

WATER PERMIT NO. 6315-3

Name of Applicant: SD Dept of Game, Fish and Parks

Address: 523 E Capitol, Pierre SD 57501

Phone: 605 773-3718

Amount of Water Claimed: 1,750⁶⁹ AF

Total Acres: NA

Source of Water Supply: Dawson Creek

Water to be used for: fish & wildlife propagation, recreational use

County: Bon Homme

Type of Waste Disposal System:

Location: East of Scotland

PRIORITY

Date Received: 3-26-2002

Fee: \$NA

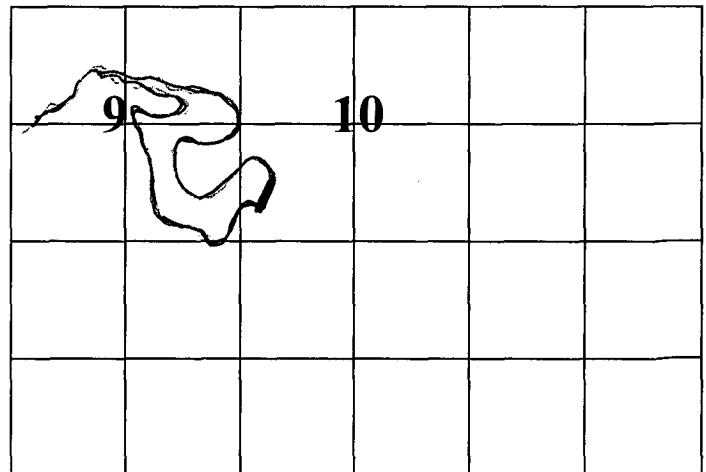
Corrected Application Received:

Period of Annual Use: January 1 – December 31

Remarks: Reconstruction of Lake Henry dam

Diversion Point: W ½ SW ¼ Section 10-
T96N-R58W

Water Impounded: W ½ SW ¼ Sec 10 and
SE ¼, S ½ NE ¼ Sec 9; all in T96N-R58W



Depth of Well: NA

Well Driller: : NA

Remarks:

Type of Map: topo

Prepared by: Jeffrey Peters, GFP

Reviewed and the Number Assigned on: 3-26-2002

By: **Karen Schlaak**

Notice of Hearing - date to intervene: _____

SOUTH DAKOTA
WATER PERMIT NO. 6315-3

Date of first receipt of application March 26, 2002.

The Chief Engineer, on behalf of the Water Management Board, issues Water Permit No. 6315-3 to the South Dakota Department of Game, Fish and Parks, 523 E Capitol, Pierre SD 57501 authorizing the reconstruction of the dam and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 6315-3 authorizes impoundment of 1,769 acre-feet of water from Dawson Creek by reconstructing Lake Henry dam located in the W ½ SW ¼ Section 10 with water impounded in the W ½ SW ¼ Section 10 and SE ¼, S ½ NE ¼ Section 9; all in T96N-R58W.
2. The water appropriated shall be used for the purpose of supplying water for fish and wildlife propagation and recreational purposes and may not exceed the amount of water needed for beneficial use.
3. The water is to be used during the following described annual period: January 1 – December 31.
4. The date of approval of Permit No. 6315-3 is June 24, 2002.
5. The date from which applicant may claim right is March 26, 2002.
6. One-fifth of the construction is to be completed on or before December 24, 2004.
7. All construction is to be completed on or before June 24, 2007.
8. Water is to be put to beneficial use on or before June 24, 2011.
9. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. Water Permit No. 6315-3 authorizes a dam with a storage capacity of 1,769 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,290.0 feet mean sea level.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.

WATER MANAGEMENT BOARD



and Erbele, Chief Engineer

Water Rights Program

Department of Environment and Natural Resources

JUL 15 2002

date



FORM 2: Application for uses other than irrigation
(type or print)

Mail to: Water Rights Program Joe Foss Building 523 E. Capitol Pierre, SD 57501-3181 (605) 773-3352	No. <u>6315-3</u>	(office use only) Hydrologic Unit <u>10160011</u>
	Basin <u>James River</u>	
	Newspaper <u>Scotland Journal</u>	

RECEIVED
MAR 26 2002
WATER RIGHTS
PROGRAM

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use(s) of water:

☐ Municipal	☐ Suburban Housing	☒ Recreational	☐ Institutional
☐ Rural Water System	☐ Commercial	☒ Fish & Wildlife	☐ Geothermal Heat
☐ Domestic (over 18 gpm)	☐ Industrial	☐ Other	

Type of Application: ☒ New ☐ Vested Right (Use predates Mar 2, 1955) ☐ Future Use Reservation
(check one) Place to Beneficial Use Water Reserved by Future Use Permit No. _____
Amendment/Correction to Permit No. _____

Description of amendment/correction: (i.e. change diversion point(s), add diversion point(s), change use, etc.) _____

- Name of Applicant South Dakota Department of Game, Fish & Parks Phone (605) 773-3718
(check one) ☐ Owner ☐ Tenant/lessee
Mailing Address 523 East Capitol Avenue; Pierre State SD 57501
(Street, RR, or Box and City) (Zip Code)
- Amount of water claimed 1769 *CFS or 1750 **GPM ***AF
(*Cubic Feet per Second) (**Gallons per Minute) (***)Acre Feet - storage capacity of dam/dugout or annual use if applicable
- Source of water supply Dawson Creek
- Location of point of diversion (example - 3 wells in SW1/4 NE1/4 section 12-T104N-R53W)
Dam Location: SW 1/4 Section 10 T96N, R58W
County Bon Homme
- County or counties where water will be used Bon Homme
- Annual period during which water is to be used Continuously Jan 1 - Dec 31
- Give a description of the project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)

The reconstruction of the Lake Henry dam will occur at the location noted in the attached map (also see attached engineering plans and designs). The dam will consist of compacted soil and a concrete primary spillway and secondary grass spillway. A low level outlet structure will be installed in the dam to allow for water manipulations for fisheries management purposes. The breached embankment will be partially removed, but some of it will remain to provide fish habitat.

Attachments: Attach Form 2A if diversion is from a well or dugout, or if storage of water is proposed. Attach map and any other technical information. (see instructions)

STATE OF SOUTH DAKOTA)

County of HUGHES)

I, Douglas R. Hansen, the applicant, certify that I have read this application, have examined the attached map and that the matters stated are true and that I intend, and am able to complete the necessary construction.

Applicant's signature

Douglas R. Hansen

Subscribed and sworn to before me this 25th

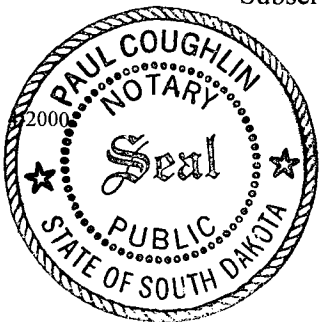
day of

MARCH

20 02

[Signature]

Notary Public signature



MY COMMISSION
EXPIRES AUG. 24, 2007

(type or print in ink)

1. Well Information - Proposed Construction

- a) Drill Hole Diameter _____ Depth _____
- b) Casing Type _____ Diameter _____ Thickness _____
- c) Screen Type _____ Diameter _____ Thickness _____
- d) Gravel Pack _____ Length of Gravel Pack _____
- e) Depth to Top of Water Bearing Material _____
- f) Depth to Water (ground surface to water level) _____
- g) Distance to nearest existing domestic well: _____
- On applicants property _____ On property owned by others _____

2. Wastewater Disposal System Information

- a) Type of System (i.e. septic tank, drain field) _____
- b) System Capacity (gallons) _____ Year Constructed _____
- c) Connected to the City of _____ Sanitary System _____

3. Dugout Information

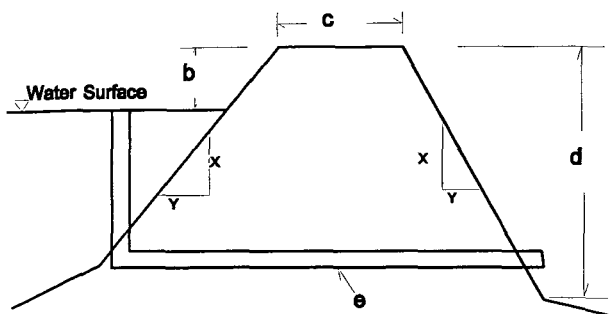
- a) Surface Dimensions _____ Depth _____
- b) Depth to water (ground surface to water level) _____

4. Water Storage Dams

If the proposed water use system contains one or more storage dams, please furnish the information requested below for each dam. The locations of the dams need to be shown on the map submitted with the application.

- a) If a private engineering firm or government agency was involved in the design of this dam, please give their name and address:

Banner Associates, Inc.
P.O. Box 298
Brookings, SD 57006-0298



- b) Freeboard **9 feet**
- c) Crest Width **15 feet**
Crest Length **1050 feet**
- d) Height **45 feet**
- e) Primary Outlet Capacity **6900 cfs**
If pipe, diameter _____
- f) Secondary Spillway Capacity **1100 cfs**
Spillway Width **Primary: 60 feet**
Secondary: 100 feet
- g) X & Y Slope Upstream **1:3 (X:Y)**
Downstream **1:2.5 (X:Y)**
- h) Surface Area of Impoundment **125 acres at**
1290 fmsl
- i) Storage **1750** Acre Feet
- j) Drainage Area Above Dam **24,977 Acres**
39.03 sq. mi. contributing

Lake Henry Dam Replacement

Scotland

Fairgro

Swimming Pool

Gravel Pit

Dawson Creek

Lake Henry

SPILLWAY 1290

Dam Location



S
C
O
T
T
I
S
H

1350

1308

1328

1300

1334

1321

1330

2

6315-3

Water Permit Application No. 6315-3
 SD Dept. of F&P
 Lake Henry Dam
 (Preliminary Plans)

Top of Dam Elev. - 1299
 2nd Spillway Elev. - 1294
 P. Spillway Elev. - 1290
 D/S Emb Toe Elev. - 1254

Cat. 2 - Significant Hazard

Ht. = 45 ft

Normal Storage Capacity - 1750
 Int. Storage Capacity - 2200
 Max Storage Capacity - 3000

Cat. 2 - Intermediate Size - 0.5 PMF unless 74:02:08:07.02
 qualifies

50% PMF = 40,000 cfs
 10% PMF = 7,800
 100 year = 1900

From USGS WRI 80-80 - "Tech for Est Flood Peaks ... 50"

OA = 39

Slope = 10 ft/mi

SI = 3.33

$Q_{100} = 132 A^{.65} S^{.46} Si^{-.67}$

$= 132 (39)^{.65} (10)^{.46} (3.33)^{-.67}$
 $= 132 (10.82) (2.88) (0.45)$
 $= 1850 \text{ cfs used } 1900 \text{ cfs}$

Spillway Capacity - Need Final PIS

Section 74:02:08:09

NRCS Annual Yield

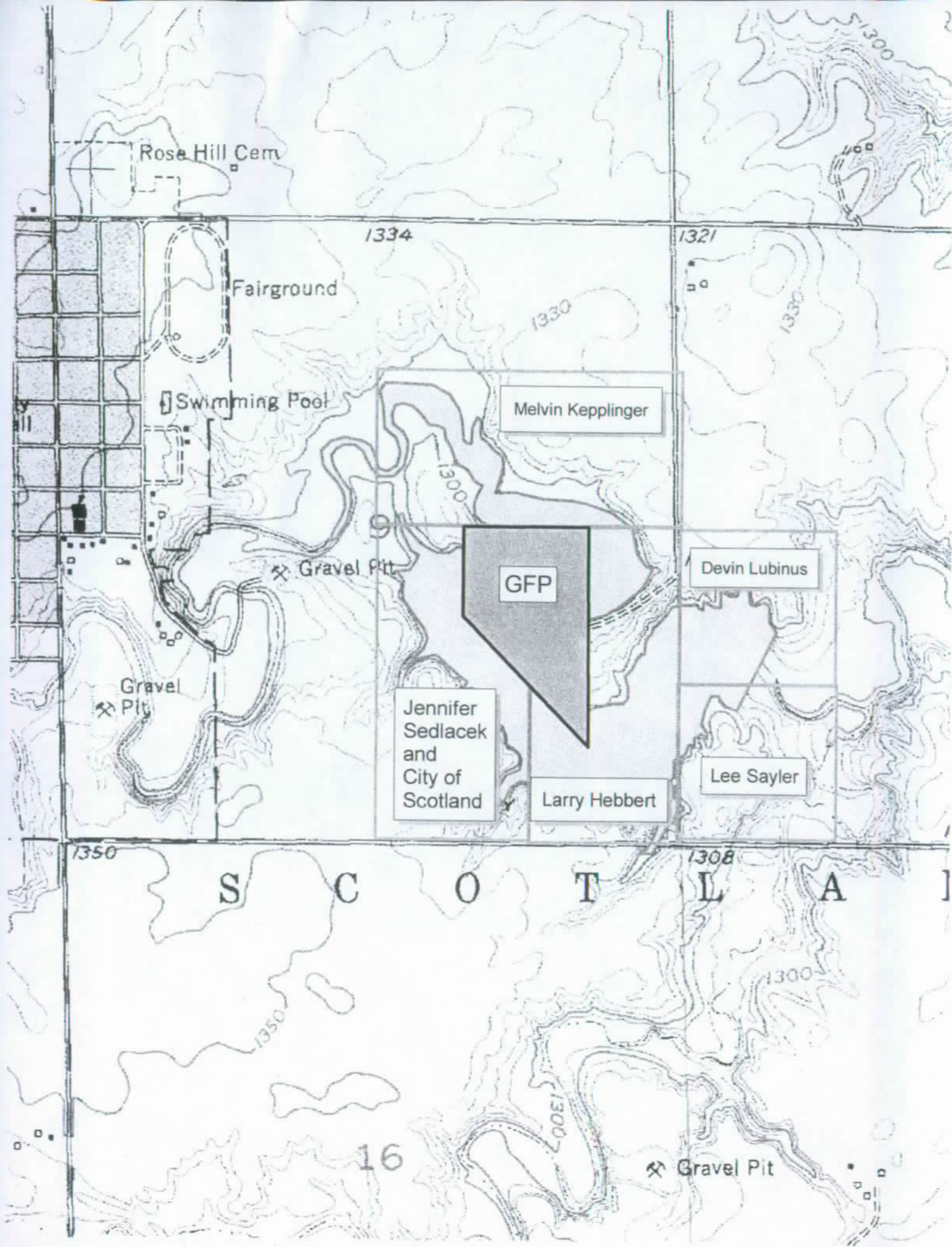
DA = 24977 CN = 72 ISO = 3

1. Topo Map - No-Need Ownership New Land
2. Dam Axis Profile - OK
3. Max X-Sec - Top of Dam Elev 1299
4. Area Capacity - OK
5. Outlet Details - OK
6. Spillway Rating - No Need Final PIS
7. Spillway Details - " "
8. Specs - OK
9. EPP - N/A Cat. 2 - May ask for one

80% chance = 0.15
 $24977 \times 0.15^{1/2} = 312 \text{ Ac-Ft}$

50% chance = 0.42
 $24977 \times 0.42^{1/2} = 875 \text{ Ac-Ft}$

10% chance = 2.2
 $24977 \times 2.2^{1/2} = 4580 \text{ Ac-Ft}$



Rose Hill Cem

Fairground

Swimming Pool

Gravel Pit

Gravel Pit

Melvin Kepplinger

GFP

Devin Lubinus

Jennifer Sedlacek and City of Scotland

Larry Hebbert

Lee Saylor

SCOTTLAND

16

Gravel Pit

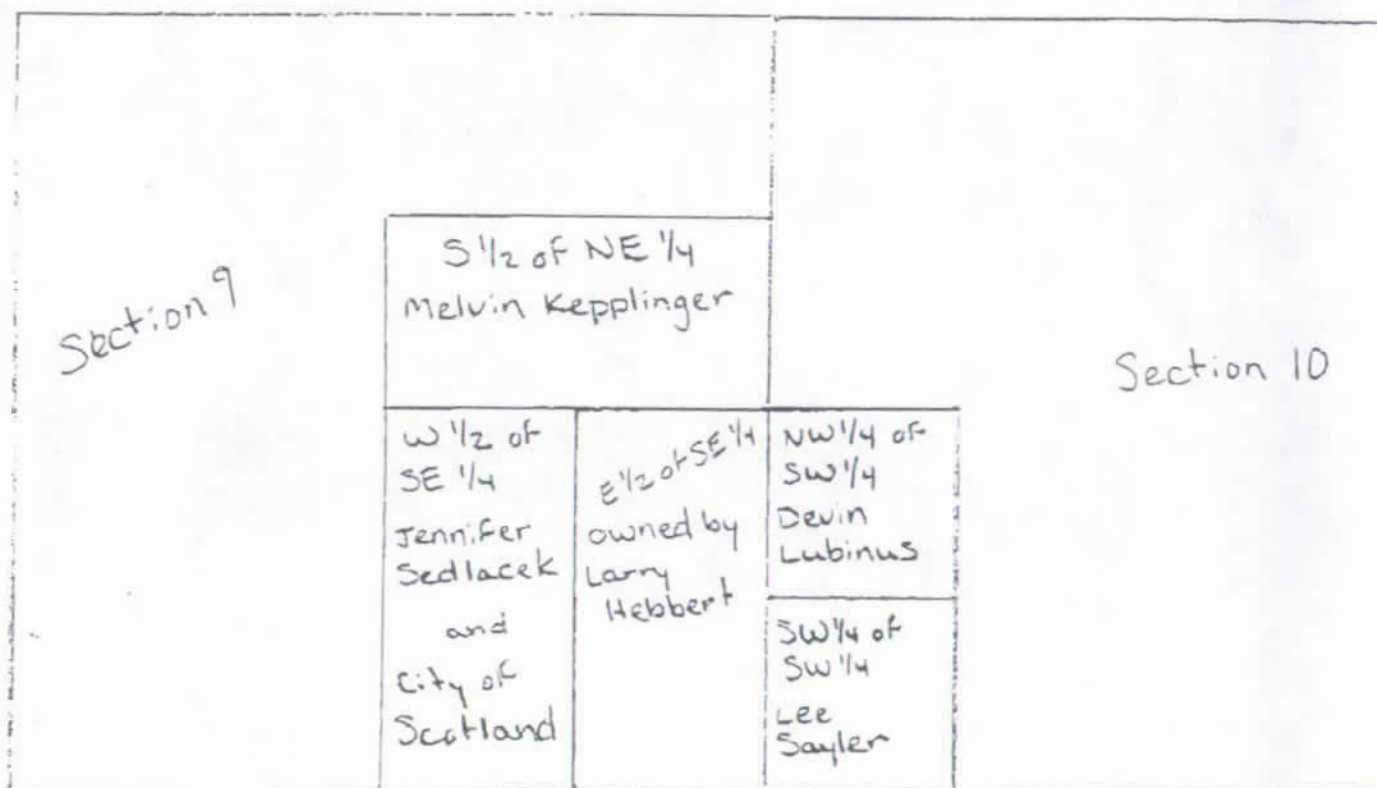
Melvin Kepplinger
29150 SD Hwy 25
Scotland SD 57059
583-4183

Larry Hebbert
29143 425th Ave.
Scotland SD 57059
583-2855

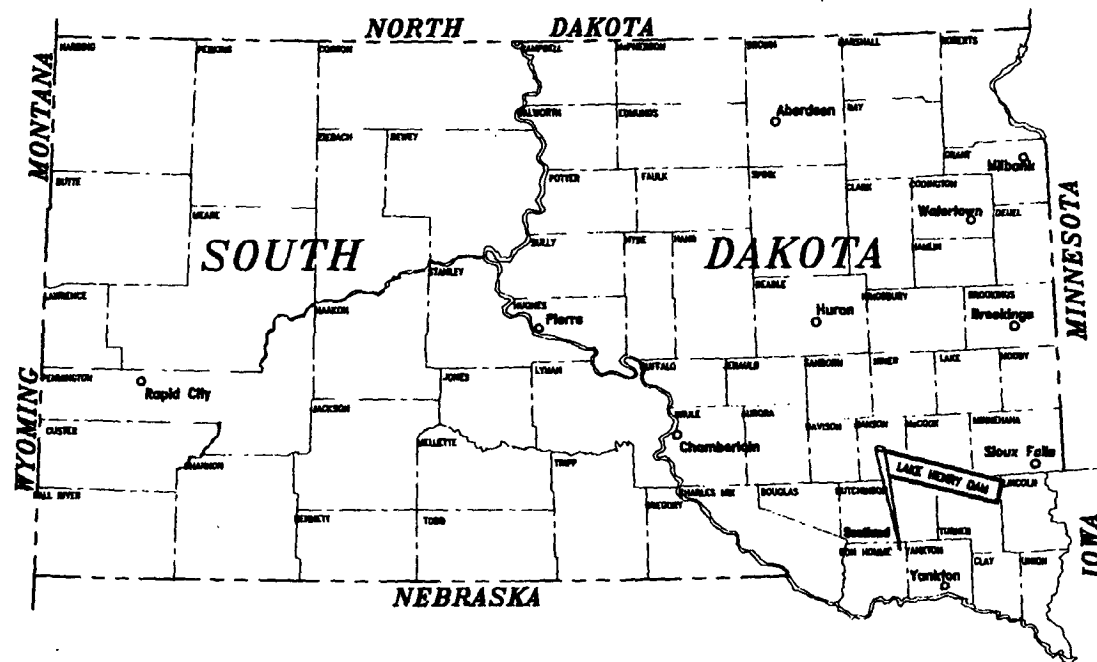
Jennifer Sedlacek
583-4321

Devin Lubinus
29206 Lake Henry Rd.
Scotland SD 57059
583-2243

Lee Saylor
583-4401



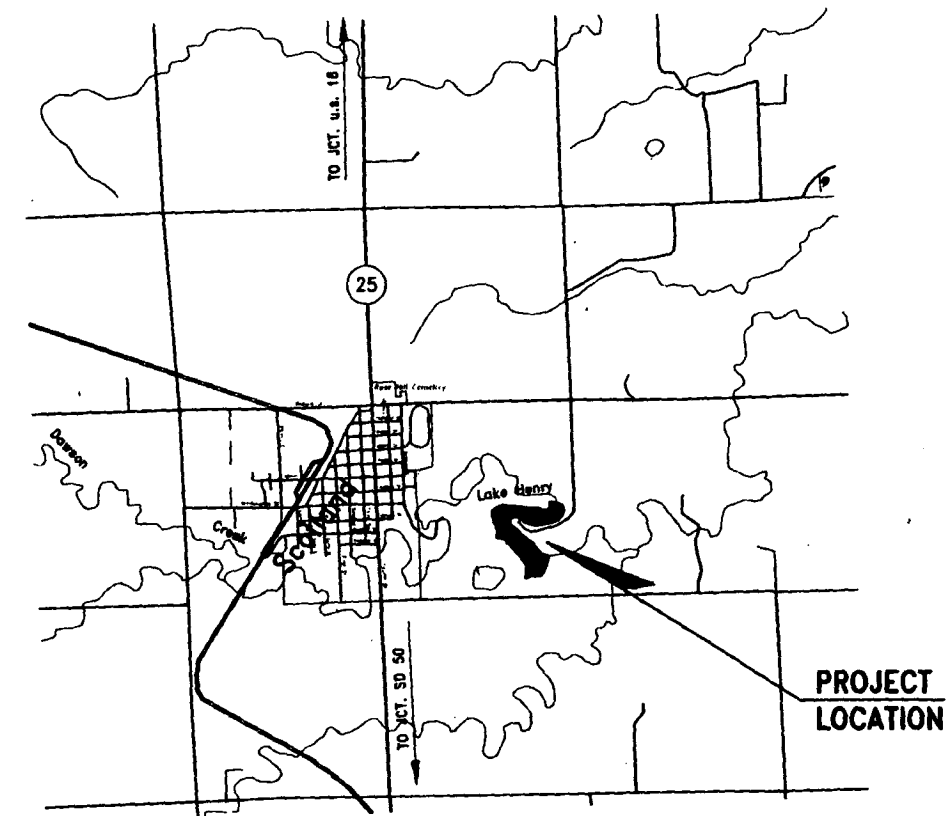
CONSTRUCTION PLANS FOR LAKE HENRY DAM RECONSTRUCTION DEPARTMENT OF GAME, FISH AND PARKS SCOTLAND, SOUTH DAKOTA OSE No. GSD971003I GFP No. W98 12 01B



North
PROJECT VICINITY MAP

INDEX OF SHEETS

SHT. NO.	DESCRIPTION
A1	TITLE AND INDEX OF SHEETS
A2	TABLES AND RATINGS CURVE
A3	GENERAL NOTES AND DETAILS
B1	EMBANKMENT LAYOUT PLAN
B2	EXCAVATION DETAILS
B3	EMBANKMENT FINISHED PLAN
B4	DAM EMBANKMENT TYPICAL SECTIONS
B5	EMBANKMENT PROFILES
B6	DAM EMBANKMENT CROSS SECTIONS
B7	DAM EMBANKMENT CROSS SECTIONS
B8	DAM EMBANKMENT CROSS SECTIONS
C1	OUTLET WORKS CENTERLINE PROFILE
C2	OUTLET WORKS INTAKE STRUCTURE
C3	OUTLET WORKS CONTROL STRUCTURE
C4	OUTLET WORKS EXIT STRUCTURE AND TOE DRAIN HEADWALL STRUCTURE
D1	SPILLWAY PLAN AND DETAILS
D2	SPILLWAY ELEVATIONS, SECTIONS AND DETAILS
D3	SPILLWAY SECTIONS AND DETAILS
E1	EXISTING SPILLWAY DEMOLITION PLAN
E2	SANITARY SEWER - PLAN & PROFILE

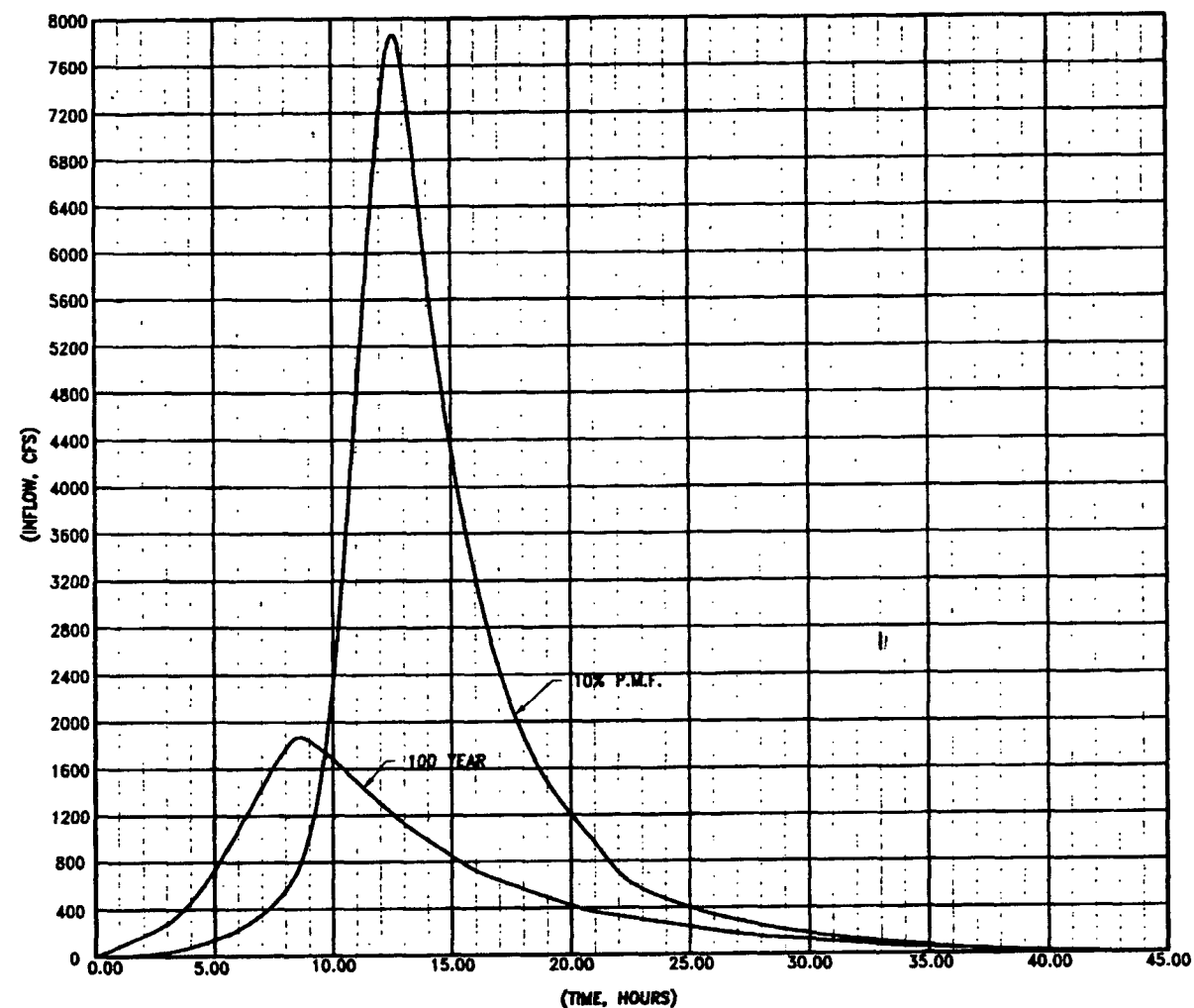


North
PROJECT VICINITY MAP
FOR REVIEW

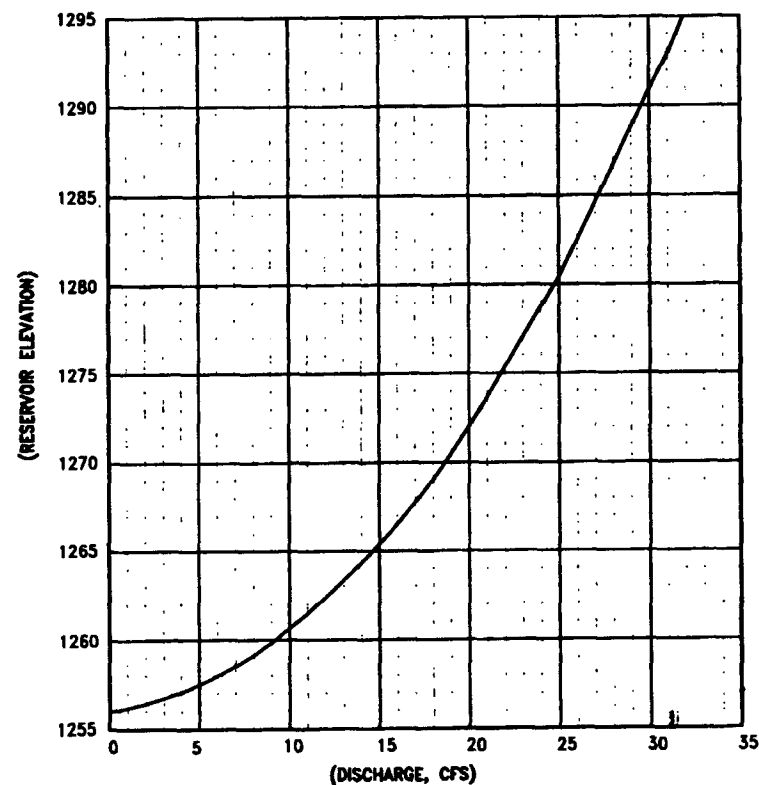
BON HOMME COUNTY, SOUTH DAKOTA
SEPTEMBER 1997

Preliminary
Use Only
FOR REVIEW
CONTRACT MANAGEMENT BY
OFFICE OF STATE ENGINEER
JOHN ST. CLAIR WHITE, P.E.
STATE ENGINEER

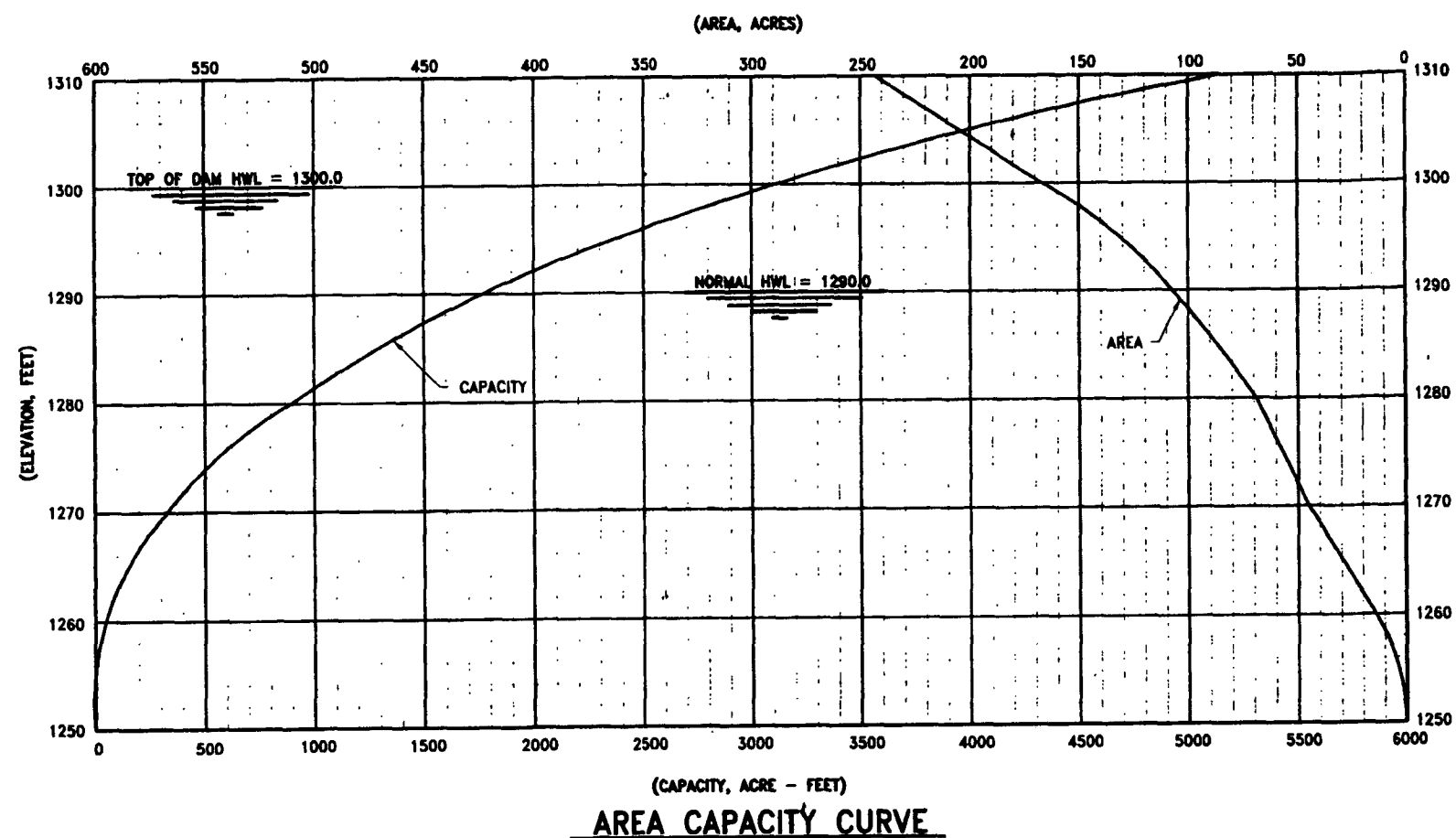
DRAWN BY: C.A.M.	REVIEWED DATE: _____ FOR _____	BANNER BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS 409 22nd Av S • P.O.Box 298 - Brookings, SD 57006 • (605)692-6342	REVISION	DATE	DESCRIPTION	BY	CK'D	Lake Henry Dam Reconstruction	Scotland, South Dakota	SCALE: _____	JOB NO. 7843-01	DATE: Sept. 97	
DESIGNED BY: S.Y.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.												
CHECKED BY: R.L.S.													
								TITLE & INDEX OF SHEETS		A1			



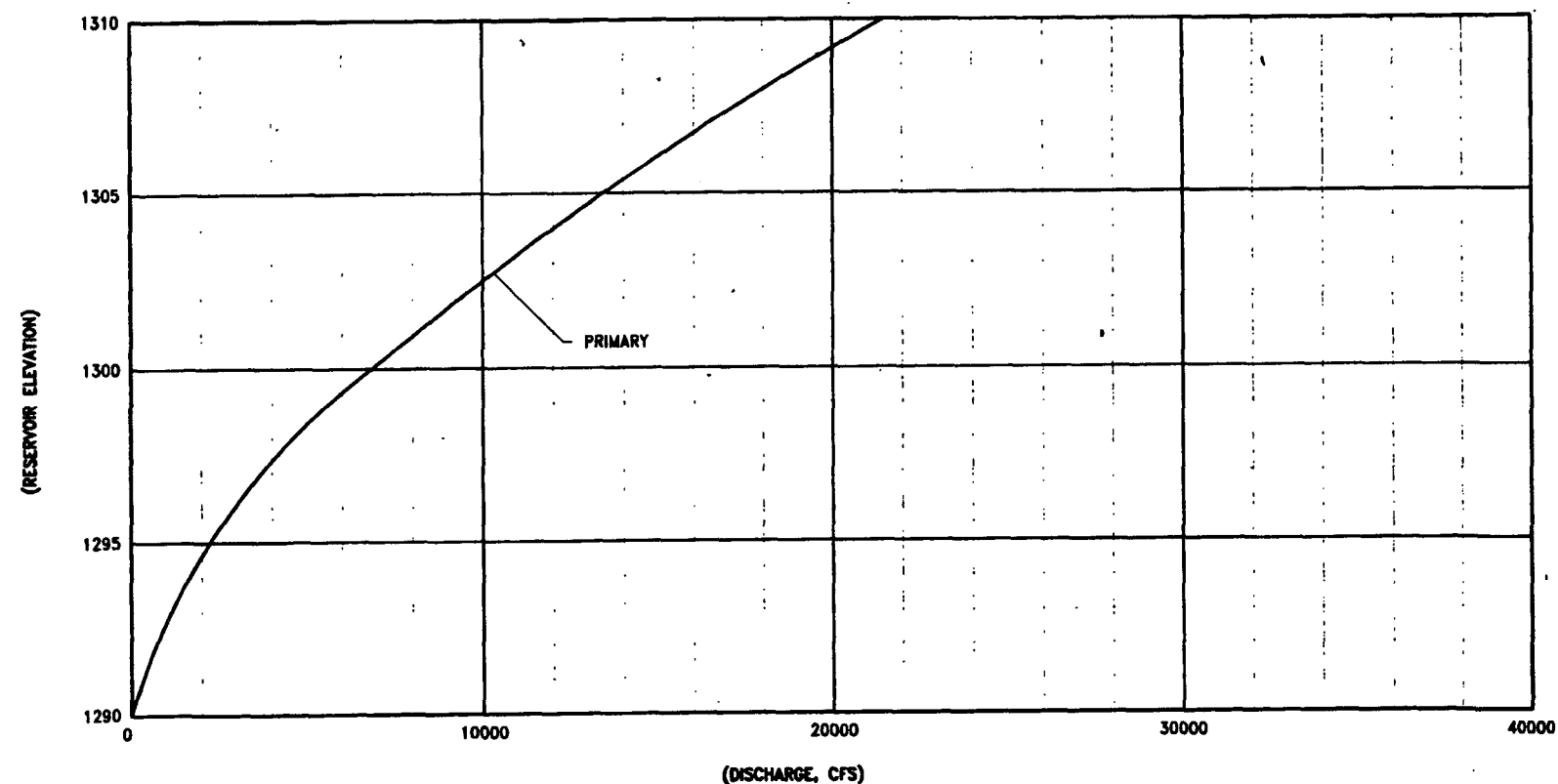
STORM HYDROGRAPHS
DAWSON CREEK ABOVE RESERVOIR



OUTLET WORKS DISCHARGE RATING CURVE



AREA CAPACITY CURVE



PRIMARY SPILLWAY DISCHARGE RATING CURVE

DRAWN BY: C.A.M.
DESIGNED BY: S.V.M.
CHECKED BY: R.L.S.

