,020	19,190	19,360	19,520	19,690	19,850	20,020	20,180	20,340	20,500	20,660	20,820	20,970	21,130	21,280	21,430	21,580	8.5
8.6	18,610	18,800	18,970	19,150	19,330	19,500	19,670	19,840	20,010	20,180	20,350	20,510	20,670	20,840	21,000	21,160	21,320	21,470	21,630	21,790	21,940	8.6
8.7	18,900	19,080	19,260	19,440	19,620	19,800	19,970	20,150	20,320	20,490	20,660	20,830	20,990	21,160	21,320	21,480	21,640	21,800	21,960	22,120	22,280	8.7
8.8	19,180	19,360	19,550	19,730	19,910	20,090	20,270	20,450	20,620	20,790	20,970	21,140	21,310	21,470	21,640	21,810	21,970	22,130	22,290	22,450	22,610	8.8
8.9	19,460	19,650	19,840	20,020	20,210	20,390	20,570	20,750	20,930	21,110	21,280	21,450	21,630	21,800	21,970	22,130	22,300	22,470	22,630	22,790	22,960	8.9
9.0	19,760	19,950	20,140	20,330	20,520	20,700	20,880	21,070	21,250	21,430	21,610	21,780	21,960	22,130	22,300	22,470	22,640	22,810	22,980	23,140	23,310	9.0
9.1	20,060	20,260	20,450	20,640	20,830	21,020	21,210	21,390	21,580	21,760	21,940	22,120	22,300	22,480	22,650	22,820	23,000	23,170	23,340	23,510	23,670	9.1
9.2	20,370	20,570	20,770	20,960	21,160	21,350	21,540	21,730	21,910	22,100	22,280	22,470	22,650	22,830	23,010	23,180	23,360	23,530	23,700	23,880	24,050	9.2
9.3	20,680	20,880	21,080	21,280	21,480	21,670	21,870	22,060	22,250	22,440	22,620	22,810	22,990	23,180	23,360	23,540	23,720	23,890	24,070	24,240	24,420	9.3
9.4	20,970	21,180	21,380	21,590	21,790	21,990	22,180	22,380	22,570	22,760	22,950	23,140	23,330	23,510	23,700	23,880	24,060	24,240	24,420	24,600	24,780	9.4
9.5*	21,040	21,250	21,460	21,660	21,860	22,060	22,260	22,450	22,650	22,840	23,030	23,220	23,410	23,590	23,780	23,960	24,140	24,330	24,500	24,680	24,860	9.5*
9.6*	21,100	21,310	21,520	21,720	21,920	22,120	22,320	22,520	22,710	22,910	23,100	23,290	23,480	23,660	23,850	24,030	24,220	24,400	24,580	24,760	24,930	9.6*
9.7*	21,160	21,370	21,570	21,780	21,980	22,180	22,380	22,580	22,770	22,970	23,160	23,350	23,540	23,730	23,910	24,100	24,280	24,460	24,640	24,820	25,000	9.7*
9.8*	21,210	21,410	21,620	21,830	22,030	22,230	22,430	22,630	22,820	23,020	23,210	23,400	23,590	23,780	23,970	24,150	24,340	24,520	24,700	24,880	25,060	9.8*
9.9*	21,240	21,450	21,660	21,870	22,070	22,270	22,470	22,670	22,870	23,060	23,260	23,450	23,640	23,830	24,010	24,200	24,380	24,570	24,750	24,930	25,110	9.9*
10.0*	21,270	21,480	21,690	21,900	22,100	22,310	22,510	22,700	22,900	23,100	23,290	23,480	23,670	23,860	24,050	24,240	24,420	24,600	24,790	24,970	25,150	10.0*

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	2,320	2,330	2,350	2,360	2,370	2,390	2,400	2,420	2,430	2,450	2,460	2,470	2,490	2,500	2,510	2,530	2,540	2,550	2,570	2,580	2,590	1.0
1.1	2,530	2,540	2,560	2,580	2,590	2,610	2,620	2,640	2,650	2,670	2,680	2,700	2,710	2,730	2,740	2,760	2,770	2,790	2,800	2,820	2,830	1.1
1.2	2,740	2,760	2,770	2,790	2,810	2,820	2,840	2,860	2,870	2,890	2,910	2,920	2,940	2,960	2,970	2,990	3,000	3,020	3,030	3,050	3,070	1.2
1.3	2,940	2,960	2,980	3,000	3,020	3,040	3,050	3,070	3,090	3,110	3,130	3,140	3,160	3,180	3,200	3,210	3,230	3,250	3,260	3,280	3,300	1.3
1.4	3,150	3,170	3,190	3,210	3,230	3,250	3,270	3,290	3,310	3,320	3,340	3,360	3,380	3,400	3,420	3,440	3,450	3,470	3,490	3,510	3,530	1.4
1.5	3,350	3,370	3,390	3,410	3,440	3,460	3,480	3,500	3,520	3,540	3,560	3,580	3,600	3,620	3,640	3,660	3,680	3,700	3,720	3,730	3,750	1.5
1.6	3,550	3,570	3,600	3,620	3,640	3,660	3,680	3,710	3,730	3,750	3,770	3,790	3,810	3,830	3,860	3,880	3,900	3,920	3,940	3,960	3,980	1.6
1.7	3,750	3,770	3,800	3,820	3,840	3,870	3,890	3,910	3,940	3,960	3,980	4,000	4,030	4,050	4,070	4,090	4,120	4,140	4,160	4,180	4,200	1.7
1.8	3,950	3,970	4,000	4,020	4,050	4,070	4,100	4,120	4,140	4,170	4,190	4,220	4,240	4,260	4,290	4,310	4,330	4,360	4,380	4,400	4,420	1.8
1.9	4,140	4,170	4,200	4,220	4,250	4,270	4,300	4,330	4,350	4,380	4,400	4,430	4,450	4,480	4,500	4,520	4,550	4,570	4,600	4,620	4,640	1.9
2.0	4,340	4,370	4,390	4,420	4,450	4,480	4,500	4,530	4,560	4,580	4,610	4,630	4,660	4,690	4,710	4,740	4,760	4,790	4,810	4,840	4,860	2.0
2.1	4,530	4,560	4,590	4,620	4,650	4,680	4,700	4,730	4,760	4,790	4,820	4,840	4,870	4,900	4,920	4,950	4,980	5,000	5,030	5,060	5,080	2.1
2.2	4,730	4,760	4,790	4,820	4,850	4,880	4,910	4,940	4,960	4,990	5,020	5,050	5,080	5,110	5,140	5,160	5,190	5,220	5,250	5,270	5,300	2.2
2.3	4,920	4,950	4,980	5,020	5,050	5,080	5,110	5,140	5,170	5,200	5,230	5,260	5,290	5,320	5,350	5,380	5,400	5,430	5,460	5,490	5,520	2.3
2.4	5,120	5,150	5,180	5,210	5,250	5,280	5,310	5,340	5,370	5,400	5,440	5,470	5,500	5,530	5,560	5,590	5,620	5,650	5,680	5,710	5,740	2.4
2.5	5,310	5,340	5,380	5,410	5,450	5,480	5,510	5,540	5,580	5,610	5,640	5,670	5,710	5,740	5,770	5,800	5,830	5,860	5,890	5,930	5,960	2.5
2.6	5,500	5,540	5,580	5,610	5,650	5,680	5,710	5,750	5,780	5,820	5,850	5,880	5,920	5,950	5,980	6,010	6,050	6,080	6,110	6,140	6,180	2.6
2.7	5,700	5,740	5,770	5,810	5,850	5,880	5,920	5,950	5,990	6,020	6,060	6,090	6,130	6,160	6,190	6,230	6,260	6,300	6,330	6,360	6,400	2.7
2.8	5,900	5,930	5,970	6,010	6,050	6,080	6,120	6,160	6,190	6,230	6,270	6,300	6,340	6,370	6,410	6,440	6,480	6,510	6,550	6,580	6,620	2.8
2.9	6,090	6,130	6,170	6,210	6,250	6,290	6,330	6,360	6,400	6,440	6,480	6,510	6,550	6,590	6,620	6,660	6,700	6,730	6,770	6,800	6,840	2.9
3.0	6,290	6,330	6,370	6,410	6,450	6,490	6,530	6,570	6,610	6,650	6,690	6,730	6,760	6,800	6,840	6,880	6,920	6,950	6,990	7,030	7,060	3.0
3.1	6,490	6,530	6,580	6,620	6,660	6,700	6,740	6,780	6,820	6,860	6,900	6,940	6,980	7,020	7,060	7,100	7,140	7,170	7,210	7,250	7,290	3.1
3.2	6,690	6,740	6,780	6,820	6,870	6,910	6,950	6,990	7,030	7,070	7,120	7,160	7,200	7,240	7,280	7,320	7,360	7,400	7,440	7,480	7,510	3.2
3.3	6,900	6,940	6,990	7,030	7,070	7,120	7,160	7,200	7,250	7,290	7,330	7,370	7,420	7,460	7,500	7,540	7,580	7,620	7,660	7,700	7,740	3.3
3.4	7,100	7,150	7,190	7,240	7,280	7,330	7,370	7,420	7,460	7,510	7,550	7,590	7,640	7,680	7,720	7,770	7,810	7,850	7,890	7,930	7,970	3.4
3.5	7,310	7,360	7,400	7,450	7,500	7,540	7,590	7,630	7,680	7,730	7,770	7,820	7,860	7,900	7,950	7,990	8,040	8,080	8,120	8,160	8,210	3.5
3.6	7,520	7,570	7,610	7,660	7,710	7,760	7,810	7,850	7,900	7,950	7,990	8,040	8,090	8,130	8,180	8,220	8,270	8,310	8,350	8,400	8,440	3.6
3.7	7,730	7,780	7,830	7,880	7,930	7,980	8,030	8,070	8,120	8,170	8,220	8,270	8,310	8,360	8,410	8,450	8,500	8,540	8,590	8,640	8,680	3.7
3.8	7,940	7,990	8,040	8,090	8,150	8,200	8,250	8,300	8,350	8,400	8,440	8,490	8,540	8,590	8,640	8,690	8,730	8,780	8,830	8,870	8,920	3.8
3.9	8,150	8,210	8,260	8,310	8,370	8,420	8,470	8,520	8,570	8,620	8,670	8,720	8,770	8,820	8,870	8,920	8,970	9,020	9,070	9,120	9,160	3.9
4.0	8,370	8,430	8,480	8,540	8,590	8,640	8,700	8,750	8,800	8,850	8,910	8,960	9,010	9,060	9,110	9,160	9,210	9,260	9,310	9,360	9,410	4.0
4.1	8,590	8,650	8,700	8,760	8,820	8,870	8,930	8,980	9,030	9,090	9,140	9,190	9,250	9,300	9,350	9,400	9,450	9,510	9,560	9,610	9,660	4.1
4.2	8,810	8,870	8,930	8,990	9,040	9,100	9,160	9,210	9,270	9,320	9,380	9,430	9,490	9,540	9,590	9,650	9,700	9,750	9,810	9,860	9,910	4.2
4.3	9,040	9,100	9,160	9,220	9,270	9,330	9,390	9,450	9,500	9,560	9,620	9,670	9,730	9,780	9,840	9,890	9,950	10,000	10,060	10,110	10,160	4.3
4.4	9,270	9,330	9,390	9,450	9,510	9,570	9,630	9,690	9,740	9,800	9,860	9,920	9,970	10,030	10,090	10,140	10,200	10,250	10,310	10,360	10,420	4.4
4.5	9,500	9,560	9,620	9,680	9,740	9,800	9,870	9,930	9,990	10,050	10,100	10,160	10,220	10,280	10,340	10,400	10,450	10,510	10,570	10,620	10,680	4.5
4.6	9,730	9,790	9,860	9,920	9,980	10,040	10,110	10,170	10,230	10,290	10,350	10,410	10,470	10,530	10,590	10,650	10,710	10,770	10,830	10,880	10,940	4.6
4.7	9,960	10,030	10,090	10,160	10,220	10,290	10,350	10,410	10,480	10,540	10,600	10,660	10,730	10,790	10,850	10,910	10,970	11,030	11,090	11,150	11,210	4.7
4.8	10,200	10,270	10,330	10,400	10,470	10,530	10,600	10,660	10,730	10,790	10,860	10,920	10,980	11,050	11,110	11,170	11,230	11,290	11,350	11,410	11,480	4.8
4.9	10,440	10,510	10,580	10,640	10,710	10,780	10,850	10,910	10,980	11,050	11,110	11,180	11,240	11,310	11,370	11,430	11,500	11,560	11,620	11,680	11,750	4.9
5.0	10,680	10,750	10,820	10,890	10,960	11,030	11,100	11,170	11,240	11,300	11,370	11,440	11,500	11,570	11,630	11,700	11,760	11,830	11,890	11,960	12,020	5.0
5.1	10,930	11,000	11,070	11,140	11,210	11,280	11,350	11,420	11,490	11,560	11,630	11,700	11,770	11,840	11,900	11,970	12,040	12,100	12,170	12,230	12,300	5.1
5.2	11,170	11,250	11,320	11,390	11,470	11,540	11,610	11,680	11,750	11,830	11,900	11,970	12,040	12,100	12,170	12,240	12,310	12,380	12,440	12,510	12,580	5.2
5.3	11,420	11,500	11,570	11,650	11,720	11,800	11,870	11,950	12,020	12,090	12,160	12,230	12,310	12,380	12,450	12,520	12,590	12,660	12,720	12,790	12,860	5.3
5.4	11,670	11,750	11,830	11,910	11,980	12,060	12,140	12,210	12,280	12,360	12,430	12,510	12,580	12,650	12,720	12,790	12,870	12,940	13,010	13,080	13,150	5.4
5.5	11,930	12,010	12,090	12,170	12,250	12,320	12,400	12,480	12,550	12,630	12,700	12,780	12,850	12,930	13,000	13,080	13,150	13,220	13,290	13,360	13,440	5.5
5.6	12,190	12,270	12,350	12,430	12,510	12,590	12,670	12,750	12,830	12,900	12,980	13,060	13,130	13,210	13,280	13,360	13,430	13,510	13,580	13,650	13,730	5.6
5.7	12,450	12,530	12,610	12,700	12,780	12,860	12,940	13,020	13,100	13,180	13,260	13,340	13,410	13,490	13,570	13,650	13,720	13,800	13,870	13,950	14,020	5.7
5.8	12,710	12,800	12,880	12,960	13,050	13,130	13,210	13,300	13,380	13,460	13,540	13,620	13,700	13,780	13,860	13,940	14,010	14,090	14,170	14,240	14,320	5.8
5.9	12,980	13,060	13,150	13,240	13,320	13,410	13,490	13,570	13,660	13,740	13,820	13,910	13,990	14,070	14,150	14,230	14,310	14,390	14,470	14,540	14,620	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	
6.0	13, 240	13, 330	13, 420	13, 510	13, 600	13, 680	13, 770	13, 860	13, 940	14, 030	14, 110	14, 190	14, 280	14, 360	14, 440	14, 520	14, 610	14, 690	14, 770	14, 850	14, 930	6.0
6.1	13, 520	13, 610	13, 700	13, 790	13, 880	13, 970	14, 050	14, 140	14, 230	14, 320	14, 400	14, 490	14, 570	14, 660	14, 740	14, 820	14, 910	14, 990	15, 070	15, 150	15, 240	6.1
6.2	13, 790	13, 880	13, 980	14, 070	14, 160	14, 250	14, 340	14, 430	14, 520	14, 610	14, 690	14, 780	14, 870	14, 960	15, 040	15, 130	15, 210	15, 300	15, 380	15, 460	15, 550	6.2
6.3	14, 070	14, 160	14, 260	14, 350	14, 440	14, 540	14, 630	14, 720	14, 810	14, 900	14, 990	15, 080	15, 170	15, 260	15, 350	15, 430	15, 520	15, 610	15, 690	15, 780	15, 860	6.3
6.4	14, 350	14, 450	14, 540	14, 640	14, 730	14, 830	14, 920	15, 020	15, 110	15, 200	15, 290	15, 380	15, 470	15, 560	15, 650	15, 740	15, 830	15, 920	16, 010	16, 090	16, 180	6.4
6.5	14, 630	14, 730	14, 830	14, 930	15, 030	15, 120	15, 220	15, 310	15, 410	15, 500	15, 600	15, 690	15, 780	15, 870	15, 970	16, 060	16, 150	16, 240	16, 330	16, 420	16, 500	6.5
6.6	14, 920	15, 020	15, 120	15, 220	15, 320	15, 420	15, 520	15, 620	15, 710	15, 810	15, 910	16, 000	16, 090	16, 190	16, 280	16, 370	16, 470	16, 560	16, 650	16, 740	16, 830	6.6
6.7	15, 210	15, 320	15, 420	15, 520	15, 620	15, 720	15, 820	15, 920	16, 020	16, 120	16, 220	16, 310	16, 410	16, 510	16, 600	16, 700	16, 790	16, 890	16, 980	17, 070	17, 160	6.7
6.8	15, 510	15, 610	15, 720	15, 820	15, 930	16, 030	16, 130	16, 230	16, 330	16, 440	16, 530	16, 630	16, 730	16, 830	16, 930	17, 020	17, 120	17, 220	17, 310	17, 410	17, 500	6.8
6.9	15, 810	15, 920	16, 020	16, 130	16, 240	16, 340	16, 450	16, 550	16, 650	16, 760	16, 860	16, 960	17, 060	17, 160	17, 260	17, 360	17, 450	17, 550	17, 650	17, 750	17, 840	6.9
7.0	16, 120	16, 230	16, 340	16, 440	16, 550	16, 660	16, 760	16, 870	16, 980	17, 080	17, 180	17, 290	17, 390	17, 490	17, 590	17, 690	17, 790	17, 890	17, 990	18, 090	18, 190	7.0
7.1	16, 430	16, 540	16, 650	16, 760	16, 870	16, 980	17, 090	17, 200	17, 300	17, 410	17, 520	17, 620	17, 730	17, 830	17, 930	18, 040	18, 140	18, 240	18, 340	18, 440	18, 540	7.1
7.2	16, 740	16, 860	16, 970	17, 080	17, 200	17, 310	17, 420	17, 530	17, 640	17, 750	17, 860	17, 960	18, 070	18, 180	18, 280	18, 390	18, 490	18, 600	18, 700	18, 800	18, 900	7.2
7.3	17, 070	17, 180	17, 300	17, 410	17, 530	17, 640	17, 760	17, 870	17, 980	18, 090	18, 200	18, 310	18, 420	18, 530	18, 640	18, 740	18, 850	18, 960	19, 060	19, 170	19, 270	7.3
7.4	17, 400	17, 510	17, 630	17, 750	17, 870	17, 980	18, 100	18, 210	18, 330	18, 440	18, 550	18, 670	18, 780	18, 890	19, 000	19, 110	19, 220	19, 320	19, 430	19, 540	19, 650	7.4
7.5	17, 730	17, 850	17, 970	18, 090	18, 210	18, 330	18, 450	18, 570	18, 680	18, 800	18, 920	19, 030	19, 140	19, 260	19, 370	19, 480	19, 590	19, 700	19, 810	19, 920	20, 030	7.5
7.6	18, 080	18, 200	18, 320	18, 450	18, 570	18, 690	18, 810	18, 930	19, 050	19, 170	19, 280	19, 400	19, 520	19, 630	19, 750	19, 860	19, 970	20, 090	20, 200	20, 310	20, 420	7.6
7.7	18, 430	18, 560	18, 680	18, 810	18, 930	19, 060	19, 180	19, 300	19, 420	19, 540	19, 660	19, 780	19, 900	20, 020	20, 130	20, 250	20, 370	20, 480	20, 600	20, 710	20, 820	7.7
7.8	18, 790	18, 920	19, 050	19, 180	19, 310	19, 430	19, 560	19, 680	19, 810	19, 930	20, 050	20, 170	20, 290	20, 410	20, 530	20, 650	20, 770	20, 890	21, 000	21, 120	21, 240	7.8
7.9	19, 160	19, 300	19, 430	19, 560	19, 690	19, 820	19, 950	20, 070	20, 200	20, 320	20, 450	20, 570	20, 700	20, 820	20, 940	21, 060	21, 180	21, 300	21, 420	21, 540	21, 660	7.9
8.0	19, 550	19, 680	19, 820	19, 950	20, 080	20, 210	20, 350	20, 480	20, 600	20, 730	20, 860	20, 990	21, 110	21, 240	21, 360	21, 490	21, 610	21, 730	21, 850	21, 980	22, 100	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	19, 940	20, 080	20, 220	20, 350	20, 490	20, 620	20, 760	20, 890	21, 020	21, 150	21, 280	21, 410	21, 540	21, 670	21, 800	21, 920	22, 050	22, 180	22, 300	22, 420	22, 550	8.1
8.2	20, 350	20, 490	20, 630	20, 770	20, 910	21, 050	21, 180	21, 320	21, 460	21, 590	21, 720	21, 850	21, 990	22, 120	22, 250	22, 380	22, 510	22, 630	22, 760	22, 890	23, 010	8.2
8.3	20, 770	20, 920	21, 060	21, 200	21, 350	21, 490	21, 630	21, 760	21, 900	22, 040	22, 180	22, 310	22, 450	22, 580	22, 710	22, 840	22, 980	23, 110	23, 240	23, 360	23, 490	8.3
8.4	21, 200	21, 350	21, 490	21, 640	21, 780	21, 930	22, 070	22, 210	22, 350	22, 490	22, 630	22, 770	22, 910	23, 040	23, 180	23, 310	23, 450	23, 580	23, 710	23, 850	23, 980	8.4
8.5	21, 580	21, 730	21, 880	22, 030	22, 180	22, 330	22, 470	22, 620	22, 760	22, 900	23, 040	23, 190	23, 330	23, 460	23, 600	23, 740	23, 880	24, 010	24, 150	24, 280	24, 420	8.5
8.6	21, 940	22, 090	22, 240	22, 400	22, 550	22, 690	22, 840	22, 990	23, 140	23, 280	23, 430	23, 570	23, 710	23, 850	23, 990	24, 130	24, 270	24, 410	24, 550	24, 690	24, 820	8.6
8.7	22, 280	22, 430	22, 590	22, 740	22, 890	23, 050	23, 200	23, 350	23, 500	23, 640	23, 790	23, 940	24, 080	24, 220	24, 370	24, 510	24, 650	24, 790	24, 930	25, 070	25, 210	8.7
8.8	22, 610	22, 770	22, 930	23, 090	23, 240	23, 390	23, 550	23, 700	23, 850	24, 000	24, 150	24, 300	24, 450	24, 590	24, 740	24, 880	25, 030	25, 170	25, 310	25, 450	25, 590	8.8
8.9	22, 960	23, 120	23, 280	23, 430	23, 590	23, 750	23, 900	24, 060	24, 210	24, 360	24, 520	24, 670	24, 820	24, 970	25, 110	25, 260	25, 410	25, 550	25, 700	25, 840	25, 980	8.9
9.0	23, 310	23, 470	23, 630	23, 800	23, 960	24, 120	24, 270	24, 430	24, 590	24, 740	24, 900	25, 050	25, 200	25, 350	25, 500	25, 650	25, 800	25, 950	26, 100	26, 240	26, 390	9.0
9.1	23, 670	23, 840	24, 010	24, 170	24, 330	24, 490	24, 660	24, 820	24, 970	25, 130	25, 290	25, 440	25, 600	25, 750	25, 910	26, 060	26, 210	26, 360	26, 510	26, 660	26, 810	9.1
9.2	24, 050	24, 220	24, 380	24, 550	24, 720	24, 880	25, 040	25, 210	25, 370	25, 530	25, 690	25, 850	26, 000	26, 160	26, 320	26, 470	26, 630	26, 780	26, 930	27, 080	27, 230	9.2
9.3	24, 420	24, 590	24, 760	24, 930	25, 100	25, 270	25, 430	25, 600	25, 760	25, 920	26, 090	26, 250	26, 410	26, 570	26, 730	26, 880	27, 040	27, 190	27, 350	27, 500	27, 660	9.3
9.4	24, 780	24, 950	25, 120	25, 300	25, 470	25, 640	25, 810	25, 970	26, 140	26, 310	26, 470	26, 640	26, 800	26, 960	27, 120	27, 280	27, 440	27, 600	27, 750	27, 910	28, 070	9.4
9.5*	24, 860	25, 040	25, 210	25, 380	25, 550	25, 730	25, 890	26, 060	26, 230	26, 400	26, 560	26, 730	26, 890	27, 050	27, 210	27, 370	27, 530	27, 690	27, 850	28, 010	28, 160	9.5*
9.6*	24, 930	25, 110	25, 290	25, 460	25, 630	25, 800	25, 970	26, 140	26, 310	26, 480	26, 640	26, 810	26, 970	27, 140	27, 300	27, 460	27, 620	27, 780	27, 940	28, 090	28, 250	9.6*
9.7*	25, 000	25, 180	25, 350	25, 530	25, 700	25, 870	26, 040	26, 210	26, 380	26, 550	26, 720	26, 880	27, 040	27, 210	27, 370	27, 530	27, 690	27, 850	28, 010	28, 170	28, 330	9.7*
9.8*	25, 060	25, 240	25, 410	25, 590	25, 760	25, 930	26, 100	26, 270	26, 440	26, 610	26, 780	26, 940	27, 110	27, 270	27, 440	27, 600	27, 760	27, 920	28, 080	28, 240	28, 390	9.8*
9.9*	25, 110	25, 290	25, 460	25, 640	25, 810	25, 980	26, 160	26, 330	26, 500	26, 660	26, 830	27, 000	27, 160	27, 330	27, 490	27, 650	27, 810	27, 970	28, 130	28, 290	28, 450	9.9*
10.0*	25, 150	25, 320	25, 500	25, 680	25, 850	26, 020	26, 200	26, 370	26, 540	26, 710	26, 870	27, 040	27, 210	27, 370	27, 530	27, 700	27, 860	28, 020	28, 180	28, 340	28, 500	10.0*

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	2,590	2,610	2,620	2,630	2,650	2,660	2,670	2,680	2,700	2,710	2,720	2,730	2,750	2,760	2,770	2,780	2,800	2,810	2,820	2,830	2,840	1.0
1.1	2,830	2,850	2,860	2,870	2,890	2,900	2,920	2,930	2,940	2,960	2,970	2,980	3,000	3,010	3,020	3,040	3,050	3,060	3,080	3,090	3,100	1.1
1.2	3,070	3,080	3,100	3,110	3,130	3,140	3,160	3,170	3,190	3,200	3,220	3,230	3,250	3,260	3,280	3,290	3,300	3,320	3,330	3,350	3,360	1.2
1.3	3,300	3,310	3,330	3,350	3,360	3,380	3,400	3,410	3,430	3,440	3,460	3,480	3,490	3,510	3,520	3,540	3,550	3,570	3,590	3,600	3,620	1.3
1.4	3,530	3,540	3,560	3,580	3,600	3,620	3,630	3,650	3,670	3,680	3,700	3,720	3,740	3,750	3,770	3,790	3,800	3,820	3,840	3,850	3,870	1.4
1.5	3,750	3,770	3,790	3,810	3,830	3,850	3,870	3,880	3,900	3,920	3,940	3,960	3,980	3,990	4,010	4,030	4,050	4,060	4,080	4,100	4,120	1.5
1.6	3,980	4,000	4,020	4,040	4,060	4,080	4,100	4,120	4,140	4,160	4,180	4,200	4,210	4,230	4,250	4,270	4,290	4,310	4,330	4,350	4,360	1.6
1.7	4,200	4,220	4,240	4,270	4,290	4,310	4,330	4,350	4,370	4,390	4,410	4,430	4,450	4,470	4,490	4,510	4,530	4,550	4,570	4,590	4,610	1.7
1.8	4,420	4,450	4,470	4,490	4,510	4,530	4,560	4,580	4,600	4,620	4,640	4,660	4,690	4,710	4,730	4,750	4,770	4,790	4,810	4,830	4,850	1.8
1.9	4,640	4,670	4,690	4,710	4,740	4,760	4,780	4,810	4,830	4,850	4,870	4,900	4,920	4,940	4,960	4,990	5,010	5,030	5,050	5,070	5,100	1.9
2.0	4,860	4,890	4,910	4,940	4,960	4,990	5,010	5,030	5,060	5,080	5,110	5,130	5,150	5,180	5,200	5,220	5,250	5,270	5,290	5,310	5,340	2.0
2.1	5,080	5,110	5,130	5,160	5,180	5,210	5,240	5,260	5,290	5,310	5,340	5,360	5,380	5,410	5,430	5,460	5,480	5,510	5,530	5,550	5,580	2.1
2.2	5,300	5,330	5,350	5,380	5,410	5,430	5,460	5,490	5,510	5,540	5,560	5,590	5,620	5,640	5,670	5,690	5,720	5,740	5,770	5,790	5,820	2.2
2.3	5,520	5,550	5,570	5,600	5,630	5,660	5,690	5,710	5,740	5,770	5,790	5,820	5,850	5,870	5,900	5,930	5,950	5,980	6,010	6,030	6,060	2.3
2.4	5,740	5,770	5,800	5,820	5,850	5,880	5,910	5,940	5,970	6,000	6,020	6,050	6,080	6,110	6,130	6,160	6,190	6,220	6,240	6,270	6,300	2.4
2.5	5,960	5,990	6,020	6,050	6,080	6,110	6,140	6,170	6,200	6,220	6,250	6,280	6,310	6,340	6,370	6,400	6,430	6,450	6,480	6,510	6,540	2.5
2.6	6,180	6,210	6,240	6,270	6,300	6,330	6,360	6,390	6,420	6,450	6,480	6,510	6,540	6,570	6,600	6,630	6,660	6,690	6,720	6,750	6,780	2.6
2.7	6,400	6,430	6,460	6,490	6,530	6,560	6,590	6,620	6,650	6,680	6,720	6,750	6,780	6,810	6,840	6,870	6,900	6,930	6,960	6,990	7,020	2.7
2.8	6,620	6,650	6,680	6,720	6,750	6,780	6,820	6,850	6,880	6,920	6,950	6,980	7,010	7,040	7,080	7,110	7,140	7,170	7,200	7,230	7,270	2.8
2.9	6,840	6,870	6,910	6,940	6,980	7,010	7,050	7,080	7,110	7,150	7,180	7,220	7,250	7,280	7,310	7,350	7,380	7,410	7,450	7,480	7,510	2.9
3.0	7,060	7,100	7,130	7,170	7,210	7,240	7,280	7,310	7,350	7,380	7,420	7,450	7,490	7,520	7,550	7,590	7,620	7,660	7,690	7,720	7,760	3.0
3.1	7,290	7,320	7,360	7,400	7,440	7,470	7,510	7,550	7,580	7,620	7,650	7,690	7,730	7,760	7,800	7,830	7,870	7,900	7,940	7,970	8,000	3.1
3.2	7,510	7,550	7,590	7,630	7,670	7,710	7,740	7,780	7,820	7,860	7,890	7,930	7,970	8,000	8,040	8,080	8,110	8,150	8,180	8,220	8,250	3.2
3.3	7,740	7,780	7,820	7,860	7,900	7,940	7,980	8,020	8,060	8,100	8,130	8,170	8,210	8,250	8,290	8,320	8,360	8,400	8,430	8,470	8,510	3.3
3.4	7,970	8,020	8,060	8,100	8,140	8,180	8,220	8,260	8,300	8,340	8,380	8,420	8,460	8,490	8,530	8,570	8,610	8,650	8,690	8,720	8,760	3.4
3.5	8,210	8,250	8,290	8,330	8,380	8,420	8,460	8,500	8,540	8,580	8,620	8,660	8,700	8,740	8,780	8,820	8,860	8,900	8,940	8,980	9,020	3.5
3.6	8,440	8,490	8,530	8,570	8,620	8,660	8,700	8,740	8,790	8,830	8,870	8,910	8,950	8,990	9,040	9,080	9,120	9,160	9,200	9,240	9,280	3.6
3.7	8,680	8,730	8,770	8,820	8,860	8,900	8,950	8,990	9,030	9,080	9,120	9,160	9,210	9,250	9,290	9,330	9,370	9,420	9,460	9,500	9,540	3.7
3.8	8,920	8,970	9,010	9,060	9,100	9,150	9,200	9,240	9,280	9,330	9,370	9,420	9,460	9,500	9,550	9,590	9,630	9,680	9,720	9,760	9,800	3.8
3.9	9,160	9,210	9,260	9,310	9,350	9,400	9,450	9,490	9,540	9,580	9,630	9,670	9,720	9,760	9,810	9,850	9,900	9,940	9,990	10,030	10,070	3.9
4.0	9,410	9,460	9,510	9,560	9,600	9,650	9,700	9,750	9,790	9,840	9,890	9,930	9,980	10,030	10,070	10,120	10,160	10,210	10,250	10,300	10,340	4.0
4.1	9,660	9,710	9,760	9,810	9,860	9,910	9,960	10,000	10,050	10,100	10,150	10,200	10,240	10,290	10,340	10,390	10,430	10,480	10,530	10,570	10,620	4.1
4.2	9,910	9,960	10,010	10,060	10,110	10,160	10,210	10,260	10,310	10,360	10,410	10,460	10,510	10,560	10,610	10,660	10,700	10,750	10,800	10,850	10,890	4.2
4.3	10,160	10,220	10,270	10,320	10,370	10,430	10,480	10,530	10,580	10,630	10,680	10,730	10,780	10,830	10,880	10,930	10,980	11,030	11,080	11,130	11,170	4.3
4.4	10,420	10,470	10,530	10,580	10,640	10,690	10,740	10,790	10,850	10,900	10,950	11,000	11,050	11,110	11,160	11,210	11,260	11,310	11,360	11,410	11,460	4.4
4.5	10,680	10,730	10,790	10,850	10,900	10,960	11,010	11,060	11,120	11,170	11,220	11,280	11,330	11,380	11,440	11,490	11,540	11,590	11,640	11,690	11,740	4.5
4.6	10,940	11,000	11,060	11,110	11,170	11,220	11,280	11,340	11,390	11,450	11,500	11,560	11,610	11,660	11,720	11,770	11,820	11,880	11,930	11,980	12,030	4.6
4.7	11,210	11,270	11,320	11,380	11,440	11,500	11,550	11,610	11,670	11,720	11,780	11,840	11,890	11,950	12,000	12,060	12,110	12,170	12,220	12,270	12,330	4.7
4.8	11,480	11,540	11,600	11,650	11,710	11,770	11,830	11,890	11,950	12,010	12,060	12,120	12,180	12,230	12,290	12,350	12,400	12,460	12,510	12,570	12,620	4.8
4.9	11,750	11,810	11,870	11,930	11,990	12,050	12,110	12,170	12,230	12,290	12,350	12,410	12,470	12,520	12,580	12,640	12,700	12,750	12,810	12,870	12,920	4.9
5.0	12,020	12,080	12,150	12,210	12,270	12,330	12,390	12,460	12,520	12,580	12,640	12,700	12,760	12,820	12,880	12,930	12,990	13,050	13,110	13,170	13,230	5.0
5.1	12,300	12,360	12,430	12,490	12,550	12,620	12,680	12,740	12,810	12,870	12,930	12,990	13,050	13,110	13,170	13,230	13,290	13,350	13,410	13,470	13,530	5.1
5.2	12,580	12,640	12,710	12,780	12,840	12,910	12,970	13,030	13,100	13,160	13,220	13,290	13,350	13,410	13,470	13,540	13,600	13,660	13,720	13,780	13,840	5.2
5.3	12,860	12,930	13,000	13,060	13,130	13,200	13,260	13,330	13,390	13,460	13,520	13,590	13,650	13,720	13,780	13,840	13,900	13,970	14,030	14,090	14,150	5.3
5.4	13,150	13,220	13,290	13,350	13,420	13,490	13,560	13,620	13,690	13,760	13,820	13,890	13,960	14,020	14,090	14,150	14,220	14,280	14,340	14,410	14,470	5.4
5.5	13,440	13,510	13,580	13,650	13,720	13,790	13,860	13,920	13,990	14,060	14,130	14,200	14,260	14,330	14,400	14,460	14,530	14,590	14,660	14,720	14,790	5.5
5.6	13,730	13,800	13,870	13,940	14,020	14,090	14,160	14,230	14,300	14,370	14,440	14,510	14,570	14,640	14,710	14,780	14,850	14,910	14,980	15,050	15,110	5.6
5.7	14,020	14,100	14,170	14,240	14,320	14,390	14,460	14,530	14,610	14,680	14,750	14,820	14,890	14,960	15,030	15,100	15,170	15,230	15,300	15,370	15,440	5.7
5.8	14,320	14,400	14,470	14,550	14,620	14,700	14,770	14,840	14,920	14,990	15,060	15,130	15,210	15,280	15,350	15,420	15,490	15,560	15,630	15,700	15,770	5.8
5.9	14,620	14,700	14,780	14,850	14,930	15,010	15,080	15,160	15,230	15,310	15,380	15,450	15,530	15,600	15,670	15,740	15,820	15,890	15,960	16,030	16,100	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	
6.0	14,930	15,010	15,090	15,160	15,240	15,320	15,400	15,470	15,550	15,630	15,700	15,780	15,850	15,930	16,000	16,070	16,150	16,220	16,290	16,370	16,440	6.0
6.1	15,240	15,320	15,400	15,480	15,560	15,640	15,710	15,790	15,870	15,950	16,030	16,100	16,180	16,260	16,330	16,410	16,480	16,560	16,630	16,710	16,780	6.1
6.2	15,550	15,630	15,710	15,790	15,870	15,960	16,040	16,120	16,200	16,280	16,350	16,430	16,510	16,590	16,670	16,740	16,820	16,900	16,970	17,050	17,120	6.2
6.3	15,860	15,950	16,030	16,110	16,200	16,280	16,360	16,440	16,530	16,610	16,690	16,770	16,850	16,930	17,010	17,080	17,160	17,240	17,320	17,400	17,470	6.3
6.4	16,180	16,270	16,350	16,440	16,520	16,610	16,690	16,780	16,860	16,940	17,020	17,110	17,190	17,270	17,350	17,430	17,510	17,590	17,670	17,750	17,830	6.4
6.5	16,500	16,590	16,680	16,770	16,850	16,940	17,030	17,110	17,200	17,280	17,360	17,450	17,530	17,610	17,700	17,780	17,860	17,940	18,020	18,100	18,180	6.5
6.6	16,830	16,920	17,010	17,100	17,190	17,280	17,360	17,450	17,540	17,620	17,710	17,800	17,880	17,960	18,050	18,130	18,220	18,300	18,380	18,460	18,550	6.6
6.7	17,160	17,260	17,350	17,440	17,530	17,620	17,710	17,800	17,880	17,970	18,060	18,150	18,230	18,320	18,410	18,490	18,580	18,660	18,750	18,830	18,910	6.7
6.8	17,500	17,590	17,690	17,780	17,870	17,960	18,050	18,150	18,240	18,330	18,420	18,500	18,590	18,680	18,770	18,860	18,940	19,030	19,120	19,200	19,290	6.8
6.9	17,840	17,940	18,030	18,130	18,220	18,320	18,410	18,500	18,590	18,680	18,780	18,870	18,960	19,050	19,140	19,230	19,310	19,400	19,490	19,580	19,670	6.9
7.0	18,190	18,290	18,380	18,480	18,580	18,670	18,770	18,860	18,960	19,050	19,140	19,240	19,330	19,420	19,510	19,600	19,690	19,780	19,870	19,960	20,050	7.0
7.1	18,540	18,640	18,740	18,840	18,940	19,040	19,130	19,230	19,330	19,420	19,520	19,610	19,700	19,800	19,890	19,980	20,080	20,170	20,260	20,350	20,440	7.1
7.2	18,900	19,010	19,110	19,210	19,310	19,410	19,510	19,600	19,700	19,800	19,900	19,990	20,090	20,180	20,280	20,370	20,470	20,560	20,660	20,750	20,840	7.2
7.3	19,270	19,370	19,480	19,580	19,680	19,780	19,880	19,990	20,090	20,180	20,280	20,380	20,480	20,580	20,670	20,770	20,870	20,960	21,060	21,150	21,250	7.3
7.4	19,650	19,750	19,860	19,960	20,070	20,170	20,270	20,370	20,480	20,580	20,680	20,780	20,880	20,980	21,080	21,180	21,280	21,370	21,470	21,570	21,660	7.4
7.5	20,030	20,140	20,240	20,350	20,460	20,560	20,670	20,770	20,880	20,980	21,080	21,190	21,290	21,390	21,490	21,590	21,690	21,790	21,890	21,990	22,090	7.5
7.6	20,420	20,530	20,640	20,750	20,860	20,970	21,070	21,180	21,290	21,390	21,500	21,600	21,710	21,810	21,910	22,020	22,120	22,220	22,320	22,420	22,520	7.6
7.7	20,820	20,940	21,050	21,160	21,270	21,380	21,490	21,600	21,710	21,810	21,920	22,030	22,140	22,240	22,350	22,450	22,560	22,660	22,760	22,870	22,970	7.7
7.8	21,240	21,350	21,460	21,580	21,690	21,800	21,920	22,030	22,140	22,250	22,360	22,470	22,570	22,680	22,790	22,900	23,000	23,110	23,220	23,320	23,430	7.8
7.9	21,660	21,780	21,890	22,010	22,120	22,240	22,350	22,470	22,580	22,690	22,810	22,920	23,030	23,140	23,250	23,360	23,470	23,570	23,680	23,790	23,900	7.9
8.0	22,100	22,220	22,340	22,450	22,570	22,690	22,810	22,920	23,040	23,150	23,270	23,380	23,490	23,610	23,720	23,830	23,940	24,050	24,160	24,270	24,380	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	22,550	22,670	22,790	22,910	23,030	23,150	23,270	23,390	23,510	23,620	23,740	23,860	23,970	24,090	24,200	24,320	24,430	24,540	24,660	24,770	24,880	8.1
8.2	23,010	23,140	23,260	23,380	23,510	23,630	23,750	23,870	23,990	24,110	24,230	24,350	24,470	24,590	24,700	24,820	24,940	25,050	25,170	25,280	25,400	8.2
8.3	23,490	23,620	23,750	23,870	24,000	24,130	24,250	24,370	24,500	24,620	24,740	24,860	24,980	25,100	25,220	25,340	25,460	25,580	25,700	25,810	25,930	8.3
8.4	23,980	24,110	24,240	24,370	24,500	24,620	24,750	24,880	25,000	25,130	25,250	25,380	25,500	25,620	25,740	25,870	25,990	26,110	26,230	26,350	26,470	8.4
8.5	24,420	24,550	24,680	24,810	24,940	25,080	25,200	25,330	25,460	25,590	25,720	25,840	25,970	26,090	26,220	26,340	26,470	26,590	26,710	26,830	26,950	8.5
8.6	24,820	24,960	25,090	25,230	25,360	25,490	25,620	25,760	25,890	26,020	26,150	26,270	26,400	26,530	26,660	26,780	26,910	27,030	27,160	27,280	27,400	8.6
8.7	25,210	25,350	25,480	25,620	25,760	25,890	26,030	26,160	26,290	26,420	26,560	26,690	26,820	26,950	27,070	27,200	27,330	27,460	27,580	27,710	27,830	8.7
8.8	25,590	25,730	25,870	26,010	26,150	26,290	26,420	26,560	26,690	26,830	26,960	27,090	27,230	27,360	27,490	27,620	27,750	27,880	28,010	28,130	28,260	8.8
8.9	25,980	26,130	26,270	26,410	26,550	26,690	26,830	26,960	27,100	27,240	27,370	27,510	27,640	27,780	27,910	28,040	28,170	28,300	28,440	28,570	28,700	8.9
9.0	26,390	26,530	26,680	26,820	26,960	27,100	27,240	27,380	27,520	27,660	27,800	27,940	28,070	28,210	28,350	28,480	28,610	28,750	28,880	29,010	29,140	9.0
9.1	26,810	26,950	27,100	27,240	27,390	27,530	27,680	27,820	27,960	28,100	28,240	28,380	28,520	28,660	28,800	28,930	29,070	29,210	29,340	29,470	29,610	9.1
9.2	27,230	27,380	27,530	27,680	27,830	27,970	28,120	28,260	28,410	28,550	28,690	28,830	28,980	29,120	29,260	29,400	29,530	29,670	29,810	29,950	30,080	9.2
9.3	27,660	27,810	27,960	28,110	28,260	28,410	28,560	28,700	28,850	29,000	29,140	29,280	29,430	29,570	29,710	29,850	30,000	30,140	30,280	30,410	30,550	9.3
9.4	28,070	28,220	28,370	28,530	28,680	28,830	28,980	29,130	29,280	29,430	29,570	29,720	29,870	30,010	30,160	30,300	30,440	30,590	30,730	30,870	31,010	9.4
9.5*	28,160	28,320	28,470	28,630	28,780	28,930	29,080	29,230	29,380	29,530	29,680	29,820	29,970	30,120	30,260	30,410	30,550	30,690	30,830	30,980	31,120	9.5*
9.6*	28,250	28,410	28,560	28,710	28,870	29,020	29,170	29,320	29,470	29,620	29,770	29,920	30,060	30,210	30,360	30,500	30,640	30,790	30,930	31,070	31,210	9.6*
9.7*	28,330	28,480	28,640	28,790	28,950	29,100	29,250	29,400	29,550	29,700	29,850	30,000	30,150	30,290	30,440	30,580	30,730	30,870	31,020	31,160	31,300	9.7*
9.8*	28,390	28,550	28,710	28,860	29,010	29,170	29,320	29,470	29,620	29,770	29,920	30,070	30,220	30,370	30,510	30,660	30,800	30,950	31,090	31,230	31,380	9.8*
9.9*	28,450	28,610	28,760	28,920	29,070	29,230	29,380	29,530	29,680	29,830	29,980	30,130	30,280	30,430	30,570	30,720	30,870	31,010	31,150	31,300	31,440	9.9*
10.0*	28,500	28,650	28,810	28,960	29,120	29,270	29,430	29,580	29,730	29,880	30,030	30,180	30,330	30,480	30,620	30,770	30,920	31,060	31,200	31,350	31,490	10.0*

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	2,840	2,860	2,870	2,880	2,890	2,900	2,910	2,930	2,940	2,950	2,960	2,970	2,980	2,990	3,010	3,020	3,030	3,040	3,050	3,060	3,070	1.0
1.1	3,100	3,120	3,130	3,140	3,160	3,170	3,180	3,190	3,210	3,220	3,230	3,240	3,260	3,270	3,280	3,290	3,310	3,320	3,330	3,340	3,360	1.1
1.2	3,360	3,380	3,390	3,400	3,420	3,430	3,450	3,460	3,470	3,490	3,500	3,510	3,530	3,540	3,550	3,570	3,580	3,590	3,610	3,620	3,630	1.2
1.3	3,620	3,630	3,650	3,660	3,680	3,690	3,710	3,720	3,740	3,750	3,770	3,780	3,790	3,810	3,820	3,840	3,850	3,870	3,880	3,890	3,910	1.3
1.4	3,870	3,880	3,900	3,920	3,930	3,950	3,960	3,980	4,000	4,010	4,030	4,040	4,060	4,070	4,090	4,110	4,120	4,140	4,150	4,170	4,180	1.4
1.5	4,120	4,130	4,150	4,170	4,190	4,200	4,220	4,240	4,250	4,270	4,290	4,300	4,320	4,340	4,350	4,370	4,390	4,400	4,420	4,440	4,450	1.5
1.6	4,360	4,380	4,400	4,420	4,440	4,460	4,470	4,490	4,510	4,530	4,540	4,560	4,580	4,600	4,620	4,630	4,650	4,670	4,680	4,700	4,720	1.6
1.7	4,610	4,630	4,650	4,670	4,690	4,710	4,720	4,740	4,760	4,780	4,800	4,820	4,840	4,860	4,870	4,890	4,910	4,930	4,950	4,970	4,980	1.7
1.8	4,850	4,870	4,890	4,910	4,930	4,950	4,970	4,990	5,010	5,030	5,050	5,070	5,090	5,110	5,130	5,150	5,170	5,190	5,210	5,230	5,250	1.8
1.9	5,100	5,120	5,140	5,160	5,180	5,200	5,220	5,240	5,260	5,290	5,310	5,330	5,350	5,370	5,390	5,410	5,430	5,450	5,470	5,490	5,510	1.9
2.0	5,340	5,360	5,380	5,400	5,430	5,450	5,470	5,490	5,510	5,540	5,560	5,580	5,600	5,620	5,640	5,670	5,690	5,710	5,730	5,750	5,770	2.0
2.1	5,580	5,600	5,620	5,650	5,670	5,690	5,720	5,740	5,760	5,790	5,810	5,830	5,850	5,880	5,900	5,920	5,940	5,970	5,990	6,010	6,030	2.1
2.2	5,820	5,840	5,870	5,890	5,920	5,940	5,960	5,990	6,010	6,040	6,060	6,080	6,110	6,130	6,150	6,180	6,200	6,220	6,250	6,270	6,290	2.2
2.3	6,060	6,080	6,110	6,130	6,160	6,180	6,210	6,230	6,260	6,280	6,310	6,330	6,360	6,380	6,410	6,430	6,460	6,480	6,500	6,530	6,550	2.3
2.4	6,300	6,320	6,350	6,380	6,400	6,430	6,460	6,480	6,510	6,530	6,560	6,590	6,610	6,640	6,660	6,690	6,710	6,740	6,760	6,790	6,810	2.4
2.5	6,540	6,570	6,590	6,620	6,650	6,680	6,700	6,730	6,760	6,780	6,810	6,840	6,860	6,890	6,920	6,940	6,970	7,000	7,020	7,050	7,070	2.5
2.6	6,780	6,810	6,840	6,870	6,890	6,920	6,950	6,980	7,010	7,030	7,060	7,090	7,120	7,150	7,170	7,200	7,230	7,250	7,280	7,310	7,330	2.6
2.7	7,020	7,050	7,080	7,110	7,140	7,170	7,200	7,230	7,260	7,290	7,310	7,340	7,370	7,400	7,430	7,460	7,490	7,510	7,540	7,570	7,600	2.7
2.8	7,270	7,300	7,330	7,360	7,390	7,420	7,450	7,480	7,510	7,540	7,570	7,600	7,630	7,660	7,690	7,720	7,750	7,770	7,800	7,830	7,860	2.8
2.9	7,510	7,540	7,570	7,610	7,640	7,670	7,700	7,730	7,760	7,790	7,820	7,850	7,890	7,920	7,950	7,980	8,010	8,040	8,070	8,100	8,130	2.9
3.0	7,760	7,790	7,820	7,850	7,890	7,920	7,950	7,980	8,020	8,050	8,080	8,110	8,140	8,180	8,210	8,240	8,270	8,300	8,330	8,360	8,390	3.0
3.1	8,000	8,040	8,070	8,110	8,140	8,170	8,210	8,240	8,270	8,310	8,340	8,370	8,410	8,440	8,470	8,500	8,530	8,570	8,600	8,630	8,660	3.1
3.2	8,250	8,290	8,320	8,360	8,390	8,430	8,460	8,500	8,530	8,570	8,600	8,630	8,670	8,700	8,740	8,770	8,800	8,830	8,870	8,900	8,930	3.2
3.3	8,510	8,540	8,580	8,620	8,650	8,690	8,720	8,760	8,790	8,830	8,860	8,900	8,930	8,970	9,000	9,040	9,070	9,110	9,140	9,170	9,210	3.3
3.4	8,760	8,800	8,840	8,870	8,910	8,950	8,980	9,020	9,060	9,090	9,130	9,170	9,200	9,240	9,270	9,310	9,340	9,380	9,410	9,450	9,480	3.4
3.5	9,020	9,060	9,100	9,130	9,170	9,210	9,250	9,290	9,320	9,360	9,400	9,430	9,470	9,510	9,540	9,580	9,620	9,650	9,690	9,730	9,760	3.5
3.6	9,280	9,320	9,360	9,400	9,440	9,470	9,510	9,550	9,590	9,630	9,670	9,710	9,740	9,780	9,820	9,860	9,890	9,930	9,970	10,010	10,040	3.6
3.7	9,540	9,580	9,620	9,660	9,700	9,740	9,780	9,820	9,860	9,900	9,940	9,980	10,020	10,060	10,100	10,140	10,170	10,210	10,250	10,290	10,330	3.7
3.8	9,800	9,850	9,890	9,930	9,970	10,010	10,050	10,100	10,140	10,180	10,220	10,260	10,300	10,340	10,380	10,420	10,460	10,500	10,540	10,580	10,620	3.8
3.9	10,070	10,120	10,160	10,200	10,240	10,290	10,330	10,370	10,410	10,460	10,500	10,540	10,580	10,620	10,660	10,700	10,740	10,780	10,830	10,870	10,910	3.9
4.0	10,340	10,390	10,430	10,480	10,520	10,560	10,610	10,650	10,690	10,740	10,780	10,820	10,870	10,910	10,950	10,990	11,030	11,080	11,120	11,160	11,200	4.0
4.1	10,620	10,660	10,710	10,750	10,800	10,840	10,890	10,930	10,980	11,020	11,070	11,110	11,150	11,200	11,240	11,280	11,330	11,370	11,410	11,450	11,500	4.1
4.2	10,890	10,940	10,990	11,030	11,080	11,130	11,170	11,220	11,260	11,310	11,360	11,400	11,440	11,490	11,530	11,580	11,620	11,670	11,710	11,750	11,800	4.2
4.3	11,170	11,220	11,270	11,320	11,370	11,410	11,460	11,510	11,550	11,600	11,650	11,690	11,740	11,790	11,830	11,880	11,920	11,970	12,010	12,060	12,100	4.3
4.4	11,460	11,510	11,560	11,610	11,650	11,700	11,750	11,800	11,850	11,900	11,940	11,990	12,040	12,080	12,130	12,180	12,230	12,270	12,320	12,360	12,410	4.4
4.5	11,740	11,800	11,850	11,900	11,950	12,000	12,050	12,090	12,140	12,190	12,240	12,290	12,340	12,390	12,440	12,480	12,530	12,580	12,630	12,670	12,720	4.5
4.6	12,030	12,090	12,140	12,190	12,240	12,290	12,340	12,390	12,440	12,490	12,540	12,590	12,640	12,690	12,740	12,790	12,840	12,890	12,940	12,990	13,040	4.6
4.7	12,330	12,380	12,430	12,490	12,540	12,590	12,640	12,700	12,750	12,800	12,850	12,900	12,950	13,000	13,050	13,100	13,150	13,200	13,250	13,300	13,350	4.7
4.8	12,620	12,680	12,730	12,790	12,840	12,890	12,950	13,000	13,050	13,110	13,160	13,210	13,260	13,320	13,370	13,420	13,470	13,520	13,570	13,620	13,680	4.8
4.9	12,920	12,980	13,030	13,090	13,150	13,200	13,260	13,310	13,360	13,420	13,470	13,530	13,580	13,630	13,690	13,740	13,790	13,840	13,900	13,950	14,000	4.9
5.0	13,230	13,280	13,340	13,400	13,450	13,510	13,570	13,620	13,680	13,730	13,790	13,840	13,900	13,950	14,010	14,060	14,120	14,170	14,220	14,280	14,330	5.0
5.1	13,530	13,590	13,650	13,710	13,770	13,820	13,880	13,940	13,990	14,050	14,110	14,160	14,220	14,280	14,330	14,390	14,440	14,500	14,550	14,610	14,660	5.1
5.2	13,840	13,900	13,960	14,020	14,080	14,140	14,200	14,260	14,320	14,370	14,430	14,490	14,550	14,600	14,660	14,720	14,770	14,830	14,890	14,940	15,000	5.2
5.3	14,150	14,220	14,280	14,340	14,400	14,460	14,520	14,580	14,640	14,700	14,760	14,820	14,880	14,930	14,990	15,050	15,110	15,170	15,220	15,280	15,340	5.3
5.4	14,470	14,530	14,600	14,660	14,720	14,780	14,840	14,910	14,970	15,030	15,090	15,150	15,210	15,270	15,330	15,390	15,450	15,510	15,560	15,620	15,680	5.4
5.5	14,790	14,850	14,920	14,980	15,050	15,110	15,170	15,230	15,300	15,360	15,420	15,480	15,550	15,610	15,670	15,730	15,790	15,850	15,910	15,970	16,030	5.5
5.6	15,110	15,180	15,240	15,310	15,370	15,440	15,500	15,570	15,630	15,700	15,760	15,820	15,880	15,950	16,010	16,070	16,130	16,200	16,260	16,320	16,380	5.6
5.7	15,440	15,510	15,570	15,640	15,710	15,770	15,840	15,900	15,970	16,030	16,100	16,160	16,230	16,290	16,360	16,420	16,480	16,550	16,610	16,670	16,730	5.7
5.8	15,770	15,840	15,910	15,970	16,040	16,110	16,180	16,240	16,310	16,380	16,440	16,510	16,580	16,640	16,710	16,770	16,840	16,900	16,970	17,030	17,090	5.8
5.9	16,100	16,170	16,240	16,310	16,380	16,450	16,520	16,590	16,660	16,720	16,790	16,860	16,930	16,990	17,060	17,130	17,190	17,260	17,330	17,390	17,460	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																						GATE OPENING IN FEET
	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000		
6.0	16,440	16,510	16,580	16,650	16,720	16,800	16,870	16,940	17,010	17,080	17,140	17,210	17,280	17,350	17,420	17,490	17,550	17,620	17,690	17,760	17,820		6.0
6.1	16,780	16,850	16,930	17,000	17,070	17,140	17,220	17,290	17,360	17,430	17,500	17,570	17,640	17,710	17,780	17,850	17,920	17,990	18,060	18,130	18,190		6.1
6.2	17,120	17,200	17,270	17,350	17,420	17,500	17,570	17,640	17,720	17,790	17,860	17,930	18,000	18,080	18,150	18,220	18,290	18,360	18,430	18,500	18,570		6.2
6.3	17,470	17,550	17,630	17,700	17,780	17,850	17,930	18,000	18,080	18,150	18,230	18,300	18,370	18,440	18,520	18,590	18,660	18,730	18,810	18,880	18,950		6.3
6.4	17,830	17,900	17,980	18,060	18,140	18,210	18,290	18,370	18,440	18,520	18,590	18,670	18,740	18,820	18,890	18,970	19,040	19,110	19,190	19,260	19,330		6.4
6.5	18,180	18,260	18,340	18,420	18,500	18,580	18,660	18,740	18,810	18,890	18,970	19,040	19,120	19,200	19,270	19,350	19,420	19,500	19,570	19,650	19,720		6.5
6.6	18,550	18,630	18,710	18,790	18,870	18,950	19,030	19,110	19,190	19,270	19,350	19,430	19,500	19,580	19,660	19,730	19,810	19,890	19,960	20,040	20,120		6.6
6.7	18,910	19,000	19,080	19,160	19,240	19,330	19,410	19,490	19,570	19,650	19,730	19,810	19,890	19,970	20,050	20,130	20,210	20,280	20,360	20,440	20,520		6.7
6.8	19,290	19,370	19,460	19,540	19,620	19,710	19,790	19,870	19,960	20,040	20,120	20,200	20,280	20,360	20,440	20,520	20,600	20,680	20,760	20,840	20,920		6.8
6.9	19,670	19,750	19,840	19,920	20,010	20,100	20,180	20,270	20,350	20,430	20,520	20,600	20,680	20,770	20,850	20,930	21,010	21,090	21,170	21,250	21,330		6.9
7.0	20,050	20,140	20,230	20,320	20,400	20,490	20,580	20,660	20,750	20,830	20,920	21,000	21,090	21,170	21,260	21,340	21,420	21,510	21,590	21,670	21,750		7.0
7.1	20,440	20,530	20,620	20,710	20,800	20,890	20,980	21,070	21,150	21,240	21,330	21,420	21,500	21,590	21,670	21,760	21,840	21,930	22,010	22,100	22,180		7.1
7.2	20,840	20,930	21,030	21,120	21,210	21,300	21,390	21,480	21,570	21,660	21,750	21,830	21,920	22,010	22,100	22,180	22,270	22,360	22,440	22,530	22,610		7.2
7.3	21,250	21,340	21,440	21,530	21,620	21,710	21,810	21,900	21,990	22,080	22,170	22,260	22,350	22,440	22,530	22,620	22,710	22,790	22,880	22,970	23,060		7.3
7.4	21,660	21,760	21,860	21,950	22,040	22,140	22,230	22,330	22,420	22,510	22,610	22,700	22,790	22,880	22,970	23,060	23,150	23,240	23,330	23,420	23,510		7.4
7.5	22,090	22,190	22,280	22,380	22,480	22,570	22,670	22,760	22,860	22,950	23,050	23,140	23,240	23,330	23,420	23,510	23,610	23,700	23,790	23,880	23,970		7.5
7.6	22,520	22,620	22,720	22,820	22,920	23,020	23,120	23,210	23,310	23,410	23,500	23,600	23,690	23,790	23,880	23,980	24,070	24,170	24,260	24,350	24,440		7.6
7.7	22,970	23,070	23,170	23,270	23,370	23,470	23,570	23,670	23,770	23,870	23,970	24,070	24,160	24,260	24,360	24,450	24,550	24,650	24,740	24,840	24,930		7.7
7.8	23,430	23,530	23,630	23,740	23,840	23,940	24,040	24,150	24,250	24,350	24,450	24,550	24,650	24,750	24,840	24,940	25,040	25,140	25,230	25,330	25,430		7.8
7.9	23,900	24,000	24,110	24,210	24,320	24,420	24,530	24,630	24,730	24,840	24,940	25,040	25,140	25,240	25,340	25,440	25,540	25,640	25,740	25,840	25,940		7.9
8.0	24,380	24,490	24,600	24,700	24,810	24,920	25,020	25,130	25,240	25,340	25,450	25,550	25,650	25,760	25,860	25,960	26,060	26,160	26,270	26,370	26,470		8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																						
8.1	24,880	24,990	25,100	25,210	25,320	25,430	25,540	25,650	25,750	25,860	25,970	26,070	26,180	26,280	26,390	26,490	26,600	26,700	26,810	26,910	27,010		8.1
8.2	25,400	25,510	25,620	25,730	25,850	25,960	26,070	26,180	26,290	26,400	26,510	26,620	26,720	26,830	26,940	27,050	27,150	27,260	27,360	27,470	27,570		8.2
8.3	25,930	26,040	26,160	26,280	26,390	26,500	26,620	26,730	26,840	26,950	27,060	27,180	27,290	27,400	27,510	27,620	27,720	27,830	27,940	28,050	28,150		8.3
8.4	26,470	26,580	26,700	26,820	26,940	27,050	27,170	27,280	27,400	27,510	27,630	27,740	27,850	27,970	28,080	28,190	28,300	28,410	28,520	28,630	28,740		8.4
8.5	26,950	27,070	27,190	27,310	27,430	27,550	27,670	27,790	27,900	28,020	28,140	28,250	28,370	28,480	28,600	28,710	28,820	28,940	29,050	29,160	29,270		8.5
8.6	27,400	27,530	27,650	27,770	27,890	28,010	28,130	28,250	28,370	28,490	28,610	28,730	28,840	28,960	29,080	29,190	29,310	29,420	29,540	29,650	29,760		8.6
8.7	27,830	27,960	28,080	28,210	28,330	28,450	28,580	28,700	28,820	28,940	29,060	29,180	29,300	29,420	29,530	29,650	29,770	29,890	30,000	30,120	30,230		8.7
8.8	28,260	28,390	28,510	28,640	28,760	28,890	29,010	29,140	29,260	29,380	29,500	29,630	29,750	29,870	29,990	30,110	30,230	30,340	30,460	30,580	30,700		8.8
8.9	28,700	28,820	28,950	29,080	29,210	29,330	29,460	29,590	29,710	29,830	29,960	30,080	30,200	30,330	30,450	30,570	30,690	30,810	30,930	31,050	31,170		8.9
9.0	29,140	29,280	29,410	29,540	29,660	29,790	29,920	30,050	30,180	30,300	30,430	30,550	30,680	30,800	30,930	31,050	31,170	31,300	31,420	31,540	31,660		9.0
9.1	29,610	29,740	29,870	30,010	30,140	30,270	30,400	30,530	30,660	30,790	30,910	31,040	31,170	31,300	31,420	31,550	31,670	31,800	31,920	32,040	32,170		9.1
9.2	30,080	30,220	30,350	30,490	30,620	30,750	30,890	31,020	31,150	31,280	31,410	31,540	31,670	31,800	31,930	32,050	32,180	32,310	32,430	32,560	32,680		9.2
9.3	30,550	30,690	30,830	30,960	31,100	31,240	31,370	31,500	31,640	31,770	31,900	32,030	32,170	32,300	32,430	32,560	32,690	32,820	32,940	33,070	33,200		9.3
9.4	31,010	31,150	31,290	31,430	31,570	31,700	31,840	31,980	32,110	32,250	32,380	32,510	32,650	32,780	32,910	33,050	33,180	33,310	33,440	33,570	33,700		9.4
9.5*	31,120	31,260	31,400	31,540	31,680	31,810	31,950	32,090	32,220	32,360	32,490	32,630	32,760	32,900	33,030	33,160	33,290	33,420	33,560	33,690	33,820		9.5*
9.6*	31,210	31,360	31,500	31,640	31,770	31,910	32,050	32,190	32,320	32,460	32,600	32,730	32,870	33,000	33,130	33,270	33,400	33,530	33,660	33,790	33,920		9.6*
9.7*	31,300	31,440	31,580	31,720	31,860	32,000	32,140	32,280	32,410	32,550	32,690	32,820	32,960	33,090	33,220	33,360	33,490	33,620	33,750	33,880	34,020		9.7*
9.8*	31,380	31,520	31,660	31,800	31,940	32,080	32,220	32,350	32,490	32,630	32,770	32,900	33,040	33,170	33,300	33,440	33,570	33,700	33,840	33,970	34,100		9.8*
9.9*	31,440	31,580	31,720	31,860	32,000	32,140	32,280	32,420	32,560	32,700	32,830	32,970	33,100	33,240	33,370	33,510	33,640	33,770	33,910	34,040	34,170		9.9*
10.0*	31,490	31,630	31,780	31,920	32,060	32,200	32,340	32,470	32,610	32,750	32,890	33,020	33,160	33,290	33,430	33,560	33,700	33,830	33,960	34,090	34,230		10.0*