REVIEWED: _____ FOR _____
DATE: _____

REVIEWED: _____ FOR BANNER ASSOCIATES, INC.
DATE: _____

BANNER
BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS
409 22nd Av S • P.O.Box 298 - Brookings, SD 57006 • (605)692-6342

REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction

Scotland, South Dakota

TABLES AND RATINGS CURVES

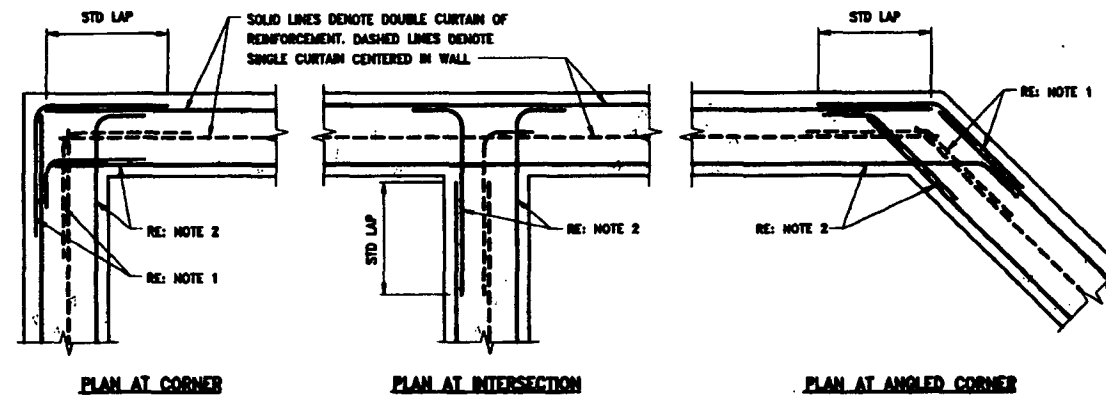
SCALE: None
DATE: 10-01-97
SHEET NO.: 1

A2

STRUCTURAL GENERAL NOTES

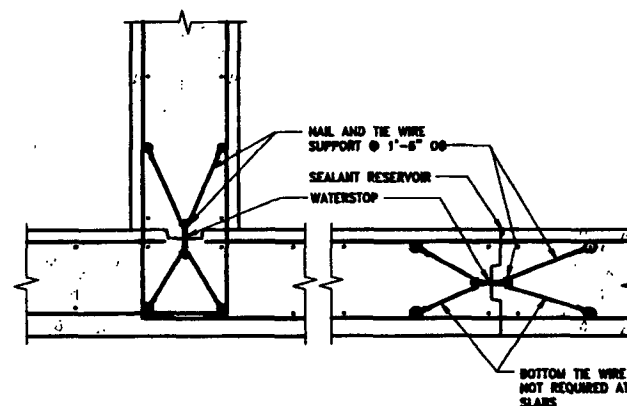
THE STRUCTURAL DESIGN WAS PREPARED USING THE FOLLOWING DATA EXCEPT WHERE NOTED:

1. DESIGN LOADS
 - a. DEAD LOADS ----- ACTUAL LOADS
 - b. LIVE LOADS -----
 - c. WATER LOADS ----- 62.4 PCF
 - d. LATERAL SOIL PRESSURES (EQUIVALENT FLUID PRESSURES) ----- GRAVIMETER FILL
 - (e.) ACTIVE ----- 33 PCF
2. STRUCTURAL MATERIALS
 - a. CONCRETE
 - i. STRUCTURAL CAST-IN-PLACE ----- $f'_c = 4000$ PSI MIN. (MAX. W.C. RATIO = 0.45)
 - ii. CEMENT ----- TYPE II WITH A SUITABLE POZZOLAN
 - b. REINFORCING STEEL
 - i. MAIN REINFORCEMENT ----- ASTM 615, GRADE 60
 - ii. STIRRUPS AND TIES ----- ASTM 615, GRADE 40
 - iii. WELDED WIRE FABRIC ----- ASTM A185
 - iv. STRUCTURAL STEEL ----- ASTM A36
 - v. STAINLESS STEEL ----- AISI 304
 - vi. BOLTS ----- ASTM A325
 - vii. ANCHOR BOLTS ----- ASTM A307
 - viii. ROCK BOLTS ----- ASTM 615, GRADE 60
3. DESIGN CRITERIA MATERIALS AND WORKMANSHIP SHALL CONFORM TO APPLICABLE REQUIREMENTS OF THE FOLLOWING DESIGN SPECIFICATIONS:
 - a. UNIFORM BUILDING CODE
 - b. AMERICAN CONCRETE INSTITUTE
 - c. AMERICAN INSTITUTE OF STEEL CONSTRUCTION
 - d. AMERICAN IRON AND STEEL INSTITUTE
 - e. AMERICAN WELDING SOCIETY
 - f. AMERICAN SOCIETY FOR TESTING AND MATERIALS
 - g. CONCRETE REINFORCING STEEL INSTITUTE
 - h. AMERICAN ASSOCIATION OF STATE HIGHWAY & TRANSPORTATION OFFICIALS
 - i. INDUSTRIAL FASTENERS INSTITUTE
 - j. AMERICAN SOCIETY OF MECHANICAL ENGINEERS - WELDING CODE
4. FOUNDATIONS
 - a. FOUNDATIONS WERE DESIGNED USING A MINIMUM FOOTING PRESSURE OF 2000 PSF ON RECOMPACTED CLAY FILL AND 8000 PSF ON THE MORGANA FORMATION
 - b. ASSUMED DESIGN FROST DEPTH = 4'-0" BELOW FINISH GRADE.
 - c. BACKFILL ON WALLS WITH FILL ON BOTH SIDES SHALL BE COMPACTED IN EQUAL LIFTS EACH SIDE OF WALL. WALL TO BE BACKFILLED FROM ONE SIDE ONLY SHALL HAVE ALL SUPPORTING SLABS IN PLACE AND CURED FOR A MINIMUM OF SEVEN DAYS BEFORE ANY BACKFILL IS PLACED.
5. AFTER EACH STRUCTURE AND OUT-OF EXCAVATION SITE HAS BEEN EXCAVATED TO DESIGN FOUNDATION DEPTH, A QUALIFIED SOILS ENGINEER SELECTED BY THE STATE, SHALL INSPECT EACH SITE BEFORE ANY STRUCTURE OR CLAY FILL CONSTRUCTION IS STARTED.
6. REINFORCING BARS SHALL BE LAPPED THE FOLLOWING MINIMUMS AT ALL SPLICES, CORNERS, AND/OR WALL INTERSECTIONS, UNLESS OTHERWISE NOTED:
 - a. No. 5 THROUGH No. 8 BARS ----- 56 BAR DIAMETERS
 - b. No. 7 AND No. 8 BARS ----- 42 BAR DIAMETERS
 - c. No. 9 AND LARGER ----- AS APPROVED
7. CONCRETE COVER OVER REBAR SHALL BE 2" CLEAR, EXCEPT FOR THE FOLLOWING, UNLESS OTHERWISE NOTED:
 - a. CONCRETE PLACED AGAINST EARTH, 3" CLEAR.
8. ALL FORMWORK SHALL BE OF HIGHEST QUALITY TO PROVIDE A SMOOTH SURFACE FINISH AND CONFORM TO ACI 347.
9. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4" UNLESS OTHERWISE NOTED.
10. CONTROL AND CONSTRUCTION JOINTS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS OR AS APPROVED BY THE ENGINEER. ALL CONSTRUCTION JOINTS IN WATER CONTAINING PORTIONS OF THE STRUCTURE BELOW GROUNDWATER SHALL HAVE A SPACING NOT EXCEEDING 30 FEET OR AS APPROVED BY THE ENGINEER. CONSTRUCTION JOINTS SHALL BE PREPARED AND BONDED AS PROVIDED IN A CI 301-72.
11. ALL DETAILS PERTAINING TO SPECIFIC EQUIPMENT INSTALLATION MUST BE COORDINATED BY THE CONTRACTOR WITH THE ACTUAL EQUIPMENT FURNISHED. ALL OPENINGS SHOWN SHALL BE VERIFIED AND COORDINATED WITH THE ACTUAL EQUIPMENT FURNISHED.
12. THE CONTRACTOR SHALL PROVIDE TO THE JOB SITE AN ADDITIONAL 50 FEET PER 1000 LINEAL FEET EACH OF EACH REBAR REQUIRED FOR USE DURING CONSTRUCTION.
13. IN LIEU OF PAINTED AND OILED DOWELS, PLASTIC-COATED STEEL DOWEL BARS MAY BE USED, CONTRACTOR'S OPTION.
14. ALL PROJECTING WATERSTOPS SHALL BE SUPPORTED AND PROTECTED FROM DAMAGE AND EXPOSURE DURING CONSTRUCTION.



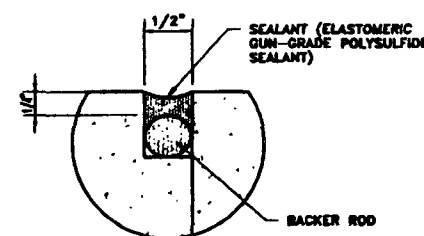
- NOTES:
1. PROVIDE CORNER BARS WITH STANDARD LAP AS INDICATED.
 2. PROVIDE MAIN WALL REINFORCEMENT WITH STANDARD HOOK AT END, OR PROVIDE SEPARATE CORNER BARS WITH END HOOK AND LAP WITH MAIN WALL REINFORCEMENT.
 3. CORNER BARS SHALL MATCH HORIZONTAL WALL REINFORCEMENT.
 4. RE: GENERAL NOTES FOR STANDARD LAP LENGTHS.

DETAIL - HORIZONTAL REINFORCEMENT AT CORNERS AND INTERSECTIONS

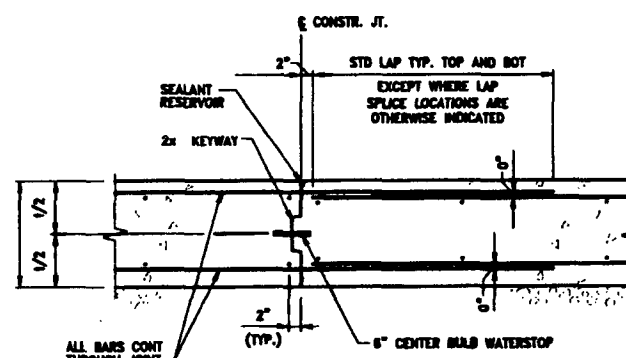


DETAIL - WATERSTOP SUPPORT

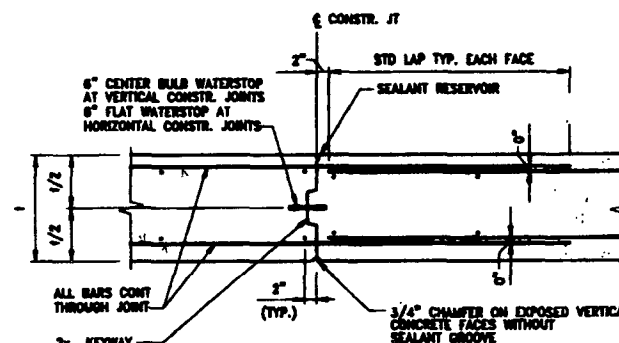
NOTE:
WALL & SLAB THICKNESSES MAY VARY AT CONSTRUCTION JOINT & EXPANSION JOINT



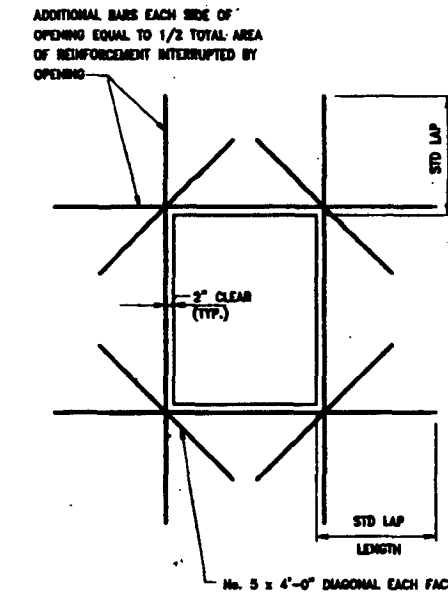
DETAIL - SEALANT



DETAIL - SLAB CONSTRUCTION JOINT

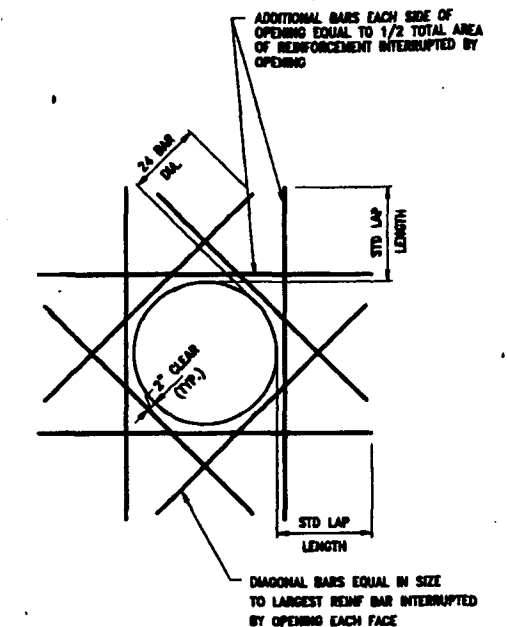


DETAIL - WALL CONSTRUCTION JOINT

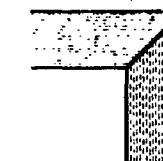


RECTANGULAR OPENING

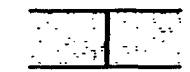
- NOTES:
1. ALL OPENINGS 12" OR LARGER IN ANY DIRECTION SHALL BE REINFORCED IN ACCORDANCE WITH THIS DETAIL, UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
 2. RE: OTHER CONTRACT DRAWINGS FOR WALL AND SLAB OPENINGS NOT SHOWN ON STRUCTURAL DRAWINGS.
 3. RE: GENERAL NOTES FOR STANDARD LAP LENGTHS.



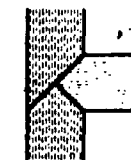
CIRCULAR OPENING



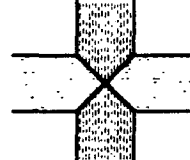
CORNER SPLICE



STRAIGHT SPLICE



TEE SPLICE



CROSS SPLICE

HEAT SPlicing WATERSTOP JOINTS

1. CUT CLEAN STRAIGHT EDGES.
2. HOLD THE TWO EDGES TO BE JOINED IN CONTACT WITH A THERMOSTATICALLY CONTROLLED ELECTRIC HEATING IRON (300° - 425° F.) UNTIL THEY BECOME MOLTEN (15 TO 30 SECONDS).
3. IMMEDIATELY JOIN THE MOLTEN ENDS, BEING CERTAIN TO MAINTAIN THE CONTINUITY OF THE CENTER BULB AND BBS.
4. ALLOW THE WATERSTOP TO COOL BEFORE STRESSING.

HEAT SPlicing WATERSTOP JOINTS

FOR REVIEW

Preliminary
Use Only

DRAWN BY: C.A.M.	REVIEWED DATE: _____ FOR _____
DESIGNED BY: S.V.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: R.I.S.	

BANNER	REVISION	DATE	DESCRIPTION	BY	CK'D
BANNER ASSOCIATES, INC.					
409 22nd Av S • P.O. Box 298 - Brookings, SD 57006 • (605) 692-6342					

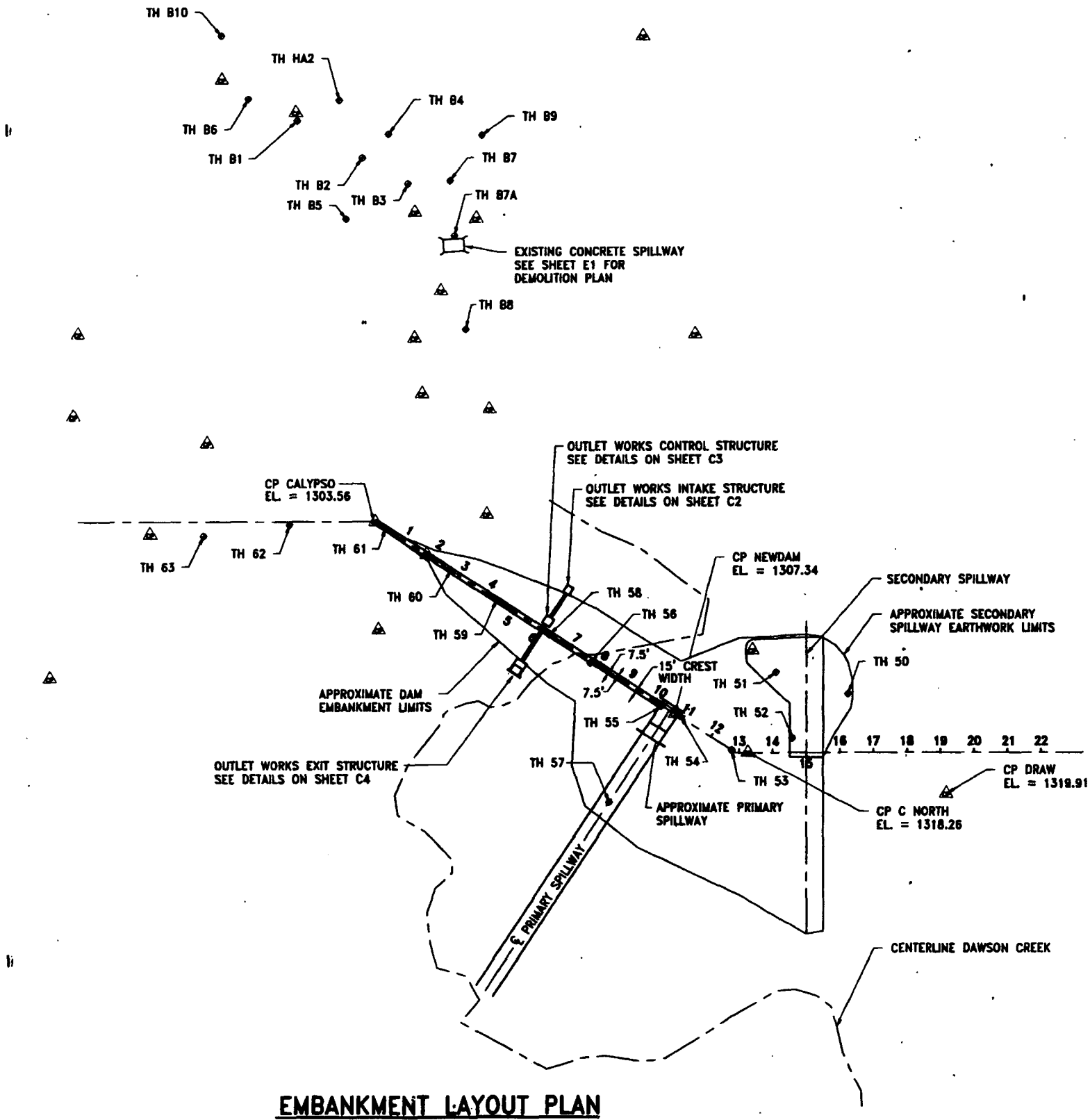
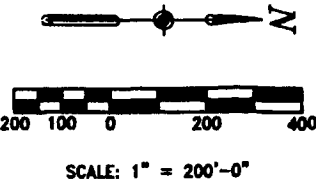
REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction - Scotland, South Dakota

GENERAL NOTES AND DETAILS

SCALE: None	JOB NO: 7843-01	DATE: Sept. 97
SHEET NO: A3		

COORDINATE TABLE				
POINT	NORTHING	EASTING	ELEVATION	REMARKS
SPILL	5000.00	5000.00	1297.53	-
SITE	4237.54	4575.64	1314.04	-
BREECH	4460.98	4697.43	1290.46	-
WEED	4816.09	4981.51	1300.04	-
INCASEOF	4920.61	4883.20	1278.18	-
VIEW	4894.14	5220.84	1276.00	-
C IN	4815.68	5365.47	1284.36	-
CALYPSO	4697.23	5922.50	1303.56	STA. 0+00 - CENTERLINE
NEWDAM	5595.10	6509.06	1307.34	STA. 10+72.5 - CENTERLINE



LEGEND

- T.H. No. TEST HOLE - AMERICAN ENGINEERING TESTING/GEOTEK ENGINEERING AND TESTING SERVICE, INC.,
- CP EL. = SURVEY CONTROL POINT

FOR REVIEW

Preliminary
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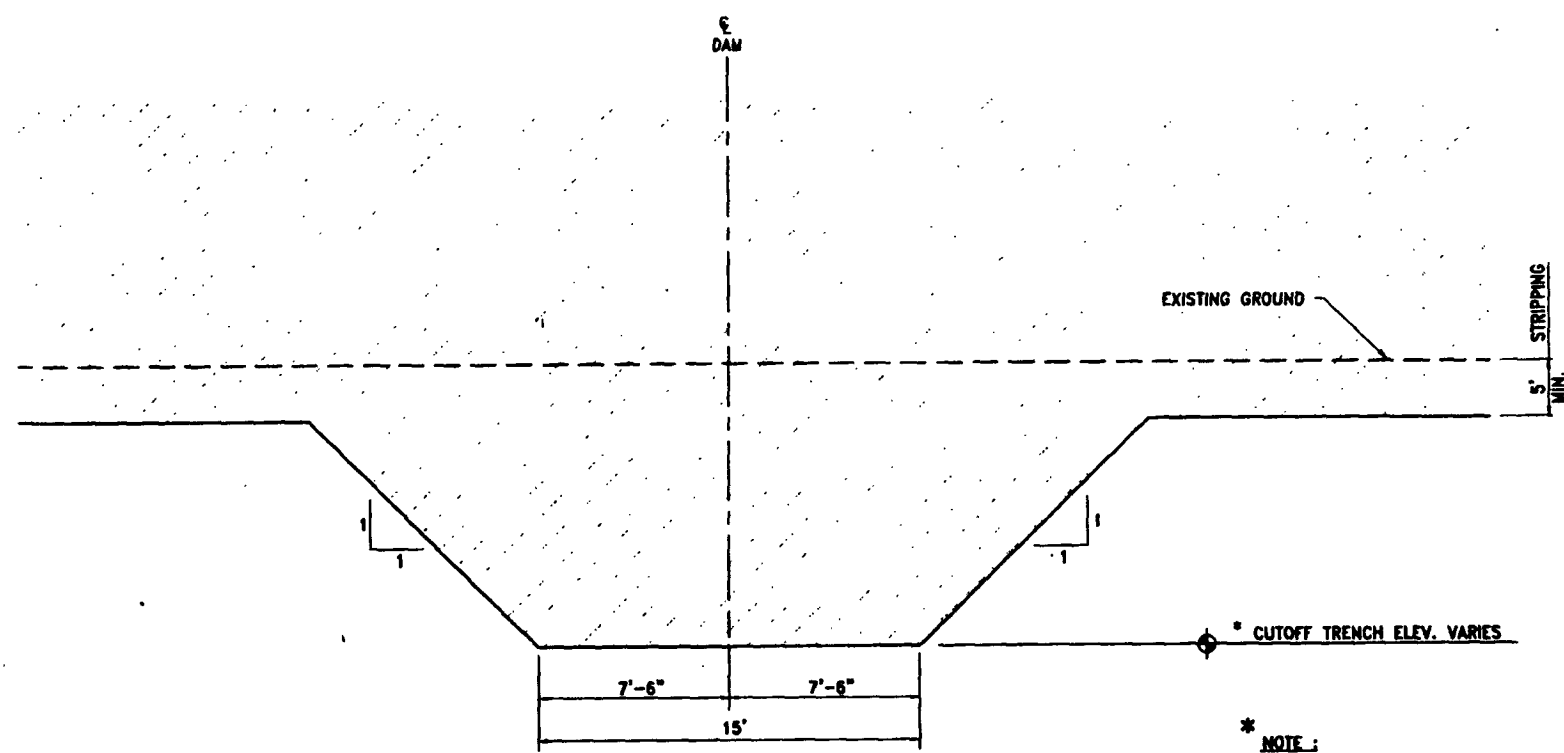
EMBankment LAYOUT PLAN

DRAWN BY: C.A.M.	REVIEWED DATE: _____ FOR _____
DESIGNED BY: S.V.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: B.S.F.	

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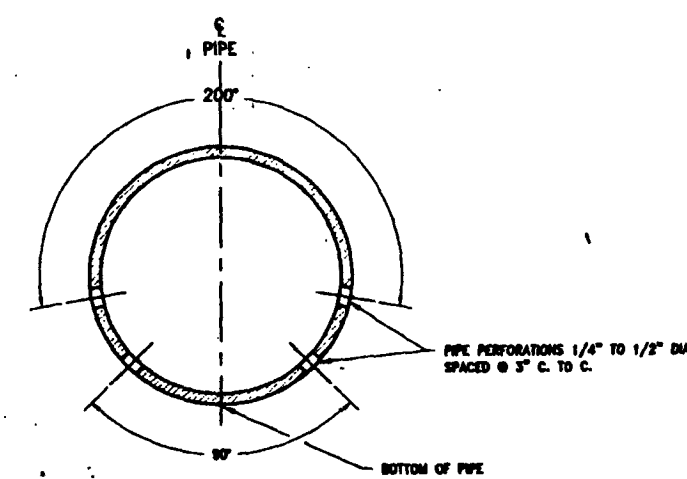
REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction		Scotland, South Dakota		SCALE: As Shown	JOB NO: 7843-01	DATE: Sept. 97
EMBankment LAYOUT PLAN		B1		SHEET NO.:		

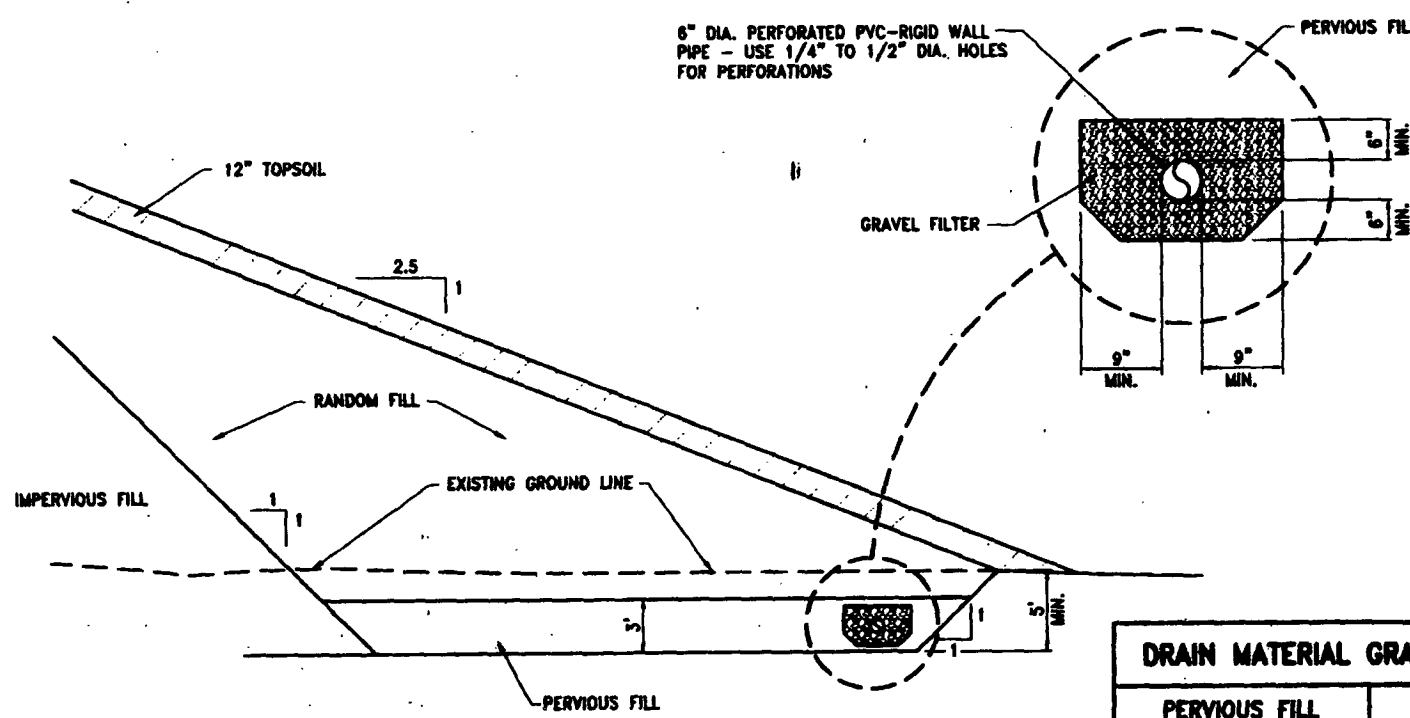


CUT-OFF TRENCH - DETAIL
Scale: NONE

* NOTE:
IF THE TOP OF THE SHALE IS LOWER THAN SHOWN ON CROSS SECTIONS; EXTEND CUTOFF DEEPER AS REQUIRED BY ENGINEER. THE CUTOFF TRENCH SHOULD BE NOTCHED 2 FOOT MINIMUM INTO THE MIOBRARA FORMATION.



LOCATION OF PIPE PERFORATIONS FOR INSTALLATION - DETAIL
Scale: NONE

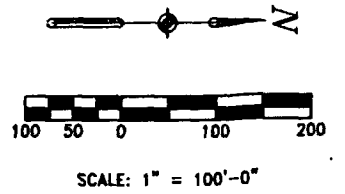


TOE DRAIN - DETAIL
Scale: NONE

DRAIN MATERIAL GRADATION TABLE			
PERVIOUS FILL		GRAVEL FILTER	
SIEVE SIZE	% FINER	SIEVE SIZE	% FINER
3/8"	100	1"	100
No. 4	90 - 100	3/4"	85 - 100
No. 10	45 - 90	3/8"	30 - 60
No. 40	15 - 45	No. 4	0 - 10
No. 200	0 - 3		

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LAKE HENRY
NORMAL HWL = 1290.0

CP C BOX
EL. = 1324.73

LINETYPE LEGEND

EXISTING CONTOURS
NEW CONTOURS

FOR REVIEW

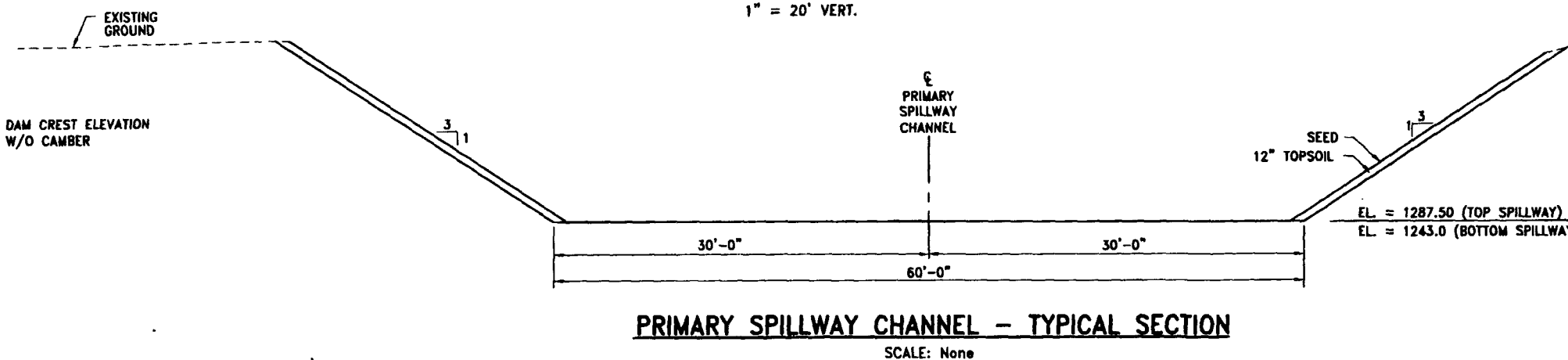
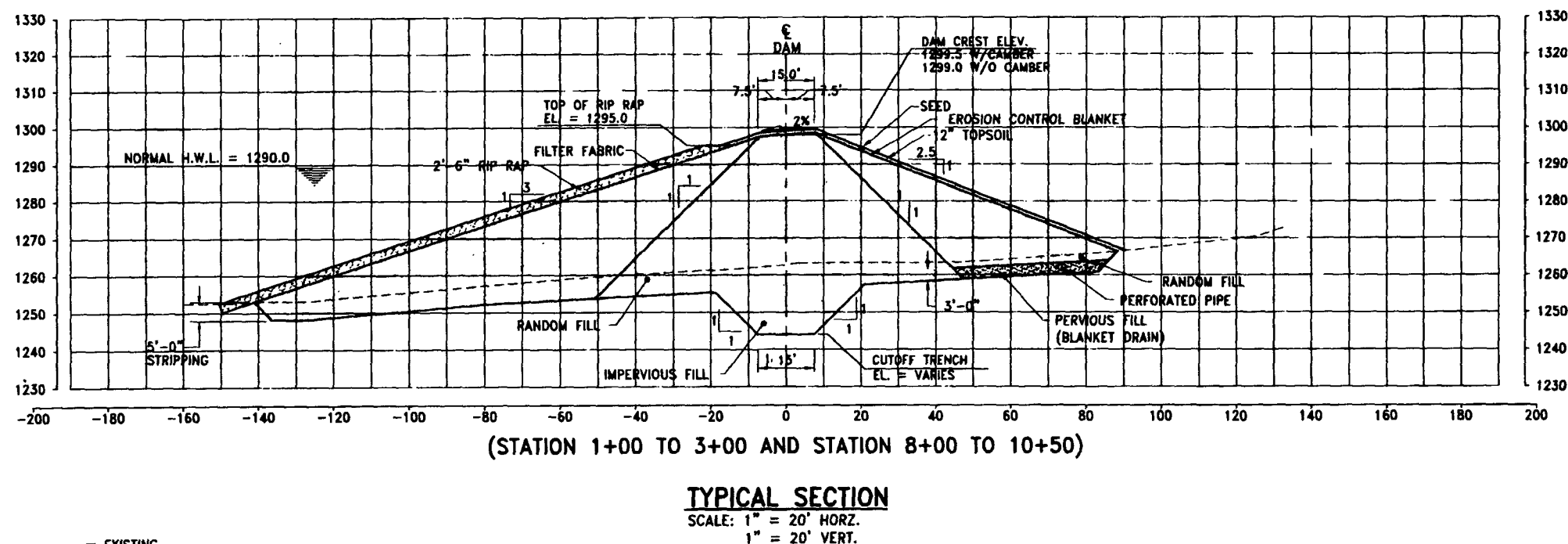
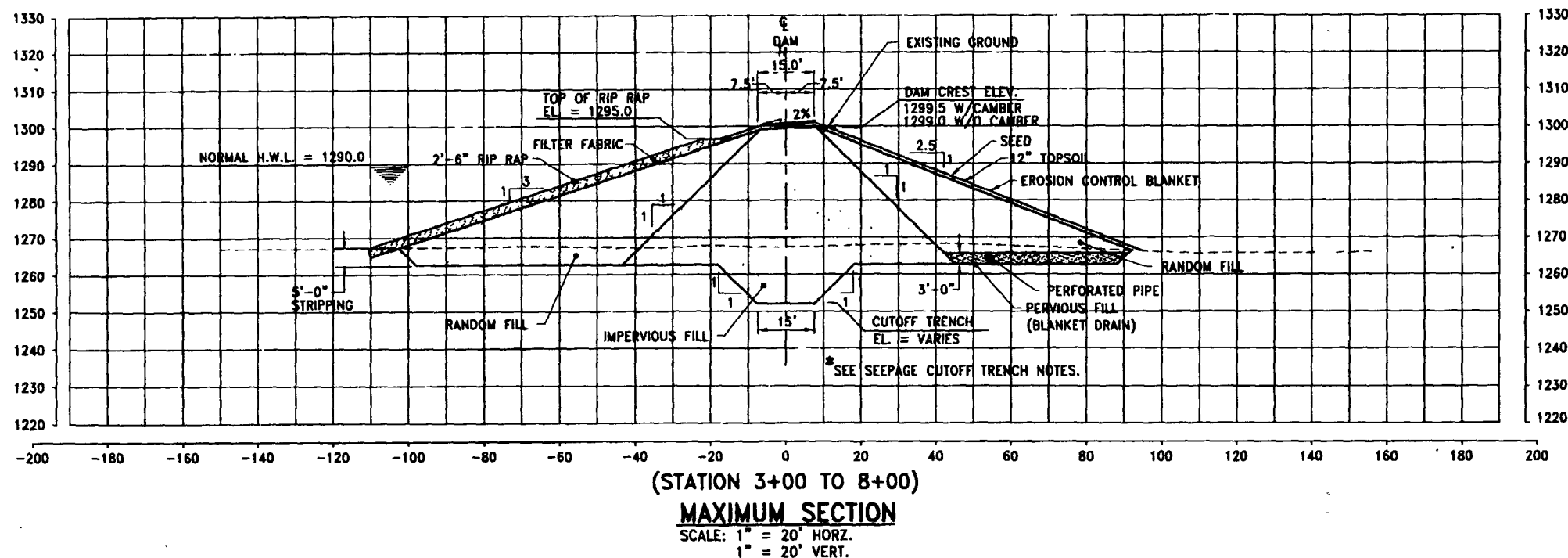
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DESIGNED BY: S.V.M.	REVIEWED _____ DATE : _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: R.L.S.	

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REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction		Scotland, South Dakota	
EMBANKMENT FINISHED PLAN		SCALE : As Shown	JOB NO : 7843-01
		DATE : Sept. 97	
		SHEET NO. :	B3



EMBANKMENT ZONE EXPLANATION

- IMPERVIOUS FILL** SANDY LEAN CLAY TILL AVAILABLE ON THE TOPS OF RIDGES ADJACENT TO THE SITE. THE IMPERVIOUS FILL SHALL CONSIST OF CL OR SC SOILS WITH A LIQUID LIMIT GREATER THAN 25 AND A PLASTICITY INDEX GREATER THAN 10 WITH A MINIMUM OF 40% PASSING THE #200 SIEVE.
- RANDOM FILL** SILTY SAND EXCAVATED FROM THE OLD DAM EMBANKMENT. SANDY LEAN CLAY FROM OTHER BORROW AREAS MAY BE USED IN LIEU OF THE SILTY SAND MATERIAL.
- PERVIOUS FILL** SAND WITH GRADATION SIMILAR TO CONCRETE SAND.
- TOPSOIL** SELECTED TOPSOIL OBTAINED FROM EXCAVATION FOR DAM EMBANKMENT FOUNDATION, OR FROM STRIPPING FROM BORROW AREAS.
- RIP RAP** REASONABLY WELL GRADED, HARD DURABLE, ANGULAR ROCK.

NOTE:
REFER TO SPECIFICATIONS FOR A COMPLETE MATERIAL SPECIFICATION OF THE ABOVE MATERIALS.

EMBANKMENT CONSTRUCTION:

PRIOR TO PLACING THE EMBANKMENT FILL, THE EXISTING DAM SHALL BE COMPLETELY EXCAVATED AND STOCKPILED. THE BLACK ORGANIC TOPSOIL MATERIAL SHALL REQUIRE A 5' MINIMUM STRIPPING DEPTH. SELECTED TOPSOIL OBTAINED FROM THE EXCAVATION SHALL BE STOCKPILED AND LATER PLACED WHERE DESIGNATED AFTER THE EMBANKMENT FILL IS COMPLETED.

THE EMBANKMENT FILL SHALL BE PLACED IN 8" MAXIMUM LAYERS OF UNIFORM THICKNESS AND THEN THOROUGHLY MIXED TO OBTAIN UNIFORMITY OF MATERIAL. THE MATERIAL SHALL BE DISKED TO BREAK UP ALL SOIL CLODS AND LUMPS GREATER THAN 3" IN NOMINAL SIZE. THE MOISTURE CONTENT SHALL BE BROUGHT TO WITHIN THE SPECIFIED RANGE OF THE MATERIAL.

ONCE THE LAYER HAS BEEN ADEQUATELY PROCESSED, THEN THE LAYER SHALL BE COMPACTED USING A HEAVY SHEEPSFOOT ROLLER. THE ACTUAL EQUIPMENT USED FOR COMPACTION SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER OBSERVING THE CONSTRUCTION. THE LAYER SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM D698. THE CLAY SHALL BE COMPACTED AT A MOISTURE CONTENT WITHIN 2% OF THE OPTIMUM MOISTURE CONTENT. THE SURFACE OF EACH LIFT SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 2" PRIOR TO PLACING ADDITIONAL LIFTS.

BEFORE PLACING IMPERVIOUS CLAY BLANKET ON AN EXISTING SLOPE STEEPER THAN 4 HORIZONTALLY TO 1 VERTICALLY (4:1), THE CONTRACTOR SHALL CONSTRUCT STEPS IN THE SLOPE, WITH THE BACK SURFACE BEING AS NEARLY VERTICAL AS PRACTICABLE AND WITH THE HORIZONTAL CUTS BEING MADE AS CLOSE TOGETHER AS THE SLOPE PERMITS, BUT WITH NO STEP BEING LESS THAN ONE FOOT IN WIDTH.

SEEPAGE CUTOFF TRENCH:

IN ORDER TO REDUCE UNDER SEEPAGE, A COMPACTED CLAY CUTOFF SHALL BE CONSTRUCTED THROUGH THE ALLUVIUM ACROSS THE VALLEY FLOOR, THE CUTOFF SHOULD EXTEND THROUGH THE ALLUVIUM AND AT LEAST 2' INTO THE MIOBRARA FORMATION. ALONG THE LEFT AND RIGHT ABUTMENTS, THE CUTOFF SHOULD BE NOTCHED 2' INTO UNDISTURBED MATERIAL. CAREFUL INSPECTION WILL BE NECESSARY IN THIS AREA TO ENSURE THAT INTIMATE CONTACT OF THE COMPACTED CLAY AGAINST THE MIOBRARA FORMATION OCCURS. IF AREAS OF SANDS ARE EXPOSED IN THE CUTOFF EXCAVATION, THEN THE CUTOFF SHALL BE EXTENDED DEEPER AS NECESSARY UNTIL THE MIOBRARA FORMATION HAS BEEN ENCOUNTERED.

DEWATERING:

CONSTRUCTION DEWATERING WILL BE NECESSARY FOR CONSTRUCTION OF THE CUTOFF EXCAVATION. THE DEWATERING SHALL BE EXTENSIVE ENOUGH SO THAT THE CUTOFF EXCAVATION IS MAINTAINED FREE OF WATER. PLACEMENT OF COMPACTED CLAY WILL NOT BE ALLOWED UNLESS THE EXCAVATION IS DRY. ALSO, DIVERSION OF THE STREAM FLOW WILL BE NECESSARY DURING CONSTRUCTION.

FOUNDATION DRAINS:

FOR PROTECTION AGAINST POTENTIAL SEEPAGE THROUGH THE ABUTMENTS AND FOUNDATION, A DOWNSTREAM INTERNAL DRAIN SHALL BE CONSTRUCTED. THE DOWNSTREAM DRAINS SHALL CONSIST OF A BLANKET DRAIN AND A PERFORATED PIPE TOE DRAIN.

THE BLANKET DRAIN SHALL CONSIST OF 3' THICK LAYER OF PERVIOUS SAND PLACED UNDER THE RANDOM FILL ZONE ON THE DOWNSTREAM SLOPE.

TO COLLECT THE SEEPAGE WHICH IS INTERCEPTED BY THE BLANKET DRAIN A 6" DIAMETER PERFORATED DRAIN PIPE SHALL BE INSTALLED IN THE LOWER PORTION OF THE DOWNSTREAM END OF THE BLANKET DRAIN. A GRAVEL FILTER SHALL BE PLACED AROUND THE PERFORATED PIPE TO PREVENT PIPING OF THE DRAINAGE FILL MATERIAL INTO THE PERFORATED PIPE. THE GRAVEL DRAIN SHOULD SURROUND THE PERFORATED PIPE AND BE A MINIMUM OF 6" THICK.

CONSTRUCTION OBSERVATION AND TESTING:

(BY OWNER)

THE CONSTRUCTION OF THE DAM WILL BE OBSERVED BY A GEOTECHNICAL ENGINEER PROVIDED BY THE OWNER. CONSTRUCTION OF THE DAM EMBANKMENT AND FOUNDATIONS DRAINS WILL ALSO BE OBSERVED BY THE GEOTECHNICAL ENGINEER OR HIS REPRESENTATIVE.

THE FOLLOWING FIELD TESTING PROGRAM WILL BE FOLLOWED DURING CONSTRUCTION. THE TEST FREQUENCIES MAY NEED TO BE MODIFIED BY THE GEOTECHNICAL ENGINEER OBSERVING THE CONSTRUCTION IF HE DEEMS IT NECESSARY. THE FOLLOWING TABLE INDICATES THE MINIMUM TEST FREQUENCY:

TEST	ASTM NUMBER	FREQUENCY
STANDARD PROCTOR	D698	1 TEST PER 10,000 C.Y.
ATTERBERG LIMITS	D4318	1 TEST PER 10,000 YDS.
PERCENT PASSING #200 SIEVE	D422	1 TEST PER 5,000 C.Y.
GRAIN SIZE DISTRIBUTION	D422	1 TEST PER 1,000 C.Y. OF PERVIOUS FILL
FIELD DENSITIES	D2922 OR D1556	1 TEST PER LIFT PER 10,000 S.F.

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DRAWN BY: C.A.M.
DESIGNED BY: S.V.M.
CHECKED BY: R.L.S.

REVIEWED: _____ FOR _____
DATE: _____
REVIEWED: _____ FOR BANNER ASSOCIATES, INC.
DATE: _____

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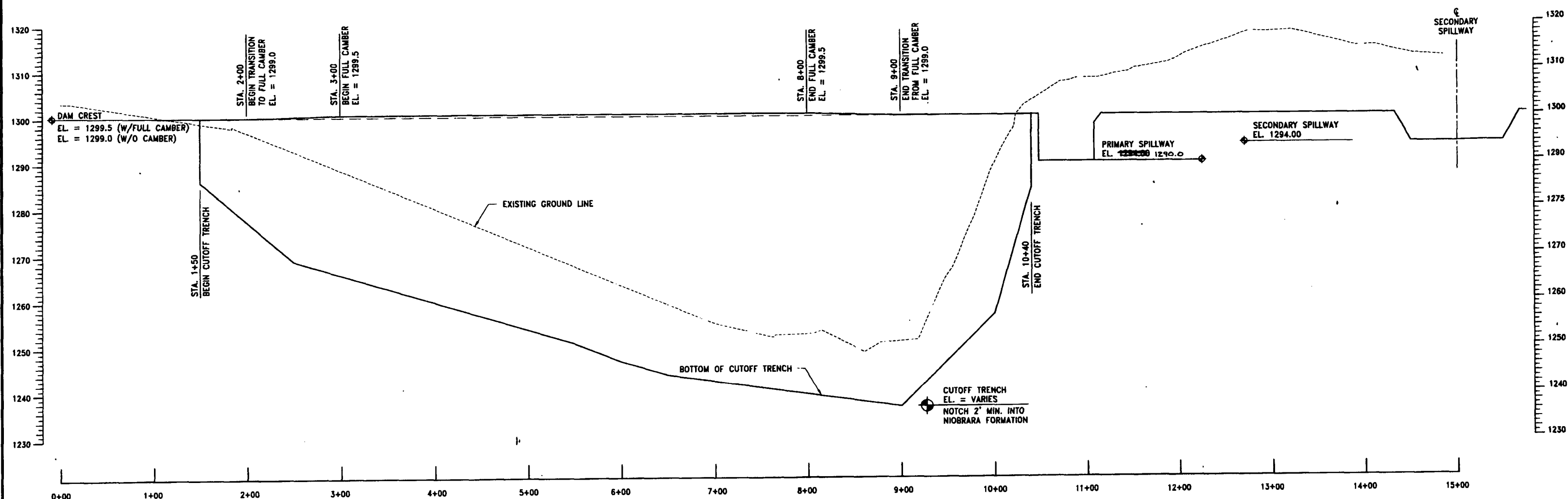
REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction

Scotland, South Dakota

DAM EMBANKMENT TYPICAL SECTIONS

SCALE: As Shown
JOB NO: 7843-01
DATE: Sept. 97
SHEET NO: 84



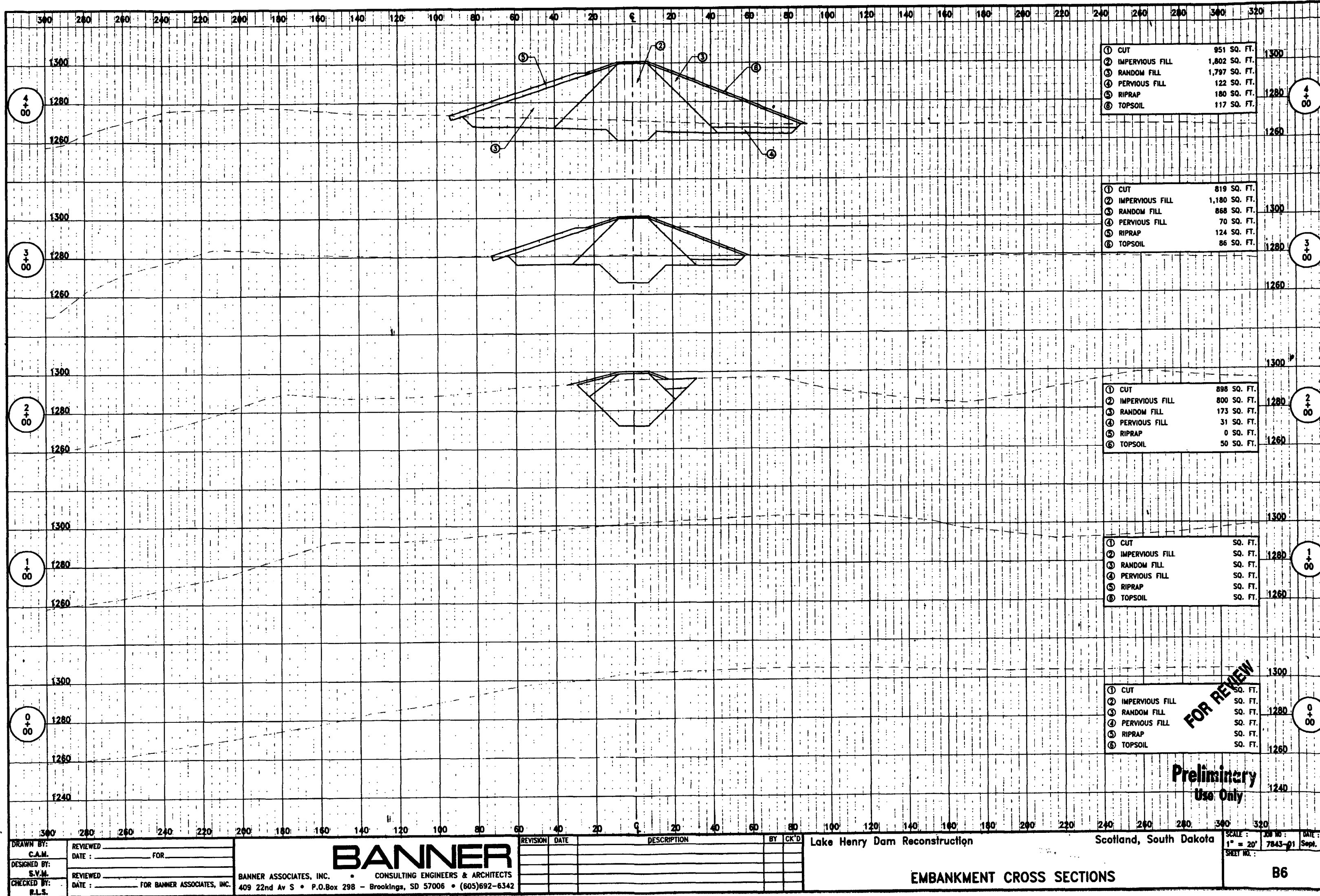
DAM PROFILE - LONGITUDINAL

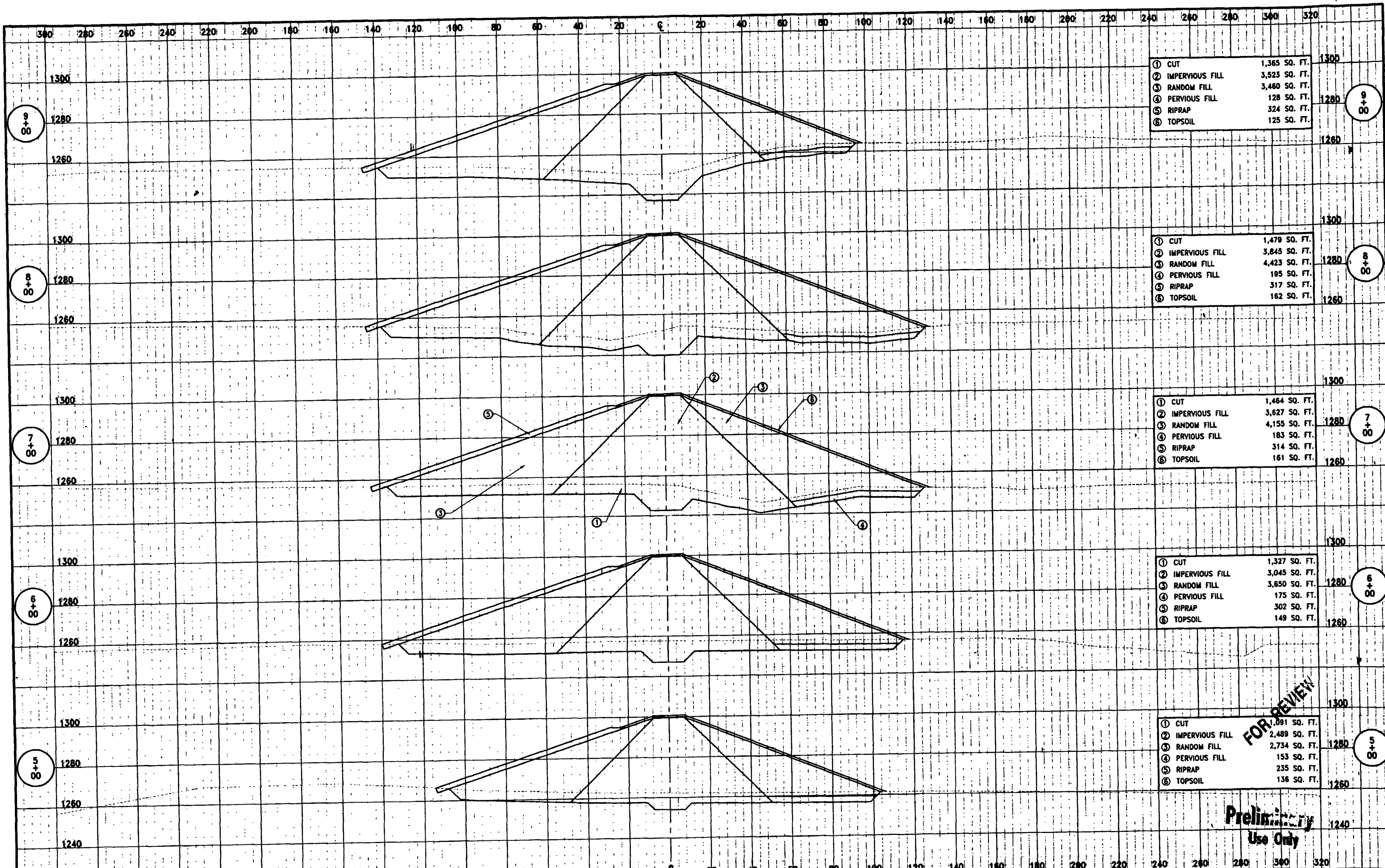
SCALE: 1" = 50' HORZ.
1" = 10' VERT.

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① CUT	1,365 SQ. FT.
② IMPERVIOUS FILL	3,523 SQ. FT.
③ RANDOM FILL	3,460 SQ. FT.
④ PERVIOUS FILL	128 SQ. FT.
⑤ RIPRAP	324 SQ. FT.
⑥ TOPSOIL	125 SQ. FT.

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① CUT	1,479 SQ. FT.
② IMPERVIOUS FILL	3,845 SQ. FT.
③ RANDOM FILL	4,423 SQ. FT.
④ PERVIOUS FILL	195 SQ. FT.
⑤ RIPRAP	317 SQ. FT.
⑥ TOPSOIL	162 SQ. FT.

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① CUT	1,464 SQ. FT.
② IMPERVIOUS FILL	3,627 SQ. FT.
③ RANDOM FILL	4,155 SQ. FT.
④ PERVIOUS FILL	183 SQ. FT.
⑤ RIPRAP	314 SQ. FT.
⑥ TOPSOIL	161 SQ. FT.

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① CUT	1,327 SQ. FT.
② IMPERVIOUS FILL	3,045 SQ. FT.
③ RANDOM FILL	3,650 SQ. FT.
④ PERVIOUS FILL	175 SQ. FT.
⑤ RIPRAP	302 SQ. FT.
⑥ TOPSOIL	149 SQ. FT.

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① CUT	1,091 SQ. FT.
② IMPERVIOUS FILL	2,489 SQ. FT.
③ RANDOM FILL	2,734 SQ. FT.
④ PERVIOUS FILL	153 SQ. FT.
⑤ RIPRAP	235 SQ. FT.
⑥ TOPSOIL	136 SQ. FT.

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DESIGNED BY: S.V.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.
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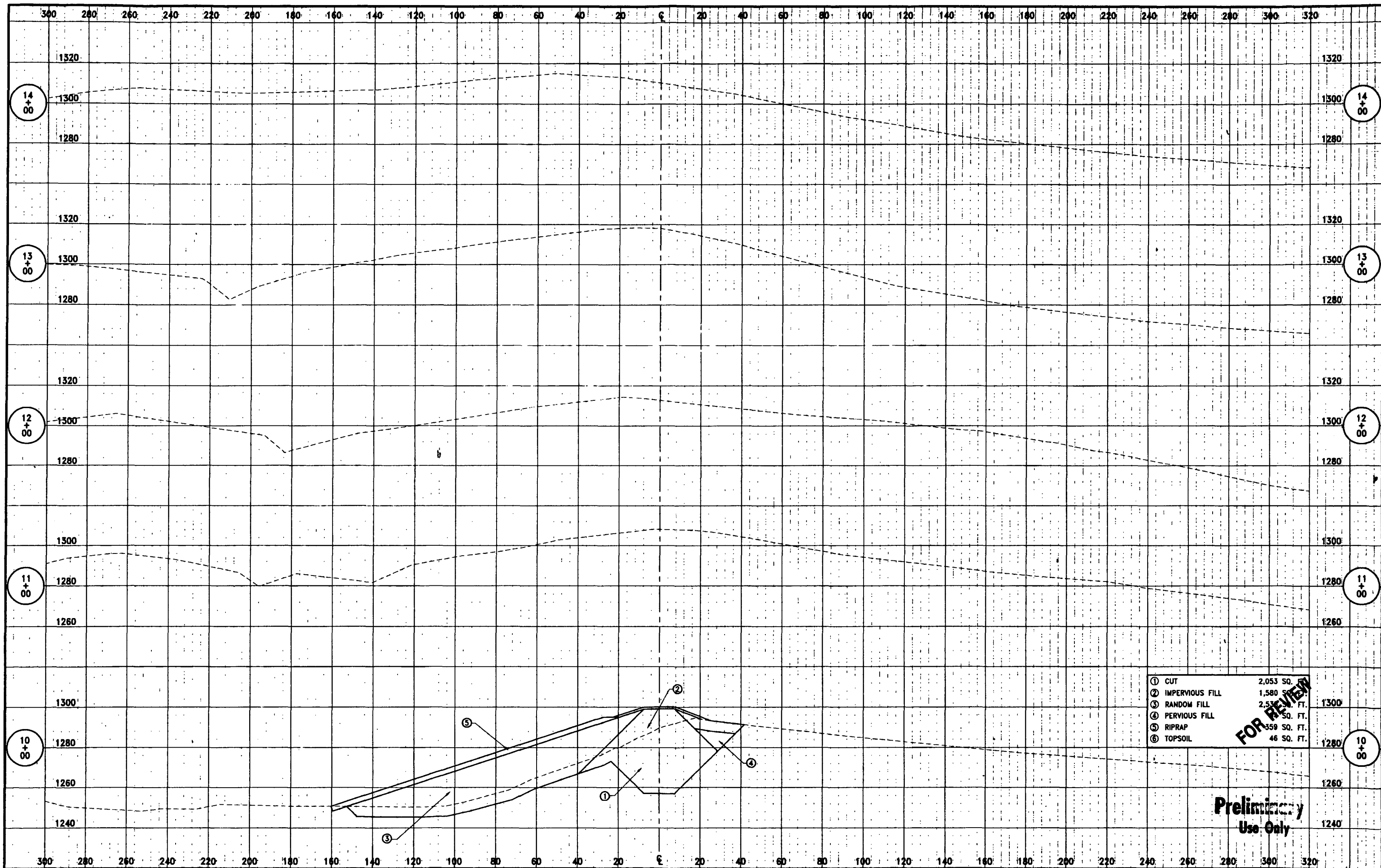
REVISION	DATE	DESCRIPTION	BY	CR'D

Lake Henry Dam Reconstruction

Scotland, South Dakota

EMBANKMENT CROSS SECTIONS

SCALE: 1" = 20'	JOB NO.: 7843-01	DATE: Sept. 97
SHEET NO.:	B7	



① CUT	2,053 SQ. FT.
② IMPERVIOUS FILL	1,580 SQ. FT.
③ RANDOM FILL	2,530 SQ. FT.
④ PERVIOUS FILL	1,500 SQ. FT.
⑤ RIPRAP	359 SQ. FT.
⑥ TOPSOIL	46 SQ. FT.

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DESIGNED BY: S.V.M.
CHECKED BY: R.L.S.

REVIEWED _____
DATE : _____ FOR _____

REVIEWED _____
DATE : _____ FOR BANNER ASSOCIATES, INC.

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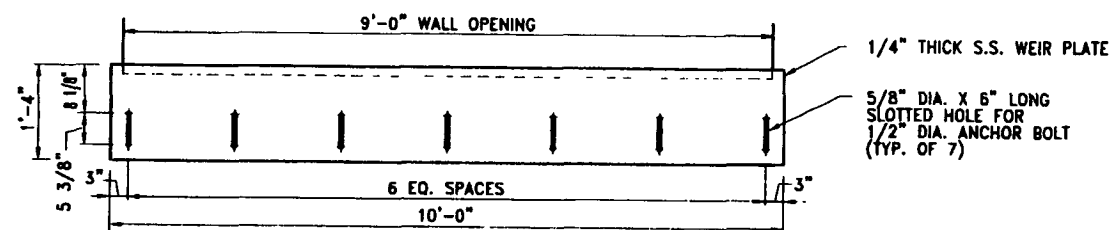
REVISION	DATE	DESCRIPTION	BY	CK'D

Lake Henry Dam Reconstruction
Scotland, South Dakota

EMBANKMENT CROSS SECTIONS

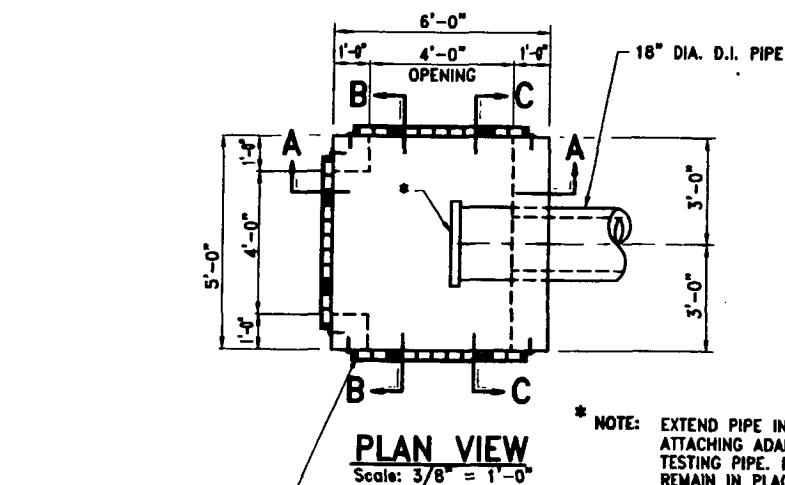
SCALE : 1" = 20'
JOB NO : 7843-01
DATE : Sept. 97

B8



WEIR PLATE DETAIL

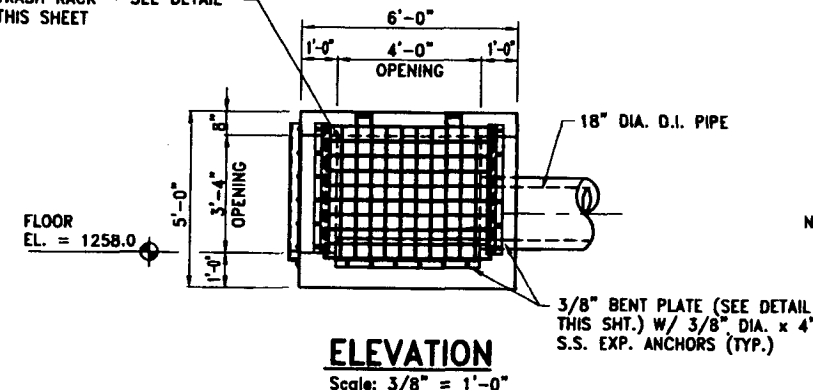
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(SEE SHEET C3)



PLAN VIEW

Scale: 3/8" = 1'-0"

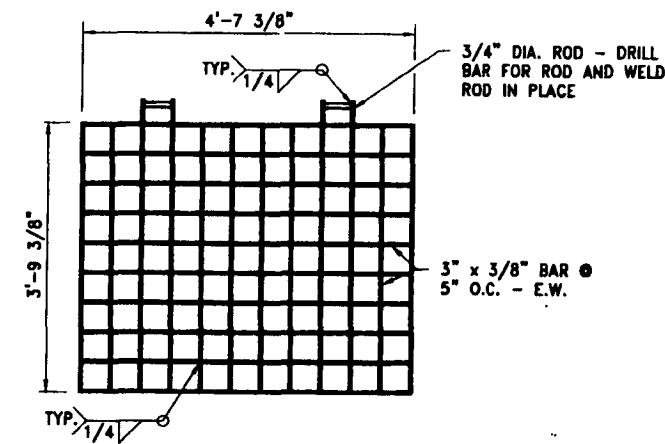
TRASH RACK - SEE DETAIL THIS SHEET



ELEVATION

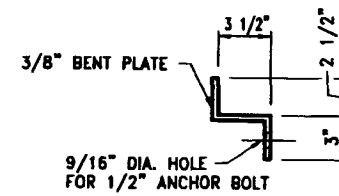
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FLOOR EL. = 1258.0



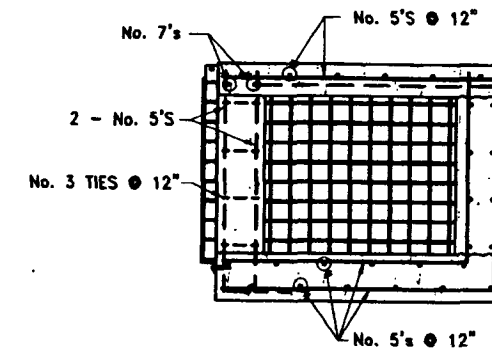
TRASH RACK DETAIL

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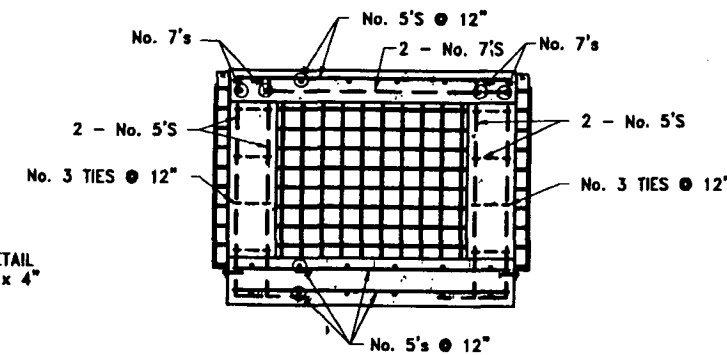
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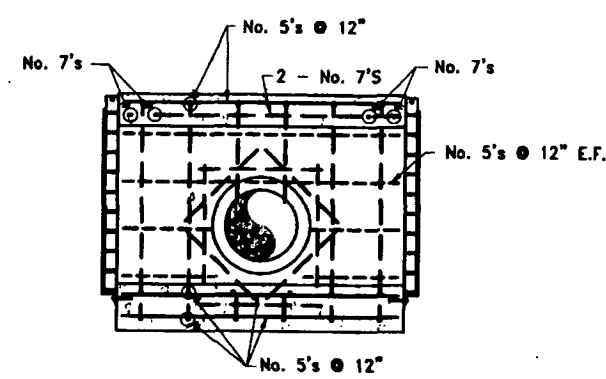
SECTION A-A

Scale: 1/2" = 1'-0"



SECTION B-B

Scale: 1/2" = 1'-0"



SECTION C-C

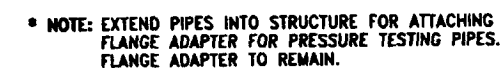
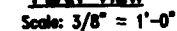
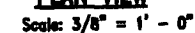
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OUTLET WORKS INTAKE STRUCTURE

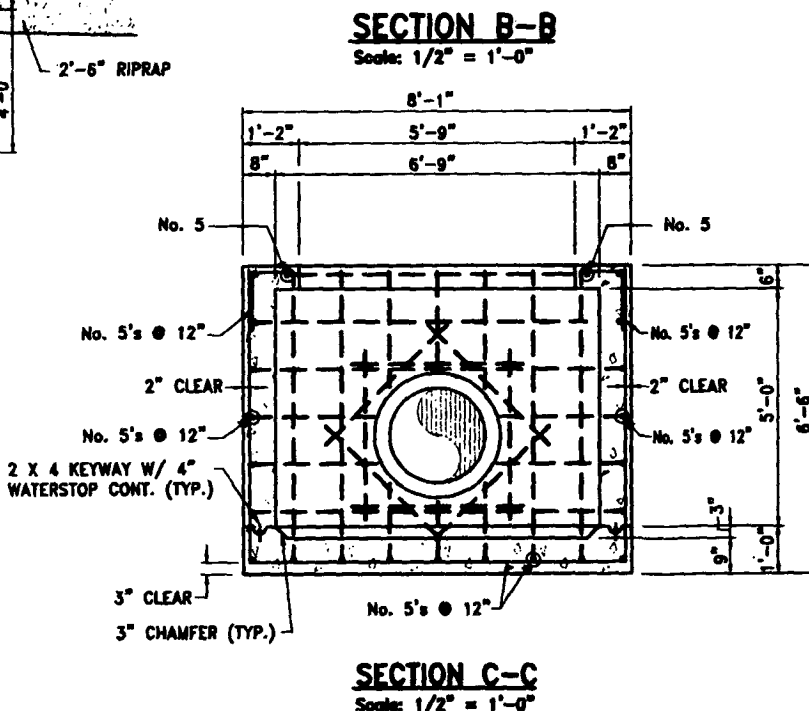
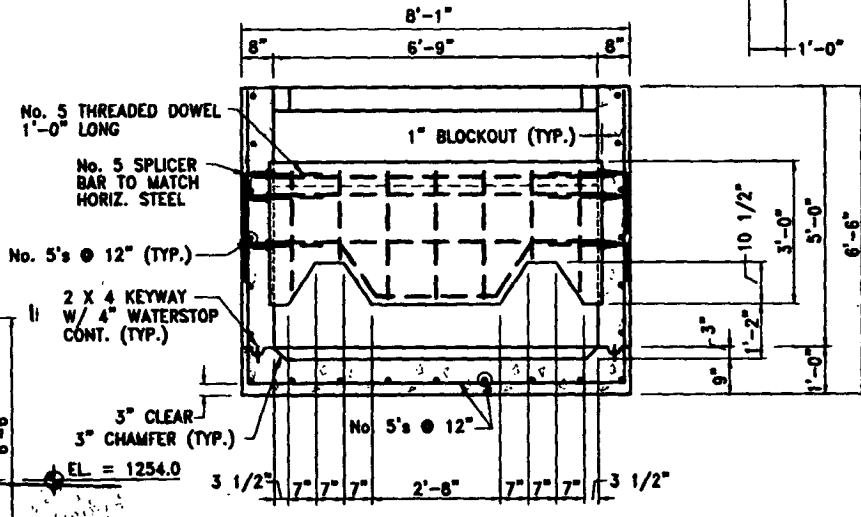
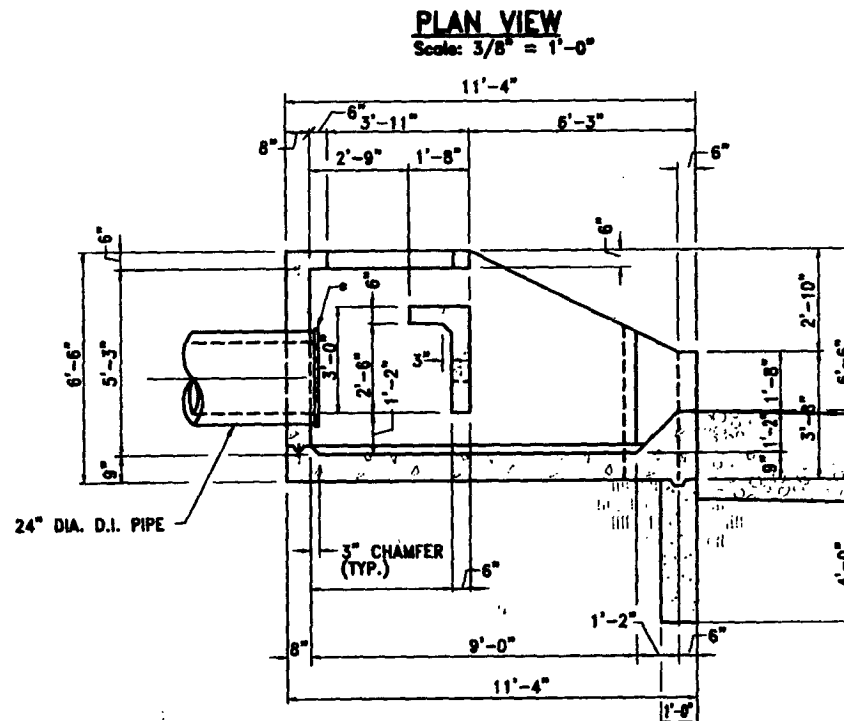
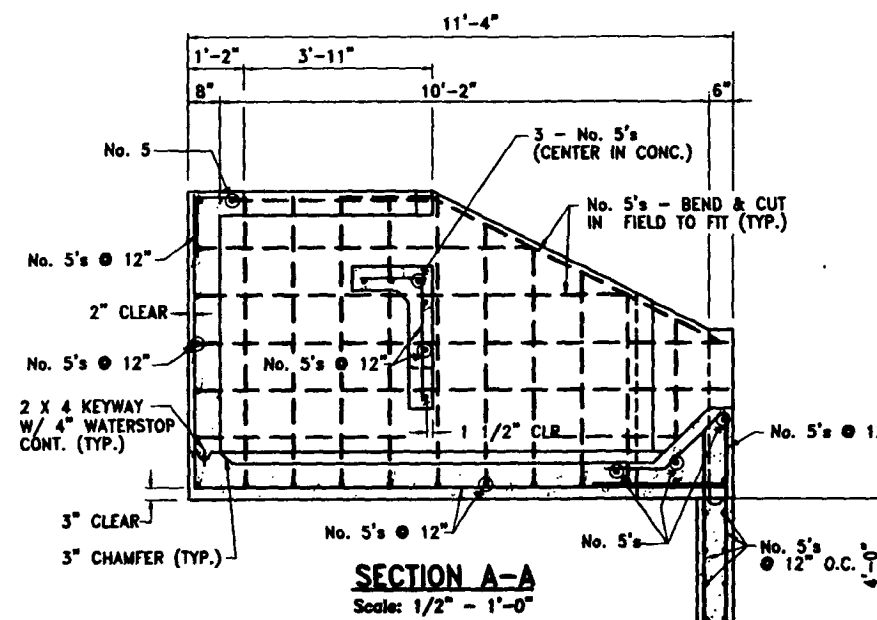
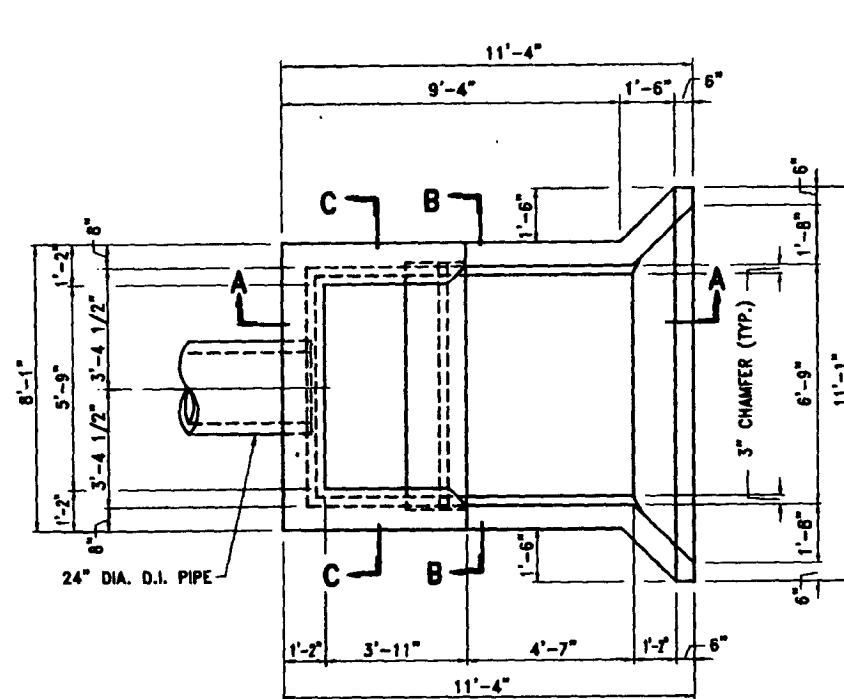
DRAWN BY: R.A.R.	REVIEWED DATE : _____ FOR _____	BANNER BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS 409 22nd Av S • P.O.Box 298 - Brookings, SD 57006 • (605)692-6342	REVISION	DATE	DESCRIPTION	BY	CK'D	Lake Henry Dam Reconstruction	Scotland, South Dakota	SCALE : _____	JOB NO : _____	DATE : _____
DESIGNED BY: S.V.M.	REVIEWED DATE : _____ FOR BANNER ASSOCIATES, INC.									As Shown	7843-01	Sept. 97
CHECKED BY: R.L.B.												
								OUTLET WORKS INTAKE STRUCTURE		C2		