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																				GATE OPENING IN FEET
	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	3,070	3,080	3,100	3,110	3,120	3,130	3,140	3,150	3,160	3,170	3,180	3,190	3,200	3,210	3,220	3,230	3,250	3,260	3,270	3,280	3,290	1.0
1.1	3,360	3,370	3,380	3,390	3,400	3,420	3,430	3,440	3,450	3,460	3,470	3,490	3,500	3,510	3,520	3,530	3,540	3,550	3,570	3,580	3,590	1.1
1.2	3,630	3,650	3,660	3,670	3,690	3,700	3,710	3,720	3,740	3,750	3,760	3,780	3,790	3,800	3,810	3,830	3,840	3,850	3,860	3,870	3,890	1.2
1.3	3,910	3,920	3,940	3,950	3,970	3,980	3,990	4,010	4,020	4,030	4,050	4,060	4,070	4,090	4,100	4,120	4,130	4,140	4,160	4,170	4,180	1.3
1.4	4,180	4,200	4,210	4,230	4,240	4,260	4,270	4,290	4,300	4,320	4,330	4,340	4,360	4,370	4,390	4,400	4,420	4,430	4,440	4,460	4,470	1.4
1.5	4,450	4,470	4,480	4,500	4,510	4,530	4,550	4,560	4,580	4,590	4,610	4,620	4,640	4,660	4,670	4,690	4,700	4,720	4,730	4,750	4,760	1.5
1.6	4,720	4,740	4,750	4,770	4,790	4,800	4,820	4,840	4,850	4,870	4,890	4,900	4,920	4,940	4,950	4,970	4,980	5,000	5,020	5,030	5,050	1.6
1.7	4,980	5,000	5,020	5,040	5,060	5,070	5,090	5,110	5,130	5,140	5,160	5,180	5,200	5,210	5,230	5,250	5,260	5,280	5,300	5,320	5,330	1.7
1.8	5,250	5,270	5,290	5,300	5,320	5,340	5,360	5,380	5,400	5,420	5,430	5,450	5,470	5,490	5,510	5,520	5,540	5,560	5,580	5,600	5,610	1.8
1.9	5,510	5,530	5,550	5,570	5,590	5,610	5,630	5,650	5,670	5,690	5,710	5,730	5,740	5,760	5,780	5,800	5,820	5,840	5,860	5,880	5,900	1.9
2.0	5,770	5,790	5,810	5,830	5,850	5,870	5,900	5,920	5,940	5,960	5,980	6,000	6,020	6,040	6,060	6,080	6,100	6,120	6,140	6,160	6,180	2.0
2.1	6,030	6,050	6,080	6,100	6,120	6,140	6,160	6,180	6,200	6,230	6,250	6,270	6,290	6,310	6,330	6,350	6,370	6,390	6,410	6,430	6,450	2.1
2.2	6,290	6,310	6,340	6,360	6,380	6,400	6,430	6,450	6,470	6,490	6,520	6,540	6,560	6,580	6,600	6,630	6,650	6,670	6,690	6,710	6,730	2.2
2.3	6,550	6,580	6,600	6,620	6,650	6,670	6,690	6,720	6,740	6,760	6,790	6,810	6,830	6,850	6,880	6,900	6,920	6,940	6,970	6,990	7,010	2.3
2.4	6,810	6,840	6,860	6,890	6,910	6,930	6,960	6,980	7,010	7,030	7,060	7,080	7,100	7,130	7,150	7,170	7,200	7,220	7,240	7,270	7,290	2.4
2.5	7,070	7,100	7,120	7,150	7,170	7,200	7,230	7,250	7,280	7,300	7,330	7,350	7,370	7,400	7,420	7,450	7,470	7,500	7,520	7,550	7,570	2.5
2.6	7,330	7,360	7,390	7,410	7,440	7,470	7,490	7,520	7,540	7,570	7,600	7,620	7,650	7,670	7,700	7,720	7,750	7,770	7,800	7,820	7,850	2.6
2.7	7,600	7,620	7,650	7,680	7,710	7,730	7,760	7,790	7,810	7,840	7,870	7,900	7,920	7,950	7,970	8,000	8,030	8,050	8,080	8,110	8,130	2.7
2.8	7,860	7,890	7,920	7,950	7,970	8,000	8,030	8,060	8,090	8,110	8,140	8,170	8,200	8,220	8,250	8,280	8,310	8,330	8,360	8,390	8,410	2.8
2.9	8,130	8,160	8,180	8,210	8,240	8,270	8,300	8,330	8,360	8,390	8,420	8,450	8,470	8,500	8,530	8,560	8,590	8,610	8,640	8,670	8,700	2.9
3.0	8,390	8,420	8,450	8,480	8,510	8,540	8,570	8,600	8,630	8,660	8,690	8,720	8,750	8,780	8,810	8,840	8,870	8,900	8,930	8,960	8,980	3.0
3.1	8,660	8,690	8,730	8,760	8,790	8,820	8,850	8,880	8,910	8,940	8,970	9,000	9,030	9,060	9,090	9,120	9,150	9,180	9,210	9,240	9,270	3.1
3.2	8,930	8,970	9,000	9,030	9,060	9,090	9,130	9,160	9,190	9,220	9,250	9,290	9,320	9,350	9,380	9,410	9,440	9,470	9,500	9,530	9,560	3.2
3.3	9,210	9,240	9,270	9,310	9,340	9,370	9,410	9,440	9,470	9,500	9,540	9,570	9,600	9,630	9,670	9,700	9,730	9,760	9,790	9,830	9,860	3.3
3.4	9,480	9,520	9,550	9,590	9,620	9,650	9,690	9,720	9,760	9,790	9,820	9,860	9,890	9,920	9,960	9,990	10,020	10,060	10,090	10,120	10,150	3.4
3.5	9,760	9,800	9,830	9,870	9,900	9,940	9,970	10,010	10,040	10,080	10,110	10,150	10,180	10,220	10,250	10,280	10,320	10,350	10,390	10,420	10,450	3.5
3.6	10,040	10,080	10,120	10,150	10,190	10,230	10,260	10,300	10,330	10,370	10,400	10,440	10,480	10,510	10,550	10,580	10,620	10,650	10,690	10,720	10,750	3.6
3.7	10,330	10,370	10,400	10,440	10,480	10,520	10,550	10,590	10,630	10,660	10,700	10,740	10,770	10,810	10,840	10,880	10,920	10,950	10,990	11,020	11,060	3.7
3.8	10,620	10,650	10,690	10,730	10,770	10,810	10,850	10,880	10,920	10,960	11,000	11,040	11,070	11,110	11,150	11,180	11,220	11,260	11,290	11,330	11,370	3.8
3.9	10,910	10,950	10,990	11,030	11,060	11,100	11,140	11,180	11,220	11,260	11,300	11,340	11,380	11,410	11,450	11,490	11,530	11,570	11,600	11,640	11,680	3.9
4.0	11,200	11,240	11,280	11,320	11,360	11,400	11,440	11,480	11,520	11,560	11,600	11,640	11,680	11,720	11,760	11,800	11,840	11,880	11,920	11,960	12,000	4.0
4.1	11,500	11,540	11,580	11,620	11,670	11,710	11,750	11,790	11,830	11,870	11,910	11,950	11,990	12,030	12,070	12,110	12,160	12,190	12,230	12,270	12,310	4.1
4.2	11,800	11,840	11,880	11,930	11,970	12,010	12,060	12,100	12,140	12,180	12,220	12,270	12,310	12,350	12,390	12,430	12,470	12,510	12,560	12,600	12,640	4.2
4.3	12,100	12,150	12,190	12,230	12,280	12,320	12,370	12,410	12,450	12,500	12,540	12,580	12,630	12,670	12,710	12,750	12,800	12,840	12,880	12,920	12,960	4.3
4.4	12,410	12,460	12,500	12,550	12,590	12,640	12,680	12,730	12,770	12,810	12,860	12,900	12,950	12,990	13,030	13,080	13,120	13,160	13,210	13,250	13,290	4.4
4.5	12,720	12,770	12,810	12,860	12,910	12,950	13,000	13,040	13,090	13,140	13,180	13,230	13,270	13,320	13,360	13,410	13,450	13,490	13,540	13,580	13,630	4.5
4.6	13,040	13,080	13,130	13,180	13,230	13,270	13,320	13,370	13,410	13,460	13,510	13,550	13,600	13,650	13,690	13,740	13,780	13,830	13,870	13,920	13,960	4.6
4.7	13,350	13,400	13,450	13,500	13,550	13,600	13,650	13,690	13,740	13,790	13,840	13,890	13,930	13,980	14,030	14,070	14,120	14,170	14,210	14,260	14,310	4.7
4.8	13,680	13,730	13,780	13,830	13,880	13,930	13,980	14,020	14,070	14,120	14,170	14,220	14,270	14,320	14,370	14,410	14,460	14,510	14,560	14,600	14,650	4.8
4.9	14,000	14,050	14,100	14,160	14,210	14,260	14,310	14,360	14,410	14,460	14,510	14,560	14,610	14,660	14,710	14,760	14,810	14,860	14,900	14,950	15,000	4.9
5.0	14,330	14,380	14,440	14,490	14,540	14,590	14,640	14,700	14,750	14,800	14,850	14,900	14,950	15,000	15,050	15,100	15,150	15,210	15,260	15,300	15,350	5.0
5.1	14,660	14,720	14,770	14,820	14,880	14,930	14,980	15,040	15,090	15,140	15,200	15,250	15,300	15,350	15,400	15,460	15,510	15,560	15,610	15,660	15,710	5.1
5.2	15,000	15,050	15,110	15,160	15,220	15,270	15,330	15,380	15,440	15,490	15,540	15,600	15,650	15,700	15,760	15,810	15,860	15,920	15,970	16,020	16,070	5.2
5.3	15,340	15,400	15,450	15,510	15,560	15,620	15,680	15,730	15,790	15,840	15,900	15,950	16,010	16,060	16,120	16,170	16,220	16,280	16,330	16,380	16,440	5.3
5.4	15,680	15,740	15,800	15,860	15,910	15,970	16,030	16,080	16,140	16,200	16,250	16,310	16,370	16,420	16,480	16,530	16,590	16,640	16,700	16,750	16,810	5.4
5.5	16,030	16,090	16,150	16,210	16,270	16,320	16,380	16,440	16,500	16,560	16,610	16,670	16,730	16,790	16,840	16,900	16,960	17,010	17,070	17,120	17,180	5.5
5.6	16,380	16,440	16,500	16,560	16,620	16,680	16,740	16,800	16,860	16,920	16,980	17,040	17,100	17,150	17,210	17,270	17,330	17,390	17,440	17,500	17,560	5.6
5.7	16,730	16,800	16,860	16,920	16,980	17,040	17,100	17,170	17,230	17,290	17,350	17,410	17,470	17,530	17,590	17,640	17,700	17,760	17,820	17,880	17,940	5.7
5.8	17,090	17,160	17,220	17,280	17,350	17,410	17,470	17,530	17,600	17,660	17,720	17,780	17,840	17,900	17,960	18,020	18,080	18,140	18,200	18,260	18,320	5.8
5.9	17,460	17,520	17,590	17,650	17,710	17,780	17,840	17,910	17,970	18,030	18,090	18,160	18,220	18,280	18,340	18,410	18,470	18,530	18,590	18,650	18,710	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	
6.0	17,820	17,890	17,950	18,020	18,090	18,150	18,220	18,280	18,350	18,410	18,480	18,540	18,600	18,670	18,730	18,790	18,860	18,920	18,980	19,040	19,110	6.0
6.1	18,190	18,260	18,330	18,400	18,460	18,530	18,600	18,660	18,730	18,790	18,860	18,930	18,990	19,060	19,120	19,190	19,250	19,310	19,380	19,440	19,500	6.1
6.2	18,570	18,640	18,710	18,780	18,840	18,910	18,980	19,050	19,120	19,180	19,250	19,320	19,380	19,450	19,520	19,580	19,650	19,710	19,780	19,840	19,910	6.2
6.3	18,950	19,020	19,090	19,160	19,230	19,300	19,370	19,440	19,510	19,570	19,640	19,710	19,780	19,850	19,910	19,980	20,050	20,120	20,180	20,250	20,320	6.3
6.4	19,330	19,400	19,480	19,550	19,620	19,690	19,760	19,830	19,900	19,970	20,040	20,110	20,180	20,250	20,320	20,390	20,460	20,520	20,590	20,660	20,730	6.4
6.5	19,720	19,790	19,870	19,940	20,010	20,090	20,160	20,230	20,300	20,370	20,450	20,520	20,590	20,660	20,730	20,800	20,870	20,940	21,010	21,080	21,150	6.5
6.6	20,120	20,190	20,270	20,340	20,410	20,490	20,560	20,640	20,710	20,780	20,860	20,930	21,000	21,070	21,140	21,220	21,290	21,360	21,430	21,500	21,570	6.6
6.7	20,520	20,590	20,670	20,750	20,820	20,900	20,970	21,050	21,120	21,200	21,270	21,350	21,420	21,490	21,570	21,640	21,710	21,780	21,860	21,930	22,000	6.7
6.8	20,920	21,000	21,080	21,160	21,230	21,310	21,390	21,460	21,540	21,620	21,690	21,770	21,840	21,920	21,990	22,070	22,140	22,220	22,290	22,360	22,440	6.8
6.9	21,330	21,410	21,490	21,570	21,650	21,730	21,810	21,890	21,970	22,040	22,120	22,200	22,270	22,350	22,430	22,500	22,580	22,660	22,730	22,810	22,880	6.9
7.0	21,750	21,830	21,920	22,000	22,080	22,160	22,240	22,320	22,400	22,480	22,560	22,630	22,710	22,790	22,870	22,950	23,020	23,100	23,180	23,250	23,330	7.0
7.1	22,180	22,260	22,350	22,430	22,510	22,590	22,670	22,760	22,840	22,920	23,000	23,080	23,160	23,240	23,320	23,400	23,480	23,560	23,630	23,710	23,790	7.1
7.2	22,610	22,700	22,780	22,870	22,950	23,040	23,120	23,200	23,280	23,370	23,450	23,530	23,610	23,690	23,780	23,860	23,940	24,020	24,100	24,180	24,260	7.2
7.3	23,060	23,140	23,230	23,320	23,400	23,490	23,570	23,660	23,740	23,830	23,910	23,990	24,080	24,160	24,240	24,320	24,410	24,490	24,570	24,650	24,730	7.3
7.4	23,510	23,600	23,690	23,770	23,860	23,950	24,030	24,120	24,210	24,290	24,380	24,460	24,550	24,630	24,720	24,800	24,890	24,970	25,050	25,140	25,220	7.4
7.5	23,970	24,060	24,150	24,240	24,330	24,420	24,510	24,600	24,680	24,770	24,860	24,950	25,030	25,120	25,210	25,290	25,380	25,460	25,550	25,630	25,720	7.5
7.6	24,440	24,540	24,630	24,720	24,810	24,900	24,990	25,080	25,170	25,260	25,350	25,440	25,530	25,620	25,700	25,790	25,880	25,970	26,050	26,140	26,230	7.6
7.7	24,930	25,020	25,120	25,210	25,300	25,400	25,490	25,580	25,670	25,760	25,850	25,950	26,040	26,130	26,220	26,310	26,390	26,480	26,570	26,660	26,750	7.7
7.8	25,430	25,520	25,620	25,710	25,810	25,900	26,000	26,090	26,190	26,280	26,370	26,460	26,560	26,650	26,740	26,830	26,920	27,010	27,100	27,190	27,280	7.8
7.9	25,940	26,040	26,140	26,230	26,330	26,430	26,520	26,620	26,710	26,810	26,900	27,000	27,090	27,190	27,280	27,370	27,470	27,560	27,650	27,740	27,830	7.9
8.0	26,470	26,570	26,670	26,770	26,870	26,960	27,060	27,160	27,260	27,350	27,450	27,550	27,640	27,740	27,840	27,930	28,030	28,120	28,210	28,310	28,400	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	27,010	27,110	27,220	27,320	27,420	27,520	27,620	27,720	27,820	27,920	28,020	28,120	28,210	28,310	28,410	28,510	28,600	28,700	28,800	28,890	28,990	8.1
8.2	27,570	27,680	27,780	27,890	27,990	28,090	28,190	28,300	28,400	28,500	28,600	28,700	28,800	28,900	29,000	29,100	29,200	29,300	29,400	29,490	29,590	8.2
8.3	28,150	28,260	28,370	28,470	28,580	28,680	28,790	28,890	29,000	29,100	29,200	29,310	29,410	29,510	29,610	29,720	29,820	29,920	30,020	30,120	30,220	8.3
8.4	28,740	28,850	28,960	29,070	29,170	29,280	29,390	29,490	29,600	29,710	29,810	29,920	30,020	30,130	30,230	30,330	30,440	30,540	30,640	30,740	30,850	8.4
8.5	29,270	29,380	29,490	29,600	29,710	29,820	29,930	30,040	30,150	30,260	30,360	30,470	30,580	30,680	30,790	30,900	31,000	31,110	31,210	31,310	31,420	8.5
8.6	29,760	29,880	29,990	30,100	30,210	30,320	30,440	30,550	30,660	30,770	30,870	30,980	31,090	31,200	31,310	31,420	31,520	31,630	31,740	31,840	31,950	8.6
8.7	30,230	30,350	30,460	30,580	30,690	30,800	30,920	31,030	31,140	31,250	31,360	31,470	31,580	31,690	31,800	31,910	32,020	32,130	32,240	32,350	32,450	8.7
8.8	30,700	30,810	30,930	31,050	31,160	31,280	31,390	31,510	31,620	31,730	31,850	31,960	32,070	32,180	32,290	32,400	32,520	32,630	32,740	32,840	32,950	8.8
8.9	31,170	31,290	31,410	31,530	31,640	31,760	31,880	31,990	32,110	32,220	32,340	32,450	32,570	32,680	32,790	32,910	33,020	33,130	33,240	33,350	33,460	8.9
9.0	31,660	31,780	31,900	32,020	32,140	32,260	32,380	32,500	32,610	32,730	32,850	32,960	33,080	33,200	33,310	33,420	33,540	33,650	33,770	33,880	33,990	9.0
9.1	32,170	32,290	32,410	32,530	32,660	32,780	32,900	33,020	33,140	33,260	33,370	33,490	33,610	33,730	33,840	33,960	34,080	34,190	34,310	34,420	34,540	9.1
9.2	32,680	32,810	32,930	33,060	33,180	33,300	33,430	33,550	33,670	33,790	33,910	34,030	34,150	34,270	34,390	34,510	34,630	34,740	34,860	34,980	35,090	9.2
9.3	33,200	33,330	33,450	33,580	33,700	33,830	33,950	34,080	34,200	34,320	34,440	34,570	34,690	34,810	34,930	35,050	35,170	35,290	35,410	35,530	35,650	9.3
9.4	33,700	33,830	33,950	34,080	34,210	34,340	34,460	34,590	34,710	34,840	34,960	35,090	35,210	35,330	35,460	35,580	35,700	35,820	35,940	36,060	36,180	9.4
9.5*	33,820	33,940	34,070	34,200	34,330	34,460	34,580	34,710	34,840	34,960	35,090	35,210	35,340	35,460	35,580	35,700	35,830	35,950	36,070	36,190	36,310	9.5*
9.6*	33,920	34,050	34,180	34,310	34,440	34,560	34,690	34,820	34,950	35,070	35,200	35,320	35,450	35,570	35,690	35,820	35,940	36,060	36,180	36,310	36,430	9.6*
9.7*	34,020	34,150	34,270	34,400	34,530	34,660	34,790	34,920	35,040	35,170	35,290	35,420	35,540	35,670	35,790	35,920	36,040	36,160	36,290	36,410	36,530	9.7*
9.8*	34,100	34,230	34,360	34,490	34,620	34,750	34,870	35,000	35,130	35,250	35,380	35,510	35,630	35,760	35,880	36,010	36,130	36,250	36,370	36,500	36,620	9.8*
9.9*	34,170	34,300	34,430	34,560	34,690	34,820	34,950	35,070	35,200	35,330	35,460	35,580	35,710	35,830	35,960	36,080	36,200	36,330	36,450	36,570	36,700	9.9*
10.0*	34,230	34,360	34,490	34,620	34,750	34,880	35,000	35,130	35,260	35,390	35,510	35,640	35,770	35,890	36,020	36,140	36,260	36,390	36,510	36,630	36,760	10.0*

MAY 2000

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

HEADWATER 1000 to 1020

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																				GATE OPENING IN FEET
	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	3,290	3,300	3,310	3,320	3,330	3,340	3,350	3,360	3,370	3,380	3,390	3,400	3,410	3,420	3,430	3,440	3,450	3,460	3,470	3,480	3,490	1.0
1.1	3,590	3,600	3,610	3,620	3,630	3,640	3,660	3,670	3,680	3,690	3,700	3,710	3,720	3,730	3,740	3,750	3,760	3,780	3,790	3,800	3,810	1.1
1.2	3,890	3,900	3,910	3,920	3,940	3,950	3,960	3,970	3,980	4,000	4,010	4,020	4,030	4,040	4,050	4,070	4,080	4,090	4,100	4,110	4,120	1.2
1.3	4,180	4,190	4,210	4,220	4,230	4,250	4,260	4,270	4,290	4,300	4,310	4,320	4,340	4,350	4,360	4,370	4,390	4,400	4,410	4,420	4,440	1.3
1.4	4,470	4,490	4,500	4,520	4,530	4,540	4,560	4,570	4,580	4,600	4,610	4,630	4,640	4,650	4,670	4,680	4,690	4,710	4,720	4,730	4,750	1.4
1.5	4,760	4,780	4,790	4,810	4,820	4,840	4,850	4,870	4,880	4,900	4,910	4,920	4,940	4,950	4,970	4,980	5,000	5,010	5,020	5,040	5,050	1.5
1.6	5,050	5,060	5,080	5,100	5,110	5,130	5,140	5,160	5,170	5,190	5,200	5,220	5,240	5,250	5,270	5,280	5,300	5,310	5,330	5,340	5,360	1.6
1.7	5,330	5,350	5,370	5,380	5,400	5,420	5,430	5,450	5,470	5,480	5,500	5,510	5,530	5,550	5,560	5,580	5,600	5,610	5,630	5,640	5,660	1.7
1.8	5,610	5,630	5,650	5,670	5,680	5,700	5,720	5,740	5,750	5,770	5,790	5,810	5,820	5,840	5,860	5,870	5,890	5,910	5,930	5,940	5,960	1.8
1.9	5,900	5,910	5,930	5,950	5,970	5,990	6,010	6,020	6,040	6,060	6,080	6,100	6,110	6,130	6,150	6,170	6,190	6,200	6,220	6,240	6,260	1.9
2.0	6,180	6,190	6,210	6,230	6,250	6,270	6,290	6,310	6,330	6,350	6,370	6,390	6,410	6,420	6,440	6,460	6,480	6,500	6,520	6,540	6,550	2.0
2.1	6,450	6,470	6,490	6,520	6,540	6,560	6,580	6,600	6,620	6,640	6,660	6,680	6,690	6,710	6,730	6,750	6,770	6,790	6,810	6,830	6,850	2.1
2.2	6,730	6,750	6,780	6,800	6,820	6,840	6,860	6,880	6,900	6,920	6,940	6,960	6,980	7,000	7,030	7,050	7,070	7,090	7,110	7,130	7,150	2.2
2.3	7,010	7,030	7,060	7,080	7,100	7,120	7,140	7,170	7,190	7,210	7,230	7,250	7,270	7,290	7,320	7,340	7,360	7,380	7,400	7,420	7,440	2.3
2.4	7,290	7,310	7,340	7,360	7,380	7,410	7,430	7,450	7,470	7,500	7,520	7,540	7,560	7,590	7,610	7,630	7,650	7,670	7,700	7,720	7,740	2.4
2.5	7,570	7,590	7,620	7,640	7,670	7,690	7,710	7,740	7,760	7,780	7,810	7,830	7,850	7,880	7,900	7,920	7,940	7,970	7,990	8,010	8,040	2.5
2.6	7,850	7,870	7,900	7,920	7,950	7,970	8,000	8,020	8,050	8,070	8,100	8,120	8,140	8,170	8,190	8,220	8,240	8,260	8,290	8,310	8,330	2.6
2.7	8,130	8,160	8,180	8,210	8,230	8,260	8,280	8,310	8,340	8,360	8,390	8,410	8,440	8,460	8,490	8,510	8,530	8,560	8,580	8,610	8,630	2.7
2.8	8,410	8,440	8,470	8,490	8,520	8,550	8,570	8,600	8,630	8,650	8,680	8,700	8,730	8,760	8,780	8,810	8,830	8,860	8,880	8,910	8,930	2.8
2.9	8,700	8,730	8,750	8,780	8,810	8,840	8,860	8,890	8,920	8,940	8,970	9,000	9,020	9,050	9,080	9,100	9,130	9,160	9,180	9,210	9,240	2.9
3.0	8,980	9,010	9,040	9,070	9,100	9,130	9,150	9,180	9,210	9,240	9,270	9,290	9,320	9,350	9,380	9,400	9,430	9,460	9,490	9,510	9,540	3.0
3.1	9,270	9,300	9,330	9,360	9,390	9,420	9,450	9,480	9,510	9,540	9,560	9,590	9,620	9,650	9,680	9,710	9,730	9,760	9,790	9,820	9,850	3.1
3.2	9,560	9,590	9,620	9,650	9,690	9,720	9,750	9,780	9,800	9,830	9,860	9,890	9,920	9,950	9,980	10,010	10,040	10,070	10,100	10,130	10,160	3.2
3.3	9,860	9,890	9,920	9,950	9,980	10,010	10,040	10,070	10,110	10,140	10,170	10,200	10,230	10,260	10,290	10,320	10,350	10,380	10,410	10,440	10,470	3.3
3.4	10,150	10,190	10,220	10,250	10,280	10,310	10,350	10,380	10,410	10,440	10,470	10,500	10,540	10,570	10,600	10,630	10,660	10,690	10,720	10,750	10,780	3.4
3.5	10,450	10,490	10,520	10,550	10,580	10,620	10,650	10,680	10,720	10,750	10,780	10,810	10,850	10,880	10,910	10,940	10,970	11,010	11,040	11,070	11,100	3.5
3.6	10,750	10,790	10,820	10,860	10,890	10,920	10,960	10,990	11,030	11,060	11,090	11,130	11,160	11,190	11,230	11,260	11,290	11,320	11,360	11,390	11,420	3.6
3.7	11,060	11,090	11,130	11,160	11,200	11,230	11,270	11,300	11,340	11,370	11,410	11,440	11,480	11,510	11,540	11,580	11,610	11,650	11,680	11,710	11,750	3.7
3.8	11,370	11,400	11,440	11,480	11,510	11,550	11,580	11,620	11,660	11,690	11,730	11,760	11,800	11,830	11,870	11,900	11,940	11,970	12,000	12,040	12,070	3.8
3.9	11,680	11,720	11,750	11,790	11,830	11,870	11,900	11,940	11,980	12,010	12,050	12,080	12,120	12,160	12,190	12,230	12,260	12,300	12,330	12,370	12,410	3.9
4.0	12,000	12,030	12,070	12,110	12,150	12,190	12,220	12,260	12,300	12,340	12,370	12,410	12,450	12,480	12,520	12,560	12,600	12,630	12,670	12,700	12,740	4.0
4.1	12,310	12,350	12,390	12,430	12,470	12,510	12,550	12,590	12,630	12,660	12,700	12,740	12,780	12,820	12,860	12,890	12,930	12,970	13,010	13,040	13,080	4.1
4.2	12,640	12,680	12,720	12,760	12,800	12,840	12,880	12,920	12,960	13,000	13,040	13,080	13,110	13,150	13,190	13,230	13,270	13,310	13,350	13,390	13,420	4.2
4.3	12,960	13,000	13,050	13,090	13,130	13,170	13,210	13,250	13,290	13,330	13,370	13,410	13,450	13,490	13,530	13,570	13,610	13,650	13,690	13,730	13,770	4.3
4.4	13,290	13,340	13,380	13,420	13,460	13,510	13,550	13,590	13,630	13,670	13,710	13,750	13,800	13,840	13,880	13,920	13,960	14,000	14,040	14,080	14,120	4.4
4.5	13,630	13,670	13,710	13,760	13,800	13,840	13,890	13,930	13,970	14,020	14,060	14,100	14,140	14,190	14,230	14,270	14,310	14,350	14,390	14,440	14,480	4.5
4.6	13,960	14,010	14,050	14,100	14,140	14,190	14,230	14,280	14,320	14,360	14,410	14,450	14,490	14,540	14,580	14,620	14,670	14,710	14,750	14,790	14,840	4.6
4.7	14,310	14,350	14,400	14,440	14,490	14,530	14,580	14,630	14,670	14,720	14,760	14,800	14,850	14,890	14,940	14,980	15,030	15,070	15,110	15,160	15,200	4.7
4.8	14,650	14,700	14,750	14,790	14,840	14,890	14,930	14,980	15,020	15,070	15,120	15,160	15,210	15,250	15,300	15,340	15,390	15,430	15,480	15,520	15,570	4.8
4.9	15,000	15,050	15,100	15,150	15,190	15,240	15,290	15,340	15,380	15,430	15,480	15,520	15,570	15,620	15,660	15,710	15,760	15,800	15,850	15,890	15,940	4.9
5.0	15,350	15,400	15,450	15,500	15,550	15,600	15,650	15,700	15,750	15,790	15,840	15,890	15,940	15,990	16,030	16,080	16,130	16,170	16,220	16,270	16,310	5.0
5.1	15,710	15,760	15,810	15,860	15,910	15,960	16,010	16,060	16,110	16,160	16,210	16,260	16,310	16,360	16,410	16,450	16,500	16,550	16,600	16,650	16,700	5.1
5.2	16,070	16,120	16,180	16,230	16,280	16,330	16,380	16,430	16,480	16,530	16,580	16,630	16,680	16,730	16,780	16,830	16,880	16,930	16,980	17,030	17,080	5.2
5.3	16,440	16,490	16,540	16,600	16,650	16,700	16,750	16,810	16,860	16,910	16,960	17,010	17,060	17,110	17,170	17,220	17,270	17,320	17,370	17,420	17,470	5.3
5.4	16,810	16,860	16,910	16,970	17,020	17,080	17,130	17,180	17,240	17,290	17,340	17,390	17,450	17,500	17,550	17,600	17,650	17,710	17,760	17,810	17,860	5.4
5.5	17,180	17,230	17,290	17,350	17,400	17,460	17,510	17,560	17,620	17,670	17,730	17,780	17,830	17,890	17,940	17,990	18,050	18,100	18,150	18,210	18,260	5.5
5.6	17,560	17,610	17,670	17,730	17,780	17,840	17,890	17,950	18,010	18,060	18,120	18,170	18,230	18,280	18,340	18,390	18,440	18,500	18,550	18,610	18,660	5.6
5.7	17,940	18,000	18,050	18,110	18,170	18,230	18,280	18,340	18,400	18,450	18,510	18,570	18,620	18,680	18,730	18,790	18,840	18,900	18,950	19,010	19,060	5.7
5.8	18,320	18,380	18,440	18,500	18,560	18,620	18,680	18,730	18,790	18,850	18,910	18,970	19,020	19,080	19,140	19,190	19,250	19,310	19,360	19,420	19,470	5.8
5.9	18,710	18,770	18,830	18,890	18,950	19,010	19,070	19,130	19,190	19,250	19,310	19,370	19,430	19,490	19,540	19,600	19,660	19,720	19,770	19,830	19,890	5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	
6.0	19,110	19,170	19,230	19,290	19,350	19,410	19,470	19,540	19,600	19,660	19,720	19,780	19,840	19,900	19,960	20,020	20,070	20,130	20,190	20,250	20,310	6.0
6.1	19,500	19,570	19,630	19,690	19,760	19,820	19,880	19,940	20,010	20,070	20,130	20,190	20,250	20,310	20,370	20,430	20,490	20,550	20,610	20,670	20,730	6.1
6.2	19,910	19,970	20,040	20,100	20,160	20,230	20,290	20,360	20,420	20,480	20,540	20,610	20,670	20,730	20,790	20,860	20,920	20,980	21,040	21,100	21,160	6.2
6.3	20,320	20,380	20,450	20,510	20,580	20,640	20,710	20,770	20,840	20,900	20,970	21,030	21,090	21,160	21,220	21,280	21,350	21,410	21,470	21,530	21,600	6.3
6.4	20,730	20,800	20,860	20,930	21,000	21,060	21,130	21,200	21,260	21,330	21,390	21,460	21,520	21,590	21,650	21,720	21,780	21,850	21,910	21,970	22,040	6.4
6.5	21,150	21,220	21,280	21,350	21,420	21,490	21,560	21,620	21,690	21,760	21,820	21,890	21,960	22,020	22,090	22,160	22,220	22,290	22,350	22,420	22,480	6.5
6.6	21,570	21,640	21,710	21,780	21,850	21,920	21,990	22,060	22,130	22,190	22,260	22,330	22,400	22,470	22,530	22,600	22,670	22,730	22,800	22,870	22,930	6.6
6.7	22,000	22,070	22,140	22,210	22,290	22,360	22,430	22,500	22,570	22,640	22,710	22,780	22,850	22,910	22,980	23,050	23,120	23,190	23,260	23,320	23,390	6.7
6.8	22,440	22,510	22,580	22,660	22,730	22,800	22,870	22,940	23,020	23,090	23,160	23,230	23,300	23,370	23,440	23,510	23,580	23,650	23,720	23,790	23,860	6.8
6.9	22,880	22,960	23,030	23,100	23,180	23,250	23,320	23,400	23,470	23,540	23,620	23,690	23,760	23,830	23,900	23,980	24,050	24,120	24,190	24,260	24,330	6.9
7.0	23,330	23,410	23,480	23,560	23,630	23,710	23,780	23,860	23,930	24,010	24,080	24,160	24,230	24,300	24,380	24,450	24,520	24,590	24,670	24,740	24,810	7.0
7.1	23,790	23,870	23,940	24,020	24,100	24,180	24,250	24,330	24,400	24,480	24,560	24,630	24,710	24,780	24,850	24,930	25,000	25,080	25,150	25,220	25,300	7.1
7.2	24,260	24,340	24,410	24,490	24,570	24,650	24,730	24,810	24,880	24,960	25,040	25,110	25,190	25,270	25,340	25,420	25,500	25,570	25,650	25,720	25,800	7.2
7.3	24,730	24,810	24,890	24,970	25,050	25,130	25,210	25,290	25,370	25,450	25,530	25,610	25,690	25,760	25,840	25,920	26,000	26,070	26,150	26,230	26,300	7.3
7.4	25,220	25,300	25,380	25,470	25,550	25,630	25,710	25,790	25,870	25,950	26,030	26,110	26,190	26,270	26,350	26,430	26,510	26,590	26,670	26,740	26,820	7.4
7.5	25,720	25,800	25,880	25,970	26,050	26,130	26,220	26,300	26,380	26,460	26,550	26,630	26,710	26,790	26,870	26,950	27,030	27,110	27,190	27,270	27,350	7.5
7.6	26,230	26,310	26,400	26,480	26,570	26,650	26,740	26,820	26,910	26,990	27,070	27,160	27,240	27,320	27,400	27,490	27,570	27,650	27,730	27,810	27,890	7.6
7.7	26,750	26,840	26,920	27,010	27,100	27,180	27,270	27,360	27,440	27,530	27,610	27,700	27,780	27,870	27,950	28,030	28,120	28,200	28,280	28,370	28,450	7.7
7.8	27,280	27,370	27,460	27,550	27,640	27,730	27,820	27,900	27,990	28,080	28,170	28,250	28,340	28,420	28,510	28,600	28,680	28,770	28,850	28,940	29,020	7.8
7.9	27,830	27,930	28,020	28,110	28,200	28,290	28,380	28,470	28,560	28,650	28,730	28,820	28,910	29,000	29,090	29,170	29,260	29,350	29,440	29,520	29,610	7.9
8.0	28,400	28,500	28,590	28,680	28,770	28,870	28,960	29,050	29,140	29,230	29,320	29,410	29,500	29,590	29,680	29,770	29,860	29,950	30,040	30,120	30,210	8.0
	WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.																					
8.1	28,990	29,080	29,180	29,270	29,370	29,460	29,550	29,650	29,740	29,830	29,930	30,020	30,110	30,200	30,290	30,380	30,480	30,570	30,660	30,750	30,840	8.1
8.2	29,590	29,690	29,790	29,880	29,980	30,080	30,170	30,270	30,360	30,460	30,550	30,650	30,740	30,830	30,930	31,020	31,110	31,200	31,300	31,390	31,480	8.2
8.3	30,220	30,320	30,420	30,510	30,610	30,710	30,810	30,910	31,000	31,100	31,200	31,290	31,390	31,490	31,580	31,680	31,770	31,870	31,960	32,050	32,150	8.3
8.4	30,850	30,950	31,050	31,150	31,250	31,350	31,450	31,550	31,650	31,750	31,850	31,950	32,040	32,140	32,240	32,340	32,430	32,530	32,630	32,720	32,820	8.4
8.5	31,420	31,520	31,630	31,730	31,830	31,930	32,030	32,140	32,240	32,340	32,440	32,540	32,640	32,740	32,840	32,940	33,040	33,130	33,230	33,330	33,430	8.5
8.6	31,950	32,050	32,160	32,260	32,370	32,470	32,570	32,680	32,780	32,880	32,990	33,090	33,190	33,290	33,390	33,490	33,590	33,690	33,790	33,890	33,990	8.6
8.7	32,450	32,560	32,670	32,770	32,880	32,990	33,090	33,200	33,300	33,400	33,510	33,610	33,720	33,820	33,920	34,020	34,130	34,230	34,330	34,430	34,530	8.7
8.8	32,950	33,060	33,170	33,280	33,390	33,490	33,600	33,710	33,810	33,920	34,030	34,130	34,240	34,340	34,450	34,550	34,650	34,760	34,860	34,960	35,070	8.8
8.9	33,460	33,570	33,690	33,790	33,900	34,010	34,120	34,230	34,340	34,450	34,550	34,660	34,770	34,870	34,980	35,090	35,190	35,300	35,400	35,510	35,610	8.9
9.0	33,990	34,100	34,220	34,330	34,440	34,550	34,660	34,770	34,880	34,990	35,100	35,210	35,320	35,430	35,530	35,640	35,750	35,850	35,960	36,070	36,170	9.0
9.1	34,540	34,650	34,770	34,880	34,990	35,110	35,220	35,330	35,440	35,550	35,660	35,770	35,890	36,000	36,100	36,210	36,320	36,430	36,540	36,650	36,760	9.1
9.2	35,090	35,210	35,330	35,440	35,560	35,670	35,790	35,900	36,010	36,130	36,240	36,350	36,460	36,580	36,690	36,800	36,910	37,020	37,130	37,240	37,350	9.2
9.3	35,650	35,770	35,880	36,000	36,120	36,230	36,350	36,470	36,580	36,700	36,810	36,930	37,040	37,150	37,270	37,380	37,490	37,600	37,720	37,830	37,940	9.3
9.4	36,180	36,300	36,420	36,540	36,660	36,780	36,900	37,020	37,130	37,250	37,370	37,480	37,600	37,710	37,830	37,940	38,060	38,170	38,290	38,400	38,510	9.4
9.5*	36,310	36,430	36,550	36,670	36,790	36,910	37,030	37,150	37,270	37,380	37,500	37,620	37,730	37,850	37,960	38,080	38,190	38,310	38,420	38,540	38,650	9.5*
9.6*	36,430	36,550	36,670	36,790	36,910	37,030	37,150	37,260	37,380	37,500	37,620	37,740	37,850	37,970	38,080	38,200	38,310	38,430	38,540	38,660	38,770	9.6*
9.7*	36,530	36,650	36,770	36,890	37,010	37,130	37,250	37,370	37,490	37,610	37,720	37,840	37,960	38,070	38,190	38,310	38,420	38,540	38,650	38,770	38,880	9.7*
9.8*	36,620	36,740	36,860	36,980	37,100	37,220	37,340	37,460	37,580	37,700	37,820	37,930	38,050	38,170	38,280	38,400	38,520	38,630	38,750	38,860	38,980	9.8*
9.9*	36,700	36,820	36,940	37,060	37,180	37,300	37,420	37,540	37,660	37,780	37,900	38,010	38,130	38,250	38,370	38,480	38,600	38,710	38,830	38,940	39,060	9.9*
10.0*	36,760	36,880	37,000	37,120	37,240	37,360	37,480	37,600	37,720	37,840	37,960	38,080	38,200	38,310	38,430	38,550	38,660	38,780	38,890	39,010	39,120	10.0*

* *Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	
	WARNING -- To avoid cavitation damage to the sluice gate seals do not open the sluices less than 1 foot.																					
1.0	3,490	3,500	3,510	3,520	3,530	3,540	3,550	3,550	3,560	3,570	3,580	3,590	3,600									1.0
1.1	3,810	3,820	3,830	3,840	3,850	3,860	3,870	3,880	3,890	3,900	3,910	3,920	3,930									1.1
1.2	4,120	4,140	4,150	4,160	4,170	4,180	4,190	4,200	4,220	4,230	4,240	4,250	4,260									1.2
1.3	4,440	4,450	4,460	4,470	4,490	4,500	4,510	4,520	4,540	4,550	4,560	4,570	4,580									1.3
1.4	4,750	4,760	4,770	4,790	4,800	4,810	4,830	4,840	4,850	4,860	4,880	4,890	4,900									1.4
1.5	5,050	5,070	5,080	5,100	5,110	5,120	5,140	5,150	5,170	5,180	5,190	5,210	5,220									1.5
1.6	5,360	5,370	5,390	5,400	5,420	5,430	5,450	5,460	5,480	5,490	5,510	5,520	5,530									1.6
1.7	5,660	5,670	5,690	5,710	5,720	5,740	5,750	5,770	5,780	5,800	5,820	5,830	5,850									1.7
1.8	5,960	5,980	5,990	6,010	6,030	6,040	6,060	6,070	6,090	6,110	6,120	6,140	6,160									1.8
1.9	6,260	6,270	6,290	6,310	6,330	6,340	6,360	6,380	6,400	6,410	6,430	6,450	6,460									1.9
2.0	6,550	6,570	6,590	6,610	6,630	6,650	6,660	6,680	6,700	6,720	6,740	6,750	6,770									2.0
2.1	6,850	6,870	6,890	6,910	6,930	6,950	6,970	6,980	7,000	7,020	7,040	7,060	7,080									2.1
2.2	7,150	7,170	7,190	7,210	7,230	7,250	7,270	7,290	7,310	7,330	7,350	7,360	7,380									2.2
2.3	7,440	7,460	7,480	7,510	7,530	7,550	7,570	7,590	7,610	7,630	7,650	7,670	7,690									2.3
2.4	7,740	7,760	7,780	7,800	7,830	7,850	7,870	7,890	7,910	7,930	7,950	7,980	8,000									2.4
2.5	8,040	8,060	8,080	8,100	8,130	8,150	8,170	8,190	8,220	8,240	8,260	8,280	8,300									2.5
2.6	8,330	8,360	8,380	8,400	8,430	8,450	8,470	8,500	8,520	8,540	8,570	8,590	8,610									2.6
2.7	8,630	8,660	8,680	8,710	8,730	8,750	8,780	8,800	8,830	8,850	8,870	8,900	8,920									2.7
2.8	8,930	8,960	8,980	9,010	9,030	9,060	9,080	9,110	9,130	9,160	9,180	9,210	9,230									2.8
2.9	9,240	9,260	9,290	9,310	9,340	9,360	9,390	9,420	9,440	9,470	9,490	9,520	9,540									2.9
3.0	9,540	9,570	9,590	9,620	9,650	9,670	9,700	9,730	9,750	9,780	9,810	9,830	9,860									3.0
3.1	9,850	9,870	9,900	9,930	9,960	9,980	10,010	10,040	10,070	10,090	10,120	10,150	10,170									3.1
3.2	10,160	10,180	10,210	10,240	10,270	10,300	10,330	10,350	10,380	10,410	10,440	10,470	10,490									3.2
3.3	10,470	10,500	10,530	10,560	10,590	10,610	10,640	10,670	10,700	10,730	10,760	10,790	10,820									3.3
3.4	10,780	10,810	10,840	10,870	10,900	10,930	10,960	10,990	11,020	11,050	11,080	11,110	11,140									3.4
3.5	11,100	11,130	11,160	11,190	11,230	11,260	11,290	11,320	11,350	11,380	11,410	11,440	11,470									3.5
3.6	11,420	11,450	11,490	11,520	11,550	11,580	11,610	11,650	11,680	11,710	11,740	11,770	11,800									3.6
3.7	11,750	11,780	11,810	11,850	11,880	11,910	11,940	11,980	12,010	12,040	12,070	12,110	12,140									3.7
3.8	12,070	12,110	12,140	12,180	12,210	12,240	12,280	12,310	12,340	12,380	12,410	12,440	12,480									3.8
3.9	12,410	12,440	12,480	12,510	12,550	12,580	12,610	12,650	12,680	12,720	12,750	12,790	12,820									3.9
4.0	12,740	12,780	12,810	12,850	12,880	12,920	12,960	12,990	13,030	13,060	13,100	13,130	13,170									4.0
4.1	13,080	13,120	13,150	13,190	13,230	13,260	13,300	13,340	13,370	13,410	13,450	13,480	13,520									4.1
4.2	13,420	13,460	13,500	13,540	13,580	13,610	13,650	13,690	13,730	13,760	13,800	13,840	13,870									4.2
4.3	13,770	13,810	13,850	13,890	13,930	13,970	14,000	14,040	14,080	14,120	14,160	14,190	14,230									4.3
4.4	14,120	14,160	14,200	14,240	14,280	14,320	14,360	14,400	14,440	14,480	14,520	14,560	14,600									4.4
4.5	14,480	14,520	14,560	14,600	14,640	14,680	14,720	14,760	14,800	14,840	14,880	14,920	14,960									4.5
4.6	14,840	14,880	14,920	14,960	15,000	15,050	15,090	15,130	15,170	15,210	15,250	15,290	15,340									4.6
4.7	15,200	15,240	15,290	15,330	15,370	15,410	15,460	15,500	15,540	15,580	15,630	15,670	15,710									4.7
4.8	15,570	15,610	15,660	15,700	15,740	15,790	15,830	15,880	15,920	15,960	16,010	16,050	16,090									4.8
4.9	15,940	15,980	16,030	16,070	16,120	16,160	16,210	16,250	16,300	16,340	16,390	16,430	16,480									4.9
5.0	16,310	16,360	16,410	16,450	16,500	16,550	16,590	16,640	16,680	16,730	16,770	16,820	16,870									5.0
5.1	16,700	16,740	16,790	16,840	16,880	16,930	16,980	17,030	17,070	17,120	17,170	17,210	17,260									5.1
5.2	17,080	17,130	17,180	17,230	17,270	17,320	17,370	17,420	17,470	17,510	17,560	17,610	17,660									5.2
5.3	17,470	17,520	17,570	17,620	17,670	17,720	17,770	17,810	17,860	17,910	17,960	18,010	18,060									5.3
5.4	17,860	17,910	17,960	18,010	18,060	18,110	18,160	18,220	18,270	18,320	18,360	18,410	18,460									5.4
5.5	18,260	18,310	18,360	18,410	18,470	18,520	18,570	18,620	18,670	18,720	18,770	18,820	18,870									5.5
5.6	18,660	18,710	18,770	18,820	18,870	18,920	18,980	19,030	19,080	19,130	19,190	19,240	19,290									5.6
5.7	19,060	19,120	19,170	19,230	19,280	19,340	19,390	19,440	19,500	19,550	19,600	19,660	19,710									5.7
5.8	19,470	19,530	19,590	19,640	19,700	19,750	19,810	19,860	19,920	19,970	20,030	20,080	20,130									5.8
5.9	19,890	19,950	20,000	20,060	20,120	20,170	20,230	20,290	20,340	20,400	20,450	20,510	20,560									5.9

NORRIS DAM

DISCHARGE FOR ALL SLUICES AT IDENTICAL OPENINGS*

IN CUBIC FEET PER SECOND

GATE OPENING IN FEET	HEADWATER ELEVATION																					GATE OPENING IN FEET
	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	
6.0	20,310	20,370	20,430	20,480	20,540	20,600	20,660	20,710	20,770	20,830	20,880	20,940	21,000									6.0
6.1	20,730	20,790	20,850	20,910	20,970	21,030	21,090	21,150	21,200	21,260	21,320	21,380	21,440									6.1
6.2	21,160	21,220	21,280	21,340	21,400	21,460	21,520	21,580	21,640	21,700	21,760	21,820	21,880									6.2
6.3	21,600	21,660	21,720	21,780	21,840	21,910	21,970	22,030	22,090	22,150	22,210	22,270	22,330									6.3
6.4	22,040	22,100	22,160	22,230	22,290	22,350	22,410	22,480	22,540	22,600	22,660	22,720	22,790									6.4
6.5	22,480	22,550	22,610	22,680	22,740	22,800	22,870	22,930	22,990	23,060	23,120	23,180	23,250									6.5
6.6	22,930	23,000	23,070	23,130	23,200	23,260	23,330	23,390	23,460	23,520	23,590	23,650	23,710									6.6
6.7	23,390	23,460	23,530	23,590	23,660	23,730	23,790	23,860	23,930	23,990	24,060	24,120	24,190									6.7
6.8	23,860	23,930	23,990	24,060	24,130	24,200	24,270	24,330	24,400	24,470	24,540	24,600	24,670									6.8
6.9	24,330	24,400	24,470	24,540	24,610	24,680	24,750	24,820	24,880	24,950	25,020	25,090	25,160									6.9
7.0	24,810	24,880	24,950	25,020	25,090	25,170	25,240	25,310	25,380	25,450	25,520	25,590	25,660									7.0
7.1	25,300	25,370	25,440	25,520	25,590	25,660	25,730	25,800	25,880	25,950	26,020	26,090	26,160									7.1
7.2	25,800	25,870	25,940	26,020	26,090	26,170	26,240	26,310	26,390	26,460	26,530	26,600	26,680									7.2
7.3	26,300	26,380	26,450	26,530	26,610	26,680	26,760	26,830	26,910	26,980	27,050	27,130	27,200									7.3
7.4	26,820	26,900	26,980	27,050	27,130	27,210	27,280	27,360	27,440	27,510	27,590	27,660	27,740									7.4
7.5	27,350	27,430	27,510	27,590	27,670	27,740	27,820	27,900	27,980	28,060	28,130	28,210	28,290									7.5
7.6	27,890	27,970	28,060	28,140	28,220	28,300	28,370	28,450	28,530	28,610	28,690	28,770	28,850									7.6
7.7	28,450	28,530	28,610	28,700	28,780	28,860	28,940	29,020	29,100	29,180	29,260	29,340	29,420									7.7
7.8	29,020	29,110	29,190	29,270	29,360	29,440	29,520	29,600	29,690	29,770	29,850	29,930	30,020									7.8
7.9	29,610	29,690	29,780	29,860	29,950	30,040	30,120	30,200	30,290	30,370	30,460	30,540	30,620									7.9
8.0	30,210	30,300	30,390	30,480	30,560	30,650	30,740	30,820	30,910	30,990	31,080	31,160	31,250									8.0

WARNING -- To avoid cavitation damage to the sluice conduits do not use openings greater than 8 feet except in emergencies.

8.1	30,840	30,930	31,020	31,100	31,190	31,280	31,370	31,460	31,550	31,630	31,720	31,810	31,890									8.1
8.2	31,480	31,570	31,660	31,750	31,850	31,940	32,030	32,120	32,210	32,290	32,380	32,470	32,560									8.2
8.3	32,150	32,240	32,330	32,430	32,520	32,610	32,700	32,800	32,890	32,980	33,070	33,160	33,250									8.3
8.4	32,820	32,910	33,010	33,100	33,200	33,290	33,390	33,480	33,570	33,670	33,760	33,850	33,950									8.4
8.5	33,430	33,530	33,620	33,720	33,820	33,910	34,010	34,100	34,200	34,290	34,390	34,480	34,580									8.5
8.6	33,990	34,090	34,190	34,290	34,390	34,480	34,580	34,680	34,780	34,870	34,970	35,070	35,160									8.6
8.7	34,530	34,630	34,730	34,830	34,930	35,030	35,130	35,230	35,330	35,430	35,530	35,620	35,720									8.7
8.8	35,070	35,170	35,270	35,370	35,470	35,570	35,680	35,780	35,880	35,980	36,080	36,170	36,270									8.8
8.9	35,610	35,710	35,820	35,920	36,020	36,130	36,230	36,330	36,430	36,530	36,640	36,740	36,840									8.9
9.0	36,170	36,280	36,380	36,490	36,590	36,700	36,800	36,910	37,010	37,110	37,220	37,320	37,420									9.0
9.1	36,760	36,860	36,970	37,080	37,180	37,290	37,400	37,500	37,610	37,710	37,820	37,920	38,020									9.1
9.2	37,350	37,460	37,570	37,680	37,780	37,890	38,000	38,110	38,210	38,320	38,430	38,530	38,640									9.2
9.3	37,940	38,050	38,160	38,270	38,380	38,490	38,600	38,710	38,820	38,930	39,040	39,140	39,250									9.3
9.4	38,510	38,630	38,740	38,850	38,960	39,070	39,180	39,290	39,410	39,520	39,630	39,730	39,840									9.4
9.5*	38,650	38,760	38,880	38,990	39,100	39,210	39,320	39,430	39,550	39,660	39,770	39,880	39,990									9.5*
9.6*	38,770	38,890	39,000	39,110	39,220	39,340	39,450	39,560	39,670	39,780	39,890	40,000	40,110									9.6*
9.7*	38,880	38,990	39,110	39,220	39,330	39,450	39,560	39,670	39,780	39,890	40,000	40,120	40,230									9.7*
9.8*	38,980	39,090	39,200	39,320	39,430	39,540	39,660	39,770	39,880	39,990	40,100	40,210	40,330									9.8*
9.9*	39,060	39,170	39,290	39,400	39,520	39,630	39,740	39,850	39,970	40,080	40,190	40,300	40,410									9.9*
10.0*	39,120	39,240	39,350	39,470	39,580	39,690	39,810	39,920	40,030	40,150	40,260	40,370	40,480									10.0*

** Except that only gates 1, 3, and 6 are opened more than 9.4 feet. For openings above 9.4 feet, gates 2, 4, 5, 7, and 8 are set to 9.4-feet open.*

FACTORS OF SAFETY (SLIDING)

With toe rock

$$\frac{\text{Forces resisting sliding}}{\text{Forces tending to cause sliding}}=\frac{10,054,500}{2,050,100}=4.90$$

Without toe rock

Forces resisting sliding

$$7,769,200-\frac{228.6-210.1}{228.6}\times 5,768,500=7,302,400$$

$$\frac{\text{Forces resisting sliding}}{\text{Forces tending to cause sliding}}=\frac{7,302,400}{2,050,100}=3.56$$

APPENDIX D

MODEL STUDIES

In the design of a dam, many features are not determinable mathematically, and where this is the case, or where a mathematical analysis must be tested for accuracy, model studies may be used. Model studies were made of Norris Dam, first, to determine the hydraulic characteristics and architectural effect of the various proposed designs of the spillway, apron, drum gates, and outlet conduits; second, to check the mathematical stress analyses for the dam; and third, to determine some mechanical and hydraulic characteristics of the tractor gates used to close the power intakes.

All of the model tests were made by the United States Bureau of Reclamation for the Tennessee Valley Authority. The Bureau's reports on the various model studies have been summarized in this appendix. The results, conclusions, and a brief description of the equipment, testing procedures, and tests which led up to the final design are given in every case. For further details the appropriate report of the Bureau of Reclamation should be consulted.

HYDRAULIC MODEL STUDIES

Hydraulic models of Norris Dam were constructed and tested as a part of the studies made of the hydraulic characteristics of the various proposed designs of the dam. The use of a model permitted the study and solution of many problems which could not be solved by mathematical or other methods. The studies[1] were made by the United States Bureau of Reclamation.

The model investigations were divided into three main parts: spillway studies, studies of auxiliary passages, and architectural studies. The spillway studies consisted of the determination of good stilling pool characteristics, the calibration of the drum gates, the determination of pressures on the drum gates, the measurement of velocities on the apron, the determination of the size of the training walls and the pressures exerted on them, and the development of a drum gate operating schedule. The studies on the auxiliary passages included tests on the outlet conduits to determine a favorable hydraulic design and an operating schedule, tests on needle valve outlets through the powerhouse, and tests to determine the hydraulic characteristics of the powerhouse water discharge. The architectural studies were made of the piers and the spillway highway bridge.

The floodwaters, with a probable maximum discharge of 240,000 cubic feet per second and a fall of 246 feet could create a maximum of 6,700,000 horsepower. If these forces were not made harmless, great danger to the dam foundation would result. Hence it was especially important that the design of the dam, and particularly the stilling pool, be structurally and hydraulically sound.

MODEL

The model was built to a scale of 1:72. The relations of the dimensions and quantities of the model and prototype based on the laws of hydraulic similitude, considering the forces of gravity and inertia only, are shown in table 150.

The model was constructed as shown in figure 330, using steel structural shapes, sheet metal, concrete, and a small amount of lumber. The drum gates were operated mechanically. Downstream from the dam the topographic features were reproduced by pouring a 1-inch concrete slab to rock elevation and covering this slab with sand and fine gravel to form the overburden.

[1] Thomas, C. W., Hydraulic Model Experiments for the Design of the Norris Dam, U. S. Bureau of Reclamation Technical Memorandum No. 406, October 15, 1934.

FIGURE 328. *Prototype—In operation in February 1937.*

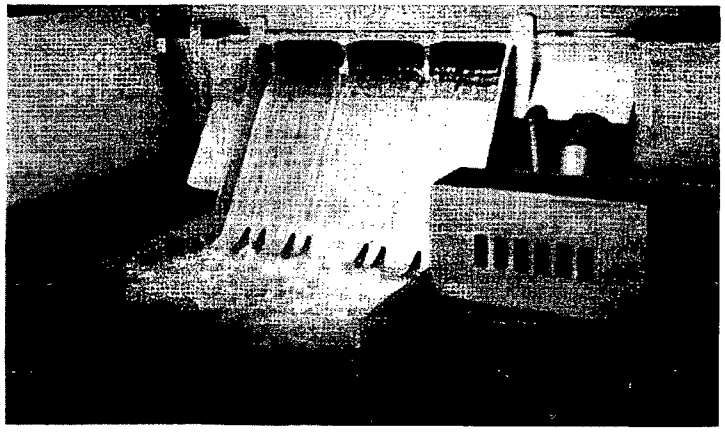


FIGURE. 329—*Model as finally developed by tests.*

TABLE 150.—*Scale relationships*

Quantity	Formula [1]	Value
Head	N	72
Other linear dimensions	N	72
Velocity	$\sqrt{N}$	8.485
Area	N^2	5,184
Discharge	$N^{5/2}$	43,988
Time	$\sqrt{N}$	8.485

[1] N denotes the scale ratio.

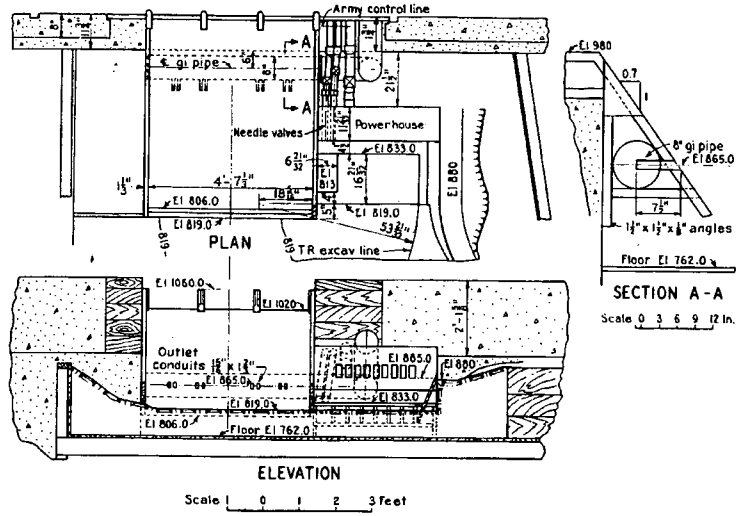


FIGURE 330.—*Model design.*

Spillway studies

The proper design of the stilling pool is of vital importance to the safety of a high dam due to the large amount of energy that must be dissipated at its base. Only in the past few years has a great deal of study been given to determining the best methods of protecting the stream beds below dams from scour; however, many different solutions have resulted from a great variety of conditions.

Preliminary studies.

A determination by means of model testing for each individual case has rapidly grown into use, even though the principles governing the design of scour protection have been worked out and the types of protection applicable to conditions for various types of dam sites have been classified.[2] Individual testing is necessary to determine which of the several forms is applicable to the conditions at a given dam site. The classification of principles, however, does narrow the necessary field of study and insures that unsatisfactory conditions are not overlooked.

Briefly, the type of scour protection depends upon the relationship, throughout the entire range of discharge, of the tail water elevation below the dam to

[2] Lane, E. W., and Bingham, W. F., Protection Against Scour Below Overfall Dams, United States Bureau of Reclamation Technical Memorandum No. 323, January 23, 1933.

the tail water elevation necessary to cause a hydraulic jump to form on a level apron at the elevation of the stream bed, or in other words, upon the relative position of the tail water rating curve and a jump height curve for an apron at stream bed level. This is true whether or not the hydraulic jump is to be used for scour protection.

The ideal condition would be to have a tail water at such a height above the river bed for each discharge that it would form a perfect hydraulic jump for the depth and velocity which would occur in the overfalling stream at the toe of the dam for that discharge. The height of the tail water, however, is controlled by the conditions in the stream channel downstream from the dam, and this ideal condition is never exactly attained. Other than this perfect condition, there are four classes into which those various tail water rating curve jump height curve relationships can fall. These are shown in figure 331.

The conditions at Norris are very favorable to the protection from scour by simple means. As will be seen in figure 332, the jump height curve for the apron at stream bed level is considerably above the tail water rating curve for all discharges. Norris, therefore, falls into class II. (See fig. 331.)

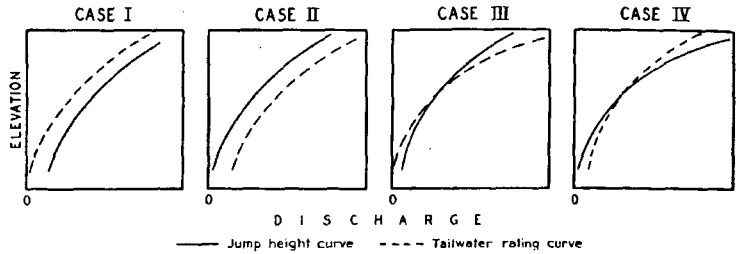


FIGURE 331.—*Relationships of jump height and tail water rating curves.*

For this condition the possible solutions are (1) sloping the bucket to throw the overfalling stream far from the base of the dam, (2) raising the tail water level by a secondary dam, (3) deepening the pool below the dam, and (4) installing various forms of baffles.

The first mentioned of these solutions with the stratified rock bottom and the very high heads acting at Norris would produce severe scour in the river bed downstream from the dam and pile up debris in the stream channel below the dam which would probably obstruct the flow from the powerhouse. Since a very good solution is possible by another one of the four methods, this method, which would have undesirable results, was not given serious consideration.

Satisfactory protection from the hydraulic standpoint could undoubtedly be secured by means of the tail water dam mentioned as the second possible solution. The secondary dam, when used, must be high enough to produce the required tail water level for all discharges. Figure 332 shows that a weir with crest at elevation 859.6 would be required to hold the water to the height necessary for a discharge of 250,000 cubic feet per second. Such a dam would be about 40 feet high and would require training walls 70 feet high along both sides of the pool. Moreover, the pool would have to be of considerable length; 4½ to 5 times the height of the jump is required to produce satisfactory conditions where the height of the secondary dam is an appreciable part of the pool depth. Some protection against scour would also be required below the secondary dam, but since (as shown on figure 332) the natural tail water curve is nearly high enough to produce a jump below the secondary dam on an apron at stream bed level, little in addition to the horizontal apron below the secondary weir would be required. The cost of the 40-foot tail water dam with its apron and 70-foot retaining walls, however, is so great that this form of protection, although undoubtedly satisfactory from the hydraulic standpoint, would be entirely too expensive.

The use of baffles of the ordinary forms to dissipate the energy of the water passing over the dam was not favored because of the unprecedented velocities which would act on them and the difficulty of building them strong enough to resist the blows to which they might be subjected by logs. The large difference

in height between the tail water rating curve and the curve for height of jump on an apron at stream bed level indicates that the energy which would have to be dissipated by any form of baffle would be large and therefore would be subjected to large impacts. Several forms of baffles were tested, however, in an attempt to shorten the length of depressed apron downstream.

The best form of protection is secured by deepening the pool by excavation, placing the pool bottom at elevation 806, or about 13 feet below the stream bed level. For this condition the depth of pool is sufficient to form a jump at all flows. The close agreement between the jump height curve and the tail water curve indicates that a nearly perfect hydraulic jump would be formed in which the energy would be efficiently dissipated.

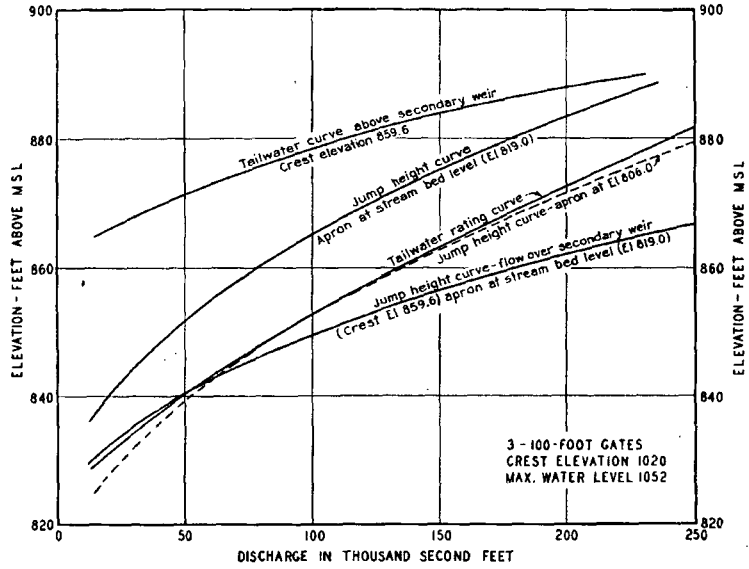


FIGURE 332.—*Jump height and tail water rating curves for Norris.*

The action of the pool as shown on figure 332 is based on the assumption that the drum gates are kept at the same elevation. For the lower discharges this is not so important since the pool is deeper than necessary for this condition and some unbalancing of the gate discharge would be permissible.

From this preliminary analysis of the conditions, the range of model tests was narrowed appreciably.

Tests and results.

The problem of designing the stilling pool was complicated throughout the tests by the necessity of meeting the requirements of the three following conditions: (1) outlet conduits discharging singly or in combination, (2) spillway discharging, and (3) outlet conduits and spillway, both discharging. In many instances a set-up would fulfill one or more of these requirements but would be objectionable for the remainder.

Throughout the series of tests on various aprons, a representative number of runs were made on each test. Model flows representing prototype flows of 20,000, 40,000, 80,000, 120,000, 160,000, 200,000, and 240,000 cubic feet per second were used. The head at the crest was regulated by means of the drum gates in all but the first six tests, which were made before the gates were installed. With the exception of the last few tests, the flows were regulated as follows: 20,000, 40,000, and 80,000 cubic feet per second with all gates held at elevation 1,034; 120,000 and 160,000 cubic feet per second with all gates set so as to hold

the reservoir at elevation 1,052; 200,000 cubic feet per second with all gates at elevation 1,020; 240,000 cubic feet per second with all gates at elevation 1,020, the flow divided 200,000 cubic feet per second over the spillway and 40,000 cubic feet per second through the conduits. The last tests were made by allowing 40,000 cubic feet per second to pass through the conduits at all flows and regulating the flow over the spillway to 20,000, 40,000, and 80,000 cubic feet per second with all gates held at elevation 1,034; 120,000 and 160,000 cubic feet per second with all gates set at the correct elevation to hold the reservoir at elevation 1,052; 200,000 cubic feet per second with all gates at elevation 1,020, making total quantities of 40,000 (sluices only discharging), 60,000, 80,000, 120,000, 160,000, 200,000, and 240,000 cubic feet per second, respectively. This change was made to follow an operating program developed by the tests.

The action of these tests was recorded pictorially by using still and moving pictures, graphically by use of point gage readings of water surface elevations, and visually by the operator.

For the first six tests, in order to expedite preliminary testing, the powerhouse, drum gates, and outlet conduits were omitted from the model and a sand box extending downstream from the end of the apron was used instead of the regular topography. After the powerhouse and outlet conduits were installed, they were changed from time to time as the designs were altered by the design and testing staffs.

In the original design much thought was given to possible scour on the apron at the toe of the dam. In order to provide for this condition an additional thickness of apron at this point was deemed necessary. The sloping apron, in addition to lessening the excavation in the pool, would provide for this added thickness. Also, the tail water rating curve and the jump-forming height curve for a level depressed apron tend to draw apart at the lower ends (see fig. 332) showing the pool to be too deep at low flows. The sloping apron, by causing the jump to form on the slope, would tend to bring these two curves together, thus giving better conditions at low flows.

In the first model set-up the apron slope was made to conform to the natural dip of the rock strata or an 8:1 slope downstream with a level apron at elevation 810. Although the theoretical analysis showed an apron at elevation 806 necessary to form the jump, the first apron tried was placed at elevation 810 and the top of the sill at the end of the apron at elevation 819. A 60-foot radius bucket connected the downstream face of the dam to the 8:1 sloping portion of the apron. Figure 333 shows this model set-up.

It was found from the first three tests that this arrangement did not give sufficient length of pool for the formation of the jump at low flows, although the action at higher flows was fairly good. The higher discharges show the water surface low over the entire apron and a slight tendency for the pool to "sweep." Considerable scour was noted. When the tail water was raised 4 feet, better results were obtained, thus showing the possibilities of a sloping section of apron with the level portion of the apron at elevation 806.

In test No. 4 a set of breaker blocks, shown in figure 333, was added at the point of tangency between the 60-foot radius bucket and the 8:1 slope across the entire width of apron. It was hoped that the jet of water over the dam might be broken up sufficiently to cause more water to remain on the apron and decrease the velocities passing the sill. Results of the test showed, however, that very little additional water was retained on the apron and the velocities over the sill were reduced only slightly. There was slightly less scour downstream from the end of the apron than in the previous tests. The benefits derived from the blocks in reducing the scour and quieting the water surface at high flows were more than offset by the bad conditions at lower flows and probable high initial cost.