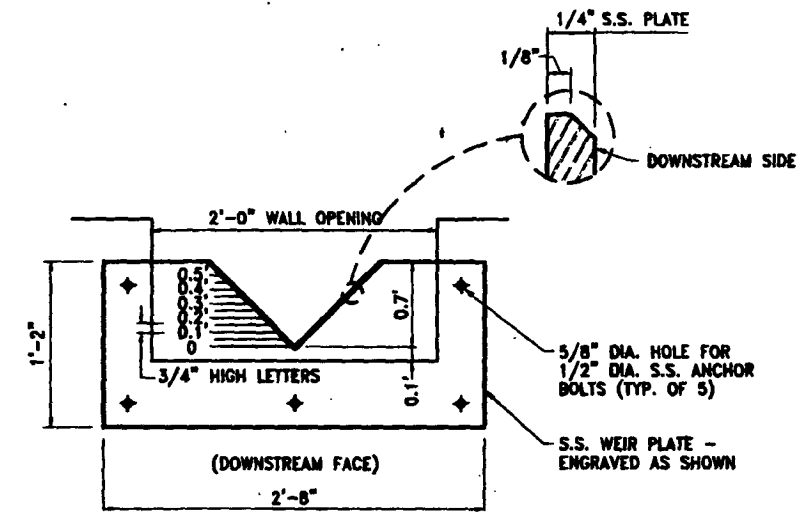
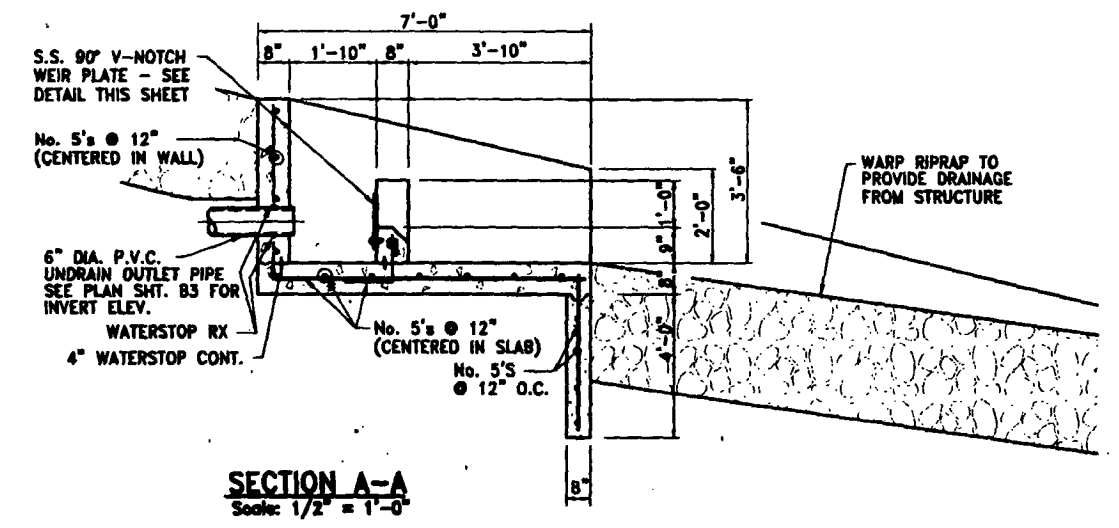
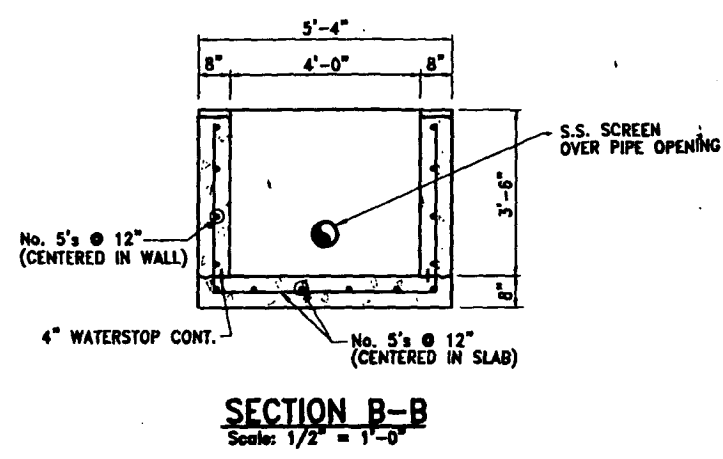
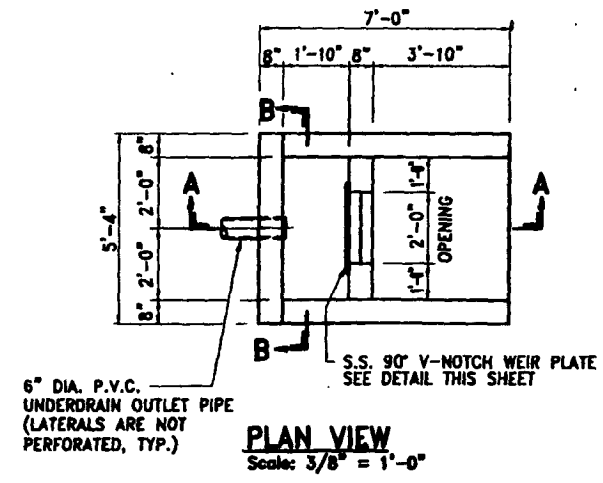
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C3

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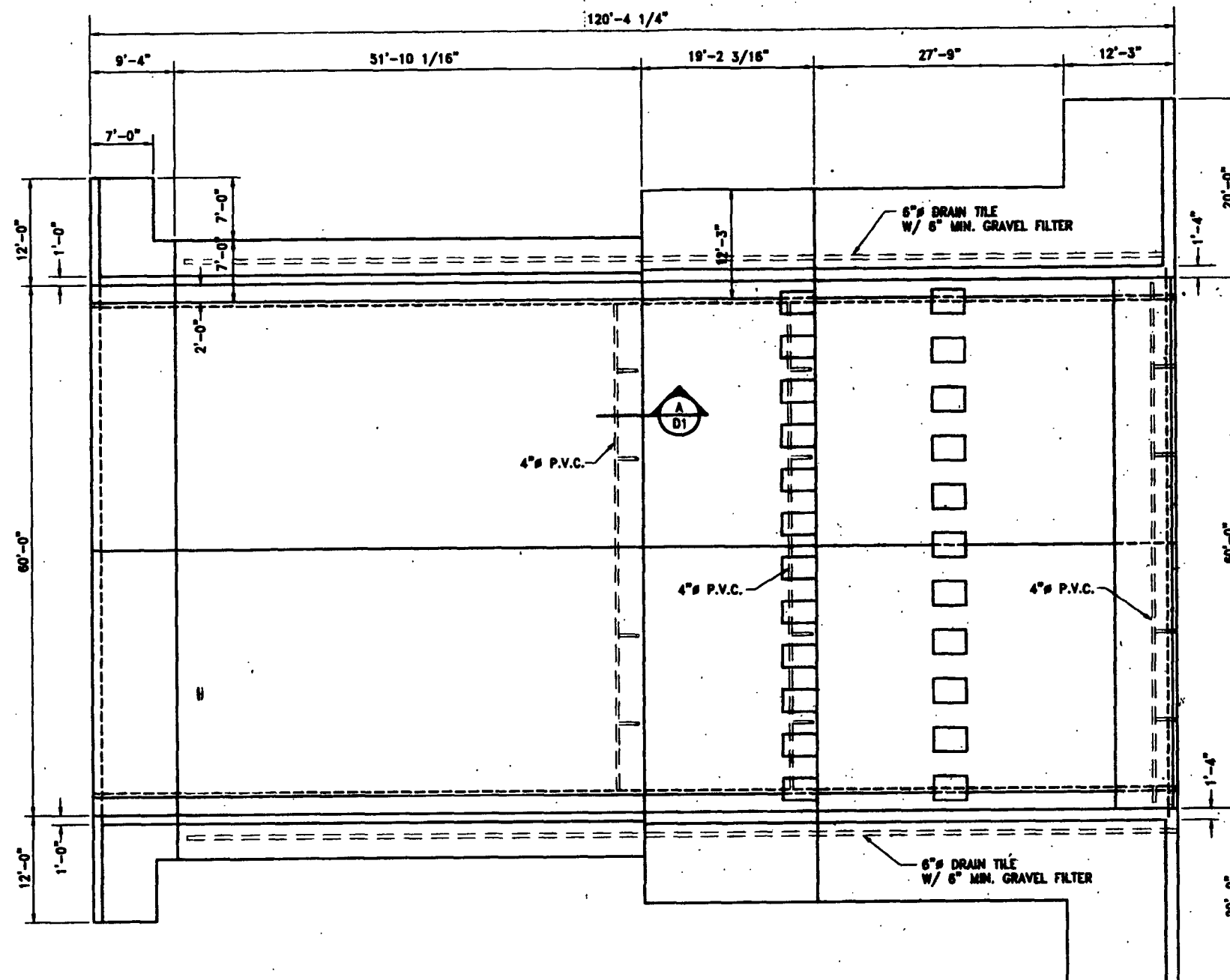


OUTLET WORKS EXIT STRUCTURE

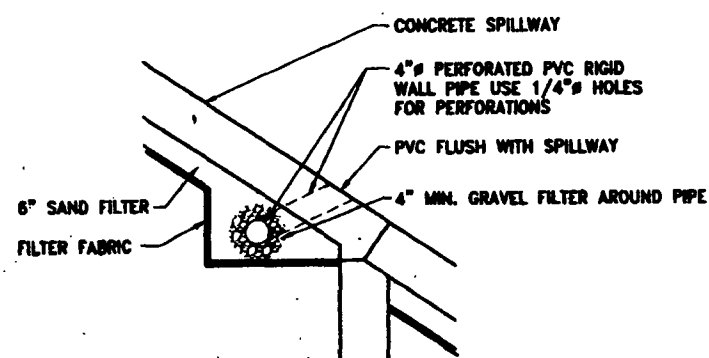


TOE DRAIN HEADWALL STRUCTURE
(2 REQUIRED)

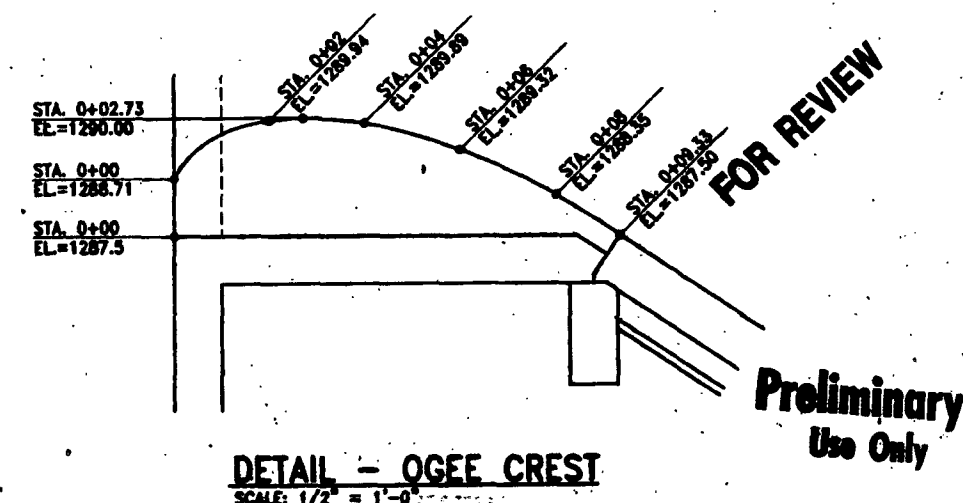
Preliminary
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SPILLWAY - PLAN VIEW
SCALE: 1/8" = 1'-0"



SECTION A-D1
SCALE: 1/2" = 1'-0"

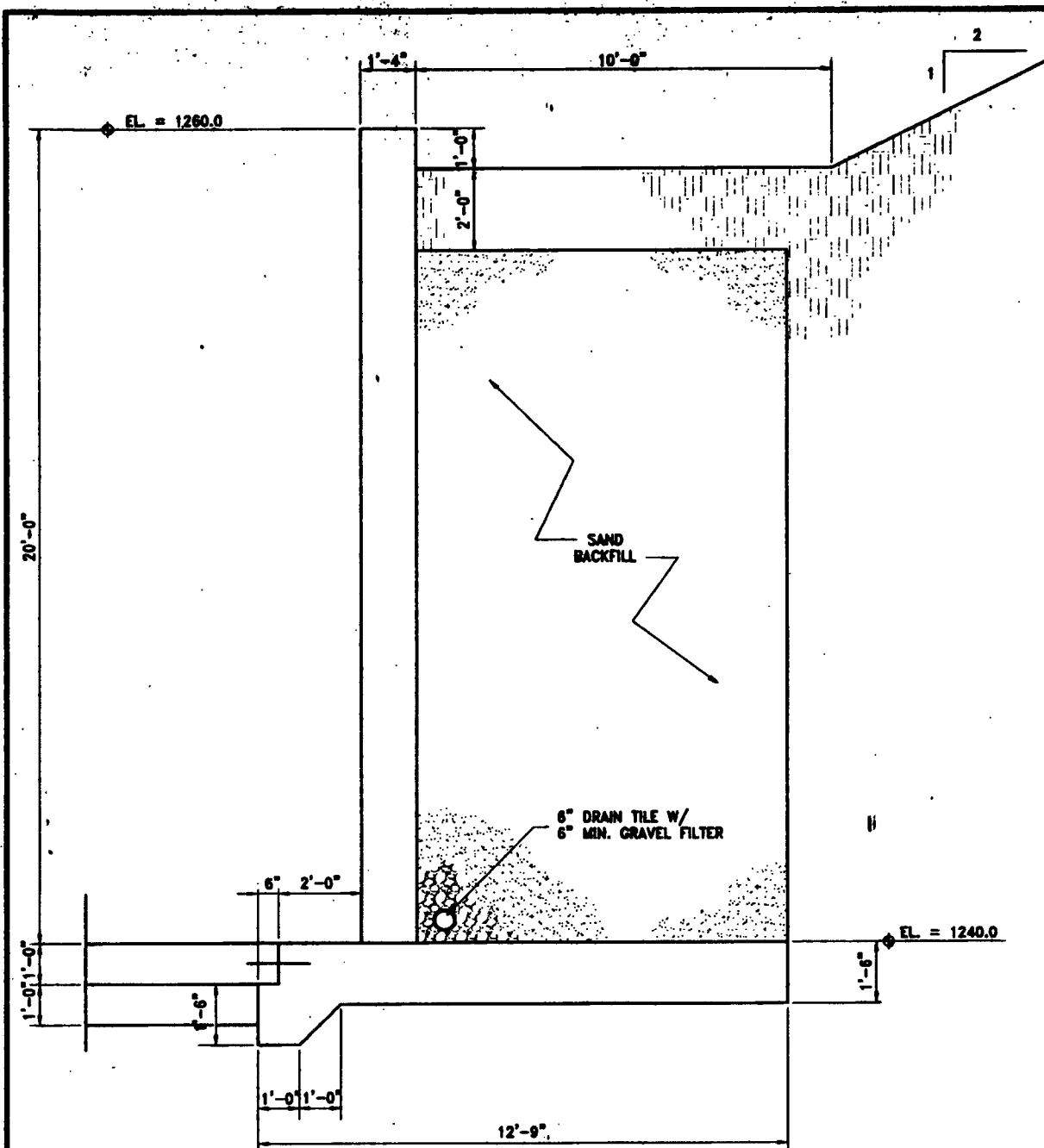


DETAIL - OGEE CREST
SCALE: 1/2" = 1'-0"

DRAWN BY: C.A.M.	REVIEWED DATE: _____ FOR _____
DESIGNED BY: S.V.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: R.L.S.	

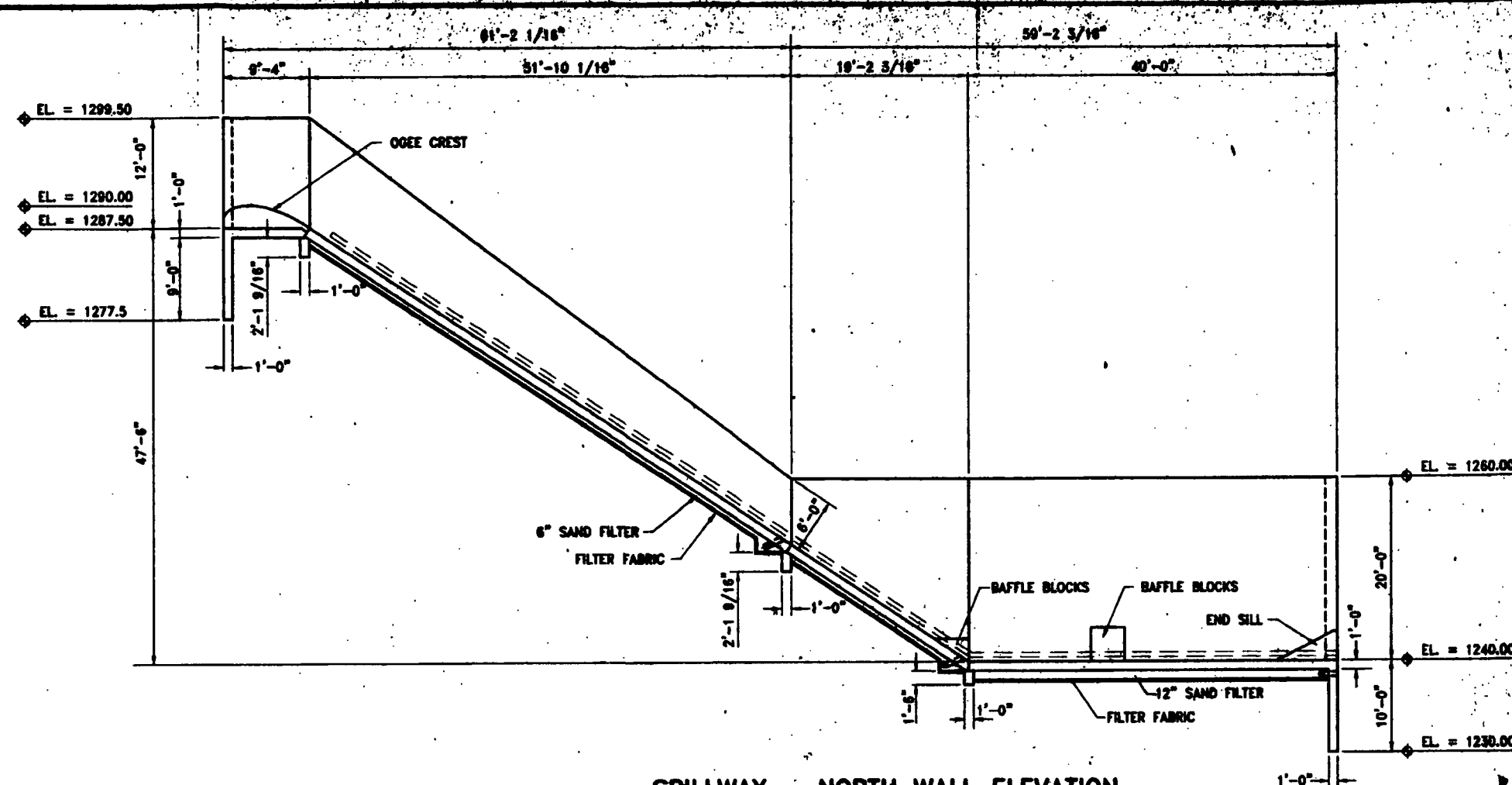
BANNER	REVISION	DATE	DESCRIPTION	BY	CHKD
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Lake Henry Dam Reconstruction	Scotland, South Dakota	SCALE: 1/8" = 1'-0"	REV NO: 7643-01	DATE: Sept. 87
SPILLWAY - PLAN AND DETAILS				
				D1



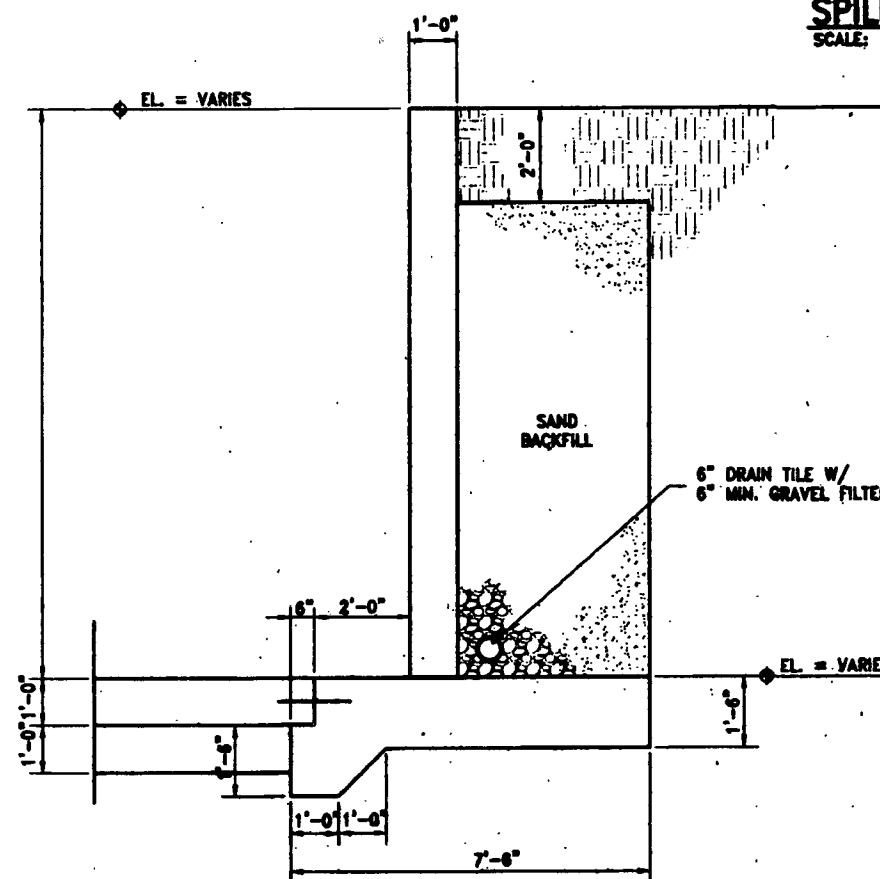
SPILLWAY SECTIONS & DETAILS

SCALE: 1/2" = 1'-0"



SPILLWAY - NORTH WALL ELEVATION

SCALE: 1/8" = 1'-0"



SPILLWAY SECTIONS & DETAILS

SCALE: 1/2" = 1'-0"

FOR REVIEW

Preliminary
Use Only

DRAWN BY: C.A.M.	REVIEWED DATE: _____ FOR _____
DESIGNED BY: S.V.M.	REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: P.L.S.	

BANNER

BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS
409 22nd Av S • P.O. Box 298 - Brookings, SD 57006 • (605) 692-6342

REVISION	DATE	DESCRIPTION	BY	CHK'D

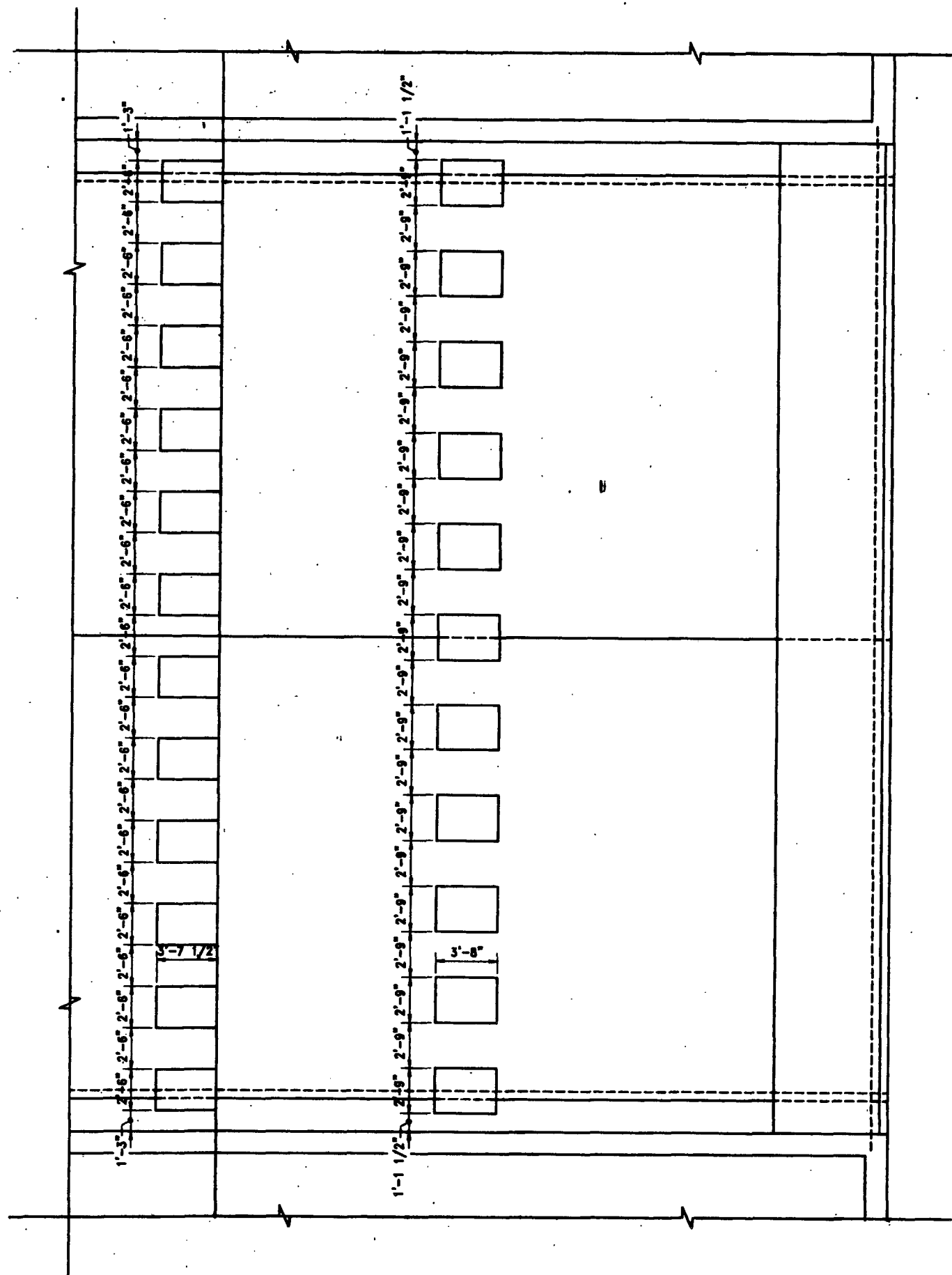
Lake Henry Dam Reconstruction

Scotland, South Dakota

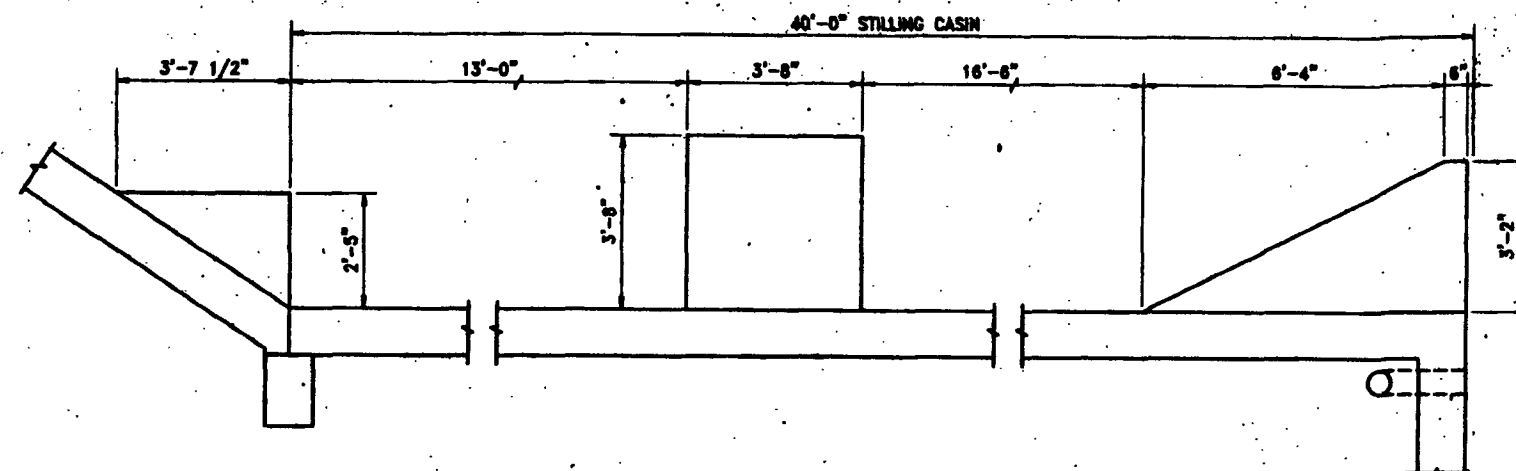
SPILLWAY - ELEVATIONS, SECTIONS AND DETAILS

SCALE: AS SHOWN
SHEET NO. 1

D2



SECTION
SCALE: 1/2" = 1'-0"



SECTION
SCALE: 1/2" = 1'-0"

FOR REVIEW

Preliminary
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DRAWN BY: C.A.M.	REVIEWED DATE : _____ FOR _____
DESIGNED BY: S.V.M.	REVIEWED DATE : _____ FOR BANNER ASSOCIATES, INC.
CHECKED BY: H.L.S.	

BANNER
BANNER ASSOCIATES, INC. CONSULTING ENGINEERS & ARCHITECTS
409 22nd Av S #P.O.Box 298 - Brookings, SD 57006- (605)692-8342

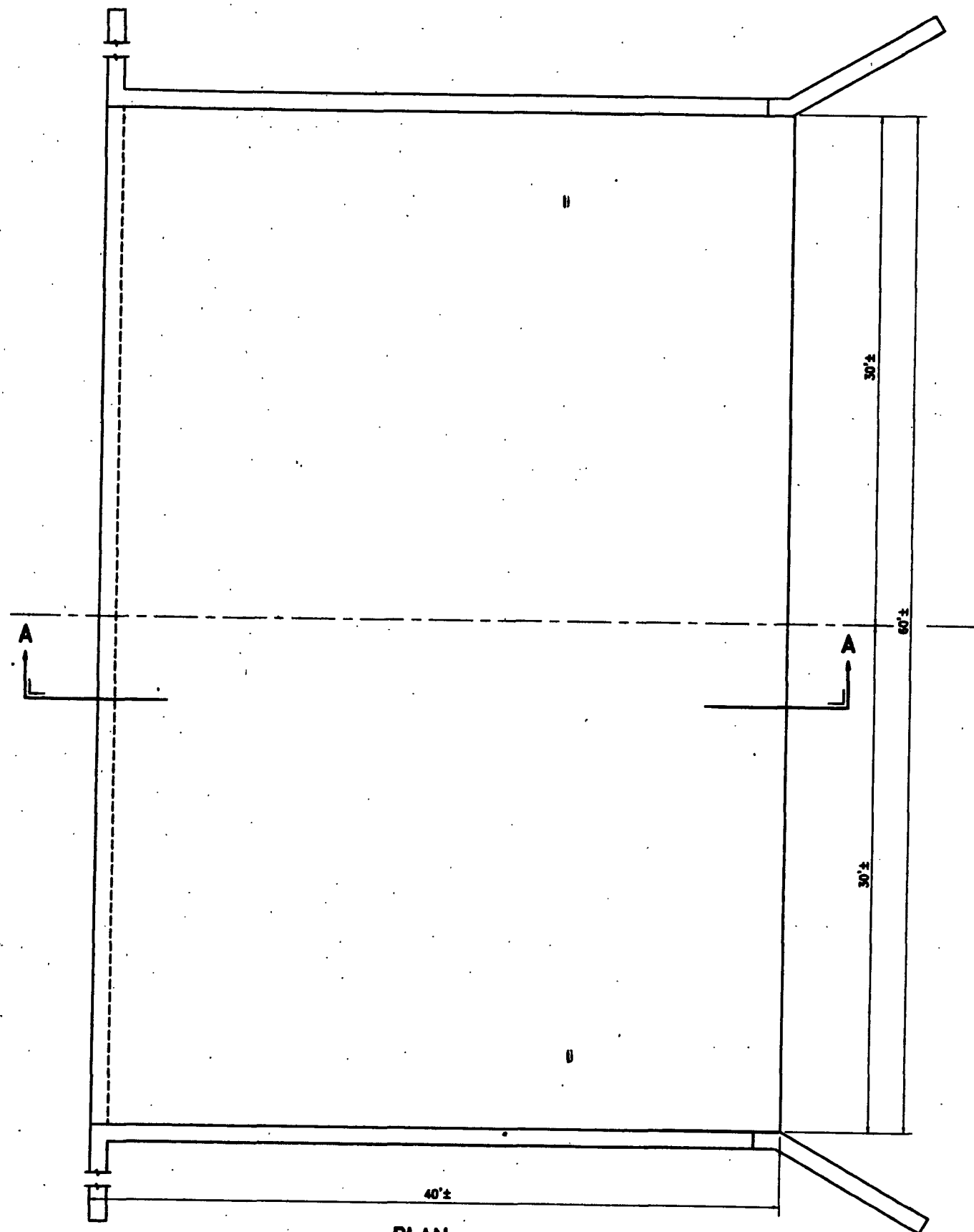
REVISION	DATE	DESCRIPTION	BY	CHK'D

Lake Henry Dam Reconstruction

Scotland, South Dakota

SPILLWAY - SECTIONS AND DETAILS

SCALE : As Shown	JOB NO : 7843-02	DATE : Sept. 97
SHEET NO. : D3		



PLAN
SCALE: 1/4"=1'-0"

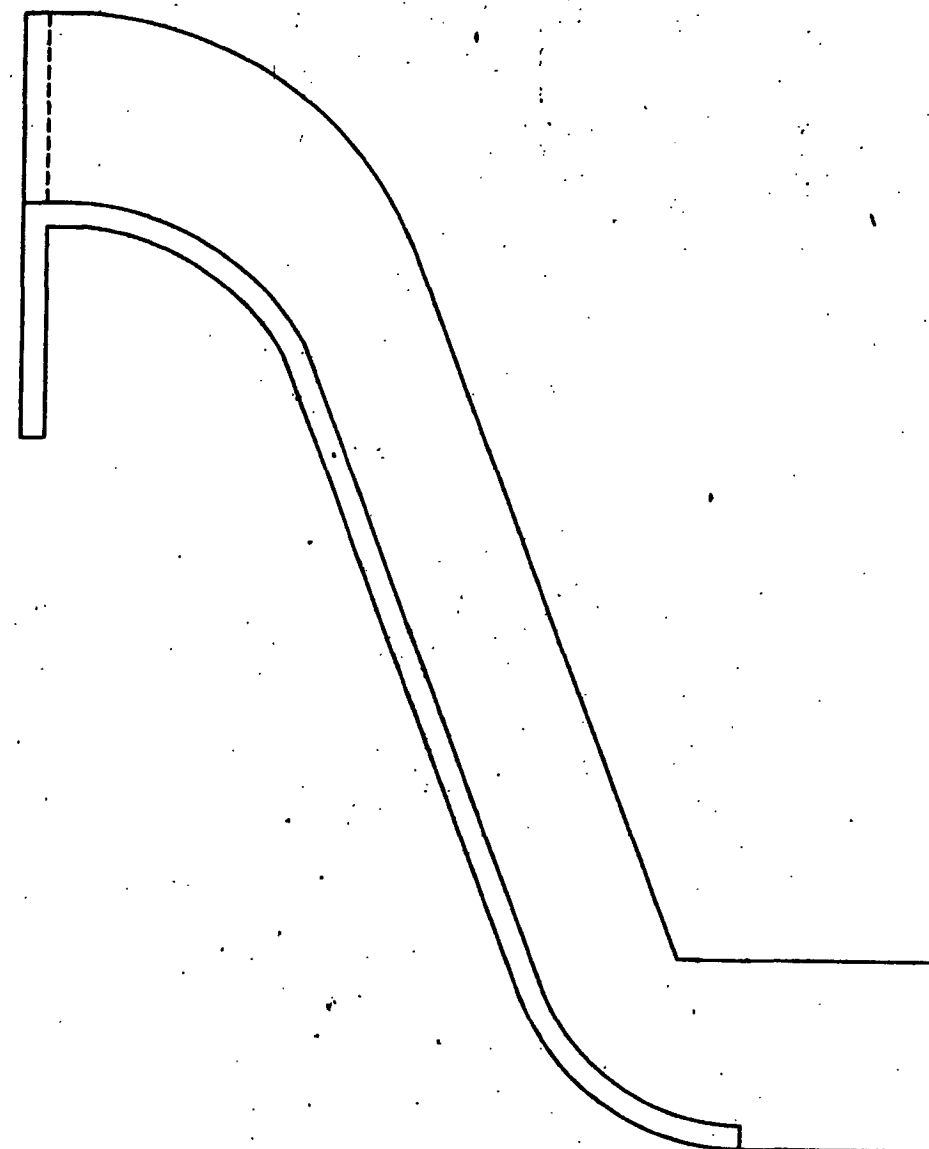
DEMOLITION NOTE:

REMOVE EXISTING CONCRETE SPILLWAY STRUCTURE. ALL CONCRETE RUBBLE FROM THE SPILLWAY SHALL BE USED AS RIPRAP ON THE NEW DIKE AND SHALL BE INSTALLED AT THE LOWER END OF THE UPSTREAM FACE OF THE DAM. CONCRETE RUBBLE SHALL BE INSTALLED BELOW ELEVATION 1270.0 AND SHALL HAVE A MINIMUM COVER OF 18" OF NEW RIPRAP. ALL REINFORCING IN THE CONCRETE RUBBLE SHALL BE REMOVED OR CUT FLUSH WITH CONCRETE SURFACES.