The sloping portion of the apron was removed for test No. 5 and the 60-foot radius bucket moved down to connect with a flat apron at elevation 810. This set-up showed insufficient tail water at the intermediate and high flow to insure the formation of a hydraulic jump. Less scour downstream resulted from this set-up than either of the previous tests. By raising the tail water 4 feet the conditions were somewhat improved, although the jump was drowned out to a certain extent at low flows.

In keeping with the indications from previous tests and the action predicted on figure 332, the flat apron was lowered to elevation 806 and connected to the 0.7 slope of the spillway by a 60-foot-radius bucket. The sill at the end of the

apron had a 1:1 slope and a top elevation of 819. The results of this test verified the assumption made from figure 332, and good jump conditions were obtained at all except low flows. The scour conditions with this set-up did not prove serious, and the same set-up was used for tests Nos. 6 and 7.

The bucket was next changed to a 100-foot radius for test No. 8 in order to provide a greater thickness of concrete at the toe of the dam to allow for possible scour at that point. It was hoped that the lower part of the large radius bucket would simulate the sloping apron. With the radius of the bucket increased from 60 to 100 feet, the flow conditions were somewhat improved but the results were not entirely satisfactory. The profile of the water surface showed very little change from conditions with the 60-foot-radius bucket.

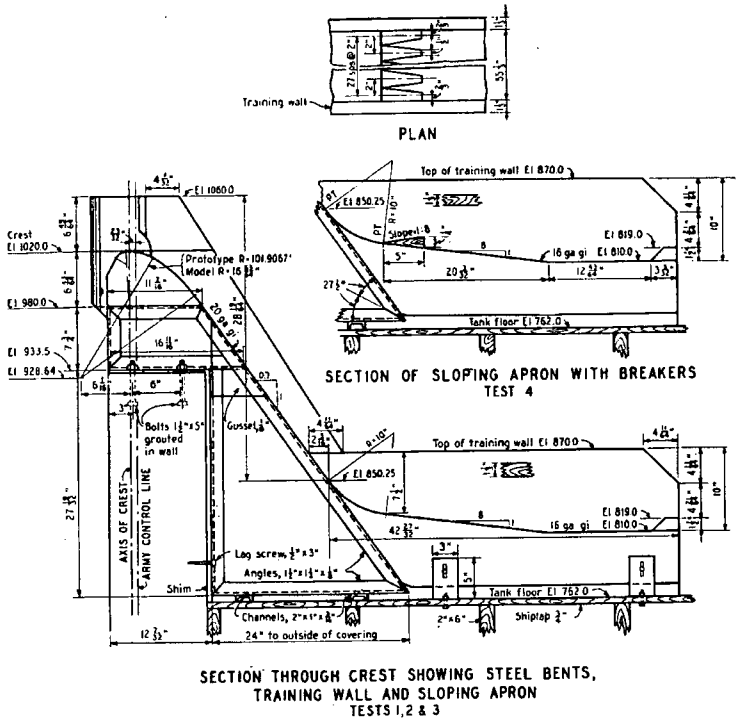


FIGURE 333.—*Model 8:1 slope, apron at elevation 810, sill at elevation 819.*

The possibilities of using a combination sloping and flat apron were kept in mind, and when the desired results of a larger radius bucket did not materialize, apron slopes of 4:1, 6:1, and 8:1 were tried. The sill at the end of the apron had an upstream slope of 1:1 with a top at elevation 819. A 60-foot-radius bucket was used. The 8:1 and 6:1 slopes did not allow sufficient length of flat apron at elevation 806 to form a good jump, but the 4:1 slope gave good condition throughout the range of flows and much better condition at the low flows than either the flatter slope or the level apron. The 4:1 slope was adopted for further testing.

After fixing the elevation of the flat portion of the apron and the rate of slope for the sloping portion of the apron, a series of tests was conducted to determine the possibility of shortening the length of horizontal apron downstream, or to improve flow conditions by addition or alteration in sills with the same length of apron.

The first change was the slope of the face of the sill at the end of the apron. The original slope was 1:1 from elevation 806 to elevation 819, and the top width was 10 feet. This was changed to a 1½:1 slope with a top width of 5 feet. A comparison of results with the 1½:1 and 1:1 slope shows that less water was held on the apron with the 1½:1 slope sill, and more stable condition of water surface was observed with the 1:1 slope sill.

Next, with this altered sill at the end of the apron an auxiliary sill 6 feet high was tested at one position on the apron, and an auxiliary sill 4 feet high was tested at two positions on the apron. More water was retained on the apron at most flows, but disturbances set up on the apron caused a very undesirable condition in the stilling pool. The sills were also subjected to severe impact by the water flowing at high velocity down the apron, thereby making it highly probable that the sills would suffer considerable scour. The results showed a generally undesirable condition.

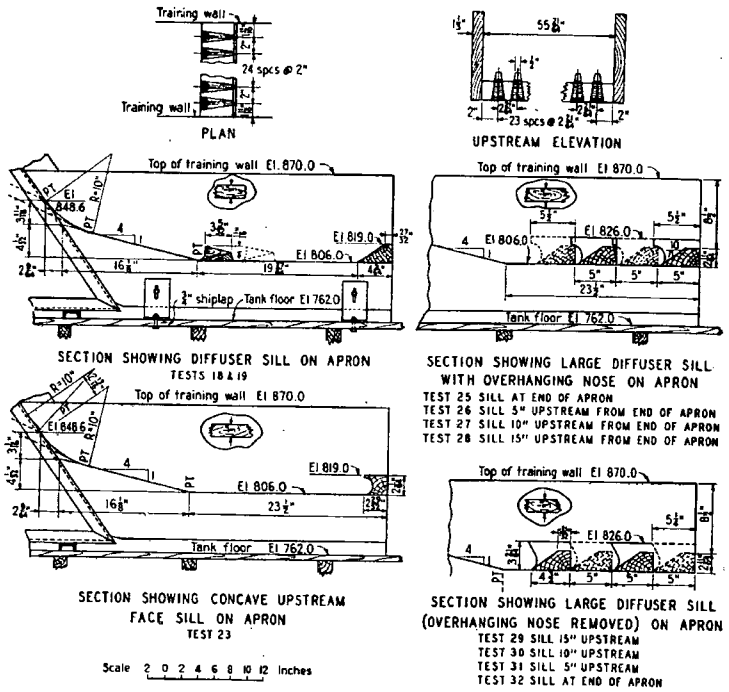


FIGURE 334.—*Types of diffuser sills tested.*

In an attempt to decrease the height of the sill the top was lowered to elevation 815. A top width of 5 feet and an upstream slope of 1½:1 were still maintained. This lower sill resulted in higher velocities passing the sill and undesirable water surface conditions.

A low diffuser sill was tested in two positions on the apron. (See fig. 334.) The primary purpose of this sill was to spread the jet from the outlet conduits. It was hoped also that flow conditions for the spillway would be improved. This sill was tested at the upstream position with the main sill at the end of the apron, and at the downstream position with the main sill removed. The flow conditions for the spillway were slightly improved, but the blocks were too small to effect a material change in flow conditions, although surface conditions were improved. Very good flow conditions were obtained at low and intermediate discharges.

A sill with a concave upstream face as shown in figure 334 was tested at the downstream end of the apron. It was thought that by using this sill the sheet of high velocity water along the apron would be turned upstream and impinge on the incoming jet. The results showed the jet to be of such depth by the time it reached the sill that it completely filled the concave space and formed in effect a sill with a vertical upstream face. This caused disturbance in the pool directly over the sill and very rough surface conditions elsewhere in the pool. If the radius of curve could have been increased considerably so that the entire high velocity jet would strike the lower half of the curve, the predicted action might have taken place, but this would have necessitated a structure of unreasonably large size.

The concave sill offered possibilities in that the curved upstream face and overhang might be applied to the diffuser-type blocks. Such a sill was tested at different positions on the flat portion of the apron, thus simulating a shortening of the apron. This sill is shown in figure 334. The results were satisfactory in that smoother water surface conditions were obtained and the velocities beyond the end of the apron were very evenly distributed. Paint tests disclosed that part of the jet was turned back on the apron by the curved upstream face of the blocks, thus causing an ellipsoidal roll to form on the apron ahead of the sill. Another portion of the water passed between the blocks and was deflected upward by the sloping portion of the sill and allowed to spread due to the increase in area as the water moved upward and outward. The high velocity jets flowing between the blocks were further broken up and the velocity diminished by the effect of the water spilling off the face of the blocks and into the chamber. Hence, the water after it passed the sill was moving in an upward direction away from the river bed, thus diminishing the possibility of scour downstream from the apron. There was very little scour noted; however, a tendency existed to deposit material at the end of the apron.

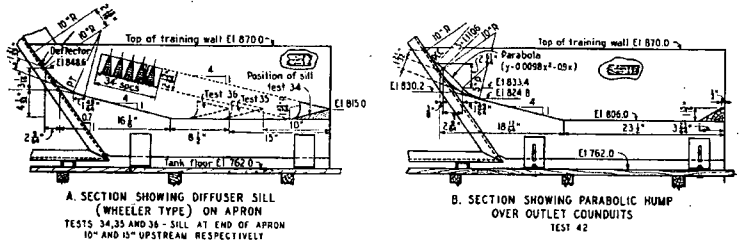


FIGURE 335.—*A. Wheeler type diffuser sill. B. Parabolic hump over outlet conduits.*

Good results were obtained at all positions of the sill on the apron, although the best results were found when the apron was shortened 60 feet. By use of this sill the apron and training walls could be shortened 60 feet and better flow conditions obtained than with a longer apron. The high initial cost, combined with the probability of damage due to excessive erosion of the sill and impact of logs on the dentates, made the use of this sill inadvisable.

The cost of construction and probability of erosion of the sill were lessened by removing the overhanging noses from the blocks, thus making the faces of the blocks tangent to the curve at 30° to the vertical. This diffuser block is shown in figure 334. This type of block was tested at different positions on the apron. Approximately the same results were obtained as for the preceding tests, except a possible improvement of conditions in the water surface in the pool. Although it was thought that the additional cost of construction of this sill could have been borne by the saving and shortening of the apron and training walls, the bad features of the sill were embodied in the very grave possibility of erosion of the sill and the resulting necessary maintenance.

A low diffuser sill similar to that used at Wheeler Dam was tested at three positions on the apron in an attempt to improve flow conditions. This type sill is shown in figure 335. The results showed an improvement in flow condi-

tions in the pool for low and medium flows and good results with just the sluices operating, but at high spillway flows very little improvement was noted except in surface conditions. The velocities downstream from the end of the apron were much higher than in other set-ups. With the sill at the end of the apron entirely removed, surface conditions agreed closely with the conditions with the diffuser sill at the end of the apron. The sill located 60 feet upstream from the end of the apron produced the best results.

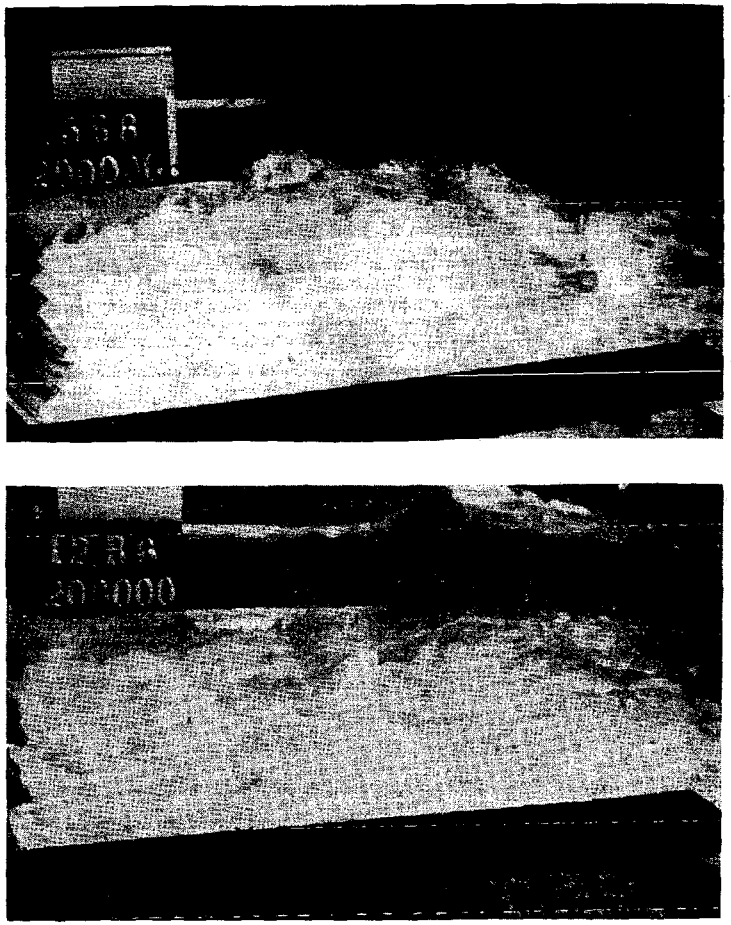


FIGURE 336.—*Comparison of pool action with one of the more unsuccessful model set-ups (A) and the adopted design (B).*

Next, a sill built with a top width of 3 feet and conforming to the contour of the stream bed at the end of the apron for the width of the spillway was tested. The bottom width was held constant at 24 feet and the slope of the upstream face varied accordingly. The velocity of water was concentrated near the center of the apron as it crossed the sill and continued downstream. This was caused

by the lower sill section at the center of the apron and the consequent flatter slope. The higher sill sections at the sides of the spillway apron caused disturbances which resulted in higher water surfaces.

From more accurate cross sections of the stream bed the average elevation of the stream bed was determined to be about elevation 817.5 instead of 819. A set of sills with their tops at that elevation, a constant top width of 3 feet, and upstream face slopes of 1½:1, 2:1, 2½:1, and 3:1 were tested. The results of these tests indicated that the 1½:1 slope sill was the best from the hydraulic standpoint, as well as being less expensive to build. Water surface conditions were improved as compared to the higher sills of the same slope, and no additional erosion was noted at the end of the apron. The modification of the sluice outlet which will be described later made their operation satisfactory with this sill. It was, therefore, recommended for the final design. A parabolic hump as shown in figure 335 on the dam over the outlet conduit opening had very little effect on the flow over the spillway.

Check runs made from time to time showed results of the stilling pool to be very consistent.

Calibration of drum gates.

Prior to the actual calibrating of the drum gates, a tentative schedule of operation was worked out for the gates to cover the range of gate elevations from 1,020 to 1,034.

For each of these gate settings a range of heads over the gates was determined. These heads were not the same for each gate setting but were tentatively determined so that the minimum head was fixed by the elevation of the gates; and the maximum head was that obtained when the elevation of the water surface of the reservoir was approximately 1 foot above the maximum of elevation 1,052.

In the original analysis of the discharge data for the gates the formula $Q=CLH^{3/2}$ was used and the value of the coefficient C was computed in terms of model values for Q, L, and H and with the gates set at elevations 1,020, 1,023.51, 1,027.11, 1,031.54, and 1,033.91, respectively. A summary of these results is shown in table 151. When the values of C were plotted on cross-section paper against the values of H, the resulting curves appeared very erratic so that logarithmic plotting was tried in an effort to straighten the data. Logarithmic plotting produced a good curve for each gate elevation. Difficulty was experienced in this method of analysis due to the short range of values of coefficient C at some gate elevations which made it extremely difficult to read values from the curves.

Since the above method of analysis had the decided disadvantage of not giving smooth curves and therefore making interpolation between observed data difficult, the values of Q and H were then plotted on a logarithmic scale with the equation $Q=KLH^n$ as a basis. The values of K_m and n were obtained from the intercepts and slopes of the straight lines through the data for each gate elevation. Very satisfactory results were produced by this method and to justify it further, additional runs were made with gates set at elevations 1,022.06, 1,025.03, 1,028.93, and 1,031.41, respectively. A decided advantage of this method of analysis was that fewer runs were required to fix the position of a particular curve.

After summarizing the data obtained from the logarithmic plottings, it was found that the values of K_m and n must be fixed with greater accuracy than is possible with logarithmic plotting, due to the slight irregularities of the printing of the paper and the impossibility of interpolating to the necessary degree of accuracy.

Trial computations using the least square method[8] of adjustment of observed data produced a much smaller percentage of error, therefore it was adopted for handling the coefficient data.

Table 152 gives a summary of results of adjusting the data by means of the method of least squares.

[8] Rohwer, Carl. The Least Square Adjustment of Experimental Data. Bureau of Agricultural Engineering. Department of Agriculture. Appendix II, U. S. Bureau of Reclamation, Technical Memorandum No. 406.

TABLE 151.—*Coefficient of discharge of spillway drum gates*

1	2	3	4	5	6	1	2	3	4	5	6
Test No.	Run No.	Gate elevation	Model Q	Head on model crest	Model C in $Q=CLH^{3/2}$	Test No.	Run No.	Gate elevation	Model Q	Head on model crest	Model C in $Q=CLH^{3/2}$
6	1	1,020.00	0.431	0.1011	3.224	7	29A	1,027.11	2.732	0.3047	3.899
	2	1,020.00	.918	.1609	3.415		29B	1,027.11	2.747	.3080	3.856
	3	1,020.00	1.839	.2464	3.608		29C	1,027.11	3.614	.3666	3.907
	4	1,020.00	2.725	.3136	3.724		30A	1,027.11	3.629	.3698	3.871
	5	1,020.00	3.625	.3739	3.805		30B	1,027.11	3.616	.3727	3.813
	6	1,020.00	4.556	.4265	3.923		30X	1,027.11	4.532	.4304	3.851
	7	1,020.00	7.901	.6096	3.983		30Y	1,027.11	4.521	.4243	3.924
	8	1,020.00	4.571	.4317	3.866		30Z	1,027.11	4.517	.4280	3.871
	9	1,020.00	4.105	.4035	3.842		37	1,031.54	.228	.0579	3.913
	10	1,020.00	3.147	.3424	3.766		38	1,031.54	.396	.0837	3.931
	11	1,020.00	6.257	.5275	3.917		39	1,031.54	.609	.1119	3.900
	12	1,020.00	7.452	.5914	3.931		40	1,031.54	.842	.1404	3.839
7	7A	1,033.91	.434	.0894	3.898		41	1,031.54	1.114	.1690	3.845
	7X	1,033.91	.226	.0578	3.901		42	1,031.54	1.401	.1950	3.913
	8A	1,033.91	.914	.1476	3.866		43	1,031.54	1.706	.2225	3.898
	9A	1,033.91	1.841	.2381	3.803		44	1,031.54	2.080	.2536	3.908
	9X	1,033.91	1.343	.1916	3.842		45	1,031.54	2.270	.2690	3.904
	9Y	1,033.91	1.349	.1918	3.853		46	1,020.00	.459	.1026	3.346
	10A	1,033.91	2.725	.3083	3.820		47	1,020.00	.917	.1586	3.482
	10B	1,033.91	3.677	.3761	3.825		48	1,020.00	1.846	.2455	3.642
	10C	1,033.91	3.162	.3424	3.787		49	1,020.00	2.746	.3144	3.737
	10D	1,033.91	3.154	.3392	3.830		50	1,020.00	3.655	.3695	3.904
	10E	1,033.91	3.671	.3748	3.839		51	1,020.00	4.531	.4303	3.851
	10X	1,033.91	2.286	.2749	3.805		52	1,020.00	5.349	.4785	3.878
	21	1,031.41	.218	.0573	3.819		53	1,020.00	6.218	.5243	3.931
	22	1,031.41	.433	.0892	3.910		50A	1,020.00	3.716	.3773	3.847
	23	1,031.41	.911	.1465	3.894		51A	1,020.00	4.522	.4340	3.796
	24	1,031.41	1.837	.2349	3.872		52A	1,020.00	5.381	.4753	3.941
	25	1,031.41	2.734	.3060	3.874		47A	1,020.00	.928	.1610	3.448
	21X	1,031.56	.323	.0725	3.980		46X	1,020.00	.229	.0661	3.222
	22A	1,031.56	.430	.0873	3.994		50B	1,020.00	3.617	.3731	3.808
	22B	1,031.56	.435	.0880	4.002		54	1,028.93	.438	.0902	3.876
	22C	1,031.56	.435	.0889	3.942		55	1,028.93	.929	.1493	3.864
	22X	1,031.56	.941	.1501	3.884		56	1,028.93	1.852	.2359	3.880
	22Y	1,031.56	.681	.1203	3.911		57	1,028.93	2.723	.3039	3.901
	23A	1,031.56	.913	.1468	3.894		58	1,025.03	.924	.1544	3.658
	23X	1,031.56	1.380	.1930	3.906		59	1,025.03	1.851	.2427	3.715
	24A	1,031.56	1.843	.2339	3.909		60	1,025.03	2.753	.3125	3.782
	24X	1,031.56	2.229	.2648	3.926		61	1,025.03	3.632	.3752	3.793
	25A	1,031.56	2.716	.3025	3.915		62	1,025.03	.438	.0952	3.582
	25B	1,031.56	2.716	.3021	3.923		63	1,022.06	.436	.1006	3.283
	26	1,026.91	.441	.0953	3.596		64	1,022.06	.923	.1615	3.413
	27	1,026.91	.916	.1519	3.709		65	1,022.06	1.470	.2167	3.496
	28	1,026.91	1.828	.2377	3.785		66	1,022.06	3.600	.3795	3.696
	29	1,026.91	2.724	.3087	3.810		67	1,022.06	4.526	.4330	3.813
	30	1,026.91	3.635	.3725	3.836		68	1,023.51	.441	.0997	3.362
	26A	1,027.11	.434	.0919	3.737		69	1,023.51	.922	.1594	3.477
	27A	1,027.11	.925	.1505	3.800		70	1,023.51	1.837	.2459	3.615
	28A	1,027.11	1.838	.2360	3.849		71	1,023.51	3.670	.3822	3.713

TABLE 152.—*Adjustment by least square method*

1	2	3	4	5	6	7	8	9
Test No.	Run No.	Gate elevation	Model head on crest	Model Q	Colog H	Log Q	$(\text{Log H})^2$	Log H × log Q
6	1	1020.00	0.1011	0.431	−0.9953	−0.3652	0.9905	+0.3635
	2	1020.00	.1609	.918	−.7934	−.0372	.6295	+.0295
	3	1020.00	.2464	1.839	−.6084	+.2645	.3701	−.1609
	4	1020.00	.3136	2.723	−.5036	+.4350	.2536	−.2191
	5	1020.00	.3739	3.625	−.4272	+.5593	.1825	−.2389
	7	1020.00	.6096	7.901	−.2150	+.8977	.0462	−.1930
	8	1020.00	.4317	4.571	−.3648	+.6600	.1331	−.2408
	9	1020.00	.4035	4.105	−.3942	+.6133	.1554	−.2417
	10	1020.00	.3424	3.147	−.4655	+.4979	.2167	−.2317
	11	1020.00	.5275	6.257	−.2778	+.7964	.0772	−.2212
	12	1020.00	.5914	7.452	−.2281	+.8723	.0520	−.1990
					−5.2733	+5.1940	3.1068	−1.5533
		$11A = 5.2733n + 5.1940$			$1.5533 + 3.1068n = 5.2733A$			
		$A = 1.2476 = \text{Log } K_m L$			$n = 1.6175$			
		$K_m L = 17.63$		$L = 4.1668$	$K_m = 4.244$			
7	46	1020.00	0.1026	0.459	−0.9889	−0.3383	0.9778	+0.3345
	46X	1020.00	.0661	.229	−1.1798	−.6407	1.3919	+.7559
	47	1020.00	.1586	.917	−.7997	−.0379	.6395	+.0303
	47A	1020.00	.1610	.928	−.7932	−.0323	.6291	+.0256
	48	1020.00	.2455	1.846	−.6100	+.2663	.3720	−.1624
	49	1020.00	.3144	2.746	−.5025	+.4387	.2525	−.2204
	50	1020.00	.3695	3.655	−.4324	+.5629	.1870	−.2434
	50A	1020.00	.3773	3.716	−.4233	+.5700	.1792	−.2413
	50B	1020.00	.3731	3.617	−.4282	+.5583	.1833	−.2391
	51	1020.00	.4303	4.531	−.3662	+.6562	.1341	−.2403
	51A	1020.00	.4340	4.522	−.3625	+.6553	.1314	−.2376
	52	1020.00	.4785	5.349	−.3201	+.7283	.1025	−.2331
	52A	1020.00	.4753	5.381	−.3230	+.7309	.1044	−.2361
	53	1020.00	.5243	6.218	−.2804	+.7937	.0786	−.2226
					−7.8102	+4.9114	5.3633	−1.1300
		$14A = 7.8102n + 4.9114$			$5.3633n + 1.1300 = 7.8102A$			
		$A = 1.2432 = \text{Log } K_m L$			$n = 1.5997$			
		$K_m L = 17.51$		$L = 4.1668$	$K_m = 4.202$			
7	63	1022.06	0.1006	0.436	−0.9974	−0.3802	0.9948	+0.3592
	64	1022.06	.1615	.923	−.7918	−.0349	.6270	+.0276
	65	1022.06	.2167	1.470	−.6642	+.1873	.4411	−.1111
	66	1022.06	.3795	3.600	−.4208	+.5563	.1771	−.2341
	67	1022.06	.4330	4.526	−.3635	+.6558	.1321	−.2384
					−3.2377	+.9843	2.3721	−.1968
		$5A = 3.2377n + 0.9843$			$0.1968 + 2.3721n = 3.2377A$			
		$A = 1.2323 = \text{Log } K_m L$			$n = 1.5990$			
		$K_m L = 17.07$		$L = 4.1670$	$K_m = 4.097$			
7	68	1023.51	0.0997	0.441	−1.0013	−0.3556	1.0026	+0.3560
	69	1023.51	.1594	.922	−.7975	−.0353	.6360	+.0282
	70	1023.51	.2459	1.837	−.6092	+.2641	.3712	−.1609
	71	1023.51	.3832	3.670	−.4166	+.5647	.1735	−.2352
					−2.8246	+.4379	2.1833	−.0119
		$4A = 2.8246n + 0.4379$			$2.1833n + 0.0119 = 2.8246A$			
		$A = 1.2220 = \text{Log } K_m L$			$n = 1.5754$			
		$K_m L = 16.67$		$L = 4.1670$	$K_m = 4.001$			

155813—40——46

TABLE 152.—*Adjustment by least square method*—Continued

1	2	3	4	5	6	7	8	9
Test No.	Run No.	Gate elevation	M3dez head on crest	Model Q	Colog H	Log Q	(Log H)²	Log H × log Q
7	58	1025.03	0.1544	0.924	−0.8114	−0.0343	0.6583	+0.0278
	59	1025.03	.2427	1.851	−.6149	+.2674	.3781	−.1644
	60	1025.03	.3125	2.753	−.5052	+.4398	.2552	−.2222
	61	1025.03	.3752	3.632	−.4257	+.5601	.1813	−.2385
	62	1025.03	.0952	.438	−1.0214	−.3581	1.0432	+.3658
					−3.3786	+.8749	2.5161	−.2315
		$5A = 3.3786n + 0.8749$			$2.5161n + 0.2315 = 3.3786A$			
		$A = 1.2175 = \text{Log } K_m L$			$n = 1.5429$			
		$K_m L = 16.50$		$L = 4.1670$	$K_m = 3.960$			
7	26A	1027.11	0.0919	0.434	−1.0367	−0.3625	1.0747	+0.3758
	27A	1027.11	.1505	.925	−.8225	−.0338	.6764	+.0278
	28A	1027.11	.2360	1.838	−.6271	+.2645	.3932	−.1658
	29A	1027.11	.3047	2.732	−.5161	+.4366	.2664	−.2253
	29B	1027.11	.3080	2.747	−.5115	+.4388	.2616	−.2244
	29C	1027.11	.3666	3.614	−.4358	+.5580	.1899	−.2432
	30A	1027.11	.3698	3.629	−.4320	+.5598	.1867	−.2419
	30B	1027.11	.3727	3.616	−.4286	+.5582	.1837	−.2393
	30X	1027.11	.4304	4.532	−.3661	+.6563	.1341	−.2403
	30Y	1027.11	.4243	4.521	−.3723	+.6552	.1386	−.2440
	30Z	1027.11	.4280	4.517	−.3686	+.6549	.1358	−.2414
					−5.9173	+4.3860	3.6411	−1.6620
		$11A = 5.9173n + 4.3859$			$3.6411n + 1.6620 = 5.9173A$			
		$A = 1.2178 = \text{Log } K_m L$			$n = 1.5227$			
		$K_m L = 16.51$		$L = 4.1670$	$K_m = 3.963$			
7	54	1028.93	0.0902	0.438	+1.0448	+0.3585	1.0916	+0.3746
	55	1028.93	.1493	.929	.8259	+.0319	.6822	+.0264
	56	1028.93	.2359	1.852	.6273	−.2677	.3935	−.1679
	57	1028.93	.3039	2.723	.5173	−.4351	.2676	−.2251
					3.0153	−.3124	2.4349	+.0080
		$4A = 3.0153n + 0.3124$			$2.4349n - 0.0080 = 3.0153A$			
		$A = 1.2119 = \text{Log } K_m L$			$n = 1.5041$			
		$K_m L = 16.29$		$L = 4.1670$	$K_m = 3.909$			
7	21	1031.41	0.0573	0.218	−1.2418	−0.6609	1.5422	+0.8208
	22	1031.41	.0892	.433	−1.0496	−.3631	1.1017	+.3811
	23	1031.41	.1465	.911	−.8342	−.0407	.6958	+.0340
	24	1031.41	.2349	1.837	−.6291	+.2641	.3958	−.1661
	25	1031.41	.3060	2.734	−.5143	+.4368	.2645	−.2246
					−4.2690	−.3638	4.0000	+.8452
		$5A = 4.2690n - 0.3638$			$4.0000n - 0.8452 = 4.2690A$			
		$A = 1.2123 = \text{Log } K_m L$			$n = 1.5051$			
		$K_m L = 16.30$		$L = 4.1670$	$K_m = 3.913$			
7	37	1031.54	0.0579	0.228	−1.2373	−0.6426	1.5310	+0.7952
	38	1031.54	.0837	.396	−1.0773	−.4021	1.1605	+.4332
	39	1031.54	.1119	.609	−.9512	−.2156	.9047	+.2050
	40	1031.54	.1404	.842	−.8526	−.0749	.7270	+.0638
	41	1031.54	.1690	1.114	−.7721	+.0468	.5962	−.0361
	42	1031.54	.1950	1.404	−.7100	+.1475	.5041	−.1047
	43	1031.54	.2225	1.706	−.6527	+.2321	.4260	−.1515
	44	1031.54	.2536	2.080	−.5959	+.3181	.3550	−.1896
	45	1031.54	.2690	2.270	−.5703	+.3560	.3252	−.2030
					−7.4194	−.2347	6.5297	+.8123
		$9A = 7.4194n - 0.2347$			$6.5297n - 0.8123 = 7.4194A$			
		$A = 1.2078 = \text{Log } K_m L$			$n = 1.4967$			
		$K_m L = 16.13$		$L = 4.1670$	$K_m = 3.872$			

TABLE 152.—*Adjustment by least square method*—Continued

1	2	3	4	5	6	7	8	9
Test No.	Run No.	Gate elevation	Model head on crest	Model Q	Colog H	Log Q	(Log H)	Log H × log Q
7	21X	1031.56	0.0725	0.323	−1.1397	−0.4902	1.2988	+0.5587
	22A	1031.56	.0873	.430	−1.0590	−.3668	1.1215	+.3884
	22B	1031.56	.0880	.435	−1.0555	−.3611	1.1141	+.3812
	22C	1031.56	.0889	.435	−1.0511	−.3618	1.1048	+.3803
	22X	1031.56	.1501	.941	−.8236	−.0262	.6784	+.0216
	22Y	1031.56	.1203	.681	−.9197	−.1672	.8459	+.1537
	23A	1031.56	.1468	.913	−.8333	−.0394	.6943	+.0328
	23X	1031.56	.1930	1.380	−.7144	+.1400	.5104	−.1000
	24A	1031.56	.2339	1.843	−.6310	+.2656	.3981	−.1676
	24X	1031.56	.2648	2.229	−.5771	+.3481	.3330	−.2009
	25A	1031.56	.3025	2.716	−.5193	+.4339	.2696	−.2253
	25B	1031.56	.3021	2.716	−.5199	+.4339	.2702	−.2255
					−9.8436	−.1912	8.6391	+.9974
		$12A = 9.8436n - 0.1912$			$8.6391n - 0.9974 = 9.8436A$			
		$A = 1.2049 = \text{Log } K_m L$			$n = 1.4883$			
		$K_m L = 16.03$		$L = 4.1670$	$K_m = 3.847$			
7	7A	1033.91	0.0894	0.434	−1.0487	−0.3627	1.0997	+1.4200
	7X	1033.91	.0578	.226	−1.2381	−.6453	1.5328	+.7989
	8A	1033.91	.1476	.914	−.8309	−.0392	.6904	+.0326
	9A	1033.91	.2381	1.841	−.6232	+.2652	.3884	−.1653
	9X	1033.91	.1916	1.343	−.7176	+.1281	.5150	−.0919
	9Y	1033.91	.1918	1.349	−.7172	+.1299	.5143	−.0931
	10A	1033.91	.3083	2.725	−.5110	+.4354	.2612	−.2225
	10B	1033.91	.3761	3.677	−.4247	+.5655	.1804	−.2402
	10C	1033.91	.3424	3.162	−.4655	+.5000	.2167	−.2327
	10D	1033.91	.3392	3.154	−.4695	+.4989	.2205	−.2343
	10E	1033.91	.3748	3.671	−.4262	+.5648	.1817	−.2407
	10Y	1033.91	.2749	2.286	−.5608	+.3590	.3145	−.2013
					−8.0334	+2.3996	6.1156	−.5101
		$12A = 8.0334n + 2.3996$			$6.1156n + 0.5101 = 8.0334A$			
		$A = 1.1951 = \text{Log } K_m L$			$n = 1.4864$			
		$K_m L = 15.67$		$L = 4.1670$	$K_m = 3.760$			

The runs were divided into groups, made with the gates at the same elevation. At the bottom of each of these groups the calculations for the values of K_m and for n for that elevation are shown.

An explanation of the laws of hydraulic similitude and the transference of results from model to prototype are given below.[4] The subscript $_p$ denotes prototype quantities, and the subscript $_m$ denotes model quantities. The scale ratio of the model is denoted by N. On page 695 it was stated that

$$Q_p = Q_m N^{5/2} \tag{1}$$

also, in the case of the quantity of water flowing over a dam

$$Q_p = K_p L_p H_p^{n_p} \tag{2}$$

and, for the model

$$Q_m = K_m L_m H_m^{n_m} \tag{3}$$

from (1) and (3)

$$Q_p = K_m L_m H_m^{n_m} N^{5/2} \tag{4}$$

equating (2) and (4)

$$K_p L_p H_p^{n_p} = K_m L_m H_m^{n_m} N^{5/2} \tag{5}$$

but

$$L_p = N L_m \quad H_p = N H_m$$

[4] Chick, Alton C., John R. Freeman's Hydraulic Laboratory Practice, p. 796.

substituting in (5), assuming $n_p = n_m = n$

$$K_p N L_m (N H_m)^n = K_m L_m H_m^n N^{5/2}$$

simplifying

$$K_p = K_m N^{3/2-n} \qquad (6)$$

With the value of K_m and n for each gate setting a table of values for K_p and n were obtained and are shown in table 153. Values of K_p were calculated using equation (6) and the values of K_m and n from table 152. The values of n are the same whether model or prototype. Table 153 gives the calculated results. These data were plotted as shown on figure 337.

TABLE 153.—*Calculations of prototype coefficient of discharge from observed data*

$K_{prots} = K_{model} \times N^{1.5-n}$ where $N = 72$ and Log $N = 1.8573$

1	2	3	4	5	6	7
Gate elevation	See table 152 n	1.5–n	Log N× (1.5–n)	$N^{1.5-n}$	K Model	K Prototype
1020.00	1.618	−0.118	−0.2182	0.6050	4.244	2.568
1020.00	1.600	−.100	−.1852	.6529	4.202	2.743
1022.06	1.600	−.100	−.1839	.6548	4.097	2.683
1023.51	1.575	−.075	−.1400	.7244	4.001	2.898
1025.03	1.543	−.043	−.0797	.8324	3.960	3.296
1027.11	1.523	−.023	−.0422	.9075	3.963	3.596
1028.93	1.504	−.004	−.0076	.9826	3.909	3.841
1031.41	1.505	−.005	−.0095	.9784	3.913	3.828
1031.54	1.497	+.003	+.0061	1.0142	3.872	3.927
1031.56	1.488	+.012	+.0217	1.0513	3.847	4.044
1033.91	1.487	+.013	+.0251	1.0594	3.760	3.984

All the curves in figure 337 are interdependent. For instance, if the prototype coefficient curve is changed slightly, then the other three curves must be changed accordingly in order for the given values to check. All the plotted points are not given the same weight on the curves as there are more observations on some than on others.

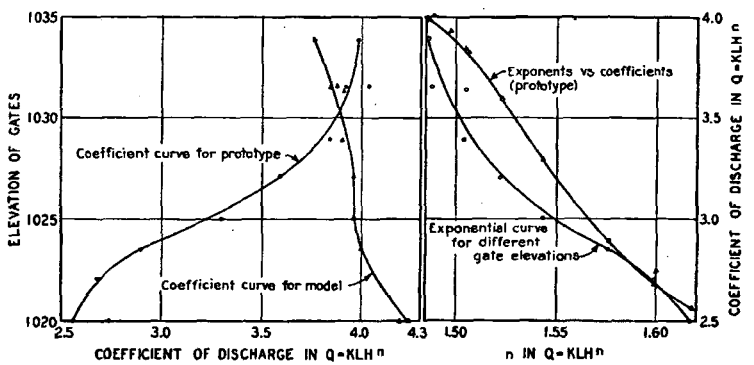


FIGURE 337.—*Coefficient (K) and exponential (n) curves for* $Q = KLH^n$

Values of K_p and n were read from these curves for each foot of gate elevation. By substituting these values in the equation $Q = K_p L H^n$, and using different values of H, the discharge table, table 154, was prepared.

Table 154 was compiled to furnish material for the construction of discharge curves. Therefore, only a sufficient number of points was calculated to fix the curves. Additional points may be calculated from the values given at the head of the column. The results in this table were plotted and are shown in figure 338. This diagram is based on having all the gate crests at the same elevation.

TABLE 154.—*Discharge table computed from the formula* $Q = KLH^n$

[Discharge (Q) for all three gates at the same elevation]

Head over gates in feet	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation	Quantity in cubic feet per second	Reservoir water surface elevation
	Gate elevation 1,020 $n=1.617$ $K_p=2.568$ $K_pL=770.4$		Gate elevation 1,021 $n=1.608$ $K_p=2.617$ $K_pL=785.1$		Gate elevation 1,022 $n=1.597$ $K_p=2.696$ $K_pL=808.8$		Gate elevation 1,023 $n=1.584$ $K_p=2.809$ $K_pL=842.7$		Gate elevation 1,024 $n=1.566$ $K_p=3.002$ $K_pL=900.6$	
1	770	1,021	785	1,022	809	1,023	843	1,024	901	1,025
2	2,364	1,022	2,393	1,023	2,447	1,024	2,527	1,025	2,667	1,026
3	4,544	1,023	4,594	1,024	4,676	1,025	4,804	1,026	5,032	1,027
4	7,252	1,024	7,296	1,025	7,404	1,026	7,577	1,027	7,895	1,028
6	13,976	1,026	14,010	1,027	14,150	1,028	14,400	1,029	14,900	1,030
8	22,250	1,028	22,240	1,029	22,400	1,030	22,720	1,031	23,380	1,032
10	31,920	1,030	31,840	1,031	31,990	1,032	32,360	1,033	33,150	1,034
12	42,860	1,032	42,690	1,033	42,810	1,034	43,190	1,035	44,110	1,036
14	55,000	1,034	54,700	1,035	54,760	1,036	55,140	1,037	56,150	1,038
16	68,260	1,036	67,810	1,037	67,770	1,038	68,130	1,039	69,210	1,040
20	97,920	1,040	97,080	1,041	96,790	1,042	97,030	1,043	98,160	1,044
24	131,500	1,044	130,100	1,045	129,500	1,046	129,560	1,047	130,600	1,048
28	168,700	1,048	166,800	1,049	165,700	1,050	165,400	1,051	166,300	1,052
32	209,400	1,052	206,700	1,053	205,100	1,054	204,300	1,055	------	------
36	253,300	1,056	------	------	------	------	------	------	------	------
	Gate elevation 1,025 $n=1.549$ $K_p=3.220$ $K_pL=966.0$		Gate elevation 1,026 $n=1.535$ $K_p=3.410$ $K_pL=1,023$		Gate elevation 1,027 $n=1.524$ $K_p=3.574$ $K_pL=1,072$		Gate elevation 1,028 $n=1.515$ $K_p=3.704$ $K_pL=1,111$		Gate elevation 1,029 $n=1.508$ $K_p=3.796$ $K_pL=1,139$	
1	966	1,026	1,023	1,027	1,072	1,028	1,111	1,029	1,139	1,030
2	2,826	1,027	2,965	1,028	3,084	1,029	3,176	1,030	3,239	1,031
3	5,294	1,028	5,524	1,029	5,720	1,030	5,870	1,031	5,970	1,032
4	8,266	1,029	8,591	1,030	8,868	1,031	9,076	1,032	9,212	1,033
6	15,490	1,031	16,010	1,032	16,450	1,033	16,780	1,034	16,980	1,035
8	24,180	1,033	24,900	1,034	25,500	1,035	25,940	1,036	26,200	1,037
10	34,160	1,035	35,070	1,036	35,830	1,037	36,370	1,038	36,680	1,039
12	45,300	1,037	46,390	1,038	47,310	1,039	47,960	1,040	48,290	1,041
14	57,510	1,039	58,770	1,040	59,840	1,041	60,560	1,042	60,930	1,043
16	70,720	1,041	72,140	1,042	73,340	1,043	74,140	1,044	74,520	1,045
20	99,910	1,045	101,600	1,046	103,100	1,047	104,000	1,048	104,300	1,049
24	132,500	1,049	134,400	1,050	136,100	1,051	137,000	1,052	137,300	1,053
28	168,200	1,053	170,300	1,054	172,100	1,055	------	------	------	------
	Gate elevation 1,030 $n=1.502$ $K_p=3.865$ $K_pL=1,160$		Gate elevation 1,031 $n=1.497$ $K_p=3.918$ $K_pL=1,175$		Gate elevation 1,032 $n=1.493$ $K_p=3.951$ $K_pL=1,185$		Gate elevation 1,033 $n=1.489$ $K_p=3.972$ $K_pL=1,192$		Gate elevation 1,034 $n=1.486$ $K_p=3.985$ $K_pL=1.196$	
1	1,160	1,031	1,175	1,032	1,185	1,033	1,192	1,034	1,196	1,035
2	3,284	1,032	3,318	1,033	3,336	1,034	3,345	1,035	3,349	1,036
3	6,038	1,033	6,089	1,034	6,112	1,035	6,119	1,036	6,117	1,037
4	9,302	1,034	9,367	1,035	9,391	1,036	9,392	1,037	9,380	1,038
6	17,100	1,036	17,190	1,037	17,200	1,038	17,180	1,039	17,140	1,040
8	26,350	1,038	26,440	1,039	26,430	1,040	26,370	1,041	26,280	1,042
10	36,840	1,040	36,930	1,041	36,880	1,042	36,770	1,043	36,610	1,044
12	48,440	1,042	48,520	1,043	48,420	1,044	48,230	1,045	48,000	1,046
14	61,060	1,044	61,120	1,045	60,950	1,046	60,680	1,047	60,350	1,048
16	74,620	1,046	74,640	1,047	74,400	1,048	74,030	1,049	73,600	1,050
20	104,300	1,050	104,300	1,051	103,800	1,052	103,200	1,053	102,500	1,054
24	137,200	1,054	137,000	1,055	------	------	------	------	------	------

The results of the coefficient test show that the spillway will discharge the quantity anticipated in the preliminary design calculations and have a small margin of safety in the form of additional discharge.

A discharge curve for the prototype spillway was the major requirement of the coefficient experiment, but in order to show the results in a more conventional form the values of C in the formula $Q=CLH^{3/2}$ as shown in table 151 were plotted against reservoir elevations. In order to obtain a smooth curve through these observed points on cross-section paper, especially when there were

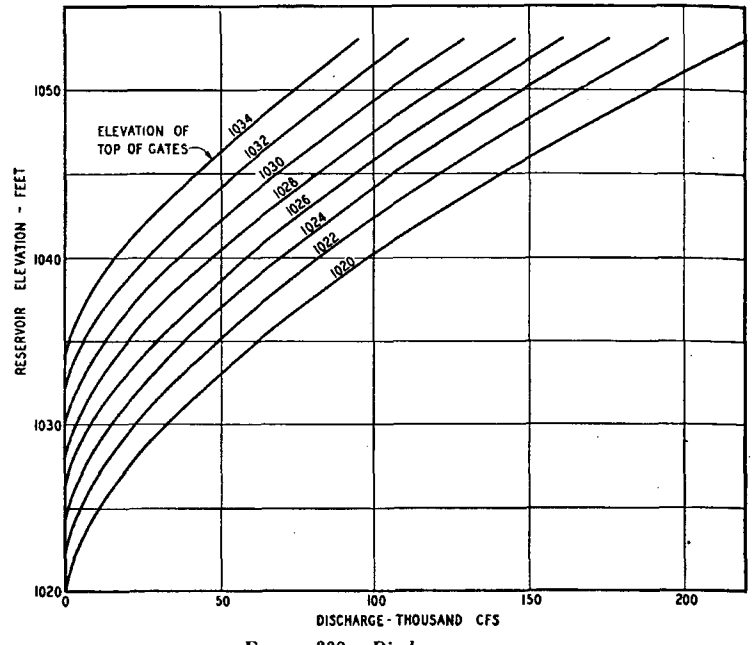


FIGURE 338.—*Discharge curves.*

only four or five observations, values of C for each curve were calculated. For each observed gate elevation, values of the head covering the observed range were assumed and values of C calculated by use of the formula $C=K_pH_p^{n-3/2}$. This equation is derived as follows:

$$Q_p=CL_pH_p^{3/2} \text{ and } Q_p=K_pL_pH_p^n \qquad (1) \text{ and } (2)$$

equating (1) and (2)

$$CL_pH_p^{3/2}=K_pL_pH_p^n \qquad (3)$$

or

$$C=K_pH_p^{n-3/2} \qquad (4)$$

The values of K_p and n were taken from the curves on figure 337. Curves were then drawn through these calculated points. As can be seen on figure 339, these are smooth curves and pass through the observed points very consistently, but there is no way of interpolating results for gate elevations between those observed directly.

By the above method, curves showing C plotted against reservoir elevation for gate elevations of 1,020, 1,022, and so forth, were plotted and are shown on figure 340. These curves were constructed to make possible a comparison between the results of these tests and tests on other models that have been calculated for C in $Q=CLH^{3/2}$.

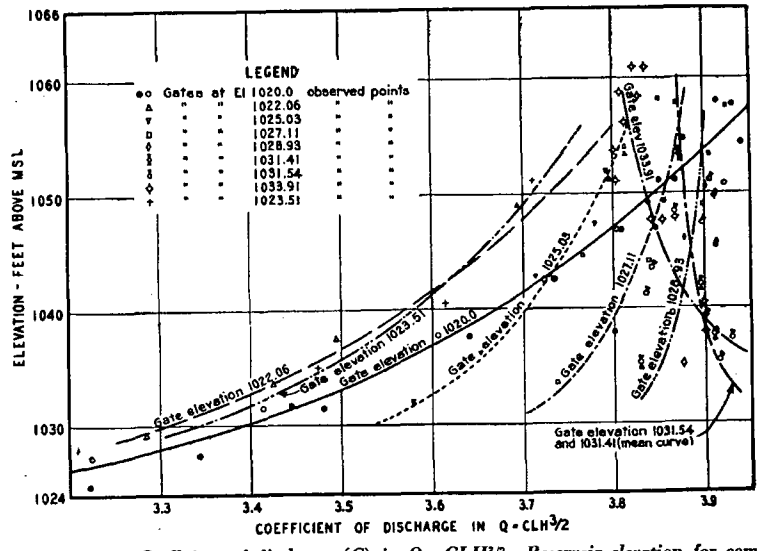


FIGURE 339.—*Coefficient of discharge (C) in $Q=CLH^{3/2}$—Reservoir elevation for comparison with observed data.*

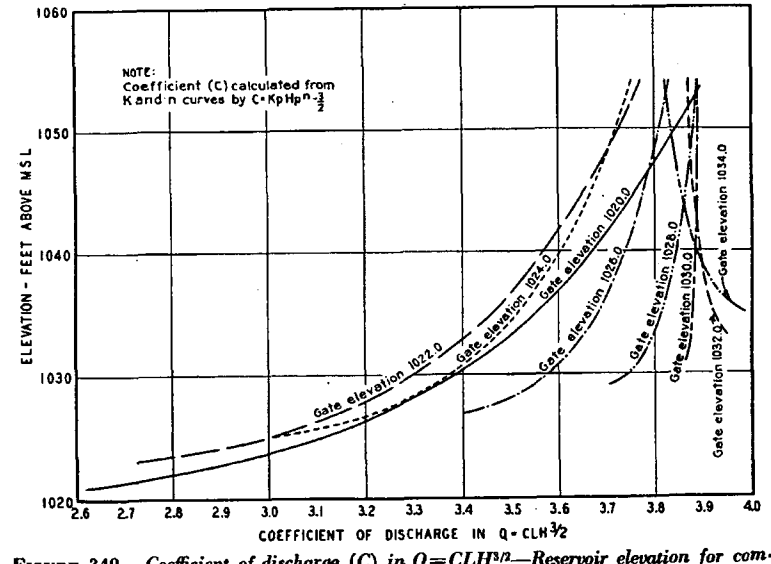


FIGURE 340.—*Coefficient of discharge (C) in $Q=CLH^{3/2}$—Reservoir elevation for comparison with other similar data.*

The fact that the curves cross each other can be explained by a study of the changing crest section as the gates are raised. The angle between the slope on the upstream face of the crest section and the chord of the gate section increases very rapidly as the gates are raised, thus changing the conditions of flow radically.

All results were checked, and the plotted curves show the final analysis of the data.

The values of C in $Q=CLH^{3/2}$ are assumed to be the same for model and prototype.

Pressures on drum gates.

Eight piezometer openings were installed in one of the drum gates and connected to glass tubes by means of rubber tubing. These piezometer openings were referenced to the gage board in such a manner that the capillary attraction in the glass tube was taken into account. The pressures were read in feet of water directly on the glass gage tubes. While the above-mentioned calibration runs were in progress, a series of readings on the gage tubes were observed for each gate elevation and head over the gate. These results were transferred to prototype values and plotted. The curves shown in figure 341 are representative of the data obtained.

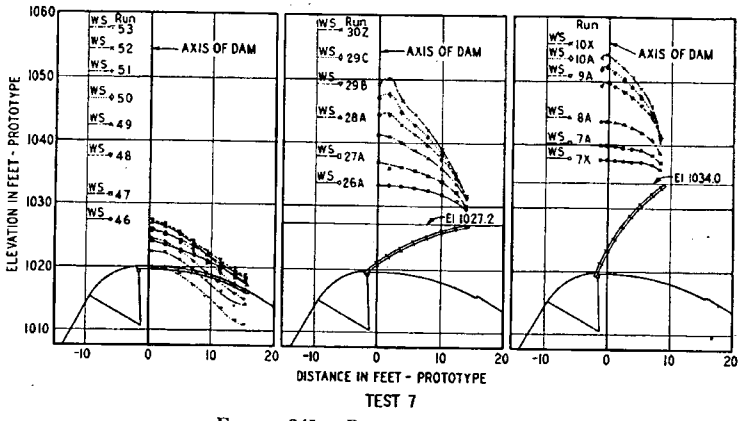


FIGURE 341.—*Drum gate pressures.*

As no pressures were found to be substantially less than atmospheric, the results could be transferred by simply multiplying model pressures by the scale ratio (72).

Tests on training walls.

From visual observations of the upper nappe of the jet along the training wall on the downstream face of the dam, it was felt that these walls might be modified to contain less yardage of concrete and improve their architectural appearance. Upper nappe measurements were made with all gates at elevation 1,034 and the reservoir surface at elevation 1,052 and all gates set so as to hold the reservoir at elevation 1,052 when quantities equal to 120,000, 160,000, and 180,000 cubic feet per second were passing the spillway.

The results of the test show that the upper corner of the training wall could be reduced to a curve of approximately 35-foot radius and result in a saving of concrete. The point of intersection of the sloping training wall with the horizontal wall could be moved closer to the downstream face of the dam, thus making a steeper slope than that given and would result in a further saving.

It was also desired to obtain pressures on the sides of the training wall on the power house side of the apron to assist in the design of this wall. Twenty-five piezometer openings were placed on the spillway side of the training wall

and connected to glass gage tubes by means of rubber tubing. Runs of 20,000, 40,000, 60,000, 80,000, 120,000, 160,000, 200,000, 240,000 cubic feet per second were made, and a series of observations made on the gage tubes for each run. A representative group of results together with the location of the openings are shown in figure 342.

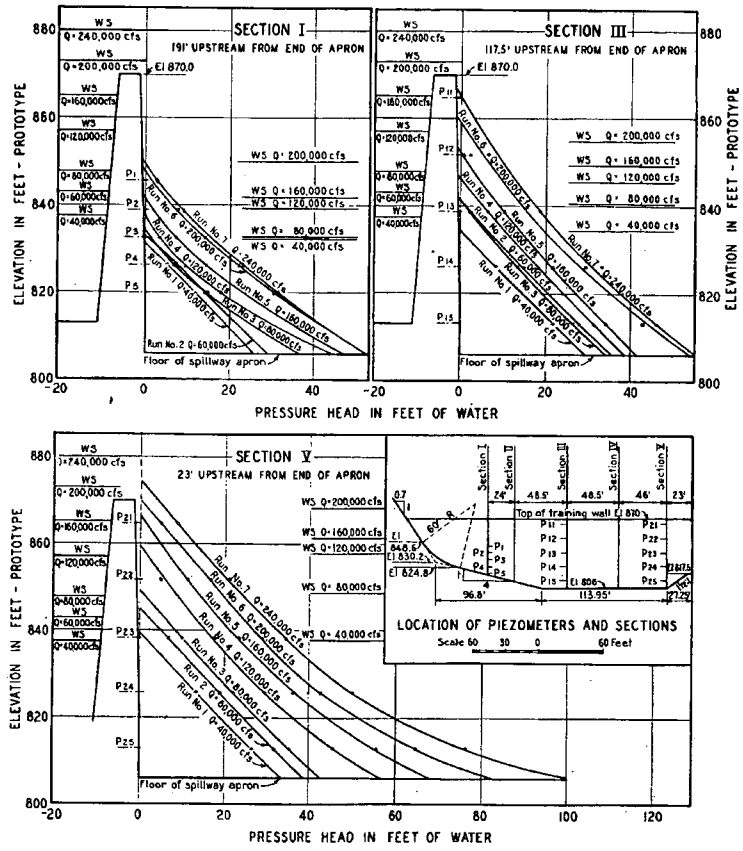


FIGURE 342.—*Training wall pressures.*

At higher discharges the section of wall from the front face of the powerhouse extending downstream is in effect an overflow dam. For all discharges above 185,000 cubic feet per second, water flows over the top of the wall from the powerhouse tailrace into the stilling pool and at 240,000 cubic feet per second reaches a depth of 10 feet. This action is shown to be maximum at section 4, and there is a slight negative pressure near the top of the wall. The water surface in the stilling pool is high enough at section 5 to make the effect negligible. There is, however, a flow over the wall into the stilling pool from the front edge of the powerhouse to the end of the apron.

Velocity studies.

Measurements of the velocities on the apron of the model were made for comparison with the computed velocities on the prototype to determine the magnitude of the error which results from the fact that the model might not

have relatively the same coefficient of roughness as the prototype. The results of the comparison of the velocities measured on the model with those computed from the prototype showed only a small difference between observed and computed values. Table 155 gives a summation of the results of the velocity studies.

TABLE 155.—*Comparison of velocities measured on model and converted to prototype and velocities computed from prototype*

Quantity in cubic feet per second	Theoretical		Friction loss in velocity head feet of water		Net				Percent difference calculated and measured velocities
					Velocity F. p. s.		Velocity head Ft.		
	Velocity F. p. s.	Velocity head Ft.	Computed	Measured	Computed	Measured	Computed	Measured	
1	2	3	4	5	6	7	8	9	10
40,000	122.6	233.9	92.9	102.2	95.2	91.6	141.0	130.6	3.74
120,000	124.8	242.0	38.5	41.4	114.4	112.6	203.5	197.1	1.61
200,000	124.4	241.0	22.5	20.6	118.4	117.7	218.5	215.5	0.56

Gate operating program.

For the purpose of determining a gate operating program, a series of runs was made with the gates set at different elevations from the fixed crests. All combinations of one gate at elevation 1,020 and the other two at elevation 1,034 were run with the reservoir elevation held at elevation 1,034 and also at 1,052. Similarly, all combinations of two gates at elevation 1,020 and one at elevation 1,034 were run with the reservoir held at elevation 1,034 and also at elevation 1,052.

Results show that when the gates are at widely different elevations the conditions in the stilling pool are not satisfactory. The jets from the gates at widely different elevations combine on the rollway and set up a disturbance before the water enters the pool. For instance, with the center gate up and the two outside gates down, the jets from the outside gates spread in under the jet from the center gate because it strikes farther down on the rollway. This disturbance is carried down through the pool.

In testing for an operating program the possibility of some irregularity that might cause one or more of the gates to become inactive was considered. For instance, a test was made of the action with gates 1 and 2 at elevation 1,034 and gate 3 at elevation 1,020. The results show bad conditions in the pool but not serious enough to cause alarm over the safety of the structure.

The most undesirable condition resulted when the tail water was at a minimum, the reservoir at elevation 1,034, all gates at elevation 1,034, and one of them suddenly dropped to elevation 1,020. This allowed approximately 18,000 cubic feet per second of water to rush into the pool. Although the tail water was swept off the sloping apron and into the flat part of the apron, whirls soon developed which prevented the tail water from being swept past the sill. The tail water very quickly filled up sufficiently to control the jump.

Undesirable conditions were caused when the gate farthest from the powerhouse was completely down and the center gate and gate nearest the powerhouse were completely raised. This condition results because there is more area in the whirl when it turns toward the powerhouse rather than away from it. A larger whirl is of more severe proportions. With the gate nearest the powerhouse completely down and the other two completely raised, the whirl beyond the end of the apron can turn both into the tailrace and toward the right bank and is somewhat dissipated in this dividing process. This causes less undesirable conditions.

STUDIES OF AUXILIARY PASSAGES

Outlet conduits.

The outlet conduits could not be built directly through the model of the dam, because the model was located over a concrete wall which was part of the permanent building. (See fig. 333.) Instead, the water was brought under the model through an 8-inch pipe and carried through the dam parallel to its axis. Outlet conduits were opened out of this header pipe perpendicular to the center line and carried through the downstream face of the dam. Figure 330 shows this model set-up. A single slide gate at the entrance from the forebay was the only control provided at first.

As originally installed, each of the eight outlet conduits was carried through the model with the center line at elevation 865. Visual observations and pictures were made of the action of the stilling pool with conduits wide open and the pond held at elevation 1,034, with the conduits closed and various flows over the spillway, and with all conduits open and 200,000 cubic feet per second flowing over the spillway.

With this set-up, the jets from the outlet conduits fell into the pool near the toe of the slope and caused serious disturbances. The set-up was generally very unsatisfactory, even with the addition of deflectors above the openings.

In the next tests the center line of the slide gates remained at elevation 865, and the invert of the outlet conduits changed to follow a parabola from the slide gates and connect with the tangent to the 60-foot-radius bucket at elevation 828.5. (See fig. 26.) The procedure of testing followed closely that given above except the various sills and diffuser baffles used on the apron were also tested in conjunction with the sluices to see if a more even distribution of velocities across the apron and sill could be obtained. Also, controls were made for each conduit so they could be operated singly or in combinations. The conduit was either completely opened or closed at all times, as this was the assumed method of operation expected on the prototype.

In the original design the conduits were brought through the dam in pairs. As a result, the jets impinging on the spillway pool caused unsatisfactory conditions. It was hoped to remedy these conditions by spreading the outlets more evenly across the bucket. Accordingly, four conduits were held with a center line perpendicular to the axis of the dam, and the other four (one of each pair) were diverged at an angle of 11° from the other one in the pair. (See fig. 343.) The invert was held at the same slope as before. Procedure similar to the above was followed in testing.

Tests were made on this set-up to determine the pressures existing in the sluiceways when water was flowing over the dam and not through the conduit openings. To do this, two conduits were sealed from the header and two openings inside each conduit were connected to gages. Runs were made with flows of 20,000, 40,000, 80,000, 120,000, 160,000, and 200,000 cubic feet per second and a series of observations on the gage taken for each run. The results of these tests are given in table 156.

As a means of decreasing the negative pressure found in the conduits, a parabolic hump was incorporated into the dam extending from the 0.7 slope down to the 60-foot-radius bucket through which the sluices opened. Testing procedures similar to those previously described were used for these tests. Table 156 shows the results of these tests.

Various types of hoods on the face of the dam above the conduit openings were tested on the model prior to installing the parabolic hump. Pressures shown in table 156 in the conduits were measured, as stated above, on the best form of these hoods.

The results of these tests show a comparatively wide range of pressures in the outlet passages as the quantity over the spillway is increased from very low flows to maximum discharge. The negative pressures might be useful in increasing the discharge through the conduits when they are operating in conjunction with the spillway, but at the same time if the outlet conduit control gates were closed and water was flowing over the spillway, these gates would have to be stronger to withstand the pressure. As the pressure varies for different flows, the effect could not be relied upon to assist in the flow through the conduits.

Conditions were improved by diverging the outlets, but neither the action of the water flowing over the dam and past the outlets or the general appearance of the dam was satisfactory. To correct these factors, the shape of the outlets through the face of the dam and bucket was changed.

The first change was to maintain the sides of the straight conduits parallel to their center lines. In the diverging conduits, the side farthest from the straight conduit was made parallel to the center line of the diverging conduit. The side of the conduit next to the straight one was made parallel to the center line of the straight one.

From a review of the results obtained from the outlet conduit tests and a study of the results of the pressure tests, it was decided to change the operating program for the model. This change was to allow the outlet conduits to discharge their maximum capacity as the flood approached and to remain open after the spillway came into action. At the maximum discharge of 240,000 cubic feet per second, the outlet conduits would be discharging 40,000 cubic feet per second and the spillway 200,000 cubic feet per second. This procedure would greatly reduce the probability of erosion on the floors of the outlet conduits at the openings and would eliminate the necessity of deflectors of any type over the outlet openings.

TABLE 156.—*Pressures in outlet conduits*

Prototype discharge in cubic feet per second	Model pressure from water column Ft.		Prototype pressure calculated Ft.	
	Straight outlet	Diverging outlet	Straight outlet	Diverging outlet
1	2	3	4	5
20,000:				
a	−0.0063	−0.0059	−0.454	−0.425
b	−.0698	−.0888	−5.026	−6.394
c	−.0286	−.0170	−2.059	−1.224
40,000:				
a	−.0240	−.0246	−1.728	−1.771
b	−.0697	−.1512	−5.018	−10.886
c	−.0421	−.0544	−3.031	−3.917
80,000:				
a	−.1378	−.1439	−9.922	−10.361
b	+.0374	−.1058	+2.693	−7.618
c	−.0568	−.2656	−4.090	−19.123
120,000:				
a	−.1101	−.1169	−7.927	−8.417
b	+.1134	−.0481	+8.165	−3.463
c	−.1031	−.2826	−7.423	−20.347
160,000:				
a	−.0681	−.0664	−4.903	−4.781
b	+.3099	+.2169	+13.457	+5.321
c	−.0621	−.2441	−4.471	−17.575
200,000:				
a	+.0119	−.0024	+.857	−.173
b	+.1969	+.0739	+22.313	+15.617
c	+.0549	−.0796	+3.953	−5.731

a = 60-foot radius deflectors, each deflector covering two outlets.
b = No deflectors over outlet openings.
c = Parabolic hump over outlet openings.

Because half of the outlet conduits came through the dam perpendicular to the axis and the other four at an angle to the axis, different conditions existed in the pool when different conduits were operated singly or in combination. This necessitated the determination of an operating program for the conduits. From a series of tests in which the conduits were operated singly and in combinations of twos, threes, fours, etc., the results showed that the gates should be opened in the following order to give best flow conditions. The sluiceways are numbered from left to right looking downstream. Outlet No. 3 should be opened first, then No. 6, then No. 8, then No. 1, then No. 4, then No. 5, then No. 2, then No. 7.

This latest change showed a decided improvement, but the symmetrical appearance of the dam was disturbed. (See fig. 343.) In order to improve the appearance of the openings and further spread the discharge jets, the sides of the outlets of the straight sluices were diverged with respect to their center lines, an amount such that the width of the floor and the openings was equal to the floor width at the openings of the diverging sluiceways.

Needle valves.

In the original design of the dam, two 72-inch needle valves located in the river end of the powerhouse and discharging into the tailrace next to the spillway training wall were included. Operation disclosed immediately that the discharge of the jets of water in the tailrace caused unsatisfactory conditions. A solution was worked out and recommended with possible modifications, but as later plans for the project eliminated the needle valves entirely, further study was unnecessary.

Powerhouse water discharge.

After the first six tests were run on the model, the powerhouse was so constructed as to simulate turbines discharging through draft tubes. The correct flow was maintained through the powerhouse and the tail water held at the height corresponding to the flow, and visual observations were made.

No quantitative studies of the flow conditions from the powerhouse were made. With the maximum flow (8,000 cubic feet per second) coming from the powerhouse, no undesirable conditions were observed with either the spillway or the outlet conduits, or both, discharging.

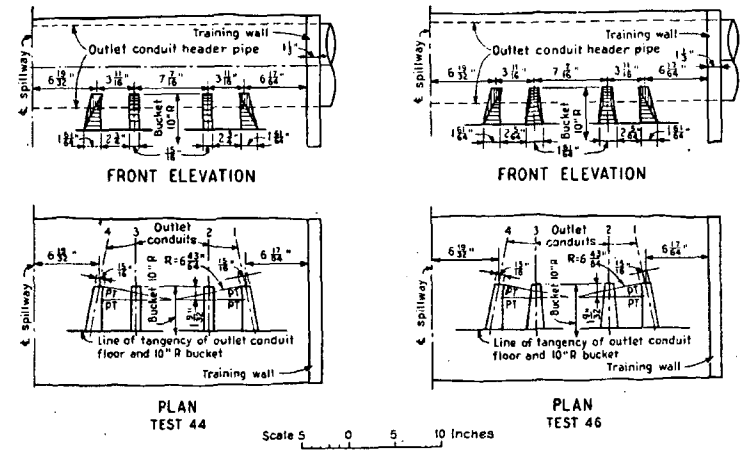


FIGURE 343.—*Details of outlets.*

COMPARISON OF PROTOTYPE WITH MODEL

Unusually heavy rains on the Ohio River drainage basin in December 1936 and January 1937 resulted in flood stages all along the Ohio River. During this period practically the entire flow of the Clinch and Powell Rivers above the dam was stored in the reservoir. This necessitated raising the spillway drum gates a maximum of about 11 feet above the concrete spillway crest to hold back the floodwaters. Late in January it was seen that moderate discharges would not cause further rises on the Ohio and Mississippi Rivers, and accordingly water was released to provide storage space for possible additional run-off. Much of the release was accomplished by lowering the crest gates and allowing the water to discharge over the spillway.

Stilling basin.[5]

Advantage was taken of this opportunity to observe the action of the spillway and stilling basin for heads on the gates up to 9.7 feet and for spillway discharges up to 30,000 cubic feet per second. Several special arrangements of the gates were tried out in order to compare the results with the model tests.

Observations of flow over the spillway and through the outlet conduits of the prototype lead to the following conclusions:

1. The hydraulic jump forms satisfactorily when all three spillway gates are operated alike.

[5] Hickox, G. H., Performance of Norris Stilling Basin During 1937 Flood, Tennessee Valley Authority, July 1938.

2. Operation of the stilling basin is not satisfactory when the spillway gates are not operated alike. Symmetrical arrangement of gate openings is not a sufficient condition for satisfactory operation of the stilling basin. The arrangement of openings must be uniform as well as symmetrical.

3. The stilling basin does not operate as well for outlet conduit discharge as for spillway discharge over uniformly operated gates. Whenever the desired discharge can be obtained by spillway operation alone, outlet conduit discharge should be avoided.

4. At low discharges, and with water flowing over the raised drum gates, waves exist on the face of the spillway. They are caused by vibration of the nappe as it falls over the gate to the crest of the dam. The vibration of the nappe is apparently not due to a lack of air supply beneath it. The true cause is not known.

5. When the gates are raised above the crest, air is drawn beneath the nappe. It escapes through the nappe a short distance below the crest of the dam, making the sheet of water on the face of the spillway thicker until all the air has escaped.

6. When the gates are lowered to the crest, entrainment of air at the surface of the water appears to be governed by the depth of water over the crest. The greater the depth, the greater is the distance traveled before entrainment of air begins. Since both the depth of flow and the distance traveled are greater, the velocity must also be greater. It seems probable that depth of flow, as well as velocity, is a factor governing the entrainment of air.

7. Performance of the prototype agrees well with the results of model tests for all conditions observed. Observations of stilling-basin operation for much higher discharges are desirable in order that the prediction of the model may be verified over as great a range of conditions as possible.

Comparison of the operation of the prototype with the model, while not exact, owing to the fact that similar conditions were not obtained, nevertheless offers good enough agreement to show the value of model tests. In all cases the model predicted faithfully the salient characteristics of flow and the general type of operation of the stilling basin.

ARCHITECTURAL STUDIES

The only purely architectural studies made were on the spillway bridge and piers. The original bridge was designed as a through-truss type in 100-foot spans from pier to pier. This was replaced by a pony-type truss and finally by a plate girder bridge. The latter necessitated changes in pier design, which, when tested, produced no undesirable results. In the final set-up, elevator towers (one of which was later eliminated) at each end of the spillway were built.

The results of the architectural studies in connection with the sluice openings are shown in figure 344. The appearance of the completed project was kept constantly in mind in conjunction with all changes. Both the through-truss type and the pony-truss type bridge appeared to be somewhat out of proportion when placed across the spillway. The plate girder bridge appeared to be much more in keeping with the other features of the dam and added greatly to the appearance of the structure. The change in design of the downstream face of the piers to support this bridge was beneficial to the aeration of the jets from the gates when they were near to and at their maximum elevation. Clearance beneath the structure was as good as in previous designs.

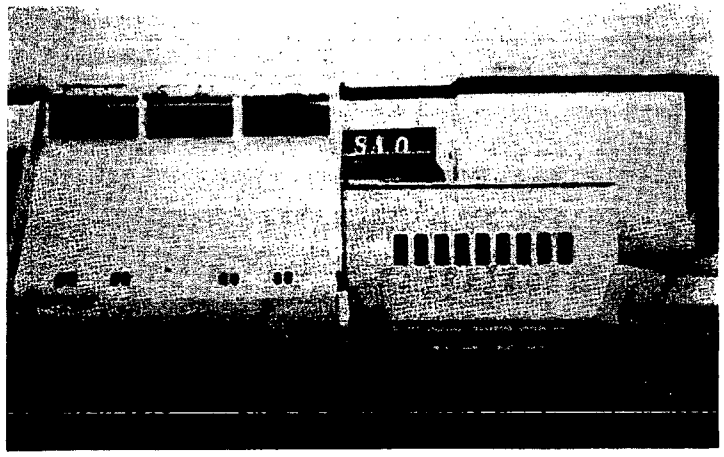
STRUCTURAL MODEL STUDIES

In connection with the design of the dam, it was deemed advisable to check at least part of the mathematical analyses by use of a structural model. The model permitted not only a check of some of the mathematical analyses but also the observation of some deflections and stresses which would not have been obtainable by other means.

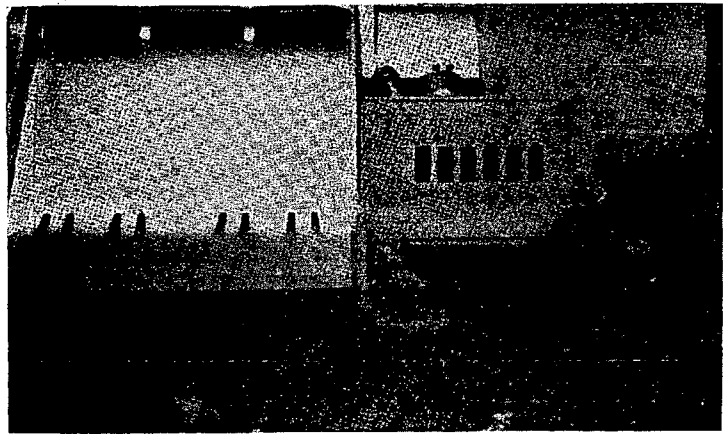
The United States Bureau of Reclamation, which conducted the tests[6] for the Authority, had previously conducted similar tests and was well equipped with both experienced personnel and proper equipment with which to conduct

[6] Smith, E. D., Tests on Plaster-celite Model of Abutment Section of Norris Dam, U. S. Bureau of Reclamation Technical Memorandum No. 433, January 31, 1935.

the Norris Dam tests. The work on the Norris model was a continuation of the testing methods applied to a model of Grand Coulee Dam[7] incorporating changes and improvements that the previous work indicated to be desirable; particularly, these changes included increased depth and the extent of foundation, provision for discontinuities in the foundation, and means for measuring stress concentration at the corners.



(A) Original design.



(B) Final design—Outlet conduits.

FIGURE 344.—*Results of architectural studies.*

The first work of importance on model studies of this type for gravity dams was that of Wilson and Gore.[8] The model arrangement used in the Norris tests

[7] Smith, E. D., Model Tests of Grand Coulee Dam, U. S. Bureau of Reclamation Technical Memorandum No. 372, March 1, 1934.

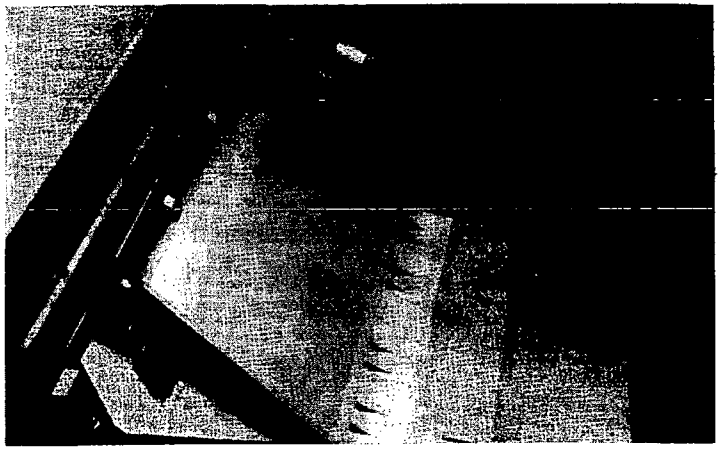
[8] Wilson, John S., and Gore, William; Stresses in Dams: An Investigation by Means of India Rubber Models, Minutes of the Proceedings of the British Institute of Civil Engineering, vol. 172, pp. 107–133, 1907–8.

is similar to that used by Wilson and Gore, except that in the case of Norris the model was much larger, a liquid live loading was used, and more sensitive apparatus was employed for the measurement of strains and deflections.

Model material.

A mixture of commercial building plaster and celite, a silica product commonly used as an admixture to concrete, was used for the construction of the model. The purpose of the celite was to dilute the plaster to produce a lower modulus of elasticity.[9]

The proportions of the material used in the model were 1 part celite, 2 parts plaster, and 3¾ parts water, all by weight. This mixture ordinarily sets in about half an hour when mixed without the addition of retarders or accelerators. Where setting is too fast, the speed can be retarded by the addition of a small amount of aqua-gel. A very desirable feature of this mixture is that it sets at practically constant volume. When freshly mixed, the resulting product has a consistency of pancake batter and will flow easily and completely



(C) Final design—Spillway bridge and piers.

FIGURE 344.—*Results of architectural studies.*

fill a form to any shape likely to be used. Some agitation is required to expel air bubbles that have become entrained in the mix. The material remains plastic even after setting until thoroughly dried. The drying period is usually about 10 days for a 3-inch thickness. When thoroughly dry, this mixture forms a homogeneous, isotropic, and highly elastic material. The average values of modulus of elasticity and Poisson's ratio determined from test specimens were 120,000 pounds per square inch and 0.2, respectively.

Similarity conditions.

When comparing the behavior of the model with the prototype, it is necessary that the following relationships be known:

1. Scale—$\frac{1}{n}$
2. Specific gravity—$\frac{1}{G}$
3. Ratio of moduli of elasticity of model and prototype—$\frac{E_m}{E_d}$

[9] Simmonds, A. W., Construction of Plaster and Celite Model of Hoover Dam, U. S. Bureau of Reclamation Technical Memorandum No. 306, October 1, 1932.

The model was loaded with mercury and the dead weight of the dam was produced by weight hung on the model to balance the liquid pressure in the same proportion that concrete would balance a water load.

With a model scale equal to $\frac{1}{n}$ and a specific gravity loading equal to G times that of water, the unit liquid pressure at the base of the dam will be $\frac{n}{G}$ times that of the model, and this ratio will be the same for the stresses. The model scale selected was $\frac{1}{60}$ and G equal to 13.6; therefore, the stresses of the dam would be $\frac{60}{13.6}=4.41$, or the stresses in the dam would be 4.41 times those of the model. If the modulus of elasticity of the concrete in the dam is equal to E_d, and the modulus of elasticity of the model is equal to E_m, the ratio between unit strain in the model and in the dam will be the ratio of the unit stress multiplied by the ratio of the two moduli of elasticity or $\frac{n}{G}\times\frac{E_m}{E_d}$. These strains are acting over lengths of the dam n times the corresponding length for the model. The total deformation of the dam given as the deflection at a certain point will therefore be n times the ratio for the unit strain compared to the total deformation of the model. The ratio between the deflection of the dam and the deflection of the model will be $\frac{n^2E_m}{GE_d}$. Assuming a modulus of elasticity for concrete equal to 3,000,000, this ratio will be $\frac{60\times60\times120{,}000}{13.6\times3{,}000{,}000}=10.59$, or the deflection of the dam will be 10.59 times the deflection of the model. This latter comparison can be made only between the model slab and a similar slab cut through the dam. If there is a difference in the modulus of elasticity of the concrete of the dam and the rock foundation, the deflections will be altered. Also, in the actual dam, the lateral restraint of the sections, due to the continuity of the structure, will reduce the deflection.

Stress-strain relations.

As stated before, the stresses in the model and prototype are connected by the relation of scale and specific gravity, but the strain relationship is not so simple. The model slab, having no lateral forces acting, is under condition of plane stress, while in the dam the lateral forces between sections prevent lateral strain so that a section through the dam will also be under plane strain. However, since the lateral stresses cannot affect the stress in the plane normal to them, the simple stress ratio between model and prototype is not affected. In reducing the strain measurements on the model to stresses, a stress-strain relationship was developed.[10]

NOTATION

ϵx, ϵy, Maximum and minimum principal strains, respectively.
ϵH, ϵD, ϵV, Measured strains about a point on gage lines making angles of 0°, 45°, and 90° with the horizontal.
σx, σy, Maximum and minimum principal stresses, respectively.
σH, σV, Horizontal and vertical stress components, respectively.
μ=Poisson's ratio.
θ=The angle between ϵx principal strain and the horizontal.

The three following equations give the magnitude and direction of the principal strains in terms of the measured strains:

1. $\epsilon x+\epsilon y=\epsilon H+\epsilon V$
2. $\epsilon x-\epsilon y=(\epsilon H-\epsilon V)\ \mathrm{Sec}\ 2\theta$
3. $\mathrm{Tan}\ 2\phi=\frac{2\epsilon D-\epsilon H-\epsilon V}{\epsilon H-\epsilon V}$

The principal stresses accompanying these principal strains are given by these equations:

$$\sigma x=\frac{E}{1-\mu^2}(\epsilon x+\mu\epsilon y);\ \sigma y=\frac{E}{1-\mu^2}(\epsilon y+\mu\epsilon x)$$

[10] Smith, E. D., Model Tests of Grand Coulee Dam, U. S. Bureau of Reclamation Technical Memorandum No. 372. March 1, 1934.

155813—40——47

From which it follows that the horizontal and vertical components will be:

$$\sigma V=\frac{E}{1-\mu^2}(\epsilon V+\mu\epsilon H);\quad \sigma H=\frac{E}{1-\mu^2}(\epsilon H+\mu\epsilon V)$$

Horizontal shearing stress is given by the following relation:

$$\tau=\tfrac{1}{2}(\sigma x-\sigma y)\sin 2\theta$$

where again θ is the angle of ϵx with the horizontal.

Design of model.

It is desirable to have a model of this type as large as space would permit since with a given specific gravity the intensity of strain increases in proportion to the linear dimensions, and because large strains can be measured with greater accuracy than small strains.

In this model the supporting frame was limited to an over-all height of 14 feet. The dam, as designed at the typical abutment section used in these tests, had a total height of 260 feet, so that with a scale of 1:60, the model height

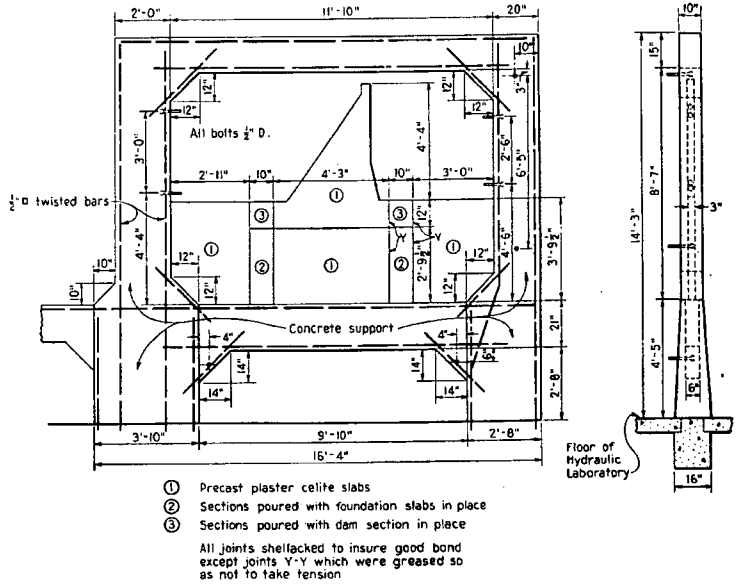


FIGURE 345.—*Model and supporting frame.*

was 52 inches. With a foundation depth of 48 inches, the total height of the model and foundation was 8 feet 4 inches. This left 7 feet 8 inches of the available space under the model for the supporting frame and loading mechanism.

The frame for this model was designed to be much heavier than the strength requirements demanded in order to insure that the frame would remain rigid.

Figure 345 shows the design of the reinforced concrete supporting frame and the model slab. Because of its large size it was necessary to cast the model slab in sections which could be assembled in the supporting frame.

The dead weights of the model were produced by the use of external loads to give an equivalent unit weight of 13.6×150, or 2,040 pounds per cubic foot. With a 3-inch thickness of model slab, this gives 3.54 pounds per square inch of model section. The dead load was distributed through the dam section by dividing the surface of the dam section into a large number of subdivisions, and through the centers of gravity of these subdivisions steel rods were placed from

which the load could be applied. The amount of load to be applied to each subdivision was equivalent to the volume of the subdivision multiplied by the unit weight. It was not possible to use a uniform size of subdivision because of the necessity of preventing the loading levers from overlapping.

In the upstream region of the dam, a large number of loading points occur very close together horizontally, so it was necessary to use three lever arm lengths in order that the different weights would not interfere with each other.

The live load system included means for applying hydrostatic pressure to both the upstream and downstream faces, corresponding to the reservoir pressure and tail water pressure, respectively. The apparatus for applying these pressures consisted of wooden frames which held rubber bags of the same width as the model slab against the faces of the dam and along the top of the foundation. The rubber bags were connected by high pressure hose to steel tanks which were filled with mercury. By hoisting the tanks to various heights, the mercury in the bags could be adjusted to any desired elevation.

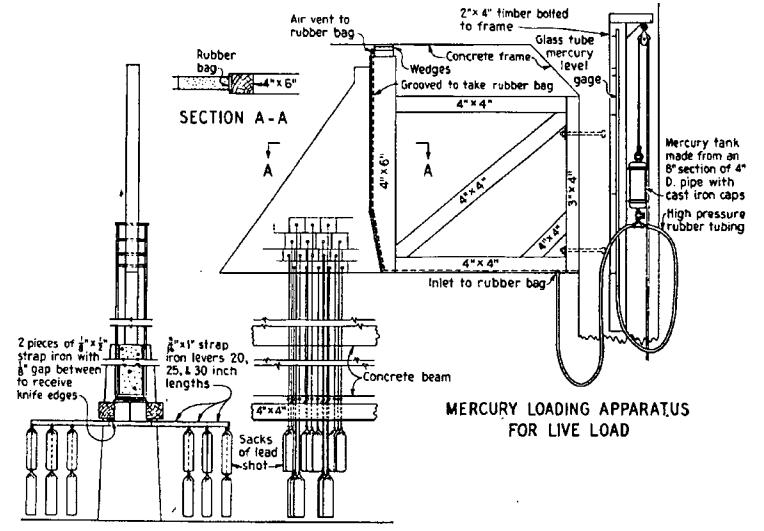


FIGURE 346.—*Arrangement for applying dead and live loads.*

Construction of model.

After the concrete supporting frame was constructed, the sections of the model and the foundation were assembled in the order shown on figure 345. The three lower sections, marked (1), were set on a layer of fresh quickset plaster to form a bond with the frame. The sections marked (2) were then poured in place to join the first sections together. The dam section, marked (1), was cast to approximate shape and placed on the middle section of the base on a freshly mixed layer of plaster celite of the same proportions as the model slab. This gave a bond between the slabs without having a discontinuity in the elastic properties. Finally the closing plugs, marked (3), were poured in place to complete the slab. The surface of the upstream joint between the dam section and closing plug (3) was formed by a sheet of greased paper so that horizontal tensile stresses could not be transmitted through the foundation.

When the model slab was completed, the correct profile of the dam was cut out with a saw. The entire slab was then given two coats of shellac and two coats of white paint to prevent the moisture content from changing and to protect the surface from abrasion.

The surface of the dam was marked off into subdivisions and the centers of the subdivisions were drilled to receive steel pins from which the dead load weights were suspended. Below each steel pin in the model was a similar pin under the concrete beam, and the ends of the two pins were connected by piano wire. The center of the lower pin was connected by a wire to a lever through which the loads were applied. In this manner the dead loads were symmetrically applied to the model slabs.

The live load apparatus was essembled in such a manner as to permit variations in tail water and headwater elevations.

Optical strain gages were used to measure the strain on the face of the dam section. Strain gage pins were located in sets of four on the circumference of 2-inch circles. They were arranged with sets of horizontal and vertical gage lines alternating with sets of 45° and 135° diagonals.

Boundary strains at the corners where the dam joined the foundation were measured with Huggenberger tensometers. The strain pins for these gages were made from lath nails forced into small drilled holes in the model.

For the measurement of deflection, "Last Word" dials and Ames dials reading to 0.0001 inch were used. These were supported on two invar steel rods, one attached to the model and the other attached to a reference member. The dials were held rigidly to one rod and measured the amount of displacement of the other. The vertical deflections were measured with reference to the concrete beam at the bottom of the model, while the horizontal deflections were measured with reference to a wooden frame supported by this beam. A dial was set at the top of this frame to bear against the bottom cord of a steel roof truss to check on the movements of the reference frame.

Testing procedure.

Tests were run on this model for deflections and strains due to dead load only and for dead load combined with full reservoir and tail water pressures. A complete testing cycle consisted of the following operations:

1. Setting and adjusting the dials and strain gages for the points being observed.
2. Making no-load observations.
3. Applying dead load.
4. Making dead load observations.
5. Applying live load to model.
6. Making combined load observations.
7. Releasing all loads.

For each arrangement of instruments, the above cycle was run a sufficient number of times to give good average values. To facilitate applying and releasing the dead load, three wooden beams were placed on each side of the concrete frames. The loading weights were tied to these beams as well as to the iron levers. When the ends of the wooden beams were lifted, the weights of the dead loads were transferred to the beams. When the wooden beams were lowered, the dead loads were transferred back to the levers.

Where horizontal deflections were measured between the model and the wooden frames, a small vertical deflection of the bottom concrete beam caused the horizontal movement of the top of the reference frame. The amount of this horizontal movement was registered on a dial bearing on the roof truss of the building. In order to eliminate this movement, a screw jack was placed under the concrete beam. When the live load was applied, the dial at the top of the reference frame was read. The jack was then raised until the concrete beam was pushed back to its original position. When this position was reached, the dial at the top of the reference frame indicated zero deflection. The horizontal deflections of the model could then be read and recorded without further correction.

Strain measurements.

The strain measurements on the face of the model section and foundation were made with a Tuckerman optical strain gage.[11] The smallest displacement that can be measured with this apparatus is $\frac{1}{2000000}$ of an inch per inch.

For the computation of the principal strain at a certain point, it is necessary that the strains on three different directions be known. If only one point were

[11] Tuckerman, Dr. L. B., American Standards for Testing Materials, Proceedings, vol. 23, 1923, p. 602.

being investigated, a rosette of six gage points on a circle about the point would be required. It was found that this number of rigid plugs set in a soft material caused a reduction in the deformation inside the rosette of gage points. Where strains were being measured at several points in a row, this difficulty was eliminated by setting the horizontal and vertical rosettes alternately with the

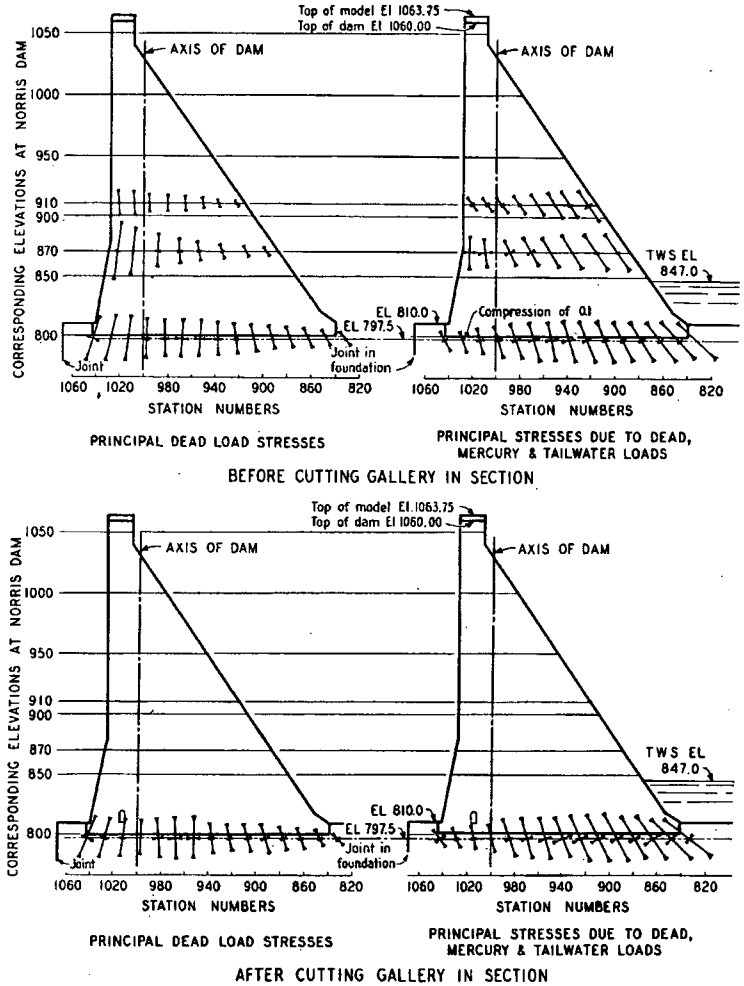


FIGURE 347.—*Principal stresses—Dead and live loads.*

45° and 135° diagonals. In this way only four strain gage pins were set in each rosette. In arranging the strains for computation, the gage readings were plotted as ordinates to a common horizontal scale. A smooth curve was drawn through the plotted point for each set of readings: the horizontals, verticals, and each of the diagonals. Any vertical line drawn through these curves will then give the four strain components for the points from which the vertical line was drawn. A check upon the accuracy of the observed readings comes from the relation that the sum of two strains at right angles to each other at a point is a constant quantity. Therefore, the sum of the horizontal and vertical components must be equal to the sum of the diagonal components. Although two different diagonal strains were observed, only the 45° diagonal was used in the computation of principal strains and stresses.

TABLE 157.—*Maximum vertical and horizontal stresses computed from strain measurements*

Elevation	Maximum vertical stress						Maximum horizontal stress					
	Dead load			Dead load+LL			Dead load			Dead load+LL		
	Station No.	Model	Dam	Station No.	Model	Dam	Station No.	Model	Dam	Station No.	Model	Dam
910	1,020.0	−21.6	−95.3	937.5	−18.8	−82.9	1,020.0	2.9	12.8	980.0	−7.5	−33.1
							922.5	−0.4	−1.8			
870	1,021.25	−47.8	−210.9	1,021.25	−27.3	−120.4	988.25	−3.6	−15.9	988.25	−11.7	−51.6
							1,021.25	1.0	4.4			
797	1,027.5	−37.4	−165.0	937.5	−33.4	−147.4	967.5	−7.8	−34.4	832.5	−24.2	−106.8
							1,042.5	4.5	19.9			
797 [1]	967.5	−33.7	−148.7	892.5	−38.4	−169.4	967.5	−10.6	−14.6	832.5	−35.6	−157.1
							1,042.5	3.3				

[1] Stresses after grouting gallery had been cut in model.

Stresses are in pounds per square inch.
— denotes compression.
LL denotes live load.

The maximum value of stresses computed from the strain measurements are given in tables 157 to 159, inclusive. A maximum prototype vertical compressive stress of 210.9 pounds per square inch occurred at elevation 870 at the upstream face and was due to dead load only. No tension in the vertical direction was found. A maximum horizontal compressive stress of 157.1 pounds per square inch occurred at elevation 797 at the downstream toe of the dam. This stress was measured after the grouting gallery had been cut in the section. Small horizontal tensile stresses in the model were found due to dead loads. The maximum was 19.9 pounds per square inch at elevation 797. It was measured before the grouting gallery was cut in the section. No horizontal tension was found due to the combined dead and live loads.

TABLE 158.—*Horizontal shearing stresses computed from strain measurements*

Elevation	Maximum horizontal shear					
	Dead load			Dead load+LL		
	Station No.	Model	Dam	Station No.	Model	Dam
910	922.5	2.0	8.8	922.5	16.5	72.8
870	1,021.25	6.4	28.2	897.5	18.8	82.9
797	1,042.5	14.7	64.9	832.5	21.4	94.4
797 [1]	1,042.5	16.7	73.7	832.5	22.9	101.0

[1] Stresses after grouting gallery had been cut in model.

LL denotes live load.
Stresses are in pounds per square inch.

The maximum horizontal shearing stress was at elevation 797 at the downstream toe and was due to the combined dead and live loads. Before cutting the gallery, this stress was 94.4 pounds per square inch, and after cutting the gallery the stress was increased to 101 pounds per square inch.

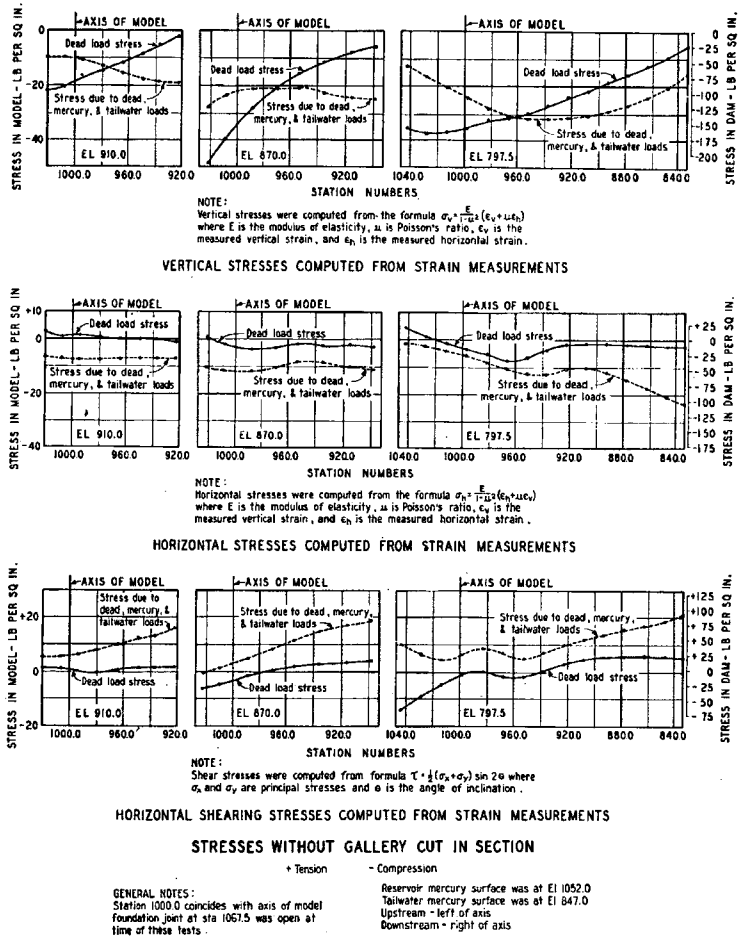


FIGURE 348.—*Vertical and horizontal stresses and horizontal shearing stresses.*

Maximum principal stresses are recorded in table 159. The largest of these occurred at elevation 797 after the gallery was cut and was due to dead load. The maximum compressive stress was 233.4 pounds per square inch and occurred at the downstream toe. The maximum tension occurred at the same elevation but nearer the center of the base and was 43.7 pounds per square inch.

A comparison of the stresses obtained analytically and experimentally is given in table 160. The variation in the two sets of stresses is due to the fact that the analytical stresses were based on the straight-line distribution of stress;

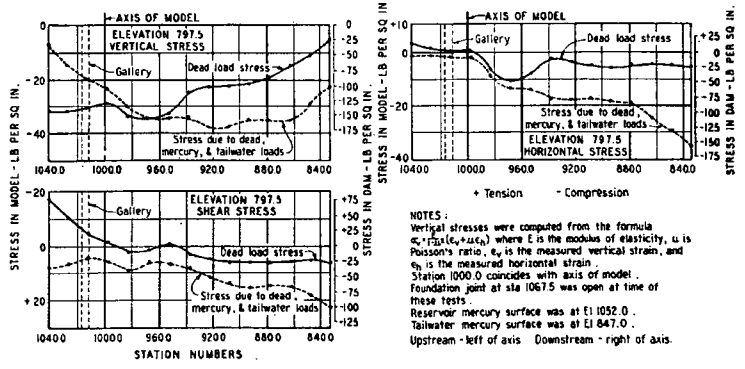
the experimental stresses were based on strain measurements of the model. The reservoir water surface elevation was 1,047 for the analytical stresses and 1,052 for the experimental. The highest stresses obtained analytically were those which occur parallel to the faces of the dam. These are compared with the larger principal stresses that occur nearest the point used in the computation.

TABLE 159.—*Maximum principal stresses computed from strain measurements*

Elevation	Maximum principal stress											
	Dead load			Dead load+LL			Dead load			Dead load+LL		
	Station No.	Model	Dam	Station No.	Model	Dam	Station No.	Model	Dam	Station No.	Model	Dam
910	1,020.0	3.0	13.2	922.5	4.6	20.3	1,020.0	−21.8	−96.2	922.0	−30.4	−134.1
				1,020.0	−2.4	−10.6						
870	988.25	−3.5	−15.4	1,021.25	−10.5	−46.3	1,021.25	−48.8	−215.3	897.5	−38.1	−168.1
	1,021.25	2.0	8.8	897.5	2.1	9.3						
797	1,042.5	9.4	41.5	952.5	−43.3	−191.0	1,042.5	−39.9	−176.0	832.5	−43.3	−191.0
	967.5	−7.8	−34.4	1,042.5	4.2	18.5						
797 [1]	1,042.5	10.0	44.1	832.5	−52.9	−233.4	1,042.5	−38.5	−169.9	892.5	−47.0	−207.4
	967.5	−9.9	−43.7	1,042.5	4.6	20.3						

[1] Stresses after grouting gallery had been cut in model.

Stresses are in pounds per square inch.
— denotes compression.
LL denotes live load.



VERTICAL, HORIZONTAL, AND SHEAR STRESSES COMPUTED FROM STRAIN MEASUREMENTS

STRESSES WITH GALLERY CUT IN SECTION

FIGURE 349.—*Vertical, horizontal, and shear stresses (with gallery cut in section).*

The results shown in table 160 show that the stresses obtained by assuming a straight-line variation of stress are larger than those that are based on a nonlinear variation of stress.

The figures for the observed stress in table 160, giving the comparison between observed and computed stresses, are taken from measurements made in the interior of the model. The stress diagrams were extended to the faces of the dam to obtain the stresses at these points. At the corners there were stress concentrations of which a special study was made. A Huggenberger tensometer was used to measure the strains occurring at these locations. These instruments were set on the model when the first loading was applied in order

to determine if any plastic flow occurred due to the concentration. It was found that at the downstream corner adjoining the foundation where the greater strain occurred the first load gave strains about 50 percent higher than the strains obtained after a considerable number of tests had been run. The stresses are shown in figure 350.

TABLE 160.—*Comparison of stresses obtained analytically and experimentally*

Elevation	Vertical stress		Stress parallel to face, analytical	Maximum principal stress, experimental
	Analytical	Experimental		
DEAD LOAD STRESS AT UPSTREAM FACE				
910		95		121
900	179		179	
870		211		215
850	211		219	
800	233		243	
797		165		176
DEAD LOAD STRESS AT DOWNSTREAM FACE				
910		10		15
900	1(T)		1.6(T)	
870		25		38
850	12		18	
800	33		49	
797		24		44
COMBINED WATER LOAD AND DEAD LOAD STRESSES AT UPSTREAM FACE				
910		43		62
900	80		80	
870		120		120
850	88		91	
800	99		103	
797		56		81
COMBINED WATER LOAD AND DEAD LOAD STRESSES AT DOWNSTREAM FACE				
910		83		134
900	98		146	
870		110		168
850	140		209	
800	183		273	
797		85		191

Stresses are in pounds per square inch.
Analytical stresses are taken from figure 321.
Experimental stresses are obtained from strain measurements on model.

At the downstream toe two corners were formed by a fillet. The stress at the upper corner, due to combined live and dead loads, was —66 pounds per square inch in the first tests and —56 pounds per square inch in the later tests. In the fillet itself, the stress was —31.9 pounds per square inch in the first tests and —64 pounds per square inch in the later tests. In the same order, at the lower corner, the stresses were —104 pounds per square inch and —84 pounds per square inch. This shows that as the number of loadings increased there was a redistribution of stress. The stress at the corners decreased due to plastic flow and was accompanied by an increase in the stress along the face of the fillet. The maximum stress at the corner where the dam joins the foundation, predicted from the model measurements, was 460 pounds per square inch against 233 pounds per square inch for the interior of the dam.

It appears from these tests that if a fillet is to be used at the toe of the dam, a smooth curve transition from the dam to the foundation would be more effective in reducing stress concentration than the wedge-shaped fillet.

The Huggenberger tensometer was also used to measure stresses around the grouting gallery. Due to the small size of the gallery compared to the gage lengths used, the results were not very conclusive. Later, however, separate large-scale experiments were made to determine gallery stresses.[12]

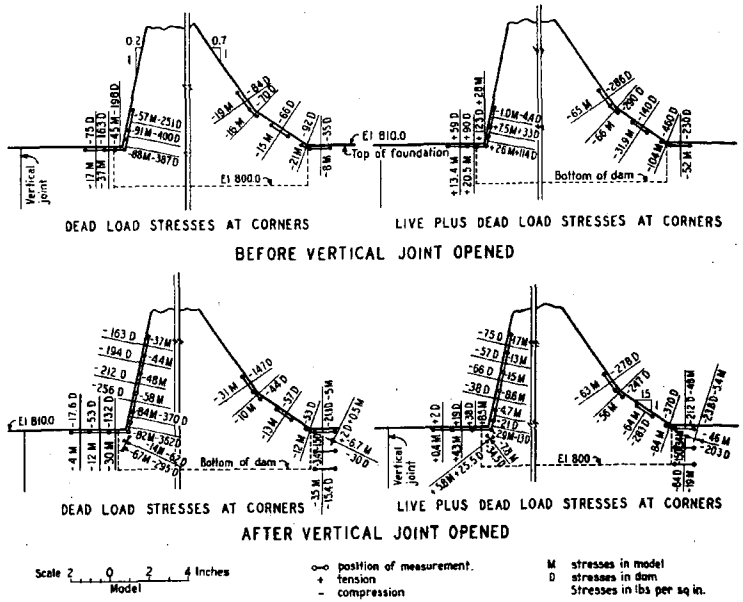


FIGURE 350.—*Dead and live load stresses at corners.*

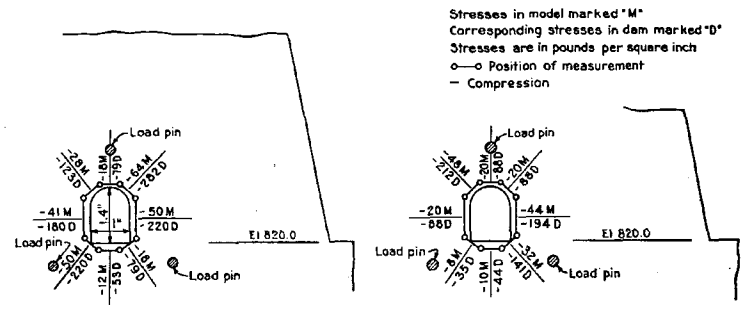


FIGURE 351.—*Observed stresses around gallery.*

Deflection measurements.

The deflection measurements were made to obtain an approximate picture of the deflection of the dam and the foundation due to the weight of the dam and to the weight of the dam plus the water load. Unlike the stresses, the

[12] Brahtz, J. H. A., Photoelastic Investigation of Stresses Around Galleries, U S. Bureau of Reclamation Technical Memorandum No. 439. April 1, 1935.

deflections of the model cannot be converted directly into deflections of the dam for reasons enumerated previously under similar conditions. They can only be used as a qualitative measure of the deflections likely to occur.

Horizontal and vertical components of deflections were measured for both upstream and downstream faces of the model and at the top of the foundation. Vertical displacements were measured in the lower part of the foundation. Figure 352 shows the results of the deflection measurements.

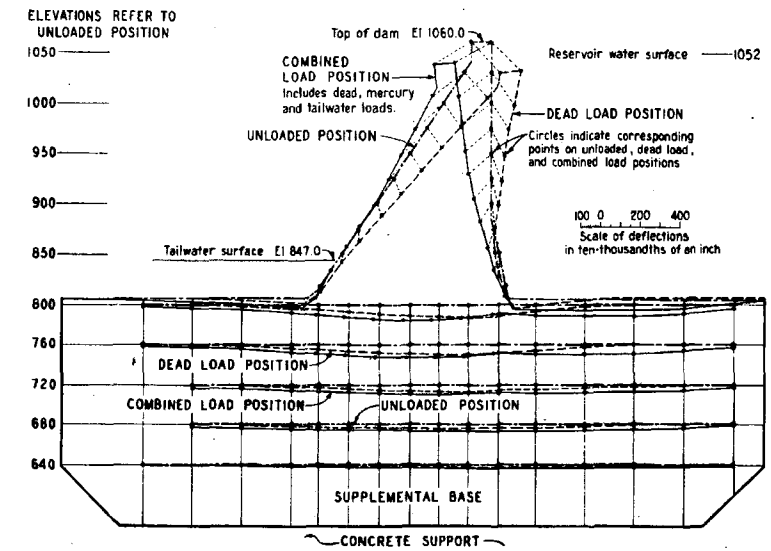


FIGURE 352.—*Deflection measurements.*

Discussion.

The theoretical accuracy of this type of model tests rests upon the application of the principle of Saint Venant. This principle states that if forces acting on a portion of an elastic body are replaced by another statically equivalent system of forces acting on the same portion of the surface, this redistribution of loading produces substantial changes in the stresses locally, but has negligible effect on the stresses at distances which are large in comparison with the linear dimensions of the surface on which the forces are changed. This principle applies directly to this type of model test. If a vertical slice is cut through a dam and its foundation, the stresses produced in the foundation by the dam will have a distribution to infinity in the foundation slab. If, then, at a finite distance from the dam, the original stresses are replaced by the reactions on a rigid supporting member, the stresses along this boundary will have undergone a change, but the statical equilibrium will remain unchanged. The more remote this supporting member is from the dam, the less will be the effect of the replacement of the original stresses by the reactions on the supporting member. In this study, the dimensions of the foundation were arbitrarily selected so that the least distance from the base of the dam to the foundation was 48 inches against a height of dam of 52 inches. Whether this distance was sufficient to eliminate the effect of the rigid support is not definitely known, but later mathematical investigations have shown that the error introduced in the region near the base of the dam was small.

There are several advantages of this type of tests over tests which require a complete model, of which the most important is the provision for obtaining dead load effects. It is possible also to make the following checks upon the results:

1. Check upon the observed strains: The sum of two diagonal strains must be equal to the sum of the horizontal and vertical strains at a given point.

2. Check upon the computed stress: The area under the stress diagram must be equal to the sum of the vertical forces.

3. Check upon the stress distribution: The center of gravity of the area under the vertical stress diagram must coincide with the center of gravity of the vertical forces.

The action of the dam section in these tests would be quite similar to a section of an actual dam where the vertical construction joints were not grouted. Where the joints are grouted so that the structure behaves as a monolith, the torsional resistance between adjacent sections produces torsional shearing strain and stresses which may affect the stresses as predicted from the model tests.

In all studies of this type, nonlinear stress distribution is observed in the lower portion of the dam, while in the upper portion the stresses approach a linear distribution quite closely. This is in agreement with the latest mathematical analysis of cantilever sections as well as with photoelastic studies.

Mathematical studies of nonlinear stress distribution and stresses at corners are based on the assumption of perfectly elastic materials; whereas, actual materials are elastic only within a certain range of stress and are subject to some plastic deformation during strain. This fact may explain why the theoretically high concentrations of stress at the corners are not observed in the model tests. When high concentrations occur, the plastic deformation will allow a redistribution of stress to occur in the model as it probably does in the actual structure. Mathematical analyses do not give the stresses where plastic flow causes a redistribution of stress.

Tractor gate model studies and tests

Model studies were made by the United States Bureau of Reclamation to determine mechanical and hydraulic characteristics of large control gates.[13] These studies were made in regard to gate design to determine hoist requirements and pressures exerted on gates due to hydrodynamic conditions. Among the various types studied was a tractor gate to be used in the Norris Dam power penstocks. After the dam had been completed, tests[14] were conducted on the prototype gate for use in checking the downpull when the gate was being operated under normal and emergency plant conditions. This section of the appendix will summarize the model studies as well as a discussion of the results of the tests made on the prototype.

Forces considered in design.

The general design of a gate hoist provides for sufficient capacity to close or open the gate under full operating head. Usually the required force to operate a gate is computed from the sum of the frictional resistances of the gate plus the weight of the moving parts for lifting the gate, and minus that weight for lowering the gate. The weight of the moving parts in water is equal to the dead weight minus the effect of buoyancy or uplift of the water. Frictional resistance varies for the different type gates. For sliding gates this force is equal to from 0.3 to 0.75 depending on the material in the leaf and seat and the water load on the leaf. In the case of fixed wheel gates the frictional resistance is equal to the axle friction plus the rolling friction of the wheel, plus a resistance due to the seal. If roller trains are used in place of wheels, the axle friction is eliminated but a link friction must be added.

There are also hydraulic forces present which may increase the load on the hoist to a point where the above design, even with the customary factor of safety, is no longer safe. This force is caused by the unbalanced water pressures on the gate leaf when it is in a throttling position. The water passing below a flat-bottom leaf exerts no pressure and may even create a partial vacuum on the under side of the leaf. As there is a pressure above the leaf—water pressure if the leaf is submerged or atmospheric pressure if it has a free-water surface—the downward force is equal to the difference of the pressures above and below the gate multiplied by the area of the bottom of the leaf. By changing the shape of the bottom of the gate or of the approach, a pressure may be built up on the bottom of the leaf which will partially or completely eliminate the unbalanced condition.

[13] Noonun, N., and Hornsby, G. J., Model Studies of the Mechanics and Hydraulics of Large Control Gates, U. S. Bureau of Reclamation, June 17, 1937.

[14] Noonun, N., Field Tests on Downpull on Norris Tractor Gate and a Comparison of Calculated Loads, U. S. Bureau of Reclamation, March 9, 1938.

Description of tractor gate.

The tractor gate developed to meet set requirements for an emergency gate for the Norris power units closes an opening 16.5 by 28.5 feet in size under a maximum head to the center line of the gate of 176 feet. It was desired that the gate and hoist be of such design that the gate, when not in use, could be raised above the water surface for storage and maintenance. This practically eliminated the use of a stem hoist. As a rope hoist cannot exert a downward thrust, the gate must be completely lowered by its weight alone. To do this the friction must be reduced to a minimum. This was accomplished by means of roller trains, the frictional resistance of the rollers being only about 0.01 of that caused by sliding surfaces. Due to the fact that the gate must be lowered by its weight in water, it was necessary to place the skin plate

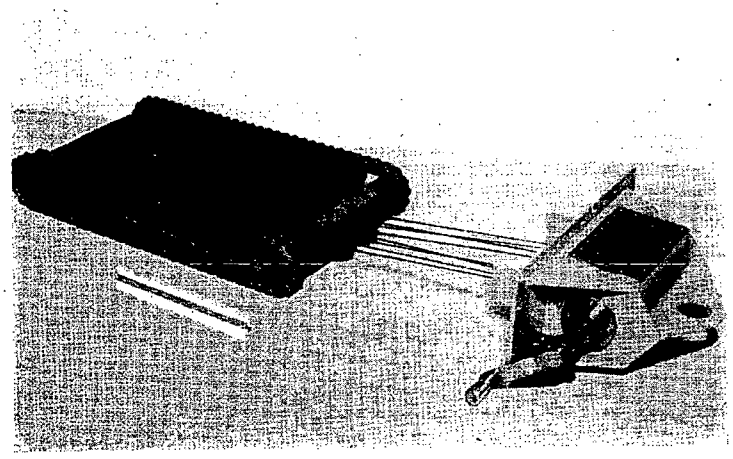


FIGURE 353.—*Tractor gate model.*

on the downstream face, allowing the water to fill completely the leaf section.

The next problem to be considered was the sealing of the gate under the 176-foot head. The common flexible metal or rubber seal could not be used because of the high head and because of the drag offered by such a seal during the raising or lowering of the gate. Sealing by a metal-to-metal contact similar to the simple slide gates was deemed a desirable feature, and a movable wedge mounted on rollers was incorporated in the roller train, the wedge to be actuated by a toggle mechanism of such a design as to insure proper sequence of all movements in relation to the gate.

Starting from the above water surface position, the sequence of the movements of the gate is as follows:

1. The leaf is lowered on the roller trains until it is directly in front of the frame opening.

2. At this point the leaf rests on stops and the toggle allows the movable wedge to be lowered.

3. In the meantime, the leaf moves in the downstream direction, transferring the water load from the roller to the gate seat.

Sealing is accomplished by metal-to-metal contact in exactly the same manner as in the simple slide gate. To open this gate the movable wedge is raised first, this move being made positive by the design of the toggle mechanism. As the wedge is raised, the gate moves upstream away from the seat, this time transferring the water load from the seat to the roller trains. The leaf is then raised on purely rolling surfaces. In short, the gate is raised or lowered as a roller gate and sealed as a slide gate.

Model studies.

Description of model.—In order to check the mechanics of the gate under working conditions, a model was constructed to a scale of 1:28. The prototype gate was to operate on the face of the dam under 176 feet of water. Since an exact duplicate set-up for mechanical or hydraulic tests, even at the 1:28 scale, would have required a large tank and overflow and would have made it almost impossible to observe the action of the leaf, a housing fitted with windows was used.

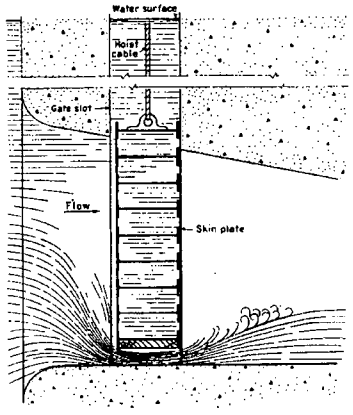


FIGURE 354.—*Submerged gate.*

Flat-bottom gate.—After testing and checking the mechanics of the leaf, a number of tests were made on the hydraulics of the gate. In order to determine the pressures and forces acting on the gate, a series of piezometers was attached to the leaf and a spring scale was attached to the stem, the rope hoist having been replaced by a stem for the tests.

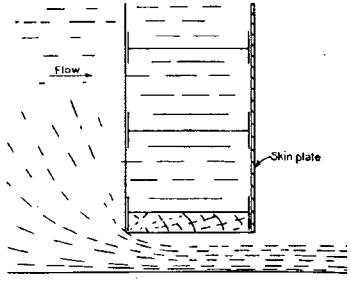


FIGURE 355.—*Flat-bottom gate.*

The gate shown in figure 354 has been raised to such a point that the distance from the bottom of the gate to the seat is slightly less than one-third the thickness of the gate. At such a position, the section under the gate is similar in effect to a short tube. If the head on the gate is relatively low, less than 40 feet, the stream leaving the back edge of the gate is agitated and divergent and its force is quickly dissipated. As there is practically no flow along the upstream face of the gate, the water pressure above and below each cross beam, except the bottom one, is very nearly balanced and is equal to the static pressure head on the respective beams. The pressure above the bottom beam is very nearly the static water pressure at that point, while the pressure below this beam is less than atmospheric (short tube effect). This pressure difference applies a downward force on the leaf of slightly more than the operating water pressure on the bottom beam multiplied by the area of the bottom of the gate.

Considering the same gate but operating under a higher head, the stream will take more the shape of a jet being discharged from a sharp-edged orifice, the short tube effect breaking down as the velocity increases. The stream, being no longer broomy, will continue in a fairly solid, clear jet for some distance after leaving the upstream edge of the leaf. (See fig. 355.) As the discharge pipe fills with water, submerging the jet, there is a change in the shape of the jet and also in the coefficient of discharge. At partial gate openings, with the discharge pipe flowing full, there is a partial vacuum formed back of the leaf. This may be reduced by installing an air vent in the discharge line near the leaf. The pressure below the leaf at free discharge is atmospheric, but it is less than atmospheric if the jet is just submerged or if there is a partial vacuum in the discharge pipe. With the pressure below the bottom beam at atmospheric or less, as before, the top of the beam is practically under full headwater pressure. The downpull in this case is also equal to slightly more than the operating water pressure on the bottom beam multiplied by the area of the bottom of the gate. The maximum downpull on a flat-bottom gate occurs at a gate opening equal to about one-third of the thickness of the leaf.

Sloping-bottom gate.—Downpull can be greatly reduced by changing the shape of the bottom of the gate as shown in figure 356. If this leaf is raised the same amount as in the two previously mentioned gates, the distance X becomes the depth of the controlling discharge area. The remainder of the gate leaf is at various distances from the seat, and therefore a given amount of water will have a changing velocity as it passes under the leaf. At point B, ignoring losses and contractions, the velocity is half that at A. As the velocity varies as the square root of the head, only one-quarter of the static head at B has been converted into velocity head. Therefore, the uplift or pressure at B is equal to three-quarters of the head on the gate. As the leaf is raised, the ratio of openings at B and A changes from an infinite value at complete closure to 2 to 1, as shown, and to nearly 1 to 1 as the gate is completely opened. At a nearly 1 to 1 ratio, the sloping bottom leaf is a little better than the flat-bottom leaf, but as a rule the gross area of the gate opening is large compared to the opening of the far end of the discharge pipe; therefore, the pipe will flow full and form a back pressure before the leaf is completely raised. In this way the back pressure comes into play about the time the major effect of the sloping bottom is lost.

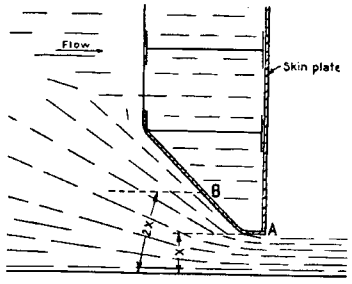


FIGURE 356.—*Sloping-bottom gate.*

The pressure on the bottom of the leaf may be further increased by changing the shape of the bottom of the frame and approach, as shown in figure 357. In all cases it will be noted that the large back area of the controlling surface has been increased. The downpull, due to unbalanced pressures at any gate opening, may be approximated on the basis of varying velocity heads below the gate leaf.

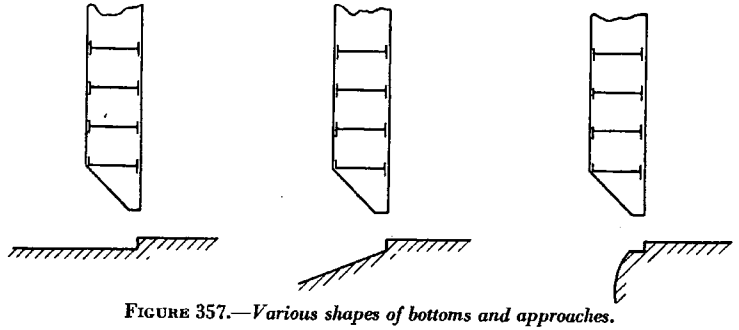


FIGURE 357.—*Various shapes of bottoms and approaches.*

All the above conditions are based on a submerged leaf having the skin plate on the downstream side. If the gate is submerged, but with the skin plate on the upstream side, the unbalanced pressure will be between the top and bottom of the gate. If the gate has a free water surface and has the skin plate on the downstream side, the above conditions for the bottom beam will still hold; but if the skin plate is on the upstream side, only atmospheric pressure acts on the top of the gate, and then the bottom beam should either be vented or shaped so as to prevent a less than atmospheric pressure under the bottom beam.

Test results.—Table 161 contains test data on various-shaped bottom beams: I-beam, T-shaped, and 45° slope types. It will be noticed that the pressure above the bottom beam drops sharply in the model test; actually this pressure on the face of the dam should drop by about the amount the gate is raised.

In this study the pump was so small that at one-half gate opening the line pressure had dropped nearly 80 percent. Such a test, to get prototype scale, would require a large constant head tank. Figure 358 shows graphically the test results on the three bottom-beam types mentioned and indicates pressure above and below the beams.

TABLE 161.—*Tractor gate model study*

Movement of gate in inches	Type bottom beam								
	Pressure above bottom beam (pounds per square inch)			Average pressure bottom side of bottom beam [1] (pounds per square inch)			Difference of pressures (pounds per square inch)		
	I	T [2]	45° [3]	I	T [2]	45° [3]	I	T	45° [3]
0	5.90	6.10	6.30	5.90	6.10	6.30	0.00	0.00	0.00
Wedge raised	5.70	5.90	6.00	5.50	5.80	6.00	.20	.10	.00
¼	5.20	5.50	5.40	4.70	5.10	5.25	.50	.40	.15
1	4.40	4.80	4.15	3.30	3.80	3.50	1.10	.90	.65
1½	3.40	3.70	3.00	1.40	2.10	2.20	2.00	1.60	.80
2	2.65	2.90	2.20	.25	.70	1.30	2.40	2.20	.90
2½	2.10	2.40	1.90	−.20	.00	1.00	2.30	2.40	.90
3	1.80	2.00	1.65	−.35	−.10	.85	2.15	2.10	.80
4	1.50	1.70	1.35	.00	.40	.80	1.50	1.30	.55
5	1.35	1.50	1.25	.25	.70	.85	1.10	.80	.40
6	1.30	1.40	1.20	.50	.80	.90	.80	.60	.30
7	1.20	1.35	1.15	.65	.95	.95	.55	.40	.20
8	1.15	1.30	1.10	.80	1.05	.95	.35	.25	.15
10	1.10	1.25	------	1.00	1.20	------	1.00	.05	------

[1] In case of 45° slope on bottom beam, the pressure on the bottom side of bottom beam is the average vertical pressure.
[2] In the above runs the gate was raised ¼ inch before the bottom of the leaf was even with the top of the bottom frame seat.
[3] Pressures on the bottom are the results of three piezometers, giving a fair average pressure. The gate was raised ¼ inch before the bottom of the leaf was even with the top of the bottom frame seat.

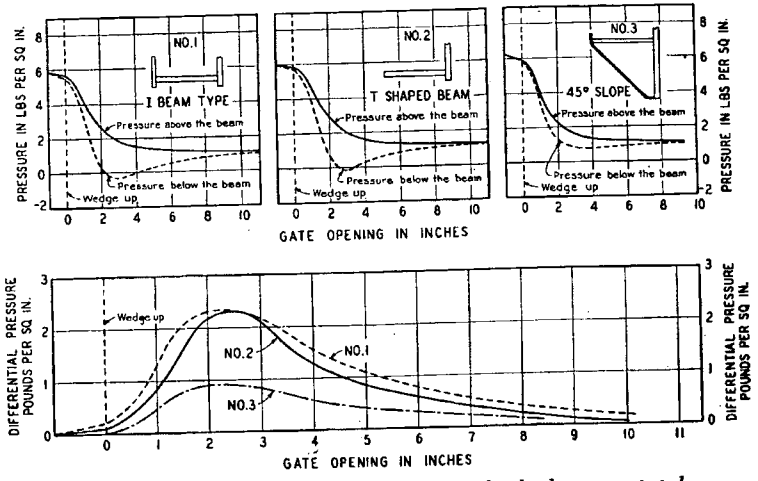


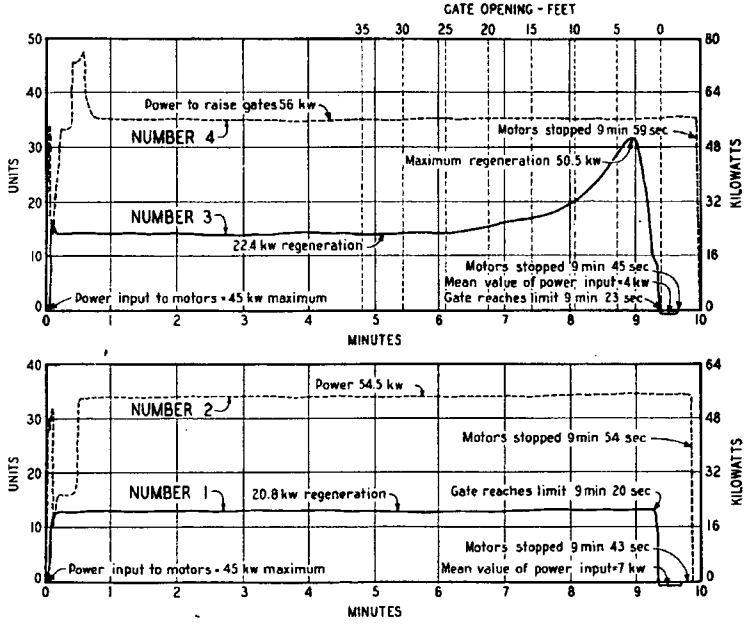
FIGURE 358.—*Pressures above and below beams for the three types tested.*

Figure 358 also offers a comparison of the three types showing differential pressure between the bottom and top of the bottom beam plotted against gate openings.

Tests on tractor gate.

In order to make a comparison of the actual downpull with calculated loads for similar conditions, tests were run on the Norris tractor gate. Four test runs were conducted in the following sequence:

1. Gate lowered under static conditions.
2. Gate raised under static conditions.
3. Gate lowered under full head and full discharge of turbine.
4. Gate raised under static conditions.



NO. 1 Power developed by the lowering of gate with the generator shut down.
NO. 2 Power used in raising gate after closure with 55.3 MW load on generator and with wicket gates blocked open.
NO. 3 Power developed by the lowering of gate with 55.3 MW load on generator and with wicket gates blocked open.
NO. 4 Power used in raising gate after it was closed under static head.

FIGURE 359.—*Recording wattmeter record—Power to lower and open gate.*

During each run a record was kept of the movement of the bottom of the gate with respect to time, and a recording wattmeter record was made of the power developed in the cases where the gate was lowered, or the power used in cases where the gate was raised. Figure 359 shows the wattmeter records for the four runs, while figure 360 is a graphical representation showing closing speed for various gate elevations. Power developed by the run represented by figure 360 is shown by curve No. 3 of figure 359.

Calculations from test data.—Maximum downpull was computed from the test data as follows:

Weight of moving parts in air (estimated), 240,000 pounds.
Weight of moving parts in water 6.8/7.8 x 240,000=209,000 pounds.
Use 210,000-pound weight in water.
From curves Nos. 1 and 2, figure 359.
Thirteen units represent power developed lowering the gate under balanced conditions.

Thirty-five units represent power used in raising the gate under balanced conditions.
Therefore:

210,000—friction=13 units.
210,000+friction=35 units.
2 friction=22 units.
Friction=11 units.
35—11=24 units=210,000 pounds.
1 unit=8,750 pounds.
11 units=96,250 pounds=friction.

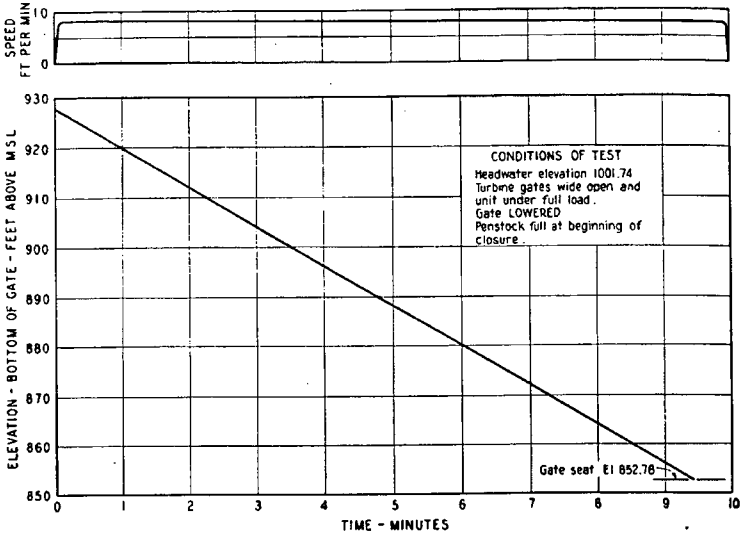


FIGURE 360.—*Closing speed.*

For all calculations the friction is assumed to be proportional to the load. In this computation the friction is $^{11}/_{24}$ or 0.458 of the load.

From curve No. 3, figure 359

Fourteen units equal load on hoist before gate reached the opening. Therefore, the increased load on the cable or downpull in any position is equal to: (reading in units at that position—14)×1.458×8,750. Maximum downpull equals (32—14)×1.458×8,750=230,000 pounds.

Gate openings are marked on curve No. 3, figure 359. It will be noted that the curve crosses the 14-unit line at 1-foot opening or 1 foot from the gate limit. On the downpull gate opening curve this position is considered zero gate opening. This 1 foot should indicate the distance from the sill to the stop. Actually the sill is only 8 inches above the stop. This difference and possibly a slight difference in the position of the maximum downpull is probably due to the stretch in the cable.

Calculation of theoretical downpull.

To afford a comparison with the test results just outlined, the theoretical downpull on a Norris tractor gate was calculated under these conditions:

Headwater elevation, 1,001.74 feet.
Gate stop elevation, 852.78 feet.
Sill elevation, 853.45 feet.
Tail water elevation, 833.00 feet.

1,001.74—833.00=168.74 feet=head on turbine.
Load on turbine=55,300 kilowatts.
Assume 85 percent efficiency,

$$Q=\frac{55{,}300\times 746}{62.5\times 168.74\times 0.85}=4{,}600 \text{ c. f. s.}$$

Area of wicket gate based on coefficient of discharge of 1.0,

$$A=\frac{Q}{\sqrt{2gh}}=\frac{4{,}600}{8.02\sqrt{168.74}}=44.2 \text{ sq. ft.}$$

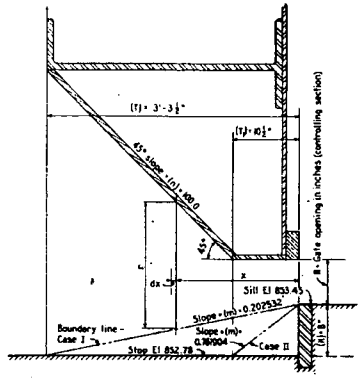


FIGURE 361.—*Dimension of bottom of gate.*

This gate area, and a coefficient of discharge of 0.90 through the tractor gate opening, were used in calculating the pressure drop through the gate.

Downpull is defined as the difference in hoist load between operating the gate under balanced conditions and under emergency or free discharge conditions. This difference is caused by a reduction of water pressure acting upward on the bottom of the gate leaf.

Figure 361 shows the dimensions of the bottom of the gates. Assuming the bottom I-beam of the gate is perforated, then the full static head will be exerted at (1). Let (2) be any section below the gate leaf.

Then writing Bernoulli's theorem from position (1) to (2),

$$H_{(1)}=h_{(2)}+\frac{V_{(2)}^2}{2g}+F_{(2)}.$$

Where: $H_{(1)}$=unit pressure acting downward, in feet of water.
$h_{(2)}$=unit pressure acting upward, in feet of water.
$V_{(2)}$=velocity of water flowing under gate, in feet per second.
$F_{(2)}$=friction losses, in feet of water.

Friction losses are being ignored in this computation.

Therefore: $$H_{(1)}-h_{(2)}=\frac{V_{(2)}^2}{2g}$$

or the difference in unit pressures is equal to the velocity head of the water passing below the gate. Then the summation of the velocity head below the gate leaf is equal to the downpull on the gate.

Also, the velocity of the water flowing under the gate is given by:

$$V=\frac{Q}{CA}$$

Considering a unit width of opening of depth, r,

$$V=\frac{Q}{Cr}$$

also $$V=\sqrt{2gh} \text{ or } h=\frac{V^2}{2g}$$

substituting $$h=\frac{Q^2}{2gC^2r^2}=\frac{\text{constant}}{r^2}$$

or the head is inversely proportional to the square of the depth of the opening. Since the depth of the opening varies under the gate leaf, the velocity head will vary inversely as r^2.

In order to calculate the downpull which is equal to the summation of the velocity head of the water flowing under the gate, the effective thickness of the gate having a zero upward pressure is computed.

Let T_e=effective thickness of gate.
T=thickness of gate=39½ inches.
R=depth of gate opening at the controlling section.

Then $$T_e=\frac{R^3T}{\Sigma r^3}$$

The downpull is then equal to the effective thicknes (T_e) multiplied by the width of the gate opening in inches and the pressure drop through the gate in pounds.

It will be noted that in raising such a gate the effective width of the gate approaches the actual width of the gate, and in the case of a free discharge the downpull will approach that for a flat-bottom gate.

Calculations, case I, based on boundary line (I)

Let m=slope of boundary line.
n=slope of gate bottom.
x=distance from controlling section.

Then

$$T_e=\int_0^{T_1}\frac{R^3dx}{(R+mx)^3}+\int_{T_1}^{T}\frac{R^3dx}{[R-T_1+(m+n)x]^3}$$

$$=\frac{-R^3}{m(R+mT_1)}+\frac{R^3}{mR}-\frac{R^3}{(m+n)R-T_1+(m+n)T}+\frac{R^3}{(m+n)(R+mT_1)}$$

Substituting values for m, n, T, and T_1 and combining terms,

$$T_e=R^3\left[\frac{-4.105912}{R+2.126582}+\frac{4.937491}{R}-\frac{0.831579}{R+37.000}\right]$$

Example: Let R=24 inches.
T_e=576 (−0.157155+0.205729−0.013632).
T_e=20.13 inches or effective width of gate.
Downpull=$P\times0.433\times T_e\times W$
=127×0.433×20.13×198
=219,180 lb.