DIMENSIONS, ELEVATIONS AND DETAILS OF EXISTING CONSTRUCTION HAVE BEEN OBTAINED FROM LIMITED FIELD INVESTIGATION AND EXISTING DOCUMENTS. THE CONTRACTOR SHALL FIELD VERIFY DIMENSIONS TO DETERMINE ACTUAL WORK.

EXISTING RIPRAP:

EXISTING RIPRAP ON UPSTREAM FACE OF DAM SHALL BE REMOVED AND STOCKPILED FOR INSTALLATION ON UPSTREAM FACE OF NEW DAM. REMOVE EXISTING VEGETATION AND SOIL FROM THE RIPRAP PRIOR TO PLACEMENT. EXISTING RIPRAP SHALL BE INSTALLED AT THE LOWER END OF THE UPSTREAM FACE OF THE DAM. ALL EXISTING RIPRAP SHALL BE INSTALLED IN THE LOWER 12" LEVEL OF RIPRAP WITH A MINIMUM COVER OF 18" OF NEW RIPRAP.



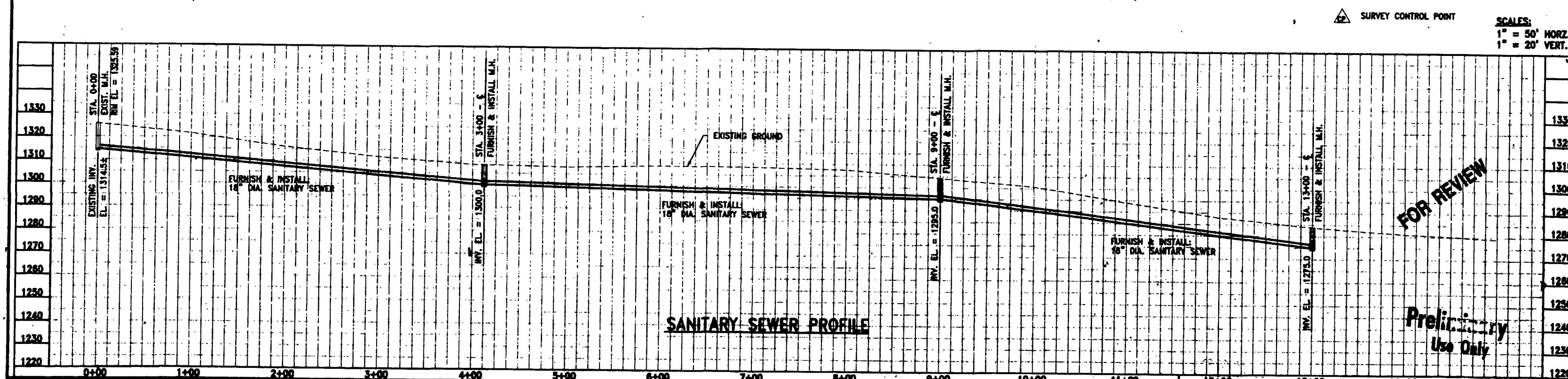
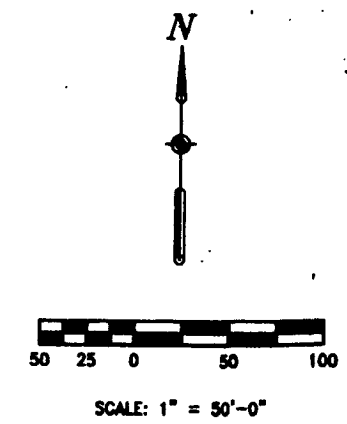
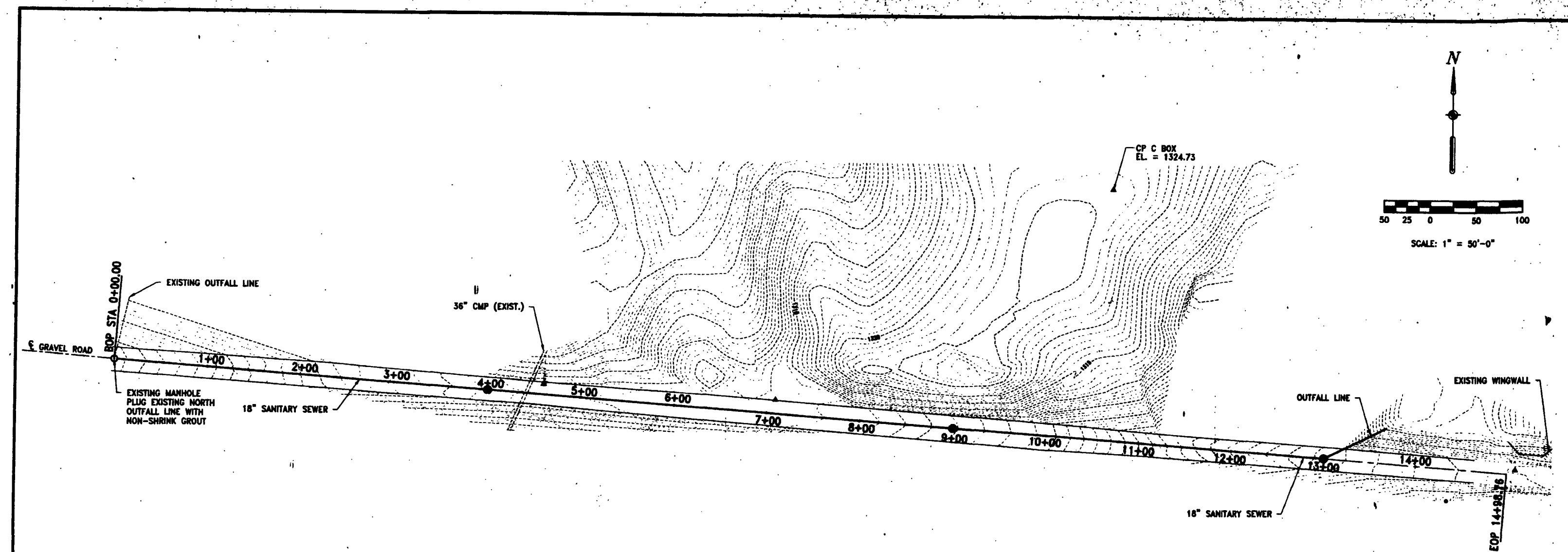
SECTION A-A
SCALE: 1/4"=1'-0"

FOR REVIEW

Preliminary
Use Only

DRAWN BY: C.A.M.		REVIEWED DATE: _____ FOR _____		BANNER BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS 408 22nd Av S • P.O. Box 296 - Brookings, SD 57006 • (605) 882-6342		REVISION		DATE		DESCRIPTION		BY		CHK'D		Lake Henry Dam Reconstruction		Scotland, South Dakota		SCALE: 1/4"=1'-0" As Shown 7842-01 Sept. 87	
DESIGNED BY: S.V.M.		REVIEWED DATE: _____ FOR BANNER ASSOCIATES, INC.				1															
CHECKED BY: R.L.S.																					

EXISTING SPILLWAY - DEMOLITION PLAN



FOR REVIEW

Preliminary
Use Only

DRAWN BY: C.A.M. DESIGNED BY: S.V.M. CHECKED BY: R.L.S.		REVIEWED: _____ DATE: _____ FOR: _____		REVIEWED: _____ DATE: _____ FOR BANNER ASSOCIATES, INC.		BANNER BANNER ASSOCIATES, INC. CONSULTING ENGINEERS & ARCHITECTS 400 22nd Av S • P.O. Box 298 - Brookings, SD 57006 • (605) 682-8342		REVISION: _____ DATE: _____ DESCRIPTION: _____ BY: _____ CK'D: _____		Lake Henry Dam Reconstruction Scotland, South Dakota		SCALE: As Shown SHEET NO.: 7843-01 DATE: Sept. 97	
PLAN AND PROFILE - SANITARY SEWER										E2			

Water Rights Program - DENR
Conversation File Documentation

NAME OF PERSON OR FILE: Water Permit Application No. 6315-3, GF&P

ADDRESS: COUNTY: Bon Homme

DATE: March 26, 2002 TELEPHONE:

RE: Construction of Lake Henry dam

COMMENTS:

I met with Leslie Petersen and Jeff Peters regarding the application they filed for reconstruction of Lake Henry. I explained that the project location on the cover page of the construction plans prepared in September 1997 is not the same as the location of the map prepared by Jeff Peters. The newer map shows the dam location approximately 1000 to 1250 feet downstream of the original dam site. I explained that we were concerned that the new reconstruction plan is at a different location than the design that we received. Mr. Peters stated that the 1997 construction plans were at the same location and alignment as represented on his map and is the location the dam will be built.

I also explained that prior to approval of the permit application or approval of the plans and specification that final stamped plans must be submitted.

File in Permit or other file as necessary. Use to document conversations and what the other party was told; why action or decision was made.

NAME: Eric Tranter



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

March 27, 2002

Leslie Petersen
Department of Game, Fish and Park
523 E. Capitol Avenue
Pierre SD 57501

Dear Leslie:

The Water Rights Program is in receipt of the water right permit application filed by the Department of Game, Fish and Parks for reconstruction of the Lake Henry dam. Jeff Peters and you confirmed that the dam will be located as shown on the USGS quadrangle map prepared by Mr. Peters and that the preliminary construction plans, dated September 1997, are for the location and alignment as shown on Mr. Peters' map.

The Water Rights Program will proceed with preparing a staff report on this application. If the Chief Engineer's recommendation is for approval, I anticipate advertising the public notice in a manner in which the application will be approved based on this recommendation provided no one contests the application. If the application is contested, a hearing will be scheduled before the Water Management Board.

The application will not be approved and the water right permit issued until final construction plans are submitted, reviewed and approved by the Water Rights Program. Therefore, it is important that final construction plans be submitted. Construction of the dam is not to begin until a water right permit is in place and the final construction plans have been approved.

We understand that the reconstruction of Lake Henry is a high priority for Game, Fish and Parks. Please feel free to contact me anytime on the status of processing this application.

Sincerely,

Eric Gronlund
Water Rights Program
(605) 773-3352



DEPARTMENT OF GAME, FISH AND PARKS

Foss Building
523 East Capitol
Pierre, South Dakota 57501-3182
(605)773-6082

April 2, 2002

RECEIVED
APR - 2 2002
WATER RIGHTS
PROGRAM

Mr. Richard Salonen
Banner Associates, Inc.
P O Box 298
Brookings, SD 57006-0298

Re: Lake Henry Dam Reconstruction/Relocation
OSE #GSD971003I
GFP #W98 12 01B

Dear Rick:

As a follow-up on our original comments for the '97 preliminary plans for Lake Henry, Tim Schaal and Gale Selken from DENR and myself reviewed our original letter dated September 30, 1997, to OSE and the "marked" set of plans.

Forward for your use is our marked copy. Please call if you have any questions.

Sincerely,

ENGINEERING SECTION

Jeffrey D. Peters, P. E.
Buildings Engineer II

JDP*cn

cc: Wayne Winter
Arden Petersen
Tim Schaal, DENR
Gale Selken, DENR
Cami Widvey, OSE

Lake Henry Checklist

Task	Responsible Person/Group	Due Date	Date Begun	Completion Date
------	-----------------------------	----------	------------	-----------------

Compliance Issues				
SHPO/THPO	Federal Aid	April 1	3-26-02	
Prime/Unique Farmlands	Federal Aid	April 1		
Endangered Species	Federal Aid	April 1		
Public Involvement (Meeting, if needed)	Federal Aid	April 30		
Wetlands and Floodplains	Federal Aid	April 1		
Clean Air (DENR)	Federal Aid	April 1		
Clean Water (DENR)	Federal Aid	April 1		

Other Issues Resolution				
404 Permit	Berg	May 1		
Water Permit	Leslie Petersen	May 1	Application filed	Ready for May WB mtng
Cooperator financing (cash, bank loans, donations, in-kind; Lingle to check with Bjork)	Federal Aid	None		
Broin ethanol effluent discharge	Leslie Petersen	June 1		

Site Planning				
Final Design Plans (Banner has been notified)	Peters	May 1		
Zoning Issues (county, city)	Region III staff	None		
Culvert on South Side of Lake	SHLA/GFP/County			
ADA accessibility standards must be met	Peters	May 1		
Watershed improvements (NRCS-DENR)	Murphey, Region III staff	None		
Appraisal reports	Vanderbeek, Petersen, Coughlin	April 29		
Signed Options	Vanderbeek, Petersen, Coughlin	May 1		
Fish Habitat	Luchesi, Koth	May 1		

Environmental Assessment				
Identify Alternatives	Federal Aid	April 1		
Public Notice that EA is being drafted	Federal Aid	April 1	Fax-3/18/02	
Completion of Draft EA	Federal Aid	May 1		
Submit Draft EA for review by other agencies/individuals, (Publish Notice that draft is available)	Federal Aid	May 1		
Incorporate public involvement and comments	Federal Aid	June 1		
Prepare final draft	Federal Aid	June 1		
Submit Final Draft of EA with grant application	Federal Aid	June 1		
FONSI prepared and published by FWS-14 day waiting period	Federal Aid	June 15		

Submit Grant				
Prepare Grant Narrative and send with EA for approval	Federal Aid	June 1		
Approved Grant and Grant Agreement	Federal Aid	June 14		
Agreement (if needed, from cooperators, after Federal Aid approval)	Federal Aid	June 21		

Construction				
Advertise for bids	Peters	May 1		
Award construction contract(s)	Peters	June 17		
Field Engineering	Peters	None		

Administration				
Contract administration	Peters	None		
Payments	Berg	None		
Reimbursements	Federal Aid	None		
Grant Administration, reports (both DJ and CDBG)	Federal Aid	None		

Important Dates

Initial Meeting between State Agencies and SLHA*	March 27
SLHA Regular Meeting	April 8
SLHA Annual Meeting	April 19

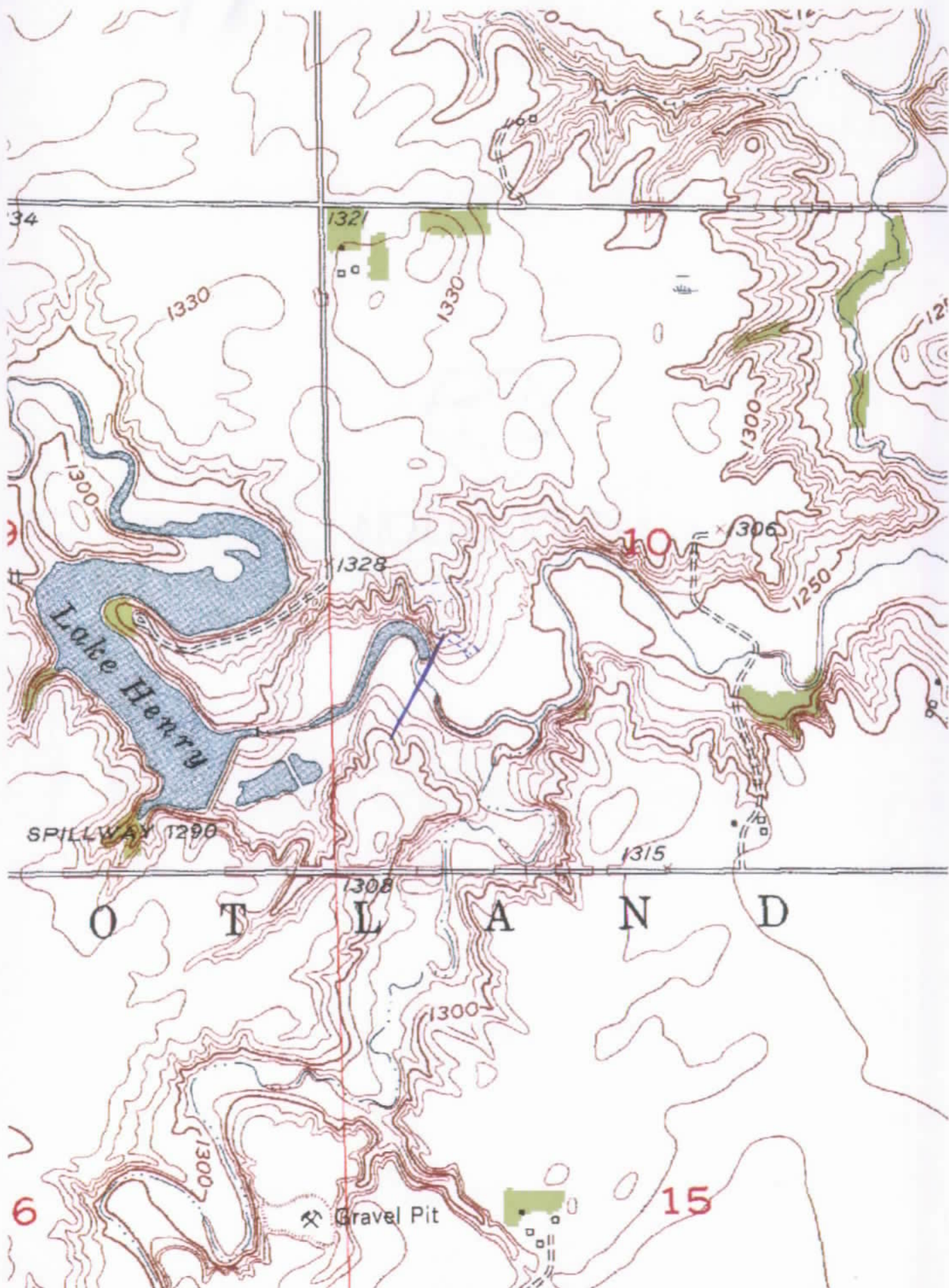
*Tentative

Contact List		
Norm Lingle	CDBG	773-5651
Steve Harding	CDBG	773-5731
Brian McGinnis	Planning District III	665-4408
Greg Henderson	Planning District III	
Stan Schuch	SCWDD	
Stan Kokesh	Bon Homme County Commission	
Les Lebahn	Randall RCD	487-7077
Paul Bainbridge	BHCCD	
Craig Winckler	SHLA	583-4617
Tim Conner	Banner and Associates	692-6342
Cami Widvey	OSE	773-7052
Gale Selken	DENR	773-4067
Tim Schaal	DENR	773-4063
Duane Murphy	DENR	773-4810
Gary LeCompte	NRCS	
Steve Vanderbeek	GFP-Region III, field contact	362-2709
Arden Petersen	Regional Supervisor, Region III	362-2706
Leslie Peterson	GFP-Water Rights	773-6208
Paul Coughlin	GFP-Land Acquisition	773-4194
Jeff Peters	GFP-Engineering	773-4619
Kelly McPhillips	GFP-Federal Aid	773-4675
Wayne Winter	GFP-Federal Aid	773-6228











BANNER ASSOCIATES, INC.
409 22nd Avenue South • P.O. Box 298
Brookings, South Dakota 57006-0298
(605) 692-6040
FAX: (605) 692-5714

May 2, 2002

Mr. Jeff Peters
Department of Game, Fish & Parks
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3182

MAY 06 2002

**RE: Lake Henry Dam Reconstruction/Relocation
Scotland, South Dakota
OSE #GSD971003!
GFP #W98 12 01B
BAI# 07843.00.02**

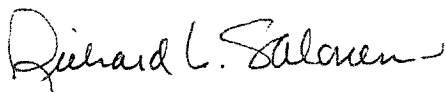
RECEIVED
MAY 07 2002
WATER RIGHTS
PROGRAM

Dear Jeff:

As a follow-up to our telephone conversation this afternoon, we are proceeding with the breach analysis for the relocated dam site per your request. It is our understanding that OSE will prepare an amendment to our contract for this analysis. We propose to perform this work based upon our standard hourly rates. Our standard hourly rates was included with our latest contract for this project.

If you have any question, please feel free to call our office.

Sincerely,



Richard Salonen, PE

cc: Cami Widvey, OSE, Pierre, SD

BANNER

CONSULTING ENGINEERS & ARCHITECTS

May 16, 2002

BANNER ASSOCIATES, INC.
 409 22nd Avenue South • P.O. Box 298
 Brookings, South Dakota 57006-0298
 (605) 682-0342
 FAX: (605) 692-5714

Mr. Jeff Peters
 Department of Game, Fish & Parks
 523 East Capitol
 Pierre, SD 57501-3182

Banner Job No. 07843.00.02

RE: Lake Henry Dam Reconstruction/Relocation
Scotland, South Dakota
OSE #GSD971003I
GFP #W98 12 01B

Dear Mr. Peters:

Tim Schaal (DENR) has requested additional information regarding reservoir routing and hydraulics documentation with regard to Lake Henry Dam at its new site and configuration. Attached are the following documents:

- Spillway rating curve showing the principal spillway, emergency spillway and the combined capacity of both spillways for the proposed construction.
- Reservoir routing program (file E1_10PMF) – this printout includes the ordinates for the 10% PMF, values for the spillway rating curves, the reservoir elevation for the routed 10% PMF (elevation 1297.72) and other information pertinent to the routing.
- Independent routing run using a second program (file PC_RESPRO) – this printout indicates a peak discharge of 6,509 cfs with a reservoir elevation of 1297.70.
- Copy of letter from Banner to John Hatch (February 5, 1997)

The results of the reservoir routing indicate the design flood (10% PMF) with a peak inflow of 8,010 cfs, when routed through the reservoir and its two spillways, will cause the reservoir to rise to elevation 1297.72 with a combined spillway discharge of 6,535 cfs (the independent routing run confirms the first run). The top of dam is at elevation 1299.0 without camber. You will note that the original dam would have overtopped slightly under the same flooding conditions (see Banner letter of February 5, 1997 to Mr. John Hatch).

We believe this is the information Mr. Schaal has requested. If additional information or further clarification is required, please do not hesitate to call.

Sincerely yours,

BANNER ASSOCIATES, INC.



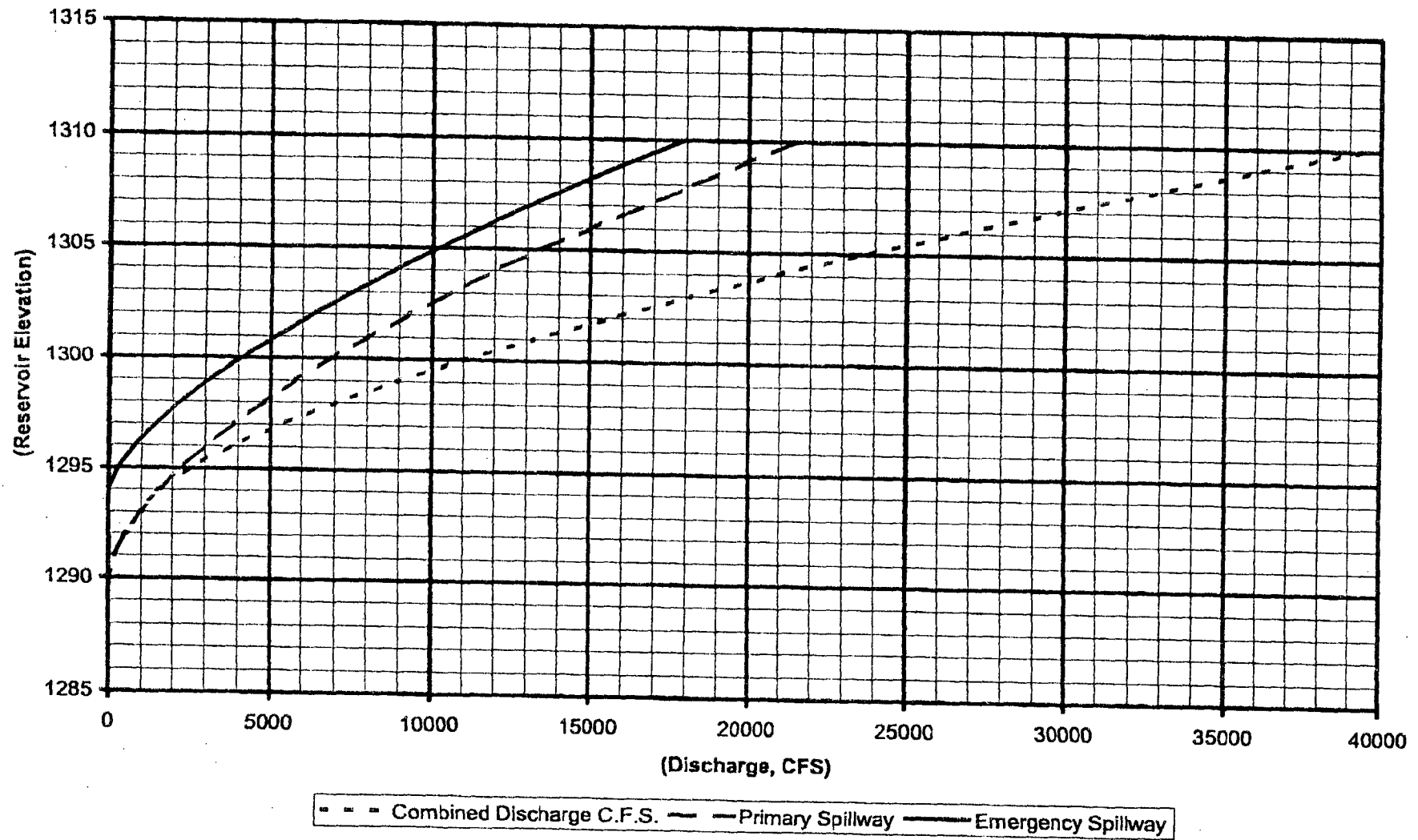
Timothy R. Conner, PE

Enclosures

cc: Tim Schaal, DENR (w/enclosure)
 Greg Henderson, Planning District III (w/enclosure)
 Cami Widvey, OSE (w/o enclosure)

Date: 5/16/02		QUICK FAX [®] OfficeFax [®]	
To: Jeff Peters		From: Tim Conner	
Co./Dept.		Co./Dept.	
Fax: 605-773-6245		Fax:	
Phone:		Phone:	
Note:		E-Mail:	

Lake Henry Dam Spillway Discharge Rating Curve



HYDROLOGIC ANALYSIS OF DAMS- CLARON L KOONTZ, USCE KCD, PHONE 816-374-3651 OR 8-758-3651 (FTS) PROGRAM DATE 3JUN80

EL-10PMF
100' E. SAWY 10% PMF

NATIONAL INVESTIGATION OF DAMS
PROGRAM NUMBER 723-C1-410

KANSAS CITY DISTRICT
U.S. ARMY CORPS OF ENGINEERS
601 E 12TH STREET
KANSAS CITY, MISSOURI

PROGRAM AUTHOR - MR. CLARON L KOONTZ
KANSAS CITY DISTRICT

HYDROLOGIC ANALYSIS OF DAMS- CLARON L KOONTZ, USCE KCD, PHONE 816-374-3651 OR 8-758-3651 (FTS) PROGRAM DATE 3JUN80

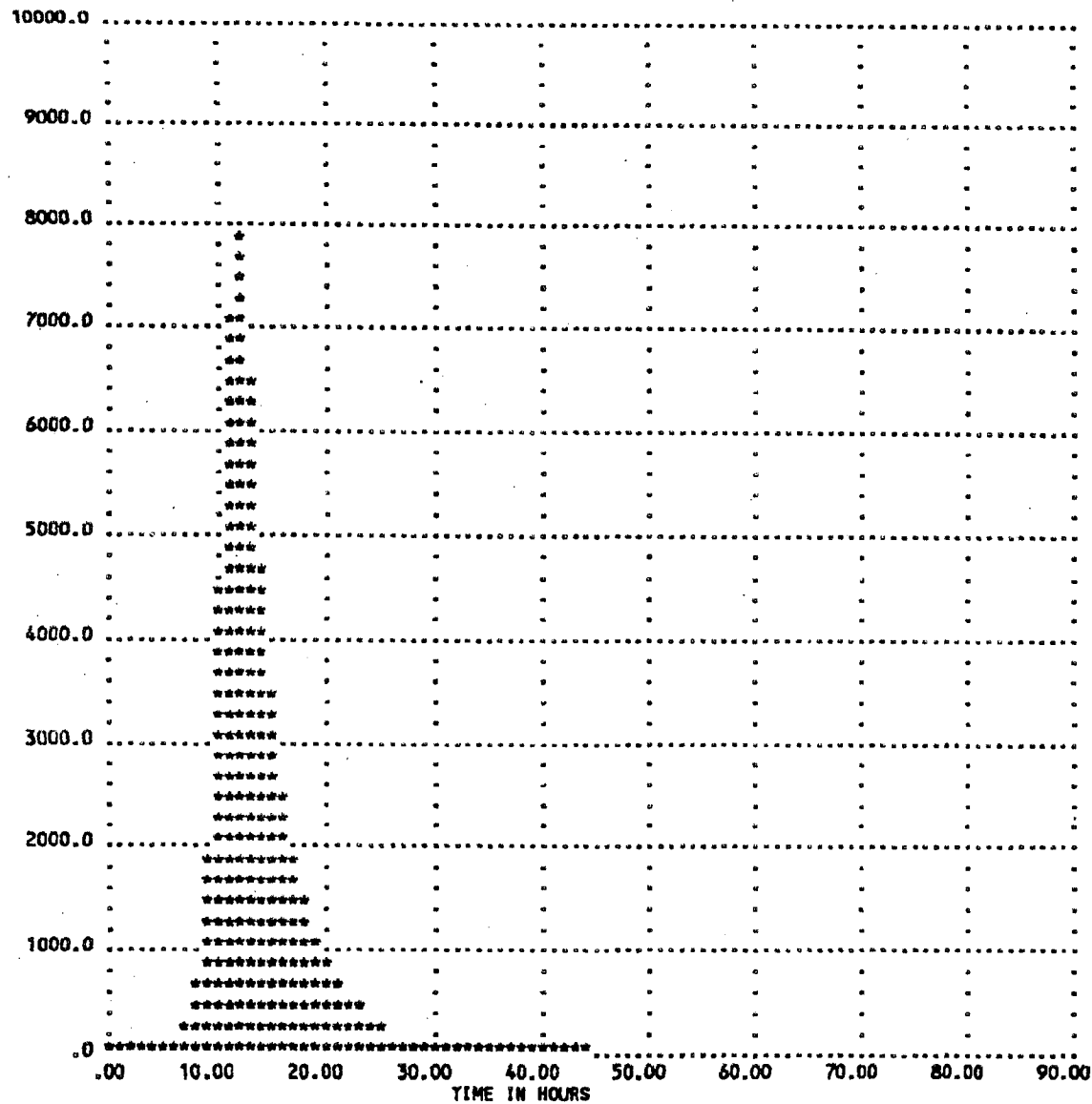
HYDROLOGIC ANALYSIS OF DAMS- CLARON L KOONTZ, USCE KCD, PHONE 816-374-3651 OR 8-758-3651 (FTS) PROGRAM DATE 3JUN80

PROGRAM CHANGES

- 14 MAR 78 - FIELD 5 OF THE 1ST CONTROL CARD IS NOW BEING USED FOR A ROUTING TIME PERIOD CONTROL (RINC).
THE PROGRAM WILL ROUTE THE HYDROGRAPH THRU THE STRUCTURE IN TIME PERIODS EQUAL TO THE DURATION (DUR-FIELD 1 OF CC1)
UNLESS A VALUE IS GIVEN FOR (RINC) FIELD 5-CC1). WHEN RINC IS SET TO A NUMBER GREATER THAN 1.0 THE PROGRAM WILL
ROUTE THE HYDROGRAPH IN TIME INCREMENTS EQUAL TO THE DURATION (DUR) DIVIDED BY THE NUMBER ENTERED FOR RINC.
MAXIMUM VALUE FOR RINC = 20.0
- 12 APR 78 - OPTIONAL CONTROL CARD (BEGIN JOB) (COLS 1-9 =BEGIN JOB).
THIS CONTROL CARD CAN BE USED AHEAD OF EACH JOB FOR EXECUTION OF SEVERAL JOBS IN ONE BATCH RUN.
INSERT A (BEGIN JOB) CARD PRECEDING THE 5 HEADER CARDS FOR EACH JOB. IF THE PROGRAM DETECTS AN ERROR DURING
THE EXECUTION OF ANY STACKED JOB, THE PROGRAM PRINTS OUT THE HEADERS OF THE JOB IN ERROR
AND BEGINS A SEARCH FOR THE NEXT (BEGIN JOB) CARD.
DATA FOLLOWING THE (BEGIN JOB) CARD IS THEN EXECUTED.
CAUTION - USE ONLY ONE (FINISHED) CARD AT THE VERY END OF ALL DATA INPUT.
- 25 APR 79 - THE PROGRAM WILL NOW LIST THE RESERVOIR OUTFLOWS AFTER ROUTING SUMMARY TABLE
TO LIST THE OUTFLOWS SET VARIABLE PROUT (FIELD 10 OF CONTROL CARD CC1) = 20.0 OR GREATER. THE VALUE OF
PROUT WILL BE SET TO THE VALUE GIVEN - 20.0, THEN A LISTING OF THE OUTFLOWS WILL BE PRINTED.
THE ROUTED OUTFLOWS ARE AUTOMATICALLY SAVED AND CAN BE USED AS SERIES INFLOW TO THE NEXT OR
FOLLOWING ROUTING. TO ADD THE SAVED FLOW TO THE DOWN STREAM RESERVOIR INFLOW, INSERT A CONTROL CARD
JUST AHEAD OF THE FIRST HEADER CARD OF THE SECOND OF NEXT ROUTING WITH COLUMNS 1-15 = SERIES ROUTING .
THE PROGRAM WILL ADD THE SAVED FLOWS TO THE COMPUTED LOCAL INFLOWS BEFORE ROUTING THE FLOOD THROUGH
THE DOWNSTREAM RESERVOIR. THE ROUTED OUTFLOWS ARE SAVED AND CAN BE USED IN THE NEXT ROUTING
NOTE THE SAVED OUTFLOWS CANNOT BE REACH ROUTED IN THIS PROGRAM. FOR MORE INFORMATION PLEASE CALL
MR. CLARON L KOONTZ AT THE ABOVE TELEPHONE NUMBER.
- NOTE-----NOTE-----NOTE-----NOTE-----NOTE-----NOTE-----NOTE-----
23 JAN 80 - A NOTCH TYPE BREACHING ROUTINE HAS BEEN INSERTED INTO THE PROGRAM.
THE RATE OF BREACHING IS DEPENDENT ON THE VELOCITY THROUGH THE BREACH SECTION. ONLY ONE
ADDITIONAL CARD OF BREACH DATA IS REQUIRED TO DESCRIBE THE BREACH PARAMETERS
AND THE VELOCITY VS. EROSION RATES. PLEASE FEEL FREE TO CALL CLARON KOONTZ FOR DETAILED
DISCUSSION OF THE BREACH CARD DATA.