Where P = pressure drop hrough gate in feet of water.
W = width of gate opening in inches.

The effect of regain of velocity head in the penstock was neglected.

Calculations, case II, based on boundary line (II)

$$T_e=\int_0^{T_1}\frac{R^3dx}{(A+mx)^3}+\int_{T_1}^{T}\frac{R^3dx}{[R+K+(x-T_1)n]^3}$$

$$=\frac{-R^3}{m(R+mT_1)}+\frac{R^3}{mR}-\frac{R^3}{n(R+K-nT_1+nT)}+\frac{R^3}{n(R+K)}$$

Substituting and combining:

$$T_e=R^3\left[\frac{-0.312502}{R+8.000}+\frac{1.312502}{R}-\frac{1}{R+37.000}\right]$$

Example:

Let R =24 inches.
T_e =576(−0.009766+0.054688−0.016393).
T_e =576×0.028529.
=16.43 inches.

Downpull=P×0.433×T_e×W
=127×0.433×16.43×198
=178,893 pounds

Discussion of results.

The test results as well as the calculated values for cases I and II are plotted on the curves of figure 362. It will be noted from the downpull gate opening curves that the downpull as shown by the test curve reaches a higher maximum than either of the calculated curves, and that there is a separation of the curves from the maximum position until a gate opening of about 13 feet is reached. Reasons for the difference may be:

1. Neither of the boundary lines used is correct but is merely an approximation. The boundary lines will not remain constant for all gate openings.
2. The coefficient of discharge was assumed to be 0.90 and constant for all gate openings. The coefficient is probably a variable, especially before and after the penstock has filled.
3. Regain of velocity head was neglected; this is probably the greatest source of error.

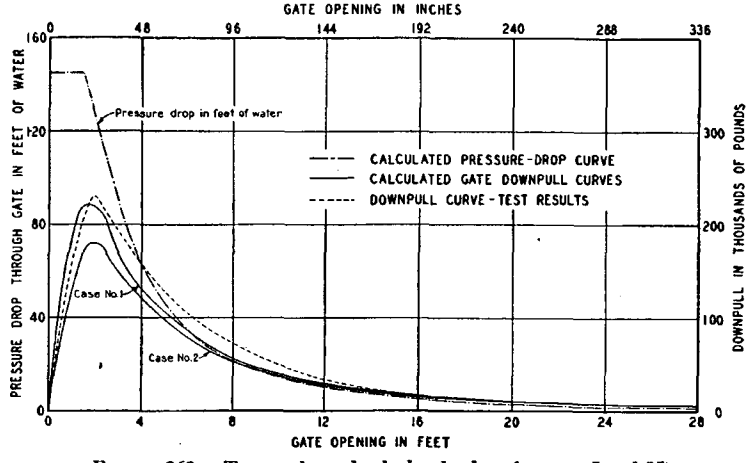


FIGURE 362.—*Test results and calculated values for cases I and II.*

4. All calculations are based on a stabilized flow for each position, but under actual conditions the effect of the gate being continually lowered will make some difference in downpull.
5. Stretch in the cables may shift the position of gate openings slightly.
6. Roller friction has been neglected.

In spite of the above listed possible sources of error, it is believed that downpull can be calculated in this manner consistently within 15 percent of the actual value.

Curve No. 4 of figure 359 (raising gate balanced condition) apparently shows that the penstock was not completely full. Note the character of the curve until a balanced condition was reached.

NORRIS DAM

July 1998

RESERVOIR OPERATION OVERVIEW

Norris is a multipurpose tributary storage project located on the Clinch River. It is the only large TVA storage project on the Clinch River. Like similar projects on other major Tennessee River tributaries, Norris is operated for many purposes including flood control, augmentation of flows for navigation, hydropower production, water supply, recreation, and aquatic ecology. Norris has an annual pool level variation of about 42 feet during normal years. This fluctuation is necessary to provide for flood storage and for economical augmentation of flows during the drier seasons of the year.

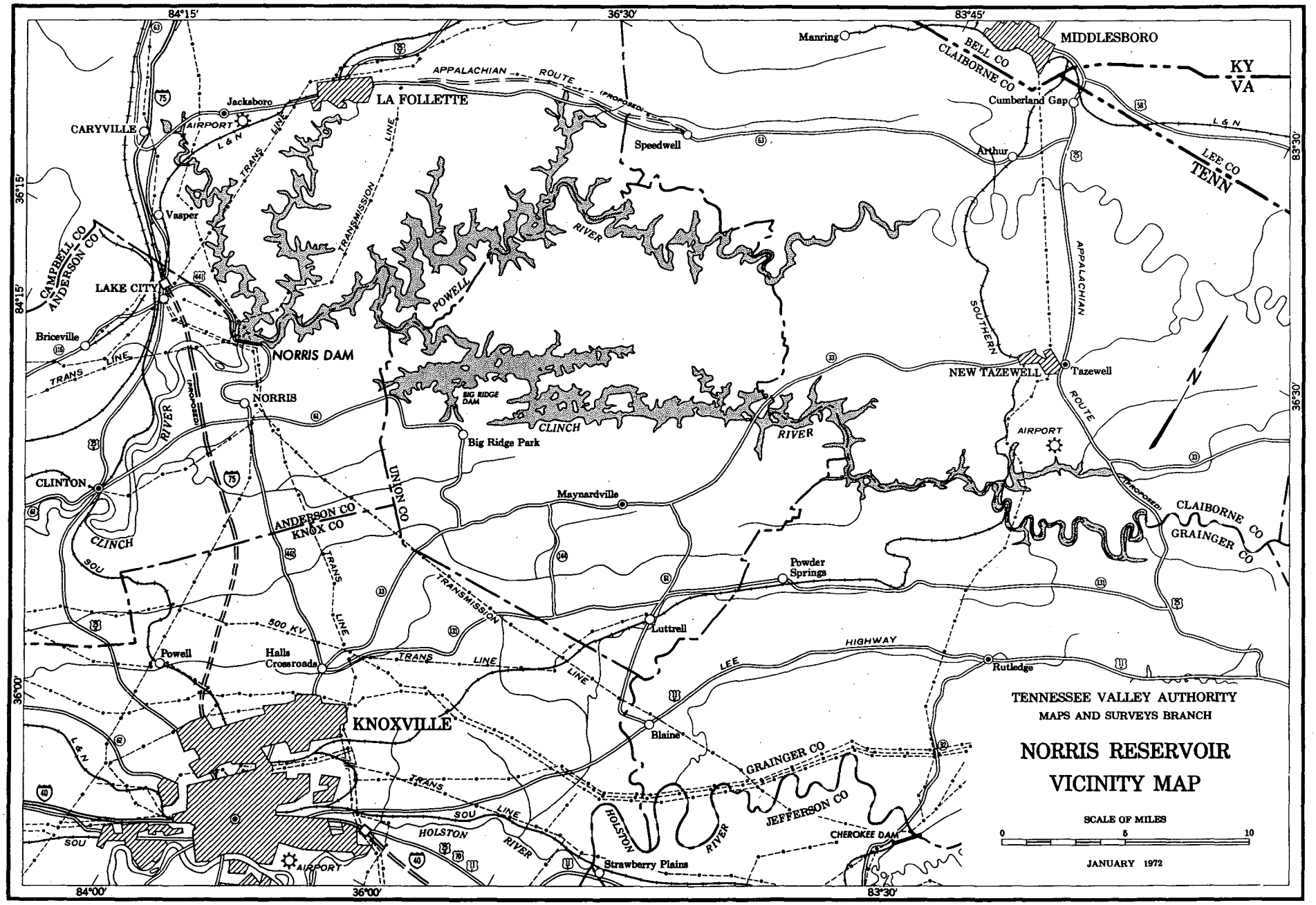
Norris was the first project built by TVA. In addition to the operational purposes listed above, the deep reservoir at Norris provides a source of cold water to help maintain a prime trout fishery in the tailwaters, and to provide cooling water for efficient operations of TVA's Bull Run Steam Plant 32 miles downstream.

TABLE OF CONTENTS

Norris Reservoir Vicinity Map 5
Figure 1: View of Spillway Drum Gates (Photo) 6
Figure 2: Generator Room (Photo) 6
Figure 3: Scroll Case Interior (Photo) 6
Figure 4: General Plan; Earthfill; Spillway & Slide Gates 7
Figure 5: Power Plant; Intake & Abutment 8
Figure 6: Upstream & Downstream Elevations. 9
Figure 7: Norris Dam Powerhouse (Photo) 10
Figure 7A: Norris Dam Switch Yard (Photo) 10
Location 11
Chronology 11
Project Cost 11
Streamflow 12
Reservoir 12-13
Tailwater 13
Head (Gross) 13
Reservoir Adjustments 13
Dam 14
Power Facilities
Intakes 15
Penstocks 15
Powerhouse 15
Generator & Turbine Modernization 15
Hydraulic Turbines 16
Generators 16
Figure 8: Single Line Diagram of Main Connections 17
Electric Controls 18
Transmission Plant 18
Transmission Plant Data 19
Reservoir and Power Data 20-22
Unit 1 Operating Characteristics 23
Unit 2 Operating Characteristics 24
Spill Compilations 25-27
Maximum & Minimum Elevations 28-29
Average Weekly CFS 30-31
Annual Operating Cycle 32
Reservoir Areas and Volumes 33
Hydro Modernization and Reservoir Release Improvements
Auto-Venting Turbine Modernization 34-36
Figure 9: Unit 2 auto-venting turbine runner 35
Figure 10: Dissolved oxygen improvement 35
Re-regulation Weir 36
Figure 11: Re-regulation Weir Downstream of Norris Dam (Photo) 37
Figure 12: East Channel Weir Anchor Rod Location Plan 38
Figure 13: West Channel Weir Anchor Rod Location Plan 39
Figure 14: East Channel Weir & Abutment Outline Partial Plan 40
Figure 15: West Channel Weir & Abutment Outline Partial Plan 41
Figure 16: Weir Timber Cribs & Piping Partial Plan 42

TABLE OF CONTENTS (CONT.)

Figure 17: Typical Weir Section 43
Housing Facilities 44
Original Construction Data
Personnel 44
Quantities 44
Figure 18: Construction Plant Layout 45-46
Construction Schedule 47-49
City of Norris Map 50


TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH
NORRIS RESERVOIR
VICINITY MAP
SCALE OF MILES
0
5
10
JANUARY 1972
84°15'
36°30'
83°45'
36°15'
84°15'
83°30'
36°30'
36°00'
84°00'
36°00'
83°30'
MIDDLESBORO
Manring
BELL CO
CLAIBORNE CO
KY
VA
Cumberland Gap
LEE CO
TENN
Arthur
Speedwell
APPALACHIAN ROUTE (PROPOSED)
LA FOLLETTE
Jacksboro
AIRPORT
CARYVILLE
L & N
TRANS LINE
TRANSMISSION LINE
Vasper
CAMPBELL CO
ANDERSON CO
LAKE CITY
Briceville
NORRIS DAM
NORRIS
POWELL
RIVER
BIG RIDGE DAM
CLINCH
RIVER
Big Ridge Park
NEW TAZEWELL
Tazewell
SOUTHERN
APPALACHIAN
ROUTE
AIRPORT
N
CLINTON
CLINCH
RIVER
UNION CO
ANDERSON CO
KNOX CO
Maynardville
CLAIBORNE CO
GRAINGER CO
Powder Springs
Luttrell
500 KV
TRANS LINE
TRANSMISSION LINE
Powell
Halls Crossroads
LEE HIGHWAY
Rutledge
KNOXVILLE
Blaine
GRAINGER CO
JEFFERSON CO
HOLSTON RIVER
CHEROKEE DAM
Strawberry Plains
AIRPORT

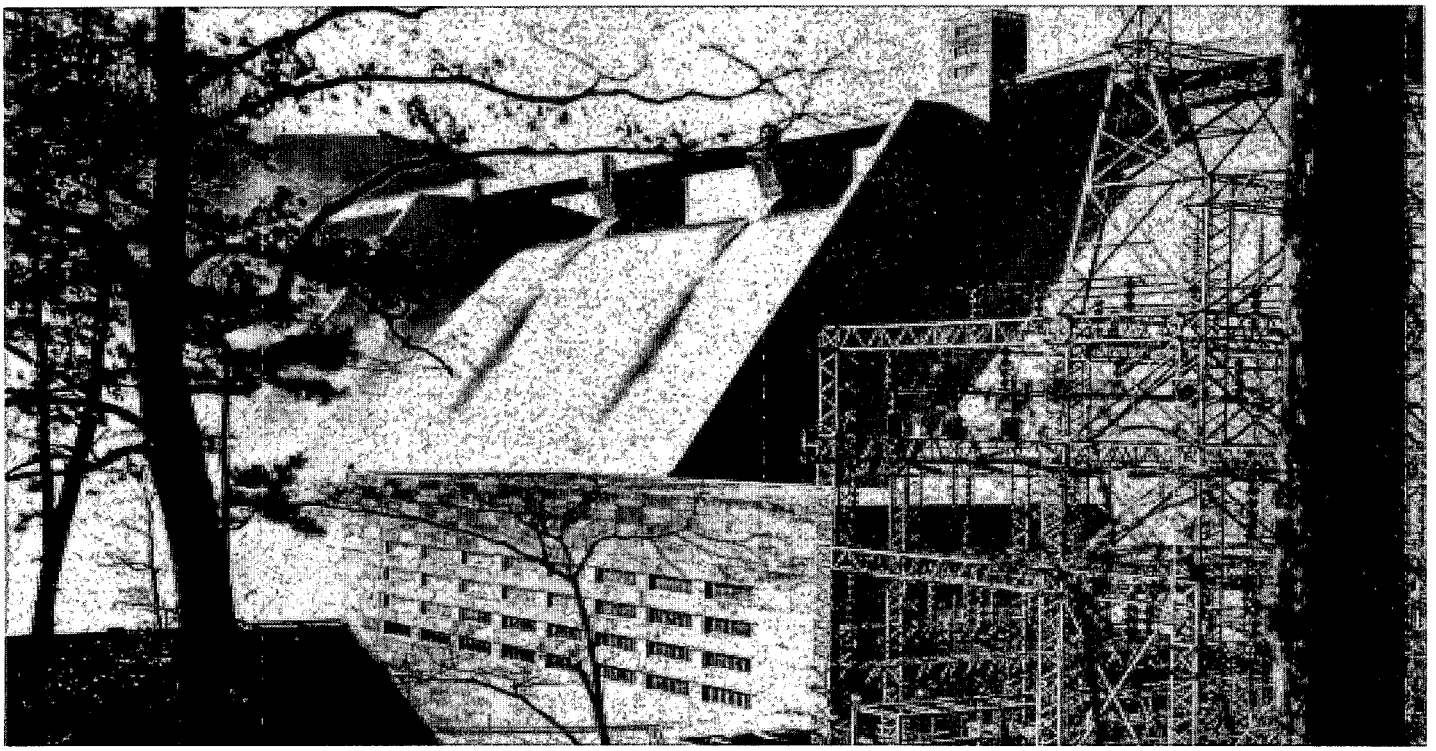


FIGURE 1
Spillway drum gates raised to regulate flood discharge, 1937

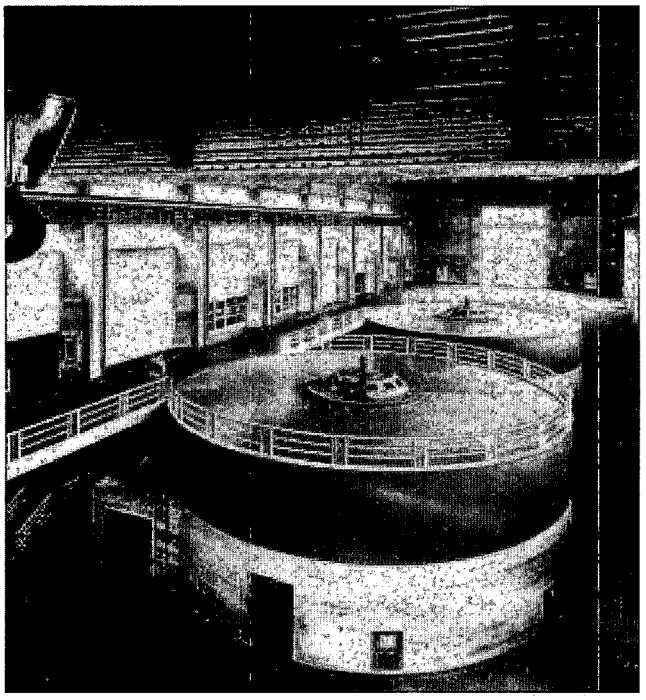


FIGURE 2 - Generator room, 1936

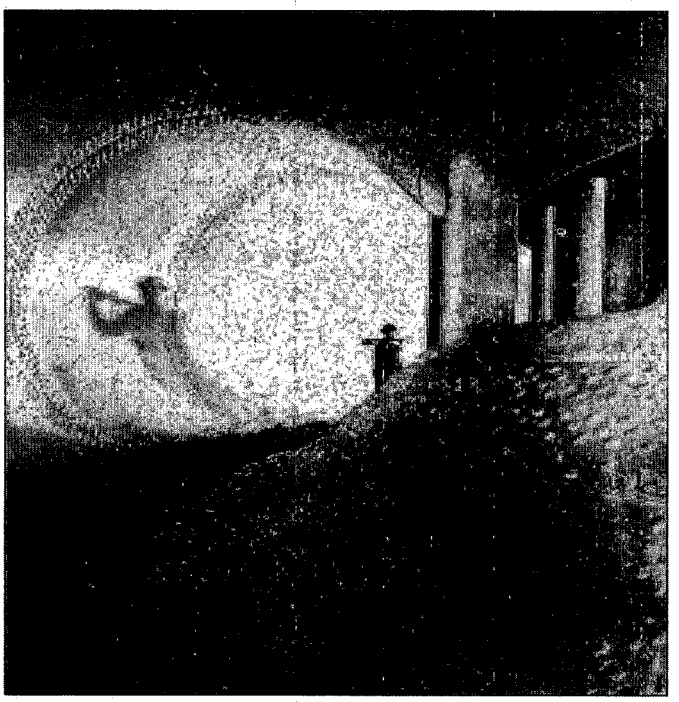


FIGURE 3 - Scroll case interior, 1936

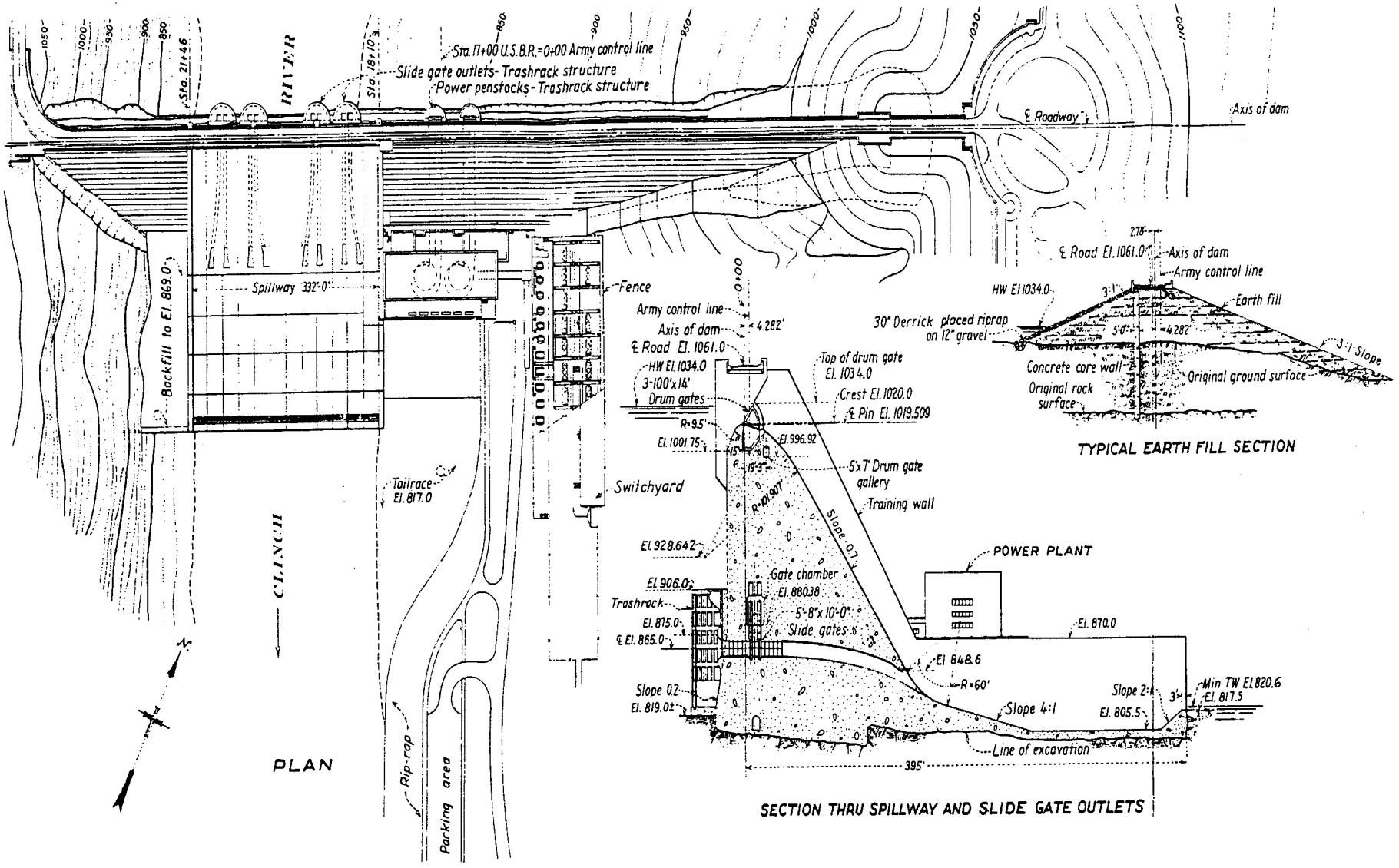
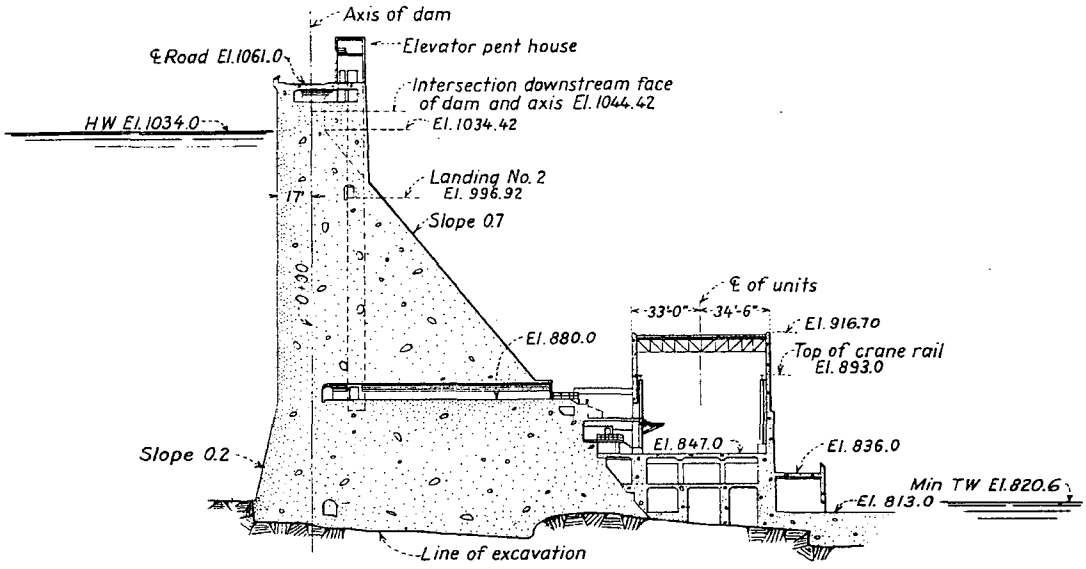
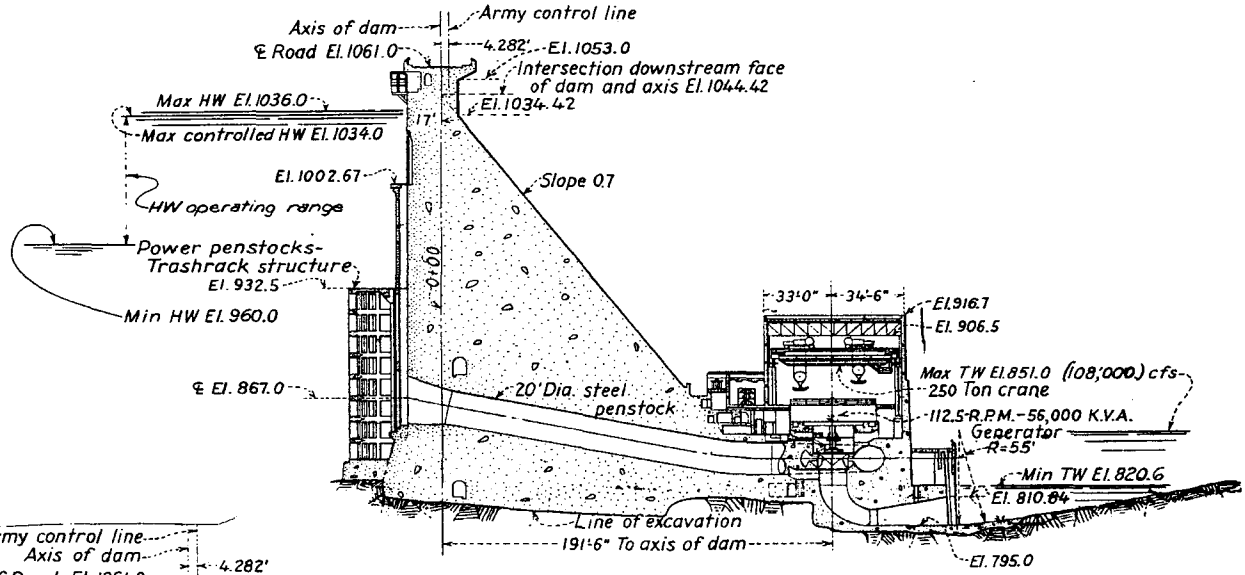


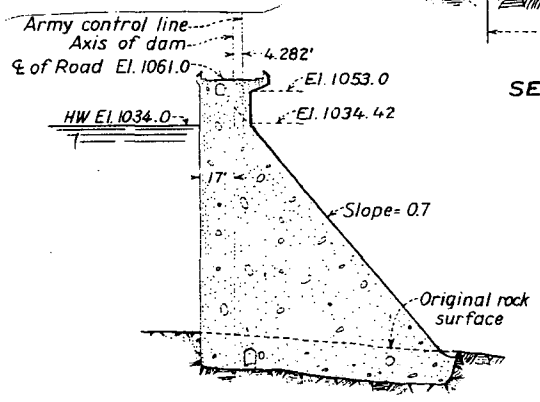
FIGURE 4 - Plan and Sections of earthfill, spillway and slide gate outlets



SECTION THRU WEST END OF POWER PLANT



SECTION THRU POWER PLANT AND INTAKE



TYPICAL ABUTMENT SECTION

FIGURE 5: Sections of: Power Plant; Intake; Abutment

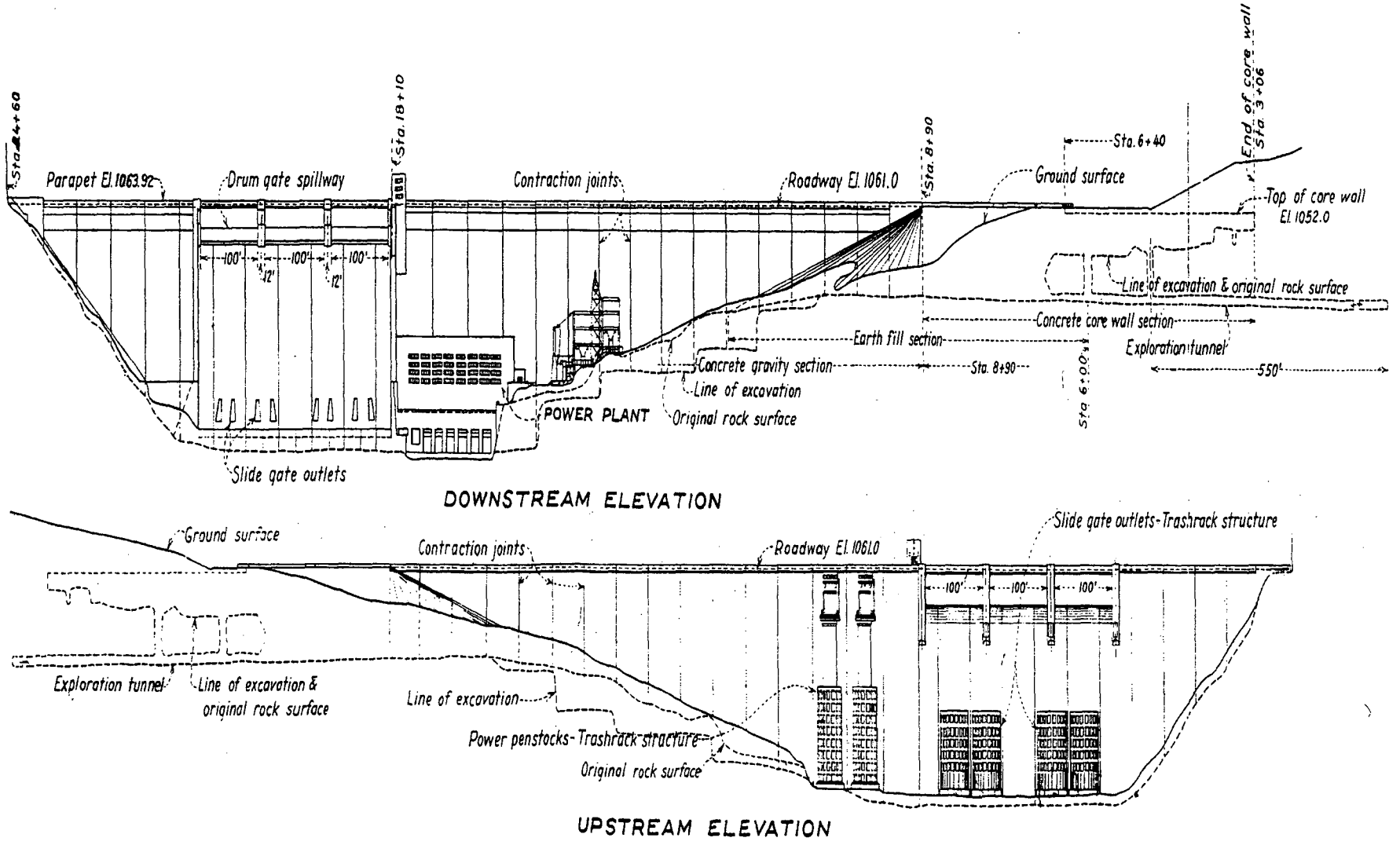


FIGURE 6: Upstream & Downstream Elevations

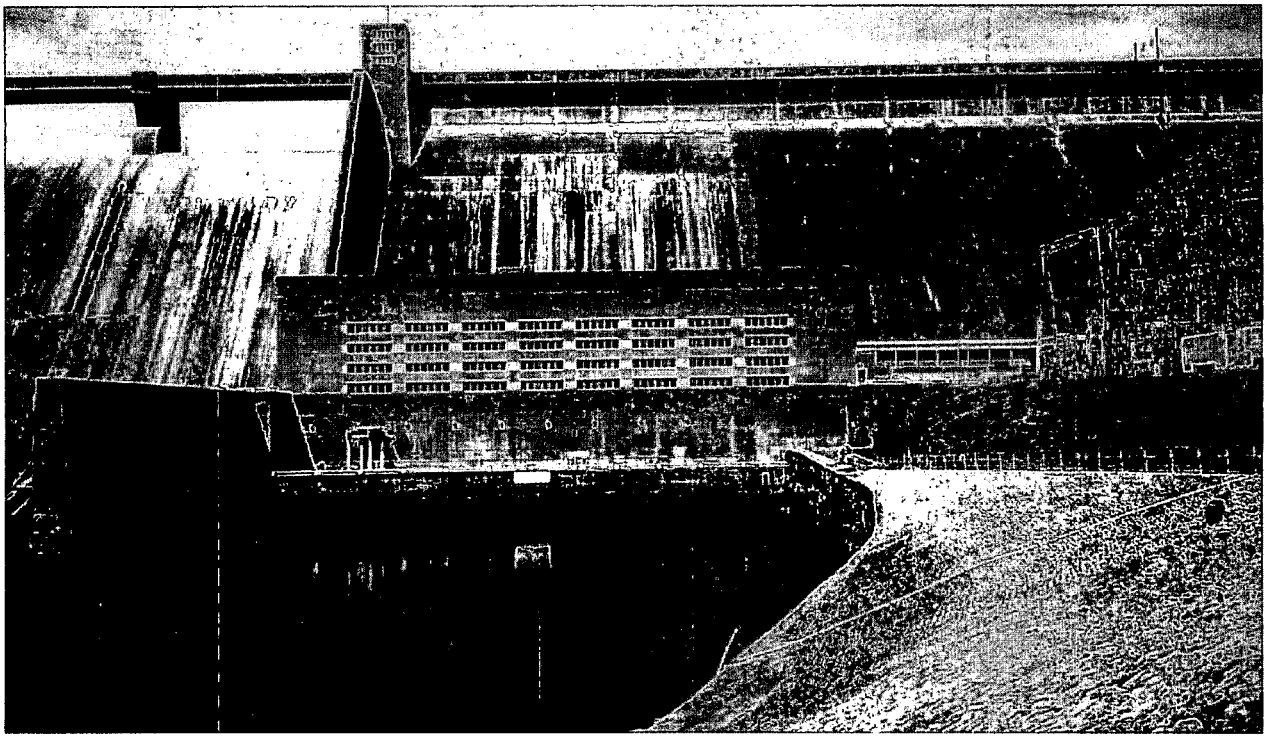


FIGURE 7 - Norris Dam Powerhouse, March 1999

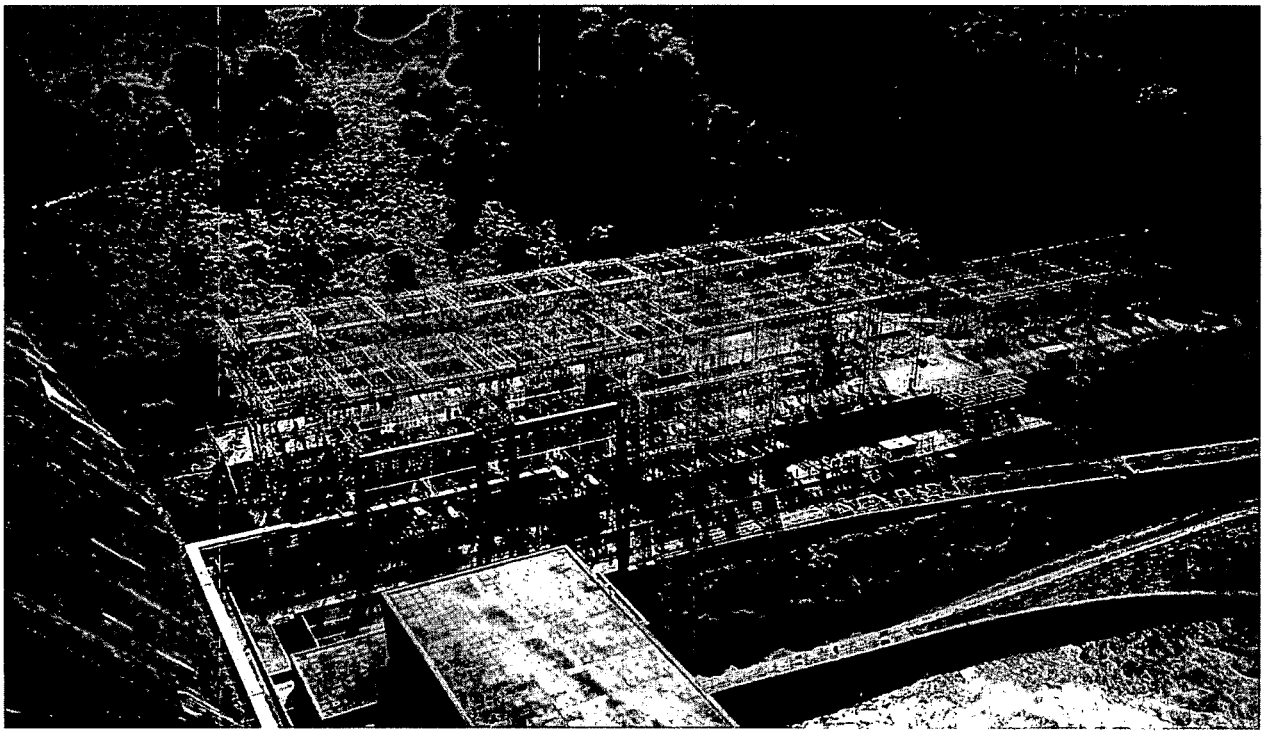


FIGURE 7A - Norris Dam Switch Yard, July 1998

NORRIS PROJECT

SUMMARY OF PRINCIPAL FEATURES

LOCATION

On Clinch River at river mile 79.8; in Campbell and Anderson Counties, Tennessee; 6 miles from Norris, Tennessee; 20 river miles above Clinton, Tennessee; 20 air miles northwest of Knoxville.

NOTE

Elevations are based on the U.S.C. & G.S. 1912 Fourth General Adjustment. To correct to the 1936 Supplementary Adjustment, add 0.11 ft.

CHRONOLOGY

Authorized	by Tennessee Valley Authority Act of the 73rd Congress, May 18, 1933
Construction started	October 1, 1933
First cofferdam started	November 6, 1938
First access roads started	November 8, 1933
First excavation	November 16, 1933
First concrete poured	July 17, 1934
Last cofferdam finished	October 9, 1934
Dam closure	March 4, 1936
Unit 2 on line	July 28, 1936
Unit 1 on line	September 30, 1936
Reservoir filled (el. 1020)	January 22, 1937
Re-regulation weir modifications	June 1995
Reservoir Release Improvements	January 20, 1996
Generator & Turbine Modernization	January 20, 1996

PROJECT COST

Initial project, including 2 units and switchyard	$32,269,027*
Reservoir Release Improvements	$ 1,412,000
Re-regulation weir modifications	$ 950,000
Generator & Turbine Modernization	$12,412,000
Total	$47,043,027

**Includes construction of Norris Freeway from Tennessee Highway 33 to West Norris Road and from U.S. Highway 25-W to Coal Creek Yard.*

STREAMFLOW

Drainage area at dam ..... 2,912 sq. miles
Gaging station discharge records (for complete records see Data Services Branch files):
- At Clinton, Tennessee, October 1903 to September 1927; drainage area ..... 3,056 sq. miles
- Near Lake City (Coal Creek), Tennessee, May 1927 to September 1937; drainage area ..... 2,921 sq. miles
- Below Norris Dam, April 1936 to date; drainage area ..... 2,913 sq. miles
- Below Norris Dam, Gage 1, Tennessee, May 1933 to September 1933; drainage area ..... 2,912 sq. miles

Maximum natural flood at dam site, estimated (April, 1977) ..... 132,000 cfs
Maximum regulated discharge since closure of dam, (February, 1937) ..... 43,000 cfs
Average unregulated flow at dam site, estimated (1921-1998) ..... 4,190 cfs
Minimum daily natural flow at dam site, (1925), approx. ..... 340 cfs

RESERVOIR

Counties affected:
- State of Tennessee ..... Anderson, Campbell, Union, Claiborne, Grainger

Reservoir land at September 30, 1977:
- Fee simple ..... 22,000 ac.
- Easements ..... 5,000 ac.
- Total ..... 27,000 ac.
- Transferred or Leased ..... 35,000 ac.

Operating levels at dam:
- Probable maximum flood elevation (PMF) ..... *el. 1057.4
- 500 year flood elevation ..... *el. 1035.0
- 100 year flood elevation ..... *el. 1032.0
- Winter flood guide level ..... el. 985.0
- Summer flood guide level ..... el. 1020.0
- Maximum used for design (200,000 cfs) ..... el. 1052.0
- Top of gates (area 39,800 ac.) ..... el. 1034.0
- Normal minimum pool ..... el. 960.0

Backwater, length at normal maximum pool level:
- Clinch River ..... 73 miles
- Powell River ..... 56 miles
- Total ..... 129 miles

**These elevations are valid at the dam and may change significantly upstream of the dam.*

RESERVOIR (CONT.)

Shoreline, length at normal maximum pool level:
- Main shore ..... 800 miles
- Islands ..... 50 miles
- Total ..... 850 miles

Original river area (to el. 1020 crossing) ..... 2,930 ac.

Storage (flat pool assumption):
- Total volume:
  - At top of gates (el. 1034) ..... 2,552,000 ac.-ft
  - At normal maximum pool(el. 1020) ..... 2,040,000 ac.-ft
  - At normal minimum pool (el. 960) ..... 630,000 ac.-ft
- Reservation for flood control on:
  - January 1 to January 24 (el. 1034-985) ..... 1,473,000 ac.-ft
  - March 15 (el. 1034-1000) ..... 1,113,000 ac.-ft
  - June 1 (el. 1034-1020) ..... 512,000 ac.-ft
  - Useful controlled storage (el. 1034-960) ... 1,922,000 ac.-ft

TAILWATER

Maximum used for design (200,000 cfs) ..... el. 859.6
Full plant operation (2 units) ..... el. 827.4
One unit operating at best efficiency ..... el. 823.5
Minimum level ..... el. 820.6

HEAD (Gross)

Maximum static (el. 1034-820.6) ..... 213.4 ft
Maximum expected operating (el. 1020-827) ..... 193.0 ft
Average operating ..... 169.0 ft
Minimum operating (el. 900-825) ..... 75.0 ft

RESERVOIR ADJUSTMENTS

Clearing (below el. 1020) ..... 18,693 ac.
Highways adjusted:
- Access ..... 21.9 miles
- State ..... 16.5 miles
- County and tertiary ..... 88.1 miles
- Total ..... 126.5 miles

Railroad adjustments ..... 2.8 miles
Bridges (highway 30; railroad 3) 33
Concrete box culverts 45
Families relocated 2,899
Utilities adjusted or relocated ..... 24 miles
Graves ..... 22 agreements; 5,226 removals

DAM

Material and type..... ..... Concrete gravity nonoverflow dam and spillway; impervious rolled earthfill embankment with concrete core wall

Lengths:

- Nonoverflow dam ..... 1,246 ft
- Spillway ..... 324 ft
- Earth embankment, left (east) bank ..... 290 ft
- Total ..... 1,860 ft

Maximum height, foundation to deck level ..... 265 ft

Maximum width at base;

- Spillway section only ..... 208 ft
- Including apron ..... 423 ft

Length of concrete core wall ..... 584 ft

Deck level ..... el. 1061.0

Top of earth embankment ..... el. 1061.0

Outlet facilities:

- Spillway clear opening (3 openings at 100 ft) ..... 300 ft
- Spillway crest level ..... el. 1020.0
- Crest gates ..... 3 drum gates, 100 ft wide, 14 ft high, hinged upstream, Bureau of Reclamation type, separated by 12-ft-thick piers
- Gate control ..... Manual from valve chamber below gates. Manual or automatic from powerhouse control room. Water for gate flotation is admitted from headwater by gravity.
- Sluices ..... Eight, 5 ft 8 in. wide, 10 ft high
- Centerline of sluices ..... el. 865.0
- Sluice gates ..... 8 sets of two 5-ft-8-in. by 10-ft hydraulically operated slide gates
- Discharge capacity:
- Spillway:
  - HW el. 1052 (design level) ..... 210,000 cfs
  - HW el. 1034 ..... 55,000 cfs
- Sluices:
  - HW el. 1034 ..... 38,400 cfs
  - HW el. 1020 ..... 36,740 cfs

Highway ..... 22 ft wide on dam

Foundation ..... Knox dolomite

Re-regulation weir:

- Riprap ..... 1,300 cu yd
- Concrete (stream bed leveling pad 640; abutments 790) 1,430 cu yd
- Wire Mesh ..... 1,500 sq yd
- Steel grating ..... 8,100 sq ft
- Rebar ..... 13 tons
- Timbers (6x6 14,000; 3.5x8 3,100) ..... 17,100 lf
- Minimum flow pipes (24 inch diameter) ..... 560 lf

POWER FACILITIES

INTAKES

Number	2
Dimensions at gate opening	16 ft wide by 28.5 ft high
Net area at gate	456 sq. ft
Gates	Two, tractor type
Hoist	Double drum, 64-in.-dia. Hoist motors, two 60 hp

PENSTOCKS

Number	2
Type	Electric machine welded steel plate
Diameter	20 ft
Length	153 ft 10 in.

POWERHOUSE

Generating capacity, 2-unit total (Original Capacity)	100,800 kW
Type of construction	Enclosed, reinforced concrete and structural steel
Principal dimensions, including service bay	205 ft long by 71 ft wide by 125 ft high
Service bay:	
East service bay	60.5 ft long by 96.5 ft wide
West service bay	43.0 ft long by 96.5 ft wide
Draft tubes:	
Type	Elbow, 2 openings
Horizontal length (centerline of turbine to downstream face)	57.0 ft
Vertical distance from centerline of distributor to floor of draft tube	37.0 ft
Net area at outlet opening	665 sq. ft
Powerhouse crane	Traveling crane with two 125-ton hooks and two 25-ton auxiliary hooks

GENERATOR & TURBINE MODERNIZATION

Norris Units 1 and 2 were modernized in January 1996 and September 1995 respectively. The equipment replaced was the turbine runners, wicket gates, generator coolers, neutral switchgear, and unit 2 stator winding. The generator field poles were reinsulated and the generator relays upgraded. The rotor fans were modified and the excitation system modernized.

POWER FACILITIES (CONT.)

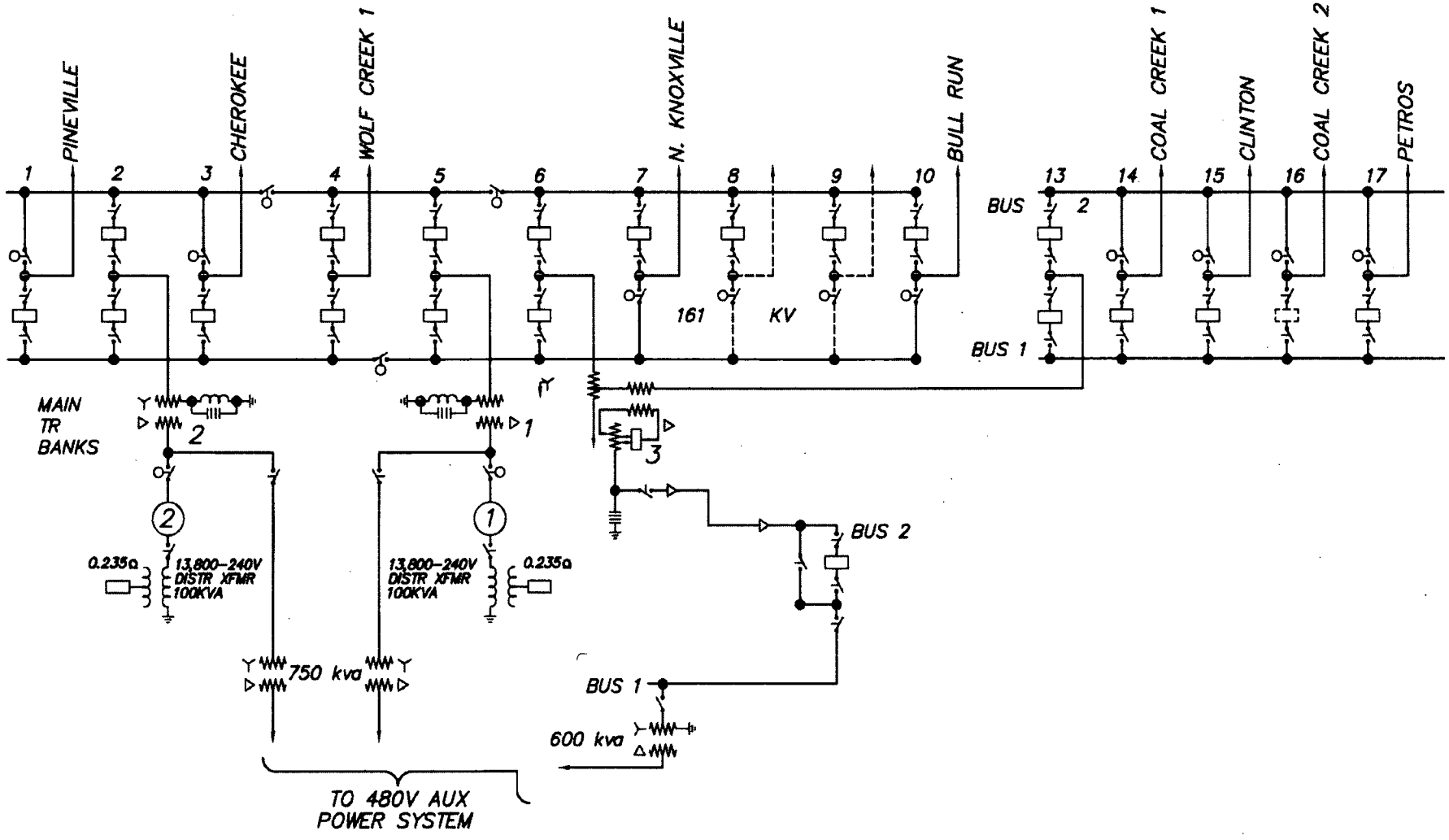
HYDRAULIC TURBINES

Number	2
Manufacturer	Newport News Shipbuilding & Dry Dock Co.
Type	Vertical Francis
Rated capacity (each)	89,680 hp at 189-ft net head
Rated speed	112.5 r/min
Maximum runaway speed	218 r/min
Specific speed at rating	48.1
Value of sigma at rating	0.16
Diameter of runner, intake	161 in.
Diameter of runner, discharge	165.187 in.
Centerline to bottom of runner	55.375 in.
Centerline to top of runner	21 in.
Diameter of guide vane circle	189 in.
Diameter of lower pit	19.5 ft
Spacing of turbines, center to center of units	60 ft
Draft tubes (see Powerhouse)	Elbow type
Governors	Woodward, cabinet actuator type
Heaviest assembly to be lifted by crane	140,000 lb
TW Safety Factor	7 ft. @ 820.6 ft. TW

GENERATORS

Manufacturer	Westinghouse Electric Corp.
Type	Enclosed, water-cooled, vertical-shaft
Rating, units 1-2	56,000 kVA, 50,400 kW 2345 A, 60 degrees C rise, 0.9 pf, 13.8 kV, 3 ph, 60 Hz
Capacity	64,400 kVA, 57,960 kW 2697 A, 80 degrees C rise
Total New Capacity	146 MW
Efficiency (tested):	
At rated kVA, 1.0 pf	98.25 percent
At 75% kVA, 0.9 pf	97.70 percent
Flywheel effect	65,300,000 lb-ft^2
Thrust bearing	Kingsbury type, dia.75 in., max. load 546 tons
Neutral high impedance grounding	13.8 kV-240V, 100 kVA distribution transformer with a 0.235 ohm resistor in the secondary winding
Exciters:	
Main	275 kW, 250 V
Pilot	15 kW, 250 V
Weight of heaviest crane lift, rotor	241.5 ton
Diameter over air housing, less trim	500 in.
Top of pilot exciter:	
Above stator soleplates	141 in.
Above turbine floor	263 in.

FIGURE 8:
SINGLE LINE DIAGRAM OF MAIN CONNECTIONS



POWER FACILITIES (CONT.)

ELECTRIC CONTROLS

Generation may be controlled by one of three methods. Normally, the local automation computer system will receive generation schedules from the Hydro Dispatch Control Cell(HDCC) in the Power Business Center in Chattanooga and respond with automatic control of the units. All pertinent data such as electrical quantities, water levels, alarms, etc. are telemetered to the HDCC. If required, the production coordinator in the HDCC may take over control of the units from Chattanooga through traditional Supervisory Control and Data Acquisition(SCADA) communications. Controls for local operation are also provided in the Norris control room. All switching is controlled either from the Power Business Center through traditional SCADA communications or locally from the control room at the plant.

TRANSMISSION PLANT

Step-up transformers: See Transmission Plant Data Spreadsheet.

Intersystem transformers: See Transmission Plant Data Spreadsheet.

161-kV circuit breakers:
12 1200-A, 5.0 MVA, pneu, General Electric
69-kV circuit breakers:
2 600-A, 0.9 MVA, 8/60-Hz,Westinghouse
3 600-A, 1.0 MVA, General Electric
14.4-kV circuit breakers:
3 600-A, 175,000-kVA, General Electric
Structures:
10 161-kV switchyard bays, 32 ft wide
5 69-kV switchyard bays, 26 ft wide
4 12.5-kV switchyard bays, 10 ft wide

TRANSMISSION PLANT DATA

Plant	Location	Phase	Serial Number	MVA Rating		Voltage kV	Cooling	Tap Changer	Oil Preservation System
				55 degrees	65 degrees				
Norris Hydro	Bank 1	3	70525B	70/93.3	78.4/104.5	161/13.8	OA/FA	DETC	Sealed Conservator
Norris Hydro	Bank 2	3	70525A	70/93.3	78.4/104.5	161/13.8	OA/FA	DETC	Sealed Conservator
Norris Hydro	Intertie 3A	1	4089187	15/20		161/69/12.45	OA/FA	LTC	Gas-Blanketed
Norris Hydro	Intertie 3B	1	4089188	15/20		161/69/12.45	OA/FA	LTC	Gas-Blanketed
Norris Hydro	Intertie 3C	1	4089186	15/20		161/69/12.45	OA/FA	LTC	Gas-Blanketed
Norris Hydro	Intertie 3S	1	4089189	15/20		161/69/12.45	OA/FA	LTC	Gas-Blanketed

Plant	Location	Phase	Oil Volume gal.	Configuration	Impedance %			Contract Number	Manufacturer	Year of Manufacture
					H-X	H-Y	X-Y			
Norris Hydro	Bank 1	3	9625	GRD Wye/Delta	10.08	N/A	N/A	94P1C-79053G-000	North American	1995
Norris Hydro	Bank 2	3	9625	GRD Wye/Delta	10.06	N/A	N/A	94P1C-79053G-000	North American	1995
Norris Hydro	Intertie 3A	1	3500	Wye/Wye/Delta				TV-98169	Westinghouse	1946
Norris Hydro	Intertie 3B	1	3500	Wye/Wye/Delta				TV-98169	Westinghouse	1946
Norris Hydro	Intertie 3A	1	3500	Wye/Wye/Delta				TV-98169	Westinghouse	1946
Norris Hydro	Intertie 3S	1	3500	Wye/Wye/Delta				TV-98169	Westinghouse	1946

RESERVOIR AND POWER DATA - NORRIS

Pool Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Potential EIS* (gWh)	Gross Head (feet)	Best Efficiency			Maximum Sustainable		
					Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs	Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs
1034	39.24	2552.0	1346.8	205.7	110.6	6,890	16.06	141.8	9,490	14.94
1033	38.87	2512.9	1324.4	204.7	110.0	6,880	15.99	140.8	9,470	14.88
1032	38.50	2474.2	1301.1	203.8	109.4	6,880	15.91	139.8	9,440	14.82
1031	38.13	2435.9	1278.1	202.8	108.8	6,870	15.84	138.8	9,420	14.76
1030	37.74	2398.0	1255.3	201.8	108.1	6,860	15.76	137.8	9,390	14.69
1029	37.36	2360.4	1232.8	200.8	107.5	6,860	15.69	136.8	9,370	14.63
1028	36.97	2323.2	1210.5	199.8	106.9	6,850	15.61	135.8	9,350	14.57
1027	36.58	2286.5	1188.3	198.8	106.3	6,840	15.53	134.8	9,320	14.48
1026	36.19	2250.1	1166.3	197.8	105.7	6,840	15.44	133.8	9,300	14.40
1025	35.80	2214.1	1144.5	196.8	105.1	6,830	15.36	132.8	9,270	14.32
1024	35.41	2178.5	1123.1	195.9	104.5	6,830	15.28	131.9	9,250	14.24
1023	35.02	2143.3	1101.9	194.9	103.9	6,820	15.20	130.9	9,230	14.16
1022	34.63	2108.4	1081.0	193.9	103.3	6,810	15.11	129.9	9,200	14.07
1021	34.23	2074.0	1060.4	192.9	102.7	6,800	15.03	128.9	9,180	13.99
1020	33.84	2040.0	1040.0	191.9	102.1	6,800	14.95	127.9	9,150	13.91
1019	33.44	2006.3	1020.0	190.9	101.5	6,790	14.87	126.9	9,120	13.83
1018	33.05	1973.1	1000.2	189.9	100.9	6,780	14.79	125.9	9,100	13.74
1017	32.66	1940.2	980.7	188.9	100.2	6,770	14.70	124.9	9,070	13.66
1016	32.27	1907.8	961.5	188.0	99.4	6,770	14.62	124.0	9,050	13.58
1015	31.89	1875.7	942.5	187.0	98.6	6,760	14.54	123.0	9,030	13.50
1014	31.51	1844.0	923.9	186.0	97.8	6,760	14.46	122.0	9,000	13.41
1013	31.13	1812.7	905.5	185.0	97.0	6,750	14.37	121.0	8,980	13.33
1012	30.75	1781.7	887.3	184.0	96.4	6,740	14.29	120.0	8,950	13.25
1011	30.37	1751.2	869.4	183.0	95.8	6,730	14.21	119.0	8,930	13.17
1010	30.00	1721.0	851.8	182.0	95.2	6,730	14.13	118.0	8,900	13.09
1009	29.63	1691.2	834.4	181.0	94.6	6,720	14.04	117.0	8,880	13.00
1008	29.26	1661.7	817.3	180.0	94.0	6,710	13.96	116.0	8,850	12.92
1007	28.90	1632.6	800.4	179.1	93.4	6,700	13.88	115.1	8,830	12.84
1006	28.54	1603.9	783.8	178.1	92.8	6,700	13.80	114.1	8,800	12.76
1005	28.19	1575.5	767.4	177.1	92.3	6,690	13.72	113.1	8,780	12.67
1004	27.83	1547.5	751.3	176.1	91.7	6,690	13.63	112.1	8,760	12.59
1003	27.48	1519.9	735.4	175.1	91.1	6,680	13.55	111.1	8,730	12.51
1002	27.14	1492.6	719.8	174.1	90.5	6,670	13.47	110.1	8,710	12.43
1001	26.80	1465.6	704.3	173.1	89.9	6,670	13.39	109.1	8,680	12.34
1000	26.46	1439.0	689.1	172.1	89.3	6,660	13.30	108.1	8,660	12.26
999	26.12	1412.7	674.2	171.2	88.7	6,650	13.22	107.2	8,630	12.18
998	25.79	1386.7	659.4	170.2	88.1	6,640	13.14	106.2	8,600	12.10
997	25.45	1361.1	644.9	169.2	87.5	6,640	13.06	105.2	8,580	12.02
996	25.12	1335.8	630.6	168.2	86.9	6,630	12.97	104.2	8,560	11.93
995	24.79	1310.9	616.6	167.2	86.3	6,620	12.89	103.2	8,530	11.85
994	24.46	1286.2	602.7	166.2	85.7	6,620	12.81	102.2	8,510	11.77
993	24.14	1261.9	589.1	165.2	85.1	6,610	12.73	101.2	8,490	11.69
992	23.81	1238.0	575.7	164.2	84.4	6,600	12.65	100.2	8,460	11.60
991	23.49	1214.3	562.5	163.3	83.6	6,600	12.56	99.3	8,430	11.52

**EIS represents energy in storage, and includes production at Norris and all downstream plants through Kentucky Dam.*

RESERVOIR AND POWER DATA - NORRIS (CONT.)

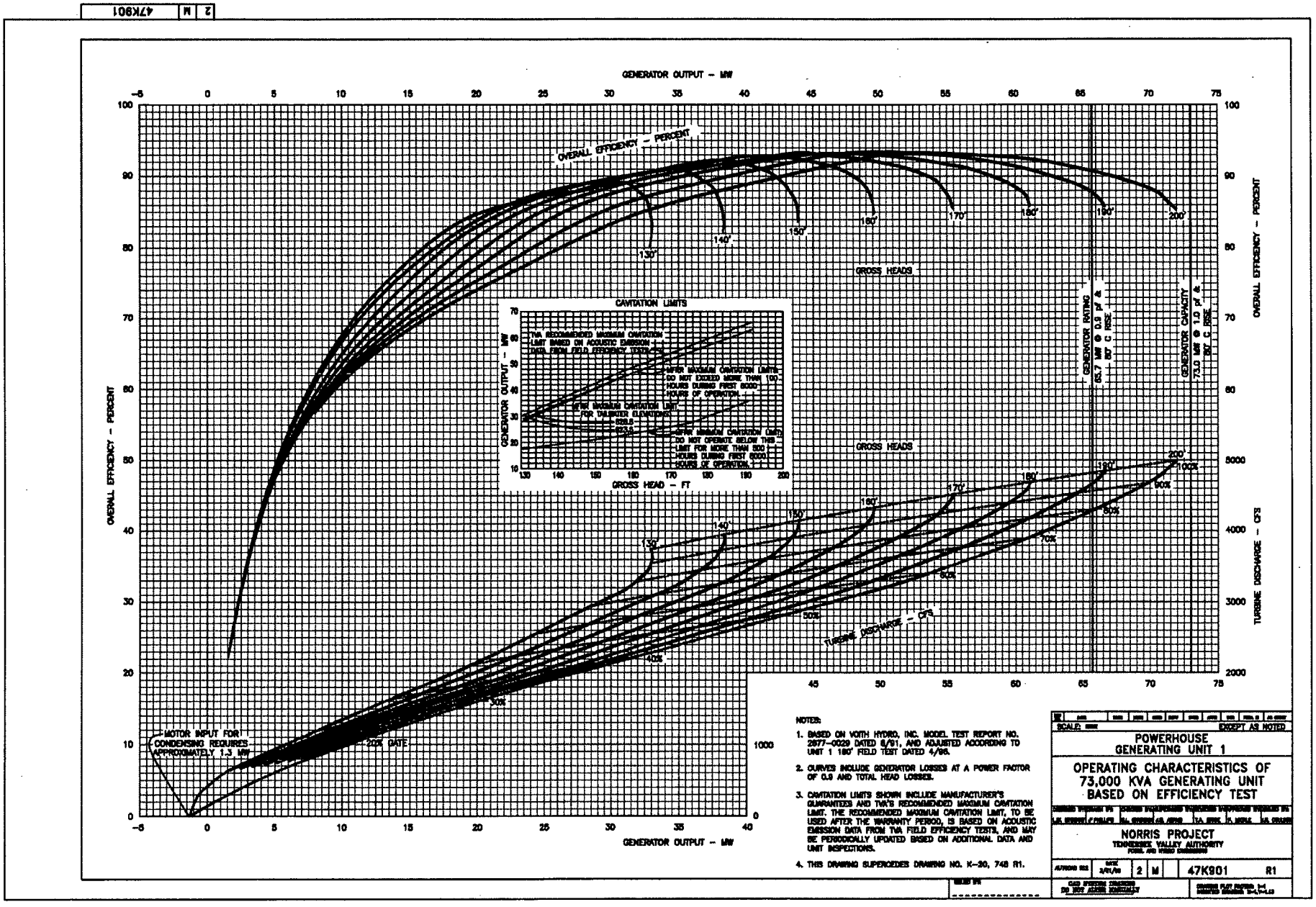
Pool Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Potential EIS* (gWh)	Gross Head (feet)	Best Efficiency			Maximum Sustainable		
					Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs	Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs
990	23.17	1191.0	549.5	162.3	82.8	6,590	12.48	98.3	8,410	11.44
989	22.85	1168.0	536.7	161.3	82.0	6,580	12.40	97.3	8,380	11.36
988	22.53	1145.3	524.1	160.3	81.2	6,570	12.32	96.3	8,360	11.27
987	22.22	1122.9	511.7	159.3	80.6	6,570	12.23	95.3	8,330	11.19
986	21.90	1100.8	499.6	158.3	80.0	6,560	12.15	94.3	8,310	11.11
985	21.59	1079.1	487.6	157.3	79.4	6,550	12.07	93.3	8,290	11.03
984	21.28	1057.7	475.9	156.3	78.8	6,550	11.99	92.3	8,260	10.95
983	20.97	1036.5	464.3	155.4	78.2	6,540	11.90	91.4	8,240	10.86
982	20.67	1015.7	452.9	154.4	77.6	6,530	11.82	90.4	8,210	10.78
981	20.37	995.2	441.7	153.4	77.0	6,530	11.74	89.4	8,190	10.70
980	20.06	975.0	430.8	152.4	76.4	6,520	11.66	88.4	8,160	10.62
979	19.76	955.1	420.0	151.4	75.8	6,510	11.58	87.4	8,140	10.53
978	19.47	935.5	409.4	150.4	75.3	6,500	11.49	86.4	8,110	10.45
977	19.17	916.1	398.9	149.4	74.7	6,500	11.41	85.4	8,090	10.37
976	18.88	897.1	388.7	148.5	74.1	6,490	11.33	84.5	8,060	10.29
975	18.59	878.4	378.7	147.5	73.5	6,480	11.25	83.5	8,030	10.21
974	18.30	859.9	368.8	146.5	72.9	6,470	11.16	82.5	8,010	10.12
973	18.02	841.8	359.1	145.5	72.3	6,460	11.08	81.5	7,980	10.04
972	17.73	823.9	349.6	144.5	71.7	6,460	11.00	80.5	7,960	9.96
971	17.45	806.3	340.2	143.5	71.1	6,450	10.92	79.5	7,930	9.88
970	17.17	789.0	331.1	142.5	70.5	6,440	10.84	78.5	7,910	9.79
969	16.90	772.0	322.1	141.5	69.9	6,430	10.75	77.5	7,880	9.71
968	16.63	755.2	313.2	140.6	69.3	6,420	10.67	76.6	7,850	9.63
967	16.37	738.7	304.5	139.6	68.7	6,420	10.59	75.6	7,830	9.55
966	16.12	722.4	296.0	138.6	68.2	6,410	10.51	74.6	7,800	9.47
965	15.87	706.4	287.7	137.6	67.6	6,400	10.42	73.6	7,780	9.38
964	15.63	690.7	279.5	136.6	67.0	6,390	10.34	72.6	7,750	9.30
963	15.40	675.2	271.4	135.6	66.4	6,390	10.26	71.6	7,730	9.22
962	15.17	659.9	263.5	134.6	65.8	6,380	10.18	70.6	7,700	9.14
961	14.95	644.8	255.7	133.7	65.2	6,370	10.10	69.7	7,670	9.05
960	14.74	630.0	248.0	132.7	64.6	6,360	10.01	68.7	7,650	8.97
959	14.52	615.4	240.5	131.7	64.0	6,350	9.93	67.7	7,620	8.89
958	14.31	600.9	233.1	130.7	63.4	6,350	9.85	66.7	7,600	8.81
957	14.08	586.8	225.9	129.7	62.8	6,340	9.77	65.7	7,570	8.73
956	13.85	572.8	218.7	128.7	62.2	6,330	9.69	64.7	7,550	8.64
955	13.62	559.0	211.8	127.7	61.6	6,320	9.60	63.7	7,520	8.56
954	13.38	545.5	204.9	126.7	61.0	6,310	9.52	62.7	7,500	8.48
953	13.14	532.3	198.2	125.8	60.5	6,310	9.44	61.8	7,470	8.40
952	12.89	519.3	191.7	124.8	59.9	6,300	9.36	60.8	7,440	8.31
951	12.64	506.5	185.2	123.8	59.3	6,290	9.27	59.8	7,420	8.23
950	12.38	494.0	179.0	122.8	58.7	6,280	9.19	58.8	7,390	8.15
949	12.12	481.7	172.8	121.8	58.1	6,270	9.11	57.8	7,370	8.07
948	11.87	469.7	166.9	120.8	57.5	6,270	9.03	56.8	7,340	7.99
947	11.63	458.0	161.0	119.8	56.9	6,260	8.95	55.8	7,320	7.90
946	11.39	446.5	155.3	118.9	56.3	6,250	8.86	54.9	7,290	7.82

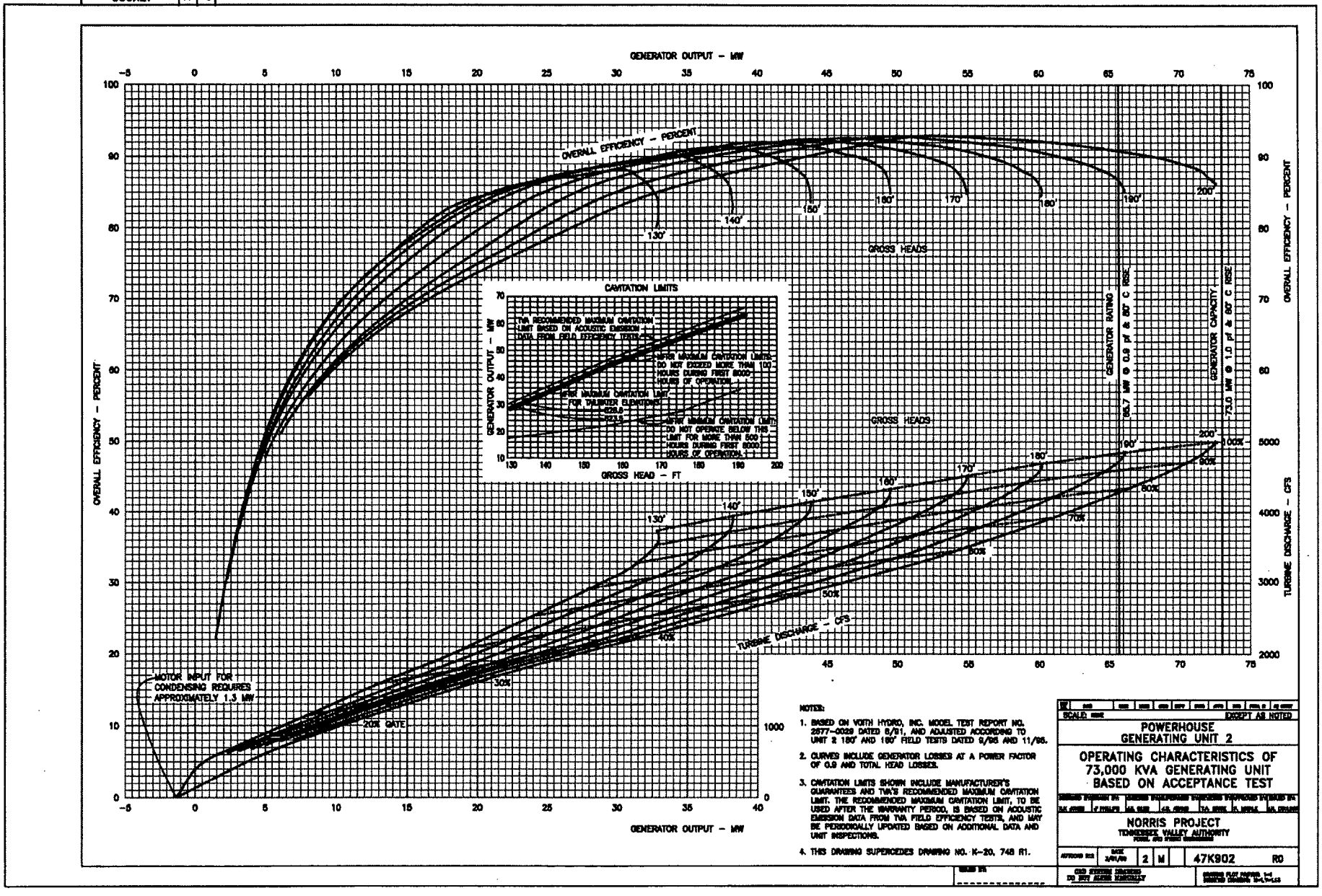
**EIS represents energy in storage, and includes production at Norris and all downstream plants through Kentucky Dam.*

RESERVOIR AND POWER DATA - NORRIS (CONT.)