***** LISTING OF CARD INPUT DATA ***** PAGE 1

Lake Henry Dam at Scotland, SD
 New Site - Dam Safety Analysis
 File Name: E1_10PMF.DAT
 Input Hydrograph: 10% PMF established by BANNER in 1990 Report
 Primary Spillway Rating as provided by DENR (checked)
 0.5 39.8 1290. 10.
 Input Hydrograph Data
 -10 90
 0 0 1 4 9 19 32 51 75 102
 135 174 220 275 342 425 531 673 884 1279
 2083 3305 4730 6230 7394 8010 7689 6651 5702 4922
 4252 3698 3194 2771 2405 2107 1855 1652 1468 1317
 1192 1080 977 886 804 732 667 610 560 514
 472 434 399 367 338 312 288 265 245 224
 206 191 176 162 148 136 125 117 108 99
 89 81 71 55 23 16 12 9 7 6
 4 3 3 2 2 1 1 1 0 0
 Lake Henry Elevation-Area Data
 3. 9.
 1250.0 0. 1260. 14. 1270. 45. 1280. 69. 1285. 87.
 1290. 107.5 1295. 131.5 1300. 167.1 1310. 243.0
 Type 3 Emergency Spillway - Broadcrested weir formula
 3. 1294. 100. 2. 2.8
 Type 3 Top of Dam - Broadcrested weir formula
 3. 1300.0 1020. 10. 2.8 3.0 .035 2.8
 Type 2 Outlet Rating - Primary Spillway
 2. 18. 1250. 10.0
 1250. 0. 1290. 0. 1291. 177. 1292. 521. 1293. 988.
 1294. 1565. 1295. 2234. 1296. 2999. 1297. 3834. 1298. 4780.
 1299. 5783. 1300. 6849. 1301. 8011. 1302. 9278. 1303. 10574.
 1304. 11943. 1305. 13421. 1310. 21466.
 FINISHED



 DAN INSPECTION HYDROLOGIC ANALYSIS - INPUT FLOOD HYDROGRAPH (LAKE INFLOW HYDROGRAPH)
 Lake Henry Dam at Scotland, SD

 DAM INSPECTION HYDROLOGIC ANALYSIS - INPUT FLOOD HYDROGRAPH (LAKE INFLOW HYDROGRAPH)

Lake Henry Dam at Scotland, SD
 New Site - Dam Safety Analysis
 File Name: E1_10PMF.DAT
 Input Hydrograph: 10% PMF established by BANNER in 1990 Report
 Primary Spillway Rating as provided by DENR (checked)

****Reservoir areas from Quads****
 **** above Spillway level ****

INPUT STORM HYDROGRAPH												
.0	.0	1.0	4.0	9.0	19.0	32.0	51.0	75.0	102.0	135.0	174.0	
220.0	275.0	342.0	425.0	531.0	673.0	884.0	1279.0	2083.0	3305.0	4730.0	6230.0	
7394.0	8010.0	7689.0	6451.0	5702.0	4922.0	4252.0	3698.0	3194.0	2771.0	2405.0	2107.0	
1855.0	1652.0	1468.0	1317.0	1192.0	1080.0	977.0	886.0	804.0	732.0	667.0	610.0	
560.0	514.0	472.0	434.0	399.0	367.0	338.0	312.0	288.0	265.0	245.0	224.0	
206.0	191.0	176.0	162.0	148.0	136.0	125.0	117.0	108.0	99.0	89.0	81.0	
71.0	55.0	23.0	16.0	12.0	9.0	7.0	6.0	4.0	3.0	3.0	2.0	
2.0	1.0	1.0	1.0	.0	.0							

DAM INSPECTION HYDROLOGIC ANALYSIS - LAKE ELEVATIONS, STORAGES AND DISCHARGE RATING TABLES

Lake Henry Dam at Scotland, SD

LAKE ELEVATION FT,MSL	LAKE STORAGE AC-FT	STORAGE PLUS HALF DISCHARGE AC-FT	OUTLET DISCHARGE C.F.S.	SPILLWAY DISCHARGE C.F.S.	OVER TOP OF DAM C.F.S.	TOTAL DISCHARGE C.F.S.
1310.000	5149.117	7828.921	21466.000	17920.000	90314.650	129700.600
1309.000	4910.230	7249.842	19857.000	16266.530	77112.000	113235.500
1308.000	4679.501	6694.803	18248.000	14667.300	64623.900	97539.200
1307.000	4456.787	6164.602	16639.000	13124.210	52893.860	82657.060
1306.000	4241.946	5660.228	15030.000	11639.380	41974.460	68643.840
1305.000	4034.837	5182.937	13421.000	10215.200	31931.050	55567.250
1304.000	3835.317	4737.095	11943.000	8854.377	22848.000	43645.380
1303.000	3643.247	4324.542	10574.000	7560.000	14840.210	32974.210
1302.000	3458.482	3947.987	9278.000	6335.677	8077.988	23691.660
1301.000	3280.883	3612.554	8011.000	5185.672	2856.000	16052.670
1300.000	3110.307	3336.842	6849.000	4115.143	.000	10964.140
1299.000	2946.937	3131.103	5783.000	3130.495	.000	8913.495
1298.000	2790.943	2935.986	4780.000	2240.000	.000	7020.000
1297.000	2642.154	2751.431	3834.000	1454.923	.000	5288.923
1296.000	2500.400	2578.727	2999.000	791.960	.000	3790.959
1295.000	2365.510	2417.453	2234.000	280.000	.000	2514.000
1294.000	2236.507	2268.842	1565.000	.000	.000	1565.000
1293.000	2112.448	2132.862	988.000	.000	.000	988.000
1292.000	1993.239	2004.003	521.000	.000	.000	521.000
1291.000	1878.780	1882.437	177.000	.000	.000	177.000
1290.000	1768.977	1768.977	.000	.000	.000	.000
1289.000	1663.614	1663.614	.000	.000	.000	.000
1288.000	1562.480	1562.480	.000	.000	.000	.000
1287.000	1465.490	1465.490	.000	.000	.000	.000
1286.000	1372.557	1372.557	.000	.000	.000	.000
1285.000	1283.594	1283.594	.000	.000	.000	.000
1284.000	1198.477	1198.477	.000	.000	.000	.000
1283.000	1117.085	1117.085	.000	.000	.000	.000
1282.000	1039.335	1039.335	.000	.000	.000	.000
1281.000	965.144	965.144	.000	.000	.000	.000
1280.000	894.427	894.427	.000	.000	.000	.000
1279.000	826.742	826.742	.000	.000	.000	.000
1278.000	761.661	761.661	.000	.000	.000	.000
1277.000	699.134	699.134	.000	.000	.000	.000
1276.000	639.109	639.109	.000	.000	.000	.000
1275.000	581.535	581.535	.000	.000	.000	.000
1274.000	526.361	526.361	.000	.000	.000	.000
1273.000	473.536	473.536	.000	.000	.000	.000
1272.000	423.008	423.008	.000	.000	.000	.000
1271.000	374.728	374.728	.000	.000	.000	.000
1270.000	328.643	328.643	.000	.000	.000	.000
1269.000	285.589	285.589	.000	.000	.000	.000
1268.000	246.339	246.339	.000	.000	.000	.000
1267.000	210.717	210.717	.000	.000	.000	.000
1266.000	178.547	178.547	.000	.000	.000	.000
1265.000	149.653	149.653	.000	.000	.000	.000

@ 1297.72

Primary = 4515

EMRG = 2020

6335 ✓

 DAM INSPECTION HYDROLOGIC ANALYSIS - LAKE ELEVATIONS, STORAGES AND DISCHARGE RATING TABLES

Lake Henry Dam at Scotland, SD

LAKE ELEVATION FT,MSL	LAKE STORAGE AC-FT	STORAGE PLUS HALF DISCHARGE AC-FT	OUTLET DISCHARGE C.F.S.	SPILLWAY DISCHARGE C.F.S.	OVER TOP OF DAM C.F.S.	TOTAL DISCHARGE C.F.S.
1264.000	123.859	123.859	.000	.000	.000	.000
1263.000	100.989	100.989	.000	.000	.000	.000
1262.000	80.867	80.867	.000	.000	.000	.000
1261.000	63.317	63.317	.000	.000	.000	.000
1260.000	48.163	48.163	.000	.000	.000	.000
1259.000	35.460	35.460	.000	.000	.000	.000
1258.000	25.216	25.216	.000	.000	.000	.000
1257.000	17.167	17.167	.000	.000	.000	.000
1256.000	11.047	11.047	.000	.000	.000	.000
1255.000	6.592	6.592	.000	.000	.000	.000
1254.000	3.535	3.535	.000	.000	.000	.000
1253.000	1.613	1.613	.000	.000	.000	.000
1252.000	.559	.559	.000	.000	.000	.000
1251.000	.108	.108	.000	.000	.000	.000
1250.000	.000	.000	.000	.000	.000	.000

DAM INSPECTION HYDROLOGIC ANALYSIS - SUMMARY TABLE

Lake Henry Dam at Scotland, SD
New Site - Dam Safety Analysis
File Name: E1_10PMF.DAT
Input Hydrograph: 10% PMF established by BANNER in 1990 Report
Primary Spillway Rating as provided by DNR (checked)

INPUT LAKE INFLOW HYDROGRAPH ORDINATES IN CFS AT .500 HOUR INTERVALS BEGINNING AT ZERO TIME												
.0	.0	1.0	4.0	9.0	19.0	32.0	51.0	75.0	102.0	135.0	174.0	
220.0	275.0	342.0	425.0	531.0	673.0	884.0	1279.0	2083.0	3305.0	4730.0	6230.0	
7394.0	8010.0	7689.0	6651.0	5702.0	4922.0	4252.0	3698.0	3194.0	2771.0	2405.0	2107.0	
1855.0	1652.0	1468.0	1317.0	1192.0	1080.0	977.0	886.0	804.0	732.0	667.0	610.0	
560.0	514.0	472.0	434.0	399.0	367.0	338.0	312.0	288.0	265.0	245.0	224.0	
206.0	191.0	176.0	162.0	148.0	136.0	125.0	117.0	108.0	99.0	89.0	81.0	
71.0	55.0	23.0	16.0	12.0	9.0	7.0	6.0	4.0	3.0	3.0	2.0	
2.0	1.0	1.0	1.0	.0	.0							

LAKE AND DAM INFORMATION										
BEGINNING POOL ELEV FT,MSL	OUTLET INVERT FT,MSL	BOTTOM OF LAKE FT,MSL	SPILLWAY CREST FT,MSL	SPILLWAY CREST WIDTH FEET	TOP OF DAM ELEVATION FT,MSL	TOP OF DAM LENGTH FEET	HEIGHT OF DAM FEET	DOWNSTREAM SLOPE OF DAM	N-VALVE ON DS SLOPE	COEF OF FLOW OVER DAM
1290.00	1290.00	1250.00	1294.00	100.0	1300.00	1020.0	50.0	1V ON 3.00H	.035	2.80

SUMMARY OF FLOOD ROUTINGS OF INFLOW HYDROGRAPH THROUGH THE LAKE										
ROUTING NUMBER	PERCENT OF LAKE INFLOW HYDROGRAPH	TOTAL INFLOW VOLUME AC-FT	MAXIMUM LAKE ELEVATION FT,MSL	DEPTH OF LAKE OVER TOP OF DAM FEET	ESTIMATED VELOCITIES CREST FPS	TOE FPS	INITIAL TIME TO OVER TOP HOUR	TOTAL TIME OVER DAM HOURS	VOLUME SPILLED OVER DAM AC-FT	MAXIMUM DISCHARGE FROM DAM CFS
1	100.0	4128.	1297.72	-2.28	.00	.00	.00	.00	.0	6535.5
2	90.0	3715.	1297.29	-2.71	.00	.00	.00	.00	.0	5794.8
3	80.0	3302.	1296.84	-3.16	.00	.00	.00	.00	.0	5046.6
4	70.0	2889.	1296.35	-3.65	.00	.00	.00	.00	.0	4313.7
5	60.0	2477.	1295.83	-4.17	.00	.00	.00	.00	.0	3567.6
6	50.0	2064.	1295.25	-4.75	.00	.00	.00	.00	.0	2829.3
7	40.0	1651.	1294.57	-5.43	.00	.00	.00	.00	.0	2109.0
8	30.0	1238.	1293.77	-6.23	.00	.00	.00	.00	.0	1429.8
9	20.0	826.	1292.77	-7.23	.00	.00	.00	.00	.0	879.1
10	10.0	413.	1291.59	-8.41	.00	.00	.00	.00	.0	378.9

FLOOD ROUTING: Lake Henry Dam - Reservoir Routing Analysis
Combined Spillway Discharge (PC_RESRO)

Top of Dam = 1299.0-ft MSL

Primary Spillway = 1290.0-ft

Emergency Spillway = 1294.0-ft

SPILLWAY

CREST=1290.0 FEET WIDTH= .0 FEET
FLOW DERIVED FROM SPILLWAY RATING TABLE

TIME, DELTA	FLOW	AVE.	AVE.	FLOW	AVE.	AVE.	STOR,	RESER.
HRS T, HRS	IN, CFS	FLOW IN, CFS	FLOW IN, AC-FT	OUT, CFS	FLOW OUT, CFS	FLOW OUT, AC-FT	AT TIME, AC-FT	ELEV., FEET
.00	.00	0	0	0	0	0	1769	1290.00
.50	.50	0	0	0	0	0	1769	1290.00
1.00	.50	1	1	0	0	0	1769	1290.00
1.50	.50	4	3	0	0	0	1769	1290.00
2.00	.50	9	7	0	1	0	1769	1290.00
2.50	.50	19	14	1	1	1	1770	1290.01
3.00	.50	32	26	1	3	2	1771	1290.02
3.50	.50	51	42	2	5	4	1772	1290.03
4.00	.50	75	63	3	9	7	1775	1290.05
4.50	.50	102	89	4	13	11	1778	1290.08
5.00	.50	135	119	5	20	17	1782	1290.11
5.50	.50	174	155	6	28	24	1788	1290.16
6.00	.50	220	197	8	38	33	1794	1290.21
6.50	.50	275	248	10	50	44	1803	1290.28
7.00	.50	342	309	13	66	58	1813	1290.37
7.50	.50	425	384	16	85	75	1826	1290.48
8.00	.50	531	478	20	108	96	1842	1290.61
8.50	.50	673	602	25	137	123	1862	1290.78
9.00	.50	884	779	32	175	156	1887	1290.99
9.50	.50	1279	1082	45	276	226	1923	1291.29
10.00	.50	2083	1681	69	434	355	1978	1291.75
10.50	.50	3305	2694	111	743	588	2065	1292.48
11.00	.50	4730	4018	166	1285	1014	2189	1293.51
11.50	.50	6230	5480	226	2314	1799	2341	1294.79
12.00	.50	7394	6812	281	3655	2984	2499	1295.89
12.50	.50	8010	7702	318	5029	4342	2638	1296.83
13.00	.50	7689	7850	324	6090	5560	2732	1297.46
13.50	.50	6651	7170	296	6509	6299	2768	1297.70
14.00	.50	5702	6177	255	6380	6444	2757	1297.63
14.50	.50	4922	5312	220	5966	6173	2722	1297.39
15.00	.50	4252	4587	190	5431	5699	2676	1297.08
15.50	.50	3698	3975	164	4914	5173	2626	1296.75
16.00	.50	3194	3446	142	4408	4661	2576	1296.41
16.50	.50	2771	2983	123	3917	4163	2527	1296.08
17.00	.50	2405	2588	107	3501	3709	2481	1295.77
17.50	.50	2107	2256	93	3126	3313	2437	1295.48
18.00	.50	1855	1981	82	2781	2953	2397	1295.21

18.50	.50	1652	1754	72	2474	2627	109	2361	1294.96
19.00	.50	1468	1560	64	2216	2345	97	2329	1294.69
19.50	.50	1317	1393	58	1984	2100	87	2299	1294.44
20.00	.50	1192	1255	52	1778	1881	78	2273	1294.22
20.50	.50	1080	1136	47	1597	1687	70	2251	1294.03
21.00	.50	977	1029	42	1482	1539	64	2229	1293.86
21.50	.50	886	932	38	1382	1432	59	2209	1293.68
22.00	.50	804	845	35	1285	1333	55	2189	1293.51
22.50	.50	732	768	32	1191	1238	51	2169	1293.35
23.00	.50	667	700	29	1101	1146	47	2151	1293.20
23.50	.50	610	639	26	1017	1059	44	2133	1293.05
24.00	.50	560	585	24	947	982	41	2117	1292.91
24.50	.50	514	537	22	886	917	38	2101	1292.78
25.00	.50	472	493	20	827	857	35	2086	1292.66
25.50	.50	434	453	19	771	799	33	2072	1292.54
26.00	.50	399	417	17	718	745	31	2058	1292.42
26.50	.50	367	383	16	668	693	29	2045	1292.31
27.00	.50	338	353	15	621	644	27	2033	1292.21
27.50	.50	312	325	13	576	599	25	2022	1292.12
28.00	.50	288	300	12	535	556	23	2011	1292.03
28.50	.50	265	277	11	502	519	21	2001	1291.95
29.00	.50	245	255	11	475	489	20	1992	1291.87
29.50	.50	224	235	10	448	461	19	1982	1291.79
30.00	.50	206	215	9	421	435	18	1973	1291.71
30.50	.50	191	199	8	396	409	17	1965	1291.64
31.00	.50	176	184	8	372	384	16	1956	1291.57
31.50	.50	162	169	7	350	361	15	1948	1291.50
32.00	.50	148	155	6	328	339	14	1941	1291.44
32.50	.50	136	142	6	307	317	13	1933	1291.38
33.00	.50	125	131	5	287	297	12	1927	1291.32
33.50	.50	117	121	5	268	278	11	1920	1291.27
34.00	.50	108	113	5	251	259	11	1914	1291.21
34.50	.50	99	104	4	234	242	10	1908	1291.17
35.00	.50	89	94	4	218	226	9	1903	1291.12
35.50	.50	81	85	4	203	211	9	1898	1291.08
36.00	.50	71	76	3	189	196	8	1893	1291.03
36.50	.50	55	63	3	176	182	8	1888	1290.99
37.00	.50	23	39	2	168	172	7	1882	1290.95
37.50	.50	16	20	1	159	163	7	1876	1290.90
38.00	.50	12	14	1	150	155	6	1870	1290.85
38.50	.50	9	11	0	142	146	6	1865	1290.80
39.00	.50	7	8	0	134	138	6	1859	1290.76
39.50	.50	6	7	0	126	130	5	1854	1290.71
40.00	.50	4	5	0	119	123	5	1849	1290.67
40.50	.50	3	4	0	112	116	5	1845	1290.63
41.00	.50	3	3	0	106	109	5	1840	1290.60
41.50	.50	2	3	0	99	103	4	1836	1290.56
42.00	.50	2	2	0	94	97	4	1832	1290.53
42.50	.50	1	2	0	88	91	4	1828	1290.50
43.00	.50	1	1	0	83	86	4	1825	1290.47
43.50	.50	1	1	0	78	81	3	1822	1290.44
44.00	.50	0	1	0	73	76	3	1819	1290.42
44.50	.50	0	0	0	69	71	3	1816	1290.39
45.00	.50	0	0	0	65	67	3	1813	1290.37

February 5, 1997

SD Department of Env. and Nat. Resc.
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

ATTENTION: Mr. John Hatch

RE: Lake Henry Hydraulic Capacity Analysis

Banner No. 7843-01
OSE #GSG971003I
GFP #W98 12 01B

Dear Mr. Hatch:

This letter is in response to comments by the GF&P (with input from Tim Schaal, DENR) dated December 13, 1996. In specific, comment 13 requesting a letter indicating the facility will have a spillway capacity equal or larger than the old spillway, and will fall within the 100-yr to 10% PMF range.

As part of our original assessment of the Lake Henry Dam (*Feasibility Study for Repair of Lake Henry Dam, July 1990* prepared by Banner for GF&P), a breach analysis was performed that included determination of the Probable Maximum Flood (PMF). The study assumes the 50% PMF occurs upstream of the dam site over the Dawson Creek watershed. Two scenarios were routed to the James River confluence using the National Weather Service DAMBRK computer program:

1) Routing the 50% PMF through Lake Henry and determining the outflow hydrograph from a breach in the dam. The outflow hydrograph was then routed down Dawson Creek.

2) Routing the 50% PMF down Dawson Creek from the site assuming Lake Henry Dam was not in place.

It is our understanding your office has a copy of the Feasibility Study. Please refer to Figure 3-1 and Table 3-1. The analysis indicated the peak flood stage near the James River confluence is approximately 11.8 feet for Scenario 1, and 11.3 feet for Scenario 2 (difference of approximately 0.5 feet). At the time of the feasibility study, it was our understanding this location coincided with the first downstream occurrence of occupied buildings.

BANNER

Mr. John Hatch
February 5, 1997
Page 2

Realistically, it is extremely improbable a Probable Maximum Precipitation (PMP) storm would center only over the Dawson Creek drainage. Most likely, the areal extent of such a storm would cause flooding in adjacent drainages and over the James River itself (due to proximity of site under consideration), and the buildings in the James River floodplain would be inundated to some degree regardless of the existence of the dam.

As to the currently proposed spillway design under consideration, our direction was to replace the spillway "in kind". The reconstructed spillway will be at the same elevation, same width (60 feet), and similar ogee crest design as the old spillway, and therefore, will have at least the same spillway capacity as the old spillway. The capacity of the proposed spillway was checked by routing both the 100-year inflow flood and a 10% PMF inflow event through Lake Henry utilizing the US Army Corps of Engineers *Computer Program 723-C1-410, Investigation of Dams, Hydrologic Analysis*. The 100-year flood inflow was as determined by the SDDENR (letter to Banner dated October 30, 1989). A summary of the results is as follows:

Original Top of Dam Elevation: 1290.4 feet
Spillway Crest Elevation: 1281 feet

<u>Flood Event</u>	<u>Peak Inflow</u>	<u>Reservoir Outflow</u>	<u>Elevation</u>
100-year	1,900 cfs	1,550 cfs	1284.97 feet
10% PMF	8,010 cfs	6,540 cfs	1290.46 feet
			(Note: slight overtopping)
9% PMF	7,210 cfs	5,720 cfs	1289.94 feet
7% PMF	5,610 cfs	4,360 cfs	1288.56 feet

The proposed design for the reconstructed spillway and stilling basin are based on the discharge which will be experienced when the reservoir is at the top of dam elevation, or slightly less than the 10% PMF event. If the risk assessment is approved, the proposed spillway and stilling basin meet the design flood requirement of between the .5 PMF and 100-year spillway design flood for an Intermediate Category 2 dam under the Section 74:02:08:07.02 exception.

If you have any questions, please do not hesitate to call.

Sincerely,
BANNER ASSOCIATES, INC.

Richard L. Salonen

Richard L. Salonen, P.E.
Project Manager

RLS/srz

BANNER ASSOCIATES, INC.
409 22nd Avenue South • P.O. Box 298
Brookings, South Dakota 57006-0298
(605) 692-6342
FAX: (605) 692-5714

May 24, 2002

Mr. Jeff Peters
Department of Game, Fish & Parks
523 East Capitol
Pierre, SD 57501-3182

Banner Job No. 07843.00.02

**RE: Lake Henry Dam Reconstruction/Relocation
Scotland, South Dakota
OSE #G2102-11X
GFP #W98 12 01B**

RECEIVED

MAY 28 2002

**WATER RIGHTS
PROGRAM**

Dear Mr. Peters:

Banner Associates, Inc. prepared a dam breach analysis as part of the *Feasibility Study for Repair of Lake Henry Dam, Scotland, SD* (July 1, 1990). The narrative for the breach analysis was included in Section 3.0 – it is included as an attachment to this letter. The 50% PMF was routed assuming two scenarios:

- Scenario 1 – 50% PMF routed through the existing Lake Henry Reservoir and the dam fails when the water level overtopping the dam reaches elevation 1300.
- Scenario 2 – 50% PMF routed through Dawson Creek, assuming Lake Henry Dam and Reservoir were not in place. This scenario was developed to establish a baseline to determine the incremental flooding caused by dam failure during the 50% PMF event.

The breach analysis for the 1990 Feasibility Study was based on reconstruction of Lake Henry Dam at its original site. The following is a summary of the modeling conditions for the existing Lake Henry Dam and Reservoir:

- Existing Lake Henry Dam and Reservoir at current location:
 - Top of dam elevation = 1,299.4
 - Normal high water = 1,290 (spillway crest elevation, approximate)
 - Reservoir capacity = 1,960 acre feet @ elevation 1,300
 - Principal spillway capacity = 6,208 cfs @ top of dam elevation 1,299.4; H = 9.4' (there was no emergency spillway)
 - Approximate dam crest length = 560'

Following publication of the 1990 Feasibility Study, a decision was made to reconstruct Lake Henry Dam at a site downstream from the existing dam site. Based upon the proposed design of the new dam at the downstream site, the following is a summary of the modeling conditions for the new Lake Henry Dam and Reservoir:

Mr. Jeff Peters
 May 24, 2002
 Page 2 of 3

- Proposed Lake Henry Dam and Reservoir at downstream location:
 - Top of dam elevation = 1,299.0 (w/o camber)
 - Normal high water = 1,290 (principal spillway crest elevation)
 - Emergency spillway crest = 1,294
 - Reservoir capacity = 3,110 acre feet @ elevation 1,300
 - Combined (principal and emergency) spillway capacity = 8,914 cfs @ top of dam elevation 1,299; H = 9.0'
 - Approximate dam crest length = 1,260' (this length includes the flow area between the dam and emergency spillway, but excludes the widths of the actual spillways)

We re-ran the models to confirm the earlier results and to make sure we could match the results of the 1990 analysis. The confirmation runs were successful. We input the characteristics of the new dam, spillway and reservoir configuration into the model and ran a new Scenario 1 (designated 1A) analysis. The dam was moved downstream so we also had to revise the first cross section and distance between the first and second cross sections. All other model inputs remained the same as the 1990 Scenario 1 analysis.

The results of the modeling are summarized in the following table which is a modification of Table 3-1 from the 1990 Feasibility Study (page 3-5):

Summary Results of the DAMBRK Modeling
 Peak Discharge (cfs)/Peak Flood Stage (feet above stream channel)

Cross Section	Scenario 1	Scenario 2	Scenario 2
	From 1990 Study at Old Dam Site	At Proposed New Dam Site	w/o Dam
1	73,276/41.5	86,204/51.4	40,052/15.8
2	73,276/20.7	86,204/22.1	39,224/16.7
3	50,123/12.0	63,208/13.6	38,345/10.7
4	47,369/14.3	60,794/15.6	38,368/13.3
5	44,564/11.8	58,667/12.8	38,421/11.3

Cross section 1 is at the dam site and cross section 5 is located at the confluence of Dawson Creek and the James River. As indicated in the above table, the flood elevation would increase by approximately 1' at cross section 5 (at the confluence with the James River). The potential impact of dam failure during the 50% PMF is increased from approximately 0.5' to 1.5' at cross section 5 for the dam located at the downstream site.

These results are not unexpected. Contributing factors which predictably increase the depth of flow and flood breach discharge for the new dam site location include:

- The proposed new reservoir has more capacity (1,960 vs. 3,110 acre feet @ elevation 1,300).
- The proposed new spillways have a higher combined capacity (6,208 cfs @ top of dam elevation 1,299.4 vs. 8,914 cfs @ top of dam elevation 1,299).

Mr. Jeff Peters
May 24, 2002
Page 3 of 3

- The proposed new dam has a longer crest length (560' vs. 1,260'). And,
- The dam is approximately 0.28 miles closer to the confluence with the James River, thus reducing the length of stream to dissipate the flood wave.

We believe this is the information Mr. Schaal has requested. If additional information or further clarification is required, please do not hesitate to call.

Sincerely yours,

BANNER ASSOCIATES, INC.



Timothy R. Conner, PE

Enclosures:

- Section 3 from *Feasibility Study for Repair of Lake Henry Dam, Scotland, SD*, Banner Associates, Inc., July 1, 1990
- DAMBRK input and output for Scenario 1A

cc: ✓ Tim Schaal, DENR (w/enclosure)
Greg Henderson, Planning District III (w/enclosure)
Cami Widvey, OSE (w/enclosure)

3.0 BREACH ANALYSIS

3.1 Purpose

The purpose of the breach analysis is to evaluate the effects of a failure of Lake Henry Dam on downstream areas and to develop a map showing an estimate of the water surface elevation and flooding which would result. A hydrologic analysis was completed to determine the 50% PMF inflow hydrograph to Lake Henry in the breach analysis.

The analysis considered the flooding which could be expected from the 50% PMF under two scenarios:

- 1) Routing the 50% PMF through Lake Henry and determining the outflow hydrograph from a breach in the dam. The outflow hydrograph from the breach was then routed down Dawson Creek to its confluence with the James River.
- 2) Routing the 50% PMF down Dawson Creek to its confluence with the James River assuming Lake Henry Dam was not in place.

The scenarios were determined to allow for an evaluation to be made of the incremental flooding which results from the breached outflow of the dam.

3.2 Probable Maximum Precipitation (PMP)

The PMP event was determined using the procedures outlined in HMR Nos. 51 and 52. The drainage area tributary to the dam is 39.8 square miles. The technical analysis completed to determine the PMP is presented in Appendix A.

3.3 Probable Maximum Flood (PMF)

The procedures given in the 1987 Edition USBR publication Design of

Small Dams were used to calculate the PMF. The infiltration rate for the basin was estimated from The Missouri River Basin Comprehensive Framework Study - Infiltration Data published by the Soil Conservation Service. A constant rate of 0.20 inches per hour was used for this study.

A synthetic unit hydrograph for the basin tributary to the dam was developed using the Dimensionless Unit Hydrograph Technique. The method used is based on unit hydrograph theory. The dimensionless unit hydrograph data for the Great Plains Region presented in Design of Small Dams was used. The following summarizes the basin characteristics, determined from USGS topographic quad maps, used to calculate the basin lag time:

- o Length of longest watercourse (L) 25.9 miles
- o Length along watercourse to the 16.7 miles
 centroid of the basin (L_{ca})
- o Overall slope of longest 13.9 feet/mile
 watercourse (S)

Appendix B presents the technical analysis completed to determine the 50% PMF for the Henry Lake drainage basin.

The analysis made shows a peak discharge of nearly 40,000 cubic feet per second for the 50% PMF. Peak discharge occurs approximately 12.5 hours from the beginning of the probable maximum precipitation event.

3.4 Modeling

The National Weather Service "DAMBRK" computer model was used to perform the analyses. The DAMBRK model is used to develop the outflow hydrograph from a dam breach and hydraulically route the flood through the downstream valley. The model uses a hydraulic routing method which is a numerical solution of the complete one-dimensional Saint-Venant equations for unsteady open-channel flow. In the case of a breached dam, the routing equations are coupled with an equation for broad-crested weir flow through

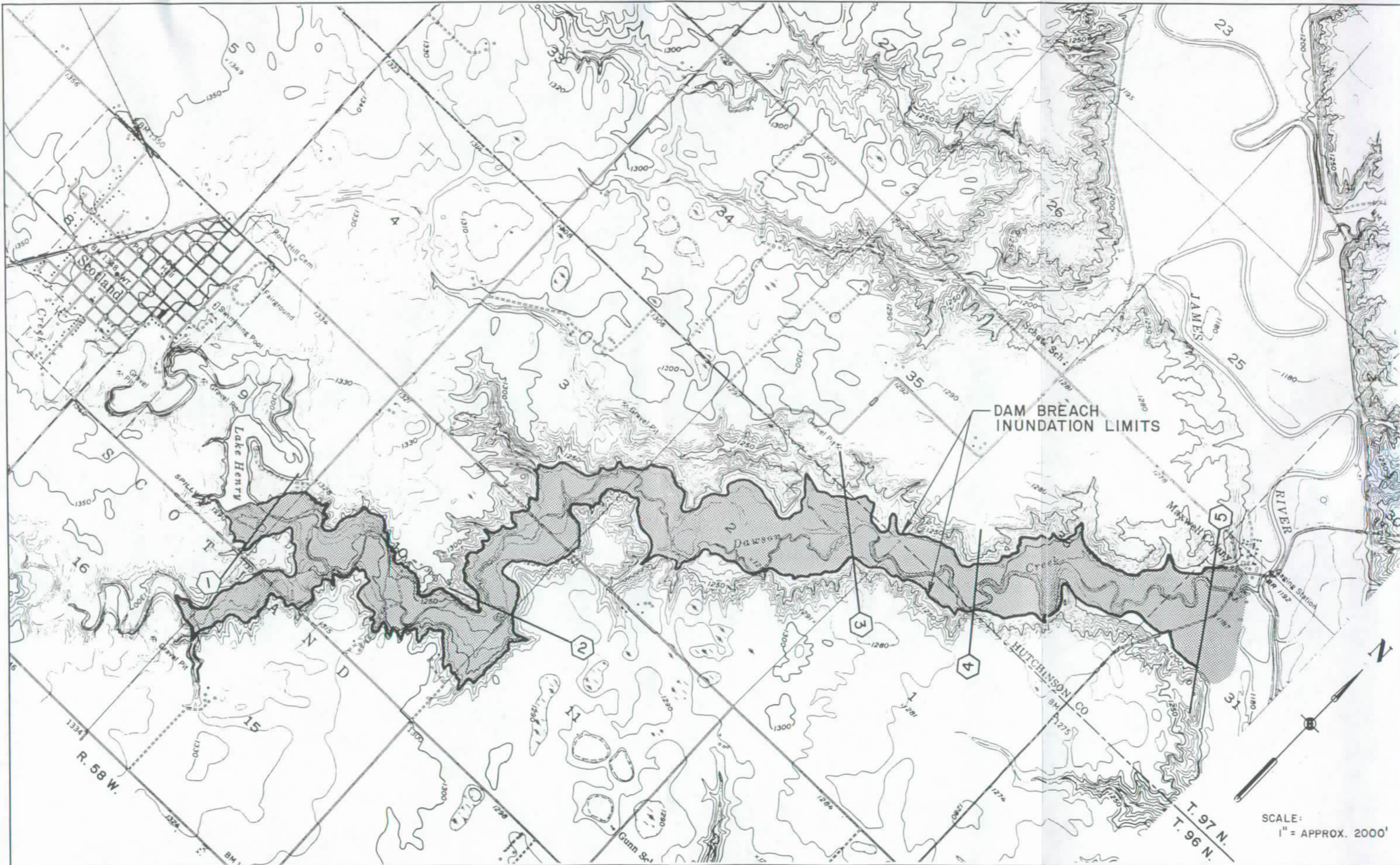
the breach. A modified Puls type routing procedure is used to route the inflow flood hydrograph (50% PMF) through the reservoir.

The breach of the dam was modeled as an overtopping failure, as the spillway does not have the hydraulic capacity to pass the 50% PMF without overtopping the dam. The breach width and depth were modeled based on the dimensions of the breach section in the failure of Menno Lake Dam in Hutchinson County and typical breach dimensions experienced at other earth embankment dams.

The model requires input of stream channel and floodplain cross-sections. Cross-sections were developed from USGS topographic quad maps for the dam site and five locations downstream. The locations of the downstream cross-sections are shown on the flood inundation map in Figure 3-1. The cross-sections were chosen to be representative of the Dawson Creek floodplain. The fifth cross-section (4.7 miles downstream of the dam) coincides with the location of the buildings located near the confluence of Dawson Creek with the James River.

3.5 Results

The modeling results in estimates of the water surface elevation and peak discharges at the cross-section locations. The results of the two scenarios are shown in Table 3-1 below:



BANNER

LAKE HENRY DAM - FEASIBILITY STUDY

FLOOD INUNDATION MAP

FIGURE
3-1

Table 3-1

Summary Results of the DAMBRK Modeling

Peak Discharge (cfs)/ Peak Flood Stage (feet above streamchannel)

<u>Cross-Section</u>	<u>Scenario 1 (dam breach)</u>	<u>Scenario 2 (w/o dam)</u>
1	73276/41.5	40052/15.8
2	73276/20.7	39224/16.7
3	50123/12.0	38345/10.7
4	47369/14.3	38368/13.3
5	44564/11.8	38421/11.3

Model output for each of the scenarios is presented in Appendix D.

The flood inundation limits along Dawson Creek are shown in Figure 3-1 for Scenario 1. In developing the flood inundation limits the extent of flooding was interpolated between the cross-sections. A dam breach failure coincident with the 50% PMF would result in an estimated peak flood stage of 11.8 feet at the confluence with the James River. Scenarios 2 shows, however, that the 50% PMF alone would result in a peak flood stage of over 11 feet at the confluence with the James River.

LAKE HENRY DAM
BANNER ASSOCIATES, INC. PO BOX 298, 409 22nd Ave S., Brookings, SD 57006

0000110100	1	1	1	5	77	0	0	0
5149.0	3110.0	1769.0	894.0	329.0	48.0	0.0		
1310.0	1300.0	1290.0	1280.0	1270.0	1260.0	1250.0		
0.	1290.0	1.36	1262.0	100.	0.60	1260.0	232.	
1300.0	1299.0	1290.0	0.	0.	0.0	3843.0	5.0	
0.	177.0	521.0	1565.0	2514.0	3791.0	7020.0	8914.0	
0.	1.	2.	4.	5.	6.	8.	9.0	
0.5	38.0							
20.	47.	93.	162.	256.	373.	511.	675.	
869.	1099.	1376.	1711.	2127.	2657.	3366.	4419.	
6395.	10413.	16525.	23649.	31148.	36971.	40052.	38444.	
33256.	28509.	24608.	21262.	18490.	15972.	13857.	12026.	
10533.	9276.	8261.	7341.	6585.	5958.	5399.	4885.	
4430.	4018.	3658.	3335.	3051.	2798.	2571.	2361.	
2168.	1993.	1835.	1689.	1560.	1440.	1327.	1224.	
1121.	1031.	953.	879.	808.	741.	678.	627.	
585.	539.	497.	444.	403.	356.	277.	116.	
80.	60.	46.	36.	28.				
5	8	5	4	0	0	0	0	
1	2	3	4	5				
0.0								
1249.	1260.	1270.	1280.	1290.	1300.	1310.	1320.	
0.	220.	435.	570.	710.	850.	920.	1527.	
0.								
1.02	1229.5							
1229.	1230.	1240.	1250.	1260.	1270.	1280.	1290.	
0.	40.	700.	840.	920.	1040.	1200.	1720.	
0.								
2.92	1208.5							
1208.	1210.	1220.	1230.	1240.	1250.	1260.	1270.	
0.	1080.	1340.	1400.	1220.	1740.	1860.	2080.	
0.								
3.42	1199.5							
1199.	1200.	1210.	1220.	1230.	1240.	1250.	1270.	
0.	80.	980.	1080.	1140.	1200.	1300.	1560.	
0.								
4.42	1179.0							
1178.	1180.	1190.	1200.	1210.	1220.	1230.	1250.	
0.	140.	2320.	2440.	2520.	2680.	2800.	3360.	
0.								
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.	0.	0.	0.	0.	0.080	0.080		
0.080	0.080	0.080	0.080	0.080	0.080	0.080		
0.	0.	0.	0.	0.				
0.	0.	0.	0.					

ANALYSIS OF THE DOWNSTREAM FLOOD HYDROGRAPH

PRODUCED BY THE DAM BREAK OF

LAKE HENRY DAM

ON

LAKE HENRY

ANALYSIS BY

BANNER ASSOCIATES, INC. PO BOX 298,
409 22nd Ave S., Brookings, SD 57006

BASED ON PROCEDURE DEVELOPED BY
DANNY L. FREAD, PH.D., SR. RESEARCH HYDROLOGIST

QUALITY CONTROL TESTING AND OTHER SUPPORT BY
JANICE M. LEWIS, RESEARCH HYDROLOGIST

HYDROLOGIC RESEARCH LABORATORY
W23, OFFICE OF HYDROLOGY
NOAA, NATIONAL WEATHER SERVICE
SILVER SPRING, MARYLAND 20910

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*****
*****
***                               ***
***  SUMMARY OF INPUT DATA  ***
***                               ***
*****
*****

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INPUT CONTROL PARAMETERS FOR LAKE HENRY DAM

PARAMETER	VARIABLE	VALUE
*****	*****	*****
NUMBER OF DYNAMIC ROUTING REACHES	KKN	1
TYPE OF RESERVOIR ROUTING	KUI	1
MULTIPLE DAM INDICATOR	MULDAM	1
PRINTING INSTRUCTIONS FOR INPUT SUMMARY	KDMP	5
NO. OF RESERVOIR INFLOW HYDROGRAPH POINTS	ITEH	77
INTERVAL OF CROSS-SECTION INFO PRINTED OUT WHEN JNK=9 NPRT		0
FLOOD-PLAIN MODEL PARAMETER	KFLP	0
METRIC INPUT/OUTPUT OPTION	METRIC	0

IOPUT= 0 0 0 0 1 1 0 1 0 0 0 0

IDAM= 1

LAKE HENRY DAM

RESERVOIR

TABLE OF ELEVATION VS VOLUME

VOLUME (ACRE-FEET) ELEVATION (FT)

SA (K)

HSA (K)

5149.0	1310.00
3110.0	1300.00
1769.0	1290.00
894.0	1280.00
329.0	1270.00
48.0	1260.00
.0	1250.00
.0	.00

SURFACE AREA TABLE BELOW ENTRY NO. 6 IS NOT EXACTLY COMPATIBLE WITH THE VOLUME TABLE. THE VOLUME TABLE SHOULD BE CHECKED FOR

POSSIBLE ERRORS. IF POSSIBLE USE A SURFACE AREA TABLE RATHER THAN A VOLUME TABLE. IF THE SURFACE AREA TABLE IS NOT AVAILABLE,

THEN THE SURFACE AREA AT THE TOP OF THE DAM SHOULD BE READ IN FOR THE PARAMETER "VOL".

LAKE HENRY DAM

RESERVOIR

TABLE OF ELEVATION VS SURFACE AREA

SURFACE AREA (ACRES) ELEVATION (FT)

SA (K)

HSA (K)

232.0	1310.00
175.8	1300.00
92.4	1290.00
82.6	1280.00
30.4	1270.00
25.8	1260.00
12.9	1250.00
.0	.00

DAM NUMBER 1

LAKE HENRY DAM

RESERVOIR AND BREACH PARAMETERS

PARAMETER	UNITS	VARIABLE	VALUE
*****	*****	*****	*****
ELEVATION OF WATER SURFACE	FEET	YO	1290.00
SIDE SLOPE OF BREACH		Z	1.36
ELEVATION OF BOTTOM OF BREACH	FEET	YBMIN	1262.00
WIDTH OF BASE OF BREACH	FEET	BB	100.00
TIME TO MAXIMUM BREACH SIZE	HR	TFH	.60
ELEVATION OF WATER WHEN BREACHED	FEET	HF	1300.00
ELEVATION OF TOP OF DAM	FEET	HD	1299.00
ELEVATION OF UNCONTROLLED SPILLWAY CREST	FEET	HSP	1290.00
ELEVATION OF CENTER OF GATE OPENINGS	FEET	HGT	.00
DISCHARGE COEF. FOR UNCONTROLLED SPILLWAY		CS	.00
DISCHARGE COEF. FOR GATE FLOW		CG	.00
DISCHARGE COEF. FOR UNCONTROLLED WEIR FLOW		CDO	3843.00
DISCHARGE THRU TURBINES	CFS	QT	5.00

QSPILL(K, 1)	HEAD(K, 1)
CFS	FEET
*****	*****
0.	.0
177.	1.0
521.	2.0
1565.	4.0
2514.	5.0
3791.	6.0
7020.	8.0
8914.	9.0

DHF (INTERVAL BETWEEN INPUT HYDROGRAPH ORDINATES) = .50 HRS.

TEH (TIME AT WHICH COMPUTATIONS TERMINATE) = 38.0000 HRS.

BREX (BREACH EXPONENT) = .000

MUD (MUD FLOW OPTION) = 0

IWF (TYPE OF WAVE FRONT TRACKING) = 0

KPRES (WETTED PERIMETER OPTION) = 0

KSL (LANDSLIDE PARAMETER) = 0

DFR (WINDOW FOR CRITICAL FROUDE NO. IN MIX FLOW ALGORITHM) = .050

INFLOW HYDROGRAPH TO LAKE HENRY DAM

20.00	47.00	93.00	162.00	256.00	373.00	511.00	675.00
869.00	1099.00	1376.00	1711.00	2127.00	2657.00	3366.00	4419.00
6395.00	10413.00	16525.00	23649.00	31148.00	36971.00	40052.00	38444.00
33256.00	28509.00	24608.00	21262.00	18490.00	15972.00	13857.00	12026.00
10533.00	9276.00	8261.00	7341.00	6585.00	5958.00	5399.00	4885.00
4430.00	4018.00	3658.00	3335.00	3051.00	2798.00	2571.00	2361.00
2168.00	1993.00	1835.00	1689.00	1560.00	1440.00	1327.00	1224.00
1121.00	1031.00	953.00	879.00	808.00	741.00	678.00	627.00
585.00	539.00	497.00	444.00	403.00	356.00	277.00	116.00
80.00	60.00	46.00	36.00	28.00			

TIME OF INFLOW HYDROGRAPH ORDINATES

.0000	.5000	1.0000	1.5000	2.0000	2.5000	3.0000	3.5000
4.0000	4.5000	5.0000	5.5000	6.0000	6.5000	7.0000	7.5000
8.0000	8.5000	9.0000	9.5000	10.0000	10.5000	11.0000	11.5000
12.0000	12.5000	13.0000	13.5000	14.0000	14.5000	15.0000	15.5000
16.0000	16.5000	17.0000	17.5000	18.0000	18.5000	19.0000	19.5000
20.0000	20.5000	21.0000	21.5000	22.0000	22.5000	23.0000	23.5000
24.0000	24.5000	25.0000	25.5000	26.0000	26.5000	27.0000	27.5000
28.0000	28.5000	29.0000	29.5000	30.0000	30.5000	31.0000	31.5000
32.0000	32.5000	33.0000	33.5000	34.0000	34.5000	35.0000	35.5000
36.0000	36.5000	37.0000	37.5000	38.0000			

CROSS-SECTIONAL PARAMETERS FOR LAKE HENRY
BELOW LAKE HENRY DAM

PARAMETER *****	VARIABLE *****	VALUE *****
NUMBER OF CROSS-SECTIONS	NS	5
MAXIMUM NUMBER OF TOP WIDTHS	NCS	8
NUMBER OF CROSS-SECTIONAL HYDROGRAPHS TO PLOT	NTT	5
TYPE OF OUTPUT OTHER THAN HYDROGRAPH PLOTS	JNK	4
CROSS-SECTIONAL SMOOTHING PARAMETER	KSA	0
DOWNSTREAM SUPERCRITICAL OR NOT	KSUPC	0
NO. OF LATERAL INFLOW HYDROGRAPHS	LQ	0
NO. OF POINTS IN GATE CONTROL CURVE	KCG	0

NUMBER OF CROSS-SECTION WHERE HYDROGRAPH DESIRED
(MAX NUMBER OF HYDROGRAPHS = 6)

1 2 3 4 5

CROSS-SECTIONAL VARIABLES FOR LAKE HENRY
BELOW LAKE HENRY DAM

PARAMETER	UNITS	VARIABLE
*****	*****	*****
LOCATION OF CROSS-SECTION	MILE	XS(I)
ELEVATION(MSL) OF FLOODING AT CROSS-SECTION	FEET	FSTG(I)
ELEV CORRESPONDING TO EACH TOP WIDTH	FEET	HS(K,I)
TOP WIDTH CORRESPONDING TO EACH ELEV	FEET	BS(K,I)
(ACTIVE FLOW PORTION)		
TOP WIDTH CORRESPONDING TO EACH ELEV	FEET	BSS(K,I)
(OFF-CHANNEL PORTION)		
NUMBER OF CROSS-SECTION		I
NUMBER OF ELEVATION LEVEL		K

1

CROSS-SECTION NUMBER 1

XS(I) = .000 FSTG(I) = .00

HS ...	1249.0	1260.0	1270.0	1280.0	1290.0	1300.0	1310.0	1320.0
BS ...	.0	220.0	435.0	570.0	710.0	850.0	920.0	1527.0
BSS ...	.0	.0	.0	.0	.0	.0	.0	.0

CROSS-SECTION NUMBER 2

XS(I) = 1.020 FSTG(I) = 1229.50

HS ...	1229.0	1230.0	1240.0	1250.0	1260.0	1270.0	1280.0	1290.0
BS ...	.0	40.0	700.0	840.0	920.0	1040.0	1200.0	1720.0
BSS ...	.0	.0	.0	.0	.0	.0	.0	.0

CROSS-SECTION NUMBER 3

XS(I) = 2.920 FSTG(I) = 1208.50

HS ...	1208.0	1210.0	1220.0	1230.0	1240.0	1250.0	1260.0	1270.0
BS ...	.0	1080.0	1340.0	1400.0	1220.0	1740.0	1860.0	2080.0
BSS ...	.0	.0	.0	.0	.0	.0	.0	.0

CROSS-SECTION NUMBER 4

XS(I) = 3.420 FSTG(I) = 1199.50

HS	...	1199.0	1200.0	1210.0	1220.0	1230.0	1240.0	1250.0	1270.0
BS	...	.0	80.0	980.0	1080.0	1140.0	1200.0	1300.0	1560.0
BSS	...	.0	.0	.0	.0	.0	.0	.0	.0

1

CROSS-SECTION NUMBER 5

XS(I) = 4.420 FSTG(I) = 1179.00

HS	...	1178.0	1180.0	1190.0	1200.0	1210.0	1220.0	1230.0	1250.0
BS	...	.0	140.0	2320.0	2440.0	2520.0	2680.0	2800.0	3360.0
BSS	...	.0	.0	.0	.0	.0	.0	.0	.0

1

MANNING N ROUGHNESS COEFFICIENTS FOR THE GIVEN REACHES
 (CM(K,I),K=1,NCS) WHERE I = REACH NUMBER

REACH	1	...	.080	.080	.080	.080	.080	.080	.080	.000
REACH	2	...	.080	.080	.080	.080	.080	.080	.080	.000
REACH	3	...	.080	.080	.080	.080	.080	.080	.080	.000
REACH	4	...	.080	.080	.080	.080	.080	.080	.080	.000

1

CROSS-SECTIONAL VARIABLES FOR LAKE HENRY
 BELOW LAKE HENRY DAM

PARAMETER	UNITS	VARIABLE
*****	*****	*****
MINIMUM COMPUTATIONAL DISTANCE USED BETWEEN CROSS-SECTIONS	MILE	DXM(I)
CONTRACTION - EXPANSION COEFFICIENTS BETWEEN CROSS-SECTIONS		FKC(I)

REACH NUMBER *****	DXM(I) *****	FKC(I) *****
1	.080	.000
2	.080	.000
3	.080	.000
4	.080	.000

1

DOWNSTREAM FLOW PARAMETERS FOR LAKE HENRY
BELOW LAKE HENRY DAM

PARAMETER *****	UNITS *****	VARIABLE *****	VALUE *****
MAX DISCHARGE AT DOWNSTREAM EXTREMITY	CFS	QMAXD	.0
MAX LATERAL OUTFLOW PRODUCING LOSSES	CFS /FEET	QLL	.000
INITIAL SIZE OF TIME STEP	HOURL	DTHM	.0000
DOWNSTREAM BOUNDARY PARAMETER	FEET	YDN	.000000
SLOPE OF CHANNEL DOWNSTREAM OF DAM	FPM	SOM	.00
THETA WEIGHTING FACTOR		THETA	.00
CONVERGENCE CRITERION FOR STAGE	FEET	EPSY	.000000
TIME AT WHICH DAM STARTS TO FAIL	HOURL	TFI	.00

AT REACH= 2 DXM SHOULD BE CHANGED TO .018 DUE TO EXP/CONTRACT CRITERIA
AT REACH= 3 DXM SHOULD BE CHANGED TO .009 DUE TO EXP/CONTRACT CRITERIA
AT REACH= 2 DXM SHOULD BE CHANGED TO .000 DUE TO (WAVE SPEED * DT) CRITERIA
AT REACH= 3 DXM SHOULD BE CHANGED TO .000 DUE TO (WAVE SPEED * DT) CRITERIA
AT REACH= 4 DXM SHOULD BE CHANGED TO .000 DUE TO (WAVE SPEED * DT) CRITERIA

COMPUTATIONS WILL USE THE FOLLOWING DXM VALUES

101.000 .080 .080 .080

TOTAL NUMBER OF CROSS SECTIONS (ORIGINAL+INTERPOLATED) (N) = 43 (MAXIMUM ALLOWABLE = 200

```

*****
*****
***          ***
*** SUMMARY OF OUTPUT DATA ***
***          ***
*****
*****

```

1

CROSS-SECTION		BOTTOM		REACH			
NO.	MILE	ELEVATION		LENGTH	SLOPE		MESSAGE
		FEET	REACH NO.	MILE	FPM		
1	.00	1249.00					
2	1.02	1229.00	1	1.02	19.61		
3	2.92	1208.00	2	1.90	11.05		
4	3.42	1199.00	3	.50	18.00		
5	4.42	1178.00	4	1.00	21.00		

RE-NUMBERED VALUES FOR IDAM

IDAM(1) = 1

INITIAL CONDITIONS

I=	1	X=	.000	YN=	1249.87	DEPN=	.87	YC=	1249.44	DEPC=	.44	IFR=	0	ITN=	14	ITC=	14
I=	2	X=	1.020	YN=	1229.75	DEPN=	.75	YC=	1229.33	DEPC=	.33	IFR=	0	ITN=	13	ITC=	13
I=	3	X=	1.103	YN=	1228.66	DEPN=	.58	YC=	1228.34	DEPC=	.25	IFR=	0	ITN=	13	ITC=	13
I=	4	X=	1.185	YN=	1227.67	DEPN=	.50	YC=	1227.39	DEPC=	.21	IFR=	0	ITN=	13	ITC=	13
I=	5	X=	1.268	YN=	1226.71	DEPN=	.45	YC=	1226.45	DEPC=	.19	IFR=	0	ITN=	13	ITC=	13
I=	6	X=	1.350	YN=	1225.77	DEPN=	.42	YC=	1225.52	DEPC=	.18	IFR=	0	ITN=	13	ITC=	13
I=	7	X=	1.433	YN=	1224.83	DEPN=	.40	YC=	1224.60	DEPC=	.17	IFR=	0	ITN=	13	ITC=	13
I=	8	X=	1.516	YN=	1223.90	DEPN=	.38	YC=	1223.68	DEPC=	.16	IFR=	0	ITN=	13	ITC=	13
I=	9	X=	1.598	YN=	1222.97	DEPN=	.36	YC=	1222.76	DEPC=	.15	IFR=	0	ITN=	13	ITC=	13
I=	10	X=	1.681	YN=	1222.05	DEPN=	.36	YC=	1221.84	DEPC=	.15	IFR=	0	ITN=	13	ITC=	13
I=	11	X=	1.763	YN=	1221.12	DEPN=	.34	YC=	1220.93	DEPC=	.15	IFR=	0	ITN=	13	ITC=	13
I=	12	X=	1.846	YN=	1220.20	DEPN=	.33	YC=	1220.01	DEPC=	.14	IFR=	0	ITN=	13	ITC=	13

I=	13	X=	1.929	YN=	1219.28	DEPN=	.33	YC=	1219.10	DEPC=	.14	IFR=	0	ITN=	13	ITC=	13
I=	14	X=	2.011	YN=	1218.36	DEPN=	.32	YC=	1218.17	DEPC=	.13	IFR=	0	ITN=	13	ITC=	13
I=	15	X=	2.094	YN=	1217.45	DEPN=	.32	YC=	1217.26	DEPC=	.13	IFR=	0	ITN=	13	ITC=	13
I=	16	X=	2.177	YN=	1216.53	DEPN=	.31	YC=	1216.35	DEPC=	.13	IFR=	0	ITN=	13	ITC=	13
I=	17	X=	2.259	YN=	1215.61	DEPN=	.30	YC=	1215.43	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	18	X=	2.342	YN=	1214.70	DEPN=	.31	YC=	1214.52	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	19	X=	2.424	YN=	1213.78	DEPN=	.30	YC=	1213.60	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	20	X=	2.507	YN=	1212.86	DEPN=	.30	YC=	1212.69	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	21	X=	2.590	YN=	1211.94	DEPN=	.29	YC=	1211.77	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	22	X=	2.672	YN=	1211.03	DEPN=	.29	YC=	1210.86	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	23	X=	2.755	YN=	1210.12	DEPN=	.29	YC=	1209.94	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	24	X=	2.837	YN=	1209.20	DEPN=	.28	YC=	1209.03	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	25	X=	2.920	YN=	1208.26	DEPN=	.26	YC=	1208.12	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	26	X=	3.003	YN=	1206.77	DEPN=	.27	YC=	1206.62	DEPC=	.12	IFR=	0	ITN=	13	ITC=	13
I=	27	X=	3.087	YN=	1205.28	DEPN=	.28	YC=	1205.13	DEPC=	.13	IFR=	0	ITN=	14	ITC=	14
I=	28	X=	3.170	YN=	1203.79	DEPN=	.29	YC=	1203.63	DEPC=	.13	IFR=	0	ITN=	14	ITC=	14
I=	29	X=	3.253	YN=	1202.32	DEPN=	.32	YC=	1202.14	DEPC=	.14	IFR=	0	ITN=	14	ITC=	14
I=	30	X=	3.337	YN=	1200.87	DEPN=	.37	YC=	1200.67	DEPC=	.17	IFR=	0	ITN=	14	ITC=	14
I=	31	X=	3.420	YN=	1199.51	DEPN=	.51	YC=	1199.25	DEPC=	.25	IFR=	0	ITN=	14	ITC=	14
I=	32	X=	3.503	YN=	1197.77	DEPN=	.52	YC=	1197.50	DEPC=	.25	IFR=	0	ITN=	14	ITC=	14
I=	33	X=	3.587	YN=	1196.02	DEPN=	.52	YC=	1195.75	DEPC=	.25	IFR=	0	ITN=	14	ITC=	14
I=	34	X=	3.670	YN=	1194.27	DEPN=	.52	YC=	1194.00	DEPC=	.25	IFR=	0	ITN=	14	ITC=	14
I=	35	X=	3.753	YN=	1192.52	DEPN=	.52	YC=	1192.25	DEPC=	.25	IFR=	0	ITN=	14	ITC=	14
I=	36	X=	3.837	YN=	1190.78	DEPN=	.53	YC=	1190.51	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	37	X=	3.920	YN=	1189.03	DEPN=	.53	YC=	1188.76	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	38	X=	4.003	YN=	1187.28	DEPN=	.53	YC=	1187.01	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	39	X=	4.087	YN=	1185.54	DEPN=	.54	YC=	1185.26	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	40	X=	4.170	YN=	1183.79	DEPN=	.54	YC=	1183.51	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	41	X=	4.253	YN=	1182.04	DEPN=	.54	YC=	1181.76	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	42	X=	4.337	YN=	1180.29	DEPN=	.54	YC=	1180.01	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14
I=	43	X=	4.420	YN=	1178.54	DEPN=	.54	YC=	1178.26	DEPC=	.26	IFR=	0	ITN=	14	ITC=	14

(IFR(I), I=1,N)

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0							

IN=	43	YNN=	1178.54	DEP=	.54				
I=	42	X=	4.337	QIL=	5.	YIL=	1180.29	DEP=	.54
I=	41	X=	4.253	QIL=	5.	YIL=	1182.04	DEP=	.54
I=	40	X=	4.170	QIL=	5.	YIL=	1183.79	DEP=	.54
I=	39	X=	4.087	QIL=	5.	YIL=	1185.53	DEP=	.53
I=	38	X=	4.003	QIL=	5.	YIL=	1187.28	DEP=	.53
I=	37	X=	3.920	QIL=	5.	YIL=	1189.03	DEP=	.53
I=	36	X=	3.837	QIL=	5.	YIL=	1190.78	DEP=	.53
I=	35	X=	3.753	QIL=	5.	YIL=	1192.53	DEP=	.53
I=	34	X=	3.670	QIL=	5.	YIL=	1194.27	DEP=	.52
I=	33	X=	3.587	QIL=	5.	YIL=	1196.02	DEP=	.52
I=	32	X=	3.503	QIL=	5.	YIL=	1197.77	DEP=	.52

ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5
ITB=	5

I=	31	X=	3.420	QIL=	5.	YIL=	1199.51	DEP=	.51	ITB=	5
I=	30	X=	3.337	QIL=	5.	YIL=	1200.89	DEP=	.39	ITB=	5
I=	29	X=	3.253	QIL=	5.	YIL=	1202.31	DEP=	.31	ITB=	5
I=	28	X=	3.170	QIL=	5.	YIL=	1203.80	DEP=	.30	ITB=	5
I=	27	X=	3.087	QIL=	5.	YIL=	1205.27	DEP=	.27	ITB=	5
I=	26	X=	3.003	QIL=	5.	YIL=	1206.77	DEP=	.27	ITB=	5
I=	25	X=	2.920	QIL=	5.	YIL=	1208.25	DEP=	.25	ITB=	6
I=	24	X=	2.837	QIL=	5.	YIL=	1209.22	DEP=	.31	ITB=	6
I=	23	X=	2.755	QIL=	5.	YIL=	1210.09	DEP=	.27	ITB=	6
I=	22	X=	2.672	QIL=	5.	YIL=	1211.04	DEP=	.30	ITB=	6
I=	21	X=	2.590	QIL=	5.	YIL=	1211.93	DEP=	.28	ITB=	6
I=	20	X=	2.507	QIL=	5.	YIL=	1212.87	DEP=	.31	ITB=	6
I=	19	X=	2.424	QIL=	5.	YIL=	1213.77	DEP=	.29	ITB=	6
I=	18	X=	2.342	QIL=	5.	YIL=	1214.70	DEP=	.31	ITB=	6
I=	17	X=	2.259	QIL=	5.	YIL=	1215.61	DEP=	.30	ITB=	6
I=	16	X=	2.177	QIL=	5.	YIL=	1216.53	DEP=	.32	ITB=	5
I=	15	X=	2.094	QIL=	5.	YIL=	1217.44	DEP=	.31	ITB=	6
I=	14	X=	2.011	QIL=	5.	YIL=	1218.37	DEP=	.32	ITB=	5
I=	13	X=	1.929	QIL=	5.	YIL=	1219.28	DEP=	.33	ITB=	5
I=	12	X=	1.846	QIL=	5.	YIL=	1220.21	DEP=	.34	ITB=	5
I=	11	X=	1.763	QIL=	5.	YIL=	1221.13	DEP=	.34	ITB=	5
I=	10	X=	1.681	QIL=	5.	YIL=	1222.05	DEP=	.35	ITB=	5
I=	9	X=	1.598	QIL=	5.	YIL=	1222.97	DEP=	.36	ITB=	5
I=	8	X=	1.516	QIL=	5.	YIL=	1223.90	DEP=	.38	ITB=	5
I=	7	X=	1.433	QIL=	5.	YIL=	1224.83	DEP=	.40	ITB=	5
I=	6	X=	1.350	QIL=	5.	YIL=	1225.77	DEP=	.42	ITB=	5
I=	5	X=	1.268	QIL=	5.	YIL=	1226.71	DEP=	.45	ITB=	5
I=	4	X=	1.185	QIL=	5.	YIL=	1227.67	DEP=	.49	ITB=	5
I=	3	X=	1.103	QIL=	5.	YIL=	1228.65	DEP=	.57	ITB=	5
I=	2	X=	1.020	QIL=	5.	YIL=	1229.72	DEP=	.72	ITB=	5
I=	1	X=	.000	QIL=	5.	YIL=	1290.00	DEP=	41.00	ITB=	0