Pool Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Potential EIS* (gWh)	Gross Head (feet)	Best Efficiency			Maximum Sustainable		
					Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs	Plant Output (MW)	Turbine Discharge (cfs)	kW/cfs
945	11.17	435.2	149.7	117.9	55.7	6,240	8.78	53.9	7,260	7.74
944	10.95	424.2	144.3	116.9	55.1	6,240	8.70	52.9	7,240	7.66
943	10.74	413.3	139.0	115.9	54.5	6,230	8.62	51.9	7,210	7.58
942	10.53	402.7	133.8	114.9	54.0	6,220	8.53	50.9	7,190	7.49
941	10.34	392.2	128.7	113.9	53.4	6,210	8.45	49.9	7,160	7.41
940	10.15	382.0	123.7	112.9	52.8	6,200	8.37	48.9	7,140	7.33
939	9.97	371.9	118.8	112.0	52.2	6,200	8.29	48.0	7,110	7.25
938	9.78	362.1	114.0	111.0	51.6	6,190	8.21	47.0	7,090	7.16
937	9.59	352.4	109.3	110.0	51.0	6,180	8.12	46.0	7,060	7.08
936	9.40	342.9	104.8	109.0	50.4	6,170	8.04	45.0	7,030	7.00
935	9.21	333.6	100.3	108.0	49.8	6,160	7.96	44.0	7,010	6.92
934	9.01	324.5	96.0	107.0	49.2	6,160	7.88	43.0	6,980	6.84
933	8.82	315.6	91.7	106.0	48.6	6,150	7.80	42.0	6,960	6.75
932	8.62	306.8	87.6	105.1	48.0	6,140	7.71	41.1	6,930	6.67
931	8.42	298.3	83.5	104.1	47.4	6,130	7.63	40.1	6,910	6.59
930	8.22	290.0	79.6	103.1	46.9	6,120	7.55	39.1	6,880	6.51
929	8.02	281.9	75.8	102.1	46.3	6,120	7.47	38.1	6,850	6.43
928	7.83	274.0	72.1	101.1	45.7	6,110	7.38	37.1	6,830	6.34
927	7.64	266.2	68.5	100.1	45.1	6,100	7.30	36.1	6,800	6.26
926	7.45	258.7	64.9	99.1	44.5	6,090	7.22	35.1	6,780	6.18
925	7.28	251.3	61.5	98.2	43.9	6,090	7.14	34.2	6,750	6.10
924	7.10	244.1	58.2	97.2	43.3	6,080	7.06	33.2	6,730	6.01
923	6.94	237.1	55.0	96.2	42.7	6,070	6.97	32.2	6,700	5.93
922	6.78	230.2	51.8	95.2	42.1	6,060	6.89	31.2	6,680	5.85
921	6.62	223.5	48.7	94.2	41.5	6,050	6.81	30.2	6,650	5.77
920	6.47	217.0	45.7	93.2	40.9	6,050	6.73	29.2	6,620	5.69
919	6.33	210.6	42.8	92.2	40.3	6,040	6.65	28.2	6,600	5.60
918	6.19	204.3	40.0	91.3	39.8	6,030	6.56	27.3	6,570	5.52
917	6.05	198.2	37.2	90.3	39.2	6,020	6.48	26.3	6,550	5.44
916	5.92	192.2	34.5	89.3	38.6	6,010	6.40	25.3	6,520	5.36
915	5.79	186.4	31.9	88.3	38.0	6,010	6.32	24.3	6,500	5.28
914	5.66	180.7	29.4	87.3	37.4	6,000	6.24	23.3	6,470	5.19
913	5.53	175.1	26.9	86.3	36.8	5,990	6.15	22.3	6,440	5.11
912	5.41	169.6	24.4	85.4	36.2	5,980	6.07	21.4	6,420	5.03
911	5.30	164.2	22.1	84.4	35.6	5,970	5.99	20.4	6,390	4.95
910	5.18	159.0	19.8	83.4	35.0	5,970	5.91	19.4	6,370	4.87
909	5.07	153.9	17.5	82.4	34.4	5,960	5.82	18.4	6,340	4.78
908	4.96	148.9	15.3	81.4	33.8	5,950	5.74	17.4	6,320	4.70
907	4.84	144.0	13.2	80.4	33.3	5,940	5.66	16.4	6,290	4.62
906	4.72	139.2	11.1	79.4	32.7	5,940	5.58	15.4	6,270	4.54
905	4.61	134.5	9.1	78.5	32.1	5,930	5.50	14.5	6,240	4.45
904	4.49	130.0	7.2	77.5	31.5	5,920	5.41	13.5	6,210	4.37
903	4.36	125.5	5.3	76.5	30.9	5,910	5.33	12.5	6,190	4.29
902	4.24	121.2	3.5	75.5	30.3	5,900	5.25	11.5	6,160	4.21
901	4.12	117.1	1.7	74.5	29.7	5,900	5.17	10.5	6,140	4.13
900	3.99	113.0	.0	73.5	29.1	5,890	5.09	9.5	6,110	4.04

**EIS represents energy in storage, and includes production at Norris and all downstream plants through Kentucky Dam.*


GENERATOR OUTPUT – MW
OVERALL EFFICIENCY – PERCENT
TURBINE DISCHARGE – CFS
GROSS HEADS
130'
140'
150'
160'
170'
180'
190'
200'
20% GATE
30%
40%
50%
60%
70%
80%
90%
100%
MOTOR INPUT FOR CONDENSING REQUIRES APPROXIMATELY 1.3 MW
CAVITATION LIMITS
TVA RECOMMENDED MAXIMUM CAVITATION LIMIT BASED ON ACOUSTIC EMISSION DATA FROM FIELD EFFICIENCY TESTS
MFRR MAXIMUM CAVITATION LIMITS DO NOT EXCEED MORE THAN 100 HOURS DURING FIRST 8000 HOURS OF OPERATION
MFRR MAXIMUM CAVITATION LIMIT FOR TAILWATER ELEVATIONS
MFRR MINIMUM CAVITATION LIMIT DO NOT OPERATE BELOW THIS LIMIT FOR MORE THAN 500 HOURS DURING FIRST 8000 HOURS OF OPERATION
GROSS HEAD – FT
GENERATOR RATING 65.7 MW @ 0.9 pf & 80° C RISE
GENERATOR CAPACITY 73.0 MW @ 1.0 pf & 80° C RISE
NOTES:
1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2877-0029 DATED 6/91, AND ADJUSTED ACCORDING TO UNIT 1 180' FIELD TEST DATED 4/96.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K-20, 748 R1.
SCALE: EXCEPT AS NOTED
POWERHOUSE GENERATING UNIT 1
OPERATING CHARACTERISTICS OF 73,000 KVA GENERATING UNIT BASED ON EFFICIENCY TEST
NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
2 M 47K901 R1


GENERATOR OUTPUT – MW
OVERALL EFFICIENCY – PERCENT
TURBINE DISCHARGE – CFS
GROSS HEADS
130'
140'
150'
160'
170'
180'
190'
200'
GENERATOR RATING
85.7 MW @ 0.9 pf & 80° C RISE
GENERATOR CAPACITY
73.0 MW @ 1.0 pf & 80° C RISE
MOTOR INPUT FOR CONDENSING REQUIRES APPROXIMATELY 1.3 MW
20% GATE
30%
40%
50%
60%
70%
80%
90%
100%
CAVITATION LIMITS
TVA RECOMMENDED MAXIMUM CAVITATION LIMIT BASED ON ACOUSTIC EMISSION DATA FROM FIELD EFFICIENCY TESTS
MFRR MAXIMUM CAVITATION LIMITS DO NOT EXCEED MORE THAN 100 HOURS DURING FIRST 8000 HOURS OF OPERATION
MFRR MAXIMUM CAVITATION LIMIT FOR TAILWATER ELEVATIONS
MFRR MINIMUM CAVITATION LIMIT DO NOT OPERATE BELOW THIS LIMIT FOR MORE THAN 500 HOURS DURING FIRST 8000 HOURS OF OPERATION
GROSS HEAD – FT
NOTES:
1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2677-0029 DATED 8/91, AND ADJUSTED ACCORDING TO UNIT 2 180' AND 160' FIELD TESTS DATED 9/95 AND 11/95.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K-20, 748 R1.
SCALE: NONE
EXCEPT AS NOTED
POWERHOUSE GENERATING UNIT 2
OPERATING CHARACTERISTICS OF 73,000 KVA GENERATING UNIT BASED ON ACCEPTANCE TEST
NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
2 M 47K902 R0

TVA - River System Operations

Norris Spill Compilation

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods in to adjacent years. Water may be spilled through the spillway and/or sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 43,000 cfs at 8 p.m. on 2/16/37. *Spillway #Spillway and sluiceways
1936	8000	12/1	10	73	6200---6/28---13; 2000---7/16---6; 500---7/23---4; 3900---7/28---5; 1000---8/1---2; 3400---8/28---7; 2100---9/3---3; 3000---9/22---14; 2500---9/27---5; 5500---12/1---14
1937	39200	2/17	14	230	*23000---2/8---8; *30000---2/12---4; #38000---2/17---13; 14000---2/28---9; 22500---3/15---15; 4300---3/25---5; #5000---5/28---47; 3100---7/18---4; 3800---7/27---10; 2800---8/2---4; 2000---8/6---1; 2000---8/10---2; 4800---8/22---5; 13000---10/8---25; 14500---11/11---53; 15000---12/18-27---37
1938	25000	2/9	13	146	25000---2/9---5; #10000---5/13---26; #5000---6/11---4; #5000---6/27---9; #700---7/3---2; 500---7/8---2; 6100---7/27---31; 2500---9/6---10; 1000---9/18---4; 1000---9/27---7; 4000---10/23---21; 500---11/3---2; 8000---12/29---19
1939	17600	3/11	3	29	10000---2/12---7; 10000---2/25---6; 12000---3/11---16
1940	11500	2/9	2	3	5500---2/9---2; 90---10/8---1
1941	7740	10/17	0	0	
1942	8606	11/12	1	7	#3820---8/23---7
1943	19829	1/7	2	31	13917---1/7---9; 9758---2/1---22
1944	11975	3/28	2	17	7230---3/29---9; #8354---4/16---8
1945	13340	12/20	1	22	8800---12/14-23---22
1946	19315	1/17	5	41	1650---1/7---1; 14300---1/13---18; 4400---2/1-3---4; 13200---2/12---13; 8800---3/10---5
1947	19191	1/28	1	14	12390---1/24---14
1948	7862	12/31	0	2	
1949	18873	1/12	4	42	3937---1/2---6; 12000---1/12---9, 4894---12/5---12; 11700---12/25---17
1950	25458	2/16	1	26	19720---2/19---26
1951	26400	12/24	1	12	18335---12/24---14
1952	21300	1/31	1	12	13319---2/1---10
1953	12510	2/25	1	4	4621---2/25---4
1954	7314	7/13	0	0	

Norris Spill Compilation

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods in to adjacent years. Water may be spilled through the spillway and/or sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 43,000 cfs at 8 p.m. on 2/16/37. *Spillway #Spillway and Sluiceways
1955	17964	3/20	2	7	9196---3/20---4; 4390---3/27---3
1956	16865	3/17	2	11	537---1/11---1; 8300---3/16&17---10
1957	25825	2/12	2	33	17090---2/12---24; 11795---12/27---11
1958	15435	1/1	0	2	
1959	7964	10/21	0	0	
1960	7922	1/14	0	0	
1961	18173	3/13	1	6	10042---3/13---6
1962	18766	3/15	2	34	10190---2/2---9; 10080---3/14---25
1963	25281	3/20	1	16	16350---3/20---16
1964	8217	11/14	0	0	
1965	16208	1/13	1	4	8110---1/13---4
1966	7650	12/14	0	0	
1967	19793	12/28	2	18	11175---3/10---10; 11610---12/28---18
1968	19425	1/1	0	10	
1969	7686	7/15	0	0	
1970	8633	2/19	0	0	
1971	8549	11/9	0	0	
1972	19785	12/19	4	43	8330---1/25---14; 10740---2/28---10; 11289---12/19---10; 15253---12/29---15
1973	19534	1/2	2	27	8024---3/22---11; #7189---5/31---9 (Spillway discharge 6 a.m., May 31 to 8:30 a.m., June 4, 1973)
1974	23652	1/15	1	46	14581---1/15---47
1975	20227	4/2	2	33	6270---3/14---9; 11258---3/27---24
1976	7583	1/15	1	1	150---10/24---1

Norris Spill Compilation

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods in to adjacent years. Water may be spilled through the spillway and/or sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 43,000 cfs at 8 p.m. on 2/16/37. *Spillway #Spillway and Sluiceways
1977	13948	12/7	2	27	3854---4/7---2; 5330---12/7---25
1978	8481	1/31	0	0	
1979	20165	3/7	2	27	7690---1/27---11; 11540---3/7-8---16
1980	8258	1/27	2	6	638---5/25---3; 676---6/1---3
1981	5733	9/3	0	0	
1982	13500	2/19-22	2	17	4990---2/12-13---9; 5000---2/19-22---8
1983	8784	6/5	0	0	
1984	24054	5/11	1	13	#15120---5/11---13
1985	7680	1/21	0	0	
1986	6649	12/31	0	0	
1987	8589	4/23	1	21	160---4/3---21
1988	8583	6/27	0	0	
1989	15948	6/22	0	8	#7419---6/22---8
1990	17906	2/18	3	22	9360---2/19---16; 524---4/30---1; 4201---12/31---19
1991	16994	12/17	6	61	7640---1/3---19; 6240---2/22-25---16; 354---5/16---2; 3900---6/25-26---4; 8515---12/7---23; 3000---12/31---9
1992	12227	1/4	4	11	7900---1/4---9; 158---9/29---2; 47---10/10---1; 141---10/31---1
1993	8786	3/28&31	0	0	
1994	22849	3/6	6	54	10181---2/15---10; 14403---3/6---13; 9290---3/12---6; 13715---4/1---13; 10835---4/18---10; 119---5/17---2
1995	8063	9/24	4	11	136---6/7---2; 1872---6/11---3; 92---11/3---1; 2930---11/28---5
1996	16366	2/4	2	27	8380---1/30---12; 4170---12/14---15
1997	12723	3/17	1	12	4020---3/8-11---12
1998	26603	4/26	2	22	*24588---4/25---15;*7173---5/14---7

RIVER SYSTEM OPERATIONS

TVA OPERATED RESERVOIR SYSTEM
ANNUAL MAXIMUM AND MINIMUM ELEVATIONS, IN ORDER OF MAGNITUDE
FROM DATE OF RESERVOIR CLOSURE THROUGH 1998

NORRIS

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
1	1031.10	1937	FEB.	11	1	878.20	1936	MAR.	4
2	1030.38	1998	APR.	22	2	909.35	1956	JAN.	24
3	1030.20	1984	MAY	10	3	929.13	1954	JAN.	15
4	1027.42	1989	JUNE	19	4	932.60	1955	DEC.	27
5	1024.72	1958	MAY	15	5	934.56	1958	DEC.	27
6	1024.60	1971	MAY	17	6	934.78	1940	JAN.	14
7	1024.10	1973	MAY	30	7	935.15	1959	JAN.	13
8	1023.26	1944	APR.	15	8	937.21	1966	FEB.	4
9	1022.85	1942	AUG.	22	9	937.65	1941	DEC.	4
10	1022.69	1994	APR.	17	10	939.55	1939	DEC.	31
11	1022.64	1972	MAY	17	11	941.00	1953	DEC.	31
12	1022.55	1938	JULY	26	12	942.12	1964	JAN.	4
13	1022.53	1997	JUNE	20	13	943.32	1963	DEC.	31
14	1022.44	1983	MAY	27	14	943.80	1948	FEB.	4
15	1022.28	1996	MAY	31	15	944.09	1942	JAN.	1
16	1022.09	1975	APR.	1	16	944.30	1965	DEC.	31
17	1021.73	1943	APR.	30	17	949.65	1960	DEC.	30
18	1021.17	1990	JUNE	2	18	949.80	1943	DEC.	24
19	1020.93	1991	JUNE	24	19	950.77	1944	JAN.	1
20	1020.44	1977	APR.	10	20	951.93	1961	JAN.	1
21	1019.77	1979	JUNE	8	21	956.15	1946	DEC.	21
22	1019.04	1974	JAN.	14	22	956.92	1981	JAN.	22
23	1019.02	1995	JUNE	7	23	957.00	1947	DEC.	31
24	1018.81	1950	AUG.	7	24	958.95	1938	JAN.	10
25	1018.65	1967	AUG.	2	25	959.57	1969	DEC.	29
26	1018.58	1993	JUNE	1	26	960.37	1937	DEC.	28
27	1018.28	1987	APR.	28	27	960.83	1968	DEC.	20
28	1018.25	1956	MAY	13	28	962.86	1962	DEC.	22
29	1017.74	1945	JUNE	25	29	964.01 %	1980	DEC.	31
30	1017.62	1951	MAY	14	30	964.64	1957	JAN.	22
31	1017.49	1949	JULY	27	31	968.45	1952	DEC.	31
32	1016.92	1970	MAY	11	32	969.25	1970	DEC.	19
33	1015.73	1992	JUNE	25	33	971.27	1951	OCT.	31
34	1015.72	1980	MAY	27	34	971.44	1987	DEC.	24
35	1015.30	1964	MAY	11	35	971.99	1967	JAN.	26
36	1014.42	1955	MAY	2	36	972.07	1945	JAN.	1
37	1014.26	1978	JUNE	16	37	972.30	1977	FEB.	23
38	1013.40	1968	JUNE	17	38	973.02	1974	NOV.	19
39	1013.16	1962	APR.	21	39	974.61	1986	JAN.	31
40	1013.01	1940	SEP.	13	40	974.68	1978	DEC.	1
41	1012.96	1946	JULY	29	41	974.74	1995	JAN.	6

RIVER SYSTEM OPERATIONS

TVA OPERATED RESERVOIR SYSTEM
ANNUAL MAXIMUM AND MINIMUM ELEVATIONS, IN ORDER OF MAGNITUDE
FROM DATE OF RESERVOIR CLOSURE THROUGH 1998

NORRIS

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
42	1012.80	1939	JULY	19	42	974.84	1988	JAN.	18
43	1012.71	1965	APR.	19	43	975.34	1994	DEC.	31
44	1012.27	1961	MAY	25	44	975.90	1985	NOV.	3
45	1011.97	1963	MAR.	19	45	976.52	1971	JAN.	2
46	1011.25	1953	MAY	31	46	976.97	1997	DEC.	20
47	1010.98	1982	JUNE	17	47	977.02	1998	JAN.	1
48	1008.98	1976	JUNE	11	48	977.87	1975	DEC.	25
49	1006.23	1948	APR.	21	49	977.95	1950	JAN.	3
50	1006.22	1981	JUNE	22	50	978.00	1983	NOV.	15
51	1005.75	1952	JUNE	2	51	978.20	1949	DEC.	31
52	1004.76	1960	APR.	17	52	978.96	1984	DEC.	21
53	1003.40	1985	JUNE	21	53	980.14	1982	NOV.	17
54	1002.25	1957	FEB.	4	54	980.20	1976	JAN.	1
55	1001.51	1959	JUNE	21	55	982.00	1979	DEC.	23
56	1001.30	1986	MAY	30	56	983.03	1972	JAN.	1
57	999.88	1936	JUNE	19	57	984.31 %	1993	NOV.	24
58	999.83	1988	MAY	31	58	984.70	1973	JAN.	18
59	997.88	1966	MAY	25	59	985.49 %	1996	JAN.	1
60	996.00	1941	AUG.	24	60	986.42	1989	JAN.	1
61	994.81	1947	MAY	18	61	986.91	1992	DEC.	16
62	994.52	1969	APR.	29	62	987.46	1990	JAN.	1
63	993.82	1954	JUNE	7	63	987.60	1991	NOV.	21

* CLOSURE
% MIDNIGHT ELEVATION
TOP-OF-GATES ELEVATION 1035

MAXIMUM, MINIMIUM, MEDIAN, AND MEAN

Adjusted Flow by Weeks
Norris
Years=1903-1998

WEEK ENDING	WEEK NO.	AVERAGE WEEKLY CFS MAXIMUM	YR	MINIMUM	YR	MEDIAN	MEAN
JAN 7	1	26,900	1919	449	1981	5,060	7,230
JAN 14	2	37,000	1974	436	1981	4,950	6,770
JAN 21	3	37,300	1947	310	1981	5,060	6,530
JAN 28	4	25,600	1937	490	1940	6,280	7,850
FEB 4	5	58,200	1957	510	1940	5,570	8,350
FEB 11	6	25,000	1994	920	1934	6,310	7,870
FEB 18	7	36,500	1948	810	1934	6,550	8,370
FEB 25	8	26,900	1991	840	1934	6,600	8,540
MAR 4	9	35,000	1962	860	1941	5,870	8,380
MAR 11	10	36,200	1917	1,760	1931	7,230	9,100
MAR 18	11	49,000	1963	1,660	1931	6,970	9,240
MAR 25	12	32,400	1955	1,470	1966	6,180	8,750
APR 1	13	36,700	1994	1,350	1910	6,060	8,520
APR 8	14	60,700	1977	1,050	1910	5,850	7,710
APR 15	15	24,800	1903	1,190	1910	5,270	6,460
APR 22	16	51,900	1998	1,090	1986	4,430	5,960
APR 29	17	21,400	1958	1,050	1986	4,120	5,050
MAY 6	18	21,000	1912	796	1986	3,740	5,190
MAY 13	19	40,200	1984	870	1942	3,500	5,160
MAY 20	20	19,500	1950	720	1941	3,000	4,260
MAY 27	21	20,700	1929	640	1941	2,930	3,690
JUN 3	22	16,200	1924	560	1936	2,460	3,430
JUN 10	23	10,500	1981	605	1988	2,110	2,940
JUN 17	24	20,300	1907	572	1988	1,770	2,790
JUN 24	25	12,400	1989	330	1944	1,770	2,340
JUL 1	26	18,200	1928	327	1988	1,690	2,210
JUL 8	27	10,400	1928	169	1988	1,740	2,140
JUL 15	28	11,800	1909	412	1964	1,680	2,180
JUL 22	29	11,600	1949	330	1944	1,450	2,100
JUL 29	30	9,300	1938	80	1944	1,420	1,850
AUG 5	31	8,870	1996	201	1986	1,370	1,960
AUG 12	32	15,100	1942	228	1957	1,340	1,770
AUG 19	33	12,100	1920	342	1988	1,240	1,950
AUG 26	34	7,890	1920	220	1987	1,210	1,700
SEP 2	35	6,020	1914	124	1988	983	1,340
SEP 9	36	9,600	1928	186	1955	902	1,160
SEP 16	37	4,310	1910	90	1964	867	1,090
SEP 23	38	6,950	1989	73	1959	796	1,050
SEP 30	39	7,280	1989	240	1959	762	1,090
OCT 7	40	13,900	1915	250	1908	677	1,370
OCT 14	41	7,670	1977	176	1988	748	1,050
OCT 21	42	9,000	1964	119	1980	720	1,200
OCT 28	43	9,090	1971	234	1952	825	1,360

MAXIMUM, MINIMIUM, MEDIAN, AND MEAN (CONT.)

Adjusted Flow by Weeks
Norris
Years=1903-1998

WEEK ENDING	WEEK NO.	AVERAGE WEEKLY CFS MAXIMUM	YR	MINIMUM	YR	MEDIAN	MEAN
NOV 4	44	16,800	1918	270	1909	886	1,520
NOV 11	45	16,300	1977	200	1910	895	1,750
NOV 18	46	13,000	1929	230	1910	1,160	2,090
NOV 25	47	24,600	1906	230	1910	1,660	2,780
DEC 2	48	38,700	1973	320	1936	1,900	3,580
DEC 9	49	25,700	1991	380	1903	2,420	3,960
DEC 16	50	31,900	1972	369	1965	2,740	4,440
DEC 23	51	25,600	1915	456	1965	2,930	4,480
DEC 31	52	46,400	1926	421	1965	4,980	6,200

AVERAGE FLOW:1903 - 1998 = 4230 CFS

ADJUSTED FLOWS COMPUTED BY:

01/01/03 - 07/02/27 Flow computed from Clinton gage records by ratio of drainage areas (2912/3056 sq. mi.).

07/03/27 - 10/07/34 Flow computed from records at Coal Creek.

10/08/34 - 12/31/35 Flow computed from records at Coal Creek adjusted for storage changes in Norris Reservoir.

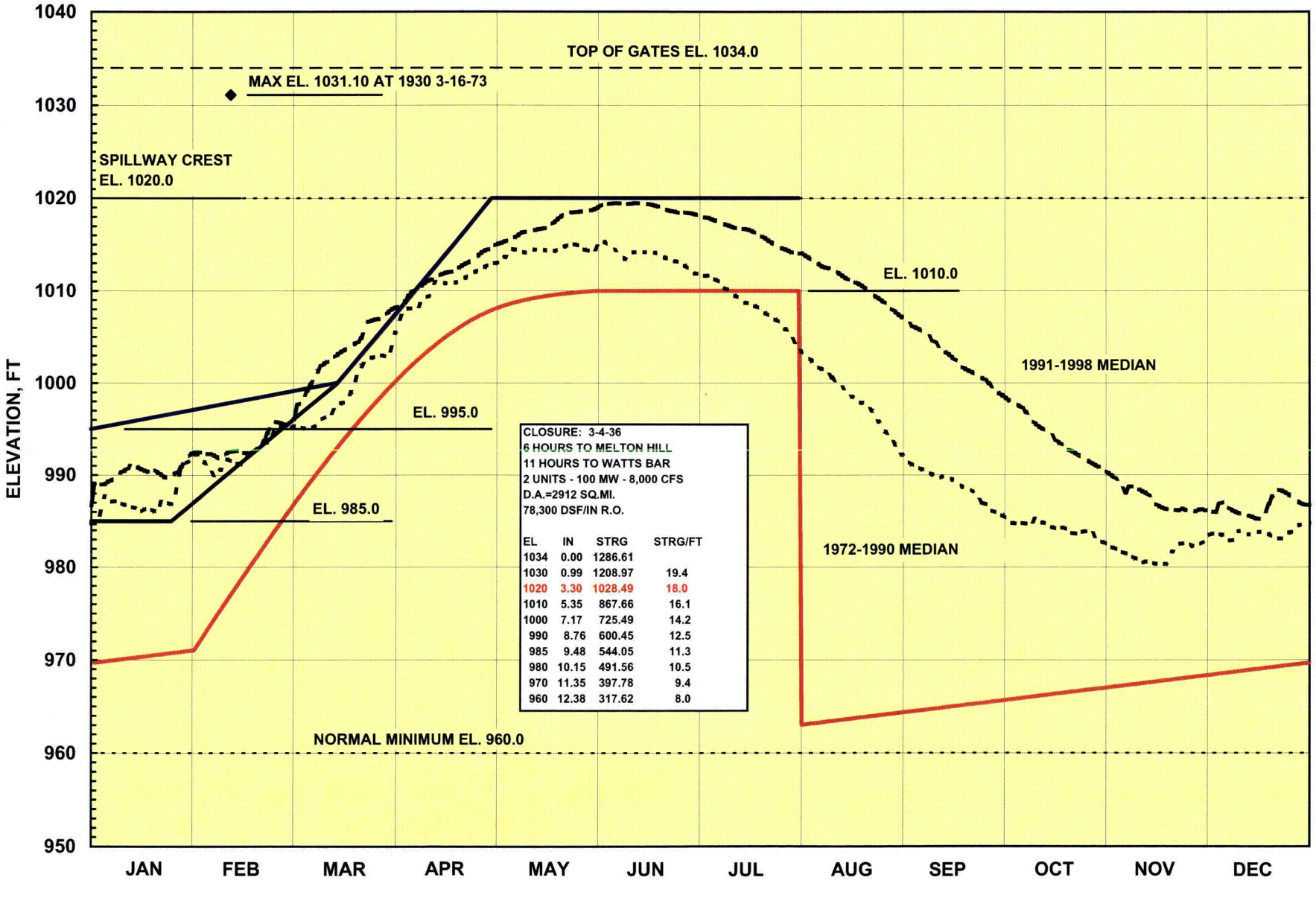
01/01/36 - 04/15/36 Same as above, with additional corrections made for rainfall on reservoir, evaporation from reservoir, and runoff which would have occurred from inundated area.

04/16/36 - 12/31/38 Same as above, except using flow records below Norris Dam.

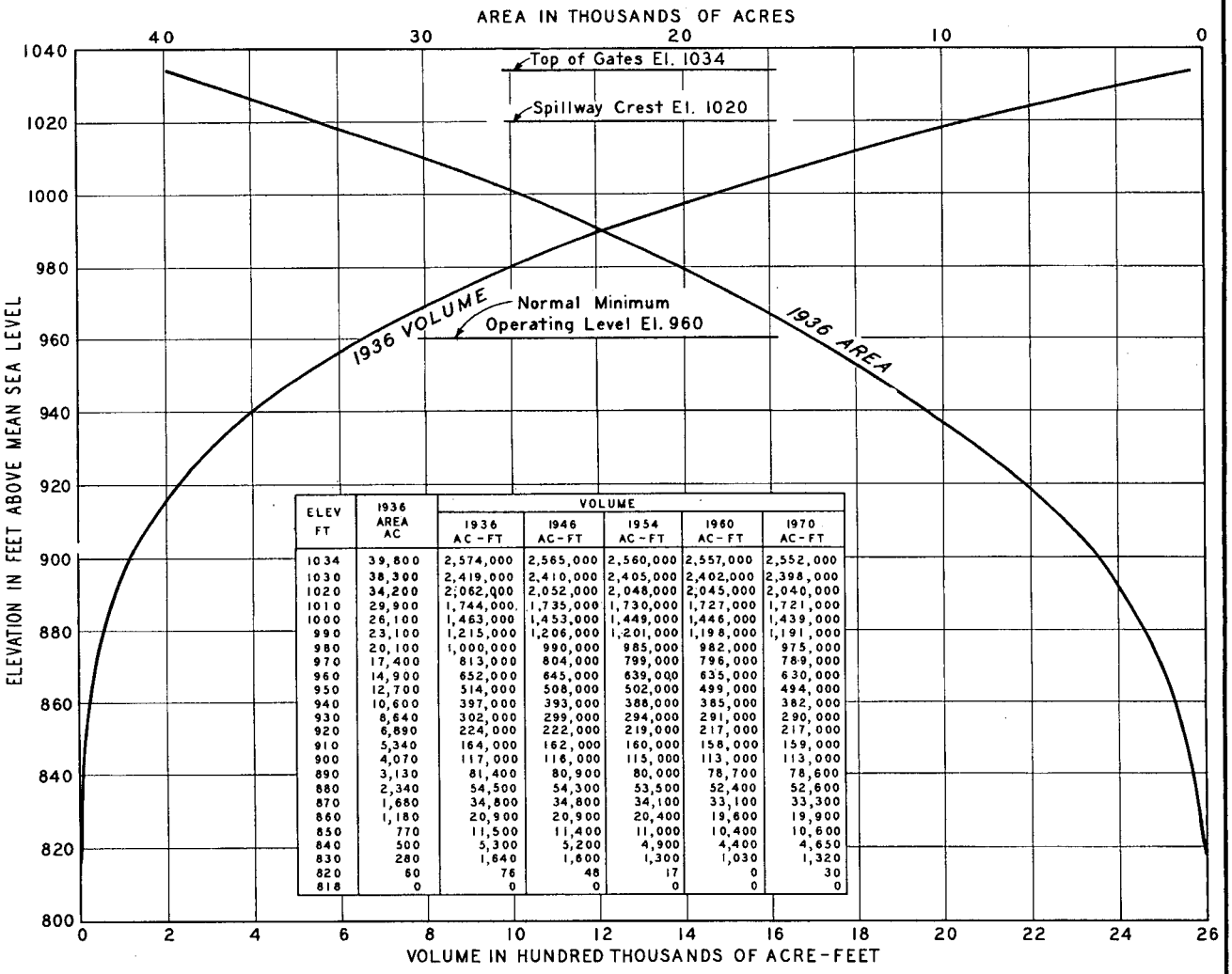
01/01/39 - 12/31/56 Flows were computed from USGS records of the Below Norris Dam, Tennessee, gage, drainage area 2,913 sq. mi., corrected for storage changes in Norris Reservoir.

01/01/57 - current Flows were computed by correcting Norris Dam reported discharges for storage changes in Norris Reservoir.

ANNUAL OPERATING CYCLE



EL	IN	STRG	STRG/FT
1034	0.00	1286.61	
1030	0.99	1208.97	19.4
1020	3.30	1028.49	18.0
1010	5.35	867.66	16.1
1000	7.17	725.49	14.2
990	8.76	600.45	12.5
985	9.48	544.05	11.3
980	10.15	491.56	10.5
970	11.35	397.78	9.4
960	12.38	317.62	8.0



ELEV FT	1936 AREA AC	VOLUME 1936 AC-FT	1946 AC-FT	1954 AC-FT	1960 AC-FT	1970 AC-FT
1034	39,800	2,574,000	2,565,000	2,560,000	2,557,000	2,552,000
1030	38,300	2,419,000	2,410,000	2,405,000	2,402,000	2,398,000
1020	34,200	2,062,000	2,052,000	2,048,000	2,045,000	2,040,000
1010	29,900	1,744,000	1,735,000	1,730,000	1,727,000	1,721,000
1000	26,100	1,463,000	1,453,000	1,449,000	1,446,000	1,439,000
990	23,100	1,215,000	1,206,000	1,201,000	1,198,000	1,191,000
980	20,100	1,000,000	990,000	985,000	982,000	975,000
970	17,400	813,000	804,000	799,000	796,000	789,000
960	14,900	652,000	645,000	639,000	635,000	630,000
950	12,700	514,000	508,000	502,000	499,000	494,000
940	10,600	397,000	393,000	388,000	385,000	382,000
930	8,640	302,000	299,000	294,000	291,000	290,000
920	6,890	224,000	222,000	219,000	217,000	217,000
910	5,340	164,000	162,000	160,000	158,000	159,000
900	4,070	117,000	116,000	115,000	113,000	113,000
890	3,130	81,400	80,900	80,000	78,700	78,600
880	2,340	54,500	54,300	53,500	52,400	52,600
870	1,680	34,800	34,800	34,100	33,100	33,300
860	1,180	20,900	20,900	20,400	19,600	19,900
850	770	11,500	11,400	11,000	10,400	10,600
840	500	5,300	5,200	4,900	4,400	4,650
830	280	1,640	1,600	1,300	1,030	1,320
820	60	76	48	17	0	30
818	0	0	0	0	0	0

NOTES:

Reservoir areas were measured on Tennessee River Survey Maps with contours drawn at 10' intervals and scale 1" = 1,250'. The contours were made to conform to elevations on the TVA sediment range cross-sections located at approximately one-half mile intervals within the reservoir. The areas on these maps were adjusted proportionately to conform to the area of the 1020 contour on the TVA Reservation Map, scale 1" = 1000'.

Elevations are referred to the 1912 Fourth General Adjustment of the USC&GS. To correct to the 1936 Supplementary Adjustment, add 0.11 Foot.

Area of original river within the reservoir = 2,930 acres.

Drainage area at the dam = 2,912 square miles.

The 1946 and subsequent volumes were determined by the constant factor method for computing sediment.

Dam closure March 4, 1936.

REV NO.	DATE	MADE	CHKD	SUPV	INSP
1	3-30-72	DCW			

CHANGE NOR. MIN. OPER. LEVEL

DRWN _____ COMPUTED _____

TRCD RHL ENGINEER _____

CHKD _____

THIS DRAWING SUPERSEDES 2-DA-1-321N783R0

CLINCH RIVER MILE 79.8

RESERVOIR AREAS AND VOLUMES

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED
Edwin H. McCain	Paul C. Spath	Reed G. Elliott

KNOXVILLE 3-5-71 2 DA 1 321G783R1

Hydro Modernization and Reservoir Release Improvements

Auto-Venting Turbine Modernization

In many reservoirs, solar heating creates thermal stratification in the summer, yielding a water column with a warm surface layer and a cool bottom layer. This arrangement is hydrodynamically stable, which inhibits mixing between the layers and isolates the bottom water from atmospheric oxygen. Concurrently, the respiration of biological organisms and decomposition of organic substances in the water and sediments deplete the dissolved oxygen (DO) in the bottom layer. With intakes located in the bottom layer, this low DO water is released during hydropower operations, often creating poor water quality in the river downstream from the reservoir. These conditions subsequently damage aquatic habitat in the river and contribute to other water quality problems. The auto-venting turbine (AVT) is usually the least-cost alternative for increasing DO in hydro releases due to minimal requirements for extra mechanical equipment, as well as reduced expenses for operation and maintenance. Auto-venting turbines increase the concentration of dissolved oxygen in hydropower releases by aspirating and mixing air with the water as it passes through the runner. These new units include aeration objectives as an integral part of the turbine design, thus improving efficiency not only for hydraulic performance but also for environmental performance. At Norris Dam, new upgrade turbines installed in 1995 and 1996 represent the first of these new type of units in the world. Each of these units contains several options to aerate the flow. These AVT units, shown in FIGURE 9, contain options to aerate the flow through central, distributed, and peripheral outlets at the exit of the turbines. For environmental performance, results show that up to 5.5 mg/L of DO uptake can be obtained for single unit operation with all aeration options operating. To meet the 6.0 mg/L target that has been established for this project, an additional 0.5 mg/L of DO improvement is obtained by the flow over the re-regulation weir downstream from the powerhouse. For hydraulic performance, efficiency losses ranging from 0 to 4 percent are obtained, depending on the operating condition and the aeration options. Compared to the original turbines, these units provide overall efficiency and capacity improvements of 3.5 and 10 percent, respectively. The new runners also have shown significant reductions in both cavitation and vibration.

In general, the environmental and hydraulic performance of a given option varies with the head and power output. Under these conditions, the options used to meet a target DO can be strategically chosen to minimize the aeration-induced efficiency loss. As an example, consider the 1996 DO data for the new units at Norris, shown in FIGURE 10. Turbine aeration was initiated in July when the scrollcase DO began to decrease. Throughout the low DO season, a mix of aeration options was used, based on the head, power output, and required DO uptake. Aeration was discontinued in November following reservoir turnover. On the average, the DO downstream of the project was main-

Hydro Modernization and Reservoir Release Improvements (CONT.)

Auto-Venting Turbine Modernization

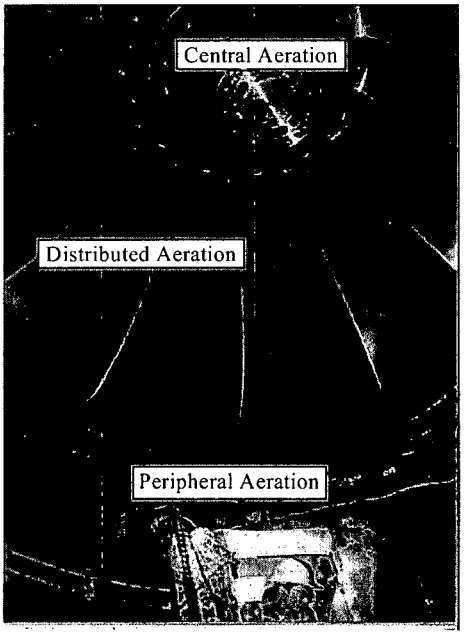


Figure 9: Unit 2 auto-venting turbine runner

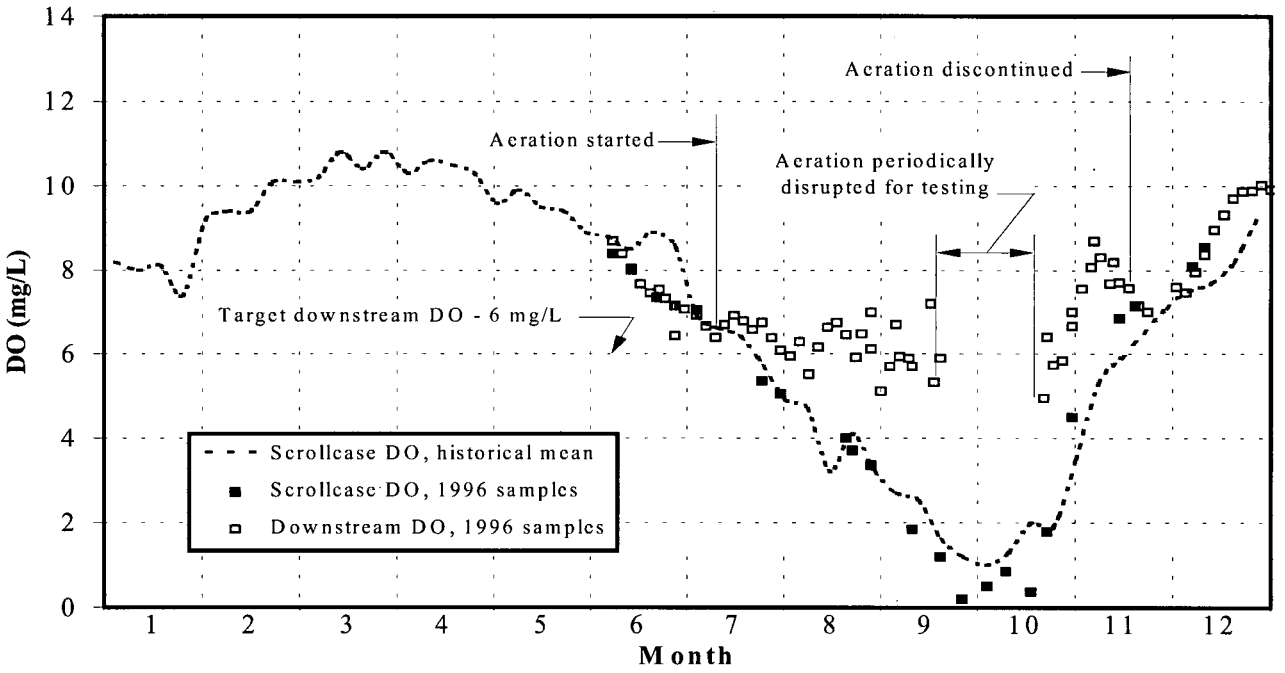


Figure 10: Dissolved oxygen improvement for Norris Dam, 1996

Hydro Modernization and Reservoir Release Improvements (CONT.)

Auto-Venting Turbine Modernization

tained near the 6.0 mg/L target to maintain and enhance an ever growing rainbow and brown trout fishery (except for a period when aeration was disrupted for an extreme series of performance tests on the new units). During the same period, the average aeration-induced turbine efficiency loss was about 1.9 percent.

TVA and Voith Hydro, Inc. have jointly developed and implemented a machine condition monitoring system to help balance the energy, economics, and environmental requirements for hydro facilities. With the monitoring system, airflow, DO, and turbine efficiency can be viewed simultaneously to help operators comply with water quality requirements and achieve the desired level of power generation.

Re-regulation Weir

The re-regulation weir was constructed in the Clinch River below Norris Dam in 1984. The Norris re-regulation weir is a hydraulic structure in the Clinch River that augments minimum flow (FIGURES 11 through 17). The weir is located 1.8 miles downstream of Norris Dam and is constructed on both sides of Hibbs Island. The minimum downstream flow (200 cfs) is provided during periods of non-generation at Norris Dam by a series of eleven pipes; periodic pulses from Norris Dam maintain water in the pool above the weir. Five of the pipes are uncontrolled open pipes. Six other pipes are controlled by float-actuated valves that open gradually as the headwater elevation on the weir decreases. Each valve has an arm length, of either 18 or 24 inches, connecting the valve and the float. As the pool level begins to drop, the valves with 24-inch arms begin to open first and the valves with 18-inch arms open last.

Various modifications to the re-regulation weir have been made since 1984 and major renovations were completed in the summer of 1995. Consequently, these modifications and renovations have enhanced and improved the aquatic environment below Norris Dam. For more information on improvements to the biological and aquatic environment see the Resource Group (Water Management) October 1996 report titled "Biological and Water Quality Responses in Tributary Tailwaters to Dissolved Oxygen and Minimum Flow Improvements".

It should be noted that Norris Dam was the first dam to benefit from the RRI program. Testing various methods of turbine venting and hub baffles in 1980-82 to increase DO in the tailwater led to routine, seasonal use of hub baffles and turbine venting from 1983 to 1995. In September 1995, a newly designed autoventing turbine runner replaced one of the two original turbine runners. The new design is more efficient at aerating discharge water, as well as generating electricity. The new Unit 1 runner became operational in December 1995.

FIGURE 11 - Re-regulation Weir Downstream of Norris Dam, July 1998

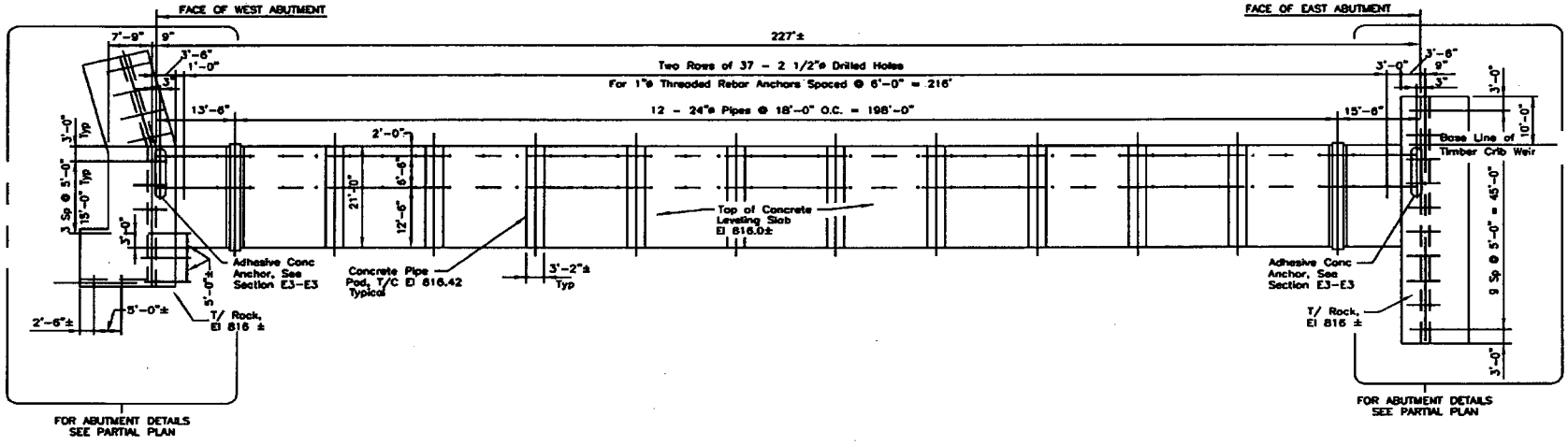


FIGURE 12: EAST CHANNEL WEIR ANCHOR ROD LOCATION PLAN

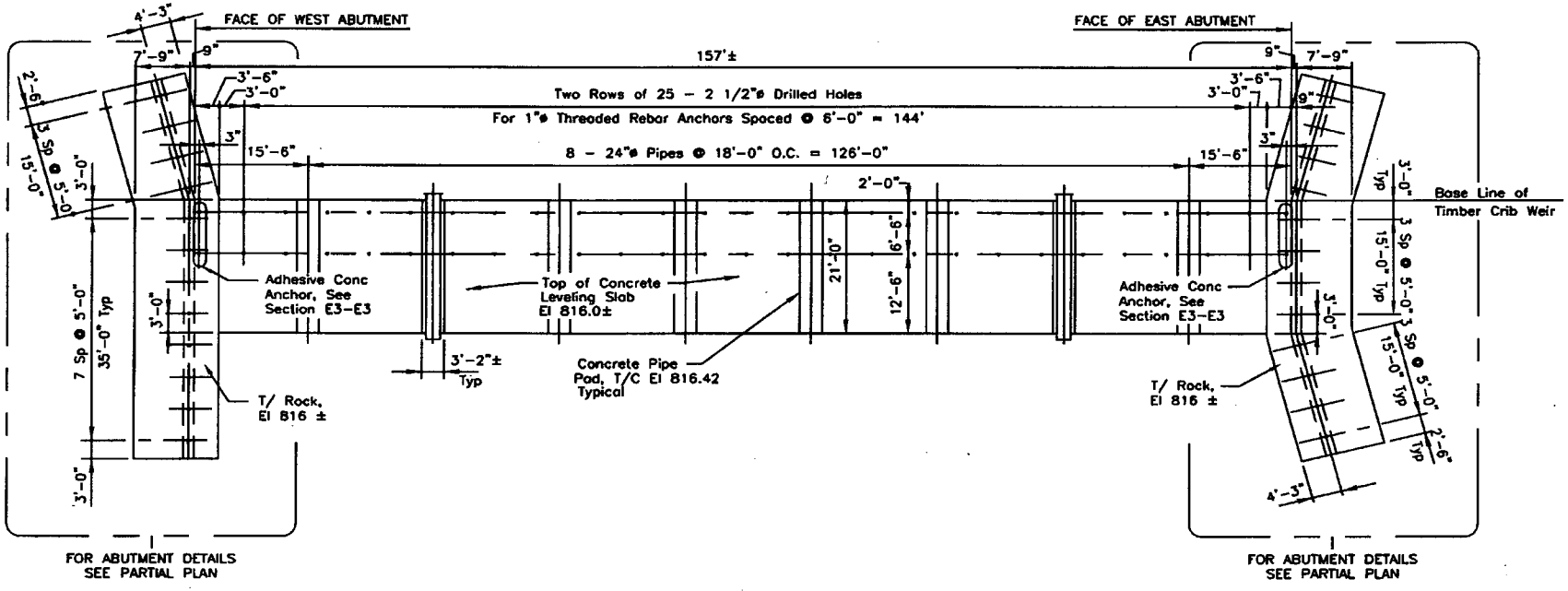


FIGURE 13: WEST CHANNEL WEIR ANCHOR ROD LOCATION PLAN

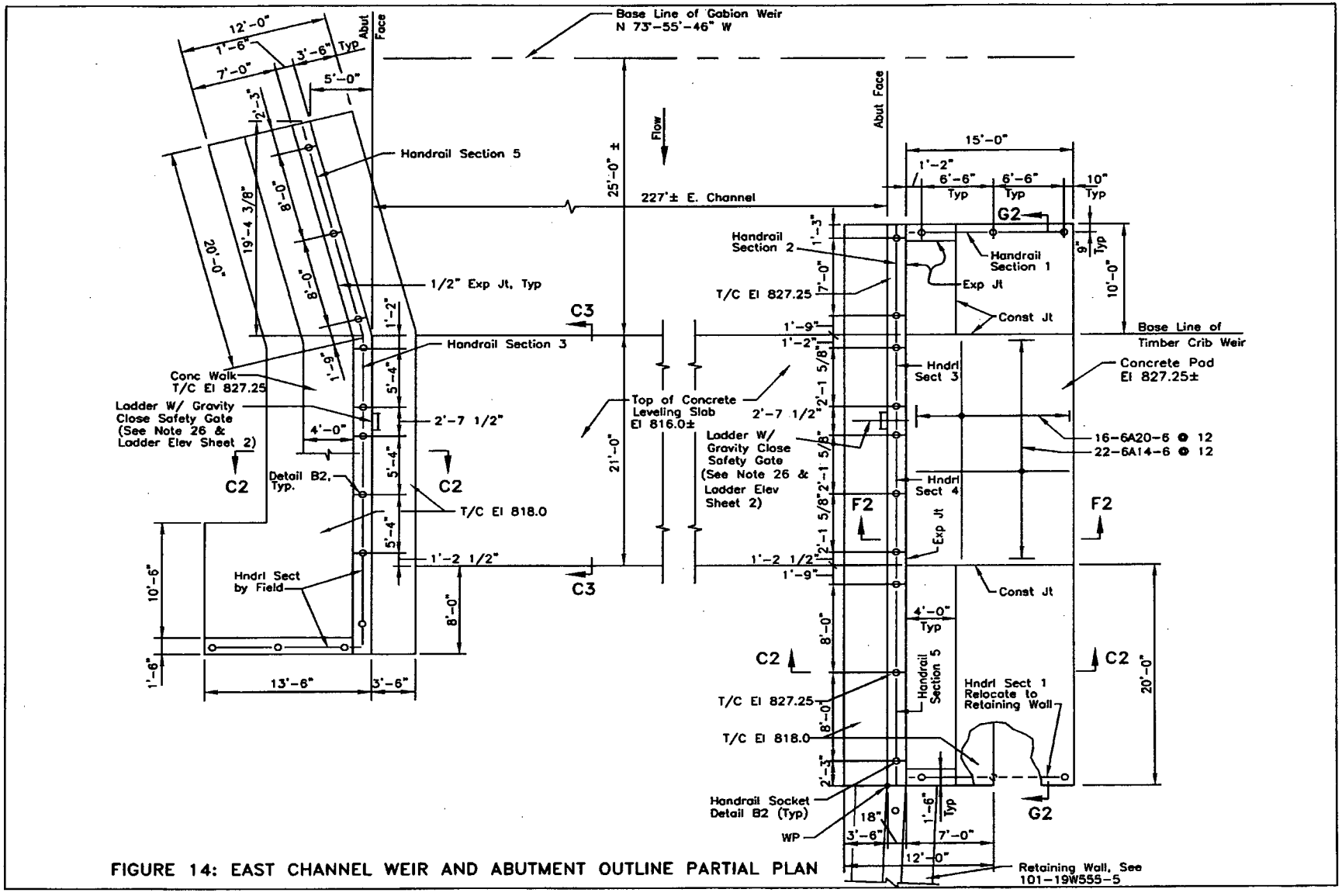


FIGURE 14: EAST CHANNEL WEIR AND ABUTMENT OUTLINE PARTIAL PLAN

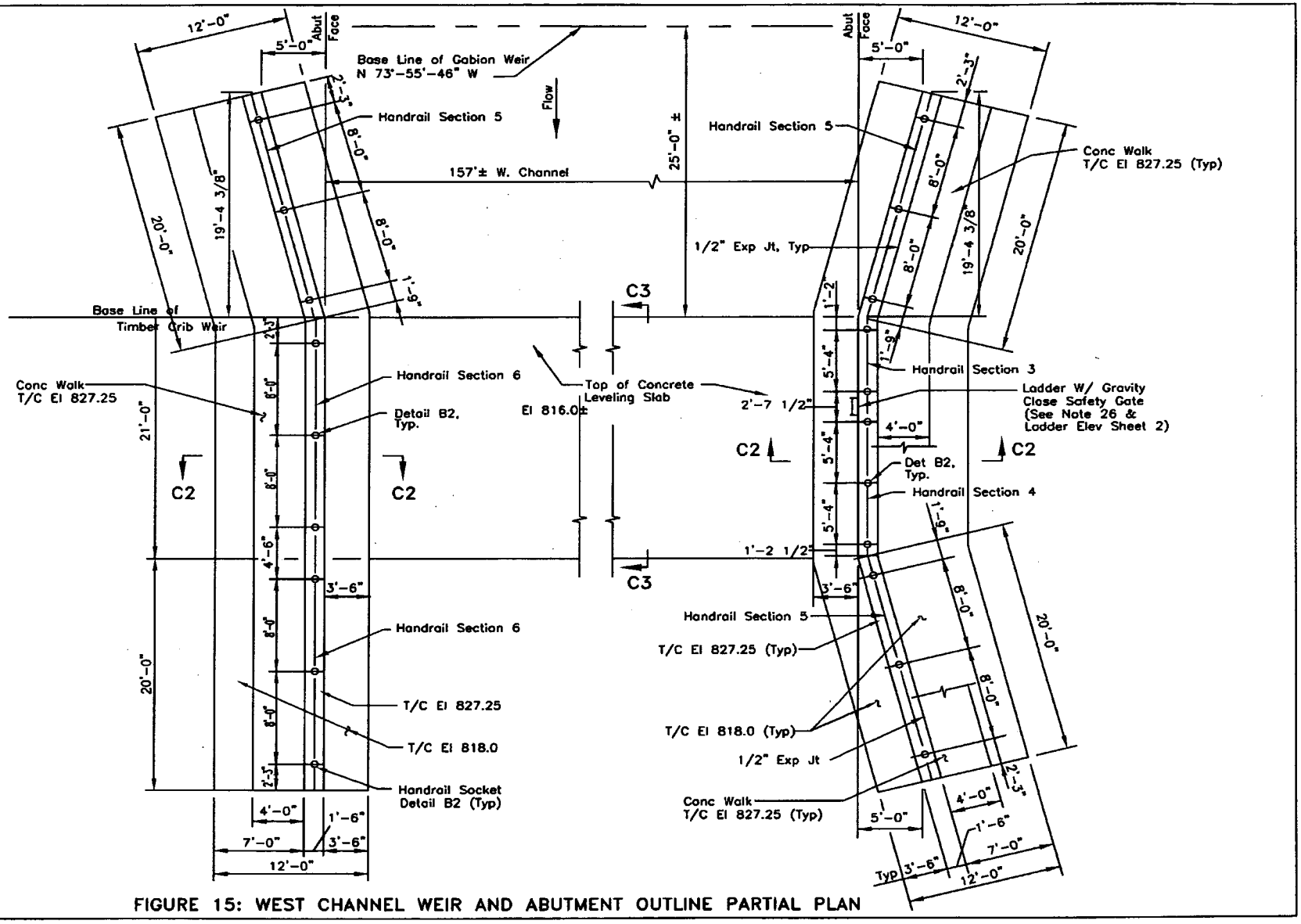


FIGURE 15: WEST CHANNEL WEIR AND ABUTMENT OUTLINE PARTIAL PLAN

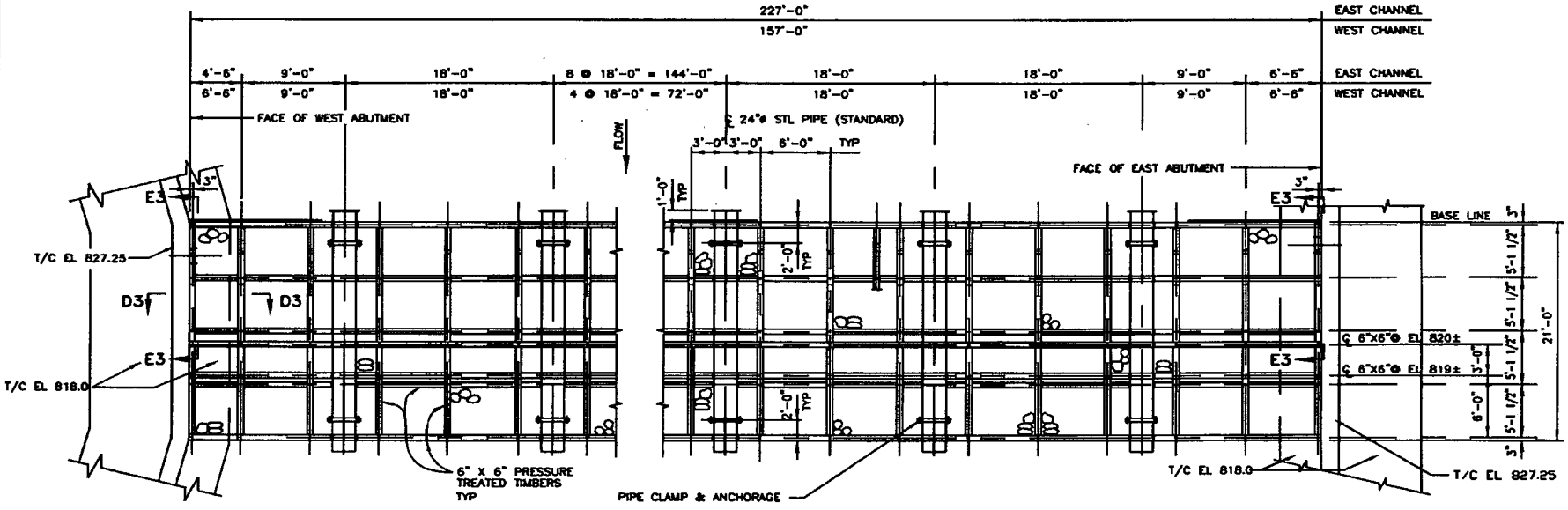


FIGURE 16: WEIR TIMBER CRIBS AND PIPING PARTIAL PLAN

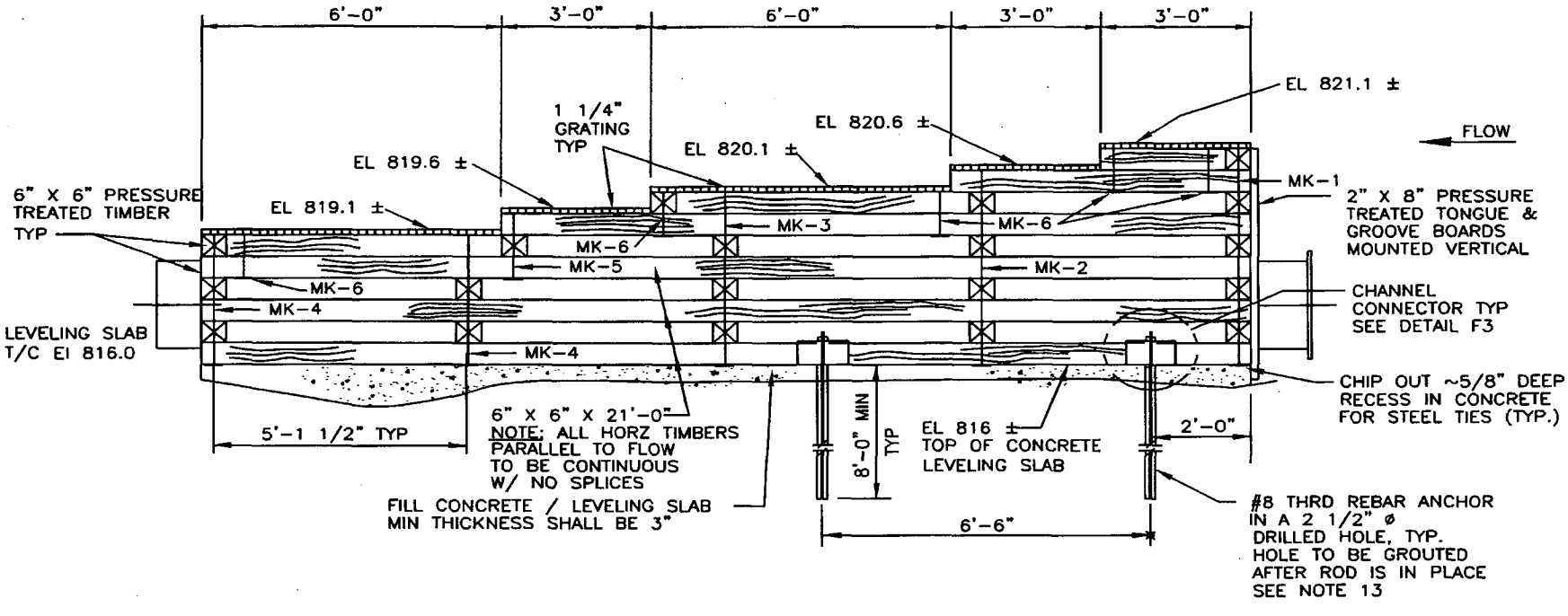


FIGURE 17: TYPICAL WEIR SECTION

HOUSING FACILITIES

(Original Project)

Permanent houses built 309
Dormitories built:
- Staff (68 capacity) 1
- Men (708 total capacity) 6
- Women (34 capacity) 1

Public buildings constructed included a cafeteria (544 seats), community and recreation building, school (400 pupils), vocational building, store, gas station, and an observation building.

ORIGINAL CONSTRUCTION DATA

PERSONNEL

	Dam and Reservoir Construction	Dam Construction Only
Peak employed	2,750*	2,100
Total man-hours	16,977,720	7,585,238
Number of injuries	962	371
Days lost	105,060	66,598
Fatalities	8	7
Accident frequency	56.7	48.9
Accident severity	6,188	8,780

**Monthly average during construction.*

QUANTITIES

Dam:
- Concrete ..... 1,002,300 cu. yd
- Earth excavation ..... 192,144 cu. yd
- Rock excavation ..... 282,647 cu. yd
- Earth and rockfill ..... 181,700 cu. yd
- Drilling for foundation ..... 204,781 lin ft
- Foundation grouting cement ..... 225,889 bags

Highway and railroad:
- Excavation ..... 2,300,000 cu. yd

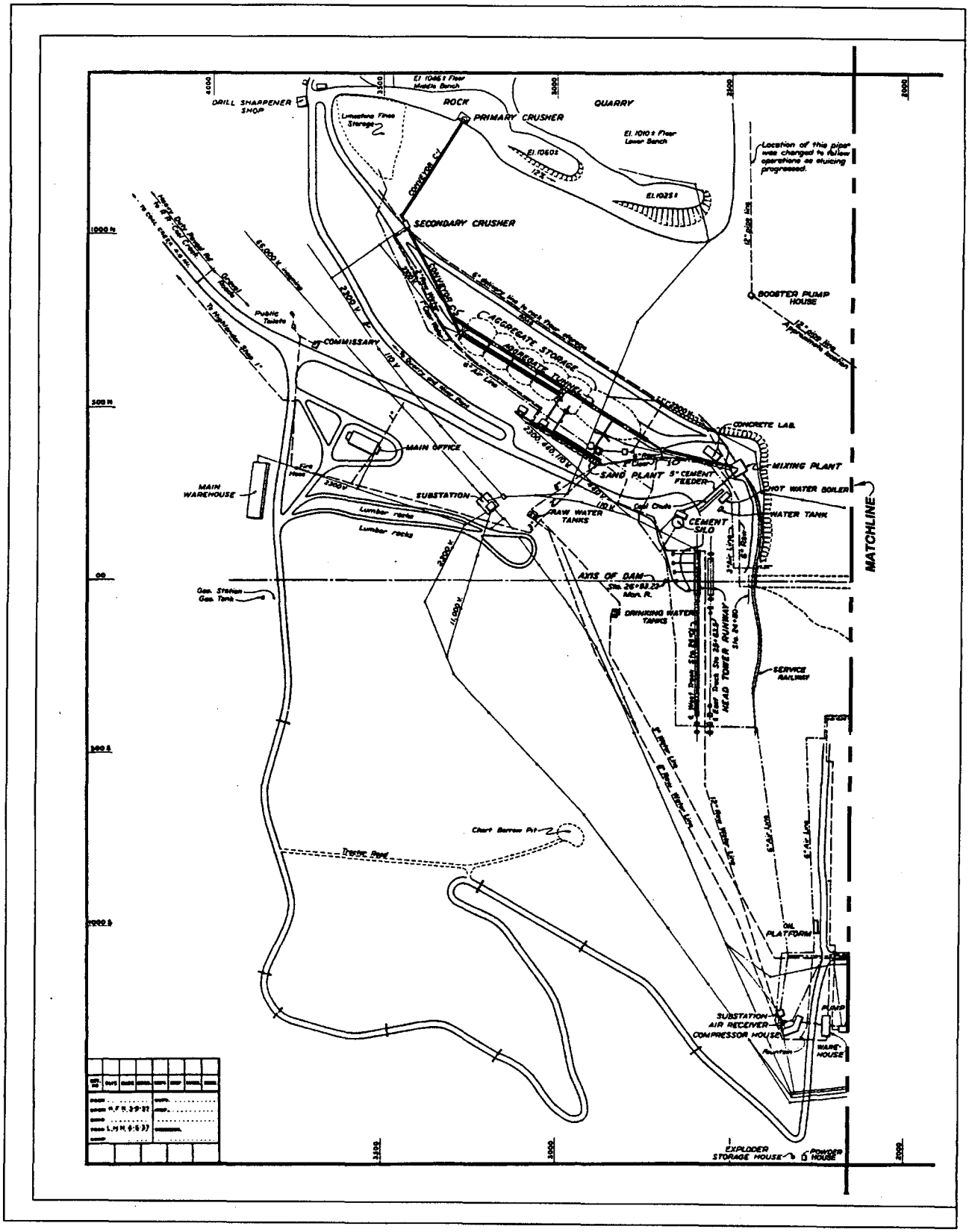


FIGURE 18: Construction Plant Layout (Part 1)

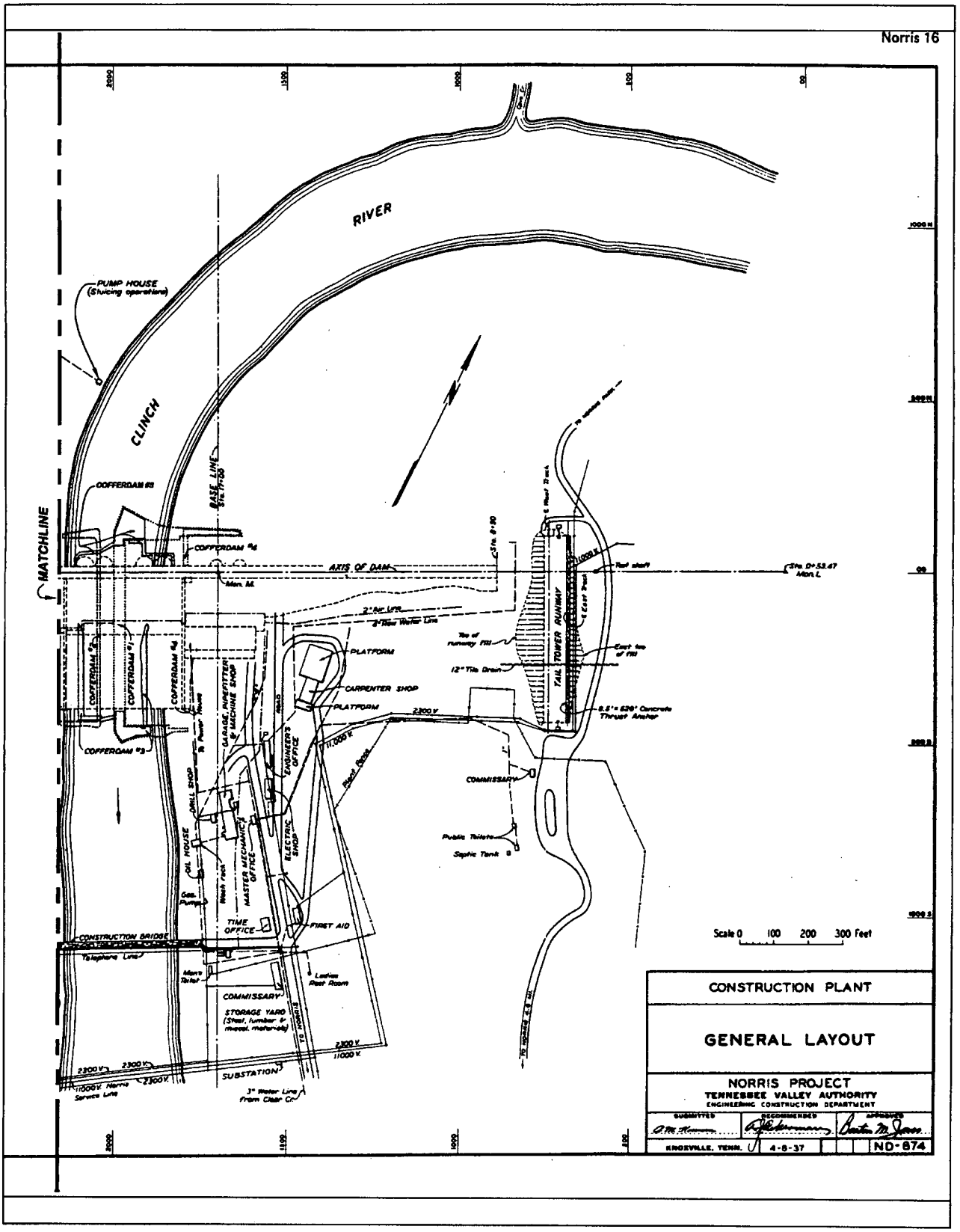
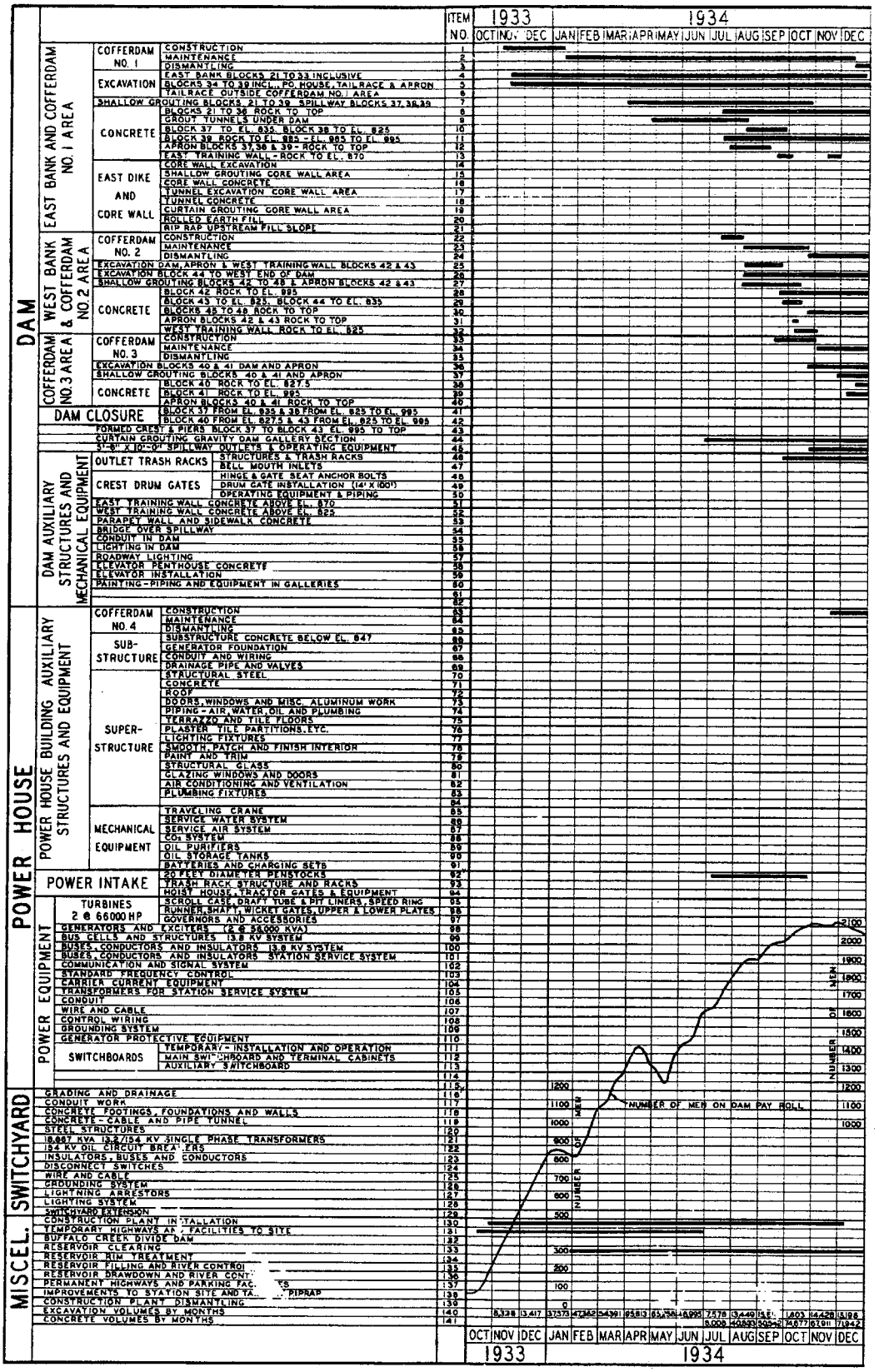
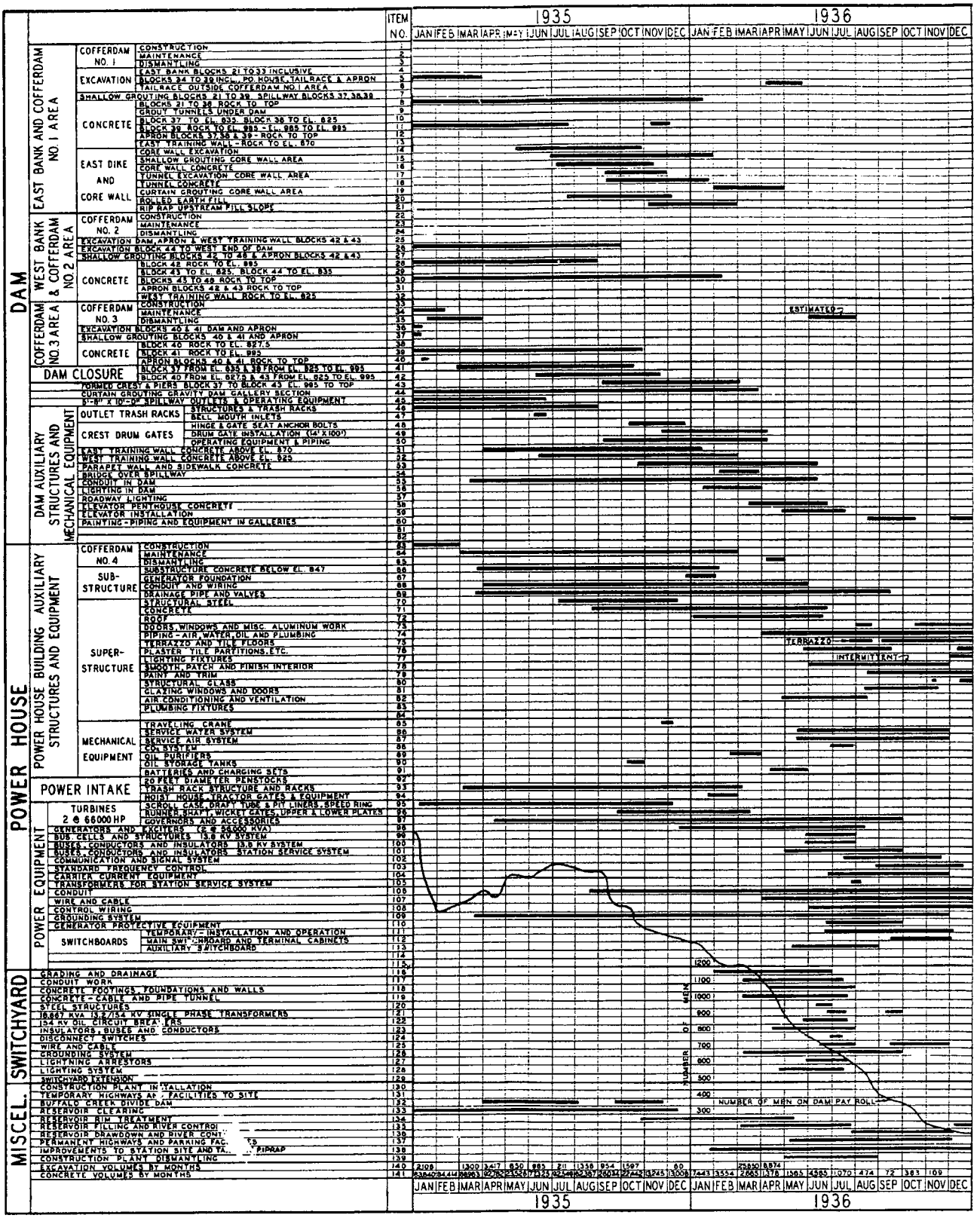


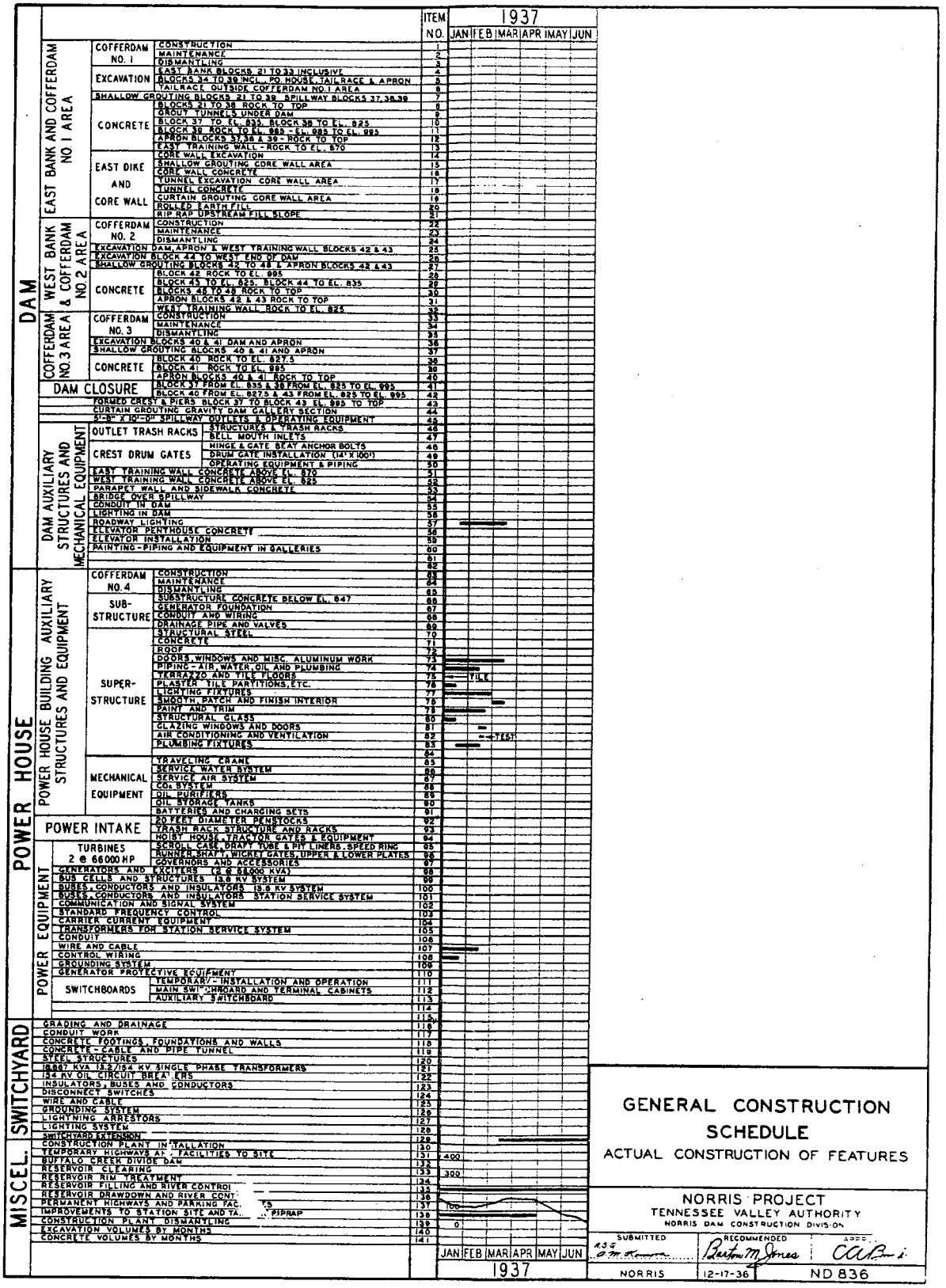
Figure 18: Construction Plant Layout (Part 2)



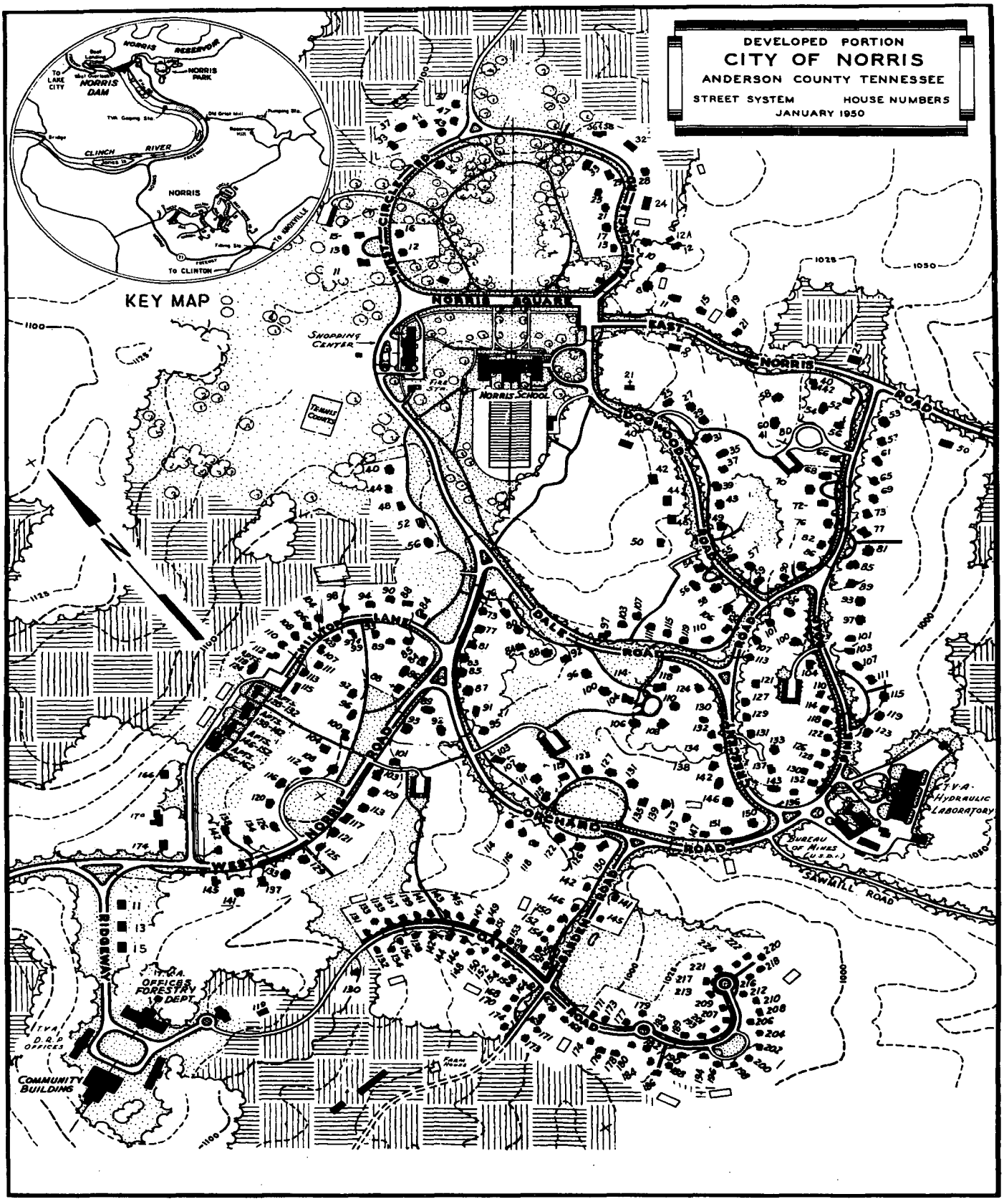
Construction Schedule (Part 1)

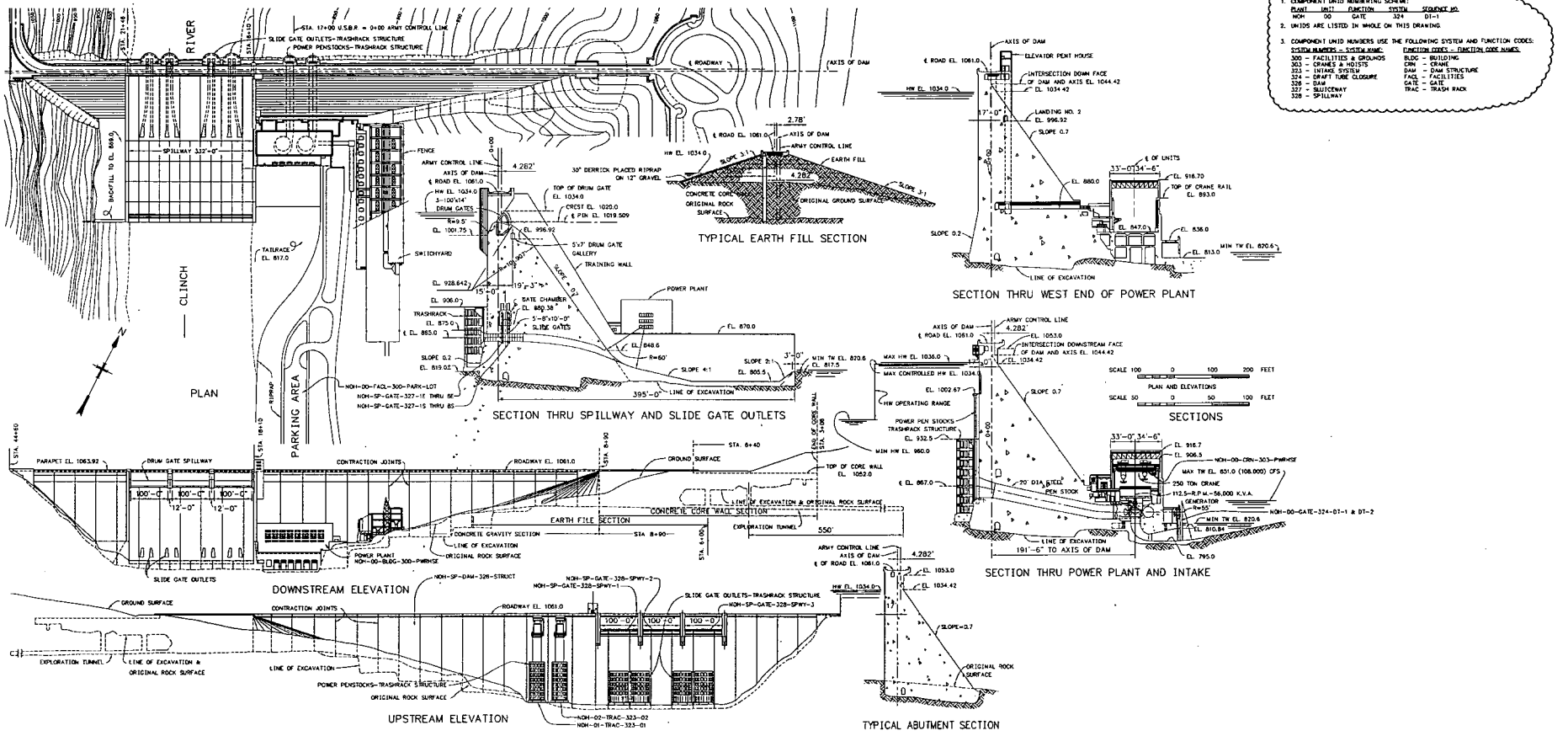


Construction Schedule (Part 2)



Construction Schedule (Part 3)


DEVELOPED PORTION
CITY OF NORRIS
ANDERSON COUNTY TENNESSEE
STREET SYSTEM HOUSE NUMBERS
JANUARY 1950
KEY MAP
NORRIS RESERVOIR
NORRIS DAM
NORRIS PARK
CLINCH RIVER
NORRIS
To LAKE CITY
To CLINTON
To KNOXVILLE
NORRIS SQUARE
SHOPPING CENTER
NORRIS SCHOOL
TENNIS COURTS
EAST NORRIS ROAD
DOGWOOD ROAD
DALE ROAD
HILLTOP LANE
WEST NORRIS ROAD
ORCHARD ROAD
SAWMILL ROAD
RIDGEWAY
T.V.A. OFFICES FORESTRY DEPT.
T.V.A. D.R.P. OFFICES
COMMUNITY BUILDING
T.V.A. HYDRAULIC LABORATORY
BUREAU OF MINES (U.S.D.I.)



1	08-29-08	AW	DMC	GDD	GDD		VEF	NOH-07-32	G

DCN NOH-07-32, REVISED FOR CRITICAL STRUCTURES, SYSTEMS & COMPONENTS VERIFICATION

REV NO.	DATE	DSGN	PREP	CHKD	SUPV	VRFD	APPD	DCN NUMBER	REV BY

SCALE: 1" = 100'-0" EXCEPT AS NOTED

NORRIS DAM

PLAN, ELEVATIONS AND SECTIONS

DESIGNED BY: | SUPERVISED BY: | VERIFIED BY:

NORRIS HYDRO PLANT
TENNESSEE VALLEY AUTHORITY
RIVER OPERATIONS

AUTOCAD 2006 | DATE | 2 | P | 10W200 | R 1

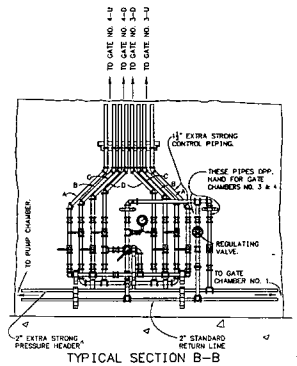
PLOT FACTOR:1200 W_HYDRO

CAD DRAWING DO NOT ALTER MANUALLY

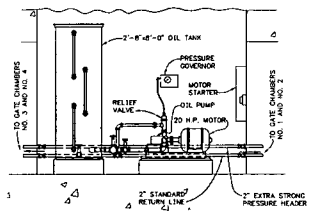
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERCEDES: 232-D-288 R9

TASK COMPLETED BY: | REV NO.

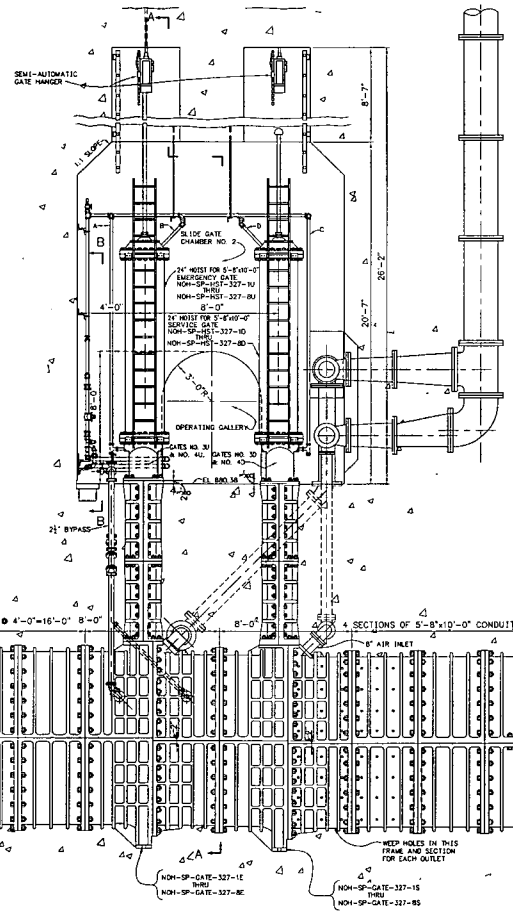
10W200 | P | 2

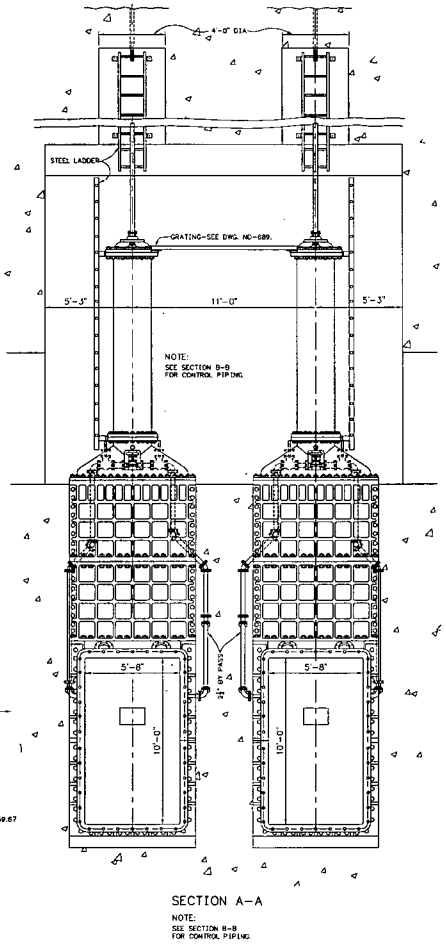


TYPICAL SECTION B–B
SLIDE GATE CHAMBER NO. 2



PUMP CHAMBER





SECTION A–A

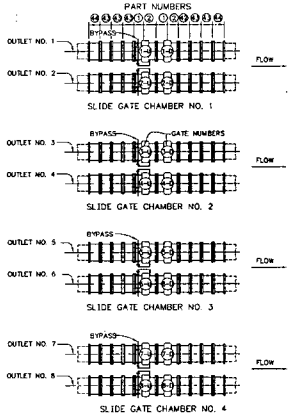
NOTE:
SEE SECTION B–B
FOR CONTROL PIPING.

NOTES:
1. WHEN ASSEMBLING FOR INSTALLATION THE FINISHED FACES OF ALL FLANGED JOINTS ARE TO BE SMOOTHLY COATED WITH A THIN MIXTURE OF WHITE LEAD AND GRAPHITE AND BOLTED TOGETHER WHILE THIS COATING IS STILL PLASTIC. THE SHANK AND THREADS OF ALL BOLTS AND STUDS ARE TO BE SIMILARLY COATED.
2. COMPONENT UNID NUMBERING SCHEME:

P-UNT	UNIT	FUNCTION	SYSTEM	SEQUENCE NO.
NOH	00	GATE	327	1S

3. UNIDS ARE LISTED IN WHOLE ON THIS DRAWING.
4. COMPONENT UNID NUMBERS USE THE FOLLOWING SYSTEM AND FUNCTION CODES:

SYSTEM NUMBERS – SYSTEM NAME:	FUNCTION CODES – FUNCTION CODE NAMES:
327 – SLUICEWAY	GATE – SLIDE GATE
	HST – HOIST



INSTALLATION DIAGRAM

REV NO	DATE	DSGN	PREP	CHKD	SUPV	VRFD	APPD	DCN NUMBER	REV BY
R 1	08-29-08	A.W.	DMC	GDD	CDD		HLP	NOH-07-33	C

DCN NOH-07-33: REVISED FOR CRITICAL STRUCTURES, SYSTEMS & COMPONENTS VERIFICATION

SCALE: NONE — EXCEPT AS NOTED

NORRIS DAM

5'–8"x10'–0" SLIDE GATES
TANDEM INSTALLATION

DRAWN BY: | CHECKED BY: | SUPERVISED BY: | VERIFIED BY: | APPROVED BY:

NORRIS HYDRO PLANT
TENNESSEE VALLEY AUTHORITY
RIVER OPERATIONS

AUTOCAD 2006 | DATE | 2 | P | 54W100 | R 1

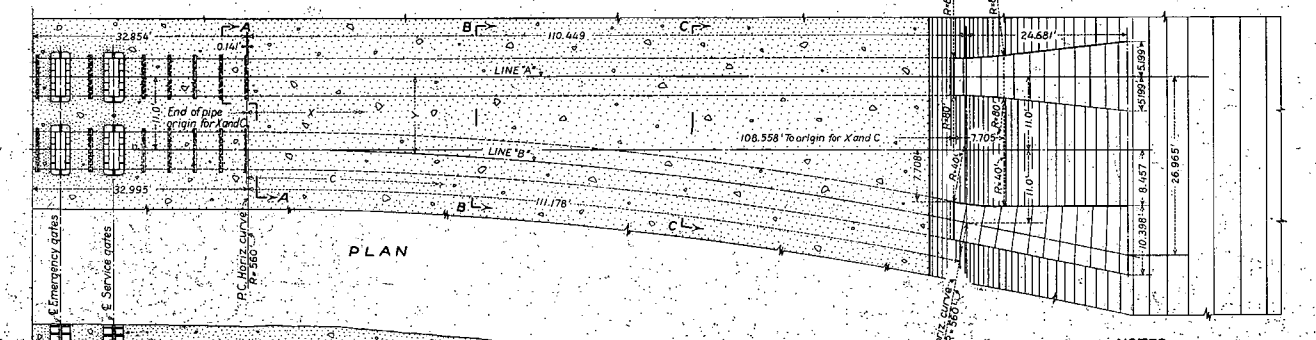
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES: [232-D-232 R0]

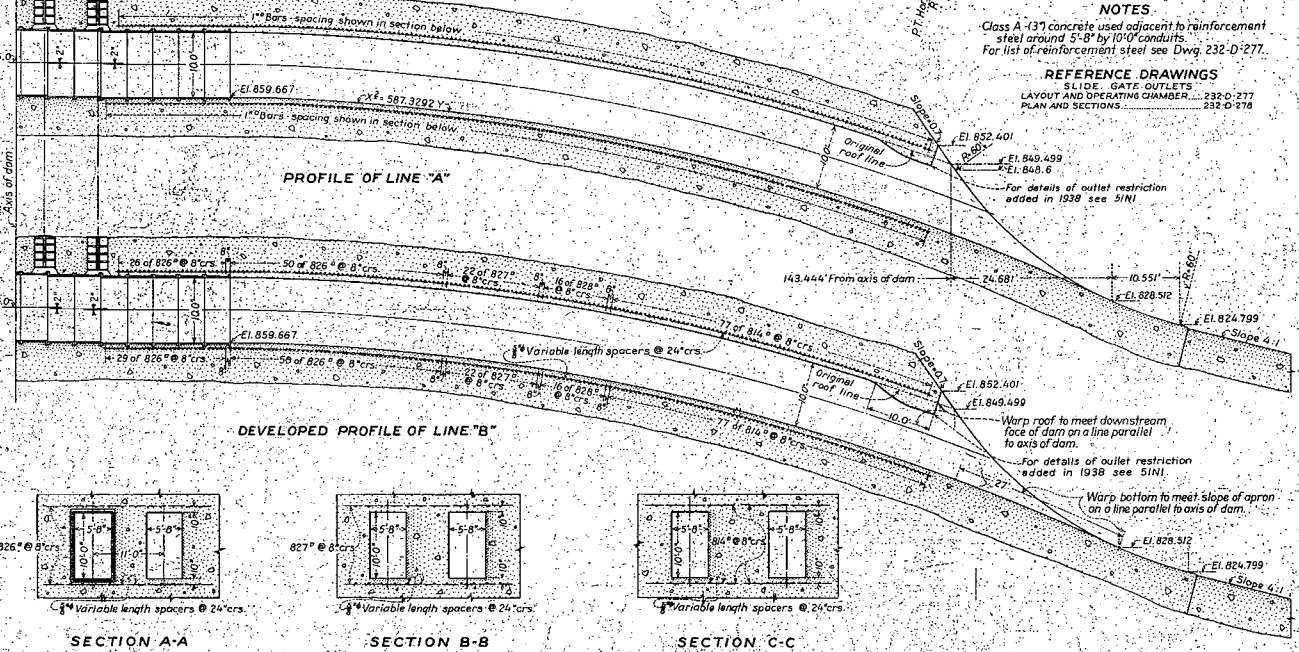
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:32
w_HYDRO

CAD DRAWING
DO NOT ALTER MANUALLY

54W100 2 P





NOTES

Class A -(3") concrete used adjacent to reinforcement steel around 5'-8" by 10'-0" conduits.
For list of reinforcement steel see Dwg. 232-D-277.

REFERENCE DRAWINGS

SLIDE GATE OUTLETS

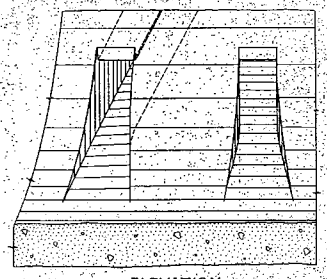
LAYOUT AND OPERATING CHAMBER	232-D-277
PLAN AND SECTIONS	232-D-278

TABLE OF COORDINATES

X	Elevation of Invert ℄	Y	C	
0	859.667	11.000	0.000	
0.141	859.667	11.000	0.141	P.C. on horizontal curve (Line "B")
10.	859.496	11.087	10.001	
20.	858.986	11.352	20.004	
30.	858.134	11.797	30.014	
40.	856.943	12.420	40.034	
50.	855.410	13.224	50.066	
60.	853.537	14.208	60.115	
70.	851.324	15.375	70.182	
80.	848.770	16.724	80.273	
90.	845.876	18.257	90.390	
100.	842.641	19.975	100.537	
110	839.065	21.882	110.717	
110.590	838.843	22.000	111.319	
120	835.149	23.893	120.917	P.T. on horizontal curve (Line "B")
130	830.892	25.905	131.118	
135.271	828.512	26.965	136.494	

EXPLANATION OF TABLE

X is measured along Line "A" with origin at end of pipe.
Y is measured normal to Line "A".
C is measured along Line "B" with origin at end of pipe.
Y = 11.00' from x = 0 to x = 0.141'
$Y = 571 - \sqrt{313.600 - (x - 0.141)^2}$ from x = 0.141' to x = 110.590'
Y = 22.000 + (x - 110.590) tan. 11°22'30.20" from x = 110.590' to x = 135.271'
C = x from x = 0 to x = 0.141
$C = 9.773842 \left(\sin^{-1}\frac{x - 0.141}{560}\right) + 0.141$ from x = 0.141 to x = 110.590 where angle is in degrees and decimal of a degree
$C = 111.319 - \frac{110.590 - x}{\cos. 11°22'30.20"}$ from x = 110.590 to x = 135.271
Elevation of invert ℄ = 859.667 − 587.3292
cos. 11°22'30.20" = 0.98035714
tan. 11°22'30.20" = 0.20118235



ELEVATION
END OF SLIDE GATE OUTLETS

UNITED STATES
TENNESSEE VALLEY AUTHORITY
CLINCH RIVER PROJECT

NORRIS DAM

SLIDE GATE OUTLETS CONDUIT PLAN AND PROFILES

FINAL FIELD REV. 7-1-46 L.B.C.
1938 H.D.D.

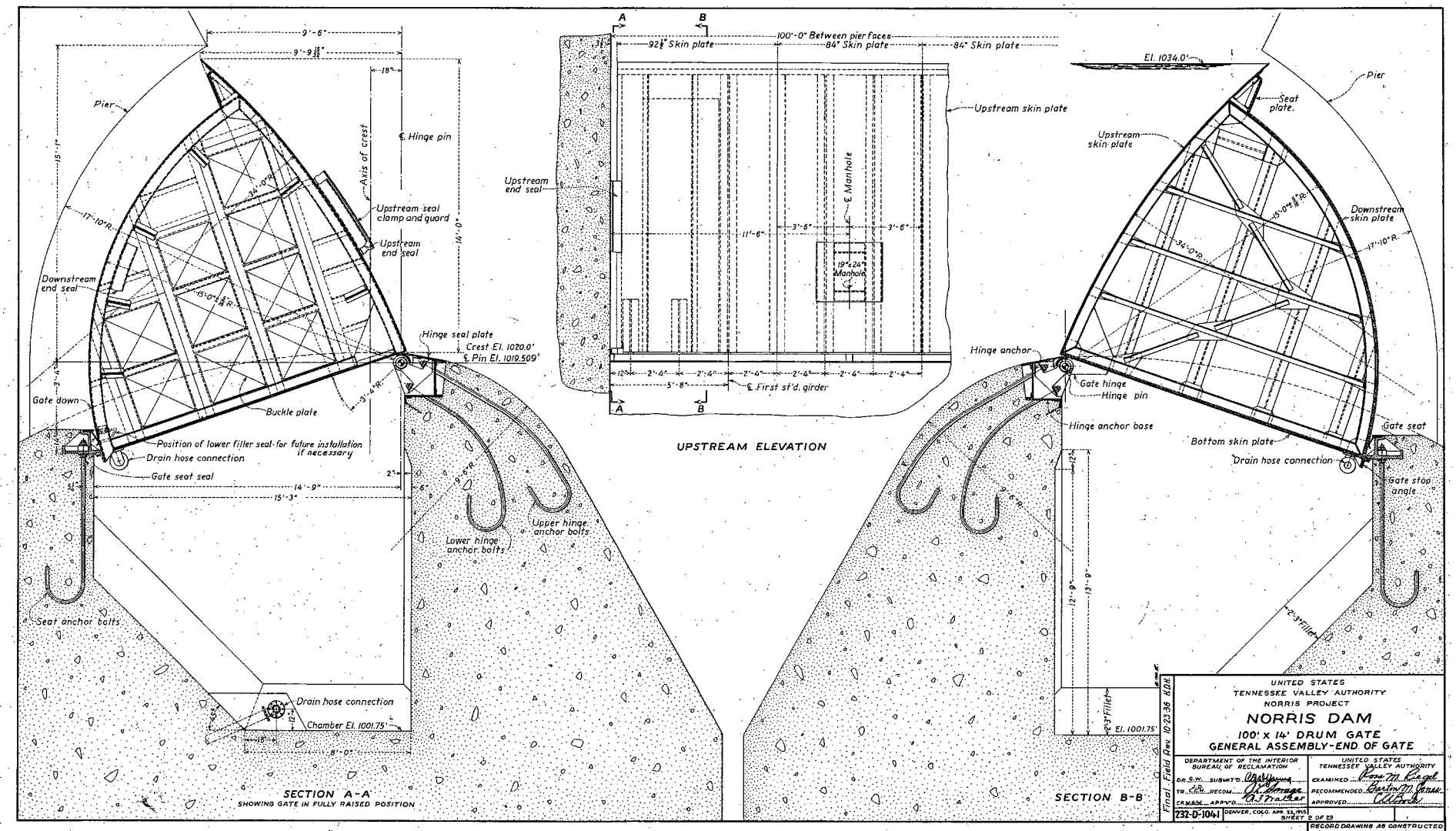
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. J.K.A. SUBMITD. A.H. Black
TR. R.A.S. RECOM. J. Clarage
CH. ENG. APPROVED. O.F. Nesbitt

UNITED STATES
TENNESSEE VALLEY AUTHORITY
EXAMINED. Geo. M. Magill
RECOMMENDED. Carlton M. Jones
APPROVED. A.H. Black

232-D-395 DENVER, COLO. JULY 26, 1934

RECORD DRAWING AS CONSTRUCTED
W. M. Brown 1937

Slide Gate Outlets JOB NO. 232-D-395
Conduit Plan and Profiles



UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT

NORRIS DAM

100' x 14' DRUM GATE
GENERAL ASSEMBLY-END OF GATE

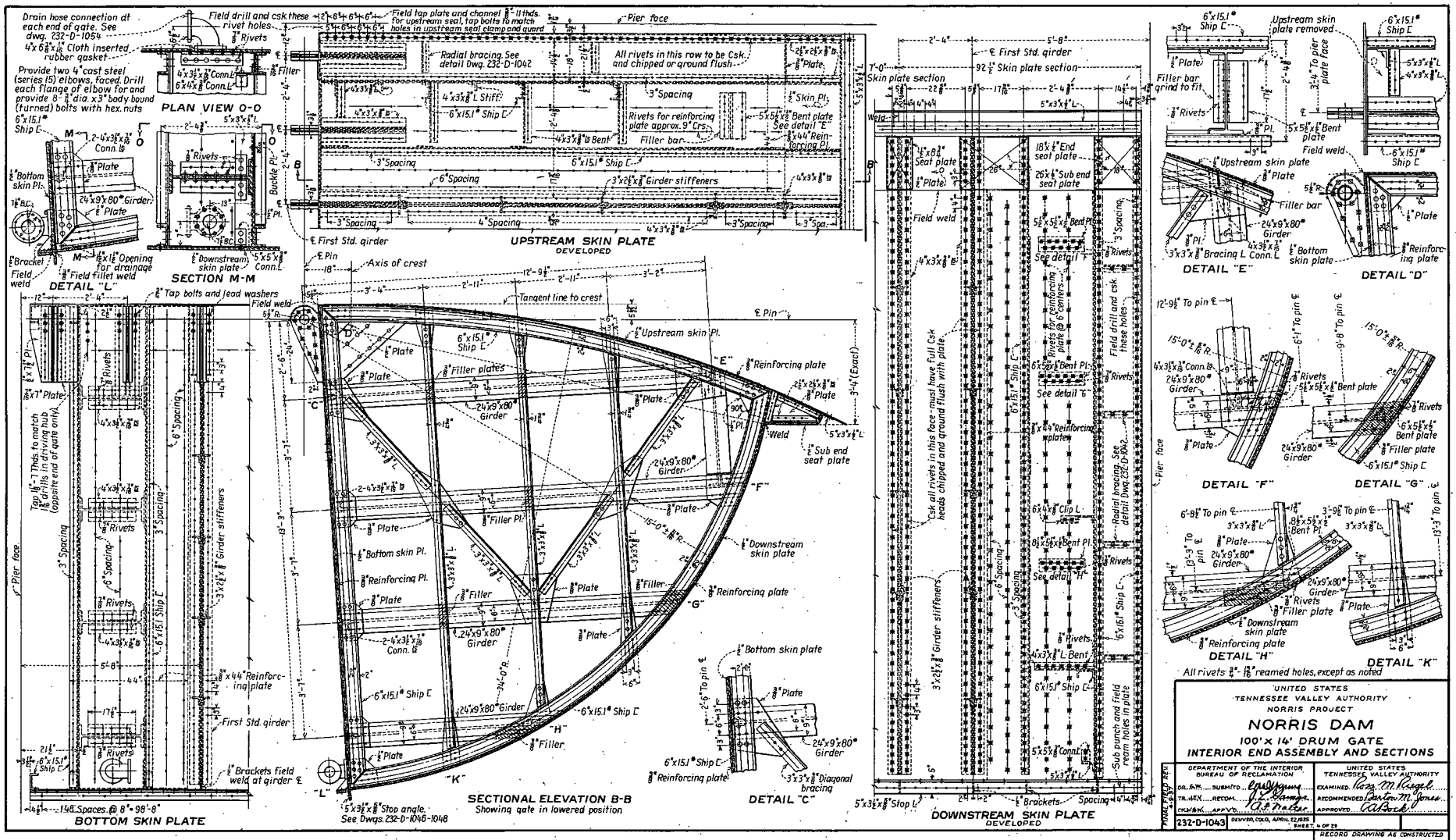
DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION	UNITED STATES TENNESSEE VALLEY AUTHORITY
DR. S.W. SUBMIT'D. [signature]	EXAMINED Ross M. Riegel
TR. [signature] RECOM. [signature]	RECOMMENDED Barton M. Jones
CK. [signature] APPV'D. [signature]	APPROVED [signature]
232-D-1041 DENVER, COLO. APR. 22, 1935 SHEET 2 OF 23	

RECORD DRAWING AS CONSTRUCTED
[signature] 1937

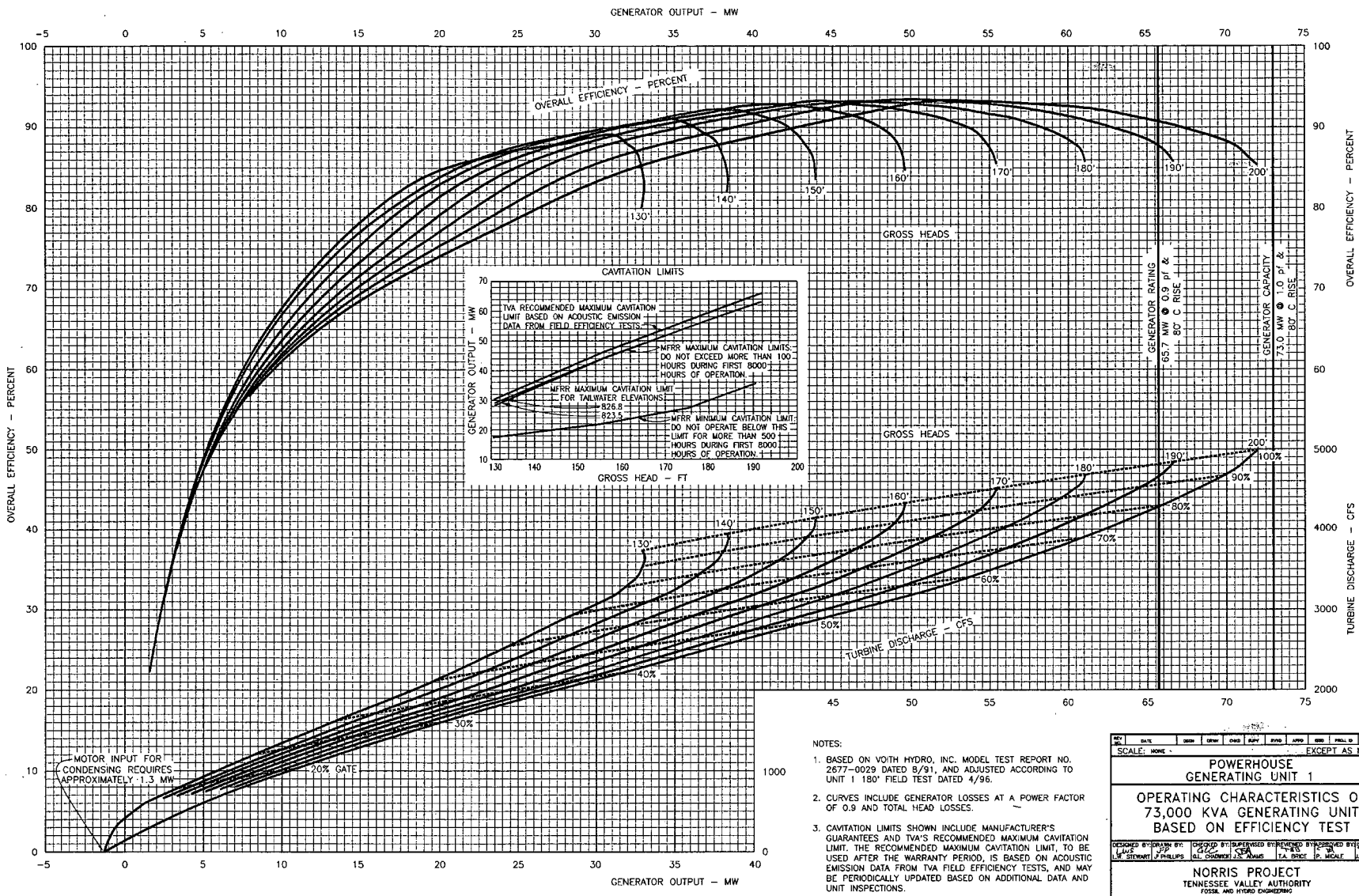
Final Field Rev. 10-23-36 H.D.H.

Job No. 232-[illegible]

21" x 36"


Drain hose connection at each end of gate. See dwg. 232-D-1054
4"x6⅝"x⅛" Cloth inserted rubber gasket
Provide two 4" cast steel (series 15) elbows, faced. Drill each flange of elbow for and provide 8-⅞" dia. x3" body bound (turned) bolts with hex. nuts
Field drill and csk. these rivet holes
⅞" Rivets
PLAN VIEW O-O
SECTION M-M
DETAIL "L"
Field tap plate and channel ⅞" lthds. For upstream seal, tap bolts to match holes in upstream seat clamp and guard
Pier face
Radial bracing. See detail Dwg. 232-D-1042
All rivets in this row to be Csk. and chipped or ground flush
UPSTREAM SKIN PLATE
DEVELOPED
First Std. girder
Axis of crest
Tangent line to crest
Tap bolts and lead washers
Upstream skin Pl.
Downstream skin plate
Sub end seat plate
Reinforcing plate
Filler plates
Girder stiffeners
Bottom skin Pl.
Brackets field weld at girder ℄
Stop angle. See Dwgs. 232-D-1046-1048
SECTIONAL ELEVATION B-B
Showing gate in lowered position
BOTTOM SKIN PLATE
DETAIL "C"
DOWNSTREAM SKIN PLATE
DEVELOPED
Csk all rivets in this face-must have full Csk heads chipped and ground flush with plate
Radial bracing. See detail Dwg. 232-D-1042
Sub punch and field ream holes in plate
DETAIL "E"
DETAIL "D"
DETAIL "F"
DETAIL "G"
DETAIL "H"
DETAIL "K"
All rivets ⅞"-⅛" reamed holes, except as noted
UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT
NORRIS DAM
100'x 14' DRUM GATE
INTERIOR END ASSEMBLY AND SECTIONS
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. BJH SUBMITTED
TR. MEN RECOM.
CK'D BK APP'D
UNITED STATES
TENNESSEE VALLEY AUTHORITY
EXAMINED
RECOMMENDED
APPROVED
232-D-1043
DENVER, COLO. APRIL 22, 1935
SHEET 4 OF 29
RECORD DRAWING AS CONSTRUCTED
1937

Job 232-2-3



NOTES:

1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2677–0029 DATED 8/91, AND ADJUSTED ACCORDING TO UNIT 1 180' FIELD TEST DATED 4/96.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K–20, 748 R1.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJ. ID	AS CONST

SCALE: NONE — EXCEPT AS NOTED

POWERHOUSE
GENERATING UNIT 1

OPERATING CHARACTERISTICS OF 73,000 KVA GENERATING UNIT BASED ON EFFICIENCY TEST

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.W. STEWART	J PHILLIPS	G.L. CHADWICK	J.S. ADAMS	T.A. BRICE	P. MICALE	J.H. COULSON

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12	DATE 3/31/99	2	M		47K901	R1

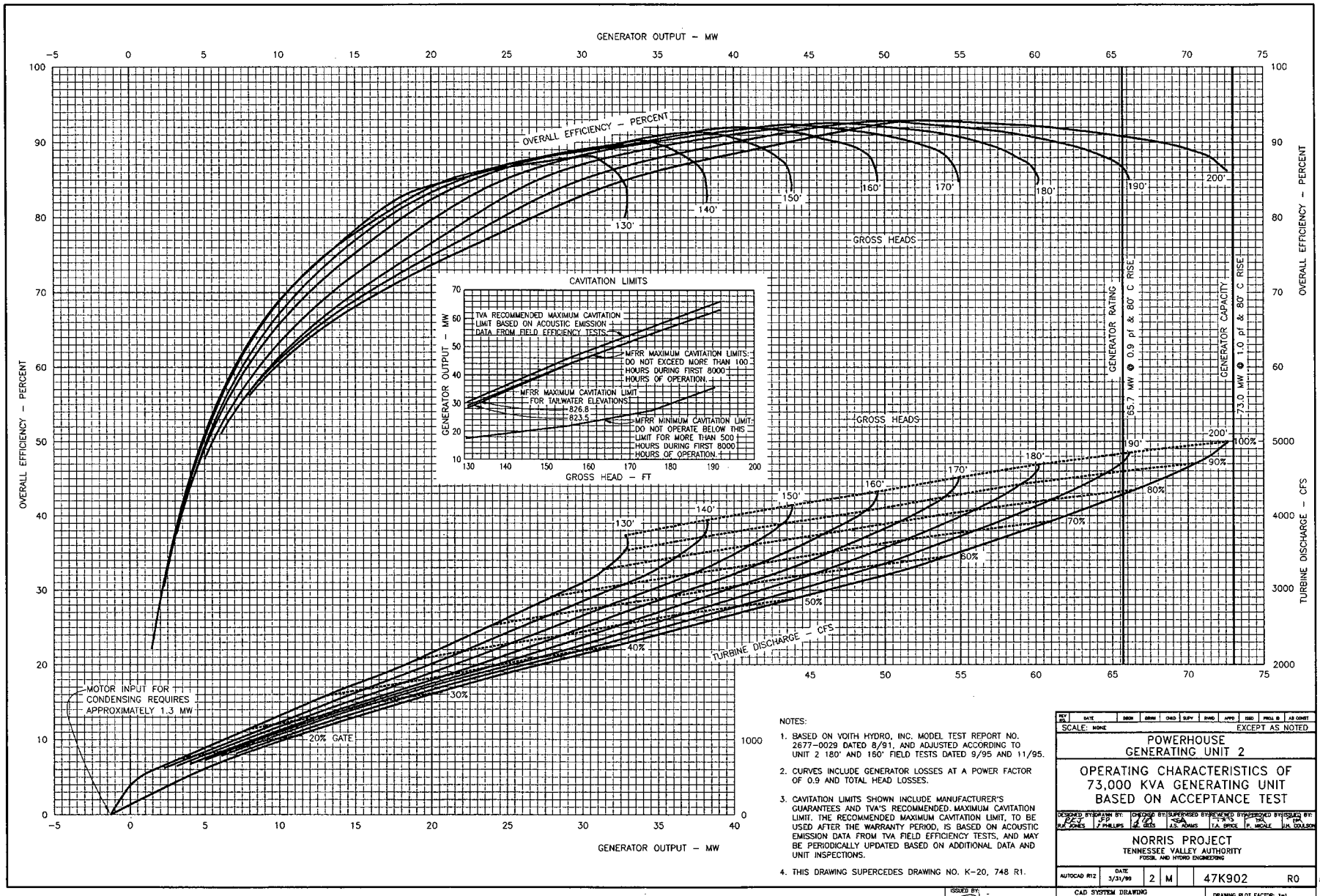
MF

ISSUED BY: P. Micale

CAD SYSTEM DRAWING
DO NOT ALTER MANUALLY

DRAWING PLOT FACTOR: 1=1
INSERTED DRAWING: X=1,Y=1.13

2 M 47K901



NOTES:

1. BASED ON VOITH HYDRO, INC. MODEL TEST REPORT NO. 2677-0029 DATED 8/91, AND ADJUSTED ACCORDING TO UNIT 2 180' AND 160' FIELD TESTS DATED 9/95 AND 11/95.
2. CURVES INCLUDE GENERATOR LOSSES AT A POWER FACTOR OF 0.9 AND TOTAL HEAD LOSSES.
3. CAVITATION LIMITS SHOWN INCLUDE MANUFACTURER'S GUARANTEES AND TVA'S RECOMMENDED. MAXIMUM CAVITATION LIMIT. THE RECOMMENDED MAXIMUM CAVITATION LIMIT, TO BE USED AFTER THE WARRANTY PERIOD, IS BASED ON ACOUSTIC EMISSION DATA FROM TVA FIELD EFFICIENCY TESTS, AND MAY BE PERIODICALLY UPDATED BASED ON ADDITIONAL DATA AND UNIT INSPECTIONS.
4. THIS DRAWING SUPERCEDES DRAWING NO. K-20, 748 R1.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJ ID	AS CONST

SCALE: NONE — EXCEPT AS NOTED

POWERHOUSE
GENERATING UNIT 2

OPERATING CHARACTERISTICS OF
73,000 KVA GENERATING UNIT
BASED ON ACCEPTANCE TEST

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.R. JONES	J. PHILLIPS	J.E. GILES	J.S. ADAMS	T.A. BRICE	P. MICALE	J.H. COULSON

NORRIS PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12	DATE 3/31/99	2	M		47K902	R0

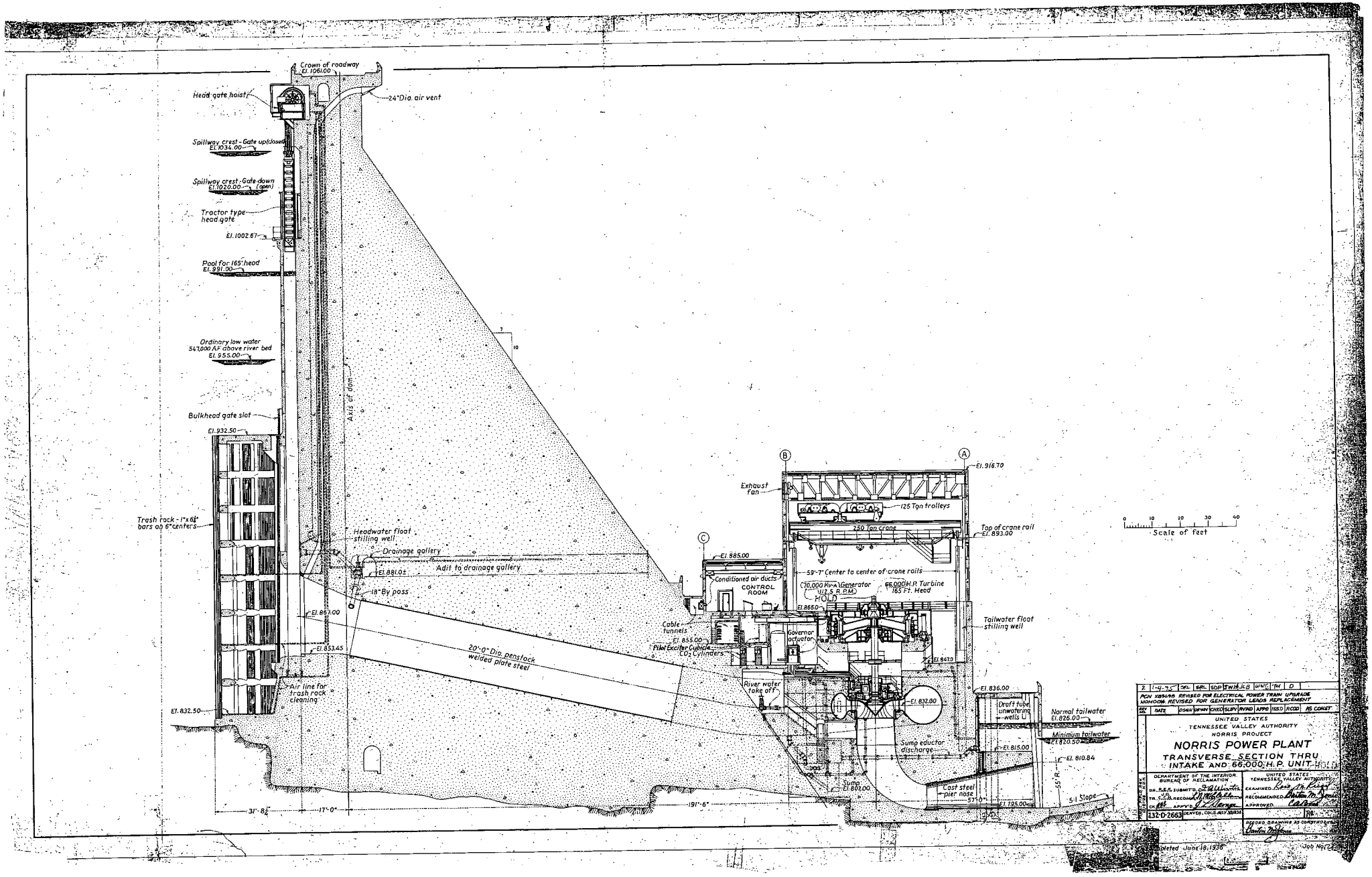
MF

ISSUED BY:

CAD SYSTEM DRAWING
DO NOT ALTER MANUALLY

DRAWING PLOT FACTOR: 1=1
INSERTED DRAWING: X=1,Y=1.13

2 | M | 47K902



Crown of roadway El. 1061.00
Head gate hoist
24" Dia. air vent
Spillway crest - Gate up (closed) El. 1034.00
Spillway crest - Gate down El. 1020.00 (open)
Tractor type head gate
El. 1002.67
Pool for 165' head El. 991.00
Ordinary low water 547,000 A.F. above river bed El. 955.00
Axis of dam
Bulkhead gate slot
El. 932.50
Trash rack - 1"x6½" bars on 6" centers
Headwater float stilling well
Drainage gallery
El. 881.0±
Adit to drainage gallery
18" By pass
El. 867.00
El. 853.45
20'-0" Dia. penstock welded plate steel
Air line for trash rack cleaning
El. 832.50
31'-8½"
17'-0"
191'-6"
Exhaust fan
El. 916.70
125 Ton trolleys
250 Ton crane
Top of crane rail El. 893.00
El. 885.00
Conditioned air ducts
CONTROL ROOM
59'-7" Center to center of crane rails
70,000 Kv-A Generator 112.5 R.P.M.
66,000 H.P. Turbine 165 Ft. Head
HOLD
El. 866.0
Cable tunnels
El. 855.00
Pilot Exciter Cubicle
CO_2 Cylinders
Governor actuator
Tailwater float stilling well
El. 847.0
River water take off
El. 832.00
El. 836.00
Draft tube unwatering wells
Normal tailwater El. 826.00
Minimum tailwater El. 820.50
Sump eductor discharge
El. 815.00
El. 810.84
Sump El. 802.00
Cast steel pier nose
57'-0"
El. 795.00
5:1 Slope
Scale of feet
0 10 20 30 40
2 1-4-75 SRL SRL SDP SWH JLB WNC TRH D
PCN X85098 REVISED FOR ELECTRICAL POWER TRAIN UPGRADE
NONOOH REVISED FOR GENERATOR LEADS REPLACEMENT
REV NO. DATE DSGN DRWN CHKD SLPV RVWD APPD ISSD RCOD AS CONST.
UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT
NORRIS POWER PLANT
TRANSVERSE SECTION THRU INTAKE AND 66,000 H.P. UNIT
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. R.E.K. SUBMIT'D
TR. S.E.B. RECOM'D
CK. APP'V'D
232-D-2663
DENVER, COLO. JULY 30, 1936
UNITED STATES
TENNESSEE VALLEY AUTHORITY
EXAMINED
RECOMMENDED
APPROVED
RECORD DRAWING AS CONSTRUCTED
Completed June 19, 1936
Job No. 2

Tennessee Valley Authority
Division of Water Control Planning
Engineering Laboratory

NORRIS DAM

DISCHARGE RATINGS

FOR ASSUMED DAM FAILURES

DURING AN EARTHQUAKE

--o--

Advance Report No. 1

--o--

Norris, Tennessee
January 1974

Report No. 2-633

NORRIS DAM
DISCHARGE RATINGS
FOR ASSUMED DAM FAILURES
DURING AN EARTHQUAKE

INTRODUCTION

At the request of the Flood Control Branch, Division of Water Control Planning, a study was conducted by the Engineering Laboratory to establish discharge rating curves for various debris configurations resulting from a failure of Norris Dam. This study was authorized by the Project Management Corporation, Clinch River Breeder Reactor. The study was made to supply flow data to be used in the determinations of the necessary flood protection works for the Clinch River Breeder Reactor. Six failure cases detailed on Plate 1 were tested. The discharge ratings for the six cases are shown on Plates 2 and 3.

THE MODEL

A 1:150 scale model of Norris Dam duplicating the failure section and the topography immediately upstream from the dam and a 2400-foot reach downstream from the dam was installed in the eight-foot laboratory flume. A general view of the model with failure Case A installed is shown in Figure 1. The topography both upstream and downstream from the dam was obtained from drawing 232-D-264 shown on Plate 4. Model discharges were obtained from readings of a carefully calibrated diaphragm orifice located in the water supply line or a calibrated eight-foot sharp crested weir located at the upstream end of the eight-foot flume. The eight-foot weir was used whenever the discharge exceeded 2,000,000 cfs. Headwater heights were measured at two piezometers located 1200 and 1800 feet upstream from the dam. The headwater levels were determined by means of hook gages reading to .001 foot. Tailwater heights were taken from a staff gage located 1300 feet downstream from the dam. The tailwater level was controlled at the end of the flume by means of slot gates.

TEST PROCEDURE

During each discharge rating test a constant discharge was set up using the appropriate tailwater level shown on Plate 5. Recordings were then made of the headwater elevation, tailwater elevation and the discharge. The test procedure was repeated at other constant flows so that sufficient information was obtained to establish a discharge rating curve of headwater elevation vs. discharge for each case tested.

TEST CASES

Six failure schemes designated as cases A, B, C, D, E and F_{1-5} were rated. Details of the schemes are shown on Plate 1. The existing topography both upstream and downstream from the dam was duplicated in the model from contours given on Plate 4. The debris configuration was assumed to be as shown on Plate 1 for each case.

Case E was identical to case A except that the sideflow to the left and right of the debris was prevented by constructing sheet metal walls as shown on Plate 1. The difference between the discharge of case A and E at any headwater elevation will give the discharge not going over the top of the debris.

Four tests labeled No TW Effect on Plate 2 were conducted with the tailwater level lowered so that it would have no influence on the headwater level. At near maximum test Q the headwater level was reduced 5.4, 5.3 and 7.6 feet for cases A, B and D, respectively, by eliminating the tailwater effect.

For case F_{1-5} the remains of the dam, assumed broken off at elevation 970, was moved to five different positions as shown on Plate 1. A discharge rating was obtained for each location so that data would be available to estimate discharge coefficients which might be applicable to failures at other dams.

TEST RESULTS

The discharge rating curves for each case are shown on Plates 2 and 3. Tabulations of the rating data are given on Tables 1 to 10. A summary of the discharges at headwater elevations 970 and 1035 is given on Table 11 to show the spread in discharge between the various cases tested.

Photographs of the dry and operating model are shown on Figures 1 to 22 for each scheme. Additional photographs and color slides of the model operation are available at the TVA Engineering Laboratory.

TABLES

Table	
1	Data Tabulations, Case A
2	Data Tabulations, Case B
3	Data Tabulations, Case C
4	Data Tabulations, Case D
5	Data Tabulations, Case E
6	Data Tabulations, Case F_1
7	Data Tabulations, Case F_2
8	Data Tabulations, Case F_3
9	Data Tabulations, Case F_4
10	Data Tabulations, Case F_5
11	Summary of Discharge, H.W. 970 and 1035

FIGURES

Figure	
1	Case A, Dry Model
2	Case A, Dry Model
3	Case A, Discharge - 2,709.400
4	Case B, Dry Model
5	Case B, Discharge - 3,010,000
6	Case C, Discharge - 2,824,000
7	Case D, Dry Model
8	Case D, Discharge - 388,100
9	Case D, Discharge - 2,196,500
10	Case E, Dry Model

Figure

11 Case E, Discharge - 1,569,600

12 Case F_1, Dry Model

13 Case F_2, Discharge - 98,500

14 Case F_3, Discharge - 1,994,200

15 Case F_4, Discharge - 2,409,000

16 Case F_5, Discharge - 3,014,700

PLATES

Plate

1 Details of Cases

2 Discharge Rating, Case A to E

3 Discharge Rating, Case F_1 to F_5

4 Topography

5 Tailwater Curve

TABLE 1

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE A

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
1A	965.42	421,800	
2A	982.75	656,500	
3A	992.97	920,300	919.0
4A	1001.80	1,181,200	932.5
5A	1011.85	1,520,300	948.0
6A	1019.65	1,805,500	959.5
7A	1028.80	2,119,400	970.2
8A	1036.60	2,436,300	981.5
9A	1045.63	2,709,400	990.0
10A	1040.20	2,709,400	T.W. Low
11A	1030.45	2,196,100	973.0
12A	912.86	95,100	
13A	925.45	141,500	
14A	939.70	214,800	
15A	1037.03	2,462,700	982.0

TABLE 2

NORRIS DAM FAILURE STUDY
SUMMARY OF TESTS RESULTS
DISCHARGE RATING
CASE B

Test No.	H. W. Elev.	Q cfs	T.W. Elev.
26B	955.53	397,000	885.0
27B	966.18	625,300	902.0
28B	973.08	800,800	913.0
29B	980.13	1,004,000	923.0
30B	986.28	1,197,000	934.0
31B	991.98	1,377,000	942.0
32B	998.43	1,597,000	950.0
33B	1004.58	1,802,000	959.0
33B	1003.38	1,802,000	Low T.W.
34B	1010.28	2,003,000	967.0
35B	1017.03	2,203,000	974.0
36B	1022.43	2,413,000	981.0
37B	1028.13	2,594,000	987.0
38B	1033.38	2,799,000	993.0
39B	1038.27	3,010,000	999.0
39B	1032.93	3,009,000	Low T.W.
40B	949.83	293,800	875.0
41B	937.68	194,900	865.0

TABLE 3

NORRIS DAM FAILURE STUDY
SUMMARY OF TESTS RESULTS
DISCHARGE RATING
CASE C

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
59C	942.23	100,900	853.0
60C	960.11	192,000	864.0
61C	973.52	295,200	876.0
62C	978.62	389,800	885.0
63C	984.62	508,700	894.5
64C	991.82	692,900	906.5
65C	998.27	901,900	918.5
66C	1004.12	1,103,000	928.5
67C	1009.67	1,295,000	938.0
68C	1014.77	1,493,000	946.5
69C	1019.42	1,686,000	954.0
70C	1024.67	1,889,000	962.5
71C	1029.47	2,095,000	969.8
72C	1033.67	2,291,000	976.0
73C	1038.50	2,493,000	983.0
74C	1043.42	2,703,000	990.0
75C	1045.79	2,824,000	994.0
76C	1043.27	2,824,000	Low T.W.
77C	930.47	57,600	845.0
78C	909.62	20,700	839.0

TABLE 4

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE D

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
42D	888.48	99,800	851.00
43D	907.15	192,800	865.00
44D	920.20	296,100	876.00
45D	929.35	388,100	885.5
46D	941.80	591,000	900.5
47D	950.13	756,200	910.5
48D	959.53	952,900	921.0
49D	971.05	1,199,800	933.0
50D	982.00	1,418,700	943.0
51D	991.00	1,599,100	951.0
52D	1000.15	1,806,400	959.0
53D	1009.60	1,996,900	966.5
54D	1018.60	2,196,500	973.5
55D	1028.05	2,421,100	981.0
56D	1035.62	2,589,800	986.5
57D	1043.20	2,778,300	993.0
58D	1027.90	2,784,900	Low T.W.

TABLE 5

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE E

Test No.	H.W. Elev.	Q cfs	T.W.(1) Elev.
16E	979.00	68,400	
17E	987.25	170,300	
18E	993.70	271,000	
19E	998.95	367,200	
20E	1010.20	601,200	900.8
21E	1018.09	781,400	912.8
22E	1025.95	979,400	923.0
23E	1033.19	1,175,600	932.2
24E	1040.80	1,386,300	942.5
25E	1046.50	1,569,600	949.8

(1) No tailwater effect

TABLE 6

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE F_1

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
81	1007.35	384,100	885.0
82	1018.63	596,600	900.5
83	1027.25	801,300	912.7
84	1035.85	997,000	923.4
85	1043.15	1,207,100	933.5
86	1049.65	1,401,700	943.0
87	1055.80	1,598,700	951.0
88[1]	983.80	96,800	851.5
89[1]	992.80	198,700	865.0
90[1]	1000.00	296,700	875.5

[1]Model flow was unstable because of the small head on the crest. Test classified as unreliable.

TABLE 7

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE F_2

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
91[1]	982.45	98,500	851.0
92[1]	991.15	199,600	864.5
93[1]	997.90	295,700	876.0
94	1004.20	392,000	885.5
95	1014.70	594,400	900.5
96	1023.85	796,400	912.5
97	1031.65	997,100	923.0
98	1038.70	1,192,900	933.0
99	1045.42	1,400,400	942.5
100	1051.90	1,604,900	951.3

[1]Model flow was unstable because of the small head on the crest. Test classified as unreliable.

TABLE 8

NORRIS DAM FAILURE STUDY
SUMMARY OF TESTS RESULTS
DISCHARGE RATING
CASE F_3

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
101	1037.65	1,609,500	951.5
102	1042.98	1,797,000	959.0
103	1048.45	1,994,200	966.0
104	1031.17	1,397,600	942.5
105	1024.65	1,196,800	933.0
106	1017.85	998,400	923.0
107	1009.90	796,100	912.50
108	1001.20	602,700	901.0
109	990.22	396,100	885.5
110	954.13	100,500	859.0
111	975.42	198,100	864.5
112	983.35	295,600	876.0

TABLE 9

NORRIS DAM FAILURE STUDY
SUMMARY OF TEST DATA
DISCHARGE RATING
CASE F_4

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
113	919.35	100,100	851.5
114	943.00	200,100	865.0
115	959.95	297,400	876.0
116	972.85	388,300	885.0
117	985.45	590,000	900.5
118	995.50	797,800	912.5
119	1003.75	994,400	923.0
120	1011.10	1,191,700	933.0
121	1017.85	1,395,000	942.5
122	1024.00	1,594,500	951.0
123	1030.22	1,807,200	959.0
124	1035.70	2,003,700	966.5
125	1041.25	2,197,500	973.5
126	1046.35	2,409,000	980.5

TABLE 10

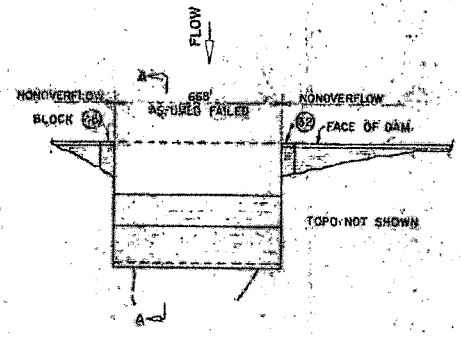
NORRIS DAM FAILURE STUDY
SUMMARY OF TEST RESULTS
DISCHARGE RATING
CASE F_5

Test No.	H.W. Elev.	Q cfs	T.W. Elev.
127	1042.68	2,598,000	987.00
128	1037.65	2,399,600	980.00
129	1047.77	2,797,700	993.00
130	1054.47	3,014,700	999.00
131	1033.09	2,190,300	973.00
132	1028.65	2,007,200	966.50
133	1023.03	1,797,200	959.00
134	1016.80	1,594,400	951.00
135	1010.20	1,394,000	942.50
136	1003.30	1,196,000	933.00
137	995.98	998,500	923.40
138	987.40	799,700	912.50
139	977.65	604.300	900.50
140	959.50	393,700	885.50
141	911.35	102,100	852.00
142	931.00	199,400	864.50
143	946.00	296,200	876.00

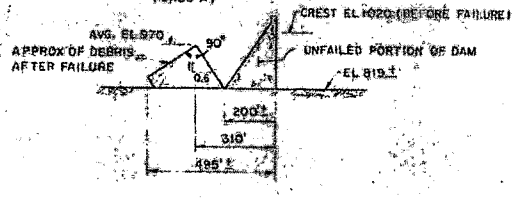
TABLE 11
SUMMARY OF DISCHARGE
CASE A THRU F_1-F_5
HEADWATER ELEVATIONS 970 & 1035

CASE	H.W. ELEV.	Q CFS	H.W. ELEV.	Q CFS
A	970	475,000	1035	2,370,000
B	970	740,000	1035	2,880,000
C	970	260,000	1035	2,310,000
D	970	1,180,000	1035	2,590,000
E	970	0	1035	1,230,000
F_1	970	0	1035	970,000
F_2	970	0	1035	1,105,000
F_3	970	165,000	1035	1,510,000
F_4	970	378,000	1035	1,980,000
F_5	970	505,000	1035	2,270,000

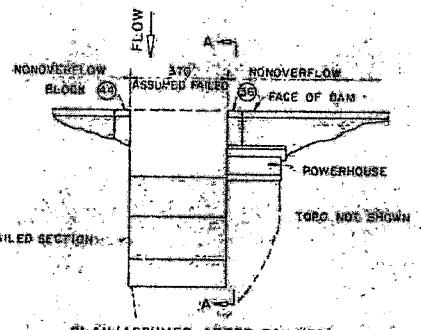
PLATE



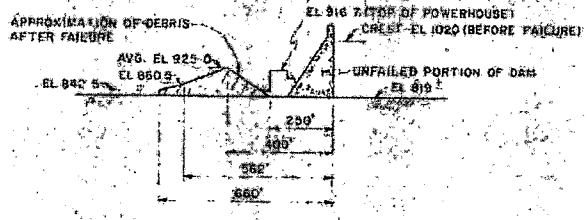
PLAN (ASSUMED AFTER FAILURE)
(CASE A)



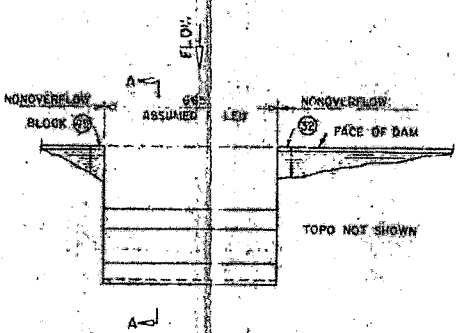
SECTION A-A



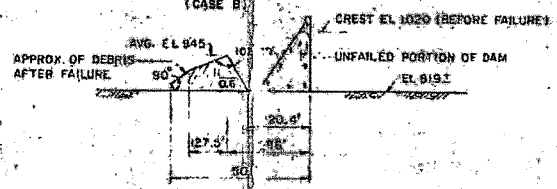
PLAN (ASSUMED AFTER FAILURE)
(CASE D)



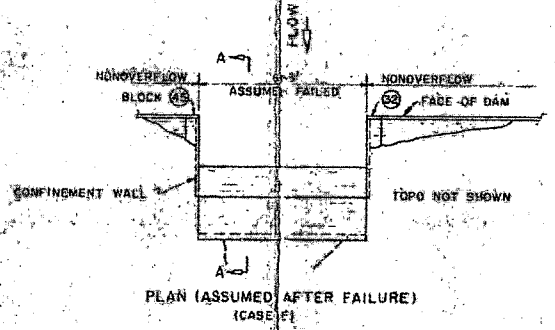
SECTION A-A



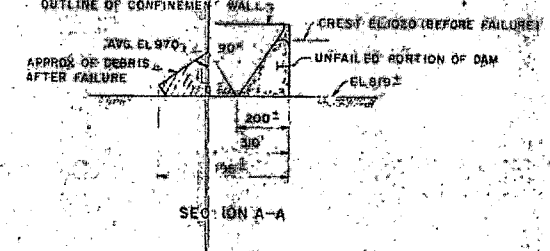
PLAN (ASSUMED AFTER FAILURE)
(CASE B)



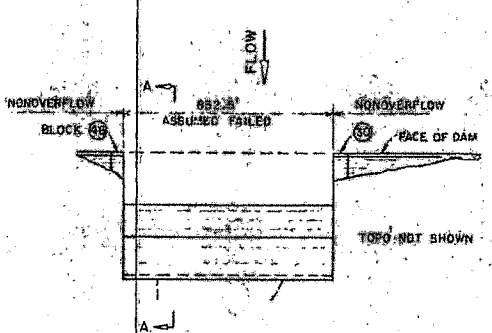
SECTION A-A



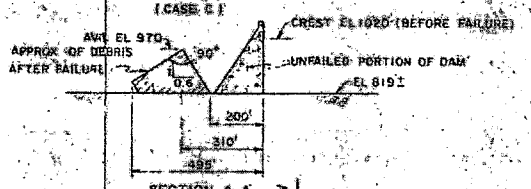
PLAN (ASSUMED AFTER FAILURE)
(CASE E)



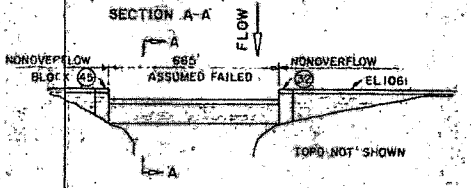
SECTION A-A



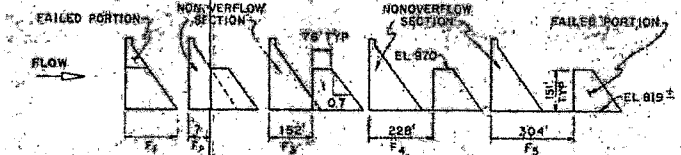
PLAN (ASSUMED AFTER FAILURE)
(CASE C)



SECTION A-A



PLAN (ASSUMED AFTER FAILURE)
(CASE F)



SECTION A-A

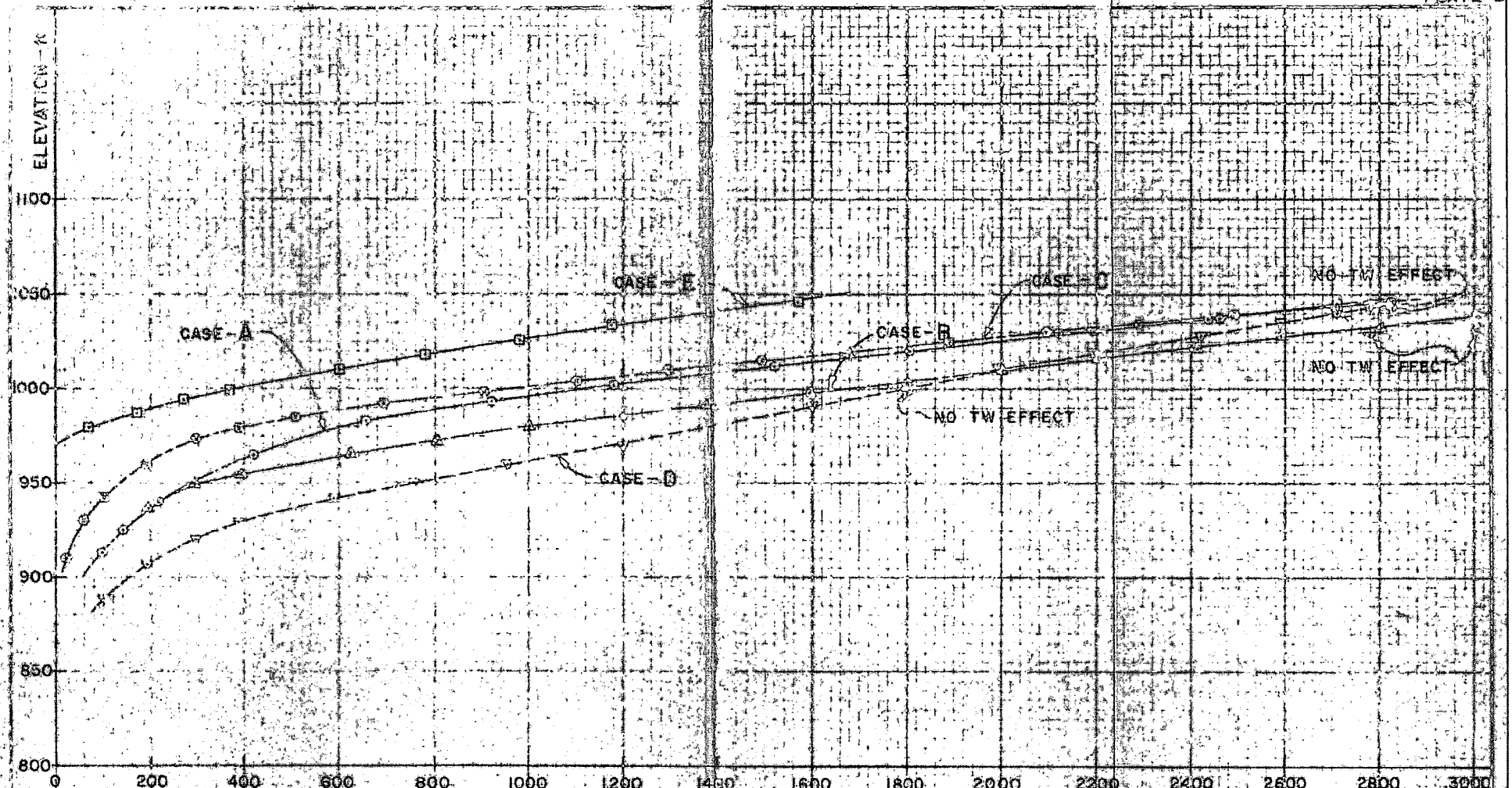
NORRIS DAM FAILURE STUDY

DETAILS OF CASES A,B,C,D,E,& F, 1 TO 5

NORRIS DAM PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
ENGINEERING LABORATORY, KNOXVILLE

12-18-73 | 2-EL-98-K-109

PLATE 2



NOTE.
Tests marked NO TW EFFECT were conducted with the tailwater lowered so that it would have no influence on the headwater level.

NORRIS DAM FAILURE STUDY

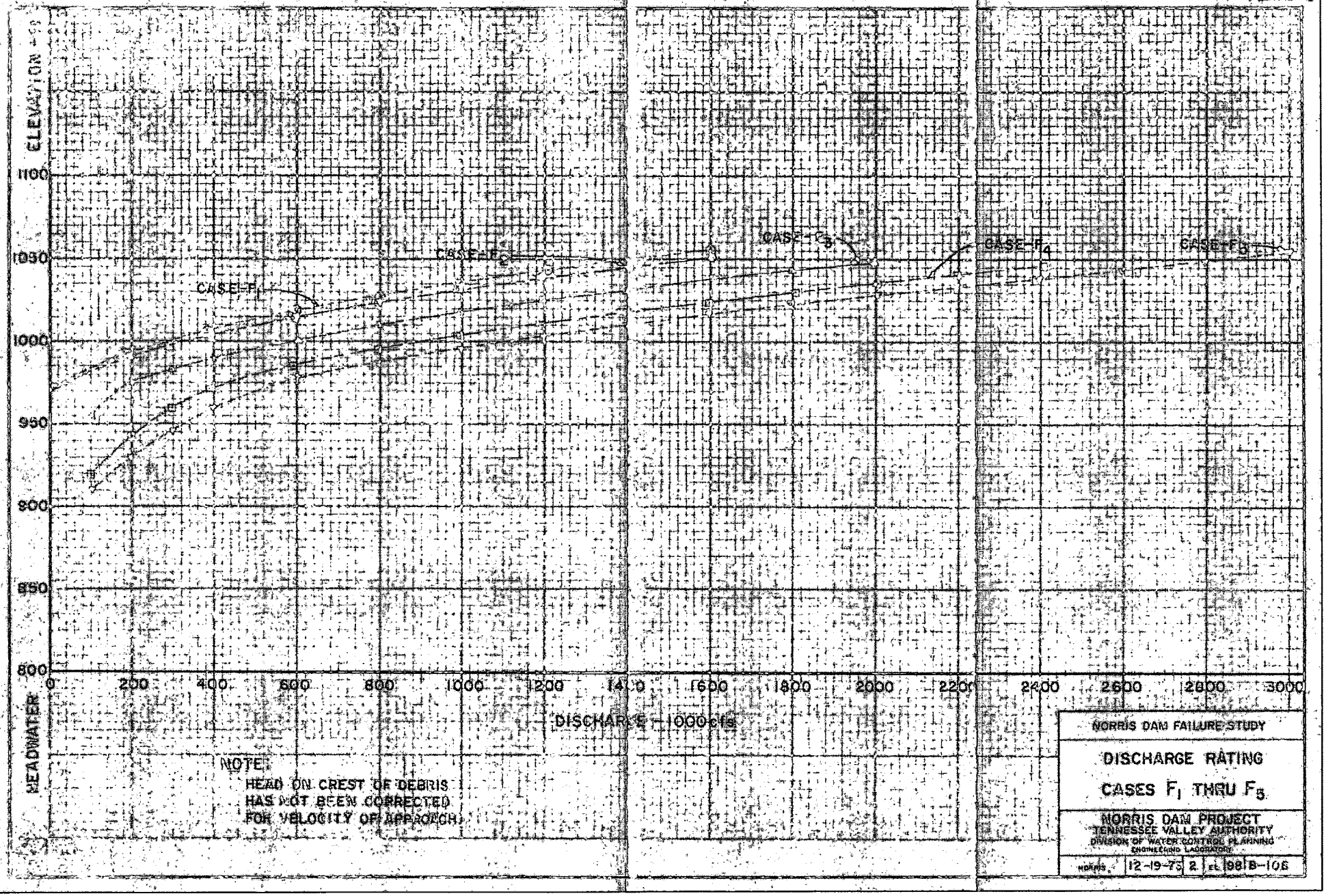
DISCHARGE RATING

CASE A, B, C, D AND E

NORRIS DAM PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
ENGINEERING LABORATORY

NORRIS	11-9-73	2	ex. 98 B-107R

PLATE 3



NORRIS DAM FAILURE STUDY

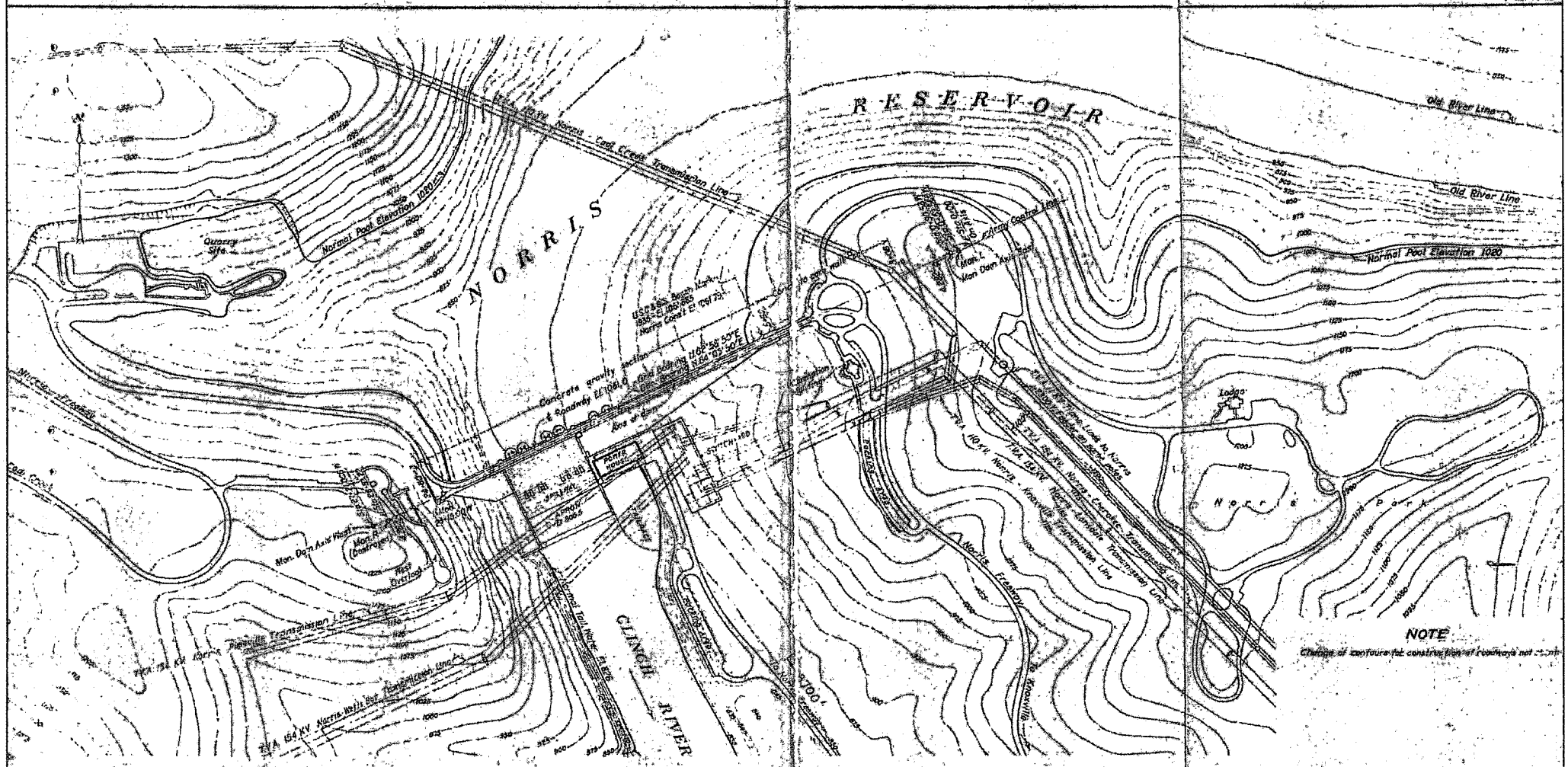
DISCHARGE RATING

CASES F_1 THRU F_5

NORRIS DAM PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
ENGINEERING LABORATORY

NORRIS | 12-19-73 | 2 | EL 981 B-106

PLATE



NOTE

Change of contours for construction of roadways not shown

Scale: 1/2000

200 0 200 400 600 800 1000 FEET

CONTOUR INTERVAL 25 FEET.
DATUM IS MEAN SEA LEVEL.

MONUMENT	CO-ORDINATES Tennessee Lambert Proj.	GEOGRAPHIC POSITION	ELEVATION Mean Sea Level Datum U.S.C.&G.S. Tide Adj.	ELEVATION U.S.C.& G.S. 1936
L	E = 2,564,254.47 N = 673,249.76	Lat. 36°13'35.03" Long. 84°05'12.87"	1153.401	
R. Destroyed	E = 2,561,902.93 N = 672,050.58	Lat. 38°13'23.63" Long. 84°05'41.85"	1199.476	
DAM AXIS EAST	E = 2,564,219.60 N = 673,236.77		1149.325	
U.S.C.&G.S. B.M. 1936			1061.75	1061.885
24+15.0011	E = 2,562,148.84 N = 672,180.78		1061.797	
DAM AXIS WEST	E = 2,561,876.24 N = 672,041.77		1206.218	

UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT

NORRIS DAM
GENERAL LAYOUT.

Retraced - EDD 11-5-37

Rev. 7-11-46
Rev. 11-15-37

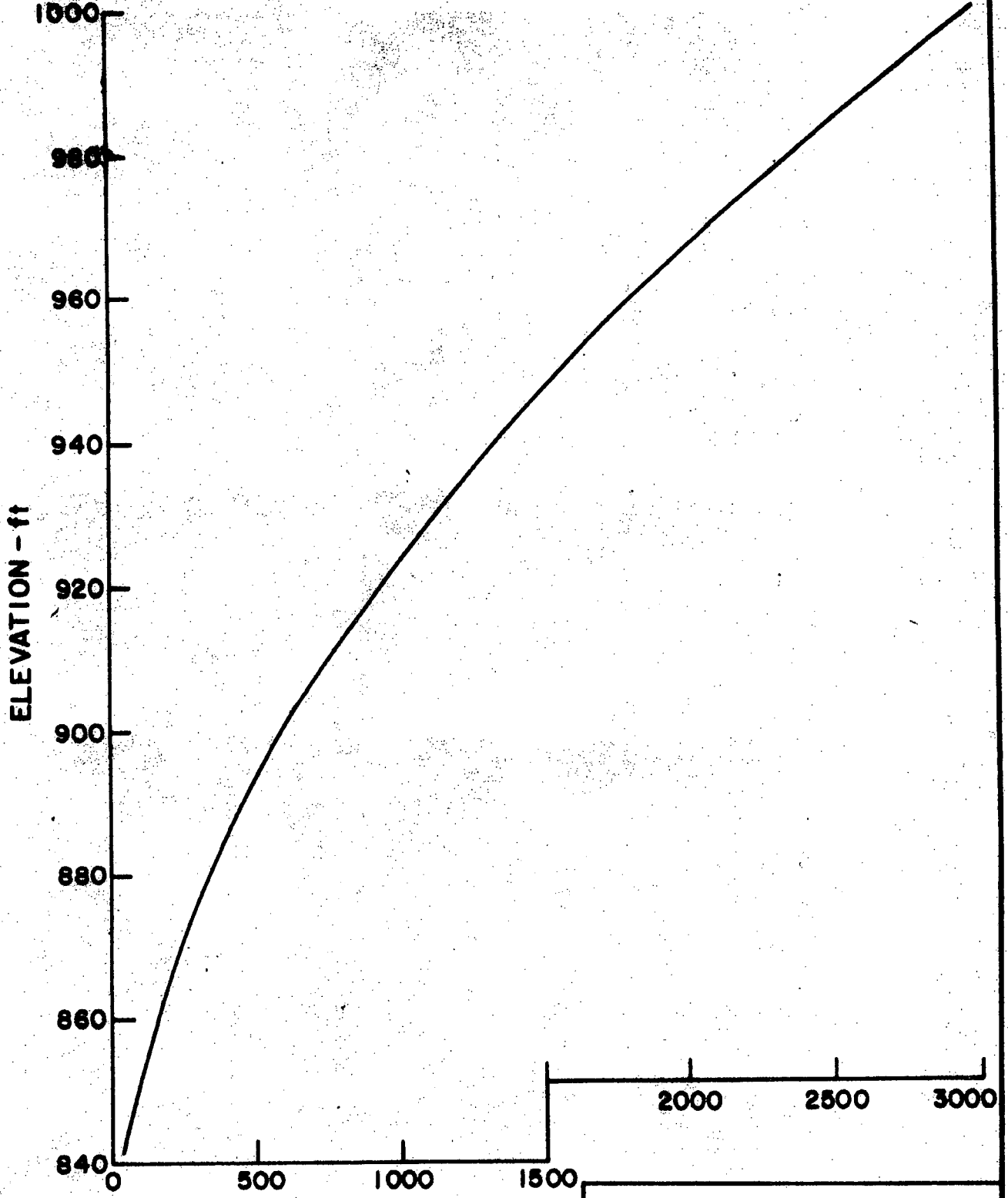
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. [signature] B. M. Steele
TR. RECOM. [signature]
CK. APPVD. [signature]

UNITED STATES
TENNESSEE VALLEY AUTHORITY
SUBMITTED [signature]
RECOMMENDED [signature]
APPROVED [signature]

232-D-264 DENVER, COLO. NAVAL LIBRARY

RECORD DRAWING AS CONSTRUCTED
[signature]

PLATE 9



NORRIS DAM FAILURE STUDY

TAILWATER RATING CURVE

NORRIS DAM
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
ENGINEERING LABORATORY

NORRIS	1-18-74	2	EL	98	A-110

DRAWN	ENGINEER
CHECKED	APPROVED
RS	BED

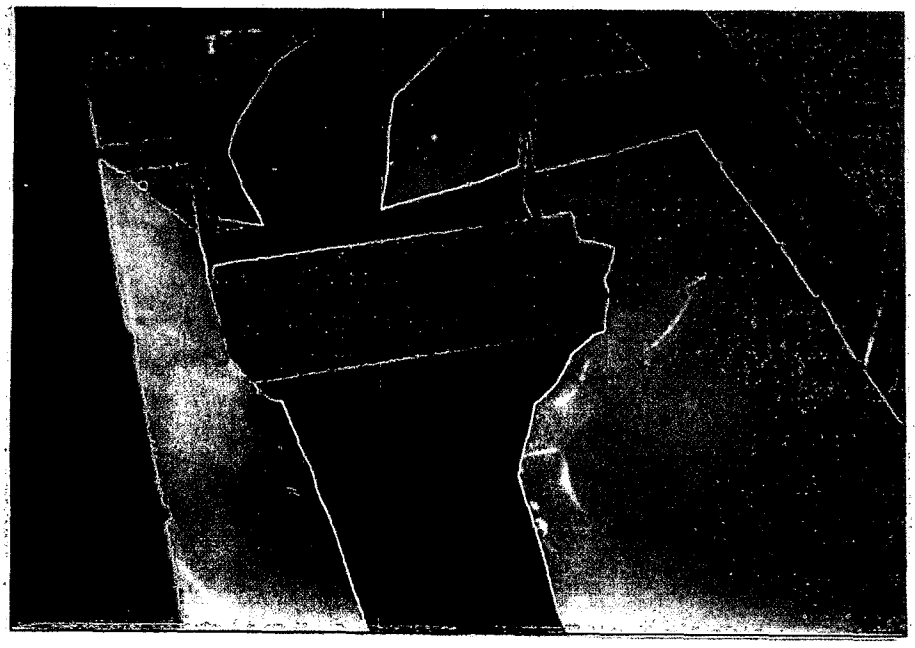


Figure 1 - General view of model
Case A - Looking upstream

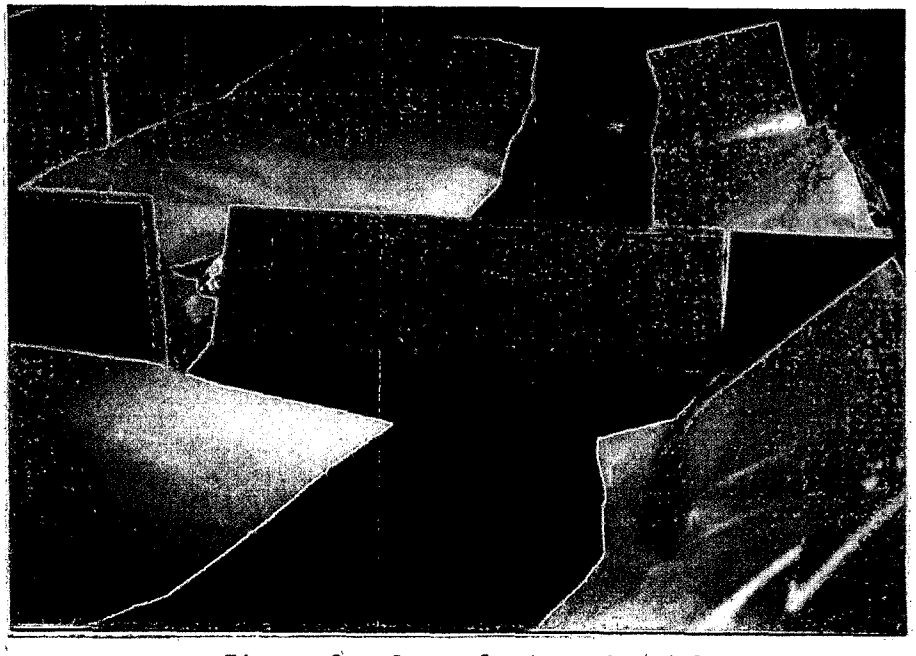


Figure 2 - General view of model
Case A - Looking downstream

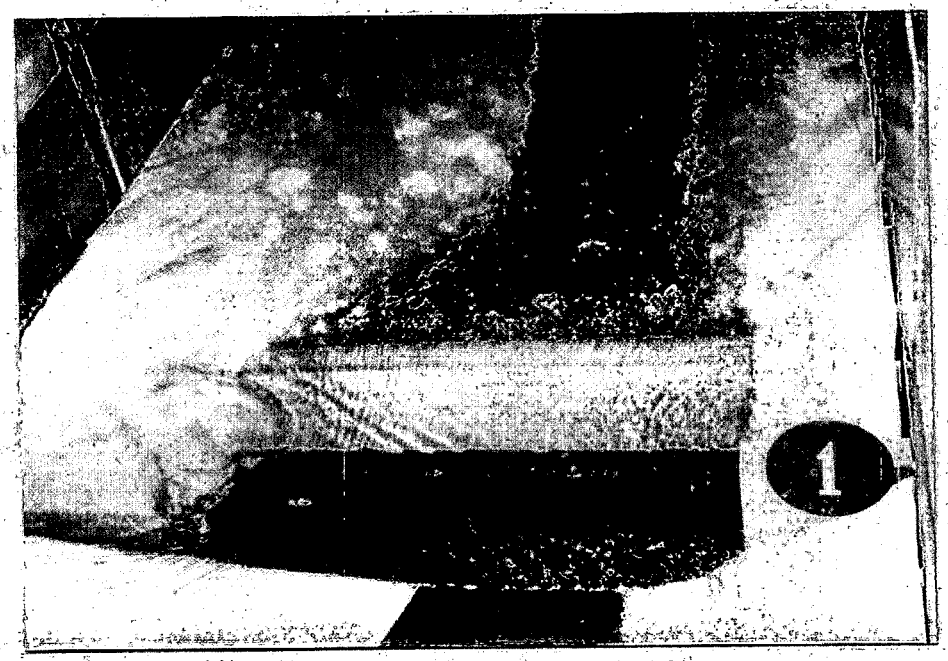


Figure 3 - H.W. El. - 1045.63
Case A - T.W. El. - 990.0
Test No. 9

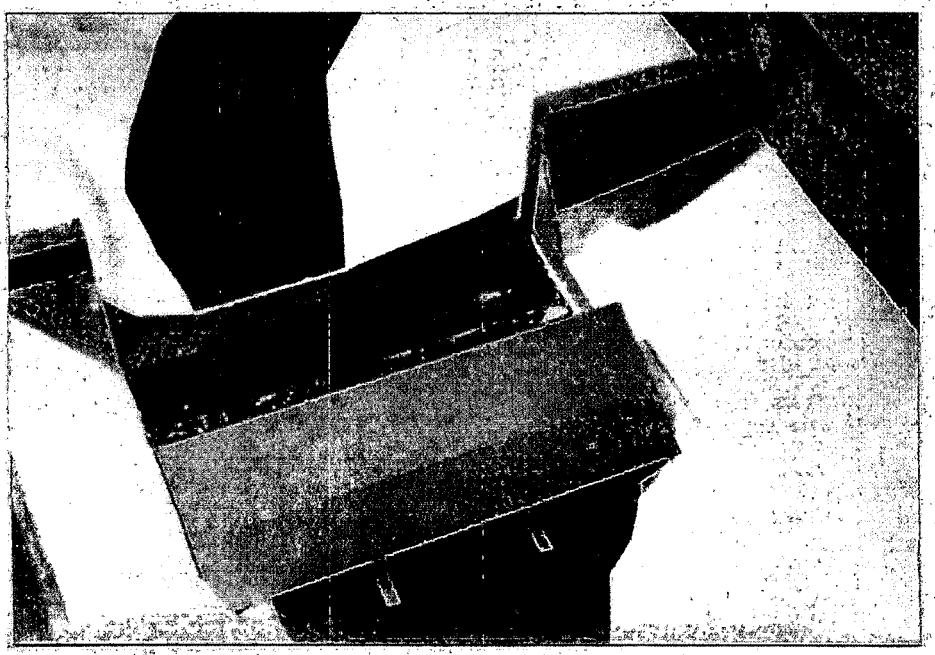


Figure 4 - General view of model
Case B - Looking upstream

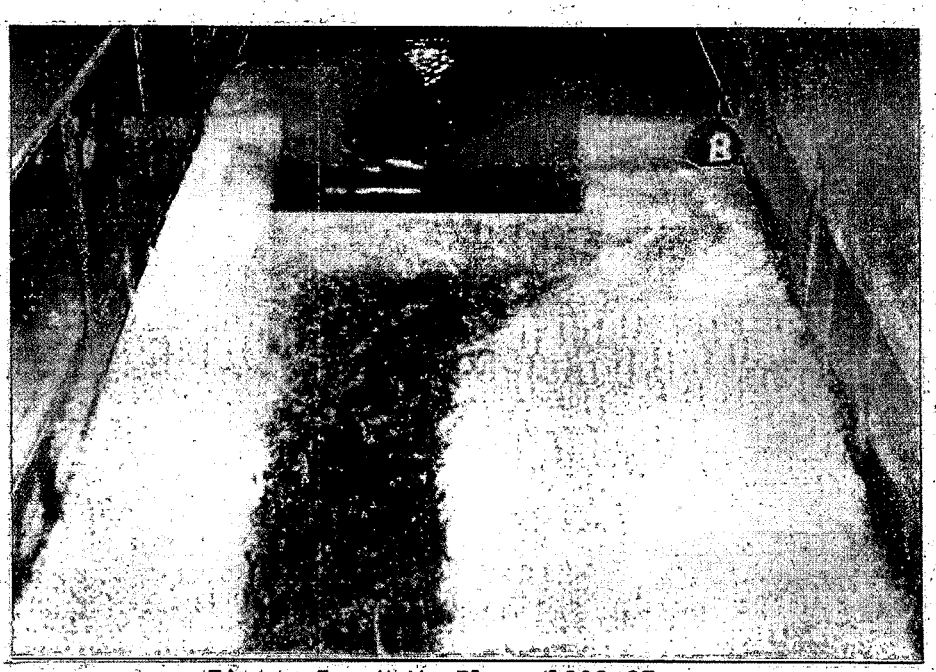


Figure 5 - H.W. El. - 1038.27
Case B - T.W. El. - 999.00
Test No. 39

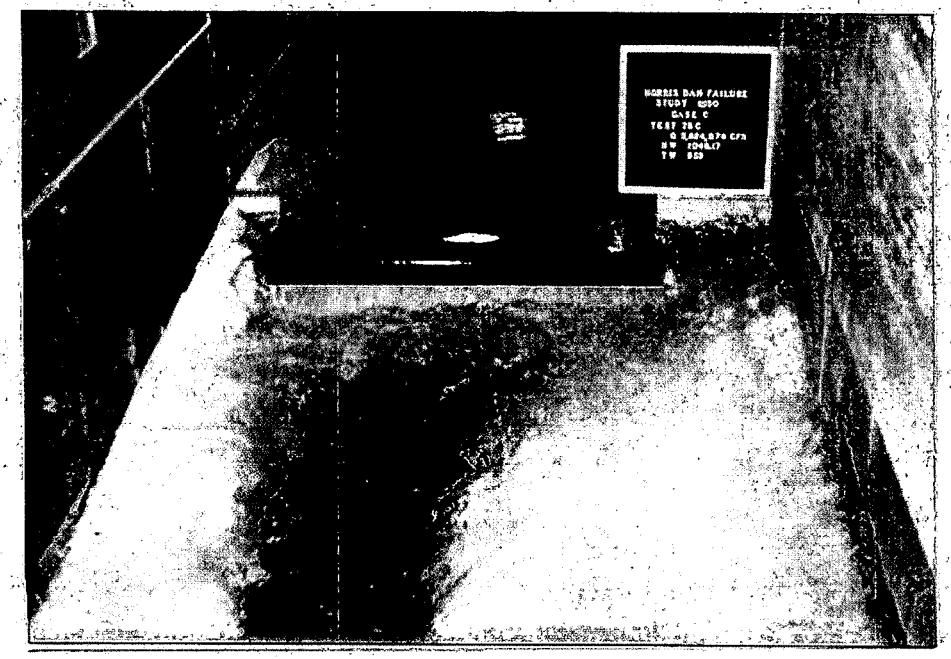


Figure 6 - H.W. El. - 1045.79
Case C - T.W. El. - 994.00
Test No. 75

Figure 7 - General view of model
Case D - Looking upstream

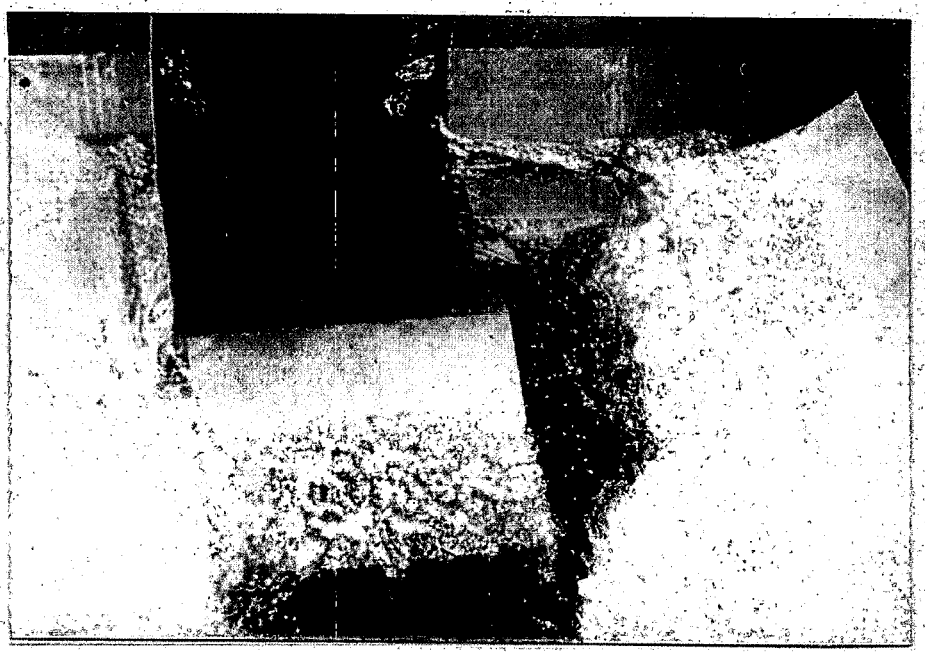


Figure 8 - H.W. El. - 929.35
Case D - T.W. El. - 885.50
Test No. 45

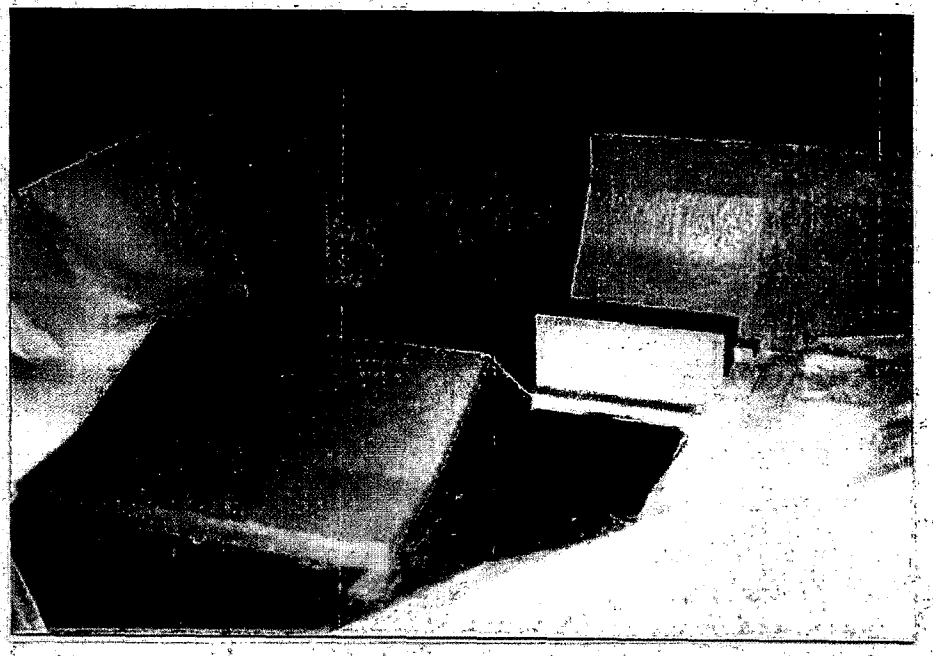


Figure 7 - General view of model
Case D - Looking upstream

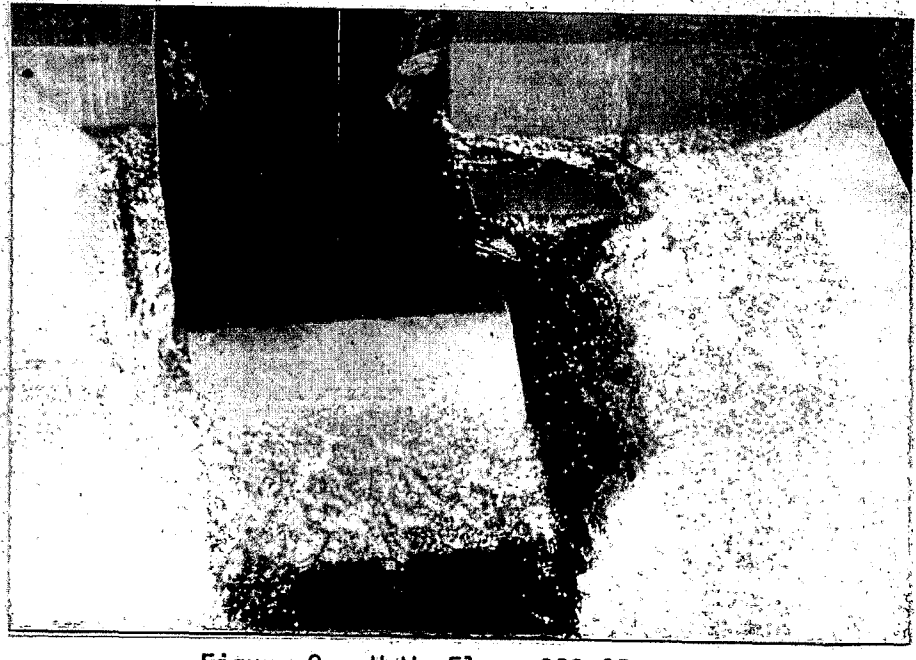


Figure 8 - H.W. El. - 929.35
Case D - T.W. El. - 885.50
Test No. 45

Figure 9 - H.W. El. - 1018.60
Case D - T.W. El. - 973.50
Test No. 54

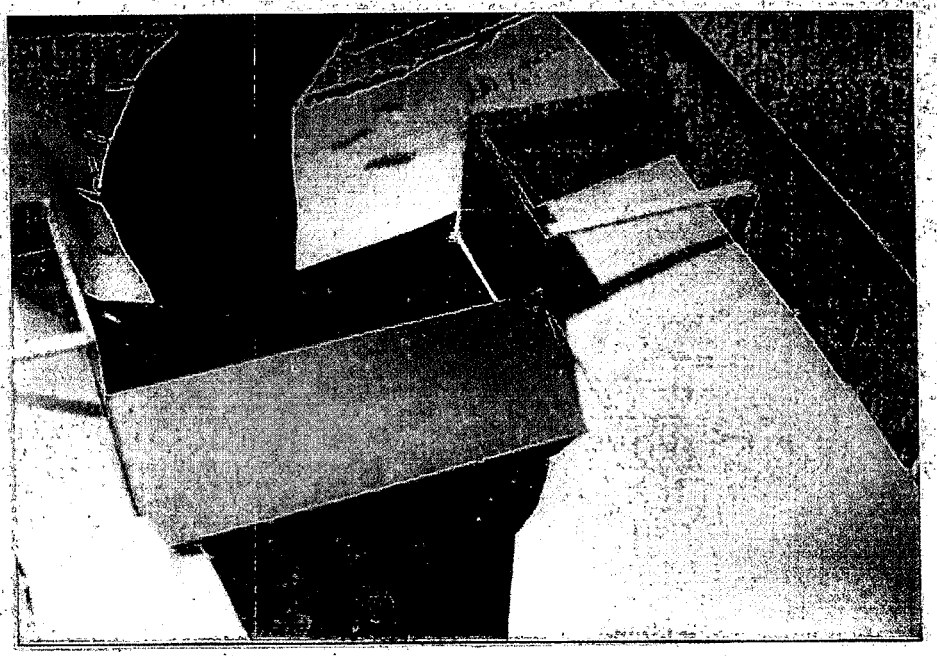


Figure 10 - General view of model
Case E - Looking upstream

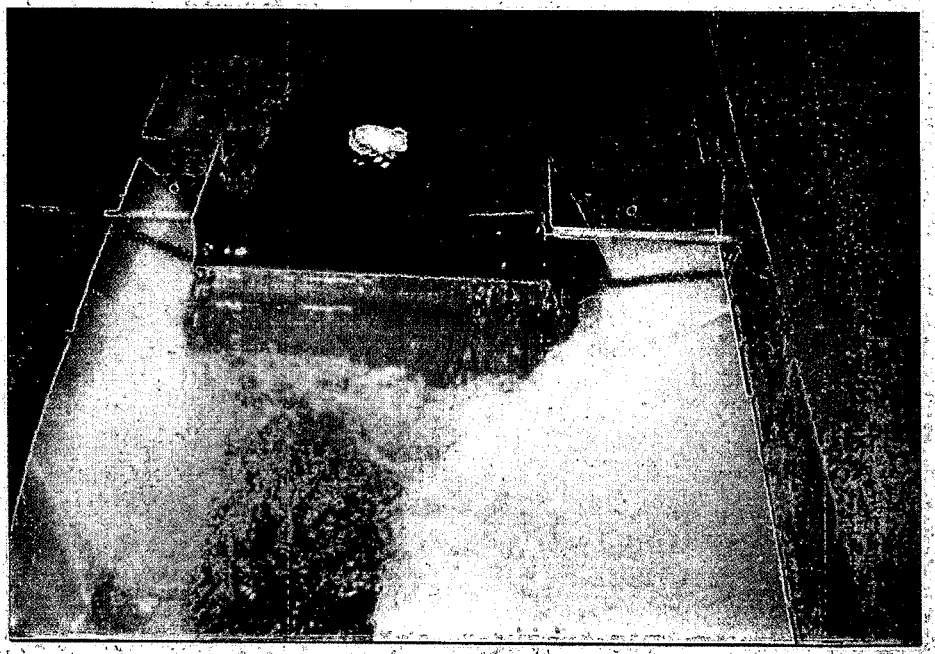


Figure 11 - H.W. El. - 1046.50
Case E - T.W. El. - 949.80
Test No. 25

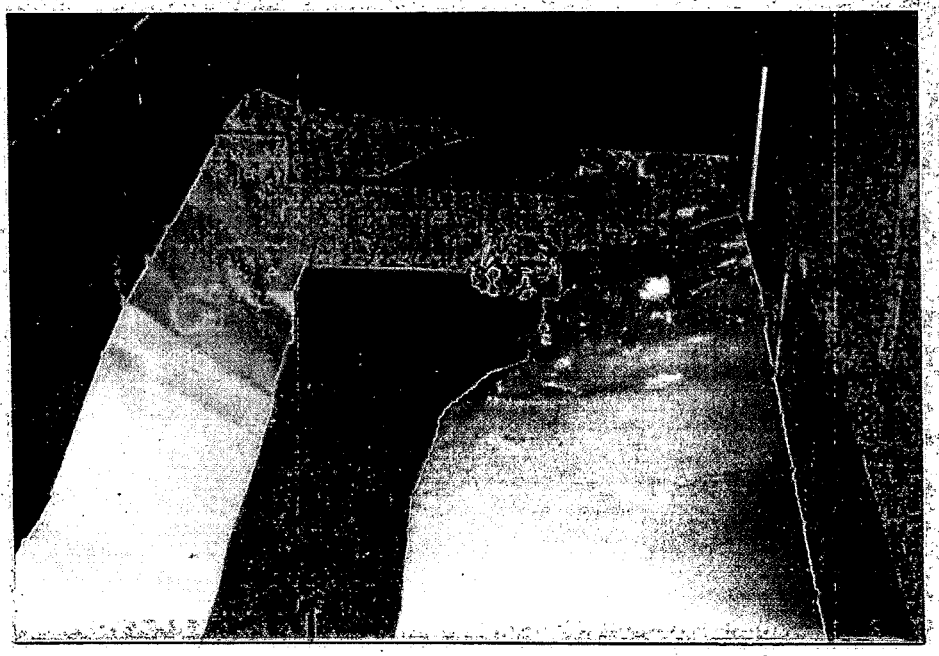


Figure 12 - General view of model
Case F_1 - Looking upstream

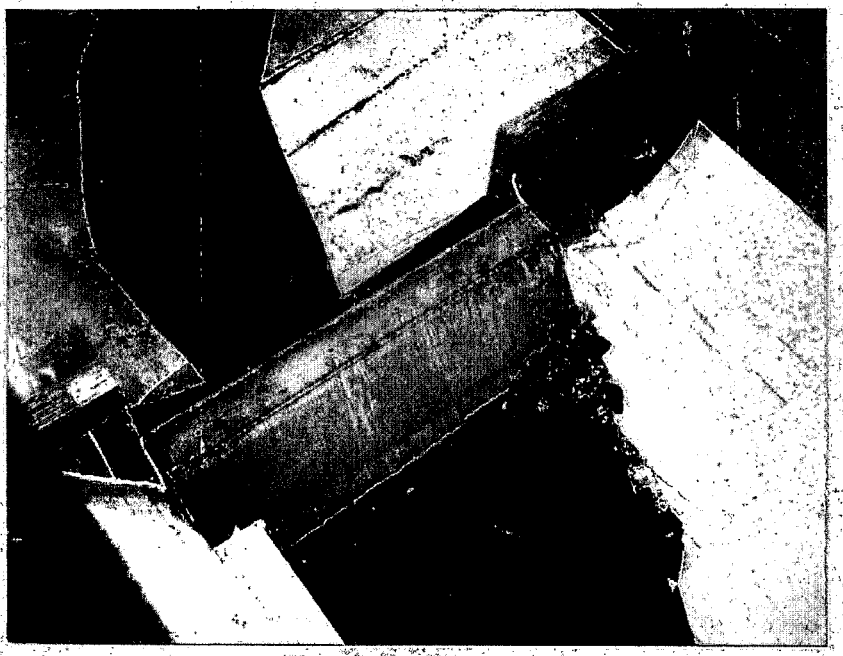
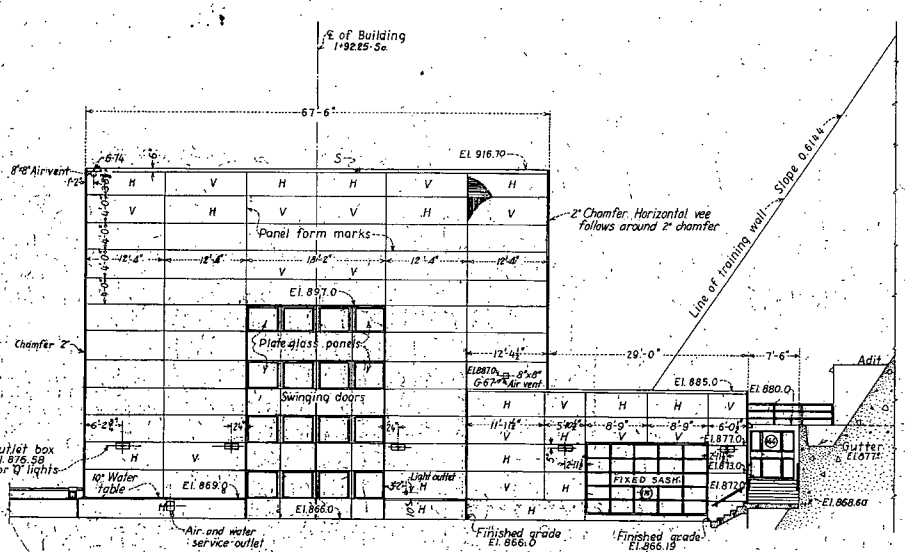


Figure 13 - H.W. El. - 982.45
Case F_2 - T.W. El. - 851.00
Test No. 91

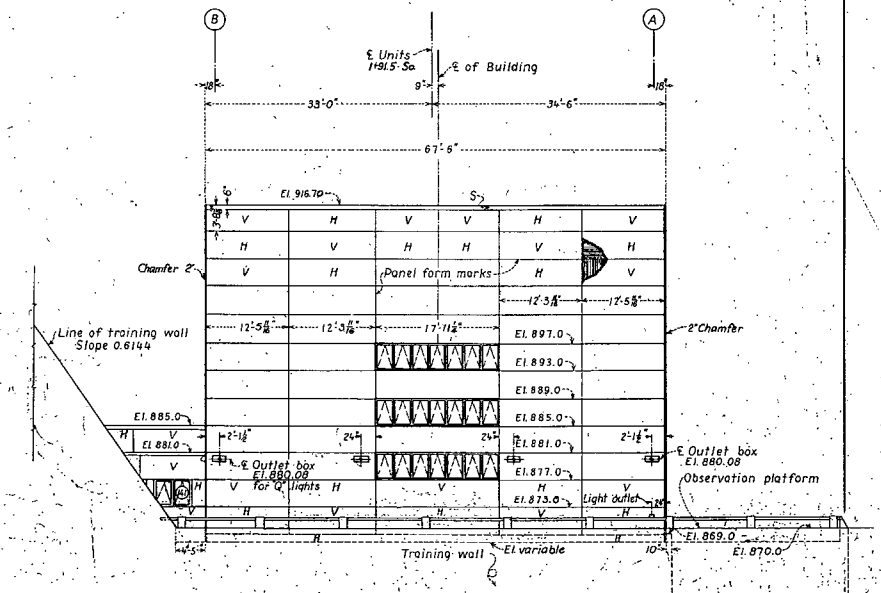
Figure 14 - H.W. El. - 1048.45
Case F_3 - T.W. El. - 966.00
Test No. 103

Figure 15 - H.W. El. - 1046.35
Case F_4 - T.W. El. - 980.50
Test No. 126

Figure 16 - H.W. El. - 1054.47
Case F_5 - T.W. El. - 999.00
Test No. 130



EAST ELEVATION

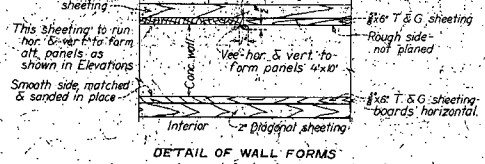


WEST ELEVATION

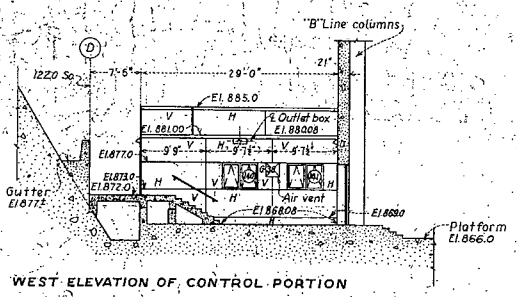
5 0 5 10 15 20
Scale of feet

NOTES

Outside wall finish: Forms lined with 8"x6" T & G sheeting with rough side against concrete, with 3"x1" vees placed horizontal and vertical to form 4'-0"x10'-0" panels (unless otherwise noted). Sheeting placed to form alternate panels of horizontal and vertical board marks as shown. All outside corners have 2" chamfer with horizontal vees following around chamfer.
Inside wall finish: Forms lined with 8"x6" T & G sheeting, all boards horizontal; smooth side against concrete, with sheeting sanded in place. Where plaster occurs on interior walls forms were not lined with 8" sheeting.



DETAIL OF WALL FORMS
For wall finish see note



WEST ELEVATION OF CONTROL PORTION

REFERENCE DRAWINGS

EXTERIOR NORTH ELEVATION 232-D-1402
EXTERIOR SOUTH ELEVATION 232-D-1403

UNITED STATES
TENNESSEE VALLEY AUTHORITY
NORRIS PROJECT

NORRIS POWER PLANT
EXTERIOR
EAST AND WEST ELEVATIONS

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DR. H.L.E. SUBMITTED R.A. Morrow
CH. D.W. RECOM. L.W. McCall
TR. A.D. CHIEF APP'VD A.S. Markell
232-D-1404 DENVER, COLO., JUNE 7, 1935

UNITED STATES
TENNESSEE VALLEY AUTHORITY
EXAMINED Lent M. Cuyler
RECOMMENDED Charles H. Jones
APPROVED A.E. Morgan

RECORD DRAWING AS CONSTRUCTED
A.M. Robertson 1937

Final Issue for Bidding 6-26-35
Field Revision 10-29-35 6-8-36
Field Revision 12-10-35 6-8-36

May 10, 1935
Job 232-8
Corrected 12-5-35
Issued Final 5-8-35