INITIAL CONDITIONS

(QDI(I), I=1,N)							
5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.

```

      (YI(I), I=1,N)
1290.00  1229.72  1228.65  1227.67  1226.71  1225.77  1224.83  1223.90
1222.97  1222.05  1221.13  1220.21  1219.28  1218.37  1217.44  1216.53
1215.61  1214.70  1213.77  1212.87  1211.93  1211.04  1210.09  1209.22
1208.25  1206.77  1205.27  1203.80  1202.31  1200.89  1199.51  1197.77
1196.02  1194.27  1192.53  1190.78  1189.03  1187.28  1185.53  1183.79
1182.04  1180.29  1178.54

1
0  PROFILE OF INVERT ELEVATION (HS) AND INITIAL WATER SURFACE ELEVATION (YI) ALONG WATERWAY (X)
      X(MILES)      HST(FEET)  -- "*"      YI(FEET)  -- "+"
0
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S      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
T      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
A      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
N      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
C      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
E      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
      +      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .      .
1178.0  1189.2  1200.4  1211.6  1222.8  1234.0  1245.2  1256.4  1267.6  1278.8  1290.0
0
      ELEVATION

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ROUTING COMPLETED.

KTIME= 309 ALLOWABLE KTIME= 699 TT= 38.1

1

PROFILE OF CRESTS AND TIMES FOR LAKE HENRY
BELOW LAKE HENRY DAM

DISTANCE FROM DAM MILE *****	MAX ELEV FEET *****	MAX FLOW CFS *****	TIME MAX ELEV-HRS *****	MAX VEL FPS *****	FLOOD ELEV FEET *****	TIME FLOOD ELEV-HRS *****
.000	1300.44	86204	9.550	4.30	.00	.00
1.020	1251.07	86204	9.970	7.00	1229.50	.00
1.103	1249.52	83928	10.000	6.85	1228.59	.00
1.185	1247.97	82134	10.000	6.70	1227.67	.00
1.268	1246.41	81434	10.030	6.56	1226.76	1.10
1.350	1244.95	80168	10.030	6.44	1225.85	1.65
1.433	1243.47	78585	10.030	6.34	1224.93	2.20
1.516	1242.06	77933	10.060	6.22	1224.02	2.20
1.598	1240.64	76835	10.060	6.10	1223.11	2.75
1.681	1239.27	75721	10.090	6.01	1222.20	2.75
1.763	1237.90	74933	10.090	5.90	1221.28	3.30
1.846	1236.58	73788	10.120	5.79	1220.37	3.30
1.929	1235.25	73119	10.150	5.71	1219.46	3.85
2.011	1233.96	72122	10.150	5.61	1218.54	3.85
2.094	1232.67	71466	10.180	5.52	1217.63	4.40
2.177	1231.41	70599	10.180	5.44	1216.72	4.40
2.259	1230.16	69938	10.210	5.35	1215.80	4.95
2.342	1228.92	69171	10.240	5.27	1214.89	4.95
2.424	1227.72	68457	10.240	5.18	1213.98	4.95
2.507	1226.54	67717	10.270	5.10	1213.07	5.50
2.590	1225.41	66877	10.300	5.01	1212.15	5.50
2.672	1224.33	66076	10.330	4.91	1211.24	6.05
2.755	1223.33	65106	10.360	4.77	1210.33	6.05
2.837	1222.41	64135	10.360	4.59	1209.41	6.05
2.920	1221.59	63208	10.390	4.34	1208.50	6.60
3.003	1220.76	62415	10.390	4.35	1207.00	6.60
3.087	1219.89	61829	10.420	4.39	1205.50	6.60
3.170	1218.95	61406	10.420	4.51	1204.00	6.60
3.253	1217.88	61110	10.420	4.75	1202.50	7.15
3.337	1216.56	60964	10.450	5.19	1201.00	6.60
3.420	1214.60	60793	10.450	6.12	1199.50	.00
3.503	1212.41	60719	10.480	5.82	1197.79	6.60
3.587	1210.28	60549	10.480	5.55	1196.08	7.15
3.670	1208.20	60449	10.510	5.33	1194.38	7.15
3.753	1206.17	60264	10.510	5.13	1192.67	7.15
3.837	1204.18	60138	10.540	4.95	1190.96	7.70
3.920	1202.21	59958	10.570	4.79	1189.25	7.70
4.003	1200.27	59764	10.570	4.65	1187.54	7.70
4.087	1198.35	59600	10.600	4.52	1185.83	7.70
4.170	1196.45	59386	10.630	4.40	1184.13	7.70
4.253	1194.56	59155	10.630	4.30	1182.42	8.25
4.337	1192.67	58954	10.660	4.21	1180.71	8.25
4.420	1190.77	58666	10.690	4.17	1179.00	8.25

MILES

ELEV	FEET	MILE
100	100	100
200	200	200
300	300	300
400	400	400
500	500	500
600	600	600
700	700	700
800	800	800
900	900	900
1000	1000	1000
1100	1100	1100
1200	1200	1200
1300	1300	1300
1400	1400	1400
1500	1500	1500
1600	1600	1600
1700	1700	1700
1800	1800	1800
1900	1900	1900
2000	2000	2000
2100	2100	2100
2200	2200	2200
2300	2300	2300
2400	2400	2400
2500	2500	2500
2600	2600	2600
2700	2700	2700
2800	2800	2800
2900	2900	2900
3000	3000	3000
3100	3100	3100
3200	3200	3200
3300	3300	3300
3400	3400	3400
3500	3500	3500
3600	3600	3600
3700	3700	3700
3800	3800	3800
3900	3900	3900
4000	4000	4000
4100	4100	4100
4200	4200	4200
4300	4300	4300
4400	4400	4400
4500	4500	4500
4600	4600	4600
4700	4700	4700
4800	4800	4800
4900	4900	4900
5000	5000	5000
5100	5100	5100
5200	5200	5200
5300	5300	5300
5400	5400	5400
5500	5500	5500
5600	5600	5600
5700	5700	5700
5800	5800	5800
5900	5900	5900
6000	6000	6000
6100	6100	6100
6200	6200	6200
6300	6300	6300
6400	6400	6400
6500	6500	6500
6600	6600	6600
6700	6700	6700
6800	6800	6800
6900	6900	6900
7000	7000	7000
7100	7100	7100
7200	7200	7200
7300	7300	7300
7400	7400	7400
7500	7500	7500
7600	7600	7600
7700	7700	7700
7800	7800	7800
7900	7900	7900
8000	8000	8000
8100	8100	8100
8200	8200	8200
8300	8300	8300
8400	8400	8400
8500	8500	8500
8600	8600	8600
8700	8700	8700
8800	8800	8800
8900	8900	8900
9000	9000	9000
9100	9100	9100
9200	9200	9200
9300	9300	9300
9400	9400	9400
9500	9500	9500
9600	9600	9600
9700	9700	9700
9800	9800	9800
9900	9900	9900
10000	10000	10000

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1244.95.

1237.90.

1231.41.

1225.41.

1220.76.

1214.60.

.1251.1 1.0

.1249.5 1.1

.1248.0 1.2

.1246.4 1.3

.1245.0 1.4

.1243.5 1.4

.1242.1 1.5

.1240.6 1.6

.1239.3 1.7

.1237.9 1.8

.1236.6 1.8

.1235.2 1.9

.1234.0 2.0

.1232.7 2.1

.1231.4 2.2

.1230.2 2.3

.1228.9 2.3

.1227.7 2.4

.1226.5 2.5

.1225.4 2.6

.1224.3 2.7

.1223.3 2.8

.1222.4 2.8

.1221.6 2.9

.1220.8 3.0

.1219.9 3.1

.1219.0 3.2

.1217.9 3.3

.1216.6 3.3

.1214.6 3.4

.1212.4 3.5

.1210.3 3.6

.1208.2 3.7

PEAK DISCHARGE PROFILE

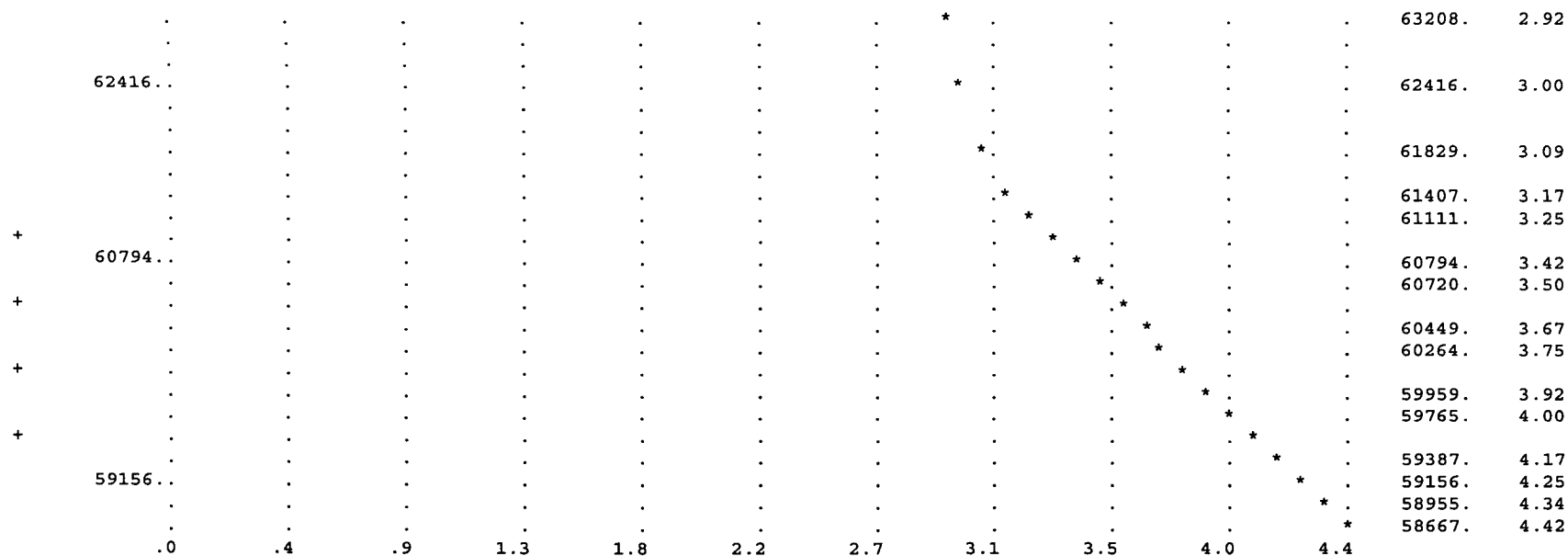
MILES

DISCHARGE
CFS MILE

[illegible]

D
I
S
C
H
A
R
G
E

74934..	*	74934.	1.76
	*	73788.	1.85
	*	73119.	1.93
	*	72123.	2.01
	*	71466.	2.09
70600..	*	70600.	2.18
	*	69939.	2.26
	*	69172.	2.34
	*	68457.	2.42
	*	67717.	2.51
66877..	*	66877.	2.59
	*	66077.	2.67
	*	65106.	2.75
	*	64135.	2.84



TIME TO PEAK ELEVATION PROFILE

MILES

												HOUR	MILE	ELEV
	.0	.4	.9	1.3	1.8	2.2	2.7	3.1	3.5	4.0	4.4			
0	10.69.	.	.	.	.	.	.	.	.	.	*	10.7	4.4	
+	.	.	.	.	.	.	.	.	.	.	*	10.7	4.3	1190.8
+	.	.	.	.	.	.	.	.	.	.	.	.	.	1192.7
+	.	.	.	.	.	.	.	.	.	.	*	10.6	4.3	1194.6
+	.	.	.	.	.	.	.	.	.	.	*	10.6	4.1	1198.3
+	10.57.	.	.	.	.	.	.	.	.	*	.	10.6	4.0	1200.3
+	.	.	.	.	.	.	.	.	.	*	.	10.5	3.8	1204.2
+	.	.	.	.	.	.	.	.	.	*	.	10.5	3.8	1206.2
+	.	.	.	.	.	.	.	.	.	.	.	.	.	

MILES

28

29

+	.	.	.	*	.	.	.	.	.	.	.
+	.	.	.	*	.	.	.	.	.	.	.
+	.	.	.	*	.	.	.	.	.	.	.
+	*	.	.	.	.	.	.	.	.	.	.
1	.0	.4	.9	1.3	1.8	2.2	2.7	3.1	3.5	4.0	4.4

DISCHARGE HYDROGRAPH FOR LAKE HENRY ... STATION NUMBER 1
BELOW LAKE HENRY DAM AT MILE .00

GAGE ZERO = 1249.00 FEET MAX ELEVATION REACHED BY FLOOD WAVE = 1300.44 FEET
FLOOD STAGE NOT AVAILABLE

MAX STAGE = 51.44 FEET AT TIME = 9.550 HOURS
MAX FLOW = 86204 CFS AT TIME = 9.970 HOURS

TIME HR	STAGE FEET	FLOW CFS	0	20000	40000	60000	80000	100000
0	41.0	5	*	.	.	.	.	.
1	41.0	13	*	.	.	.	.	.
2	41.2	36	*	.	.	.	.	.
3	41.5	86	*	.	.	.	.	.
4	41.9	178	*	.	.	.	.	.
5	42.6	390	*	.	.	.	.	.
6	43.5	782	*	.	.	.	.	.
7	44.7	1393	.*	.	.	.	.	.
8	46.4	3118	.*	.	.	.	.	.
9	49.6	8207	.*	.	.	.	.	.
10	45.6	80907	.	.	.	.	*	.
11	35.0	40037	.	.	*	.	.	.
12	33.7	36205	.	.	*	.	.	.
13	30.6	27628	.	.	*	.	.	.
14	27.8	20605	.	*	.	.	.	.
15	25.3	15317	.	*	.	.	.	.
16	23.3	11464	.	*	.	.	.	.
17	21.7	8824	.	*	.	.	.	.
18	20.5	6972	.	*	.	.	.	.
19	19.6	5699	.	*	.	.	.	.
20	18.8	4690	.	*	.	.	.	.
21	18.2	3878	.	*	.	.	.	.
22	17.6	3236	.	*	.	.	.	.
23	17.1	2727	.*	.	.	.	.	.
24	16.7	2308	.*	.	.	.	.	.
25	16.3	1957	.*	.	.	.	.	.
26	16.0	1665	.*	.	.	.	.	.
27	15.7	1423	.*	.	.	.	.	.
28	15.4	1211	.*	.	.	.	.	.
29	15.2	1029	.*	.	.	.	.	.
30	15.0	878	*	.	.	.	.	.
31	14.8	744	*	.	.	.	.	.
32	14.6	636	*	.	.	.	.	.
33	14.4	546	*	.	.	.	.	.
34	14.3	456	*	.	.	.	.	.
35	14.1	357	*	.	.	.	.	.
36	13.7	188	*	.	.	.	.	.
37	13.5	102	*	.	.	.	.	.

1

DISCHARGE HYDROGRAPH FOR LAKE HENRY
BELOW LAKE HENRY DAM

... STATION NUMBER 2
AT MILE 1.02

GAGE ZERO = 1229.00 FEET MAX ELEVATION REACHED BY FLOOD WAVE = 1251.07 FEET

FLOOD STAGE = .50 FEET
MAX STAGE = 22.07 FEET AT TIME = 9.970 HOURS
MAX FLOW = 86204 CFS AT TIME = 9.970 HOURS

TIME HR	STAGE FEET	FLOW CFS	0	20000	40000	60000	80000	100000
0	.7	5	*	.	.	.	.	.
1	1.0	13	*	.	.	.	.	.
2	1.5	36	*	.	.	.	.	.
3	1.9	86	*	.	.	.	.	.
4	2.5	178	*	.	.	.	.	.
5	3.2	390	*	.	.	.	.	.
6	4.1	782	*	.	.	.	.	.
7	5.0	1393	.*	.	.	.	.	.
8	6.6	3118	.*	.	.	.	.	.
9	9.5	8207	.*	.	.	.	.	.
10	22.0	80907	.	.	.	.	*	.
11	16.8	40037	.	.	*	.	.	.
12	16.2	36205	.	.	*	.	.	.
13	14.7	27628	.	.	*	.	.	.
14	13.2	20605	.	*	.	.	.	.
15	12.0	15317	.	*	.	.	.	.
16	10.9	11464	.	*	.	.	.	.
17	9.9	8824	.	*	.	.	.	.
18	9.1	6972	.	*	.	.	.	.
19	8.4	5699	.	*	.	.	.	.
20	7.8	4690	.	*	.	.	.	.
21	7.3	3878	.	*	.	.	.	.
22	6.9	3236	.	*	.	.	.	.
23	6.5	2727	.*	.	.	.	.	.
24	6.1	2308	.*	.	.	.	.	.
25	5.7	1957	.*	.	.	.	.	.
26	5.4	1665	.*	.	.	.	.	.
27	5.1	1423	.*	.	.	.	.	.
28	4.8	1211	.*	.	.	.	.	.
29	4.6	1029	.*	.	.	.	.	.
30	4.3	878	*	.	.	.	.	.
31	4.1	744	*	.	.	.	.	.
32	3.9	636	*	.	.	.	.	.
33	3.7	546	*	.	.	.	.	.
34	3.5	456	*	.	.	.	.	.
35	3.2	357	*	.	.	.	.	.
36	2.6	188	*	.	.	.	.	.
37	2.1	102	*	.	.	.	.	.

DISCHARGE HYDROGRAPH FOR LAKE HENRY
BELOW LAKE HENRY DAM

... STATION NUMBER 25
AT MILE 2.92

GAGE ZERO = 1208.00 FEET MAX ELEVATION REACHED BY FLOOD WAVE = 1221.59 FEET

FLOOD STAGE = .50 FEET

MAX STAGE = 13.59 FEET AT TIME = 10.390 HOURS

MAX FLOW = 63208 CFS AT TIME = 10.300 HOURS

TIME	STAGE	FLOW						
HR	FEET	CFS	0	20000	40000	60000	80000	100000
0	.3	5	*	.	.	.	.	.
1	.3	5	*	.	.	.	.	.
2	.3	5	*	.	.	.	.	.
3	.3	5	*	.	.	.	.	.
4	.3	5	*	.	.	.	.	.
5	.3	5	*	.	.	.	.	.
6	.4	18	*	.	.	.	.	.
7	1.1	269	*	.	.	.	.	.
8	1.9	1111	.*	.	.	.	.	.
9	2.9	3241	.*	.	.	.	.	.
10	7.5	25093	.	.	*	.	.	.
11	11.6	43576	.	.	.	*	.	.
12	10.8	38804	.	.	.	*	.	.
13	9.8	31494	.	.	*	.	.	.
14	8.5	24049	.	.	*	.	.	.
15	7.2	18245	.	.	*	.	.	.
16	6.2	13816	.	.	*	.	.	.
17	5.3	10582	.	.	*	.	.	.
18	4.6	8314	.	.	*	.	.	.
19	4.1	6696	.	.	*	.	.	.
20	3.7	5536	.	.	*	.	.	.
21	3.4	4603	.	.	*	.	.	.
22	3.1	3848	.	.	*	.	.	.
23	2.9	3244	.	.	*	.	.	.
24	2.7	2759	.	.	*	.	.	.
25	2.6	2357	.	.	*	.	.	.
26	2.4	2018	.	.	*	.	.	.
27	2.3	1734	.	.	*	.	.	.
28	2.2	1496	.	.	*	.	.	.
29	2.1	1290	.	.	*	.	.	.
30	2.0	1112	.	.	*	.	.	.
31	1.9	960	*	.	.	.	.	.
32	1.8	829	*	.	.	.	.	.
33	1.7	718	*	.	.	.	.	.
34	1.6	626	*	.	.	.	.	.
35	1.5	545	*	.	.	.	.	.
36	1.4	467	*	.	.	.	.	.
37	1.3	384	*	.	.	.	.	.

DISCHARGE HYDROGRAPH FOR LAKE HENRY
BELOW LAKE HENRY DAM

... STATION NUMBER 31
AT MILE 3.42

GAGE ZERO = 1199.00 FEET MAX ELEVATION REACHED BY FLOOD WAVE = 1214.60 FEET

FLOOD STAGE = .50 FEET
MAX STAGE = 15.60 FEET AT TIME = 10.450 HOURS
MAX FLOW = 60794 CFS AT TIME = 10.420 HOURS

TIME HR	STAGE FEET	FLOW CFS	0	20000	40000	60000	80000	100000
0	.5	5	*	.	.	.	.	.
1	.5	5	*	.	.	.	.	.
2	.5	5	*	.	.	.	.	.
3	.5	5	*	.	.	.	.	.
4	.5	5	*	.	.	.	.	.
5	.5	5	*	.	.	.	.	.
6	.5	5	*	.	.	.	.	.
7	1.0	39	*	.	.	.	.	.
8	2.9	601	*	.	.	.	.	.
9	4.9	2271	.*	.	.	.	.	.
10	8.9	12326	.	*	.	.	.	.
11	14.2	45620	.	.	.	*	.	.
12	13.4	39220	.	.	*	.	.	.
13	12.6	32506	.	.	*	.	.	.
14	11.6	25002	.	.	*	.	.	.
15	10.7	19153	.	*	.	.	.	.
16	9.7	14582	.	*	.	.	.	.
17	8.8	11187	.	*	.	.	.	.
18	8.0	8779	.	*	.	.	.	.
19	7.4	7049	.	*	.	.	.	.
20	6.9	5816	.	*	.	.	.	.
21	6.5	4844	.	*	.	.	.	.
22	6.1	4053	.	*	.	.	.	.
23	5.7	3416	.	*	.	.	.	.
24	5.4	2904	.	*	.	.	.	.
25	5.1	2484	.	*	.	.	.	.
26	4.8	2129	.	*	.	.	.	.
27	4.6	1831	.	*	.	.	.	.
28	4.3	1581	.	*	.	.	.	.
29	4.1	1368	.	*	.	.	.	.
30	3.9	1181	.	*	.	.	.	.
31	3.7	1022	.	*	.	.	.	.
32	3.5	885	.	*	.	.	.	.
33	3.3	770	.	*	.	.	.	.
34	3.2	670	.	*	.	.	.	.
35	3.0	586	.	*	.	.	.	.
36	2.9	510	.	*	.	.	.	.
37	2.7	433	.	*	.	.	.	.

DISCHARGE HYDROGRAPH FOR LAKE HENRY
BELOW LAKE HENRY DAM

... STATION NUMBER 43

AT MILE 4.42

GAGE ZERO = 1178.00 FEET MAX ELEVATION REACHED BY FLOOD WAVE = 1190.77 FEET

FLOOD STAGE = 1.00 FEET

MAX STAGE = 12.77 FEET AT TIME = 10.690 HOURS

MAX FLOW = 58667 CFS AT TIME = 10.660 HOURS

TIME HR	STAGE FEET	FLOW CFS	0	20000	40000	60000	80000	100000
0	.5	5	*	.	.	.	.	.
1	.5	5	*	.	.	.	.	.
2	.5	5	*	.	.	.	.	.
3	.5	5	*	.	.	.	.	.
4	.5	5	*	.	.	.	.	.
5	.5	5	*	.	.	.	.	.
6	.5	5	*	.	.	.	.	.
7	.5	5	*	.	.	.	.	.
8	1.2	60	*	.	.	.	.	.
9	3.5	876	*	.	.	.	.	.
10	5.7	4588	.	*	.	.	.	.
11	12.3	50507	.	.	*	.	.	.
12	11.4	39862	.	.	*	.	.	.
13	10.9	34525	.	.	*	.	.	.
14	10.1	27037	.	*	.	.	.	.
15	9.3	20869	.	*	.	.	.	.
16	8.5	16032	.	*	.	.	.	.
17	7.9	12329	.	*	.	.	.	.
18	7.3	9643	.	*	.	.	.	.
19	6.8	7712	.	*	.	.	.	.
20	6.4	6324	.	*	.	.	.	.
21	6.0	5275	.	*	.	.	.	.
22	5.7	4421	.	*	.	.	.	.
23	5.4	3726	.	*	.	.	.	.
24	5.2	3165	.	*	.	.	.	.
25	5.0	2709	*	.	.	.	.	.
26	4.7	2328	*	.	.	.	.	.
27	4.5	2005	*	.	.	.	.	.
28	4.4	1733	*	.	.	.	.	.
29	4.2	1503	*	.	.	.	.	.
30	4.0	1304	*	.	.	.	.	.
31	3.8	1131	*	.	.	.	.	.
32	3.7	983	*	.	.	.	.	.
33	3.6	855	*	.	.	.	.	.
34	3.4	746	*	.	.	.	.	.
35	3.3	653	*	.	.	.	.	.
36	3.2	574	*	.	.	.	.	.
37	3.0	499	*	.	.	.	.	.

Water Rights Division -DENR
Conversation or File Documentation

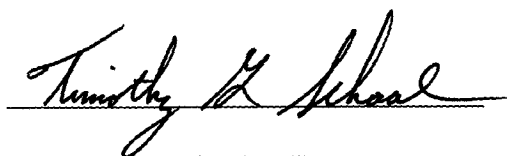
NAME OF PERSON OR FILE: Department of Game, Fish & Parks

ADDRESS: 523 E. Capitol Ave. Pierre, SD 57501 COUNTY: Bon Homme

DATE: May 17, 2002 TELEPHONE: (605) 773-3718

RE: Lake Henry Dam storage capacity

On May 17, 2002, I talked to Jeff Peters from GF&P about the storage capacity of Lake Henry Dam. We discussed that the amount of storage on the application should reflect that used in the reservoir routing analysis submitted by Banner Associates, Inc. on May 16, 2002. He agreed and I told him we would change the storage capacity of 1750 acre-feet listed on the application to 1769 acre-feet.

A handwritten signature in black ink, reading "Timothy G. Schaal", written over a horizontal line.

Timothy G. Schaal, P.E.
Natural Resources Engineer III
Water Rights Program

old dam	old dam	new preliminary
height	38 ft	45 ft.
storage	400 ac.ft	1750 ac.ft
top dam	1050 ac.ft	3000 ac.ft

Not sure old breach analysis will justify the spillway design flood between 10 & 50% PMF based on breach analysis of old dam. New dam 7 ft higher and 3 times more storage

Generally I am not comfortable with this report and application with all of the what "ifs" and should "bes"

John M. Selken
23 April 02

REPORT ON
WATER PERMIT APPLICATION No. 6315-3
Department of Game, Fish & Parks
May 17, 2002

Water Permit Application No. 6315-3 has been filed by the South Dakota Department of Game, Fish and Parks to impound 1769 acre-feet of water by reconstructing Lake Henry Dam (Scotland Dam). The dam will be located on Dawson Creek in the W 1/2 SW 1/4 of Section 10-T96N-R58W, in Bon Homme County. The water will be used for fish and wildlife propagation and recreational purposes.

Discussion:

Lake Henry Dam was originally constructed in 1937 by the Works Progress Administration (WPA). It was 38 feet high with a normal storage capacity of 400 acre-feet with the reservoir level at the primary spillway elevation, and a maximum storage capacity of 1050 acre-feet with the reservoir level at the top of dam elevation.

Lake Henry Dam was breached during the Fall of 1994. The primary spillway structure was undermined and near complete failure; the dam embankment was overgrown with large trees and had excessive seepage occurring through the embankment; and the reservoir was severely silted in. The Department of Game, Fish and Parks chose to breach the dam in order to assess the silt removal and dam repair options.

Banner Associates, Inc. developed preliminary plans in 1997 for the Lake Henry Dam Reconstruction/Relocation Project. This project involves constructing a new embankment about 1600 feet downstream of the existing dam. The preliminary plans and specifications are being reviewed with the understanding that final plans and specifications need to be approved before the project can be constructed. The new Lake Henry Dam will be 45 feet high with a normal storage capacity of 1769 acre-feet with the reservoir level at the primary spillway elevation, and a maximum storage capacity of 2947 acre-feet with the reservoir level at the top of dam elevation. The new dam will have a 60 foot wide concrete chute primary spillway and an earthcut secondary spillway at least 100 feet wide. The width of the secondary spillway may increase, depending on the need for additional fill material for the embankment.

The new Lake Henry Dam will be classified as an intermediate size, Significant Hazard Category 2 Dam. It has this classification because a paved road exists about one mile below the dam and there are several of Maxwell Colony's livestock buildings in the floodplain about five miles below the dam. Our Safety of Dams Rules, Chapter 74:02:08 require a dam of this size and hazard category to have a spillway capacity capable of passing 50 percent of the Probable Maximum Flood (PMF), unless it qualifies for the exception listed in 74:02:08:07.02. This exception states that unless the reservoir of a Category 2 dam serves as the sole water supply source for a water distribution system, the spillway design flood for a new or rebuilt intermediate size category 2 dam may be

lowered to a design flood between the 0.5 PMF and the 100-year design flood based upon a risk assessment.

Banner Associates, Inc. performed a breach analysis on the original embankment as part of their Feasibility Study dated July 1, 1990. The analysis indicated that flooding conditions in the lower reaches of the study area, near the Maxwell Colony at the confluence of Dawson Creek and the James River, would be essentially the same when comparing a 50 percent PMF event with a dam failure and without the dam in place. It was determined that the new Lake Henry Dam should have a spillway capacity capable of passing at least a 10 percent PMF event. An additional Breach Analysis will be required for the proposed structure; however, based on the size of the drainage area and the 50 percent PMF event, the results should be similar.

Lake Henry Dam will have a drainage area of 39.8 square miles. This drainage area produces approximately 40,000 cfs during a 50 percent PMF event and approximately 8000 cfs during a 10 percent PMF event. A 100-year event for this drainage area is approximately 1900 cfs. Banner Associates, Inc. used a Corps of Engineers version of the HEC-1 model to route the 10 percent PMF event through the 60 foot wide primary spillway and 100 foot wide secondary spillway. The event is routed through the structure with a combined spillway capacity of 6535 cfs and a maximum reservoir elevation of 1297.7, leaving 1.3 feet of available freeboard. The maximum combined spillway capacity with a reservoir level at the top of dam elevation of 1299 is approximately 8900 cfs, or 11 percent of the PMF. The combined spillway capacity will increase if the width of the secondary spillway is increased.

A Water Permit or Vested Right Claim for the original dam was never filed. Since the dam has been breached for a number of years and the new dam will have an increased storage capacity, the Department of Game, Fish and Parks has filed Water Permit Application No. 6315-3 to store 1769 acre-feet with a priority date of March 26, 2002.

The annual yield for this drainage area with an 80 percent chance of occurrence, or 8 out of 10 years, is expected to be 312 acre-feet. The annual yield with a 50 percent chance of occurrence, or 1 out of 2 years, is expected to be 875 acre-feet and the annual yield with a 10 percent chance, or 1 out of 10 years, is expected to be 4580 acre-feet.

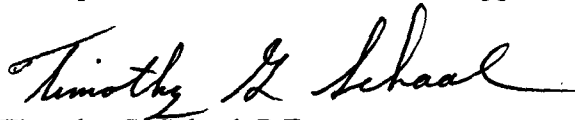
The new Lake Henry Dam will be located on Dawson Creek about 5 miles upstream of the confluence of Dawson Creek and the James River. There are no existing Water Permits/Rights on Dawson Creek between the proposed dam and the James River.

Conclusions:

1. Preliminary plans and specifications for the Lake Henry Reconstruction/Relocation Project are being reviewed. Final plans and specifications will need to be filed and approved prior to construction of the dam. They should include total spillway capacity reflecting the final size of the secondary spillway, a Breach Analysis for the

new structure and indicate ownership or easements for the additional property between the old and new embankments.

2. Water Permit Application No. 6315-3 should be approved since unappropriated water is available and approval will not have an adverse effect on existing Water Permits/Rights. Water Permit Application No. 6315-3 will not be approved until submittal and approval of final plans and specifications as mentioned above.
3. If approved, the low flow bypass requirement for downstream domestic use should be a qualification on Water Permit Application No. 6315-3.



Timothy G. Schaal, P.E.
Natural Resources Engineer Specialist

Approved by:



Gale N. Selken, P.E.
Natural Resources Engineer Director



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 6315-3, SD Department of Game, Fish and Parks**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Water Permit Application No. 6315-3, SD Department of Game, Fish and Parks, c/o Douglas R. Hansen, 523 E. Capitol Ave., Pierre SD 57501.

The Chief Engineer is recommending APPROVAL of Application No. 6315-3 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) it is in the public interest with the following qualifications:

1. Water Permit No. 6315-3 authorizes a dam with a storage capacity of 1,769 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,290.0 feet mean sea level.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.

See report on application for additional information.

Garland Erbele, Chief Engineer
May 23, 2002



DEPARTMENT OF GAME, FISH AND PARKS

Foss Building
523 East Capitol
Pierre, South Dakota 57501-3182
(605)773-6082

RECEIVED

JUN 07 2002

**WATER RIGHTS
PROGRAM**

Ms. Cami Widvey
Office of the State Engineer
523 East Capitol
Pierre, SD 57501

Rick Salonen
Tim Conner
Scott VanderMeulen
Banner Associates, Inc.
P O Box 298
Brookings, SD 57006-0298

With this cover letter we are forwarding a marked copy of your schematics with comments from myself and Gale Selken and Tim Schaal from DENR. We have found no critical elements missing. As the final review plans become available, we will solicit field comments.

If you would like to discuss any of our comments, please contact us, by conference call if you wish.

Sincerely,

ENGINEERING SECTION

Jeffrey D. Peters, P. E.
Buildings Engineer II

JDP*cn

Enclosure

cc: Wayne Winter, GFP
Arden Petersen, GFP
Tim Schaal, DENR

Gale Selken, DENR
Norm Lingle, GOED
Greg Henderson, Planning Dist III



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

www.state.sd.us/denr

NOTE: TO BE SURE OF PUBLICATION ON
THE CORRECT DATES, CONTACT
THE NEWSPAPER RIGHT AWAY.

May 23, 2002

South Dakota Department of Game, Fish & Parks
% Doug Hansen
523 East Capitol Avenue
Pierre, SD 57501

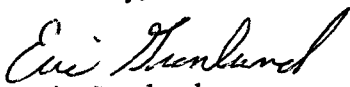
Dear Mr. Hansen:

Water Permit Application No. 6315-3 for recreational use has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice of hearing has been sent to the Publisher of the Scotland Journal printed at Scotland, SD (Ph # 605-583-4419). You will need to contact the newspaper and authorize publication of this notice. For your information, a copy of the notice, the recommendation of the Chief Engineer and a report on the application are enclosed. Please review the notice prior to publication and notify this office, if you have any corrections or questions.

Be sure to contact the above newspaper to authorize publication of your Notice of Hearing and to arrange for payment. Early contact with the paper can eliminate delays. Upon receiving authorization, the publisher has been instructed to publish your notice once each week for two consecutive weeks with the last publication to occur twenty days before the board meeting. The newspaper has also been instructed to send us the Proof of Publication. We must receive Proof of Publication before action can be taken on the application.

Final plans and specifications including an updated breach analysis must be filed and approved prior to the permit being issued.

Sincerely,


Eric Gronlund
Natural Resources Engineer
(605) 773-3352

enclosures

cc: Leslie Petersen, Game Fish & Parks

NOTE: If you plan to contest any part of the Chief Engineer's recommendation, you must file a petition pursuant to the procedures outlined in the attached notice of hearing. The Water Management Board will then consider your concerns during a hearing on the application.



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

May 23, 2002

Scotland Journal
PO Box 388
Scotland, SD 57059-0388

ATTENTION: Legal Public Notice

Enclosed is a Notice of Hearing on Application No. 6315-3 to Appropriate Water to be published twice. Please publish the first notice on May 29, 2002 with the second publication 7 days later.

The applicant must verify to you that the notice is to be published, before you make the first publication **Please BILL the APPLICANT for the cost of publication.** The APPLICANT is South Dakota Department of Game, Fish and Parks, % Doug Hansen, 523 E. Capitol, Pierre, SD (Ph # 605-773-3718).

Please send the Water Rights Program the first publication immediately. The publication is checked for accuracy so any corrections can be made in the second publication. You may use the form below or fax a copy of the first publication. Any fax should be sent to the attention of Karen Schlaak at (605) 773-4068. Publication errors can invalidate the public notice.

After the second publication, **please send us an affidavit or use the enclosed Proof of Publication form.** The applicant pays the cost of publication, but the Water Rights Program records require an affidavit or Proof of Publication. Delays in receiving the affidavit can be costly to the applicant.

Sincerely,


Eric Gronlund
Natural Resources Engineer
605 773-3352

enclosures

-----CUT HERE-----

No. 6315-3

TO: Eric Gronlund
Water Rights Program
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of May 23, 2002 enclosing Notice of Hearing to Appropriate Water by Application No. 6315-3 which was first published in our issue of _____. **ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.**

Name

Newspaper

Instruction to Newspaper - Publish first Notice on May 29, 2002 with the second publication 7 days later. The applicant is responsible for payment.

NOTICE OF APPLICATION NO. 6315-3 to Appropriate Water

Notice is given that the South Dakota Department of Game, Fish and Parks, 523 E Capitol, Pierre SD 57501 has filed an application for a water permit to impound 1,769 acre-feet of water from Dawson Creek by reconstructing Lake Henry dam located in the W $\frac{1}{2}$ SW $\frac{1}{4}$ Section 10 with water impounded in the W $\frac{1}{2}$ SW $\frac{1}{4}$ Section 10 and SE $\frac{1}{4}$, S $\frac{1}{2}$ NE $\frac{1}{4}$ Section 9; all in T96N-R58W. This application request impoundment of sufficient water to maintain water to an outlet elevation of 1290 feet mean sea level. The water is for fish and wildlife propagation and recreational purposes.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 6315-3 because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. In accordance with SDCL 46-2A-23, the Chief Engineer will act on the application, as recommended, unless a petition is filed opposing the application or the applicant files a petition contesting the Chief Engineer's recommendation. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider the application. Notice of the hearing will be given to the applicant and any person filing a petition.

Any person interested in opposing or supporting this application or recommendation must file a written petition with BOTH the applicant and Chief Engineer. The applicant must file a petition if contesting the Chief Engineer's recommendation. The Chief Engineer's address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501 (605 773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by June 17, 2002.

The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained. Contact Eric Gronlund at the above Water Rights Program address to request copies of information pertaining to this application. Steven M. Pirner, Secretary, Department of Environment and Natural Resources.

Gronlund, Eric

From: Gronlund, Eric
Sent: Wednesday, May 29, 2002 8:53 AM
To: Peters, Jeff; Petersen, Leslie
Cc: Erbele, Garland; Schaal, Tim; Schlaak, Karen
Subject: publication notice for the Lake Henry application

The Scotland Journal called and due to a snafu on their part the publication notice for Lake Henry did not get published this week. They will now publish on June 5 and 12. This will mean the final date to receive petitions to intervene is pushed back by one week to June 24th.

Eric

*Barb called
Peggy will for
notice 6/5/02*

Form 8

OK

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA)
) SS
 County of Bon Homme)

I, Rebecca Tyer

certify that the attached printed Notice was taken

from the Scotland Journal

printed and published in Scotland, SD

County of Bon Homme and

state of South Dakota. The notice was published.

in the newspaper on the following two dates:

June 5, 2002

June 12, 2002

Cost of Printing \$40.99

66c34.5 + 80% X 1

Rebecca Tyer
 (Signature)

Publisher
 (Title)

6-12-02
 (Date Signed)

NOTICE OF APPLICATION
 NO. 6315-3 TO
 APPROPRIATE WATER

Notice is given that the South Dakota Department of Game, Fish and Parks, 523 E Capitol, Pierre, SD 57501 has filed an application for a water permit to impound 1,769 acre-feet of water from Dawson Creek by reconstructing Lake Henry dam located in the W 1/2 SW 1/4 Section 10 with water impounded in the W 1/2 SW 1/4 Section 10 and SE 1/4, S 1/2 NE 1/4 Section 9; all in T96N-R58W. This application request impoundment of sufficient water to maintain water to an outlet elevation of 1290 feet mean sea level. The water is for fish and wildlife propagation and recreational purposes.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 6315-3 because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. In accordance with SDCL 46-2A-23, the Chief Engineer will act on the application, as recommended, unless a petition is filed opposing the application or the applicant files a petition contesting the Chief Engineer's recommendation. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider the application. Notice of the hearing will be given to the applicant and any person filing a petition.

Any person interested in opposing or supporting this application or recommendation must file a written petition with BOTH the applicant and Chief Engineer. The applicant must file a petition if contesting the Chief Engineer's recommendation. The Chief Engineer's address is "Water Rights Program, Ross Building, 523 E Capitol, Pierre SD 57501, (605 773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by June 24, 2002.

The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained. Contact Eric Granlund at the above Water Rights Program address to request copies of information pertaining to this application. Steven M. Plmer, Secretary, Department of Environment and Natural Resources.

(June 5 & 12)

Water Permit Application No. 6315-3
SD Dept of GFIP
Lake Henry Dam

Top of Dam Elev. - 1299
2nd Spillway Elev. - 1294
1st Spillway Elev. - 1290
O/S Toe Elev. - 1254

Cat. 2 - Significant Hazard

Ht = 45 ft

Normal Storage Capacity - 1769 Ac-Ft
Int Storage Capacity - 2236
Max Storage Capacity - 2947

Taken from May 2002
Reservoir Routing
Banner Associates, Inc.

Cat 2 - Intermediate Size - 0.5 PMF Spillway Design Flood
unless Sec. 74:02:08:07.02 applies - which states
the Spillway Design Flood can be lower to between
50% PMF and 100 year flood

Banner Associates, Inc. performed a Breach Analysis on the original embankment in 1990. The analysis indicated that flooding conditions would be essentially the same when comparing a 50% PMF event with a dam failure and without the dam in place. It was determined that the new Lake Henry Dam should have a spillway capacity capable of passing at least a 10% PMF event (8000 cfs). Banner conducted another Breach Analysis in May 2002 on the proposed dam and the results were similar. The potential impact of dam failure during the 50 PMF event increased from approximately 0.5 ft to 1.5 ft at the last cross section. (See Banner Associates, Inc. 5/24/02 letter). The requirement for Lake Henry Dam to pass at least a 10% PMF should still be adequate.

50% PMF event = 40,000 cfs
10% PMF event = 7800
100 yr event = 1900

Combined Spillway Capacity = 8914 cfs (11% PMF)

Section 74:02:08:09

1. Topo Map - OK - GFIP purchased new land
2. Dam Profile - OK
3. Dam Max X-sec. - OK
4. Area Capacity - OK
5. Outlet Details - OK
6. Spillway Rating - OK - 8914 cfs $\approx$ 11% PMF
7. Spillway Details - OK
8. Specs - OK
9. EPP - N/A - Cat. 2 - GFIP and County plan on providing EPP



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

July 15, 2002

Douglas Hansen
SD Dept. of Game, Fish & Parks
523 E. Capitol
Pierre, SD 57501

Dear Mr. Hanson

We have reviewed the plans and specifications for the Lake Henry Dam Reconstruction/Relocation project located in the SW 1/4 of Section 10-T96N-R58E, in Bon Homme County. The plans and specifications as submitted are approved. Approval of the plans and specifications does not authorize construction of the dam. The construction of the dam may not begin until Water Permit No. 6315-3 is approved.

Our review was to determine compliance with the requirements of the Water Management Board Safety of Dams Rules, Chapter 74:02:08. Approval of these plans and specifications does not release the Department of Game, Fish and Parks, as owner of the dam, from the responsibility for operating and maintaining the dam in good repair to ensure the safety of the dam.

The Reconstructed Lake Henry Dam will be classified as an intermediate size Category 2, Significant Hazard Dam with a dam height of 45 feet and a normal storage capacity of 1769 acre-feet and a maximum storage capacity of 2947 acre-feet.

If you have any questions, please feel free to contact us.

Sincerely,

Gale N. Selken, P.E.
Natural Resources Engineer Director
for Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

c: Jeff Peters, P.E., GF&P
Leslie Peterson, GF&P
Kent Woodmansey, P.E., DENR
Richard L. Salonen, PE, Banner Associates Inc.



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

JUL 15 2002

SD Department of Game Fish & Parks
% Doug Hansen
523 E Capitol
Pierre SD 57501

Dear Mr. Hansen:

Enclosed is Water Permit No. 6315-3 authorizing construction of your water diversion system and beneficial use of the water, not exceeding the limits as specified in the Water Permit.

Form 10, *Notice of Completion of Works and Application of Water to Beneficial Use*, is enclosed. Please return this completed form after you have finished the system and have put the water to beneficial use. An investigation can then be scheduled so the water license may be issued, thus completing the acquisition of a water right.

An informational sheet *Common Water Right Questions?* is also enclosed. This sheet is intended to answer some of the questions associated with obtaining and keeping a water right.

Sincerely,

Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

Permit No. 6315-3
James River - Water District

Report Of Examination Of Works And/Or Application of Water To Beneficial Use

TO: Chief Engineer, Water Rights Program, DENR, Foss Bldg., Pierre, SD 57501

I have this day, **June 2, 2004**, made a thorough examination of the water use system constructed by **SD Department of Game, Fish and Parks** of **523 E. Capitol, Pierre, SD 57501** holder of Permit No. **6315-3**, bearing the priority of **March 26, 2002** authorizing the storage of **1769** acre-feet of the waters of **Dawson Creek** for **recreational use and fish & wildlife propagation** purposes, in **Bon Homme** County.

I have to report on the conditions of the same as follows:

A. Works used to divert the water:

A 45 ft. high earthen dam with a normal storage capacity of 1769 acre-feet

B. Works used to transport water to place of use:

pipeline/ditch

C. Works used to apply water to beneficial use:

A 45 ft. high earthen dam with a normal storage capacity of 1769 acre-feet

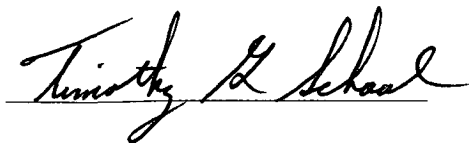
The system is in the following condition **good**. The point of diversion is located **1500 ft. north & 700 ft. east of the SW corner of Sec. 10-T96N-R58W (W ½ SW ¼)**. The works are capable of storing **1769** acre-feet of water which is to be used for **recreational use and fish & wildlife propagation**. Water has been put to beneficial use to the maximum extent as follows:

A 45 ft. high earthen dam with a normal storage capacity of 1769 acre-feet

and the license should be issued for **1769** acre-feet of storage.

Applicable permit qualifications have been complied with: Yes **X**

Exceptions to compliance are: **none** Date Report Completed: **June 29, 2004**



Timothy G. Schaal, P.E.
Natural Resources Engineer Specialist
DENR, Water Rights Program

REPORT ON INSPECTION OF PERMIT NO. 6315-3

DATE OF INSPECTION: June 2, 2004

NAME & ADDRESS OF PERMIT HOLDER: SD Department of Game, Fish and Parks,
523 E. Capitol, Pierre, SD 57501

DIVERSION POINT LEGAL LOCATION: 1500 ft. north & 700 ft east of the SW corner of
Sec. 10-T96N-R58W (W ½ SW ¼).

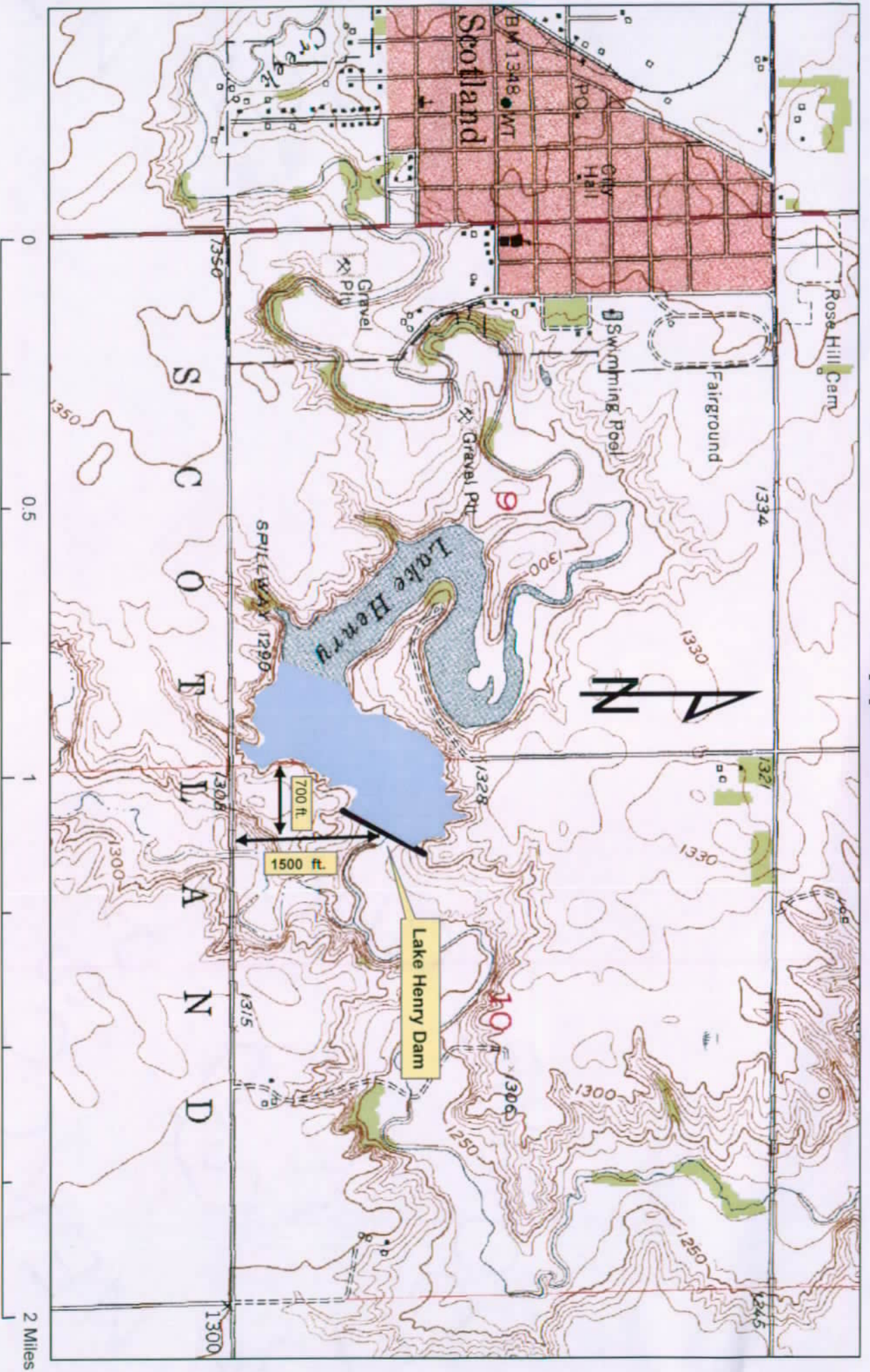
DAM INFORMATION:

- 1) Height to crest 45 feet
- 2) Height to primary spillway 36 feet
- 3) Height to secondary spillway 40 feet
- 4) Crest width 15 feet
- 5) Crest length 1050 feet
- 6) Spillway length XXX feet
- 7) Spillway width primary 60 ft, secondary 100 ft.
- 8) Approx. storage (Normal) 1769 acre-feet
- 9) Approx. storage (Maximum) 3000 acre-feet
- 10) Date constructed: Fall 2002 – Spring 2004

PERMIT QUALIFICATIONS AND REGULATIONS:

- 1) Soil and water permit lands agree with lands being irrigated and lands listed on permit N/A
- 2) Special qualifications to permit being abided by yes
- 3) All structures, wells and lands on map yes
- 4) Irrigation Questionnaires checked to determine if permit owner started irrigation by the end of construction period N/A

Water Permit Application No. 6315-3



Timothy G. Schaal
 Timothy G. Schaal, P.E.
 Natural Resources Engineer Specialist
 DENR, Water Rights Program
 June 29, 2004

STATE OF SOUTH DAKOTA

WATER LICENSE NO. 6315-3

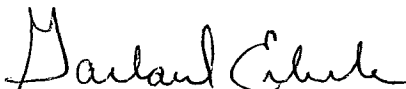
(1) South Dakota Department of Game, Fish and Parks, 523 E Capitol, Pierre SD 57501 made Application No. 6315-3, March 26, 2002 for a water permit to impound 1,769 acre feet of water from Dawson Creek, Bon Homme County, South Dakota in Lake Henry Dam for fish and wildlife propagation and recreational purposes. Permit No. 6315-3, with a priority date of March 26, 2002 was approved June 24, 2002 and issued to the applicant for diversion of water with construction of the described water supply system to be completed on or before June 24, 2007 and for the application to beneficial use of water on or before June 24, 2011.

(2) The water supply system has been completed and water applied to beneficial use in accordance with South Dakota State Law. Pursuant to South Dakota Codified Law 46-5-30.1, the holder and/or owner of Water Right No. 6315-3 is issued a license, bearing a priority date of March 26, 2002, to impound 1,769 acre feet of water.

The location of the storage dam (spillway) is 1,500 feet north and 700 feet east of the southwest corner of Section 10-T96N-R58W (W ½ SW ¼).

(3) This license is subject to South Dakota Water Law, any limitations or conditions listed in Water Permit No. 6315-3, including the following now applicable qualifications:

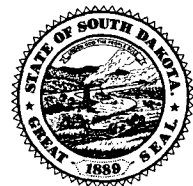
- Water Permit No. 6315-3 authorizes a dam with a storage capacity of 1,769 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,290.0 feet mean sea level.
- Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.



Garland Erbele, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

JUL 27 2004

date





**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

JUL 27 2004

6315-3

SD Department of Game Fish & Parks
%Douglas Hansen
523 E Capitol
Pierre SD 57501

Dear Mr. Hansen:

Enclosed is Water License No. 6315-3. This is the final water right document completing your process of obtaining a Water Right.

As long as you use the water beneficially, as stated in the Water License, State Water Laws provide that you have a continuing right to use the water.

Sincerely,

Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures