

WATER PERMIT NO. 6825-3

Name of Applicant: Marlo Wieman

Address: PO Box 135, Marion SD 57043

Phone: 605 648-3536

Amount of Water Claimed: 69.70 AF

Total Acres: NA

Source of Water Supply: unnamed tributary to West Fork Vermillion R.

Water to be used for: recreation

County: Turner

Type of Waste Disposal System:

Location: 2 miles north of Marion

PRIORITY

Date Received: 3-9-07

Application/License Fee: \$200

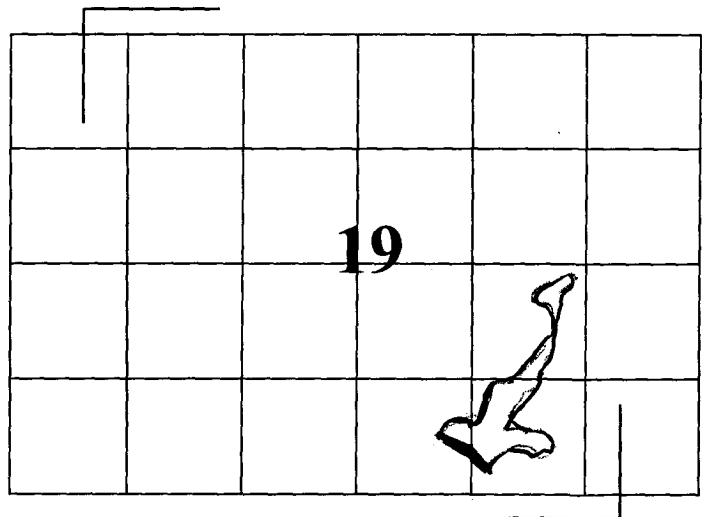
Corrected Application Received:

Period of Annual Use: Jan 1 – Dec 31

Remarks:

Diversion Point: S ½ SE ¼ Sec 19-T100N-R54W

Water Impounded: S ½ SE ¼, NE ¼ SE ¼ Sec 19-T100N-R54W



Depth of Well: NA

Well Driller: : NA

Remarks:

Type of Map: topo

Prepared by: Bradley D Stangohr, PE

Reviewed and the Number Assigned on: 3-12-07

By: **Karen Schlaak**

Notice of Hearing - date to intervene: _____

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MAR - 9 2007
WATER RIGHTS
PROGRAM

Mail to: Water Rights Program Joe Foss Building 523 E. Capitol Pierre, SD 57501-3181 (605) 773-3352	No. <u>6825-3</u> (office use only) Hydrologic Unit <u>10170102</u>
	Basin <u>Vermillion River</u>
	Newspaper <u>The New Era</u> PO Box <u>579</u>
	<u>605-297-4419</u> <u>Parker SD 57053</u>

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.)

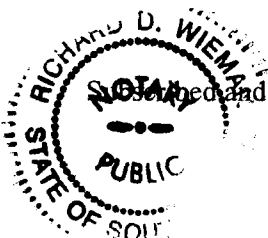
- Name of Applicant Marlo Wieman Phone (605) 648-3536
(check one) ☒ Owner ☐ Tenant/lessee
Mailing Address PO Box 135 Marion State SD 57043
(Street, RR, or Box and City) (Zip Code)
- Amount of water claimed _____ *CFS or _____ **GPM 69.70 ***AF
(*Cubic Feet per Second) (**Gallons per Minute) (**Acre Feet - storage capacity of dam/dugout or annual use if applicable)
- Source of water supply Unnamed tributary to the West Fork of the Vermillion River
- Location of point of diversion (example - 3 wells in SW1/4 NE1/4 section 12-T104N-R53W) County Turner
1 Earthen Dam in the SE1/4 section 19 - T100N-R54W Water Impoundment SE 1/2 SE 1/4
SE 1/2 NE 1/4 SE 1/4 Sec 19 T100N R54W
- County or counties where water will be used Turner
- Annual period during which water is to be used Year-round 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)

Constructing an earthen dam with a principal pipe spillway and vegetated emergency. The resultant reservoir will be used for recreational purposes.

STATE OF SOUTH DAKOTA)
County of Turner) SS

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)

I, Marlo Wieman, 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 Marlo E. Wieman
Subscribed and sworn to before me this 8 day of March 20 07

Richard D. Wieman
12-15-2010 Notary Public signature

**SOUTH DAKOTA
WATER PERMIT NO. 6825-3**

Date of first receipt of application March 9, 2007.

The Chief Engineer, on behalf of the Water Management Board, issues Water Permit No. 6825-3 to Marlo Wieman, PO Box 135, Marion SD 57043 authorizing the construction of the dam and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 6825-3 authorizes impoundment of 69.70 acre-feet of water from an unnamed tributary to the West Fork of the Vermillion River by constructing a dam located in the S ½ SE ¼ Section 19 with water impounded in the S ½ SE ¼, NE ¼ SE ¼ Section 19; all in T100N-R54W.
2. The water appropriated shall be used for the purpose of fish and wildlife propagation, recreation and livestock water 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. 6825-3 is May 14, 2007.
5. The date from which applicant may claim right is March 9, 2007.
6. One-fifth of the construction is to be completed on or before November 14, 2009.
7. All construction is to be completed on or before May 14, 2012.
8. Water is to be put to beneficial use on or before May 14, 2016.
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. 6825-3 authorizes a dam with a storage capacity of 69.7 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,433.0 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

By: Garland Erbele

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

JUN 20 2007

date



(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

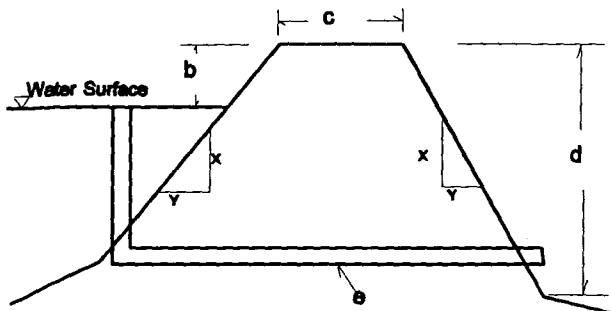
- a) Surface Dimensions _____ Depth _____
- b) Depth to water (ground surface to water level) _____

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:

Clark Engineering Corporation
Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328



- b) Freeboard _____ 5'
- c) Crest Width _____ 16'
- Crest Length _____ 350'
- d) Height _____ 30'
- e) Primary Outlet Capacity _____ 156 cfs
- If pipe, diameter _____ 36"
- f) Secondary Spillway Capacity _____ 232 cfs
- Spillway Width _____ 45'
- g) X & Y Slope _____ 4:1
- Upstream _____ 4:1
- Downstream _____ 4:1
- h) Surface Area of Impoundment _____ 11.6 Ac
- i) Storage _____ 69.7 Acre Feet
- j) Drainage Area Above Dam _____ 1,613.4 Acres

RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date 3/12, 20 05

RECEIVED OF CLARK ENGINEERING 1410 W RUSSELL ST SIOUX FALLS SD 57104

The following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct and to put water to beneficial use	150	00
Fee for Application for Permit No. _____ to Appropriate Water for Future use		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____	50	00
Fee for Filing Transfer Form _____		
Fee for _____		
Fee for Issuing New Well Driller's License No. _____ for C.Y. _____		
Fee for Renewal of Well Driller's License No. _____ for C.Y. _____		
Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____		
Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____		
(Any Other Work Provided by Law)	TOTAL	200 000

No.

0298A

By *Jonathan Erbe*
Chief Engineer



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www.clark-eng.com

TRANSMITTAL LETTER

TO: Mr. Tim Schaal
Dept of Environment & Natural Resources
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3182

DATE: March 8, 2007

CLARK-SF PROJECT NUMBER: X03031

REGARDING: Wieman Dam near Marion, SD

TRANSMITTED HERewith are the following items:

NUMBER	DATE	DESCRIPTION
1	3/8/07	Water Rights Permit Application
1	3/8/07	Risk Assessment for the Wieman Dam
1	3/8/07	Project Manual for the Wieman Dam

REMARKS:

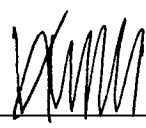
Mr. Schaal:

Please review the following plans, specifications and risk assessment for the Wieman Dam Project in Marion, South Dakota. We would like to try and make the May 9th Water Management Board Meeting (if necessary).

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

Thank you.

Copies To:


Vanessa Victor, EIT

If this transmittal is incomplete or incorrect, please notify the sender immediately.

Minneapolis
Minnesota

Aberdeen
South Dakota

Sioux Falls
South Dakota

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Schaal, Tim

From: Schaal, Tim
Sent: Thursday, March 15, 2007 2:21 PM
To: 'vvictor@clark-eng.com'
Subject: RE: wieman dam

Thanks Vanessa--Yes that is the info I'm looking for. Attached is Section 74:02:08:09 of our Safety of Dams Rules that lists the Minimum contents of plans and specifications, No. 6 is basically the additional information I need. Along with this correspondence, I'm writing up a file doc stating we discussed the dam height as 30 feet with a downstream embankment toe elevation of 1408; the riprap details on the upstream slope & embankment crest; the Geotech Report and your selection to not use a keyway or core trench for the embankment (as described in #3); and the connection between the box manhole inlet structure and the 36 RCP principal spillway pipe (as described in #5) and your assurance that either Clark Engineering or Cretex Concrete Products would be on site when the spillway is installed.

If you have any questions or additional details, please let me know.

<http://legis.state.sd.us/rules/DisplayRule.aspx?Rule=74:02:08:09>

Tim Schaal, P.E.
SD DENR
(605) 773-3352

-----Original Message-----

From: Vanessa Victor [mailto:vvictor@clark-eng.com]
Sent: Thursday, March 15, 2007 1:49 PM
To: Schaal, Tim
Subject: wieman dam

Per our conversation earlier today, I will be sending you the following information:

Peak flows using the regression analysis

Calculations for sizing the principal spillway

Calculations for sizing the emergency spillway

Earth sliding calculation

Comparison of head and discharge rates

Let me know if any other information is needed.

Vanessa Victor, EIT



Convention Center Plaza
1410 West Russell Street

03/15/2007

Water Rights Division -DENR
Conversation or File Documentation

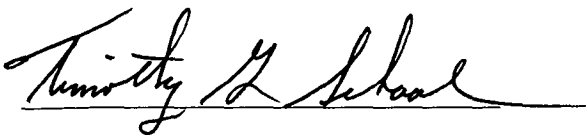
NAME OF PERSON OR FILE: Marlo Wieman

ADDRESS: PO Box 135, Marion, SD 57043 COUNTY: Turner

DATE: March 15, 2007 TELEPHONE: XXXXXXX

RE: phone conversation with Vanessa Victor, Clark Engineering 331-2505

I talked to Vanessa Victor today about Water Permit Application No. 6825-3 and the P&S submitted for the dam. I had several questions for her: 1) what was the dam height and D/S embankment toe elevation? The Geotech Report indicated the height as 35 feet and Form 2a had 30 feet. She indicated that the toe elevation would be 1408, making the embankment height as 30 feet. 2) I asked about the Geotech Report and if the Geotech Engineer recommended a core or cutoff trench, she responded that they did not need one! 3) I asked about the use of riprap up and over the embankment crest. She indicated that riprap on the crest was being used to stop vehicle traffic over the crest. I mentioned that having riprap on the crest may be unnecessary and it could hinder inspections of the dam and the crest can be a good indicator of structural problems with the dam, she indicated that they did not expect to have any problems. 4) I asked her to submit any spillway routing or sizing information they had for the spillway sizes they selected. She indicated that they used the regression equations and sized the spillway accordingly. She indicated that she could send me some of that information. 5) I asked about the connection between the box manhole riser and the RCP spillway pipe and the Plans were not very clear as to what was being used to insure a water tight seal, she indicated that either Clark Engineering or Cretex Concrete Products would be on site to insure proper construction. 6) They submitted some Storm Water Permitting info along with the Water Permit Application and I asked if they wanted me to forward that information to our Storm Water Permitting people, she indicated that they would do that.



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



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TRANSMITTAL LETTER

TO: Mr. Tim Schaal
Dept of Environment & Natural Resources
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3182

DATE: March 20, 2007

CLARK-SF PROJECT NUMBER: X03031

REGARDING: Wieman Dam Project, Marion, SD

TRANSMITTED HERewith are the following items:

NUMBER	DATE	DESCRIPTION
1		Peak flows using the regression analysis, 2 pages
1		Calculations for sizing the principal spillway, 2 pages
1		Calculations for sizing the emergency spillway, 2 pages
1		Earth sliding calculation, 2 pages
1		Comparison of head and discharge rates, 2 pages

REMARKS:

Tim:

Based on our conversation on March 15, 2007, I am sending you the five items you requested.

If you have any other questions or need any additional information, please let me know.

Thank you.

Copies To:


Vanessa Victor, EIT

Minneapolis
Minnesota

Aberdeen
South Dakota

Sioux Falls
South Dakota

If this transmittal is incomplete or incorrect, please notify the sender immediately.

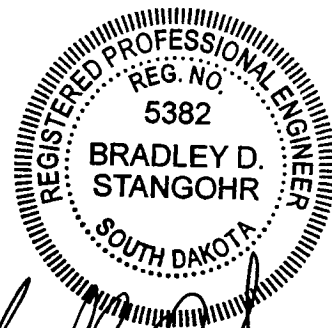
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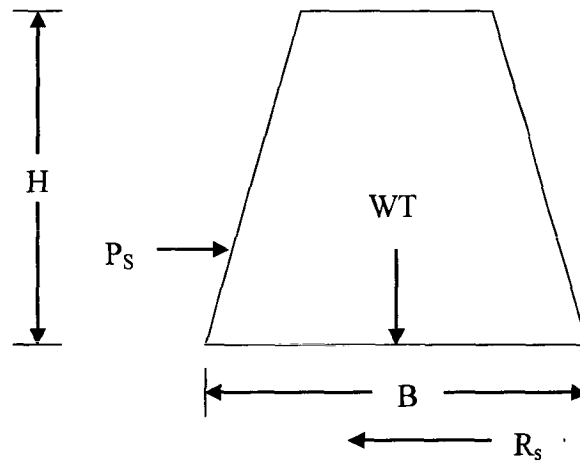
Wieman Dam

Earth Sliding Calculations



Bradley D. Stango
20 March 2007

Design Parameters



Soil := 120pcf

Unit Weight of Soil.

Fill := 814482ft³

Volume of Earth Fill.

γ_w := 62.4pcf

Unit Weight of Water.

$\bar{H}$:= 30ft

Height of Dam.

B := 295ft

Width of Dam.

$\bar{\delta}$:= 17deg

Angle of friction between soil and foundation.

Calculated Parameters

WT := Fill · Soil

Weight of Earth Fill.

WT = 9.774 × 10⁷ lb

$P_s := \frac{\gamma_w \cdot H^2 \cdot 1\text{ft}}{2}$

Horizontal Driving Force of Water.

$P_s = 2.808 \times 10^4$ lb

$R_s := WT \cdot \tan(\bar{\delta}) + 136800\text{psf} \cdot B \cdot 1\text{ft}$

Horizontal Resisting Force of Embankment.

$R_s = 7.024 \times 10^7$ lb

$FS := \frac{R_s}{P_s}$

Factor of Safety for Sliding

FS = 2.501 × 10³



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Wieman Dam

Comparison of Head and Discharge Rates



Bradley D. Stango
20 March 2007

Project Name: X03031 -Wieman Dam

Computed by: VV

Date: 1/16/2007

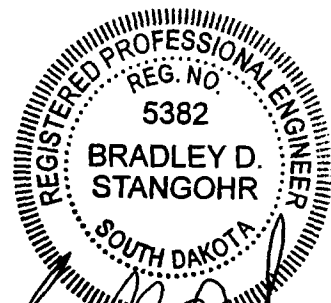
Elevation	Principal Spillway Head Ft	Discharge Prinipal Spillway CFS	Vegetated Spillway Head Ft	Discharge Vegetated Spillway CFS	Discharge TOTAL CFS
1433	0	0	0	0	0
1433.5	0.5	73	0	0	73
1434	1	156	0	0	156
1434.5	1.5	158	0.5	128	286
1435	2	159	1	412	571
1435.5	2.5	161	1.5	513	674
1436	3	162	2	672	834
1436.5	3.5	164	2.5	824	988
1437	4	165	3	917	1082



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Wieman Dam

Peak Flow Computations



Bradley D. Stango
20 March 2007

FLOW COMPUTATIONS

per USGS Report 98-4055

Clark Project No. X03031

Wieman Dam - 4 miles North of Marion in Turner County

SUBREGION B Enter A or B

CA = 2.52

PII = 1.10

From fig. 5

<u>REC</u>	<u>Qu</u>	
2	31	$18.6 \cdot (CA^{0.425}) \cdot (PII^{1.1})$
5	89	$51.6 \cdot (CA^{0.508}) \cdot (PII^{0.835})$
10	155	$86.8 \cdot (CA^{0.546}) \cdot (PII^{0.764})$
25	272	$148 \cdot (CA^{0.584}) \cdot (PII^{0.73})$
50	387	$206 \cdot (CA^{0.606}) \cdot (PII^{0.728})$
100	526	$275 \cdot (CA^{0.625}) \cdot (PII^{0.742})$
500	955	$480 \cdot (CA^{0.661}) \cdot (PII^{0.811})$

CA = contributing drainage area in square miles

PII = precipitation intensity index

REC = Recurrence Interval in years

Q = flow in cfs

Formulas from Table 4, Water-Resources Investigations Report 98-4055 by USGS

PII from Table 5, Water-Resources Investigations Report 98-4055 by USGS



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Wieman Dam

Principal Spillway Calculations



Bradley D. Stango
20 March 2007

Project Name: X03031 - Wieman Dam

Computed by: VV

Date: 1/16/2007

Checked by: _____

Date: _____

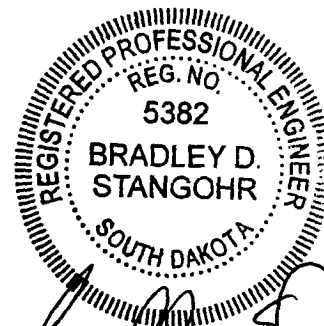
				Outflow, CFS			Structure Outflow, CFS	Controlling Factor	Benchmark
				Elevation	HW Ft	Weir	Slug Flow	Full Pipe	
Input Data				30.0	0.0	0.00	0.00	142.51	0.00 Weir Flow
				30.1	0.0	0.00	0.00	142.86	0.00 Weir Flow
				30.2	0.0	0.00	0.00	143.21	0.00 Weir Flow
				30.3	0.0	0.00	0.00	143.56	0.00 Weir Flow
				30.4	0.0	0.00	0.00	143.91	0.00 Weir Flow
Principal Spillway Crest Elev (ft)		30		30.5	0.0	0.00	0.00	144.26	0.00 Weir Flow
Inside Wall - Type	Smooth			30.6	0.0	0.00	0.00	144.61	0.00 Weir Flow
Pipe Diameter (in)		36		30.7	0.0	0.00	0.00	144.96	0.00 Weir Flow
Pipe Length (ft)		166		30.8	0.0	0.00	0.00	145.30	0.00 Weir Flow
Entrance Coefficient 'Ke'		1		30.9	0.0	0.00	0.00	145.65	0.00 Weir Flow
Mannings 'n'-value		0.013		31.0	0.0	0.00	0.00	145.99	0.00 Weir Flow
				31.1	0.0	0.00	0.00	146.34	0.00 Weir Flow
				31.2	0.0	0.00	0.00	146.68	0.00 Weir Flow
Outlet Type	Cantilever			31.3	0.0	0.00	0.00	147.02	0.00 Weir Flow
Outlet Elevation (ft)		8		31.4	0.0	0.00	0.00	147.36	0.00 Weir Flow
				31.5	0.0	0.00	0.00	147.70	0.00 Weir Flow
Auxiliary Spillway Elev (ft)		34		31.6	0.0	0.00	0.00	148.04	0.00 Weir Flow
Maximum Headwater Elev (ft)		38		31.7	0.0	0.00	0.00	148.38	0.00 Weir Flow
Elev increment After Full Pipe Flow		0.1		31.8	0.0	0.00	0.00	148.72	0.00 Weir Flow
				31.9	0.0	0.00	0.00	149.06	0.00 Weir Flow
				32.0	0.0	0.00	0.00	149.40	0.00 Weir Flow
Basic Output				32.1	0.0	0.00	0.00	149.73	0.00 Weir Flow
Full Pipe Flow - Max. Outflow (cfs):	168.38			32.2	0.0	0.00	0.00	150.07	0.00 Weir Flow
Full Pipe Flow - Max. Velocity (fps):	23.82			32.3	0.0	0.00	0.00	150.40	0.00 Weir Flow
				32.4	0.0	0.00	0.00	150.74	0.00 Weir Flow
Barrel Area (Sq Ft):	7.07			32.5	0.0	0.00	0.00	151.07	0.00 Weir Flow
Kp:	0.0072323			32.6	0.0	0.00	0.00	151.40	0.00 Weir Flow
Friction Slope (HW at the A.S. Crest):	0.05468			32.7	0.0	0.00	0.00	151.73	0.00 Weir Flow
Pipe Slope:	0.13371			32.8	0.0	0.00	0.00	152.06	0.00 Weir Flow
Outlet Elbow Angle (deg):	0.0			32.9	0.0	0.00	0.00	152.39	0.00 Weir Flow
				33.0	0.0	0.00	0.00	152.72	0.00 Weir Flow
				33.1	3.1	35.85	0.00	153.05	35.85 Weir Flow Start Flow
Km:	0.00000			33.2	3.2	37.41	10.39	153.38	37.41 Weir Flow
Tailwater Elev Used For Full Pipe Flow:	9.8			33.3	3.3	38.97	31.18	153.71	38.97 Weir Flow
				33.4	3.4	40.53	51.96	154.03	51.96 Slug Flow
				33.5	3.5	42.09	72.75	154.36	72.75 Slug Flow
Notes & Warnings				33.6	3.6	43.65	93.53	154.69	93.53 Slug Flow Q5
				33.7	3.7	44.95	114.32	155.01	114.32 Slug Flow
				33.8	3.8	46.25	135.10	155.33	135.10 Slug Flow
				33.9	3.9	47.54	155.88	155.65	155.65 Full Pipe Flow Q10
				34.0	4.0	48.84	176.67	155.98	155.98 Full Pipe Flow
				34.1	4.1	50.14	197.45	156.30	156.30 Full Pipe Flow
				34.2	4.2	51.44	218.24	156.62	156.62 Full Pipe Flow
				34.3	4.3	52.74	239.02	156.94	156.94 Full Pipe Flow
				34.4	4.4	54.04	259.81	157.26	157.26 Full Pipe Flow
				34.5	4.5	55.34	280.59	157.58	157.58 Full Pipe Flow
				34.6	4.6	56.64	301.38	157.90	157.90 Full Pipe Flow
				34.7	4.7	57.94	322.16	158.22	158.22 Full Pipe Flow
				34.8	4.8	59.24	342.95	158.54	158.54 Full Pipe Flow
				34.9	4.9	60.54	363.73	158.85	158.85 Full Pipe Flow
				35.0	5.0	61.83	384.52	159.17	159.17 Full Pipe Flow
				35.1	5.1	63.13	405.30	159.49	159.49 Full Pipe Flow
				35.2	5.2	64.43	426.08	159.80	159.80 Full Pipe Flow
				35.3	5.3	65.73	446.87	160.11	160.11 Full Pipe Flow
				35.4	5.4	67.03	467.65	160.43	160.43 Full Pipe Flow
				35.5	5.5			160.74	160.74 Full Pipe Flow
				35.6	5.6			161.05	161.05 Full Pipe Flow
				35.7	5.7			161.37	161.37 Full Pipe Flow
				35.8	5.8			161.68	161.68 Full Pipe Flow
				35.9	5.9			161.99	161.99 Full Pipe Flow
				36.0	6.0			162.30	162.30 Full Pipe Flow
				36.1	6.1			162.61	162.61 Full Pipe Flow
				36.2	6.2			162.92	162.92 Full Pipe Flow
				36.3	6.3			163.22	163.22 Full Pipe Flow
				36.4	6.4			163.53	163.53 Full Pipe Flow
				36.5	6.5			163.84	163.84 Full Pipe Flow
				36.6	6.6			164.15	164.15 Full Pipe Flow
				36.7	6.7			164.45	164.45 Full Pipe Flow
				36.8	6.8			164.76	164.76 Full Pipe Flow
				36.9	6.9			165.06	165.06 Full Pipe Flow
				37.0	7.0			165.37	165.37 Full Pipe Flow
				37.1	7.1			165.67	165.67 Full Pipe Flow
				37.2	7.2			165.97	165.97 Full Pipe Flow
				37.3	7.3			166.28	166.28 Full Pipe Flow
				37.4	7.4			166.58	166.58 Full Pipe Flow
				37.5	7.5			166.88	166.88 Full Pipe Flow
				37.6	7.6			167.18	167.18 Full Pipe Flow
				37.7	7.7			167.48	167.48 Full Pipe Flow
				37.8	7.8			167.78	167.78 Full Pipe Flow
				37.9	7.9			168.08	168.08 Full Pipe Flow
				38.0	8.0			168.38	168.38 Full Pipe Flow



Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505 Phone
(605) 331-2602 Fax
siouxfalls@clark-eng.com
www.clark-eng.com

Wieman Dam

Vegetated Spillway Calculations



Bradley D. Stangoehr
20 March 2007



Design Parameters

$$n := 0.05$$

Manning's Roughness Coefficient.

$$H_w := 1 \text{ ft}$$

Depth of Flow.

$$S_S := 3$$

Side Slope (H:V).

$$S_C := 0.09$$

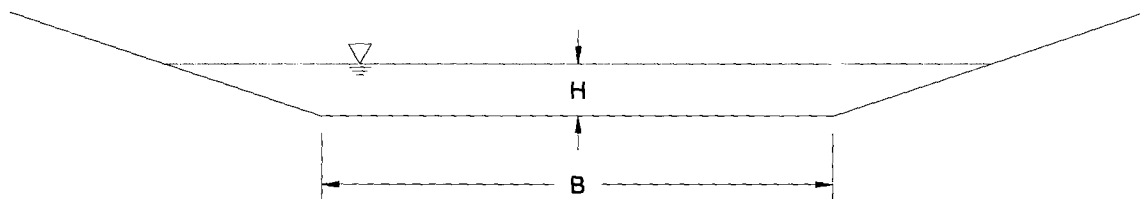
Channel Slope (V:H).

$$Q := 232 \text{ cfs}$$

Flow Needed to acquire 50 year flow at specified depth.

$$B := 45 \text{ ft}$$

Bottom Width of Channel



Calculated Parameters

$$P_W := 2(S_S \cdot H) + B$$

Wetted Perimeter, ft, at Design Height.

$$A_W := (S_S \cdot H) \cdot H + B \cdot H$$

Wetted Area, ft², at Design Height.

$$R_w := \frac{A_W}{P_W}$$

Hydraulic Radius, ft, at Design Height.

$$V_w := \frac{1.49}{n} \cdot R^{\frac{2}{3}} \cdot S_C^{\frac{1}{2}}$$

Velocity at Design Height.

$$V = 8.586 \frac{\text{ft}}{\text{sec}}$$

$$Q_w := V \cdot A_W$$

Flow with 1 ft of flow.

$$Q = 412 \text{ cfs}$$

SIMPLIFIED DAMBREAK MODEL (SMPDBK) VERSION: 7/88-1
 BY L. FREAD, J.M. LEWIS, & J.N. WETMORE - PHONE: (301) 427-7640
 NWS HYDROLOGIC RESEARCH LAB, RM 530 8060 13TH ST, SILVER SPRING, MD 20910

THE DATA FOR THIS DAM IS AS FOLLOWS:

TYPE OF DAM (IDAM)	EARTH
DAM BREACH ELEVATION (HDE)	1438.00 FT
FINAL BREACH ELEVATION (BME)	1408.00 FT
VOLUME OF RESERVOIR (VOL)	128. ACRE-FT
SURFACE AREA OF RESERVOIR (SA)	8.53 ACRES *
FINAL BREACH WIDTH (BW)	30.00 FT
TIME OF DAM FAILURE (TFM)	7.00 MINUTES
NON-BREACH FLOW (QO)	388.00 CFS
DEAD STORAGE EQUIV. MANN. N (CMS)	.30

CROSS SECTION NO. 1

FLOOD DEPTH (FLD) 1408.00 FT

ELEV.(FT) (HS)	1408.0	1410.0	1420.0	1425.0	1430.0
TWIDTHS(FT) (BS)	10.0	100.0	270.0	350.0	430.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0
MANNING N (CM) *	.035	.035	.035	.035	.035

CROSS SECTION NO. 2

REACH LENGTH (D) .17 MI

FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	1400.0	1405.0	1410.0	1420.0	1430.0
TWIDTHS(FT) (BS)	10.0	80.0	165.0	230.0	400.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.050	.050	.050	.050

CROSS SECTION NO. 3

REACH LENGTH (D) .46 MI

FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	1390.0	1400.0	1410.0	1420.0	1430.0
TWIDTHS(FT) (BS)	10.0	260.0	400.0	600.0	1100.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.050	.050	.050	.050

CROSS SECTION NO. 4

REACH LENGTH (D) .64 MI

FLOOD DEPTH (FLD) .00 FT

ELEV.(FT) (HS)	1380.0	1390.0	1400.0	1410.0	1420.0
TWIDTHS(FT) (BS)	10.0	260.0	335.0	500.0	825.0

INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.050	.050	.050	.050

CROSS SECTION NO. 5
 REACH LENGTH (D) .90 MI
 FLOOD DEPTH (FLD) 20.00 FT

ELEV.(FT) (HS)	1365.0	1370.0	1375.0	1380.0	1385.0
TWIDTHS(FT) (BS)	25.0	260.0	450.0	660.0	1000.0
INACTIVE TW(FT) (BSS)	.0	.0	.0	.0	.0
MANNING N (CM) *	.050	.050	.050	.050	.050

AN ASTERISK (*) BESIDE A PARAMETER IMPLIES THAT A DEFAULT VALUE WAS COMPUTED

NAME OF DAM: Wieman Dam
 Vermillion

NAME OF RIVER: trib.

RVR MILE FROM DAM DEPTH(FT)	MAX FLOW (CFS)	MAX ELEV (FT-MSL)	MAX DEPTH (FT)	TIME(HR) MAX DEPTH	TIME(HR) FLOOD	TIME(HR) DEFLOOD	FLOOD
*****	*****	*****	*****	*****	*****	*****	

.00	11995.	1416.00	8.00	.12	.00	.00	1408.00
.17	11116.	1411.77	11.77	.14	.00	.00	.00
.46	10117.	1400.13	10.13	.18	.00	.00	.00
.64	9871.	1389.16	9.16	.21	.00	.00	.00
.90	9762.	1371.91	6.91	.27	.00	.00	20.00

ANALYSIS IS COMPLETE

1
 NAME OF DAM: Wieman Dam
 Vermillion

NAME OF RIVER: trib.

0

MILE FEET

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	1370	1380	1390	1400	1410	1420	1430
1440	1450	1460	1470				

PEAK WATER ELEV (FEET)

NAME OF DAM: Wieman Dam
Vermillion

NAME OF RIVER: trib.

0
1
MILE TCFS

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.	.	.		.90	9.762	.	.

	10	20	30	40	50	60	70
80	90	100	110				

PEAK DISCHARGE (TCFS)

Water Rights Division -DENR
Conversation or File Documentation

NAME OF PERSON OR FILE: Marlo Wieman

ADDRESS: PO Box 135, Marion, SD 57043 COUNTY: Turner

DATE: March 30, 2007 TELEPHONE: XXXXXXX

RE: phone conversation with Vanessa Victor, Clark Engineering (331-2505)

I talked to Vanessa Victor today about Water Permit Application No. 6825-3 and the P&S submitted for the dam. I explained to her that I thought her analysis of the primary spillway flow was wrong and she will not get her desired Q10 flow thru the primary spillway with only 1 foot of elevation difference between the primary and secondary spillway. The weir for the box inlet structure will be the control (see P&S review notes) until there is a 2 foot head on the structure, then she would be getting her Q10 flow of 156 cfs thru the structure. I recommended to her that they change the secondary spillway elevation to allow 2 foot of difference between the spillways. It sounded like she did not agree with my analysis and did not want to change her design. I told her this was not enough for me to not approve the P&S, since they do accomplish the minimum spillway design requirements; however I also told her it was unusual to see only 1 foot of difference between spillways. The result will be the secondary spillway will function more, since the primary spillway will have less than a Q5 capacity and there could be more erosion in the secondary spillway.



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

WIEMAN DAM

PROJECT MANUAL



CLARK
ENGINEERING CORPORATION

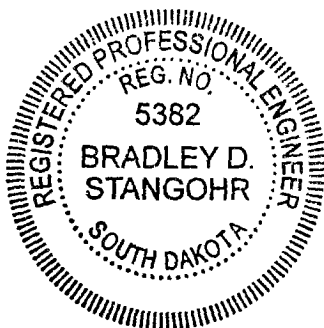
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siouxfalls@clark-eng.com
www.clark-eng.com
Clark Proj. No: X03031

WIEMAN DAM PROJECT

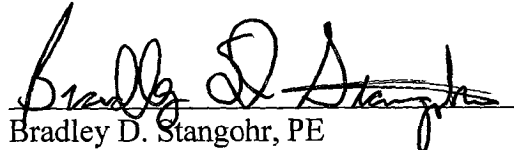
A Project in Marion, South Dakota

Ownership of Documents: This document, and the ideas and designs incorporated herein, as an instrument of professional service, is the property of Clark Engineering Corporation, and is not to be used, in whole or in part, for any other purpose without the written authorization of Clark Engineering Corporation.

Engineer's Certification:



I, Bradley D. Stangohr, PE, hereby certify that these Plans, Specifications, and other documents were prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.


Bradley D. Stangohr, PE
Registration Number 5382

Date: 8 March 2007

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OPERATION AND MAINTENANCE MANUAL FOR THE WIEMAN DAM NEAR MARION, SOUTH DAKOTA

PRINCIPAL SPILLWAY

Spillway structure should be cleared of debris periodically and after any significant rainfall event where inspection reveals a significant blockage.

During low water conditions, concrete spillway structures should be inspected to decide if water is passing through any joints or other structure contacts and to identify any cracks, spalling, broken or loose sections. Any cracked, spalled, broken or loose sections should be cleaned and refilled with an appropriate concrete patching material. A professional engineer should be consulted to repair extensive leakage, spalls or fractures.

Outlet protection and discharge channels should be cleared of brush at least once per year.

Any repairs made to the principal spillway should be reviewed by a professional engineer. Vertical trenching to expose the barrel should not be allowed under any circumstances. The trench side slopes should be stepped back at a 2:1 slope, minimum.

TRASH RACK

Maintenance should include periodic checks of the trash rack for rusted and broken sections and repairing as needed. The trash rack should be checked frequently during and after storm events to ensure that it is functioning properly and to remove accumulated debris. Extreme caution should be used when attempting to remove accumulated debris during periods of high flow.

Trash rack locking and hinge mechanisms should be inspected and tested periodically to make sure they are intact and operative.

VEGETATED SPILLWAY

Vegetated emergency spillway channels should be mowed concurrently with the embankment and should not be cut to less than 6 to 8 inches in height.

The emergency spillway approach and discharge channels should be cleared of brush and other woody growth periodically.

After any flow has passed through the emergency spillway, the spillway crest (control section) and exit channel should be inspected for erosion. All eroded areas should be repaired and stabilized.

To maintain the protective plant cover on the emergency spillway, mow it frequently and fertilize when needed. Mowing prevents the growth of woody plants where undesirable and helps develop a cover and root system more resistant to runoff.

Burrowing animals such as badgers, gophers, beaver, and prairie dogs cause severe damage to spillways. The emergency spillway should be frequently checked for animal related damages. Any destruction caused to the spillway should be immediately repaired.

All seeding repairs should be done with the specified seed mixtures and application guidelines from the original plans.

DAM EMBANKMENT

Fill any rills on the side slopes of the dam immediately with suitable material and compact it thoroughly. Fertilize as needed and reseed or resod these areas.

If seepage through or under the dam is evident, consult an engineer at once so that you can take proper corrective measures before serious damage occurs.

To maintain the protective plant cover on the dam, mow it frequently and fertilize when needed. Mowing prevents the growth of woody plants where undesirable and helps develop a cover and root system more resistant to runoff.

Burrowing animals such as badgers, gophers, beaver, and prairie dogs cause severe damage to dams. The dam embankment should be frequently checked for animal related damages. Any destruction should be immediately repaired.

All seeding repairs should be done with the specified seed mixtures and application guidelines from the original plans.

PROTECTION OF NEWLY GRADED AREAS

Protect newly graded areas from traffic and erosion and keep free of trash and weeds. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.

RIPRAP

Riprap on the face of the dam and in plunge pools will be maintained to original dimensions and thickness as shown on the plan drawings. Any void or disturbed areas will be filled.

GENERAL PLAN NOTES

HISTORICAL FOUNDATION

There is a historical foundation on the project site. The location is denoted in the plan sheets. No work is to infringe on the integrity of this structure.

If the structure appears to be in danger, cease operations immediately. Notify Engineer, and do not resume operations until directed.

TRAFFIC

The contractor is to maintain traffic on all private drive and public roads.

The contractor shall keep all public roadways free of mud, soil and debris.

CONTRACTOR NOTICE

The Contractor shall notify the Engineer one week before starting Work on the site. Additionally, the Contractor shall give a minimum of 24 hours "written" notice to all adjacent residents (with a copy to the Engineer) before commencing any construction activities. The notice shall indicate the type of activities to take place, the anticipated duration of activities, and a contact person (from the Contractor) for residents to contact with questions and/or problems.

Additionally, the contractor shall obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

OBSTRUCTIONS

The Contractor shall notify the Engineer of any obstructions in the work area before beginning construction.

UTILITIES

Preliminary utility locates were conducted via SD One-Call and the utilities located are depicted in the Drawings. The Contractor shall not rely on the Drawings for the location of any utilities. The Contractor shall coordinate the location of all utilities via South Dakota One Call at 1-800-781-7474 and verify the location of all utilities regardless of whether shown in the Drawings (SE Quarter of Section 19, T100N, R54W).

Any time existing utilities conflict with the Work, the Contractor shall immediately notify the Engineer. If the Contractor is unable to locate a utility or discovers that the utility owner has incorrectly located the facility, the Contractor shall promptly notify the Engineer, the utility owner, and South Dakota One Call.

SURFACE DRAINAGE & DE-WATERING

Drainage of both surface and sub-surface water is the Contractor's responsibility. The Contractor shall not divert or otherwise alter the pre-existing drainage patterns without the explicit permission of the Engineer.

See enclosed soils report for further information on groundwater levels.

During earthwork operations the contractor will be required to pump uncontaminated excess water from upstream reaches around the project site.

HAZARDOUS WASTES

Should any hazardous waste be generated during the implementation of this project, the generator must abide by all applicable hazardous waste regulations found in *ARSD 74:28* and *CFR Part 262*.

If any contamination is encountered during construction activities, the contractor, owner, or party responsible for the release must report the contamination to the Department of Environment and Natural Resources at (605) 773-3296. Any contaminated soil encountered must be temporarily stockpiled and sampled to determine disposal requirements.

WASTE DISPOSAL SITE

The Contractor will be required to furnish a site(s) for the disposal of construction debris generated by this project. The waste disposal site(s) shall be approved by the Engineer.

Potential wastes include, but are not limited to, unsuitable fill, trees, stumps and other vegetation.

EROSION CONTROL PERMIT

The Contractor is advised this project is under the Phase II Storm Water Regulations and must receive coverage under the DENR General Permit for Construction Activities. The procedures for obtaining a storm water construction permit on this Project are outlined in the Storm Water Pollution Prevention Plan (SWPPP). The SWPPP shall be available on the Project Site at all times.

The contractor is advised that permit coverage may also be required for off-site activities, such as waste, borrow, and staging areas, and are the responsibility of the Contractor. The Contractor will install erosion control measures as directed by the engineer.

TECHNICAL SPECIFICATION FOR THE CONSTRUCTION OF PRINCIPAL PIPE SPILLWAYS

DELIVERY, STORAGE AND HANDLING OF PIPING AND APPURTENANCES

Materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall be stored at the jobsite in a manner that will not damage pipe or fittings. The inside of pipes and fittings shall be kept free of dirt and debris. Gasket materials and plastic materials shall be protected from exposure to the direct sunlight over extended periods. The contractor is responsible for safe storage of all materials until they have been incorporated into the completed project.

Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

REINFORCED CONCRETE PIPE

Reinforced concrete pipe shall conform to the requirements of ASTM C-76 (AASHTO M170) and ASTM C361. Type II Portland Cement shall be used with class 2 reinforcing and the 28 day compressive strength shall be at least 4000 psi. Pipe should have bell and spigot joints and a wall C thickness.

All piping is required to have waterproof joints. Joints shall meet the requirements of ASTM C443 (AASHTO M198), ASTM C361, and the Bureau of Reclamation R-4 Specifications.

ANTI-SEEP COLLARS

Anti-seep collars shall be constructed with reinforced concrete and placed at the locations denoted in the project drawings. Collars shall conform to the standard details and drawings. Additionally, the collars shall meet the requirements and is subject to testing as stated in the *Technical Specification for Cast-in-Place Concrete*.

PRINCIPAL SPILLWAY INLET STRUCTURE

The principal spillway inlet structure shall be constructed of precast box sections and shall be made waterproof and sealed accordingly. If more than one section is needed, the joints between sections shall be of watertight construction utilizing an all-weather butyl rubber gasket in flexible rope form meeting or exceeding all requirements of Federal Specification SS-S-210A and AASHTO M-198. The portland cement mortar or concrete used for the filling or grouting of openings in the precast sections shall be "non-shrink" as approved by the Engineer.

The inlet structure is to be built to the dimensions shown in the approved shop drawings. All sections shall be numbered and/or measured by the Contractor before installation to insure that the finished inlet will be to the grade specified on the shop drawings.

The inlet that shall be built with the base and bottom box section being cast together in one integral concrete pour. Such will provide for no joint between the base and barrel section ensuring a watertight seal. This section shall be constructed to meet the Specifications of ASTM C478.

The hinged stainless steel or galvanized trash rack is to be cast integrally into the top of the inlet structure per the standard details.

The flow channel shall slope at a rate of 2 inches per foot and be cast integrally with the base requiring no field grouting. The sloping base shall be plastered with epoxy mortar (Ceilcote "HT 648," Sike "Sikedur Hi-Mod," or equal) and left smooth and clean.

Care shall be taken to properly prepare the pipe and to provide the water seal required at the pipe entrance per manufacturers recommendations.

The bottom of the excavation upon which the inlet base is to be placed shall be in a stable and unyielding condition with gravel bedding material leveled to 4" thickness to provide uniform support. If an unstable condition exists at the site of excavation, the unstable material shall be over excavated and backfilled with 1 1/2" uniformly graded coarse aggregate.

TRASH RACK

All parts of the trash rack for this spillway shall be made of galvanized or stainless steel. It shall be equipped with an antivortex baffle be able to be locked (as a safety precaution). The trash rack shall be aligned with the inlet structure by the precast manufacturer. Special precautions shall be made to ensure that the spillover into the inlet (through the trash rack) occurs at elevation 1433.00. The trash rack shall conform to the standard details and drawings.

LAYING PIPE

Each pipe shall be carefully examined before being laid and defective or damaged pipe shall not be used.

Bell and spigot pipe shall be laid with the bells facing upstream. Adequate bell clearance in the subgrade/bedding shall be provided.

Joints should be made watertight by use of Waterstop-RX or other method recommended by the manufacturer and approved by the engineer. All joining shall be conducted as recommended by the manufacturer. Joints should have a smooth finish to aid in hydraulic conductivity.

The joints shall be covered by a minimum of 2-foot wide, 4-ply thickness of filter fabric . Filter fabric shall be wrapped completely around the joint and overlapped a minimum of 12-inches at the top of the pipe. Lap shall be securely fastened to ensure filter fabric fits snugly during backfill operations. Filter fabric to be centered on the joint. Filter fabric shall conform to Material Specification 592, Table 2 Non-woven, Class II.

All pipe shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced. The lift holes in the RC Pipe shall be plugged with grout.

ALIGNMENT OF THE PIPELINE AND INLET STRUCTURE

The construction of the pipeline and inlet structures shall conform to the horizontal and vertical alignment shown in the Drawings.

The Engineer will furnish all horizontal and vertical alignment stakes, bench marks and/or other control as may be necessary for the construction. It is the exclusive responsibility of the Contractor to protect all construction stakes from damage or alteration. The Contractor shall be required to pay all costs for the repair or replacement of damaged or altered construction stakes, when in the opinion of the Engineer, the damage or alteration results from the negligence of the Contractor to protect the construction stakes.

The Contractor shall control the horizontal and vertical alignment of the pipeline and inlet structure using methods acceptable to the Engineer. The preferred method of alignment control is a laser beam system capable of continuously projecting both horizontal and vertical alignment along the pipeline and inlet structure as it is constructed with the laser beam being referenced as each successive section of pipe is installed. Other methods of alignment control may be allowed with the prior approval of the Engineer. The Contractor shall periodically check the horizontal and vertical alignment using the construction stakes provided. If a visual or other check discloses an apparent error in alignment, the construction of the pipeline shall be suspended and the Engineer notified. The entire cost for the removal and reconstruction of an improperly aligned pipeline shall rest solely with the Contractor, unless an error in the

construction stakes provided by the Engineer can be verified. At no time shall the Contractor change the horizontal or vertical alignment without the prior approval of the Engineer.

FLUSHING AND TESTING OF PIPELINE

Visual Inspection

As work progresses, each section of pipe shall be examined for interior damage to the pipe or the lining and all joints shall be checked for smoothness and continuity. Any chips, cracks, faulty joints or other defects shall be corrected by the Contractor at his expense.

Pipeline Flushing

If, through inspection, it is determined the pipeline has debris, the Contractor, at the end of the job, shall flush the pipelines by means that are in accordance with good practice to insure that earth, sand, rocks or other foreign materials are removed from the interior of the pipeline.

Pipeline Testing

Prior to the placement of concrete backfill around the conduit, the conduit shall be tested for leaks in the following manner:

1. Plug the outlet of the pipeline.
2. Brace the conduit at each end to prevent slippage.
3. Fill the conduit with water.
4. Allow the water to sit for at least two hours.

Any leaks shall be repaired and the conduit shall be re-tested as described above. The procedure shall be repeated until the conduit is watertight.

REMOVAL OF WATER

The trench and entire Construction Area shall be maintained in a dry condition until all construction operations including backfilling and compaction have been completed. The Contractor shall at all times during construction provide and maintain ample equipment for the removal and proper disposal of all surface and ground water entering the Construction Area. The Contractor shall be responsible for all damages resulting from the disposal of water. The entire construction of all pipelines shall occur under dry conditions. No construction activities shall occur in the trench when in the opinion of the Engineer the trench is not sufficiently dry to allow for the proper construction of the Project.

Before undertaking any surface or ground dewatering operations, the Contractor shall be solely and exclusively responsible for obtaining all permits and for notifying any governing agencies as may be required by law. The South Dakota Department of Environment and Natural Resources (SD DENR) may require a "General Permit to Discharge under the Surface Water Discharge System for Temporary Dewatering Activities in South Dakota." An application may be obtained from SD DENR at the Joe Foss Building, 523 East Capitol Avenue, Pierre, SD 57501-3181.

Surface Water - The Construction Area shall be graded to prevent the accumulation of surface runoff in the trench, or at any other locations within the Construction Area. The Contractor shall promptly remove all accumulations of surface runoff whether resulting from natural occurrences such as rainfall or snowfall, or as otherwise may occur due to other non-natural causes. The method for removal and disposal of surface runoff accumulations shall be approved by the Engineer before implementation of dewatering efforts. The preferred method of removal and disposal of surface runoff accumulations is by the use pumps to transport the surface water to an adjacent storm sewer or other existing drainage structure as approved by the Engineer.

Ground Water - The enclosed soils report has information on ground water levels. Should ground water be encountered during the excavation process, the construction of the pipeline shall be suspended and the Engineer notified. The Contractor shall be required to lower the elevation of the water table to a point at least twelve (12) inches below the maximum depth of excavation in the trench. The method for removal and disposal of ground water shall be approved by the Engineer before implementation of dewatering efforts. The preferred method of lowering the water table is by well points spaced in close enough proximity along the trench to adequately lower the water table at every location along the trench. The preferred method of disposing of the water is to transport the ground water to an adjacent storm sewer or other existing drainage structure as approved by the Engineer.

FOUNDATION PREPARATION

All pipelines and appurtenant structures shall be constructed on a stable and uniform foundation. The foundation shall be shaped such that the pipe rests at the established horizontal and vertical alignment, and to provide uniform bearing and support for the lower quadrant of each pipe along its entire length. Where necessitated by the configuration of the pipe joints, bell holes shall be constructed in the foundation to ensure uniform bearing and support of the pipe between the joints, and to allow for the proper construction of the pipe joints.

Over-excavation shall be backfilled with bedding or foundation material as directed by the Engineer.

FOUNDATION STABILIZATION

The Engineer shall determine the extent of over-excavation required for stabilization of the foundation. Over-excavated areas shall be backfilled with foundation material extending across the entire trench width from the over-excavated trench floor up to the bottom of the bedding zone.

Foundation stabilization is anticipated. When the undisturbed native material in the trench is determined to be unacceptable by the Engineer and over-excavation is chosen as the method of foundation stabilization, the Engineer will determine the type of foundation material to be used based on the severity of the instability and the availability of suitable foundation material in the excavation stockpile.

Native foundation material will be chosen from the most suitable material available within the excavation stockpile, and shall be approved by the Engineer before its incorporation into the Project. It shall be placed and compacted using methods approved by the Engineer.

Foundation material shall be placed beginning on a stable, uniformly shaped trench floor. The preferred method of placement shall be to carefully deposit the foundation material in horizontal lifts of approximately six (6) inches in uncompacted thickness, with each lift being compacted before the placement of the next lift. This procedure shall be repeated up to the bottom of the bedding zone, or other level deemed appropriate by the Engineer for the construction of the Project. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. Foundation stabilization shall not occur over frozen ground or when the foundation material is frozen.

EXCAVATION

The top edge of the open pipeline trench shall be sufficiently protected from any overburden which could cause a collapse or sliding of the trench walls, including the excavation stockpile, construction loads or traffic loads. When conditions warrant, the use of short tunnels may be allowed provided all applicable safety Laws and Regulations are observed. All excavation shall be classified as either "earth" or "rock."

Earth Excavation - All excavation, excluding rock excavation, required for the construction of the Project, regardless of the character of the material or the presence of obstructions, shall be classified as earth excavation, including over-excavation for foundation stabilization. The Contractor shall excavate the trench to the proper depth and configuration necessary for the safe construction of the Project as described in the Contract Documents. The Engineer shall approve the method of earth excavation before its commencement.

Rock Excavation - All rock excavation shall be under one classification. It shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, blasting, or other method of fracturing to allow for its removal, and boulders that exceed one half (½) cubic yard in volume. All other material shall be classified as earth excavation. Whenever rock is encountered in the trench, it shall be stripped of earth and the Engineer notified and given time to make a profile for the determination of quantities before any rock excavation begins. The Engineer shall approve the procedure for rock excavation before its commencement. The rock shall be removed from the rock surface to a point 6 inches below the pipe and to the minimum width specified under Trench Configuration, except the trench width shall not be increased above the pipe until the uppermost surface of the rock.

Express written permission from the Engineer shall be obtained before the use of explosives will be allowed. The Contractor shall further employ expert personnel acceptable to the Client for the execution of all blasting operations. The magnitude of charge used shall be limited to ensure the prevention of any damage to public or private property through vibrations or other means. The Contractor shall provide adequate protection to insure that no rock fragments or other flying debris are discharged as a result of blasting. Proof of insurance protection in an amount acceptable to the Client shall be provided by the Contractor before the commencement any blasting activities. The Client may further require the Contractor to purchase special insurance protection, in addition to the standard liability insurance, to cover all damages that may result from the use of explosives.

Excavation Stockpiles - All material removed from the trench during the excavation process shall be stockpiled by the Contractor. Generally, the excavation stockpile may be placed adjacent the trench from which the material was excavated. However, circumstances (both foreseeable and unforeseeable) may arise which require excavation stockpiles to be placed elsewhere on the Project Site.

Excavation material unsuitable for use as foundation, bedding, or backfill material, such as construction debris, rock, boulders, muck, peat, expansive clays and/or organic materials shall be classified as surplus excavation material and separated from the excavation stockpile. This material shall be classified as Surplus Excavation Material and the Contractor shall dispose of surplus excavation material outside the Project Site at an appropriate disposal site.

Protective Trench Shielding - The Contractor shall employ sheeting, bracing, or the use of a trench box or other protective shielding as required by Laws and Regulations to protect personnel, equipment, property and/or the Project from any collapse or sliding of the trench walls. Should the specified trench configuration or bedding zone, make it impossible to place the protective shielding on grade at the bottom of the excavation, the protective shielding shall rest on ledges above the pipe, and a narrower, deeper trench will be cut inside the protective shielding to accommodate the pipe, bedding material, and/or backfill material up to twelve (12) inches above the top of the pipe. However, this requirement in no way relieves the Contractor of any legal responsibility for safety on the Project Site.

Protection of Excavated Areas - The Contractor shall provide and maintain adequate signs, barricades, and other work zone safety measures in compliance with MUTCD and OSHA.

TRENCH CONFIGURATION

Trench walls shall be as near to vertical as conditions will allow. The width of the trench shall be no wider than is necessary to properly construct the pipe foundation, place the pipe, place the bedding material, and place and compact the backfill material.

The minimum trench width from a point twelve (12) inches above the top of the pipe to the bottom of the excavation, and at all points between, shall be at least twelve (12) inches plus the outside diameter of the pipe. The maximum trench width from a point twelve (12) inches above the top of the pipe to the bottom of the excavation, and at all points between, should be no greater than twenty-four (24) inches plus the outside diameter of the pipe. Exceptions of the maximum trench width may be permitted to ensure the proper placement and compaction of the bedding material under the pipe.

The width of the trench from twelve (12) inches above the top of the pipe to the top of the trench shall be no wider than necessary to provide for worker access to the pipe and clearance for protective shielding. Additionally, the Contractor may slope or bench the trench side walls from twelve (12) inches above the top of the pipe to the top of the trench with the prior approval of the Engineer.

BACKFILLING

The trench shall be backfilled using suitable native backfill material beginning at the top of the bedding zone. Native backfill material shall not contain debris, frozen material, large clods or stones, organic matter or other unstable material. Native backfill material will be chosen from the excavation stockpile and approved by the Engineer. It shall be free from rocks greater than six (6) inches, and shall be placed and compacted using methods approved by the Engineer.

The preferred method of placement shall be to carefully deposit the backfill material in horizontal lifts of approximately six (6) inches in uncompacted thickness, with each lift being compacted before the placement of the next lift. This procedure shall be repeated until the trench is filled to the level of the surrounding terrain or other level deemed appropriate by the Engineer for the construction of the Project. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. Backfilling shall not occur over frozen ground or when the backfill material is frozen. Stones larger than 3 inches in diameter shall not be placed within 2 feet of the top of the pipe.

COMPACTION

Foundation and backfill materials shall be compacted utilizing procedures and equipment which, with adequate moisture content, will result in a stable, uniformly compacted embankment. The Engineer shall approve the method of compaction for the various materials before their placement.

The preferred method of compaction for foundation and backfill material shall be the uniform densification of the material in ascending horizontal lifts by mechanical means wherever practicable. Sufficient cover shall be in place above the pipe before compaction with heavy equipment such as wheel or sheep's foot rollers is allowed. The preferred method of compaction for bedding material shall be the uniform densification of the material in ascending horizontal lifts by shovel slicing and pneumatic tamping. The Engineer may require the use of hand compaction equipment when compacting material in close proximity to a pipe or other structure to protect them from damage by mechanical equipment. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. However, changing conditions or failure to meet relative density requirements shall result in the Contractor being required to re-work and/or re-compact previously compacted materials.

Density Requirements - The relative density of foundation and bedding materials shall meet or exceed ninety-eight (98) percent of maximum dry density at all locations. When excessive variations occur, the Engineer may direct the Contractor to re-work and/or re-compact previously compacted areas to provide a uniformly compacted embankment even when minimum density requirements are met.

Moisture Content - The clay engineered fill should be placed at a moisture content ranging from minus 2% to plus 3% of the standard proctor. When moisture content is outside the specified range, the Engineer may direct the Contractor to scarify, adjust the moisture content, and re-compact previously compacted areas even when minimum density requirements are met.

The moisture content of all foundation and/or backfill materials shall be uniform before compaction. When conditions warrant, the Contractor shall be required to modify the existing moisture content of the material using methods acceptable to the Engineer. The preferred method of reducing water content in excessively wet materials shall be to repeatedly scarify and aerate the material until reaching acceptable, uniform moisture content. The preferred method of increasing water content in excessively dry materials shall be to repeatedly wet and mix the material until reaching acceptable, uniform moisture content. Blending of wet and dry materials to achieve acceptable, uniform moisture content may be used to adjust moisture content with the prior approval of the Engineer.

DENSITY AND MOISTURE CONTENT TESTING

All foundation and backfill material shall be subject to density and moisture content testing. The Engineer will perform laboratory and field tests to determine the relative density and moisture content of all soil materials placed during the construction of the Project to ensure strict compliance with the Contract Documents. Density and moisture tests will be performed on a periodic basis dependent on the progress of construction of the Project. The frequency of testing shall be determined by the engineer.

All testing shall be performed in accordance with the latest published ASTM Standard. The maximum dry density and optimum moisture content of the various materials shall be determined in accordance with ASTM D-698 (Standard Proctor Method). The relative density of the compacted material shall be determined in accordance with ASTM D-1556 (Sand Cone Method), ASTM D-2167 (Balloon Method), or ASTM D-2922 (Nuclear Method). The moisture content of the compacted material shall be determined in accordance with ASTM D-2216 (Laboratory Method), or ASTM D-2922 (Nuclear Method).

Areas of embankment failing to meet the density and/or moisture requirements in the Contract Documents shall be rejected by the Engineer and alternately re-worked and re-tested until compliance with the Contract Documents is verified. If the second density or moisture test fails at any location, all costs for the second density and moisture test and all subsequent tests shall be the responsibility of the Contractor.

TECHNICAL SPECIFICATION FOR EARTHWORK

EARTHWORK QUANTITIES

Section	Cut or Fill (Cu. Yds.)
Overexcavation	13,366 (cut)
Emergency Spillway	14,340 (cut)
Dam	30,166 (fill)
37% Shrinkage	11,161 (fill)
Needed Borrow	13,621

SITE PREPARATION

Areas designated for borrow areas, embankment, and structural works shall be cleared, grubbed and stripped of topsoil. All trees, vegetation, roots and other objectionable material shall be removed. Channel banks and sharp breaks shall be sloped to no steeper than 1:1. All trees shall be cleared and grubbed within 15 feet of the toe of the embankment.

Areas to be covered by the reservoir will be cleared of all trees, brush, logs, fences, rubbish and other objectionable material unless otherwise designated on the plans. Trees, brush, and stumps shall be cut approximately level with the ground surface.

All cleared and grubbed material shall be disposed of outside and below the limits of the dam and reservoir as directed by the Client.

Topsoil is defined as organic surface soil. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over two inches in diameter, and without weeds, roots, and other objectionable material.

Strip topsoil to whatever depths encountered (min. 6 in.), and in such manner so as to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

Stockpile topsoil in storage piles in areas indicated or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust.

Additionally over excavation of the existing channel and side slopes must take place prior to any backfilling operations. Over excavation shall conform to the contours shown in the drawings and staked by the Engineer. Further excavation may be required in the event of large amounts of unstable foundation material.

BORROW AREAS

Additional backfill material shall be obtained from adjacent hillsides upstream from the dam site. To obtain suitable material for placement in the dam embankment, the topsoil, redeposited and/or other weak soils encountered at the bottom and along the side slopes of the creek shall be excavated to expose stiff competent clay till soils. Generally, this entails excavating to approximately ten feet below existing grade in the channel bottom and two feet below the existing grade on side slopes. To ensure that competent clay soils are being utilized, a geotechnical engineer shall periodically observe the excavation and filling operations. Additionally, backfill material shall be free of roots, stumps, wood, rubbish, stones greater than 6", frozen or other objectionable materials.

EARTHWORK OPERATIONS

The contours in the drawings indicate the top of the final grade, be it rip rap elevation or top of topsoil as appropriate. Grading shall be to the contours shown in the drawings and staked by the Engineer. All areas shall be graded to drain as indicated in the drawings. Generally, the maximum allowable variation in elevation from planned grade will be four inches except for areas designated for Fine Grading. Areas designated for Fine Grading in the drawings shall closely match the grades shown in the drawings and staked by the Engineer. The maximum allowable variation in elevation from planned grade will be one inch in areas designated for Fine Grading.

The excavation and embankments for dam, drainage ways and similar features shall be finished to reasonably smooth and uniform surfaces.

Prior to placing fill material for embankment, all clearing and stripping of topsoil and overexcavation shall be completed

The cleared surface under the areas to be filled shall be scarified to a depth of 6 inches, the moisture content adjusted to a value 0 to 4% above the optimum moisture content and compacted as specified for subsequent layers of embankment. If soft, wet or other unsuitable or unstable material is found to exist at embankment foundations, such unsuitable materials shall be removed to such depths as may be required or directed by the Engineer.

Clay fill materials for the construction of the dam embankment shall be placed in maximum 8 inch thick (before compaction) layers which are to be continuous over the entire length of the fill. Place layers horizontally and compact each layer prior to placing additional fill. Each layer shall be watered, if necessary, to adjust the moisture content. Compaction shall be accomplished by sheepfoot rolling or other suitable equipment which is demonstrated to achieve the required results. Clay fill shall be compacted to at least 98% of the Standard Proctor Density (ASTM: D698).

The clay engineered fill should be placed at a moisture content ranging from minus 2% to plus 3% of the Standard Proctor.

Prior to topsoiling and finish grading operations, all rough graded areas shall be corrected, adjusted and/or repaired and shall be inspected and approved by the Engineer. All mounds and ridges shall be cut off, gullies and depressions filled, and other necessary repairs performed. All surfaces shall be even and properly compacted.

Spread topsoil material to a minimum depth of six (6) inches within the grading limits. Complete grading of site, eliminating rough or low areas, and bring to finish elevations indicated on the Drawings. Surface on general turf areas shall be bladed smooth. If there is an excess of topsoil, use as subsoil beneath the six (6) inches of topsoil. The final grade shall be feathered smoothly to blend with adjacent ground shapes and to provide continuous and harmonious lines in the finished work.

Do not place topsoil when subgrade or topsoil is frozen. Do not place topsoil when moisture or other conditions cause clodding.

SUBGRADE COMPACTION TESTING AND CONTROL

Owner shall employ a Geotechnical Engineer to furnish soils testing services during construction of the facilities. Before beginning inspections, the Geotechnical Engineer shall review with the Engineer the allowable soil bearing values that the foundations were designed for. Geotechnical Engineer to perform preliminary tests to establish moisture-density relations for all materials encountered.

The extent of compaction testing shall be as necessary to assure compliance with specifications. The contractor shall give adequate notice to Geotechnical Engineer when ready for compaction or subgrade testing and inspection. In the event backfill compaction requirements are not met, the Contractor shall remove fill material, adjust moisture content if required, replace and recompact until the required density is achieved.

WATER

Where natural soil moisture content is less than required for embankment, the Contractor shall haul and apply water uniformly to each layer of embankment material placed. Watered embankment material shall be mechanically scarified, bladed and manipulated to provide uniform moisture distribution in each layer before compaction operations are started. Excess moisture, either through natural causes or over watering shall be corrected by drying operations, or by mixing with drier soil materials to achieve the specified moisture content.

The contractor shall not withdraw water directly from streams in watershed of the James, Vermillion, and Big Sioux Rivers. Water may be obtained from other sources not directly connected to these streams such as stock dams, wetlands, or wells. This note does not relieve the Contractor of his/her responsibility to obtain the necessary permits from other agencies such as DENR (South Dakota Department of Environmental and Natural Resources) and COE (Corps of Engineer).

SURPLUS EARTH

Unless designated elsewhere for use or disposal on Owner's property, surplus earth becomes the property of the Contractor and shall be removed from the Owner's site.

RIPRAP

Included in this section is the work required to provide and install riprap stabilization on side slopes as shown on the drawings, specified herein, or both. The Contractor shall submit a complete description of the source and character of all riprap and related materials to the Engineer for his approval prior to beginning the work.

Riprap will be on the basis of volume in cubic yards. Measurements of thickness will be performed to insure minimum plan thickness is achieved.

Section	Fill (Cu. Yds.)	Class
Principal Spillway Plunge Pool	950	C
Emergency Spillway Basin	1,146	C
Dam Wave Protection	1,546	A
Total Needed Riprap	3,642	

Before placing riprap, dress slopes to be protected to a smooth surface, free from plants, brush, debris, and other objectionable materials. Additionally, all slopes shall be compacted and any soft or objectionable material shall be removed and replaced with approved material as directed by the Engineer.

When drainage fabric is specified on the plans, the surface to be covered shall be smooth, free of obstructions, and shall conform to plan shown dimensions prior to placement of the drainage fabric.

The drainage fabric shall be placed under and along all sides of the riprap that are in contact with earth, unless otherwise shown on the plans. Lapped joints in the drainage fabric shall be placed transverse to the direction of flow with the overlap in the direction of flow. All lapped joints shall be lapped a minimum of one foot (300 mm). Vehicles and equipment shall not be operated directly on the drainage fabric.

Stone for riprap shall be hard and durable and shall have a minimum unit weight of 155 pounds per cubic foot. Stone shall be quarried ledge rock. If field stone is utilized for Class C or larger, the stone shall have a minimum of 2 fractured faces as defined under SD 211 subsection 3.4. Stone shall be free from overburden, spoil, shale and organic material, and shall meet the following gradation requirements.

Riprap Class	Rock Size (ft)	Rock Size (lbs)	Percent of Riprap Smaller Than
A	1.30	200	100
	0.95	75	50
	0.40	5	15
C	2.25	1000	100
	1.8	500	50
	0.95	75	15

Riprap shall be placed in a manner which will produce a reasonable well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades and thicknesses shown on the drawings. Riprap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

The larger stones shall be well distributed and the entire mass of stone shall conform to the gradation specified. All material going into riprap protection shall be so placed and distributed that there will be no large accumulations of either the larger or smaller sizes of stone. It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to achieve the desired results as directed by the Engineer.

All riprap shall have drainage fabric beneath it.

DRAINAGE FABRIC

All drainage fabric shall be Type B and shall conform to the requirements set forth in *2004 Standard Specifications for Roads & Bridges – Section 831*.

TECHNICAL SPECIFICATION FOR EROSION CONTROL

TEMPORARY DIVERSION DIKE

Temporary Diversion Dikes shall be constructed at the locations generally indicated in the Erosion Control Plans as detailed in Sioux Falls Standard Plate 734.04. The exact location for each temporary diversion dike shall be determined by the Contractor and approved by the Engineer.

EROSION WATTLES

Erosion Control wattles shall be installed at locations indicated in the Erosion Control Plan or as directed by the Engineer. Refer to SD-DOT Standard Plate 734.06 for details. Erosion Control Wattles shall be placed promptly after seeding.

The erosion control wattles provided shall be from the list shown below:

Product	Manufacturer
Straw Logs	Western Excelsior Corporation Mancos, CO Phone: 1-800-833-8573 www.westernexcelsior.com
Earth Saver Rice Straw Wattles	R. H. Dyck Inc. Winters, CA Phone: 1-530-795-4751 www.earth-savers.com

The quantity of Erosion Control Wattle is 60 linear feet.

Erosion Control Wattles can not contain noxious weeds and shall be removed by owner after vegetation is established.

HIGH FLOW SILT FENCE

The high flow silt fence fabric provided shall be from the list shown below:

High Flow Silt Fence Fabric (Water Flow Range: 75-145 gal/min/sq ft)	
Product	Manufacturer
FF101 FW300 FW402	Mirafi Construction Products Pendergrass, GA Phone: 1-706-693-2226 tcmirafi.com
111F 914 D	SI Geosolutions Chickamauga, GA Phone: 1-800-635-2308 www.fixsoil.com

High flow silt fence shall be placed at the locations noted in the drawings and at locations that will minimize siltation of adjacent streams, lakes, dams, or drainage areas as determined by the Engineer during construction. Refer to Standard Plate 734.05 for details.

The quantity of high flow silt fence is 400 linear feet.

Mucking silt fence shall consist of removing muck trapped by the silt fence and spreading the material evenly over the adjacent area to conform to the existing grade. The Contractor shall remove muck when the surface of the muck is at approximately 1/3 the height of the silt fence.

Silt fence shall be removed when vegetation is established. Some or all of the silt fence may be left on the project until vegetation is established. Any silt fence left in place after Final Completion shall be removed by the Client.

TURF REINFORCEMENT MAT

The composite turf reinforcement mat (C-TRM) shall be placed at the locations noted in the table and depicted in the drawings.

TABLE OF TURF REINFORCEMENT MAT

Location	Quantity (SqYd)	Note
1+55 – 35' R to 35' L To 2+00 – 22.5' R to 22.5' L	350	
2+00 – 22.5' R to 22.5' L To 5+25 – 22.5' R to 22.5' L	1,750	TRM shall be installed before the riprap outlet protection has been installed.

The composite turf reinforcement mat shall be the North American Green C350, or equivalent.

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% coconut fiber matrix incorporated into permanent three-dimensional turf reinforcement matting.

The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a super heavy duty UV stabilized bottom net with 0.50 x 0.50 inch openings, an ultra-heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch openings, and covered by a super heavy duty UV stabilized top net with 0.50 x 0.50 inch openings. The corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

The mat shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the U.S. Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications For Construction of Roads and Bridges on Federal Highway Projects, FP-03 2003 Section 713.18* as a *Type 5A, B, and C Permanent Turf Reinforcement Mat*.

Installation staple patterns shall be clearly marked on the turf reinforcement matting with environmentally safe paint. All mats shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

Topsoil shall be shaped for the C-TRM as specified on Standard Plate 734.01 and as recommended by the manufacturer.

ROCK CHECK DAM – CLASS A RIPRAP

The rock for the rock check dams shall be class A Riprap. The rock check dams shall be constructed at the locations noted in the plans and conforming to SD-DOT Standard Plate 734.03. Rock can be placed by hand or mechanical methods (no dumping of rock) to achieve complete swale coverage. Prior to placing any riprap, excess soil should be removed and the side slope shall be smoothly graded.

Rock check dams shall be keyed into the channel bottom to a depth of 6 inches.

Table of Rock Check Dams:

Location	Quantity of Class A Rip Rap (Cu. Yds.)
Sta. 7+53 – 144' Lt. To Sta. 8+03 – 251' Lt.	18
Sta. 8+98 – 33' Lt. To Sta. 9+67 – 62' Lt.	11
Sta. 11+63 – 106' Rt. To Sta. 11+97 – 276' Rt.	26
Sta. 13+39 – 4' Rt. To Sta. 14+32 – 190' Rt.	31

DOWNSTREAM DAM REPAIR

The downstream dam shall be repaired to restore the hydraulic integrity of the tributary. Construction dimensions and elevations should conform to the standard details. Prior to placing any gabions, excess soil should be removed and the side slope shall be smoothly graded. The outer dimensions of the dam are 133 feet by 39 feet.

GABIONS

Wire baskets and mats shall be constructed to the depths called for on the drawings. Baskets shall be assembled into units not less than 6', nor more than 12' in length. Baskets shall conform to Section 721 of the South Dakota Department of Transportation Standard Specifications, latest edition. Wire shall be zinc coated per FS QQ-W-461g, Class 3. Wire gauge shall be No. 11 for mesh and No. 9 gauge for edge wire and selvage wire. Lacing wire shall be gauge No. 13½.

Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately six inch spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every four inches. Empty gabion units shall be set to line and grade as shown on the plans or as directed by the Engineer. Wire ties or connecting wire shall be used to join the units together in the same manner as described above for assembling. Internal tie wires shall be uniformly spaced and securely fastened in each outside cell of the structure or where ordered by the Engineer. When gabions are being placed as slope protection, the cross connecting wires may be deleted if ordered by the Engineer. A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.

The gabions shall be filled with stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. After gabion has been filled, the lid shall be bent over until it meets the sides and edges. The lid shall then be secured to the sides, ends and diaphragms with the wire ties or connecting wire in the manner described above for assembling.

GENERAL SEEDING, MULCHING AND FERTILIZING

Seeding shall be performed by an experienced landscape contractor with local experience. The contractor shall seed all areas as designated in the plan and by the Engineer.

Seeding is not permitted between June 1 and August 1. Seeding shall not be done when ground is frozen or excessively wet. Additionally, winds shall be less than 15 mph.

Do not deliver seed or fertilizer until immediately prior to use. Seed & Fertilizer should be stored in original unopened containers or bags with complete product labeling.

Areas to be seeded shall be finished to grades shown on the drawings and then cultivated to provide a reasonably firm, but friable seedbed. Till newly topsoiled areas and all other areas to be seeded to a depth of six inches to eliminate clods and voids. Pack soil to a firm, but not hardpacked condition. A minimum of six inches of surface soil shall be in friable condition.

Seed shall consist of a uniform blend of the following varieties:

RURAL AREA	(In pounds Pure Live Seed per acre)
Fairway Crested Wheat Grass	6½ lbs
Western Wheat Grass	6½ lbs
Alfalfa	2 lbs

The estimated quantity of Rural Seed is 48 lbs.

All permanent seed shall be planted in the topsoil at a depth of ¼" to ½". Slopes shall be worked longitudinally, on contour. Use approved mechanical seeding equipment such as seed drills, cultipacker seeders or landscape seeders to apply seed in the amount and mixtures specified.

The seeded areas shall be maintained until all work in the entire contract or designated portions thereof have been completed and accepted. Maintenance shall consist of providing protection against traffic and of repairing any damage.

If at any time before completion and acceptance of the entire contract work, the seeded areas are damaged by erosion, trespass or other cause, the areas shall be repaired and reseeded, as originally specified.

Fertilizing

Fertilizer shall be applied not more than 48 hours prior to seeding.

A commercial fertilizer with a minimum guaranteed analysis of 18-46-0, 11-52-0, or an approved alternate fertilizer, shall be applied to all areas designated for permanent seeding. The application rate of fertilizer shall be 100 pounds per acre.

The estimated quantity of Fertilizer is 1100 lbs for the entire project.

Mulching

Mulch must be placed within 48 hours of seeding. Mulch shall be blown on and punched in longitudinally on contour over the seeded areas at an application rate of 2 tons per acre. Grass hay or straw mulch shall be free of weed seeds and objectionable material.

The estimated quantity of Mulch is 22 tons for the entire project.

WETLAND SEEDING

Work shall be performed in compliance with applicable requirements of governing authorities having jurisdiction.

Contractor shall submit the following qualifications:

1. Shall have at least three years of experience planting prairies or savannas of similar size to this project.
2. A list of at least three successfully completed installations (i.e. good diversity of species, without occurrence of non-natives) with addresses of the projects and client names and phone numbers.
3. That the personnel supervising and planting this project have the documented experience successfully planting prairies.
4. That the contractor has access to the equipment necessary for installing a prairie Brillion or Truax® drills or approved equal).
5. That the contractor's business specializes in prairie and savanna plantings and/or restorations.
6. Demonstrated experience in the successful establishment and/or restoration of, at minimum, five wetland projects of comparable size.
7. Submitted resume of experience, equipment, personnel qualifications, subcontractor qualifications and selected client references.
8. Submitted letters of recommendation referencing specific projects. This may also include written or verbal commentary from public agency personnel within the natural resources management field.
9. Assignment of a Qualified Project Supervisor capable of being present full time during all installation and maintenance work. Qualifications will include:
 - A bachelor's degree in Natural Resources Management or related field.
 - Minimum of five years experience in landscape restoration and maintenance supervision, with experience or training in prairie and wetland management, entomology, pest control, soils, fertilizers and plant identification.
 - Current herbicide and pesticide applicators license.
10. Assignment of a Qualified Labor Force thoroughly familiar and trained in the work.

All seeded areas shall be guaranteed 25% germination within the first growing season. However, abuse of areas such as through vehicle traffic; or paths caused by human traffic, are not to be covered by said guarantee. All bare spots in excess of ten (10) sq ft shall be replaced at no added cost to Owner.

Seed

Seed mixture shall be as shown below mixture of no less than 8 pounds pure live seed (PLS) per acre. Any deviation from the mix presented in the table below must be approved by the Engineer prior to the application of the seed.

All grass seed shall be free of noxious weed seeds, treated with appropriate fungicide at time of mixing and delivered to the site in sealed containers with dealer's guaranteed analysis.

Cover crop of oats will be planted in all wetland areas at a rate of 30 pounds per acre.

Wetland Mix 1 FAC-FACW

Common Name	Species		PLS
Switch grass	Panicum virgatum	FAC	15.0%
Big Bluestem	Andropogon gerardii	FACU	16.0%
Indian grass	Sorghsdtrum nutans	FACU	14.0%
Elymus virginicus	Virginia Wild Rye	FAC	40.0%
Prairie Cordgrass	Spartina pectinata	FACW	15.0%
	Totals		100%

The estimated area for Wetland Mix 1 seeding is 5.3 Acres.

Wetland Mix 2 Obligate

Common Name	Species		PLS
Switch grass	Panicum virgatum	FAC	20.0%
Elymus virginicus	Virginia Wild Rye	FAC	42.0%
Prairie Cordgrass	Spartina pectinata	FACW	16.8%
Green Bulrush	Sciprus atrovirens	OBL	0.1%
Wool Grass	Scirpus cyperinus	OBL	0.1%
Giant Bur-reed	Sparganium eurycarpum	OBL	21.0%
			100.0%

The estimated area for Wetland Mix 2 seeding is 2.5 Acres.

Preparation

Topsoil shall be the existing surface soil stripped and stockpiled on site.

Surface shall be graded and shaped to receive seeding to bring surface to true uniform planes free from irregularities and to provide drainage. Cut or fill irregularities that develop shall be shaped as required until area is true and uniform, free from lumps, depressions, and irregularities. Topsoil shall be tilled or disked to a depth of 2".

Installation

Seeding shall be done with Brillion / Truax Seeder and drilled in. Planting depth of wetland mixes shall be between ¼ and ½ inch.

Cover crop shall be planted with broad cast planter prior to wetland mix planting.

Mulch will be clean straw, free of noxious weed seed or other objectionable materials. Mulch will be crimped or anchored into the soil.

Seeding times shall be from April 15th to July 15th or September 1st to November 15th.

Clean-up

All soils and debris resulting from wetland seeding shall be gathered and removed from the site.

TECHNICAL SPECIFICATIONS FOR CAST-IN-PLACE CONCRETE

SCOPE OF WORK

Included in this section is cast-in-place concrete. The Contractor shall furnish all the necessary labor, services, materials, equipment, tools, supplies and the like that are necessary to construct various concrete structures, as shown on the plans and called for in the specifications. The Contractor shall furnish everything necessary to do this, whether or not it may be specifically called for in these specifications or on the plans.

Throughout the progress of installation of the work of this section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this section. Use adequate number of skilled workmen to ensure installation in strict accordance with the drawings and specifications.

Materials and installed work may require testing and retesting, as directed by the Engineer, at any time during progress of the work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

FORM MATERIALS

Formwork for exposed concrete surfaces shall be constructed with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous straight, smooth, exposed surfaces. Form material shall have sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. Additionally, formwork shall be furnished in the largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

Forms for concrete surfaces which will not be exposed shall be constructed with plywood, lumber, metal or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit.

Commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces shall be utilized.

REINFORCING MATERIALS

Reinforcing bars shall be grade 60, deformed and satisfy ANSI/ASTM A615. All steel wire shall be plain, cold-drawn steel and satisfy ANSI/ASTM A82. Additionally, welded steel wire fabric shall satisfy ANSI/ASTM A185.

Contractor shall provide bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

CONCRETE MATERIALS

Only one brand of cement may be used for the duration of the project, unless otherwise stated by the Engineer. Cement shall be Type II Portland cement that satisfies ANSI/ASTM C150, unless otherwise acceptable to Engineer.

Normal weight aggregates shall satisfy ANSI/ASTM C33 and be supplied from a single source.

Water must be potable and air-entraining admixtures must conform to ANSI/ASTM C260. Additionally, the use of calcium chloride and flyash is prohibited.

RELATED MATERIALS

Moisture Barrier: Provide moisture barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in accordance with ANSI/ASTM E154, such as polyethylene sheeting that is at least 6 mils thick.

Non-Shrink Grout: CRD-C 588, factory premixed grout subject to compliance with requirements, provide Type D, nonmetallic, one of the following:

1. "Masterflow 713"; Master Builders.
2. "SonogROUT"; Sonneborn-Contech.
3. "Euco-NS"; Euclid Chemical Co.
4. "Five Star Grout"; U. S. Grout Co.
5. "DuragROUT"; L & M Const. Chemical Co.

Moisture-Retaining Cover for Curing: One of the following, complying with ANSI/ASTM C171:

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

Liquid Membrane-Forming Curing Compound: Federal Spec TT-C-800, Type I, unless other type acceptable to the Engineer. Products offered by manufacturers to comply with the requirements for membrane-forming curing compounds include the following:

1. "Klearseal"; Setcon Industries.
2. "Floor Coat"; The Euclid Chemical Corp.
3. "MB-429"; Master Builders.
4. "Kure N Seal 800"; Sonneborn-Contech.
5. "Klorkure 800"; Setcon Industries.
6. "Clear Seal 800"; W. R. Grace.
7. "Dress and Seal"; L & M Const. Chemicals.
8. "Sealco 800"; Gifford-Hill.
9. "Horn WB-309 Cure"; AC Horn, Inc.

Expansion Joint Materials:

1. Fiber: Nonextruding, ASTM D554.
2. Foam: Resilient closed cell polyurethane, W.R. Meadows "Rescor" or equivalent.
3. Sealer: Cold applied, polymer based elastomer, W.R. Meadows "Gardox" or equivalent.

Waterstops: PVC, 4" size, meet Corps of Engineers Specification CRD-C572, heat welded joints.

PROPORTIONING AND DESIGN OF MIXES

Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs.

Submit written reports to Engineer of each proposed mix for each class of concrete at least fifteen days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.

Concrete of the various mixes indicated as required in these specifications or on the drawings shall be proportioned in accordance with the following requirements as a minimum. Appropriate structural concrete designs shall be furnished by the Contractor.

Location	Walls & Slabs in Contact With Soil	Footings, Pipe Easements and Interior Slabs and not Subject to Freezing	Miscellaneous Concrete Permanently Exposed to Weather, Such as Sidewalks, Pipe Supports, Etc.
Compressive strength at 28 days	4000 psi	3000 psi	4000 psi
Minimum Cement Content	578 lbs/CY	517 lbs/CY	578 lbs/CY
Maximum Water Cement Ratio	0.45	0.53	0.45
Size of Course Aggregate	3/4"	3/4"	3/4"
Slump Range **	3" - 4"	2" - 3"	3" - 4"
Air Content	5% - 6%	5% - 6%*	5% - 6%

* Air may be omitted from interior floor slabs not subject to freezing.

** Slump Ranges do not apply if an approved high range water reducing agent is used.

CONCRETE MIXES

Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C94, and as herein specified. Each batch or truckload of concrete shall be in place within one and one-half hours from the time the water is introduced into the mixture. Retempering of delayed batches which have stiffened shall be prohibited. Indiscriminate addition of water to increase slump shall be prohibited. When the concrete arrives at the project with slump below that suitable for placing, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water must be incorporated by additional mixing equal to at least half of the total mixing required. Any addition of water above that permitted by the limitation of water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain the specified water-cement ratio. Such addition must be reviewed by the Engineer.

During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C94 may be required. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

FORMWORK

Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.

Formwork shall be constructed to ensure that concrete members and structure are of correct size, shape, alignment, elevation and position. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

Formwork shall be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

Form ties shall be factory-fabricated, adjustable-length, removable or snapoff metal. They shall be designed to prevent form deflection, and to prevent spalling concrete surfaces. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1 1/2" inside concrete. Ties shall not leave holes larger than 1" diameter in concrete surface.

Openings in concrete formwork shall be provided to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is completed to eliminate mortar leaks and maintain proper alignment.

PLACING REINFORCEMENT

Placement of reinforcement must comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

Prior to placement, the reinforcement shall be cleaned to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

Reinforcement shall be accurately positioned, supported and secured against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

Place reinforcement to obtain the required coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

JOINTS

Construction Joints:

- A. Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Engineer.
- B. Provide keyways at least 1 1/2" deep in construction joints in walls, slabs, beams, columns and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
- C. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints except for slabs on grade.
- D. Build in water stops at all construction joints shown on the plans, or at other construction joint locations for tank and other structures used for water containment.

Isolation Joints in Slabs-on-Ground:

- A. Construct isolation joints in slabs-on-ground at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

Contraction (Control) Joints in Slabs-on-Ground:

- A. Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4" wide x 1/4" of slab depth, unless otherwise indicated.
- B. Form contraction joints by inserting premolded hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured, remove inserts and clean groove of loose debris.
- C. Contraction joints may be formed by saw cuts as soon after slab finishing as possible without dislodging aggregate.

Joint filler and sealant materials shall be proposed by Contractor and approved by the Engineer.

INSTALLATION OF EMBEDDED ITEMS

Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

PREPARATION OF FORM SURFACES

- A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel form work is not acceptable.

CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete form work installation, reinforcing steel, and items to be embedded or casted. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Coordinate the installation of joint materials and moisture barrier with placement of forms and reinforcing steel.
- C. General: Comply with ACI 304, and as herein specified.
- D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- E. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

- F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
- G. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- I. Bring slab surfaced to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- J. Maintain reinforcing in proper position during concrete placement operations.
- K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be used by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 60 degrees F, and not more than 80 degrees F at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

- L. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Wet forms thoroughly before placing concrete.

FINISH OF FORMED SURFACES

Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.

Moisten concrete surfaces and rub with carborundum brick and other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

MONOLITHIC SLAB FINISHES

Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified. After screening, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by handfloating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint, urethane, or other thin film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance. Tolerances shall be true planes + 1/8" from finish floor elevation in 10' as determined by 10' straightedge placed anywhere on the slab in any direction. Grind smooth surface defects which would telegraph through applied floor covering system.

Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

SCHEDULE OF CONCRETE FINISH

<u>Location</u>	<u>Concrete Type of Finish</u>	<u>Surface Treatment</u>
Floor	Float	None
Sidewalk/Curb & Gutter	Nonslip Broom	None
Repair areas		

CONCRETE CURING AND PROTECTION

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified.

Provide moisture curing by following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

Provide moisture-cover curing as following: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

Provide curing compound to slabs as follows: Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three hours after initial applications. Maintain continuity of coating and repair damage during curing period.

Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, flooring, painting, and other coatings and finish materials, unless the manufacturer of the curing compound specifies that such use will not affect the bond of the covering.

Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, tops of beams and walls, floor topping, and other flat surfaces by appropriate methods.

REMOVAL OF FORMS

Form work not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work may be removed after cumulatively curing at not less than 50 degrees F for twelve hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

Form work supporting weight of concrete, may not be removed in less than fourteen days and until concrete has attained a minimum compressive strength of 3000 psi. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

Form facing material may be removed for days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

REUSE OF FORMS

Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new form work.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

MISCELLANEOUS CONCRETE ITEMS

Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

CONCRETE SURFACE REPAIRS

Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.

Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

For exposed-to-view surfaces, blend white Portland Cement and standard Portland Cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

Correct high areas in unformed surfaces by grinding, after concrete has cured at least fourteen days.

Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.

Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and applying a bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland Cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

Use epoxy-based mortar for structural repairs, where directed by Engineer.

Repair methods not specified above may be used, subject to acceptance of Engineer.

QUALITY CONTROL TESTING DURING CONSTRUCTION

Engineer will perform field testing for slump and/or air content of concrete and arrange for laboratory testing of cured concrete specimens at the expense of the Contractor. Contractor will sample concrete and prepare test cylinders.

Testing Schedule:

<u>Test</u>	<u>Reference Specifications</u>	<u>Frequency</u>
Slump	ASTM C143	Each Load
Air Content	ASTM C173	First load each day's work
Air Content	----	Hourly if air temp. Below 40 degrees F or above 80 degrees F.
Temperature		

<u>Test</u>	<u>Reference Specifications</u>	<u>Frequency</u>
Compression Specimens	ASTM C39	One set of 4 cylinders per day plus add'l. set per each add'l. 50 CY placed in one day.
		One specimen at 7 days, one at 14 days and two specimens at 28 days.

Additional Tests: If test results indicate that specified concrete strengths or other characteristics have not been attained, the Contractor may be required to conduct tests to determine adequacy of a concrete by cored cylinders complying with ASTM C42, or by other methods as directed or agreed to by the Engineer. The Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

STORM WATER POLLUTION PREVENTION PLAN - CERTIFICATION

PROJECT: _____

OWNER: _____

CONTRACTOR: _____

SUB-CONTRACTOR(S): _____

PRIMARY RESPONSIBLE PARTY FOR EROSION CONTROL

The following individual representing the indicated Contractor/Sub-contractor will be the Primary Responsible Party for erosion control.

Primary Responsible Party: _____

Contractor/Sub-Contractor: _____

CERTIFICATIONS

Certification of Compliance with Federal, State, and Local Regulations

The undersigned hereby individually certify under penalty of law that:

- The SWPPP and all attachments were prepared under their direction or supervision.
- The information included is, to the best of my knowledge and belief, true, accurate, and complete.
- The SWPPP for this project reflects the requirements of all local municipal jurisdictions for storm water management and sediment and erosion control as established by ordinance, as well as other state and federal requirements for sediment and erosion control plans, permits, notices, or documentation as appropriate.
- They are aware of the significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____(Signature) Date: _____
Owner's Representative

_____(Signature) Date: _____
Primary Responsible Party

This Certification shall be executed any time there is a change in the Owner's Representative or the Primary Responsible Party for Erosion Control on the project.



DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

NOTICE OF INTENT (NOI) to Obtain Coverage Under the SWD General Permit for Storm Water Discharges Associated with Industrial or Construction Activities

Return to: SD Department of Environment and Natural Resources
Surface Water Quality Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3181
Telephone: (605) 773-3351 or 1-800-SDSTORM

PLEASE PRINT OR TYPE

I. Applicant/Owner Information:

Name _____ Phone _____
Responsible Contact Person _____
Street _____
City _____ State _____ Zip Code _____

II. Facility/Site Information:

Name _____ Phone _____
Responsible Contact Person _____
Street _____
City _____ State _____ Zip Code _____

Type of Ownership: ☐ Private ☐ Federal
☐ State ☐ Public (Other than Federal or State)

III. Type of Permit Requested: Check (X) the appropriate response:

☐ Industrial Activity ☐ Sand/Gravel Mining Activity ☐ Construction Activity

IV. Pollution Prevention Plan

A. Has the Pollution Prevention Plan been developed as Required? Yes ☐ No ☐

If No, when will it be developed? _____
Please note: The plan must be developed before any industrial or construction activity begins

B. Please include a brief description of best management practices (pollution control measures) being used at the facility/site:

V. Facility/Site Location:

A. Quarter _____ Section _____ Township _____ Range _____
County _____ [If available: Latitude _____ Longitude _____]
B. Site/Project Name: _____
C. What is the total area covered by the site (in acres) _____

FOR DENR USE ONLY

Postmark Date: _____ Permit Number: _____ Date Permitted: _____

VI. Receiving Waters:

Please list all possible receiving waters of the storm water discharge (if discharging to a Municipal Storm Sewer, indicate which municipality and the ultimate receiving water):

VII. Nature of Discharge

- A. **Standard Industrial Classification (SIC) codes of this facility** (Include at least one, and up to four, SIC or 6-digit North American Industry Classification (NAIC) codes which best describe the facility. For example, the SIC Code for a sand/gravel pit is 1442. For construction activities, no codes are assigned; therefore, indicate CO):

- B. Please include a brief description of the activities conducted at this facility or construction site: _____

VIII. Operational History (Industrial Only)

Date Constructed: _____

Operational Start-up: _____

Construction Project History (Construction or sand/gravel mining)

Project Start Date (MM/DD/YY): _____

Estimated Area of Total Disturbance (in acres): _____

Estimated Completion Date (MM/DD/YY): _____

IX. Existing Environmental Permits

Please check (X) all other Environmental Permits which are held by this facility/activity. Include permit numbers in the space provided:

- ☐ SWD or NPDES (Discharges to Surface Water) _____
- ☐ UIC (Underground Injection of Fluids) _____
- ☐ RCRA (Hazardous Wastes) _____
- ☐ PSD (Air Emissions from Proposed Sources) _____
- ☐ Other (please specify) _____

X. Certification (Authorized representative should *initial* the box)

☐ I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including revocation of the permit and the possibility of fine and imprisonment for knowing violations. In addition, I certify that I am aware of the terms and conditions of the General Storm Water permit and I agree to comply with those requirements.

CERTIFICATION OF APPLICANT (COA)

I, _____, the applicant in the above matter after being duly sworn upon oath hereby certify the following information in regard to this application:

South Dakota Codified Laws Section 1-40-27 provides:

"The secretary may reject an application for any permit filed pursuant to Titles 34A or 45, including any application by any concentrated swine feeding operation for authorization to operate under a general permit, upon making a specific finding that:

(1) The applicant is unsuited or unqualified to perform the obligations of a permit holder based upon a finding that the applicant, any officer, director, partner or resident general manager of the facility for which application has been made:

- (a) Has intentionally misrepresented a material fact in applying for a permit;*
- (b) Has been convicted of a felony or other crime involving moral turpitude;*
- (c) Has habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage;*
- (d) Has had any permit revoked under the environmental laws of any state or the United States; or*
- (e) Has otherwise demonstrated through clear and convincing evidence of previous actions that the applicant lacks the necessary good character and competency to reliably carry out the obligations imposed by law upon the permit holder; or*

(2) The application substantially duplicates an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Nothing in this subdivision may be construed to prohibit an applicant from submitting a new application for a permit previously denied, if the new application represents a good faith attempt by the applicant to correct the deficiencies that served as the basis for the denial in the original application.

All applications filed pursuant to Titles 34A and 45 shall include a certification, sworn to under oath and signed by the applicant, that he is not disqualified by reason of this section from obtaining a permit. In the absence of evidence to the contrary, that certification shall constitute a prima facie showing of the suitability and qualification of the applicant. If at any point in the application review, recommendation or hearing process, the secretary finds the applicant has intentionally made any material misrepresentation of fact in regard to this certification, consideration of the application may be suspended and the application may be rejected as provided for under this section.

Applications rejected pursuant to this section constitute final agency action upon that application and may be appealed to circuit court as provided for under chapter 1-26."

Pursuant to SDCL 1-40-27, I certify that I have read the forgoing provision of state law, and that I am not disqualified by reason of that provision from obtaining the permit for which application has been made.

NOTE: The Notice of Intent must be signed by the authorized chief elective, an executive officer or a corporate responsible official of the applicant, or by the applicant, if an individual.

I declare and affirm under the penalties of perjury that this certification has been examined by me, and to the best of my knowledge and belief, is in all things true and correct.

Name (print) _____
Title _____
Signature _____
Date _____

**PLEASE ATTACH SHEET DISCLOSING ALL FACTS PERTAINING TO SDCL 1-40-27 (1) (a) THROUGH (e).
ALL VIOLATIONS MUST BE DISCLOSED, BUT WILL NOT
AUTOMATICALLY RESULT IN THE REJECTION OF AN APPLICATION.**

**STORM WATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT**

PROJECT: _____

OWNER: _____

PRIMARY RESPONSIBLE PARTY: _____ **Date:** _____

Days since Last Rainfall: _____ **Amount of Last Rainfall:** _____ (Inches)

Erosion Control Item	Stabilized? (Yes/No)	CONDITION

Stabilization Required: _____

Primary Responsible Party (Signature) Date: _____

Owner's Representative (Signature) Date: _____



DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

NOTICE OF TERMINATION (NOT) of Coverage Under the SWD General Permit for Storm Water Discharges Associated with Industrial or Construction Activities

This form is required to be submitted when a discharge permit is no longer required or necessary. Submission of this form shall in no way relieve the permittee of permit obligations required prior to submission of this form. Please submit this form to the following address:

original to: SD Department of Environment and Natural Resources
Surface Water Quality Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3181
Telephone: (605) 773-3351 or 1-800-SDSTORM

PLEASE PRINT OR TYPE

I. Applicant/Owner Information

Name _____ Phone _____
Street _____
City _____ State _____ Zip Code _____

II. Facility/Site Information

Name _____ Phone _____
Responsible Contact Person _____
Street _____
City _____
State _____ County _____ Zip Code _____

III. Permit Number: _____ Site/Project Name: _____

IV. Check the reason for termination of permit coverage:

☐ Storm Water Discharge associated with permitted activity is no longer occurring. If construction, has the area been restabilized? Please explain:

☐ You are no longer the operator of the facility/site. Please explain:

I certify under penalty of law that all storm water discharges associated with industrial or construction activity from the identified facility that are authorized by a SWD general permit have been eliminated or that I am no longer the operator of the facility or construction site. I understand that by submitting the Notice of Termination, I am no longer authorized to discharge storm water associated with industrial or construction activity under this general permit, and that discharging pollutants in storm water associated with industrial or construction activity to waters of the state is unlawful under the federal Clean Water Act, where the discharge is not authorized by a SWD permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the South Dakota Water Pollution Control Act. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

NOTE: NOT must be signed by the authorized chief elective or executive officer of the applicant, or by the applicant, if an individual.

Name (print) _____ Title _____

Signature _____ Date _____

FOR DENR USE ONLY

Permit Number: _____ Postmark Date: _____ Date Terminated: _____

WIEMAN DAM PROJECT

RESPONSE TO ARCHEOLOGICAL ASSESSMENT

PROJECT DESCRIPTION

The project includes the construction of an earth-filled dam in rural Turner County, South Dakota (Figure 1) more specifically described as the SE Quarter of Section 19, T100N, R54W. The project is being proposed by Mr. Marlo Wieman the current owner of proposed dam site. The project is located approximately four miles north of the City of Marion adjacent 447th Avenue. The dam will be constructed on an unnamed tributary to the West Fork of the Vermillion River approximately 1.5 miles up stream of said West Fork of the Vermillion River.

ARCHEOLOGICAL ASSESSMENT

USACOE personnel have performed an archeological assessment of the proposed project and identified a small stone foundation which may be of historical or archeological significance (Figure 2). The stone foundation is located adjacent the unnamed tributary and upstream of the proposed dam site (Figure 3) in an area potentially affected by the construction of the project.

POSSIBLE CONSEQUENCES

Clark Engineering has established the elevation of the foundation at 1440.3 feet. The maximum water level in the proposed reservoir will be the anticipated spillway elevation of 1433.0 leaving nearly 7 vertical feet and approximately 65 horizontal feet to the high water edge. Additionally the foundation location will be clearly indicated on the final construction plans and a note requiring its protection during construction.

CONCLUSION

It is the conclusion of Clark Engineering that the proposed project can be constructed without adverse affect of the stone foundation.

**Assessment of the Potential Impacts of a Proposed Dam on an
Unnamed Tributary of the West Fork of the Vermillion River
to the Endangered Topeka Shiner (*Notropis topeka*)**

June 5, 2006

Prepared For:

Mr. M. Wieman
and
Clark Engineering

CLARK ENGINEERING
CORPORATION

JUL 03 2006

BIOUX FALLS, S.D.

Prepared By:

Sheila K. Thomson
Steven S. Wall

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List of Abbreviations

dd – decimal degrees

m – meters

mm – millimeter

cm/s – centimeters per second

" – inch

P – pool

RU – run

RI – riffle

BS – bank slumpage

IB – bank incision

UB – bank undercutting

OV – overhanging vegetation

GR/F – grasses/forbes

WR – riparian woody vegetation

EV – emergent vegetation

SV – submergent vegetation

FA – filamentous algae

S/C – silt/clay

Sa – sand

Gr – gravel

Co – cobble

Bo – boulder

BIS – bigmouth shiner

BRM – brassy minnow

BRS – brook stickleback

CNS – common shiner

CRC – creek chub

FHM – fathead minnow

GSF – green sunfish

OSF – orange-spotted sunfish

RES – red shiner

SAS – sand shiner

STR – central stoneroller

TOS – Topeka shiner

R – stream reach

WD – woody debris

Introduction

Problem Statement

A proposal to construct an impoundment by damming an unnamed tributary to the West Fork of the Vermillion River (Figure 1) has caused concern as to the effect this structure may have on the Topeka shiner, a federally endangered species. Topeka shiners inhabit the West Fork of the Vermillion River and have been found in its headwaters. Although the unnamed tributary where dam construction has been proposed is classified as "low-probability" to support the Topeka shiner (Wall et al. 2001), the species has been found in similar "low-probability" tributaries within its range. Construction of impoundments on streams inhabited by Topeka shiners were correlated to decreased numbers of the species and in some cases extirpation of local meta-populations (Layer 1993; Mammoliti 1995; Stark et al. 1999; Winston 1999; Schrank et al. 2001). Cause and effect have not been established, but it has been suggested that altered habitat, barriers to migration, altered hydrology, and the introduction of exotic piscivores (i.e. largemouth bass) may be the cause of the local extirpations. The purpose of this study was to determine the potential use of the tributary by Topeka shiners and possible impacts the proposed dam may have on this species. Specific objectives of this study were to: 1) Sample stream reaches to determine the presence or absence of the Topeka shiner in this tributary; 2) Conduct habitat surveys to determine potential use of the tributary by Topeka shiners; and, 3) Assess accessibility of the tributary by Topeka shiners inhabiting the mainstem of the West Fork of the Vermillion River.

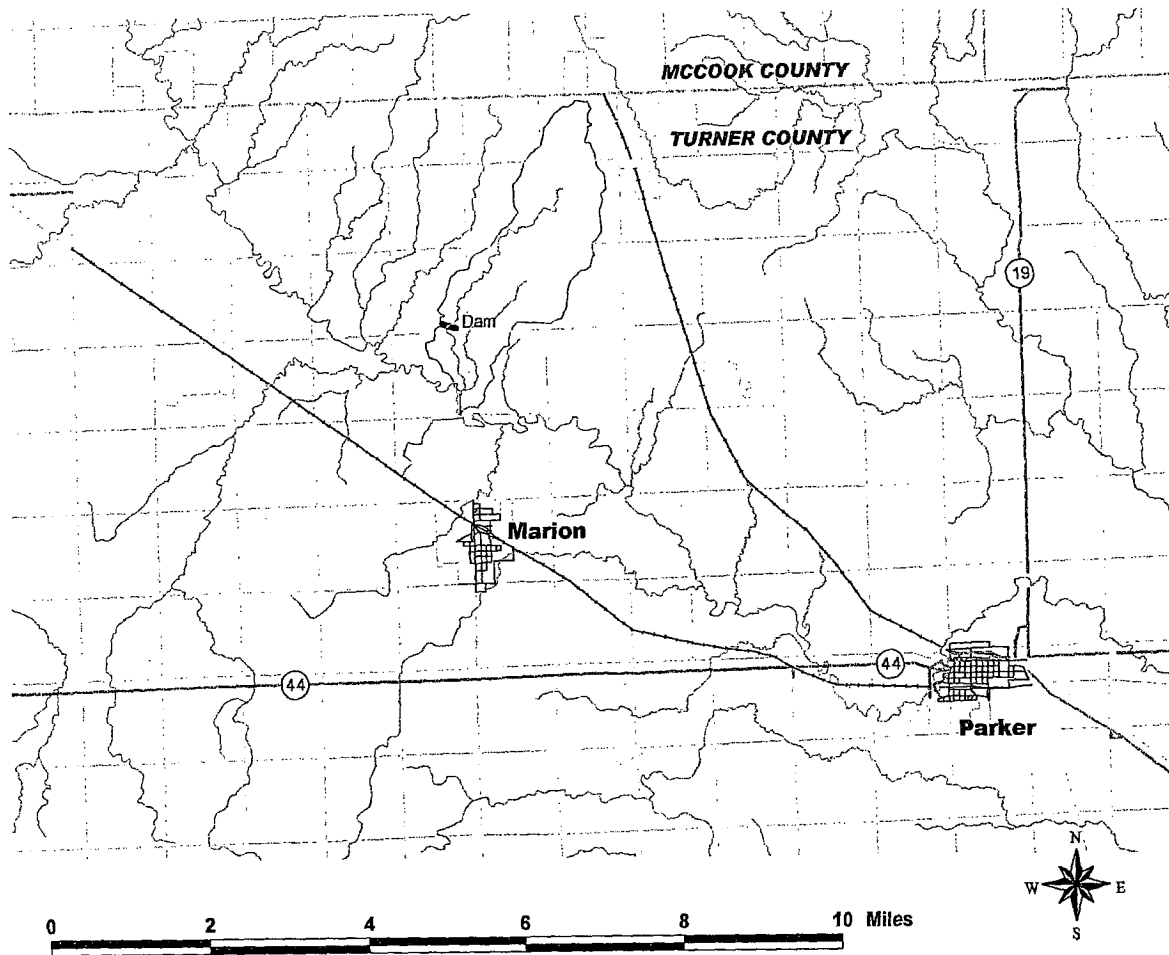


Figure 1. Location of proposed dam on an unnamed tributary to the West Fork of the Vermillion River. Gray area indicates tributary watershed.

Topeka shiner

The Topeka shiner is a small Cyprinid found in six states: South Dakota, Minnesota, Nebraska, Iowa, Kansas, and Missouri (Bailey and Allum 1962). It has a three-year life expectancy (Cross and Collins 1995; Pflieger 1997) and reaches a maximum length of approximately 75 mm (Hatch 2001; Shearer 2003; Wall and Berry 2004). Characteristics of the Topeka shiner include a dusky lateral band, a dark wedge-shaped caudal spot, prominent pigmentation outlining scales above the lateral line, and

crowding of the dorsal scales posterior to the head (Wall and Berry 2004). Breeding males have orange-red colored fins and a copper-hue to their heads.

Topeka shiner habitat includes pools of low order streams (Kerns and Bonneau 2002; Minkley and Cross 1959; Wall and Berry 2004) and clear, vegetated backwaters (Kiutinen 2001) with substrates varying from gravel and sand to silt-covered hardpan clay (Minckley and Cross 1959; Wall and Berry 2004). The Topeka shiner is intolerant of high velocity water and resorts to oral grasping to avoid being swept downstream in strong currents, although flows > 55 cm/s likely exceed the Topeka shiner's ability to grasp and maintain their position within stream reaches (Adams et al. 2000).

The Topeka shiner was listed as federally endangered in 1999 due to an 80% reduction across its historical distribution (Wall and Berry 2004). Reasons for the species' decline include altered stream hydrology and reduced water quality due to wetland drainage, stream channelization, tiling, groundwater withdrawal, and water impoundment (Wall and Berry 2004). Largemouth bass (a non-native predator) has also been linked to local extirpation of Topeka shiner populations (Schrack et al. 2001), although Knight and Gido (2005) found that largemouth bass opportunistically (rather than preferentially) feed on the Topeka shiner.

Methods

Fish Community

Reconnaissance surveys of the tributary above and below the proposed dam were conducted to select suitable sample sites. To maximize our ability to detect Topeka shiners in the tributary, we used statewide data from records at South Dakota State University (SDSU), of the prevalence of Topeka shiners in streams and determined that, if present, Topeka shiners were detected on average in one out of 10 reaches sampled within a stream (S. Wall; unpublished data). Applying detection probabilities (i.e. the number of samples to catch a target fish at the same site; Hayer et al. 2006) to the SDSU data showed that Topeka shiners were captured in a stream reach on average within three sampling efforts. Basing our sampling effort on this data, 10 stream reaches (Table 1; Appendix A) were sampled and were numbered 1 through 10 from downstream to upstream (Figure 2). Reach lengths were based on 40 mean stream widths measured

Table 1. The latitudes (dd), longitudes (dd), and lengths (m) of the 10 stream reaches sampled.

Reach #	DOWNSTREAM		UPSTREAM		Length (m)
	Latitude	Longitude	Latitude	Longitude	
1	43°26.894'	97°15.849'	43°26.957'	97°15.787'	170
2	43°27.002'	97°15.749'	43°27.064'	97°15.745'	170
3	43°27.120'	97°15.800'	43°27.177'	97°15.825'	170
4	43°27.306'	97°15.860'	43°27.362'	97°15.925'	170
5	43°27.395'	97°15.919'	43°27.460'	97°15.882'	170
6	43°27.562'	97°15.982'	43°27.615'	97°15.962'	150
7	43°27.644'	97°15.947'	43°27.652'	97°15.870'	150
8	43°27.675'	97°15.865'	43°27.730'	97°15.837'	150
9	43°27.773'	97°15.816'	43°27.823'	97°15.835'	150
10	43°28.028'	97°15.605'	43°28.074'	97°15.554'	150

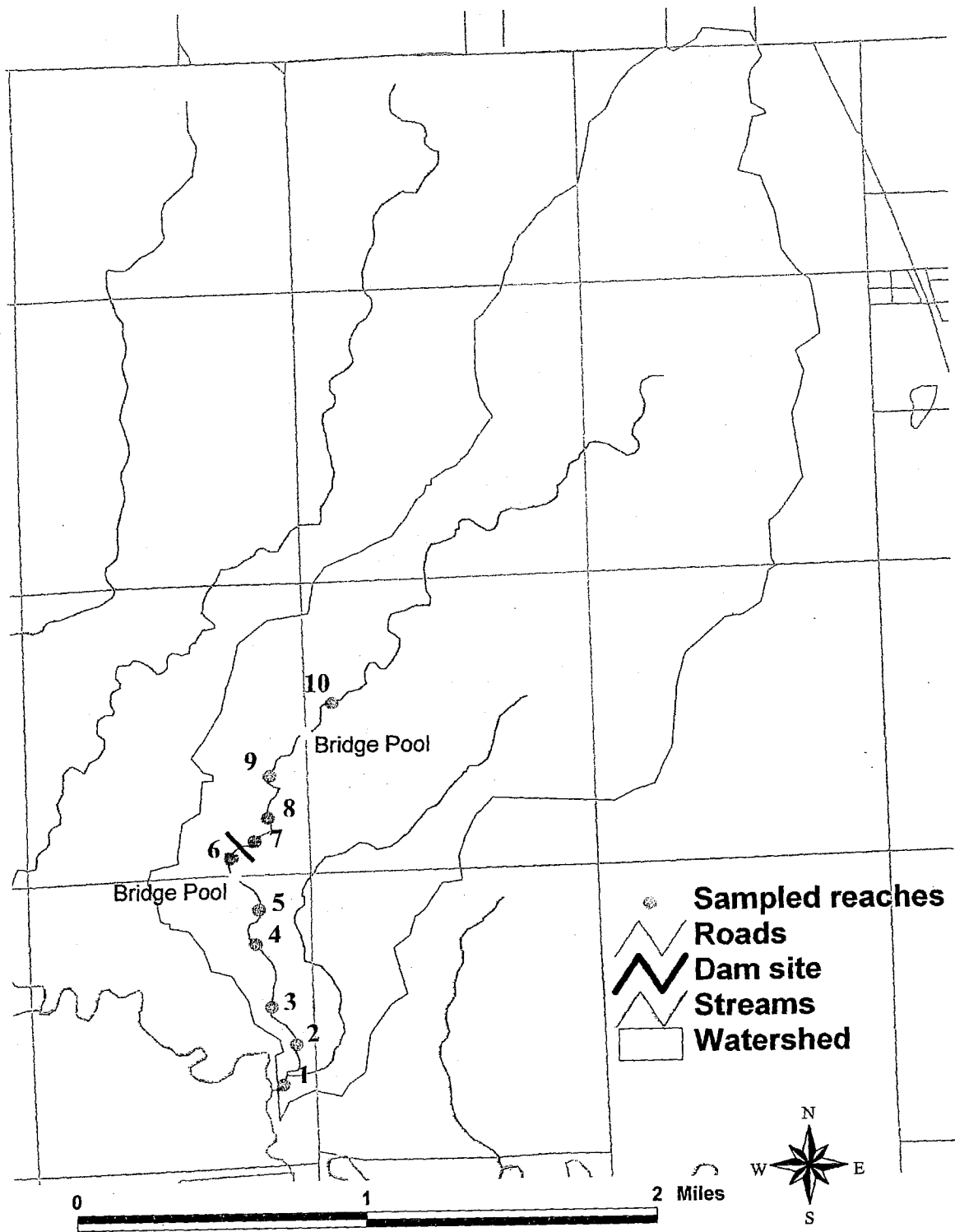


Figure 2. Location of sampled reaches (red) and bridge pools (yellow).

from bankfull to bankfull, with a minimum reach length of 150 meters. In addition, two pools located under bridges were sampled (Figure 2). If Topeka shiners were not found during initial sampling, then stream reaches were sampled an additional two times (over a 3-week period) to account for detection probability. Sampling took place early to mid-May when the stream was likely to contain the most water. The watershed above Reach 10 was dominated by row-crop agriculture (Figure 4) where the stream was plowed under and no longer discernable, making Reach 10 the furthest sampled upstream site. Stream reaches were sampled for fishes using a 3/16" mesh seine, and all captured fish species were identified, recorded, and released on site.

Habitat

The following habitat variables were assessed for each reach:

1. macrohabitat - pool, run, riffle;
2. stream banks – bank slumpage, bank incision, bank undercutting, overhanging vegetation;
3. riparian zone – grasses/forbes, sedges, woody vegetation;
4. aquatic vegetation – emergent vegetation, submergent vegetation, filamentous algae;
5. substrate composition – silt/clay, sand, gravel, cobble, boulder;
6. instream woody debris;
7. % wetted and dry stream

Habitat variables 2 – 6 were quantified according to the following categories:

0 – 0%

1 - >0 - 10%

2 - 10 - 40%

3 - 40 - 75%

4 - 75 - 100%

Results

Fish Community

A total of 12 fish species were found within the ten sampled reaches (Table 2; Appendix B). All species were found downstream of the proposed dam location, whereas only two species were found upstream of the proposed dam site.

Two stream reaches (1 and 3) contained the Topeka shiner. Reach 1 was the furthest downstream reach that directly adjoins to the West Fork of the Vermilion River (Figure 2) and contained the highest number of Topeka shiners (180). The majority of the Topeka shiners occurred at the junction of the tributary with the West Fork. Seven other fish species were found within the same reach: bigmouth shiner, brassy minnow, common shiner, fathead minnow, orange-spotted sunfish, sand shiner, and red shiner. Reach 3 contained 43 Topeka shiners and five other species: brassy minnow, common shiner, creek chub, fathead minnow, and green sunfish. All remaining reaches (2, 4-10) were sampled three times; no Topeka shiners were found. No Topeka shiners were found in the pools located under the bridges.

Reaches 1 and 3 had the highest species richness, with eight and six species, sequentially (Figure 3). Reaches 6 and 7 had the lowest richness, with no fish species present. Only low abundances of fathead minnows and green sunfish were found in the three upper-most reaches (Table 2).

Table 2. The presence/absence of each fish species within each stream reach. Abbreviations: spp = fish species; BIS = bigmouth shiner; BRM = brassy minnow; BRS = brook stickleback; CNS = common shiner; CRC = creek chub; FHM = fathead minnow; GSF = green sunfish; OSF = orange-spotted sunfish; RES = red shiner; SAS = sand shiner; STR = central stoneroller; TOS = Topeka shiner; R = reach; + = fish presence; # spp. = total number of species found in each reach.

<i>Spp.</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
BIS	+									
BRM	+	+	+	+	+					
BRS					+					
CNS	+		+							
CRC		+	+							
FHM	+	+	+	+	+			+	+	+
GSF			+		+			+	+	
OSF	+									
RES	+									
SAS	+									
STR		+								
TOS	+		+							
# Spp.	8	4	6	2	4	0	0	2	2	1

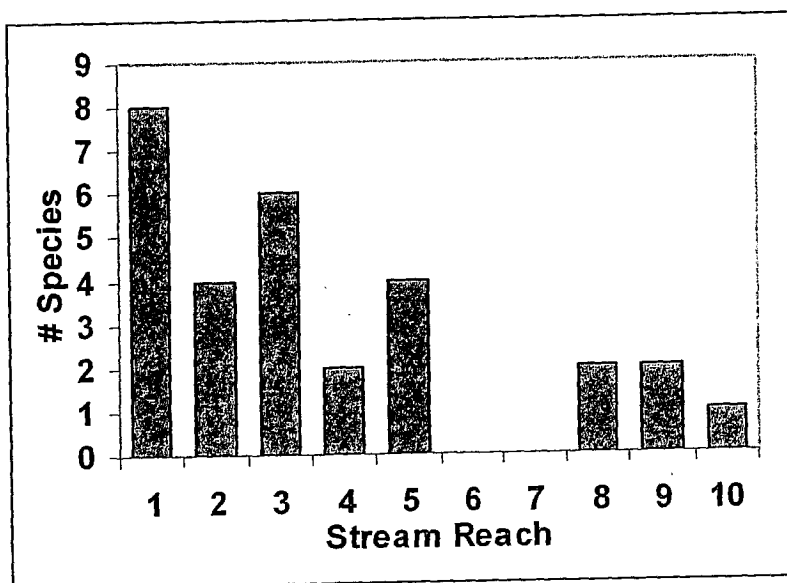


Figure 3. Species richness of each sampled stream reach.

Habitat

It should be noted that habitat was assessed in reaches up to two weeks after sampling for fish. During this time span, portions of many reaches (particularly downstream Reaches 1 and 2 and upstream Reach 10) had dried out in this ephemeral tributary. Water was no longer flowing. Macrohabitats were classified according to geomorphic characteristics and what would have been conditions during water flow. For example, geomorphic characteristics of a riffle were sections of the reach that were shallow (i.e. raised elevations) and contained coarse substrates. Pools were deep sections adjoined downstream to riffles. Runs, although now dry or having some stagnant water, were likely to have a positive water velocity under conditions of normal water flow.

Runs were the most common macrohabitat type of every stream reach, representing 69.9 - 100% of the stream reaches (Table 3). Reaches 5, 6, and 10 were entirely composed of runs. Instream pools were found in 3 downstream reaches and 2 upstream reaches, representing 2.4 - 19.6% of macrohabitats. Riffles were the least common, representing 4.4 - 10.5% of 3 downstream and 2 upstream reaches.

Eight of the 10 reaches had dry segments, ranging from 6.2 - 91.3% of the total stream reach length (Table 3). Reaches 1 (the furthest downstream) and 10 (the furthest upstream) were the driest stream segments sampled.

Extensive bank slumpage, incision, undercutting, and stream downcutting was evident across most stream reaches (Table 4). All reaches had dense overhanging vegetation. Riparian zones were primarily composed of grasses and forbes, with sedges in the 5 downstream reaches, and intermittent woody vegetation. Filamentous algae occurred in every reach, ranging from categories 1 to 3 (i.e. >0 - 75%). Emergent aquatic

Table 3. The percentage of pools, runs, riffles, wetted stream, and dry stream for each stream reach. Note: The percentages in reach #8 do not sum to 100% because a portion of the reach was filled in with bank slumpage and could not be classified.

<i>Variable</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
% Pool	3.5	0	4.4	2.4	0	0	0	12.2	19.6	0
% Run	88.7	92.6	91.3	97.6	100	100	92.4	83.1	69.9	100
% Riffle	4.7	7.4	4.4	0	0	0	7.6	0	10.5	0
% Wet	18.3	43.5	93.8	85.5	75.3	100	93.1	95.3	89.5	8.7
% Dry	81.7	56.5	6.2	14.5	24.7	0	6.9	0	10.5	91.3

Table 4. The estimated categories for habitat variables within each stream reach. Estimations are based on the average of all scores (0-4; Appendix C) obtained within a reach and rounded to the nearest whole number. Abbreviations: R = stream reach; BS = bank slumpage; IB = incised banks; UB = undercut banks; OV = overhanging vegetation; Rip. Zone = riparian zone; GR/F = grasses/forbes; SE = sedges; WR = riparian woody vegetation; Aq. Veg. = aquatic vegetation; EV = emergent vegetation; SV = submergent vegetation; FA = filamentous algae; S/C = silt/clay; Sa = sand; Gr = gravel; Co = cobble; Bo = boulder; WD = instream woody debris. See *Methods* for details on scoring variables.

	<i>Variable</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
<i>Banks</i>	BS	2	2	4	2	4	4	3	3	1	1
	IB	4	1	4	1	3	4	3	3	2	3
	UB	3	2	2	1	3	3	3	3	1	2
	OV	3	3	3	4	4	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	2	3	2	3	4	4	4	4	4	4
	SE	3	2	4	1	1	0	0	0	0	0
	WR	1	0	1	3	1	0	1	1	1	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0	0	0	0
	SV	1	0	0	0	0	0	0	0	1	0
	FA	2	1	2	3	2	3	2	3	1	2
<i>Substrate</i>	S/C	3	1	2	4	4	4	2	3	3	4
	Sa	2	2	2	0	1	1	1	1	1	0
	Gr	1	3	3	0	1	2	3	2	1	0
	Co	2	1	1	1	0	1	1	1	1	0
	Bo	1	1	0	0	0	0	0	1	1	0
<i>Other</i>	WD	1	1	1	2	4	4	0	1	1	0

vegetation was non-existent, while submergent vegetation was minimal (>0 - 10%),

occurring only in Reaches 1 and 9. Substrates were primarily clay or hardpan clay and

silt with sand and gravel. Cobble and boulders were sporadic. Instream woody debris was found in 8 out of 10 reaches, with reaches 5 and 6 containing the most.

Discussion

Topeka shiners were found only in two downstream reaches (1 and 3; Table 2; Appendix B), near the West Fork of the Vermillion River where this species is commonly found (Wall et al. 2001). No Topeka shiners were found in reaches sampled above the proposed dam site. Reaches containing Topeka shiners had the highest species richness of all 10 stream reaches sampled (Figure 3). Fish species commonly associated with the Topeka shiner include green sunfish, orange-spotted sunfish, red shiner, sand shiner, bigmouth shiner, common shiner, and creek chub (Wall and Berry 2006; Minckley and Cross 1959), all of which occurred in one or both of the stream reaches containing the Topeka shiner. Reaches sampled above the proposed dam site contained simple fish communities not typical of those associated with Topeka shiners, which are associated with more diverse communities (Wall and Berry 2006; S. Thomson unpublished data).

Overall, the stream habitat was very unstable as evident by the high proportion of bank slumpage, undercutting, incision, and stream downcutting throughout the tributary (Table 4). In addition, a segment of Reach 8 was completely filled in with bank slumpage (Appendix C). The stream reaches containing Topeka shiners were the only two downstream reaches that contained all three macrohabitat types (pools, riffles, and runs; Table 3). Being a species intolerant of high velocity waters (Adams et al. 2000), Topeka shiners prefer pool habitat, resorting to riffle habitat only in the presence of predators (Kerns and Bonneau 2002; Knight and Gido 2005).

Reach 1 (where most Topeka shiners [180] were found) was desiccated within a week, and did not provide any significant habitat for the Topeka shiner, which likely returned to the mainstem with receding water. The Topeka shiners in Reach 3 were found in two isolated, instream pools. These pools had a constant water depth throughout the three week survey and were likely groundwater fed because no water was flowing from upstream, and these isolated pools were more resilient than those downstream that had dried out. Topeka shiners only inhabited downstream reaches and were not found in reaches above the proposed dam site, likely because the natural high gradient of mid-reaches (Appendix A) and the absence of permanent pools make the mid-upper reaches of this tributary inaccessible and inhabitable by the Topeka shiner.

The north portion of the watershed is dominated by row-crop agriculture (Figure 4) and the natural, headwater, stream channels no longer exist (observed during site reconnaissance). Due to the loss of the stream network, riparian zones, and wetlands that likely existed prior to agricultural development, overland flow with high velocity and excessive sediment loads result (Leopold et al. 1964; Jacobson et al. 2000). This causes extensive disruption and destruction of the stream channel and natural hydrology, creating a highly unstable environment with a high degree of bank slumpage and incision (Schumm 1960). The instability of the stream, riparian zone, and aquatic habitat due to increased water volume, water velocity, and sediment load has reduced habitat quality for Topeka shiners and other stream fishes in downstream reaches. In addition, high sediment loads in the tributary are deposited in the West Fork of the Vermillion River, thus reducing habitat quality for Topeka shiners in this stream also. Reduced water quality due to such activities as wetland drainage, stream channelization, and tiling,

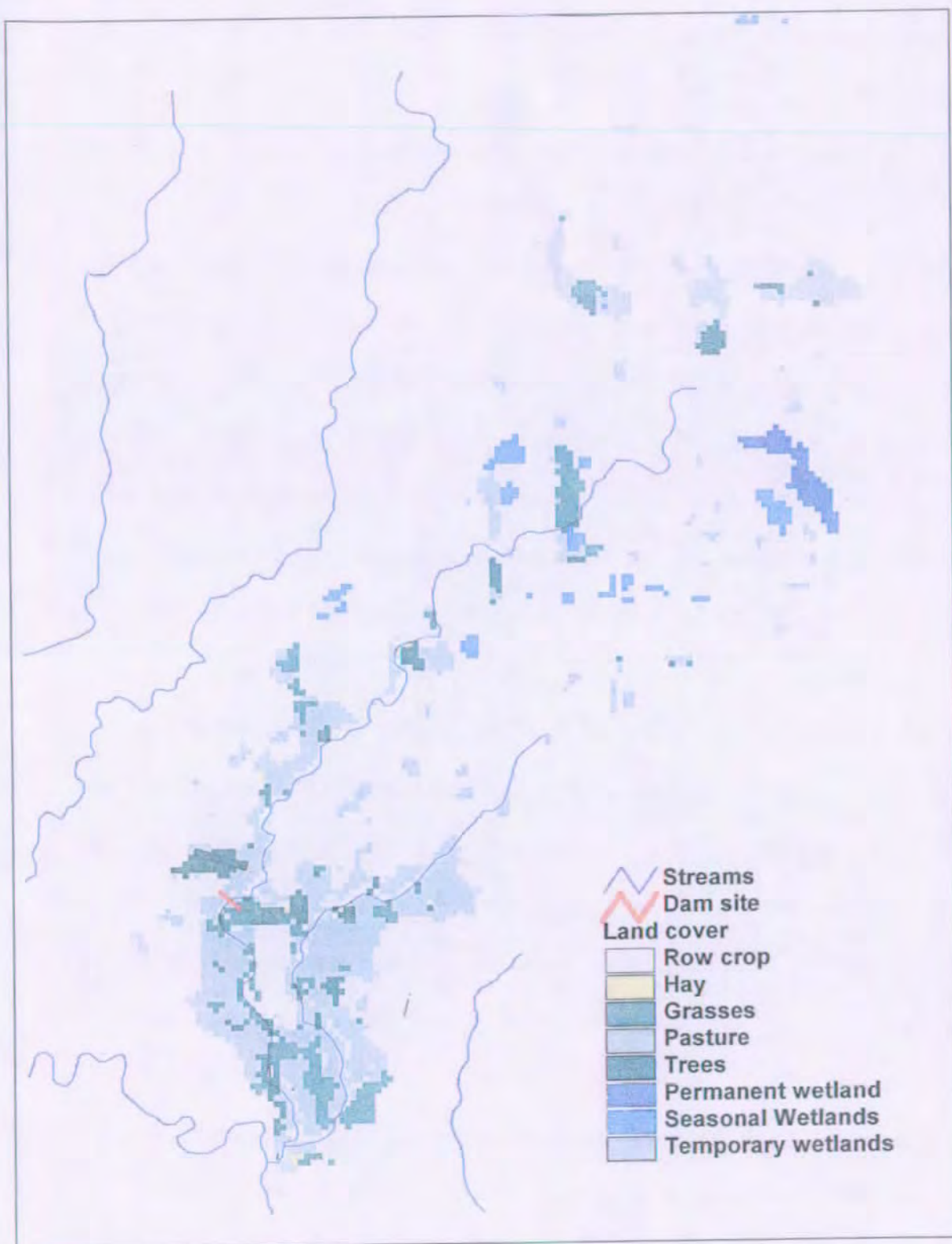


Figure 4. Land cover within unnamed tributary watershed.

has been attributed to Topeka shiner decline in other areas of its distribution (Wall and Berry 2004).

Impoundments have been correlated to the decline, and in some cases, extirpation of local meta-populations of Topeka shiners (Layer 1993; Mammoliti 1995; Stark et al. 1999; Winston 1999; Schrank et al. 2001). Possible impacts caused by impoundments include: 1) barrier to migration upstream and downstream of dam resulting in habitat fragmentation, population isolation and decreased genetic diversity, 2) altered hydrology, and 3) introduction of exotic piscivores that prey upon Topeka shiners and/or cause displacement. In the case of the Wieman dam project, the Topeka shiner was not found upstream of the proposed dam, nor was suitable habitat for the species found, thus eliminating the problem of a barrier and its possible impacts. The hydrology of the stream has already been severely altered by agricultural activities that have essentially wiped out the ability of the upper watershed to retain water and sediment resulting in high velocity water flows as indicated by extensive downcutting, bank incision and bank slumpage. The proposed impoundment could benefit the Topeka shiner and other stream fishes by functioning in a similar manner to previously-existing, headwater wetlands (Shearer 2003). The proposed impoundment may improve overall stream health for both the unnamed tributary and the West Fork of the Vermillion River by: 1) retaining sediments, thus, significantly reducing the sediment load of waters contributing to downstream segments; 2) reducing water volume to segments downstream of the impoundment; and, 3) reducing water velocity to downstream segments, thereby, reducing stream downcutting, stabilizing stream banks, stabilizing riparian zone habitat,

improving water quality, and allowing the downstream segments to return to their natural state.

Summary

The proposed dam may affect but is not likely to adversely affect the Topeka shiner for the following reasons.

1. Topeka shiners were not found in the stream above the proposed dam site, nor in the three stream reaches immediately below the proposed dam site. Our sampling effort was based upon statewide data of the prevalence of Topeka shiners within inhabited streams and detection probability within sites, and should have detected the species if present.
2. Habitat was unsuitable for Topeka shiners above the proposed dam site, and in the three stream reaches immediately below the proposed dam site.
3. Fish community found above the proposed dam site, and in the three reaches immediately below the proposed dam site, was not indicative of Topeka shiner presence.
4. The furthest downstream reach where most Topeka shiners were found was immediately adjacent to the mainstem. This reach dried up within a week and does not provide any significant habitat for the shiner, which likely returned to the mainstem with receding water.
5. Isolated pools downstream of the proposed dam site (Reach 3) where Topeka shiners were found are maintained by groundwater influx and not dependant on surface flows.
6. Stream hydrology has been altered by agricultural activities evident by extensive bank erosion, bank slumpage and downcutting.
7. The proposed impoundment may benefit the Topeka shiner by functioning similar to wetlands that would filter out sediments and restore downstream reaches to a more natural, stable hydrology.

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Appendix A. Photographs of the ten stream reaches sampled from the unnamed tributary of the West Fork of the Vermillion River.



Reach 1 – Downstream



Reach 1 – Dry run



Reach 1 – Upstream



Reach 2 - Downstream



Reach 2 – Upstream



Reach 3 - Downstream



Reach 3 – Upstream



Reach 4 – Downstream



Reach 4 – Upstream



Reach 5 - Downstream



Reach 5 – Upstream



Pool under bridge



Reach 3 – Upstream



Reach 4 – Downstream



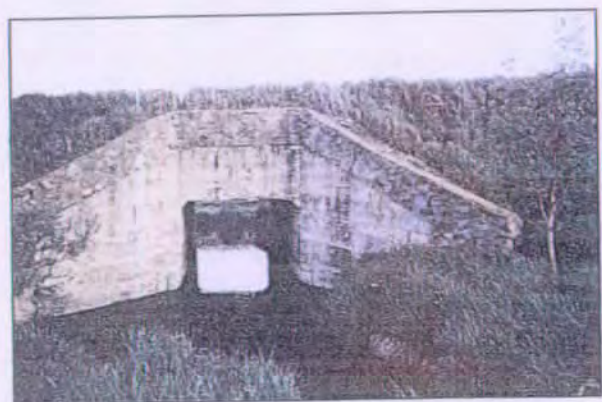
Reach 4 – Upstream



Reach 5 - Downstream



Reach 5 – Upstream



Pool under bridge



Reach 9 – Gradient



Reach 9 - Upstream



Reach 10 – Downstream



Reach 10 - Midreach



Reach 10 – Midreach



Reach 10 – Upstream



Pool upstream of bridge

Appendix B. Aquatic species seined and recorded from each stream reach. Highlighted reaches are those that contained Topeka shiners. Abbreviations: m = meters; spp. = species; BIS = bigmouth shiner; BRM = brassy minnow; BRS = brook stickleback; CNS = common shiner; CRC = creek chub; FHM = fathead minnow; GSF = green sunfish; OSF = orange-spotted sunfish; RES = red shiner; SAS = sand shiner; STR = central stoneroller; TOS = Topeka shiner.

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/5/2006	1	1	10	Seine	BIS
5/5/2006	1	1	10	Seine	CNS
5/5/2006	1	1	10	Seine	FHM
5/5/2006	1	1	10	Seine	OSF
5/5/2006	1	1	10	Seine	RES
5/5/2006	1	1	10	Seine	SAS
5/5/2006	1	1	10	Seine	TOS
5/5/2006	1	2	30	Kick	-
5/5/2006	1	3	5	Seine	-
5/5/2006	1	4	20	Kick	FHM
5/5/2006	1	4	20	Kick	OSF
5/5/2006	1	4	20	Kick	RES
5/5/2006	1	4	20	Kick	SAS
5/5/2006	1	4	20	Kick	TOS
5/5/2006	1	5	15	Seine	BIS
5/5/2006	1	5	15	Seine	BRM
5/5/2006	1	5	15	Seine	FHM
5/5/2006	1	5	15	Seine	OSF
5/5/2006	1	5	15	Seine	RES
5/5/2006	1	5	15	Seine	SAS
5/5/2006	1	5	15	Seine	TOS
5/5/2006	1	6	20	Kick	-
5/5/2006	1	7	30	Seine	FHM
5/5/2006	1	7	30	Seine	RES
5/5/2006	1	7	30	Seine	SAS
5/5/2006	1	7	30	Seine	TOS
5/5/2006	1	8	20	Seine	RES
5/6/2006	2	1	10	Seine	CRC
5/6/2006	2	2	25	Seine	STR
5/6/2006	2	3	25	Seine	BRM
5/6/2006	2	4	30	Seine	CRC
5/6/2006	2	5	40	Seine	FHM
5/6/2006	2	5	40	Seine	CRC
5/6/2006	2	6	25	Seine	-
5/6/2006	3	1	40	Seine	BRM
5/6/2006	3	1	40	Seine	CNS
5/6/2006	3	1	40	Seine	FHM

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/6/2006	3	1	40	Seine	TOS
5/6/2006	3	2	30	Seine	FHM
5/6/2006	3	3	15	Seine	BRM
5/6/2006	3	3	15	Seine	CNS
5/6/2006	3	3	15	Seine	FHM
5/6/2006	3	3	15	Seine	TOS
5/6/2006	3	4	15	Seine	FHM
5/6/2006	3	4	15	Seine	GSF
5/6/2006	3	5	30	Seine	BRM
5/6/2006	3	5	30	Seine	FHM
5/6/2006	3	5	30	Seine	TOS
5/6/2006	3	6	20	Kick	-
5/6/2006	3	7	40	Seine	BRM
5/6/2006	3	7	40	Seine	CRC
5/6/2006	3	7	40	Seine	FHM
5/6/2006	3	7	40	Seine	TOS
5/6/2006	4	1	50	Seine	FHM
5/6/2006	4	2	35	Kick	-
5/6/2006	4	3	25	Kick	-
5/6/2006	4	4	15	Seine	BRM
5/6/2006	4	4	15	Seine	FHM
5/6/2006	4	5	15	Seine	BRM
5/6/2006	4	5	15	Seine	FHM
5/6/2006	5	1	20	Seine	BRS
5/6/2006	5	1	20	Seine	FHM
5/6/2006	5	1	20	Seine	GSF
5/6/2006	5	2	45	Kick	FHM
5/6/2006	5	3	3	Seine	BRM
5/6/2006	5	3	3	Seine	FHM
5/6/2006	5	4	30	Seine	FHM
5/6/2006	5	5	20	Seine	FHM
5/6/2006	5	6	10	Kick	-
5/6/2006	5	7	20	Seine	-
5/6/2006	5	8	20	Kick	-
5/7/2006	2	1	10	Seine	-
5/7/2006	2	2	25	Seine	-
5/7/2006	2	3	25	Seine	-
5/7/2006	2	4	30	Seine	-
5/7/2006	2	5	40	Seine	FHM
5/7/2006	2	6	25	Seine	FHM
5/7/2006	4	1	50	Seine	BRM
5/7/2006	4	1	50	Seine	FHM
5/7/2006	4	2	35	Kick	-

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/7/2006	4	3	25	Kick	-
5/7/2006	4	4	15	Seine	BRM
5/7/2006	4	4	15	Seine	FHM
5/7/2006	4	5	15	Seine	BRM
5/7/2006	4	5	15	Seine	FHM
5/7/2006	5	1	20	Seine	BRS
5/7/2006	5	1	20	Seine	BRM
5/7/2006	5	1	20	Seine	FHM
5/7/2006	5	2	45	Kick	-
5/7/2006	5	3	3	Seine	FHM
5/7/2006	5	4	30	Seine	FHM
5/7/2006	5	5	20	Seine	-
5/7/2006	5	6	10	Kick	-
5/7/2006	5	7	20	Seine	-
5/7/2006	5	8	20	Kick	-
5/12/2006	Pool under bridge			Seine	BRM
5/12/2006	Pool under bridge			Seine	FHM
5/12/2006	6	1	20	Seine	-
5/12/2006	6	2	15	Kick	-
5/12/2006	6	3	25	Seine	-
5/12/2006	6	4	30	Kick	-
5/12/2006	6	5	25	Seine	-
5/12/2006	6	6	30	Seine	-
5/12/2006	7	1	40	Seine	-
5/12/2006	7	2	10	Kick	-
5/12/2006	7	3	10	Seine	-
5/12/2006	7	4	20	Seine	-
5/12/2006	7	5	10	Kick	-
5/12/2006	7	6	15	Seine	-
5/12/2006	7	7	20	Seine	-
5/12/2006	7	8	20	Kick	-
5/12/2006	7	8	20	Kick	-
5/12/2006	8	1	35	Seine	-
5/12/2006	8	2	10	Seine	-
5/12/2006	8	3	15	Seine	-
5/12/2006	8	4	10	Seine	FHM
5/12/2006	8	5	15	Seine	-
5/12/2006	8	6	55	Seine	FHM
5/12/2006	9	1	30	Seine	-
5/12/2006	9	2	20	Seine	-
5/12/2006	9	3	12	Seine	FHM

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/12/2006	9	3	12	Seine	GSF
5/12/2006	9	4	25	Seine	FHM
5/12/2006	9	5	10	Seine	FHM
5/13/2006	10	1	20	Seine	-
5/13/2006	10	2	30	Seine	FHM
5/13/2006	Pool upstream of bridge			Seine	-
5/13/2006	9	1	30	Seine	-
5/13/2006	9	2	20	Seine	-
5/13/2006	9	3	12	Seine	FHM
5/13/2006	9	4	25	Seine	FHM
5/13/2006	9	5	10	Seine	FHM
5/13/2006	8	1	20	Seine	-
5/13/2006	8	2	20	Seine	-
5/13/2006	8	3	15	Seine	-
5/13/2006	8	4	10	Seine	FHM
5/13/2006	8	5	15	Seine	-
5/13/2006	8	6	55	Seine	FHM
5/13/2006	7	1	40	Seine	-
5/13/2006	7	2	10	Kick	-
5/13/2006	7	3	10	Seine	-
5/13/2006	7	4	20	Seine	-
5/13/2006	7	5	10	Kick	-
5/13/2006	7	6	15	Seine	-
5/13/2006	7	7	20	Seine	-
5/13/2006	7	8	20	Kick	-
5/13/2006	6	1	20	Seine	-
5/13/2006	6	2	15	Kick	-
5/13/2006	6	3	25	Seine	-
5/13/2006	6	4	30	Kick	-
5/13/2006	6	5	25	Seine	-
5/13/2006	6	6	30	Seine	-
5/13/2006	5	1	20	Seine	FHM
5/13/2006	5	2	45	Kick	-
5/13/2006	5	3	3	Seine	-
5/13/2006	5	4	30	Seine	-
5/13/2006	5	5	20	Seine	-
5/13/2006	5	6	10	Kick	-
5/13/2006	5	7	20	Seine	-
5/13/2006	5	8	20	Dry	-
5/13/2006	4	1	50	Seine	-
5/13/2006	4	2	35	Kick	-
5/13/2006	4	3	25	Kick	-

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/13/2006	4	4	15	Seine	BRM
5/13/2006	4	4	15	Seine	FHM
5/13/2006	4	5	15	Seine	BRM
5/13/2006	4	5	15	Seine	FHM
5/14/2006	10	1	20	Seine	-
5/14/2006	10	2	30	Seine	FHM
5/14/2006	9	1	30	Seine	-
5/14/2006	9	2	20	Seine	GSF
5/14/2006	9	3	12	Seine	FHM
5/14/2006	9	4	25	Seine	FHM
5/14/2006	9	5	10	Seine	FHM
5/14/2006	8	1	20	Seine	-
5/14/2006	8	2	20	Seine	-
5/14/2006	8	3	15	Seine	-
5/14/2006	8	4	10	Seine	-
5/14/2006	8	5	15	Seine	-
5/14/2006	8	6	55	Seine	FHM
5/14/2006	8	6	55	Seine	GSF
5/14/2006	7	1	40	Seine	-
5/14/2006	7	2	10	Seine	-
5/14/2006	7	3	10	Seine	-
5/14/2006	7	4	20	Seine	-
5/14/2006	7	5	10	Kick	-
5/14/2006	7	6	15	Seine	-
5/14/2006	7	7	20	Seine	-
5/14/2006	7	8	20	Kick	-
5/14/2006	6	1	20	Seine	-
5/14/2006	6	2	15	Kick	-
5/14/2006	6	3	25	Seine	-
5/14/2006	6	3	25	Seine	-
5/14/2006	6	4	30	Seine	-
5/14/2006	6	5	25	Seine	-
5/14/2006	6	6	30	Seine	-
5/14/2006	2	1	10	Seine	-
5/14/2006	2	2	25	Seine	-
5/14/2006	2	3	25	Seine	-
5/14/2006	2	4	30	Seine	-
5/14/2006	2	5	40	Seine	-
5/14/2006	2	6	25	Seine	-

Appendix C. Habitat data collected from each stream reach on 05/20/2006 and 05/21/2006. Abbreviations: S = site (sequentially from downstream to upstream for each stream reach); P = pool; RU = run; RI = riffle; BS = bank slumpage; IB = incised banks; UB = undercut banks; OV = overhanging vegetation; Rip. Zone = riparian zone; GR/F = grasses/forbes; SE = sedges; WR = riparian woody vegetation; Aq. Veg. = aquatic vegetation; EV = emergent vegetation; SV = submergent vegetation; FA = filamentous algae; S/C = silt/clay; Sa = sand; Gr = gravel; Co = cobble; Bo = boulder; WD = instream woody debris; ft = feet. See *Methods* for details on scoring variables.

REACH 1; 05/21/06

	Variable	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
<i>Habitat</i>	P			X						X			
	RU	X	X		X		X		X		X		X
	RI					X		X				X	
<i>Banks</i>	BS	2	2	2	2	2	3	0	1	3	4	4	1
	IB	2	3	4	4	4	3	3	4	4	4	4	4
	UB	3	2	2	2	2	2	1	3	3	3	4	4
	OV	4	3	3	3	3	3	2	3	3	3	4	4
<i>Rip. Zone</i>	GR/F	2	0	1	1	1	4	2	4	1	2	0	3
	SE	4	0	4	4	4	2	3	1	4	3	4	3
	WR	0	0	1	1	1	0	0	0	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0	0	0	0	0	0
	SV	3	0	0	0	0	0	0	0	0	0	0	0
	FA	1	0	3	3	3	1	1	3	4	0	1	2
<i>Substrate</i>	S/C	4	3	4	3	0	3	1	4	4	1	1	3
	Sa	1	2	3	2	2	1	1	0	1	4	1	3
	Gr	1	2	0	2	2	2	2	0	0	1	1	1
	Co	1	0	1	1	3	1	3	1	0	2	4	1
	Bo	0	0	0	1	0	1	0	1	0	2	0	1
<i>Other</i>	WD	1	1	1	1	1	1	0	0	1	1	1	1
	% Wet	100	0	90	0	0	51	5	50	100	5	0	5.4
	% Dry	0	100	10	100	100	49	95	50	0	95	100	94.6
	Length (ft)	17	4	8	103	11	55	5	42	11	24	10	277

Appendix C (cont).

REACH 2; 05/21/06

	Variable	S1	S2	S3	S4	S5	S6	S7
<i>Habitat</i>	P							
	RU							X
	RI	X	X	X	X	X	X	
<i>Banks</i>	BS	4	2	1	1	1	1	4
	IB	1	1	0	0	1	0	4
	UB	3	3	1	1	1	1	4
	OV	4	3	3	2	4	1	4
<i>Rip. Zone</i>	GR/F	3	3	1	4	4	1	3
	SE	2	3	4	1	1	3	3
	WR	0	0	0	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0
	SV	0	0	0	0	0	0	0
	FA	0	0	0	0	0	1	1
<i>Substrate</i>	S/C	0	0	2	0	1	2	3
	Sa	0	2	2	1	3	3	1
	Gr	4	4	3	2	3	2	3
	Co	0	0	0	0	0	0	1
	Bo	0	2	0	0	0	0	1
<i>Other</i>	WD	0	0	0	0	0	1	1
	% Wet	0	0	0	0	0	10	47
	% Dry	100	100	100	100	100	90	53
	Length (ft)	12	11	5	5	3	5	509

Appendix C (cont).

REACH 3; 05/21/06

	Variable	S1	S2	S3	S4
<i>Habitat</i>	P		X		
	RU				X
	RI	X		X	
<i>Banks</i>	BS	3	4	4	4
	IB	3	4	4	4
	UB	0	2	3	4
	OV	1	2	4	4
<i>Rip. Zone</i>	GR/F	1	2	3	1
	SE	4	3	3	4
	WR	0	0	0	1
<i>Aq. Veg.</i>	EV	0	0	0	0
	SV	0	0	0	0
	FA	1	3	0	2
<i>Substrate</i>	S/C	2	4	1	2
	Sa	2	1	2	1
	Gr	2	1	3	4
	Co	0	0	0	1
	Bo	0	0	0	0
<i>Other</i>	WD	0	0	0	1
	% Wet	100	100	0	95
	% Dry	0	0	100	5
	Length (ft)	14	24	10	502

Appendix C (cont).

REACH 4; 05/21/06

	Variable	S1	S2
<i>Habitat</i>	P		X
	RU	X	
	RI		
<i>Banks</i>	BS	3	0
	IB	2	0
	UB	2	0
	OV	4	4
<i>Rip. Zone</i>	GR/F	4	2
	SE	1	0
	WR	3	3
<i>Aq. Veg.</i>	EV	0	0
	SV	0	0
	FA	3	3
<i>Substrate</i>	S/C	4	4
	Sa	0	0
	Gr	0	0
	Co	1	0
	Bo	0	0
<i>Other</i>	WD	2	2
	% Wet	85	100
	% Dry	15	0
	Length (ft)	537	13

Appendix C (cont).

REACH 5; 05/21/06

	Variable	S1
<i>Habitat</i>	P	
	RU	X
	RI	
<i>Banks</i>	BS	4
	IB	3
	UB	3
	OV	4
<i>Rip. Zone</i>	GR/F	4
	SE	1
	WR	1
<i>Aq. Veg.</i>	EV	0
	SV	0
	FA	2
<i>Substrate</i>	S/C	4
	Sa	1
	Gr	1
	Co	0
	Bo	0
<i>Other</i>	WD	0
	% Wet	75.3
	% Dry	24.7
	Length (ft)	550

Appendix C (cont).

REACH 6; 05/20/06

	Variable	S1
<i>Habitat</i>	P	
	RU	X
	RI	
<i>Banks</i>	BS	4
	IB	4
	UB	3
	OV	4
<i>Rip. Zone</i>	GR/F	4
	SE	0
	WR	0
<i>Aq. Veg.</i>	EV	0
	SV	0
	FA	3
<i>Substrate</i>	S/C	4
	Sa	1
	Gr	2
	Co	1
	Bo	0
<i>Other</i>	WD	0
	% Wet	100
	% Dry	0
	Length (ft)	485

Appendix C (cont).

REACH 7; 05/20/2006

	Variable	S1	S2	S3	S4	S5
<i>Habitat</i>	P					
	RU	X		X		X
	RI		X		X	
<i>Banks</i>	BS	3	4	3	2	3
	IB	4	4	4	0	4
	UB	3	3	4	0	3
	OV	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4
	SE	0	0	0	0	0
	WR	1	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0
	SV	0	0	0	0	0
	FA	2	2	3	0	3
<i>Substrate</i>	S/C	3	3	3	0	3
	Sa	1	1	0	0	1
	Gr	2	3	2	4	3
	Co	0	0	1	0	0
	Bo	0	0	0	0	0
<i>Other</i>	WD	0	0	0	0	0
	% Wet	100	10	100	0	100
	% Dry	0	90	0	100	0
	Length (ft)	88	34	243	3	117

Appendix C (cont).

REACH 8; 05/20/2006

	Variable	S1	S2*	S3	S4	S5	S6
<i>Habitat</i>	P		-	X		X	
	RU	X	-		X		X
	RI		-				
<i>Banks</i>	BS	4	4	1	4	2	4
	IB	3	4	3	4	2	4
	UB	3	-	3	3	2	3
	OV	4	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4	4
	SE	0	-	0	0	0	0
	WR	1	-	0	1	0	1
<i>Aq. Veg.</i>	EV	0	-	0	0	0	0
	SV	0	-	0	0	0	0
	FA	3	-	3	2	3	2
<i>Substrate</i>	S/C	4	-	3	4	4	2
	Sa	1	-	0	0	0	0
	Gr	2	-	2	1	0	4
	Co	0	-	0	1	1	1
	Bo	0	-	1	1	0	0
<i>Other</i>	WD	0	-	0	1	1	1
	% Wet	100	-	100	100	100	100
	% Dry	0	-	0	0	0	0
	Length (ft)	202	23	27	56	32	145

* The channel of S2 was filled in with bank slumpage.

Appendix C (cont).

REACH 9; 05/20/06

	Variable	S1	S2	S3	S4	S5	S6
<i>Habitat</i>	P		X		X		X
	RU	X				X	
	RI			X			
<i>Banks</i>	BS	4	2	1	1	0	0
	IB	4	2	1	1	3	0
	UB	2	2	1	1	2	0
	OV	4	4	4		4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4	4
	SE	0	0	0	0	0	0
	WR	1	0	0	1	0	1
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0
	SV	1	1	0	0	0	0
	FA	0	0	0	1	0	0
<i>Substrate</i>	S/C	4	4	2	1	4	4
	Sa	0	0	0	4	1	0
	Gr	2	1	2	1	1	0
	Co	0	1	1	0	0	1
	Bo	0	0	1	0	0	1
<i>Other</i>	WD	1	0	0	1	0	1
	% Wet	100	100	0	100	100	100.0
	% Dry	0	0	100	0.0	0.0	0.0
	Length (ft)	231	13	51	38	108	44

Appendix C (cont).

REACH 10; 05/20/2006

	Variable	S1	S2*	S3
<i>Habitat</i>	P			
	RU	X	X	X
	RI			
<i>Banks</i>	BS	2	0	2
	IB	4	0	4
	UB	2	0	4
	OV	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4
	SE	0	0	0
	WR	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0
	SV	0	0	0
	FA	3	0	3
<i>Substrate</i>	S/C	4	4	4
	Sa	0	0	0
	Gr	0	0	0
	Co	0	0	0
	Bo	0	0	0
<i>Other</i>	WD	0	0	0
	% Wet	0	0	26
	% Dry	100	100	74
	Length (ft)	31	175	279

* S2 had a poorly defined channel (see photograph _ in Appendix A).

**CLARK ENGINEERING CORPORATION
SIOUX FALLS, SD**

**SOIL EXPLORATION PROGRAM
PROPOSED WIEMAN DAM
SIOUX FALLS, SOUTH DAKOTA
STI #03-0611**

July 29, 2003

EXECUTIVE SUMMARY

Based on the test hole data, it is our opinion that the native clay soils encountered at the site are suitable for construction on the dam. Most of the native clay soils at the site consist of lean clay glacial till. However, some of the soils at the bottom of the creek appear to be re-deposited soils placed as part of the creek erosion and surrounding run-off. These re-deposited soils are typically weak, and would not be favorable for use as embankment fill, or in providing a suitable foundation for support of the embankment fill.

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SOIL EXPLORATION PROGRAM

PROPOSED WIEMAN DAM

NEAR MARION, SOUTH DAKOTA

STI #03-0611

INTRODUCTION

1.1 Project Information

We understand the project will consist of the construction of a small earthen dam north of Marion, SD. The site of the proposed dam is bordered on the south by 271st Street and on the east by 447th Avenue. The dam will be about 350 feet wide and have a maximum height of about 35 feet. Earthen spillways will be constructed along the outside edges of the dam. Borrow material is anticipated to be obtained from the hillsides adjacent to the dam. The upstream slope of the embankment is planned to be 5:1 while the down stream will be 4:1. We assume that the slopes of the embankment and the spillway sugrade will be seeded or sodded and that the upstream face of the embankment will be protected with rip-rap.

2.0 ENGINEERING REVIEW

The engineering recommendations provided in this report are based on our understanding of the project as described above. The recommendations are valid for a specific set of project conditions. If the characteristics of the project change from those indicated in this report, it is necessary that we be notified so that we can determine whether the new conditions affect our recommendations.

The primary purpose of performing the field and laboratory tests is to determine the general parameters of soils relative to the feasibility of constructing the dam. Other tests (such as triaxial tests) and analysis to determine the safety factors of the dam were not performed at your request. If you determine that these tests and analysis are needed, additional authorization and agreement of fees would be needed.

2.1 Discussion

- **General**

Based on the test hole data, most of the native soils at the site consist of clay till (glacial deposited soils). It is our opinion that most of these clay till soils are suitable for construction on the dam. However, some of the surficial soils encountered at the bottom of the creek consist of clay and sand which appear to have been re-deposited as part of the creek erosion and surrounding run-off processes. These re-deposited soils are typically weak, and would not be favorable for construction of the dam, neither for use as embankment fill nor in providing a suitable foundation for support of the embankment fill.

2.2 General Soil Profiles

- **Bottom of Creek**

The logs of test holes #2, #3, #5, #6, #7, #8 and #9, performed along the bottom of the creek from the site of the dam and extending upstream approximately ½ mile, suggest that the general soil profile consist of about 2 feet of re-deposited topsoil overlying lean clay till (glacial deposited soils). The first few feet of lean clay till soils, encountered immediately below the re-deposited topsoil, appear to have high moisture contents and are somewhat weak. More specifically, the point resistance (qc), shown on the log of test hole #2, suggests that the top 6 feet of clay soil is weak relative to the proposed construction.

- **Borrow Areas**

The logs of test holes #1 and #4, performed in the borrow areas at the top of the hillsides adjacent to the proposed dam, suggest that the general soil profile consist of 0.5 to 0.7 feet of topsoil overlying primarily lean clay till soils. However, some sand alluvium soils were encountered at 15 and 27.5 feet in test hole #1. Also, some lean clay fine alluvium (water deposited soils) was encountered near the surface of test hole #4. Lab test suggest that the upper 6 feet of these borrow soils are somewhat dry with moisture contents of 15% (optimum is 20.9% per the Standard Proctor Test).

2.3 General Recommendations

1. To provide a suitable foundation for placement of the dam embankment, the topsoil, re-deposited and/or other weak soils encountered at the bottom and along the side-slopes of

the creek shall be excavated to expose stiff competent clay till soils. The depth of the competent clay till soils will likely vary, but the log of test hole #2 suggest the depth is up to 10 feet below existing grade. To insure that competent clay soils are exposed, a geotechnical engineer shall periodically observe the bottom of the entire foundation excavation, during and once it is completed.

2. All backfill operations used to construct the dam shall be performed in an engineered and controlled manner, after the environment has been made water free. During the entire time of construction, arrangement shall be made to accommodate the creek's water flow in a manner that it does not adversely affect the construction operations.
3. Only selected lean clays and sandy lean clay till soils, such as encountered in test holes #1 and #4, shall be used for embankment fill in the core of the dam. The use of only the lean or sandy lean clay soils should be closely monitored by the engineer during the entire fill operations. Any pockets of sand encountered in the clay borrow areas shall be distinctly separated from the clay till soils and not used in construction of the embankment. If the design incorporates any retaining structures (wing walls etc.), only non-plastic granular soils shall be placed immediately adjacent to them; and if appropriate, a proper sub-drainage system shall be constructed behind the retaining structure. If lateral earth pressures, sub-drainage gradations or geofabrics are needed for design, please contact us.
4. Clay engineered fill used for construction of the core of the embankment shall be placed in maximum 8 inch loose lifts and compacted to at least 98% of the Standard Proctor Density (ASTM: D698). Granular engineered fill placed behind any retaining structure should be compacted to 70% relative density as per ASTM D4253/4258. The clay engineered fill should be placed at a moisture content ranging from minus 2% to plus 3% of the Standard Proctor.
5. The weak clay and or silt soils excavated from the bottom and side walls of the creek can be placed and used as a stabilizing berm on the outside the embankment core soils, either upstream or downstream of the embankment core soils, however they shall not be used as the core soils of the embankment.

• Settlements

Settlement estimates based on the point resistance (q_c) values of test hole #2 suggest that the total settlement under the maximum cross-section of the dam (approximately 33 feet) will be on the order of 6 to 8 inches. The settlement will taper to near zero inches at the minimum cross sections. An additional 1 to 2 inches will occur in the fill soils at the maximum cross section of the embankment. The settlements will occur over several years. We suggest that the crest of the dam be built higher than the final grade to account for these settlements.

3.0 CONSTRUCTION CONSIDERATIONS

3.1 Site Excavation

- **Soil Disturbance & Moisture Changes**

The clay soils encountered at the site are sensitive to disturbance and strength loss under the influence of construction traffic and/or additional moisture. Disturbance or any saturation of these soils will require additional excavation and backfilling. Excavation to expose some of these soils at the bottom and side slopes of the creek may require using a backhoe with a smooth bucket. Also, the excavations should be left open a minimal amount of time to prevent strength loss of these soils by ponding of water.

- **OSHA**

All excavations must comply with the requirements of OSHA 29 CFR Part 1926, Subpart P, "Excavations." Reference to this OSHA requirement should be included in the project specifications.

3.2 Excavation Observation and Testing

Performance of the engineered fill at the site is dependent upon removing all unsuitable soils prior to fill placement and maintaining adequate compaction as the fill is placed. The excavations must be observed by a qualified geotechnical engineer or his representative prior to fill placement, and density/moisture testing must be performed within the fill sequence.

4.0 GENERAL EXPLORATION INFORMATION

4.1 Scope of Exploration

Nine test holes (borings) were performed at the site on June 30 and July 2, 2003. The test holes were advanced at the general locations shown on the sketch attached. The subsurface information was obtained using Cone Penetration Testing (CPT) methods as per ASTM: D5778 and Macro-Core sampling methods. A cone factor (N_k) of 18 was used for determination of the undrained shear strength. Some settlement of the soils used to fill the open test holes should be anticipated and final closure of the holes is the responsibility of the client or property owner.

4.2 Site Surface Conditions

The site of the proposed dam is approximately two miles north of Marion, SD, in the creek west of 447th Avenue. The proposed dam is bordered on the south by 271st Street. The site surface consisted mostly of grassland at the time of our soil exploration program. The general topography of the site is hilly. The surface elevations of the test holes were not taken.

4.3 Site Subsurface Conditions

The subsurface conditions encountered at each test hole location are illustrated on logs attached to this report. A review of the test hole logs suggests a general soil profile consisting of surficial topsoil overlying primarily native clay till (glacial deposited soils) with some sand, silt and clay alluvium (water deposited soils). The clay till soils extended to the termination depths of the test holes. We wish to point out that the subsurface conditions at other times and locations on this site may differ from those found at our test locations. If different subsurface conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

4.4 Water Levels

Observations for subsurface groundwater were made at the test hole locations during our field operations. Groundwater was encountered at some of the test hole locations. The levels where the groundwater was measured are shown in the table below and at the bottom of the test hole logs.

Test Hole Number	Groundwater Measurements (feet below surface)
1	None
2	2.3
3	7.0
4	17.0
5	None
6	None
7	None
8	None
9	4.0

It should be noted that in order to accurately determine the static groundwater level, observations over a long period are usually required. Such periods of observation are normally not available in

a typical soil exploration program. Seasonal and annual fluctuations in the groundwater levels can be expected to occur.

4.5 Laboratory Tests

Soil samples were selected for laboratory tests to determine the engineering and index properties. Where applicable, the tests were performed in accordance with the American Society for Testing and Materials (ASTM) procedures. The test results are shown on the test hole logs opposite the samples upon which the tests were made or are shown below.

TEST HOLE	DEPTH (ft.)	% Passing the #200 Sieve	Moisture Content (% by weight)	Dry Density (lbs./ft ³)
2	4.5-5.0	73	30	--

5.0 REVIEW, USE AND PURPOSE OF REPORT

- **Review of Report**

The analyses and recommendations submitted in this report are based upon the data obtained from the test holes performed at the locations indicated on the attached sketch(s). Variations can occur around and between these test holes, the nature and extent of which may not become evident until additional exploration or construction is conducted. Therefore, a review of the recommendations of this report should be made after performing on-site observations during the construction. The variations may result in additional construction costs, and it is suggested that a contingency be provided for this purpose.

This report is based on the design of the proposed construction as submitted to us for preparation of this report. It is recommended that we be retained to briefly review the geotechnical aspects of the final design and specifications to determine whether any changes in design may have had an affect on the validity of the recommendations contained in this report, and whether our recommendations have been correctly communicated to you so that their intent has been implemented in the design and specifications. If we are not permitted to make this recommended review, we will not be liable for losses arising out of such design changes or misinterpretation or misapplication of our recommendations.

- **Use of Report**

This report is for the exclusive use of the addressee and its representatives for use in general design of the proposed construction described herein. The data, analyses and recommendations may not be appropriate for other structures or purposes. All parties contemplating other structures or purposes must contact us for additional review. In the absence of our written review and approval, we make not representation and assume no responsibility to any parties regarding this report.

- **Purpose of Report**

The purpose of this report is to present the results of our field and laboratory tests as well as our geotechnical engineering review and recommendations for the project. Our work is intended for geotechnical purposes only and not to verify the presence or extent of any contamination at the site(s).

6.0 STANDARD OF CARE

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted engineering procedures at this time and location. Other than this, no warranty, either expressed or implied, is intended.

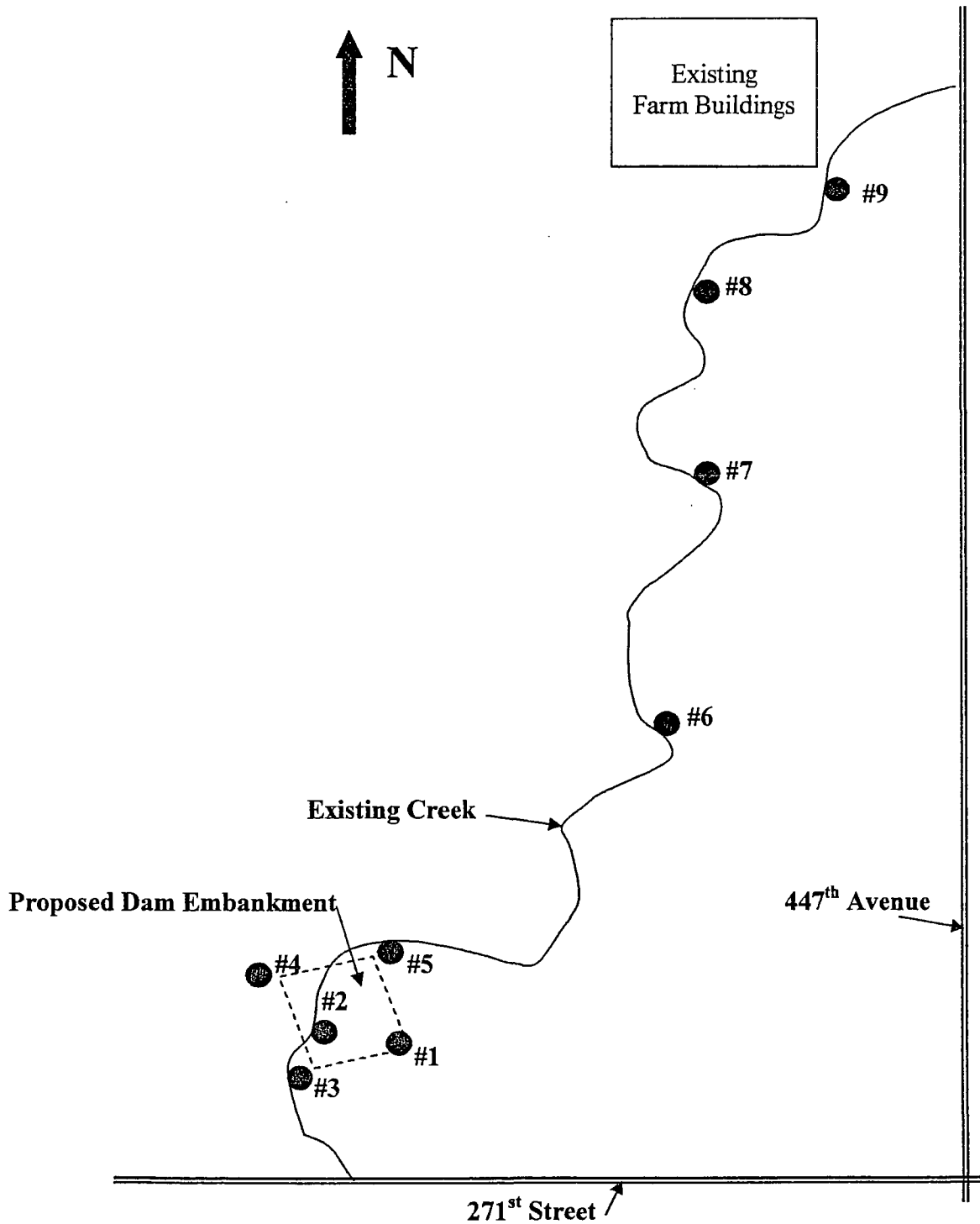
This report was prepared by:



Kim E. Stoecker, PE
Consulting Geotechnical Engineer



**PROPOSED WIEMAN DAM
NEAR MARION, SD
STI #03-0611**



- - Denotes Test Hole Locations
- Drawing Not To Scale

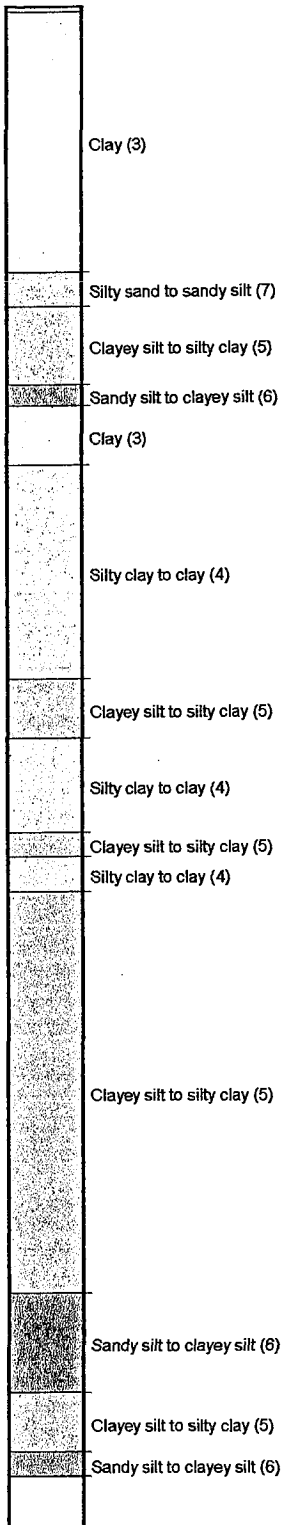
LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #1						
		LOCATION: Near Marion, SD		Sheet 1 of 1						
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL	"N"	SAMPLE NO. TYPE	LABORATORY TESTS				
						W	D	LL	PL	QU
0.7	Lean Clay, black (CL-OL)	TOPSOIL			1 MC					
	Sandy Lean Clay, a little gravel, brown mottled (CL)	TILL								
	** Proctor and permeability performed on soils between 2' and 8', see attached sheets.									**
	** #200 Sieve = 70%				2 MC		15	41	19	**
					3 MC					
15	Silty Sand, fine grained, light brown, moist (SM)	COARSE ALLUVIUM			4 MC					
18.5	Sandy Lean Clay, a little gravel, brown mottled, a layer of silty sand at 23' (CL)	TILL			5 MC					
					6 MC					
27.5	Clayey Sand, fine to coarse grained, brown, wet (SC)	MIXED ALLUVIUM								
30	END OF TEST HOLE									
DATE		WATER LEVEL MEASUREMENTS		START: 06-30-03 COMPLETE: 06-30-03						
6-30	Sampled to: 22', Cave In: 21'	WL=None		METHOD: at 11:57						
6-30	Sampled to: 30', Cave In: 29.5'	WL=None		Macro Core Sampling to 30'						
7-2	Cave In: 28.8'	WL=None		Crew Chief: K.Stoecker (STI)						
SOIL TECHNOLOGIES, INC										
401 E. 8TH STREET, SIOUX FALLS, SD 57103										
TELEPHONE: (605) 330-9993 FAX: (605) 330-9994										

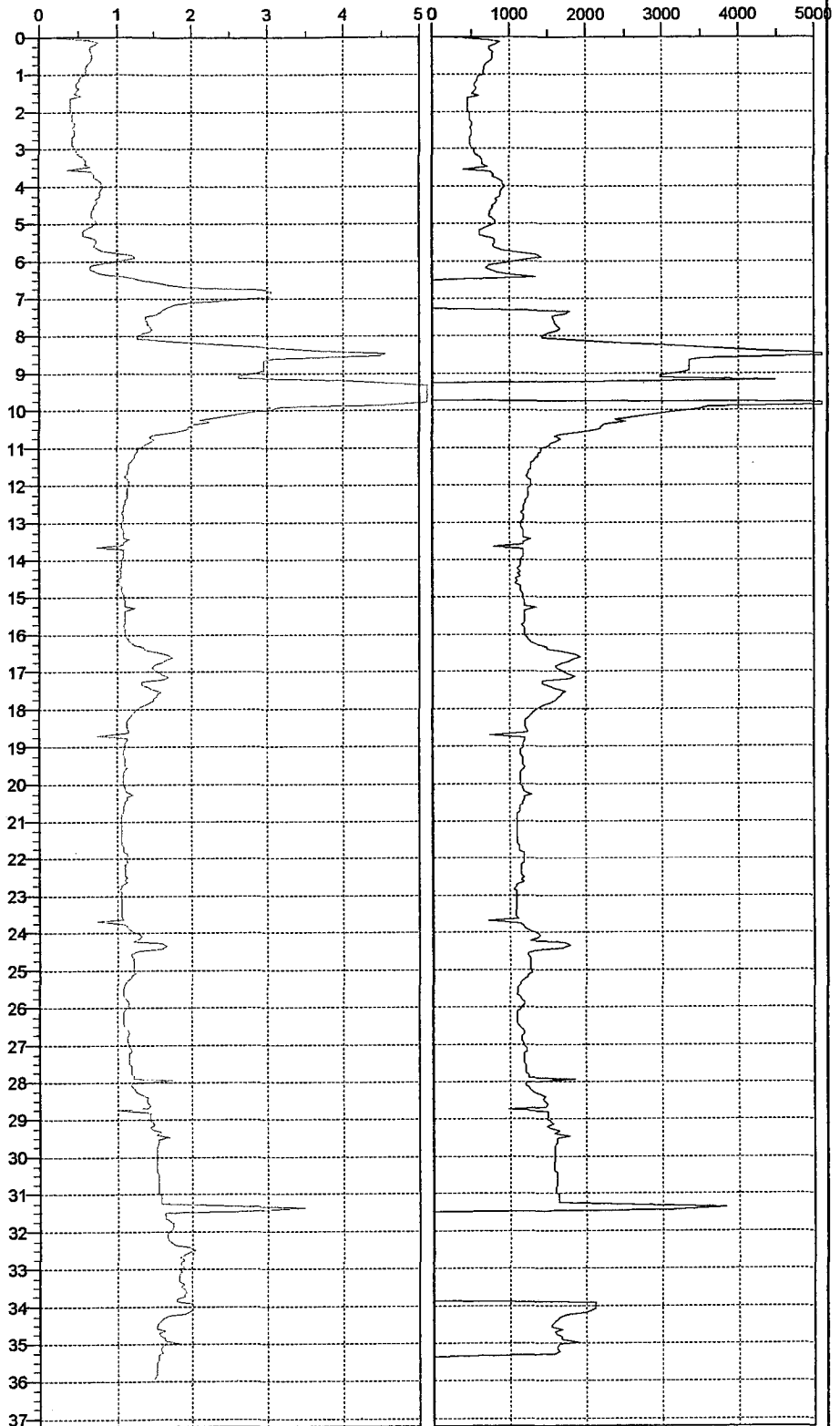
TEST HOLE #2

qc [MPa]

Su [psf]



Depth [ft]



Cone No: 0
Tip area [cm²]: 10
Sleeve area [cm²]: 150

STI

Test no: 2	Position:	Ground level:	
Client:	Clark Engineering Corp.	Date: 6/30/03	Scale: 1 : 56
Project:	Proposed Wieman Dam, Near Marion, SD	Page: 1/1	Fig:
Water: 2.3'		File:	0611-2.cpd

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #3							
		LOCATION: Near Marion, SD		Sheet 1 of 1							
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS				
					NO	TYPE	W	D	LL	PL	QU
2	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL	▼		1	MC					
	Lean Clay, a little gravel, gray and brown mottled, lenses of silt at 7'-8' (CL)	TILL			2	MC					
	Lean Clay, a little gravel, gray (CL)						24	99			
10	END OF TEST HOLE										
DATE		WATER LEVEL MEASUREMENTS		START: 06-30-03 COMPLETE: 06-30-03							
6-30	At completion of test hole, Sampled to: 5'	WL= 7'		METHOD:							
				Macro Core Sampling to 10'							
				Crew Chief: K.Stoecker (STI)							
SOIL TECHNOLOGIES, INC		401 E. 8TH STREET, SIOUX FALLS, SD 57103									
		TELEPHONE: (605) 330-9993 FAX: (605) 330-9994									

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #4								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	W	D	LL	PL	QU	
0.5	Lean Clay, black (CL-OL)	TOPSOIL			1	MC						
	Lean Clay, brown (CL)	FINE ALLUVIUM										
3	Sandy Lean Clay, a little gravel, brown mottled, a layer of water bearing silty sand at 18' (CL)	TILL					15		43	19		
					2	MC						
					3	MC						
					4	MC						
					5	MC						
					6	MC						
27	Lean Clay, a little gravel, gray, (CL)											
30												
END OF TEST HOLE												
DATE	WATER LEVEL MEASUREMENTS		START: 07-2-03		COMPLETE: 07-2-03							
7-2	Sampled to: 20', Cave In: 17.7'	WL=17	METHOD:		at 11:58							
7-2	Sampled to: 30', Cave In: 29'	WL=19.1	Macro Core Sampling to 30'									
			Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC 401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994												

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #5								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
	SURFACE ELEVATION =											
	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL			1	MC						
2.5	Lean Clay, a little gravel, gray and brown mottled (CL)	TILL										
5	END OF TEST HOLE											
DATE			WATER LEVEL MEASUREMENTS			START: 06-30-03 COMPLETE: 06-30-03						
6-30	At completion of test hole, Sampled to: 5'	WL= None	METHOD:									
			Macro Core Sampling to 5'									
			Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103									
			TELEPHONE: (605) 330-9993 FAX: (605) 330-9994									

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #6							
		LOCATION: Near Marion, SD		Sheet 1 of 1							
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE	LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU
2.5	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL			HA						
	Lean Clay, a little gravel, gray and brown mottled, a 4" layer of clayey sand at 4' (CL)	TILL									
5	END OF TEST HOLE										
DATE			WATER LEVEL MEASUREMENTS			START: 07-2-03 COMPLETE: 07-2-03					
7-2	At completion of test hole, Sampled to: 5'	WL= None	METHOD: Hand Auger To 5'								
			Crew Chief: K.Stoecker (STI)								
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994								

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #7	
		LOCATION: Near Marion, SD		Sheet 1 of 1	
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL "N"	SAMPLE NO TYPE	LABORATORY TESTS W D LL PL QU
	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL		HA	
3	Sandy Lean Clay, dark brown (CL)	MIXED ALLUVIUM			
5	END OF TEST HOLE				
DATE			WATER LEVEL MEASUREMENTS		START: 07-2-03 COMPLETE: 07-2-03
7-2	At completion of test hole, Sampled to: 5'	WL= None	METHOD:		
			Hand Auger To 5'		
			Crew Chief: K.Stoecker (STI)		
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103		
			TELEPHONE: (605) 330-9993 FAX: (605) 330-9994		

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #8								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
2.5	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL				HA						
	Lean Clay, a little gravel, gray and brown mottled (CL)	TILL										
5	END OF TEST HOLE											
DATE			WATER LEVEL MEASUREMENTS			START: 07-2-03 COMPLETE: 07-2-03						
7-2	At completion of test hole, Sampled to: 5'	WL= None	METHOD:									
			Hand Auger To 5'									
			Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994									

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #9								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
2	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL				HA						
5	Lean Clay, a little gravel, gray and brown mottled (CL)	TILL										
	END OF TEST HOLE											
DATE			WATER LEVEL MEASUREMENTS			START: 07-2-03 COMPLETE: 07-2-03						
7-2	At completion of test hole, Sampled to: 5'	WL = 4'	METHOD: Hand Auger To 5'									
			Crew Chief: K. Stoecker (STI)									

SOIL TECHNOLOGIES, INC

401 E. 8TH STREET, SIOUX FALLS, SD 57103
 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994

STI No. 03-0611, Proposed Wieman Dam



Sample Number 1

Reported To Soil Technologies, Inc.

Job No. GEO-070309 Date 7/20/2003

Location _____

Copies To _____

Source of Material Boring 1, Minus 2.0' to 8.0'

Description of Material SANDY LEAN CLAY, brown, trace
(ASTM: D 2488 - Visual) of gravel (CL) 1.4% + #4

Test Methods ASTM: D 698-00a Method A

ASTM: D2216-98

ASTM: D4318-00

TEST RESULTS

Moisture Content As Received 20.5%

Maximum Dry Density 103.6 PCF

Optimum Water Content 20.9%

Preparation Method Moist

Rammer Type Manual

ATTEBERG LIMITS

LL

PL

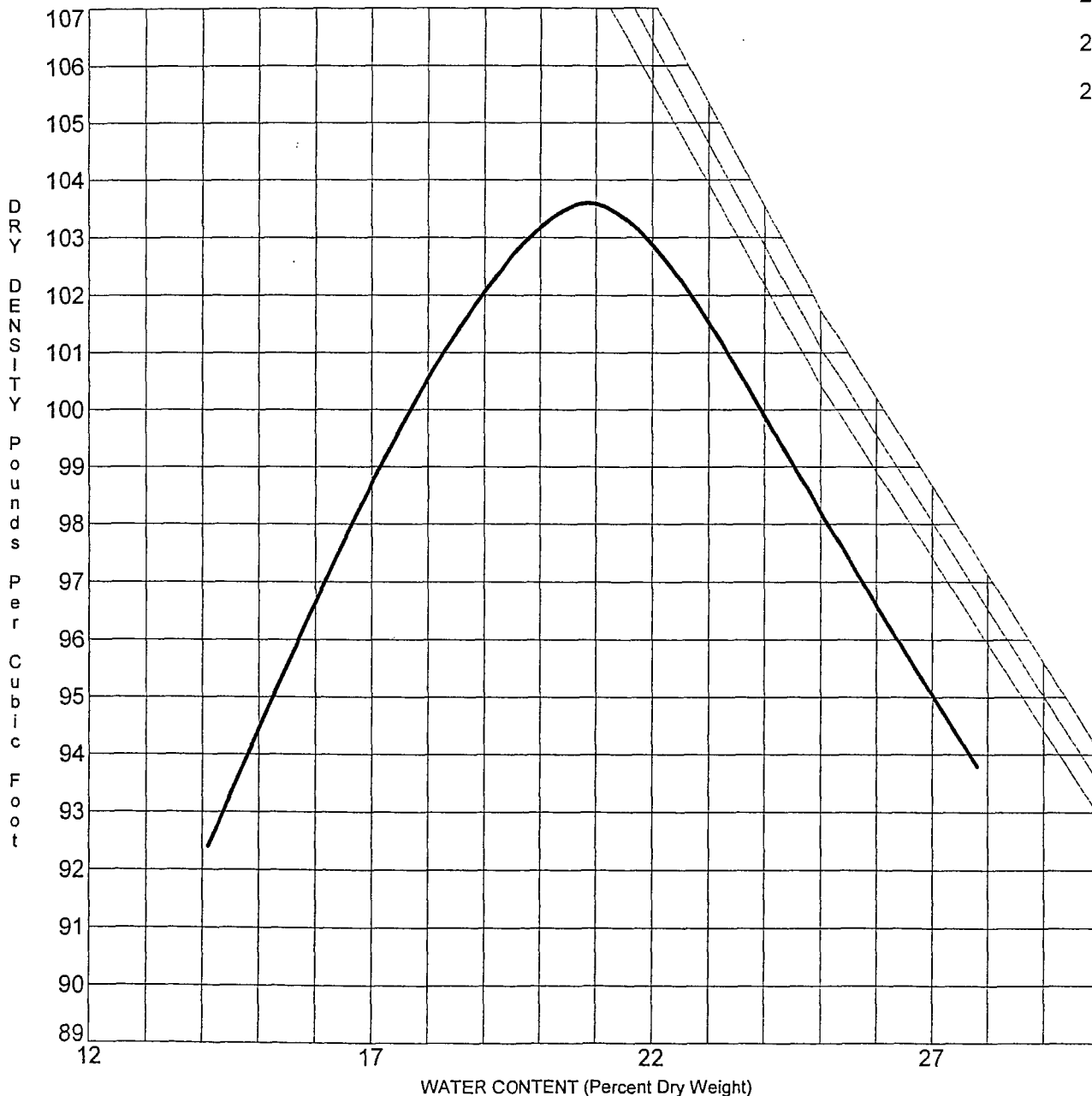
PI

CURVES OF 100% SATURATION
FOR SPECIFIC GRAVITY
EQUAL TO:

2.75

2.72

2.69



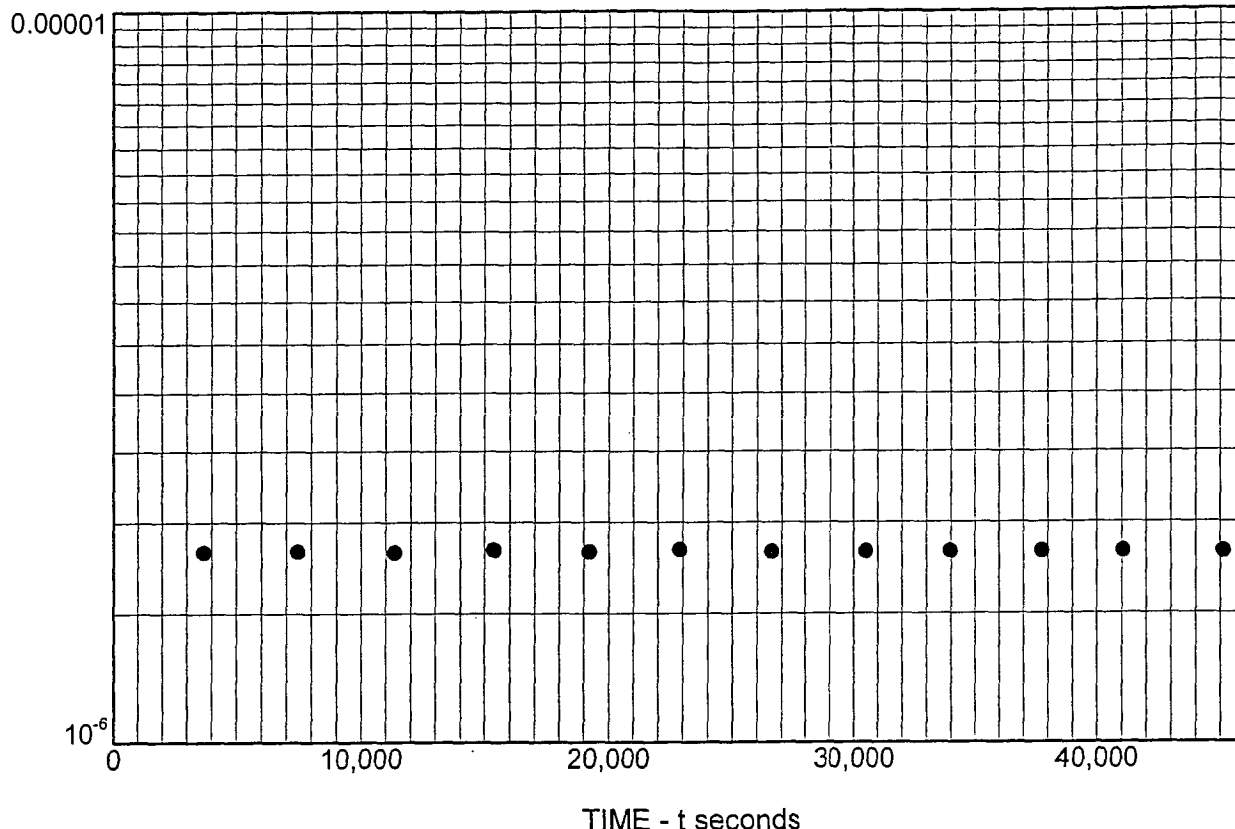
LABORATORY COMPACTION CHARACTERISTICS OF SOIL

GEOSERV INC Testing - Exploration - Engineering
Bismarck, ND 58501

ASTM: D 5084-00 "MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED
POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER" METHOD B



HYDRAULIC
CONDUCTIVITY
K
20C
cm-sec



Sample Identification: 1 Sample Depth (ft): 8.0 LL: N/T
 Sample Location: B-1 PL: N/T
 Sample Method: Auger PI: N/T
 Remolded Compaction Method: ASTM: D 698-00a Method A Minus #200 Wash (%): N/T
 Maximum Dry Density (pcf): 103.6 Optimum Moisture Content (%): 20.9
 Classification (ASTM: D 2488 - visual): SANDY LEAN CLAY, brown (CL)
 Comments: Initial Percent Compaction: 95.0

	INITIAL	FINAL
Sample Length (cm):	7.23	7.29
Sample Diameter (cm):	7.18	7.29
Sample Moisture Content (%):	21.0	25.3
Sample Unit Weight (pcf):	98.4	95.8
Sample Degree of Saturation (%):	89.5	97.3

Permeant Liquid Used: Deaired Water Cell Pressure (psi): 10.2
 Maximum Effective Stress (psi): 6.2 Maximum Head Pressure (psi): 6.2
 Minimum Effective Stress (psi): 4.0 Maximum Tail Pressure (psi): 4.0
 Range Of Hydraulic Gradient: 1.6248 to 1.6112
 Calculated Hydraulic Conductivity K-20C cm/sec: 1.8271E-06
 Average Hydraulic Conductivity (last 4 readings) K-20C cm/sec: 1.8260E-06
 Average Hydraulic Conductivity (last 4 readings) K-20C in/day: 6.2112E-02

Remarks: Final Percent Compaction: 92.5

PROJECT STI No. 03-0611, Proposed Wieman Dam, JOB NO. GEO-070309
 REPORTED TO Soil Technologies, Inc. DATE 7/20/2003

FALLING HEAD PERMEABILITY
 GEOSERV INC Testing - Exploration - Engineering
 Bismarck, ND 58501

SYMBOLS AND TERMINOLOGY

DRILLING AND SAMPLING SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
B	Bag Sample
CPT	Cone Penetration Test
CR	Core Recovery (percent)
DC	Steel Drive Casing
DM	Drilling Mud
FA	Flight Auger
HA	Hand Auger
HSA	Hollow Stem Auger
JW	Jetting Water
MC	Macro Core Sampler
NSR	No Sample Recovered
<u>Q</u>	BQ, NQ or PQ Wireline System
<u>RC</u>	Rotary Casing
SB	Split Barrel Sampler
3TW	3" Thin Walled Tube Sampler
3TP	3" Thin Walled Tube (Pitcher Sampler)
<u>X</u>	AX, BX, Or NX Double Tube Barrel
<u>▼</u>	Water Level Symbol

TEST SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
W	Water Content % of Dry Weight (ASTM: D2216)
D	Dry Density - pounds per cubic foot
LL	Liquid Limit (ASTM: D4318)
PL	Plastic Limit (ASTM: D438)
Qu	Unconfined Compressive Strength - pounds per square foot (ASTM: D2166)
Pq	Penetrometer Reading - tons per square foot
qc	Point resistance - Mpa (megapascals)
fs	Sleeve friction - Mpa (megapascals)
Su	Undrained Shear Strength
ID	Relative density (%)
N	Standard Penetration - blows per foot*
R	Laboratory Resistivity
G	Specific Gravity - ASTM: D854
OC	Organic Content
K	Coefficient of Permeability
VS	Field Vane Shear (ASTM: D2573)
RQD	Rock Quality Designation - percent

WATER LEVELS

Water levels shown on the test hole (boring) logs are the water levels measured in the test holes at the time and under the conditions indicated. In sand soil, the indicated levels may be considered fairly reliable ground water levels. In clay soil, it may not be possible to determine the ground water level within the normal time required for the test hole, except where lenses or layers of more pervious waterbearing soil are present. Even then, an extended period of time may be necessary to reach equilibrium. Therefore, the water levels shown on the test hole logs for cohesive or mixed texture soils may not indicate the true level of the ground water table. Perched water refers to water above an impervious layer, thus impeded in reaching the water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

<u>"N" VALUE*</u>	<u>DENSITY</u>	<u>CONSISTENCY</u>
0 - 4 blows/ft.	Very Loose	Soft
5 - 8 blows/ft.	Loose	Medium
9 - 15 blows/ft.	Medium Dense	Rather Stiff
16 - 30 blows/ft.	Dense	Stiff
Over 30	Very Dense	Very Stiff

*"N" is the Standard Penetration, in blows per foot, of a 140 pound hammer falling 30 inches onto a 2 inch OD split barrel sampler. If CPT equipment is used, the "N" value is derived from the point resistance.

Lamination	Up to 1/2" thick stratum
Layer	1/2" to 6"
Lens	1/2" to 6" discontinuous stratum, pocket
Varved	Alternating laminations of clay, silt and /or fine grained sand, or colors thereof
Dry	Powdery, no noticeable water
Moist	Below saturation
Wet	Saturated, above liquid limit
Waterbearing	Pervious soil below water

RELATIVE GRAVEL PROPORTIONS

<u>CONDITION</u>	<u>TERM</u>	<u>RANGE</u>
Coarse Grained Soils	A little gravel	2 - 14%
	With gravel	15 - 49%
Fine Grained Soils		
	15-29% + No. 200	A little gravel 2 - 7%
	15-29% + No. 200	With gravel 8 - 29%
	30% + No. 200	A little gravel 2 - 14%
	30% + No. 200	With gravel 15 - 24%
	30% + No. 200	Gravelly 16 - 49%

RELATIVE SIZES

Boulder	Over 12"
Cobble	3" - 12"
Gravel - Coarse	3/4" - 3"
Gravel - Fine	#4 - 3/4"
Sand - Coarse	#4 - #10
Sand - Medium	#10 - #40
Sand - Fine	#40 - #200
Silt & Clay	-#200, Based on Plasticity

Soil Technologies, Inc.

PRECAUTIONS FOR EXCAVATING AND REFILLING DURING COLD WEATHER

The winter season in this area presents specific problems for foundation construction. Soils which are allowed to freeze undergo a moisture volume expansion, resulting in a loss of density. These frost-expanded soils will consolidate upon thawing, causing settlement of any structure supported on them. To prevent this settlement, frost should not be allowed to penetrate into the soils below any proposed structure.

Ideally, winter excavation should be limited to areas small enough to be refilled to a grade higher than footing grade on the same day. Typically, these areas should be filled to floor grade. Trenching back down to unfrozen soils for foundation construction can then be performed just prior to footing placement. The excavated trenches should be protected from freezing by means of insulating or heating during foundation construction. Backfilling of the foundation trenches should be performed immediately after the below-grade foundation construction is finished. In addition, any interior footings, or footings designed without frost protection should be extended below frost depth, unless adequate precautions are taken to prevent frost intrusion until the building can be enclosed and heated.

In many cases, final grade cannot be attained in one day's time, even though small areas are worked. In the event final grade cannot be attained in one day's time, frost can be expected to develop overnight. The depth of frost penetration can be minimized by leaving a layer of loose soil on top of the compacted material overnight. However, any frost which forms in this loose layer, or snow which accumulates, should be completely removed from the fill area prior to compaction and additional soil placement. Frozen soils, or soils containing frozen material or snow should never be used as fill material.

After the structure has been enclosed, all floor slab areas should be subjected to ample periods of heating to allow thawing of the soil system. Alternatively, the frozen soils can be completely removed and be replaced with an engineered fill. The floor slab areas should be checked at random and representative locations for remnant areas of frost, and density tests should be performed to document fill compaction prior to slab placement.

Due to the potential problems associated with fill placement during cold weather, any filling operations should be monitored by a full-time, on-site soils technician. Full-time monitoring aids in detecting areas of frozen material, or potential problems with frozen material within the fill, so that appropriate measures can be taken. The choice of fill material is particularly important during cold weather, since clean granular fill materials can be placed and compacted more efficiently than silty or clayey soils. In addition, greater magnitudes of heaving can be expected with freezing of the more frost susceptible silts and clays.

If more specific frost information or cold weather data concerning other construction materials is required, please contact us.

CONSTRUCTION OBSERVATIONS AND TESTING

The recommendations made in this report have been made based on the subsurface conditions found in the test holes. It is possible that there are soil and water conditions on-site that were not represented by those test holes. Therefore, we recommend that the completed excavation and prepared subgrade be observed and tested by a soils engineer prior to fill placement or construction of any foundation elements. These observations are necessary to judge if all unsuitable materials have been removed from within the planned construction area and that an appropriate degree of lateral oversize has been provided for in those areas where fill will be placed below the bottom of foundation grade.

We recommend a representative number of field density tests be taken in the engineered fill to aid in judging its suitability. At least one density test should be performed for each 2' of fill depth. The tests should be spaced so that there is a minimum of one test for every 2000 square feet of engineered fill placed. Additional tests should be taken in confined areas. The actual number of tests should be left to the discretion of a qualified engineer or his representative. Any proposed fill material should be submitted to the laboratory for tests to check compliance with our recommendations and project specifications.

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration, the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geo-

technical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or ground-water fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed un-

der the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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ASFE THE ASSOCIATION
OF ENGINEERING FIRMS
PRACTICING IN THE GEOSCIENCES

8811 Colesville Road/Suite G106/Silver Spring, Maryland 20910/(301) 565-2733

STORM WATER POLLUTION PREVENTION PLAN - NARRATIVE

SD-DENR STORM WATER DISCHARGE PERMIT

Coverage under the "Storm Water Discharge General Permit for Storm Water Discharges Associated with Construction Activities" must be obtained from the South Dakota Department of Environment and Natural Resources (SD-DENR) before any construction activities can begin.

The Engineer will submit "Notice of Intent" to obtain coverage under the general permit to SD-DENR upon receipt of a fully executed copy of the "Storm Water Pollution Prevention Plan Certification". Blank copies of the "Storm Water Pollution Prevention Plan Certification" form and the "Notice of Intent" form are provided in the Contract Documents.

The Engineer will file the "Notice of Termination" with SD-DENR when the site has reached final stabilization. A blank copy of the "Notice of Termination" form is provided in the Contract Documents.

PRIMARY RESPONSIBLE PARTY FOR EROSION CONTROL

The Contractor shall assign a specific individual to be the Primary Responsible Party for Erosion Control. The Primary Responsible Party may be a representative of the Contractor or a Sub-contractor, and is subject to the approval of the Engineer. The Primary Responsible Party will perform all required inspections and prepare the Erosion and Sediment Control Inspection and Maintenance Reports until the Final Completion date.

PROJECT DESCRIPTION

The project consists of the construction of grading and earth moving for an earthen dam and associated spillways in rural Turner County, South Dakota. The project is located approximately two miles north of the City of Marion adjacent to 447th Avenue. The location and project limits are generally shown on the Drawings.

AREA & VOLUME

The area to be disturbed by this project is approximately 20 acres on the project site. A total of 41,327 cubic yards of unclassified excavation is anticipated.

EXISTING SITE CONDITION

The existing project site consists of a sloping fields with adjacent wetland and grass areas consistent with normal rural land uses. Drainage is generally toward the West Fork of the Vermillion River (south).

ADJACENT AREAS

Adjacent areas include rural homesteads.

SOILS

The existing underlying soils at the project site consist primarily of lean clay glacial till with low erosion potential. The overlying soils consist of topsoil and re-deposited soils.

CONSTRUCTION SCHEDULE & SEQUENCE

The Contractor shall submit a construction schedule including the erosion control sequence at the preconstruction meeting. The erosion control sequence shall be subject to Engineer Approval, and will generally be as follows:

- 1. Install perimeter protection.
- 2. Install channel and ditch bottom protection.
- 3. Clearing and grubbing.
- 4. Remove and store topsoil.
- 5. Complete final grading.
- 6. Install erosion control items.
- 7. Replace topsoil and seed designated areas.

Stabilize disturbed areas and install culvert protection within 21 days of completing activity.

EROSION CONTROL PLAN

Erosion control measures are identified in the Erosion Control Plan, and will generally be placed before construction activities commence on any portion of the project site. Permanent soil stabilization shall be applied to disturbed areas as soon as practicable.

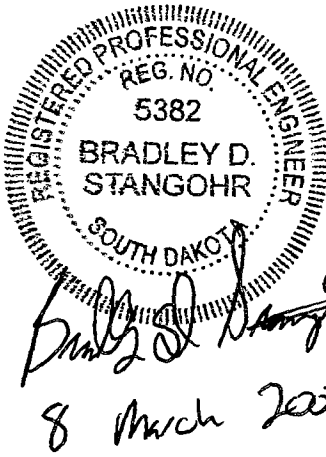
Erosion control measures will consist of permanent seeding, temporary mulching, turf reinforcement mats, rock check dams, erosion control blanket, temporary erosion control wattles, temporary diversion dikes and temporary silt fence. At the conclusion of the project, the project area and reservoir will be designated for recreational use.

When changes are made to the construction project that require alterations in the erosion control measures, the Storm Water Pollution Prevention Plan (SWPPP) will be amended to provide appropriate protection to disturbed areas, all storm water structures, and adjacent waters.

Areas designated on the plans will be seeded upon completion of grading operations.

ALTERNATE STORM WATER POLLUTION PREVENTION PLAN

The Storm Water Pollution Prevention Plan incorporated into these plans may be altered by the Contractor with the prior approval of the Engineer. If altered by the Contractor, the Contractor shall provide a revised Storm Water Pollution Prevention Plan to the Engineer for approval. No Alternative Storm Water Pollution Prevention Plans will be considered until after a Contract has been Awarded.



STORM WATER POLLUTION PREVENTION PLAN - NARRATIVE	
WIEMAN DAM	
MARION, SOUTH DAKOTA	
DATE: 3/5/2007	SCALE: NTS
PROJ. NO. 03031	DRAWN BY: VLV
CHECKED BY: BDS	REVISIONS:
Convention Center Plaza 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2505 Fax (605) 331-2602 siouxfalls@clark-eng.com	
CLARK ENGINEERING CORPORATION	
SHEET 1 of 8	

SWPPP - NARRATIVE - (continued)

INSPECTION, MAINTENANCE, & CLEANUP

Inspection of erosion and sediment control measures should be scheduled weekly and following any storm event of one-half inch or greater. All measures will be maintained in good working order. Necessary repairs will be initiated within 24 hours of the site inspection report.

Silt fence will be inspected for depth of sediment and for tears in order to ensure the fabric is securely attached to the posts and that the posts are well anchored. Sediment buildup will be removed from the silt fence when it reaches one-third of the height of the silt fence.

Check dams will be inspected for stability. Sediment will be removed when depth reaches one-half the height of the dam.

All seeded areas will be checked for bare spots, washouts, and vigorous growth free of significant weed infestations.

Inspection and maintenance procedures will continue until all disturbed areas are stabilized and the Notice of Termination is filed with SD-DENR. From the Notice to Proceed date until the Final Completion date, the Contractor will inspect and maintain all erosion and sediment control measures, prepare the written Erosion and Sediment Control Inspection and Maintenance Reports on the form provided in the Contract Documents, and provide a copy of each report to the Engineer. After the Final Completion date, the City will inspect and maintain all erosion and sediment control measures, prepare the written Erosion and Sediment Control Inspection and Maintenance Report on the form provided in the Contract Documents, and provide a copy of each report to the Primary Responsible Party.

FINAL CLEANUP

Upon sufficient establishment of permanent stabilization measures, all remaining temporary erosion control measures, such as silt fence, erosion bales, sedimentation basins, etc... will be removed including the removal and disposal of any accumulated sediment and a Notice of Termination filed with SD-DENR. Removal of temporary erosion control measures after the Final Completion Date will be performed City.

AREA FOR STOCKPILES AND STORAGE

Topsoil and other excavated or stockpiled material will be properly stockpiled and protected from erosion.

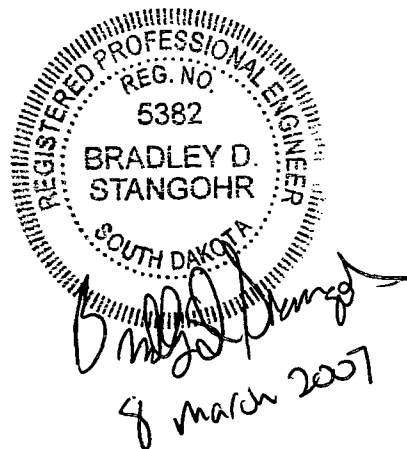
NON-STORM WATER DISCHARGES

No non-storm water discharges are anticipated as part of this project.

MATERIALS INVENTORY

The following materials or substances are expected to be present on the site during the construction period.

- Concrete and Portland Cement
- Detergents
- Metals
- Bituminous Materials
- Petroleum Based Products
- Cleaning Solvents
- Wood
- Cure
- Texture
- Chemical Fertilizers



WASTE DISPOSAL

All waste materials will be collected and stored in appropriate containers. All trash and construction debris from the site will be deposited in the approved containers. Containers will be serviced as necessary, and the trash will be hauled to an approved disposal site or licensed landfill. All onsite personnel will be instructed in the proper procedures for waste disposal.

HAZARDOUS WASTE

All hazardous waste materials will be disposed of in a manner specified by local or state regulations or by the manufacturer.

SANITARY WASTE

Portable sanitary facilities will be provided at the project site. Sanitary waste will be collected from the portable units in a timely manner by a licensed waste management contractor or as required by any local regulations.

SPILL PREVENTION - HOUSEKEEPING

Only necessary products will be stored on-site by the Contractor. Except for bulk materials the Contractor will store all materials under cover and in appropriate containers. Products must be stored in original containers and labeled. Material mixing will be conducted in accordance with the manufacturer's recommendations. When possible, all products will be completely used before properly disposing of the container off site. The manufacturer's directions for disposal of materials and containers will be followed. The contractor's site superintendent will inspect materials storage areas regularly to ensure proper use and disposal. Dust generated will be controlled in an environmentally safe manner. Vegetation areas not essential to the construction project will be preserved and maintained as noted on the plans.

SPILL PREVENTION - HAZARDOUS MATERIALS

Products will be kept in original containers unless the container is not re-sealable. Original labels and material safety data sheets will be retained in a safe place to relay important product information. If surplus product must be disposed of, manufacturer's label directions for disposal will be followed. Maintenance and repair of all equipment and vehicles involving oil changes, hydraulic system drain down, de-greasing operations, fuel tank drain down and removal, and other activities which may result in the accidental release of contaminants will be conducted on an impervious surface and under cover during wet weather to prevent the release of contaminants onto the ground. Wheel wash water will be collected and allowed to settle out suspended solids prior to discharge. Wheel wash water will not be discharged directly into any storm water system or storm water treatment system. Potential pH-modifying materials such as: bulk cement, cement kiln dust, fly ash, new concrete washings, concrete pumping, and mixer washout waters will be collected on site and managed to prevent contamination of storm water runoff.

SPILL PREVENTION - PRODUCT SPECIFIC PRACTICES

Petroleum Products - All on-site vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which are clearly labeled.

Fertilizers - Fertilizers will be applied only in the amounts specified in the Plans. Once applied, fertilizers will be worked into the soil to limit the exposure to storm water. Fertilizers will be stored in an enclosed area. The contents of partially used fertilizer bags will be transferred to sealable containers to avoid spills.

Paints - All containers will be tightly sealed and stored when not required for use. The excess will be disposed of according to the manufacturer's instructions and any applicable state and local regulations.

Concrete Trucks - Contractors will provide designated truck washout areas on the site. These areas must be self contained and not connected to any storm water outlet of the site. Upon completion of construction washout areas will be properly stabilized.

STORM WATER POLLUTION PREVENTION PLAN - NARRATIVE

WIEMAN DAM

MARION, SOUTH DAKOTA

DATE:
3/5/2007

SCALE:
NTS

PROJ. NO. 03031

DRAWN BY: VLV

CHECKED BY: BDS

REVISIONS:

Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505
Fax (605) 331-2602
siouxfalls@clark-eng.com

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SWPPP - NARRATIVE - (continued)

SPILL PREVENTION - SPILL CONTROL PRACTICES

In addition to the previous housekeeping and management practices, the following practices will be followed for spill prevention and cleanup if needed. For all hazardous materials stored on site, the manufacturer’s recommended methods for spill clean up will be clearly posted. Site personnel will be made aware of the procedures and the locations of the information and cleanup supplies. Appropriate cleanup materials and equipment will be maintained by the contractor in the materials storage area on-site. As appropriate, equipment and materials may include items such as booms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for clean up purposes. All spills will be cleaned immediately after discovery and the materials disposed of properly. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance. After a spill a report will be prepared describing the spill, what caused it, and the cleanup measures taken. The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring, as well as clean up instructions in the event of reoccurrences. The contractor’s site superintendent, responsible for day-to-day operations, will be the spill prevention and cleanup coordinator. The contractor is responsible for ensuring that the site superintendent has had appropriate training for hazardous materials handling, spill management, and cleanup.

SPILL PREVENTION - SPILL RESPONSE

The primary objective in responding to a spill is to quickly contain the material(s) and prevent or minimize migration into storm water runoff and conveyance systems. If the release has impacted on-site storm water, it is critical to contain the released materials on-site and prevent their release into receiving waters. If a spill of pollutants threatens storm water or surface water at the site, the spill response procedures outlined below must be implemented in a timely manner to prevent the release of pollutants. The contractor’s site superintendent will be notified immediately when a spill or the threat of a spill is observed. The superintendent will assess the situation and determine the appropriate response. If spills represent an imminent threat of escaping erosion and sediment controls and entering receiving waters, personnel will be directed to respond immediately to contain the release and notify the superintendent after the situation has been stabilized. Spill kits containing appropriate materials and equipment for spill response and cleanup will be maintained by the contractor at the site. If oil sheen is observed on surface water (e.g. settling ponds, detention ponds, swales), action will be taken immediately to remove the material causing the sheen. The contractor will use appropriate materials to contain and absorb the spill. The source of the oil sheen will also be identified and removed or repaired as necessary to prevent further releases. If a spill occurs the superintendent or the superintendent’s designee will be responsible for completing the spill reporting form and for reporting the spill to SD DENR. Personnel with primary responsibility for spill response and clean up will receive training by the contractor’s site superintendent or designee. The training must include identifying the location of the spill kits and other spill response equipment and the use of spill response materials. Spill response equipment will be inspected and maintained as necessary to replace any materials used in spill response activities.

SPILL NOTIFICATION

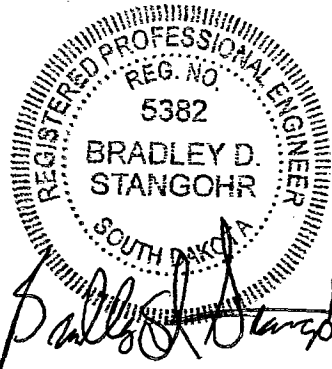
In the event of a spill, the contractor’s site superintendent will make the appropriate notification(s), consistent with the following procedures:

- A reportable spill is a quantity of 25 gallons or more or any spill of oil which: 1) violates water quality standards, 2) produces a "sheen" on a surface water, or 3) causes a sludge or emulsion must be reported immediately to the National Response Center .
- Any spill of oil or hazardous substance to waters of the state must be reported immediately by telephone to the SD DENR.
- Emergency Agency Contact Information:

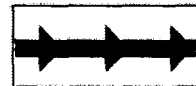
SD DENR Contact Spill Reporting: Business Hours Monday-Friday (605) 773-3296
Nights and Weekends (605) 773-3231

SD DENR Contact for Hazardous Materials: (605) 773-3153

National Response Center Hotline: (800) 424-8802



STORM WATER POLLUTION PREVENTION PLAN - NARRATIVE	
WIEMAN DAM	
MARION, SOUTH DAKOTA	
DATE: 3/5/2007	SCALE: NTS
PROJ. NO. 03031	DRAWN BY: VLV
CHECKED BY: BDS	REVISIONS:
Convention Center Plaza 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2505 Fax (605) 331-2602 siouxfalls@clark-eng.com	
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SHEET 3 of 8	



TEMPORARY DIVERSION DIKE

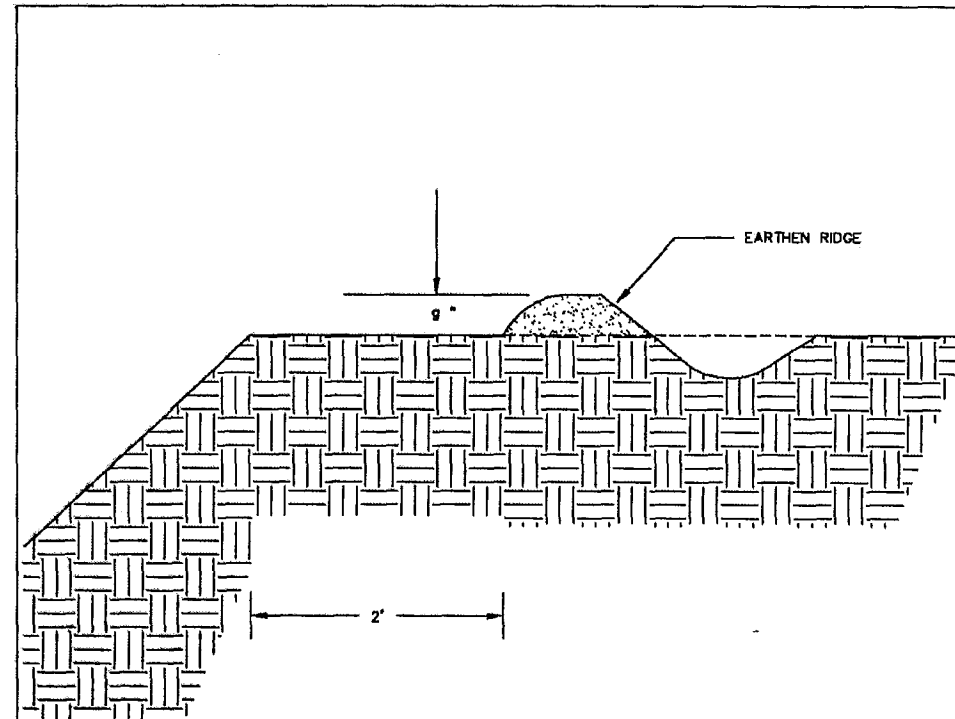
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DEFINITION:

A TEMPORARY RIDGE OF COMPACTED SOIL LOCATED AT THE TOP, MID SLOPE, OR BASE OF A DISTURBED AREA.

PURPOSES:

1. TO DIVERT STORM RUNOFF FROM HIGHER DRAINAGE AREAS AWAY FROM UNPROTECTED SLOPES TO A PERMANENT CHANNEL OR TEMPORARY CHANNEL DIVERSION.
2. TO DIVERT SEDIMENT-LADEN RUNOFF FROM THE MID SLOPE OF A DISTURBED AREA TO A TEMPORARY SLOPE DRAIN.
3. TO DIVERT SEDIMENT-LADEN RUNOFF FROM THE BASE OF A DISTURBED AREA TO A SEDIMENT TRAPPING FACILITY.



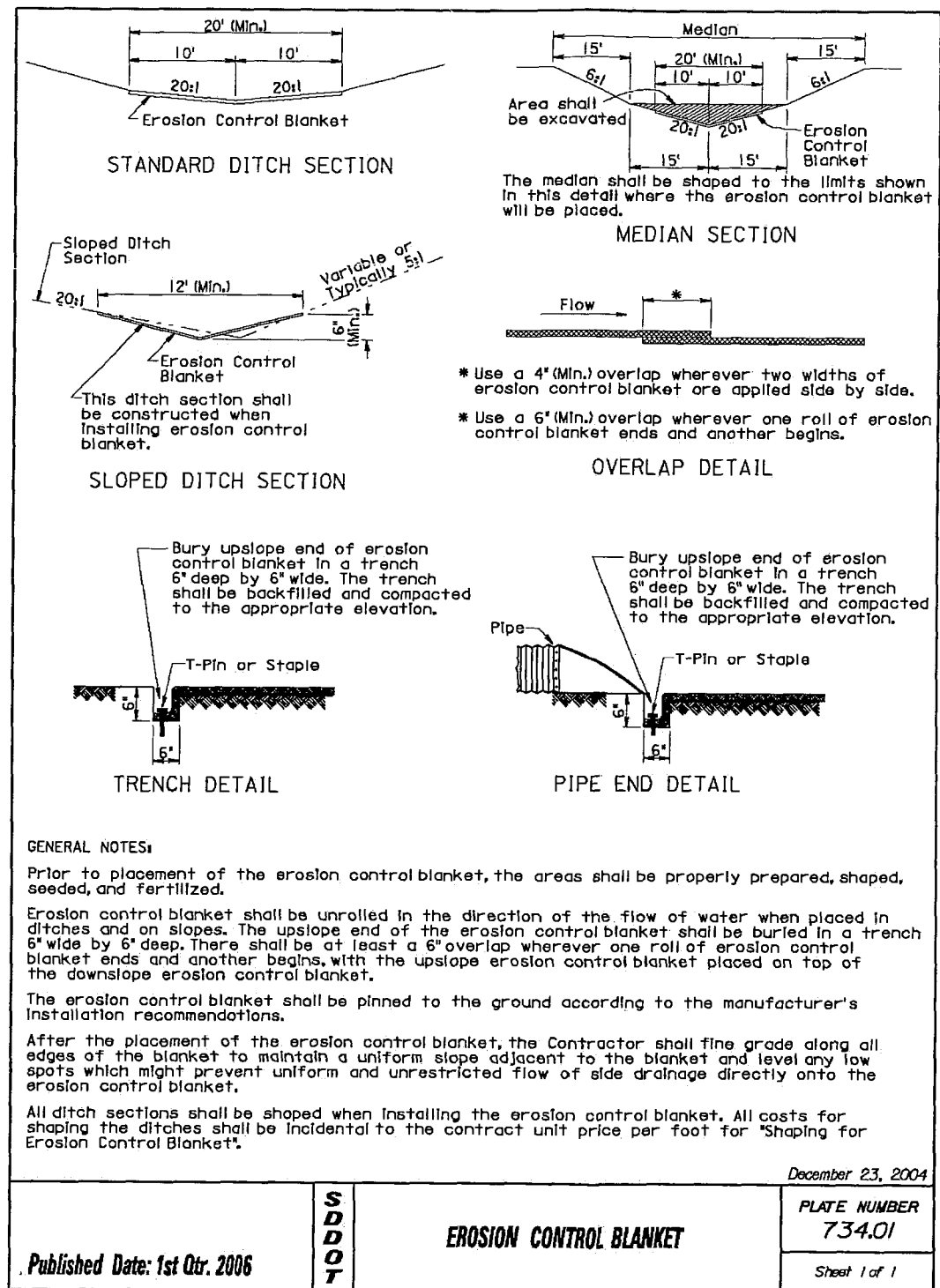
REVISED: JUNE 2000

SPECIFICATION
REFERENCE
NO.
734



CITY OF SIOUX FALLS
ENGINEERING DIVISION
TEMPORARY DIVERSION DIKE

PLATE
NUMBER
734.04



STORM WATER POLLUTION PREVENTION PLAN - DETAILS

WIEMAN DAM

MARION, SOUTH DAKOTA

DATE:
3/5/2007

SCALE:
NTS

PROJ. NO. 03031
DRAWN BY: VLV
CHECKED BY: BDS

REVISIONS:

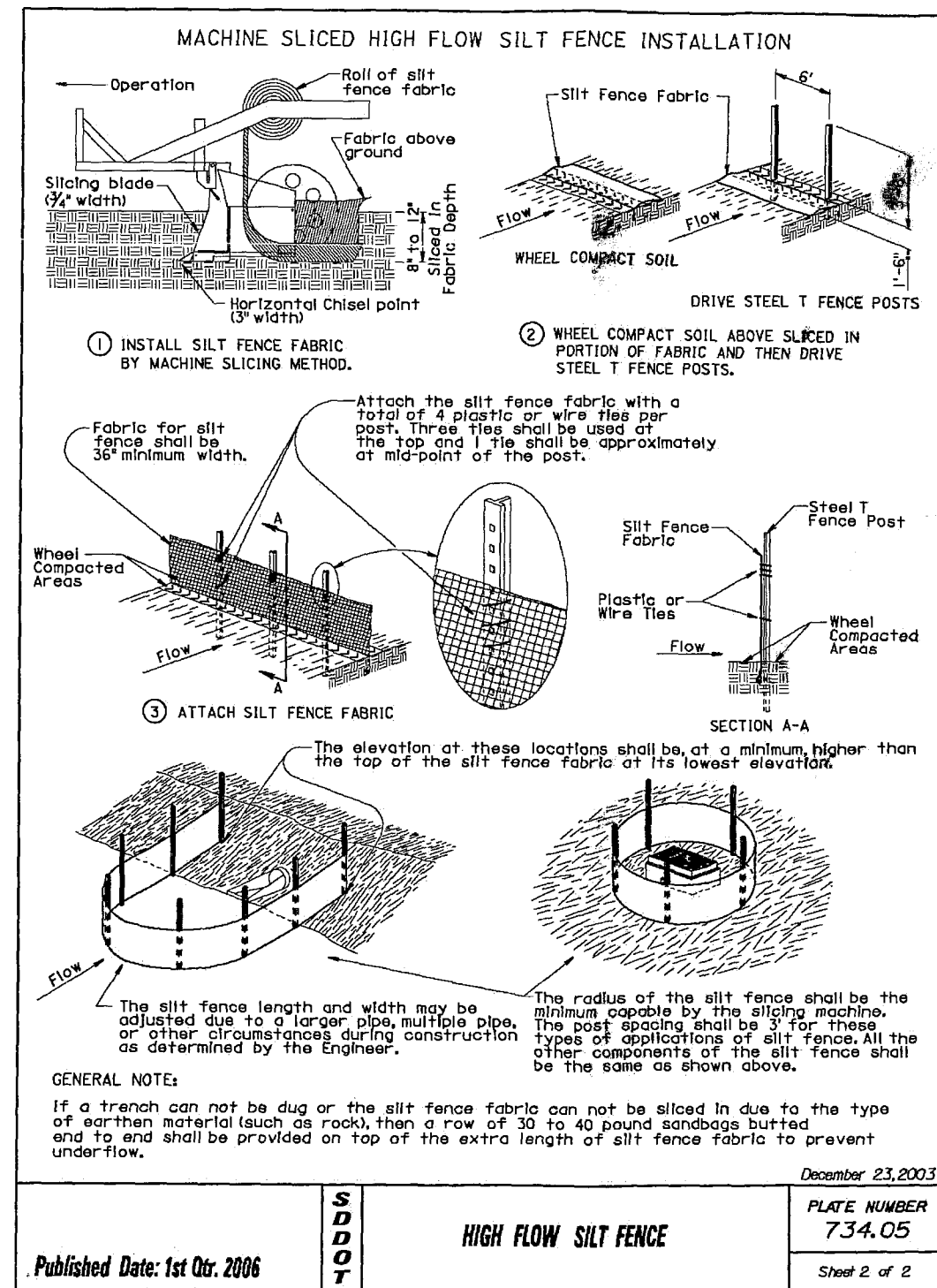
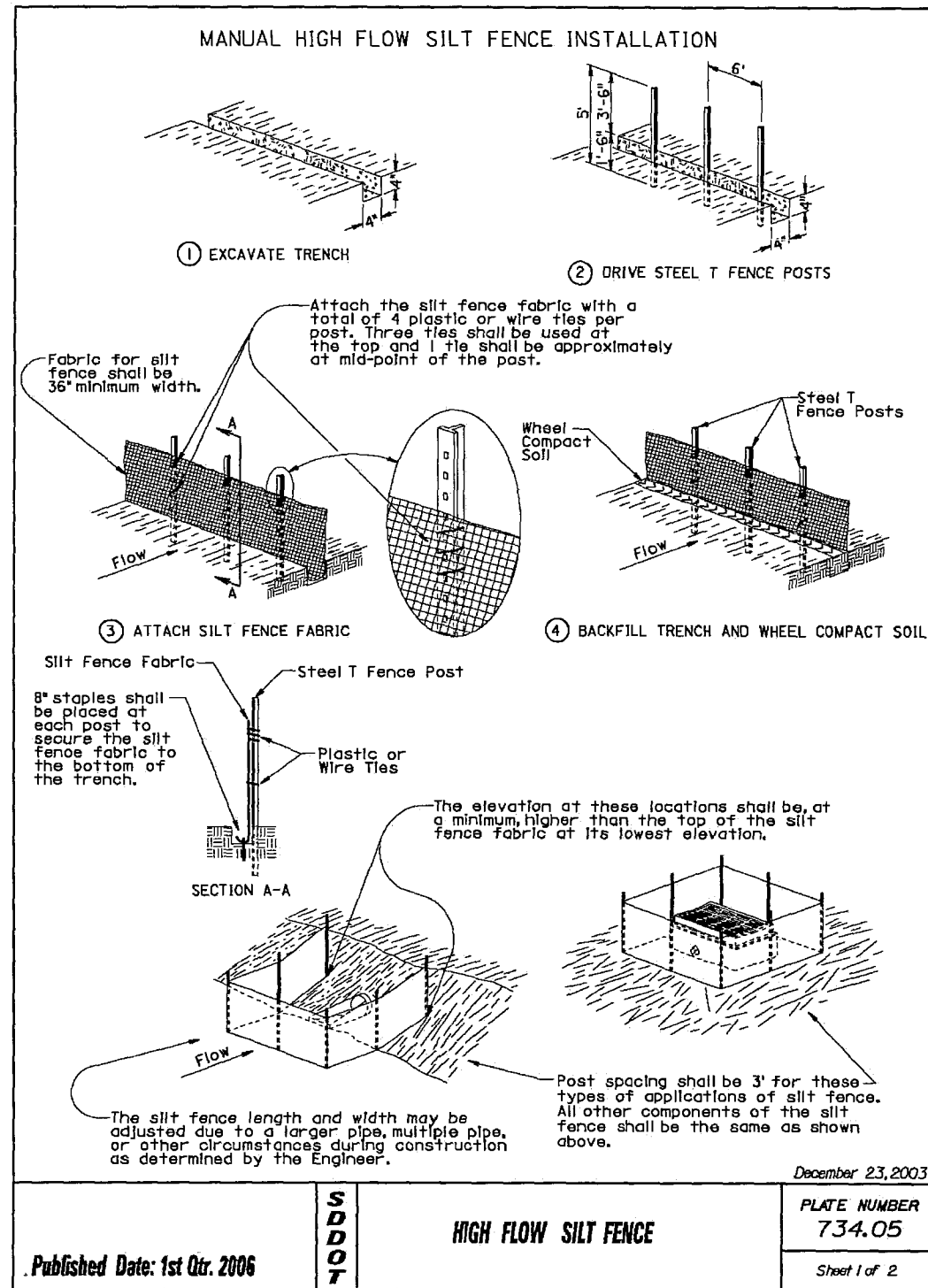
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STORM WATER POLLUTION PREVENTION PLAN - DETAILS

WIEMAN DAM

MARION, SOUTH DAKOTA

DATE:
3/5/2007

SCALE:
N.T.S.

PROJ. NO. 0303

DRAWN BY: JLV

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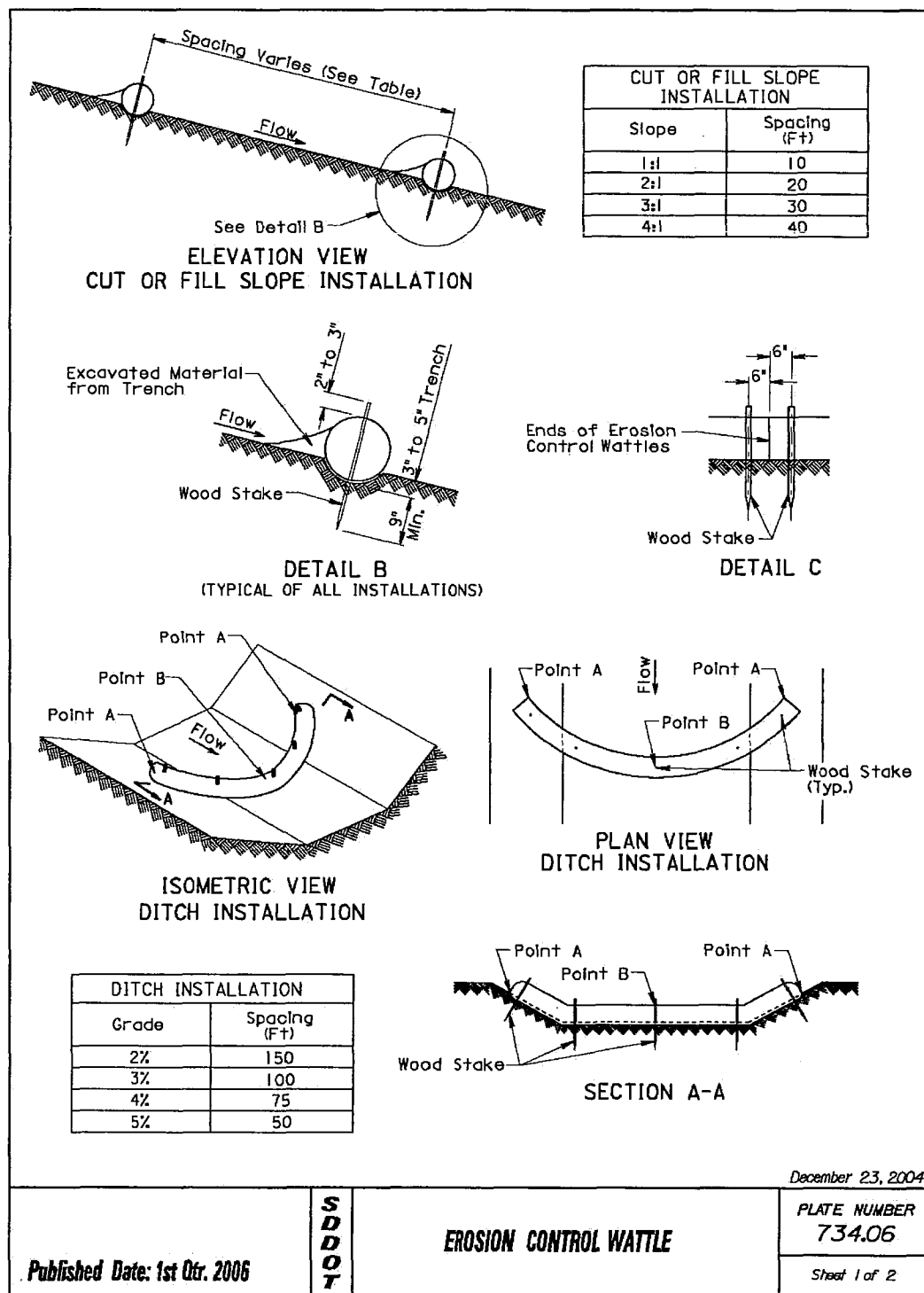
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GENERAL NOTES:

At cut or fill slope installations, wattles shall be installed along the contour and perpendicular to the water flow.

At ditch installations, point A must be higher than point B to ensure that water flows over the wattle and not around the ends.

The Contractor shall dig a 3" to 5" trench, install the wattle tightly in the trench so that daylight can not be seen under the wattle, and then compact the soil excavated from the trench against the wattle on the uphill side. See Detail B.

The stakes shall be 1"x2" or 2"x2" wood stakes, however, other types of stakes such as rebar may be used only if approved by the Engineer. The stakes shall be placed 6" from the ends of the wattles and the spacing of the stakes along the wattles shall be 3' to 4'.

Where installing running lengths of wattles, the Contractor shall butt the second wattle tightly against the first and shall not overlap the ends. See Detail C.

The Contractor and Engineer shall inspect the erosion control wattles once every week and within 24 hours after every rainfall event greater than 1/2". The Contractor shall remove, dispose, or reshape the accumulated sediment when necessary as determined by the Engineer.

Sediment removal, disposal, or necessary shaping shall be as directed by the Engineer. All costs for removing accumulated sediment, disposal of sediment, and necessary shaping shall be incidental to the contract unit price per cubic yard for "Remove Sediment".

All costs for furnishing and installing the erosion control wattles including labor, equipment, and materials shall be incidental to the contract unit price per foot for the corresponding erosion control wattle bid item.

All costs for removing the erosion control wattle from the project including labor, equipment, and materials shall be incidental to the contract unit price per foot for "Remove Erosion Control Wattle".

Published Date: 1st Qtr. 2006

SDOT

EROSION CONTROL WATTLE

December 23, 2004
PLATE NUMBER
734.06
Sheet 2 of 2

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STORM WATER POLLUTION PREVENTION PLAN - DETAILS

WIEMAN DAM

MARION, SOUTH DAKOTA

DATE:
5/5/2007

SCALE:
NTS

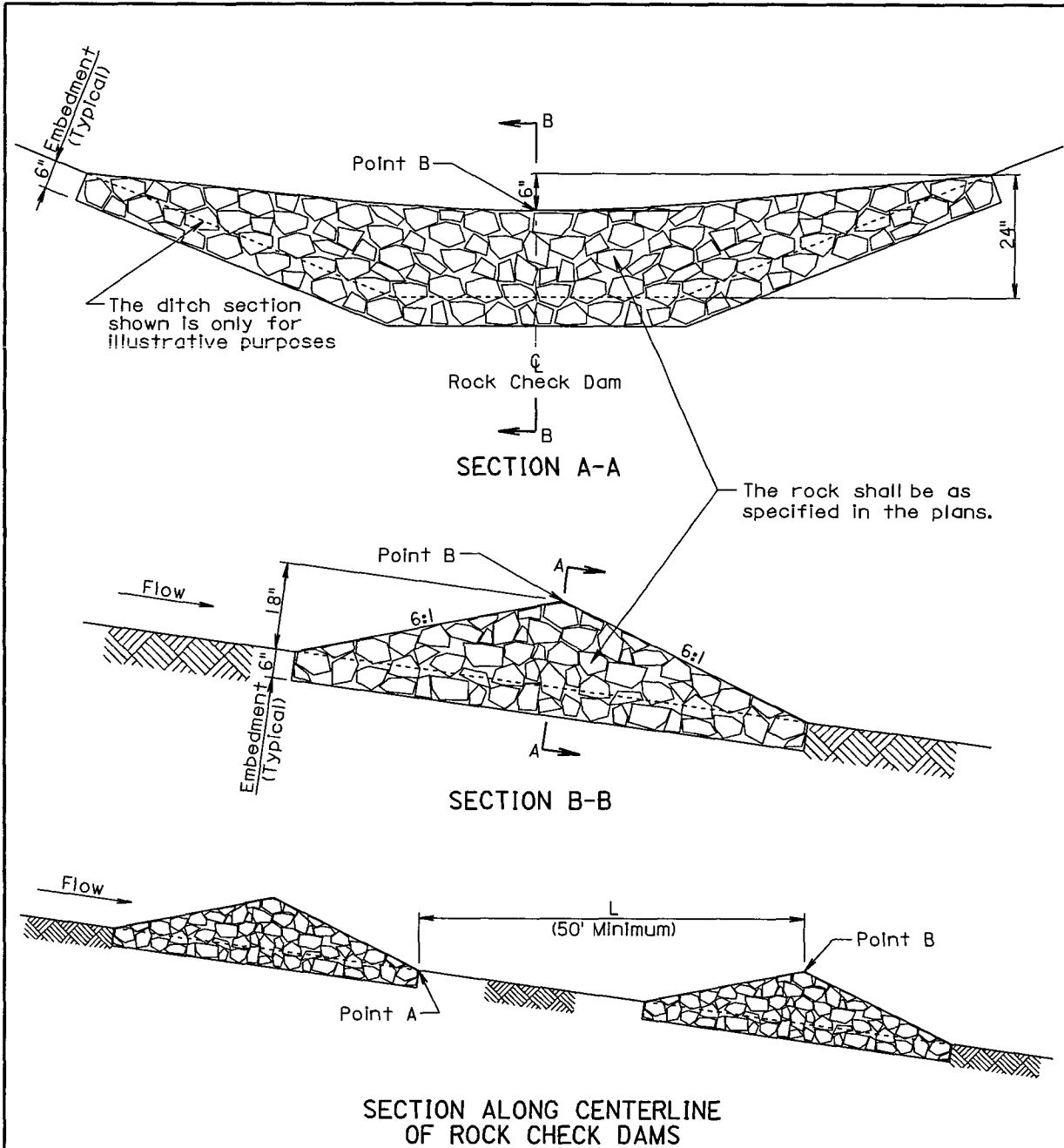
PROJ. NO. 03031

DRAWN BY: VLV

CHECKED BY: BDS

REVISIONS:

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GENERAL NOTES:

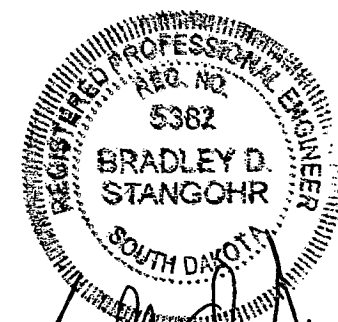
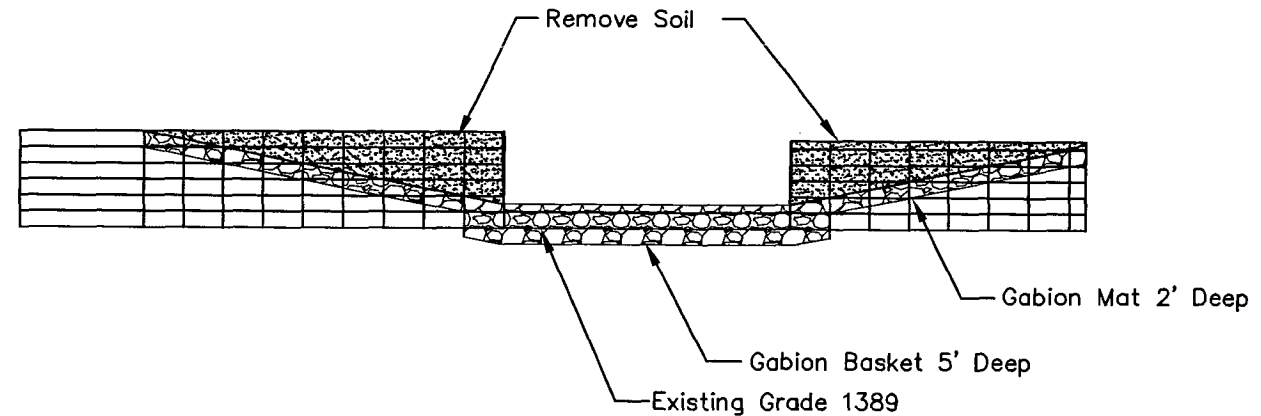
The elevation of Point A and Point B shall be the same. The distance L is the distance required such that Point A and Point B are at the same elevation.

All costs for constructing the Rock Check Dam including labor, equipment, excavation, and rock shall be incidental to the contract unit price per cubic yard for "Rock Check Dam".

March 28, 2001

Published Date: 1st Qtr. 2007	S D D O T	ROCK CHECK DAM	PLATE NUMBER 734.03
			Sheet 1 of 1

BERM REPAIR



Bradley D. Stango
8 March 2007

STORM WATER POLLUTION PREVENTION PLAN - DETAILS

WIEMAN DAM

MARION, SOUTH DAKOTA

DATE:
3/5/2007

SCALE:
NTS

PROJ. NO. 03031

DRAWN BY: VLV

CHECKED BY: BDS

REVISIONS:

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WIEMAN DAM

PLANS FOR PROPOSED CONSTRUCTION OF



PROJECT
LOCATION

LOCATION

SE Quarter of Section 19, T100N, R54W

OWNER INFORMATION

Marlo Wieman
PO Box 135
Marion, SD 57043



SHEET INDEX

Sheet 1	Title Sheet
Sheet 2	General Project Layout
Sheet 3	Overexcavation Plan
Sheet 4	Typical Dam Plan & Profile
Sheet 5	Principal Spillway Plan & Profile
Sheet 6	Typical Vegetated Spillway Plan & Profile
Sheet 7-10	Vegetated Spillway Cross-sections
Sheet 11-14	Standard Details



LEGEND

- Existing Fence
- Proposed Surface
- Water Elevation
- Telephone Line
- Centerline

HISTORICAL FOUNDATION
Not To Be Disturbed



Bradley D. Stango
8 March 2007

Areas of Fine Grading

271st Street

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SHEET
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General Project Layout
Wieman Dam
Marion, South Dakota

DATE: 03/01/07

SCALE: 1" = 100'

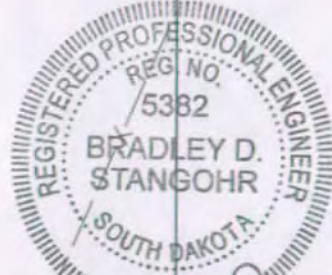
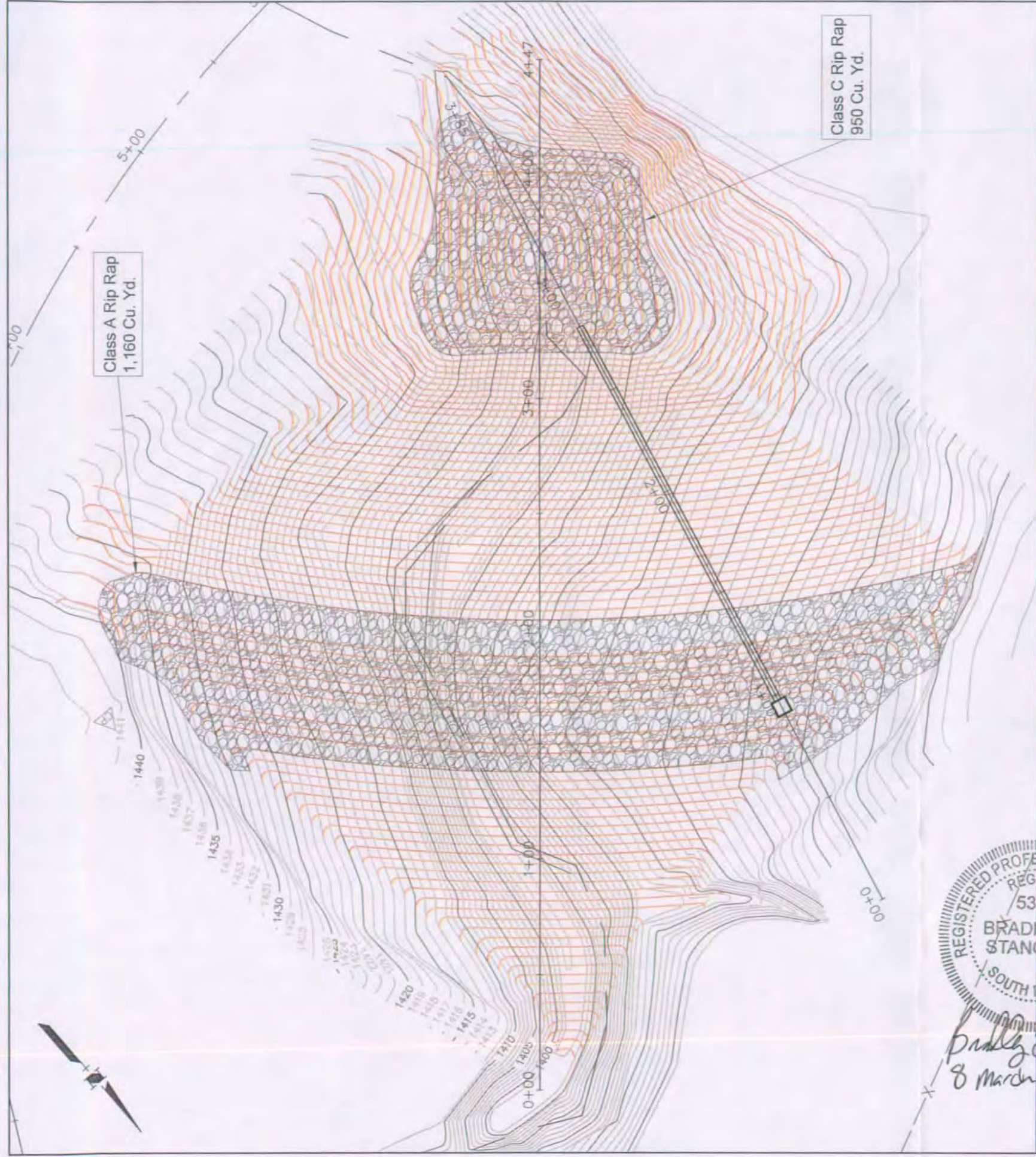
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DRAWN BY: EDG
CHECKED BY: BTJ
REVISIONS:

BOB

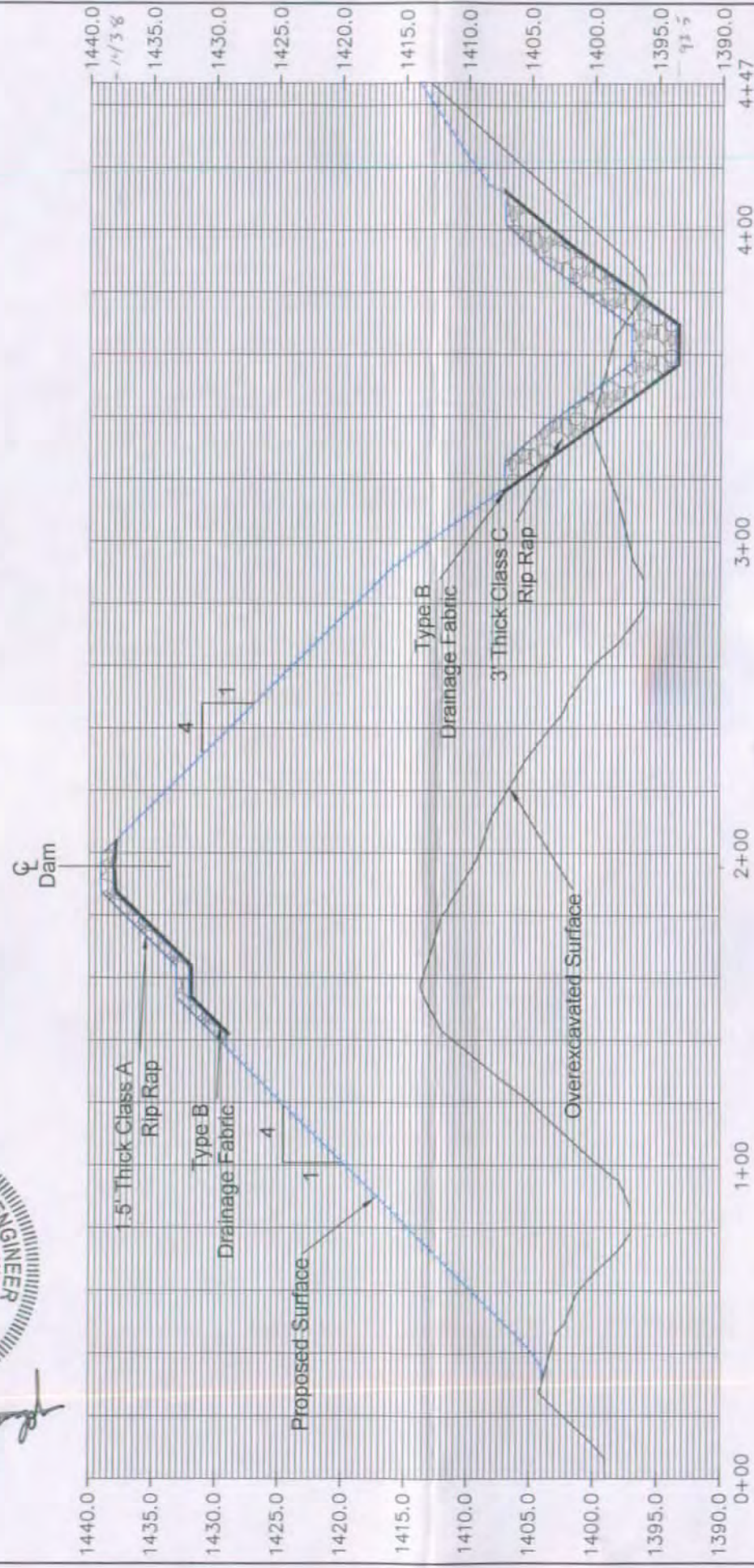
PLANS BY: BOB CLARK
DATE: 10/03/00
SCALE: 1" = 100'
PROJECT: 1410 WEST RUSSELL STREET
SIoux FALLS, SD 57104-1328



PROJ. NO. 03031 DRAWN BY: VLV CHECKED BY: BGS REVISIONS:	DATE: 03/01/07 SCALE: 1" = 50'	Overexcavation Plan Wieman Dam Marion, South Dakota
CLARK ENGINEERING CORPORATION 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2503 Fax (605) 331-2602 siouxfalls@clark-eng.com	SHEET 3 OF 14	REGISTERED PROFESSIONAL ENGINEER REG. NO. 5382 BRADLEY D. STANGO SOUTH DAKOTA 8 March 2007



Bradley D. Stango
8 March 2007



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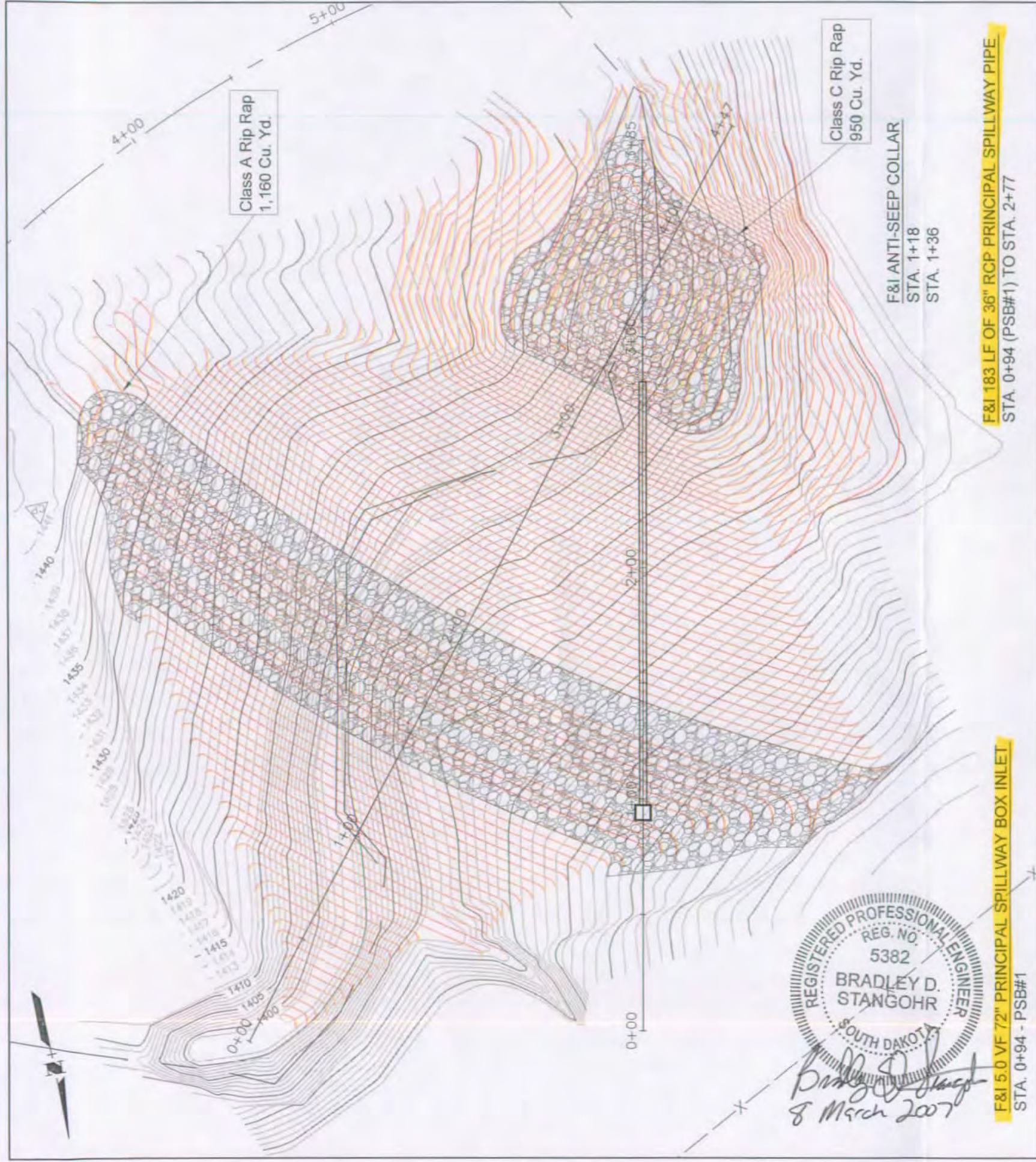
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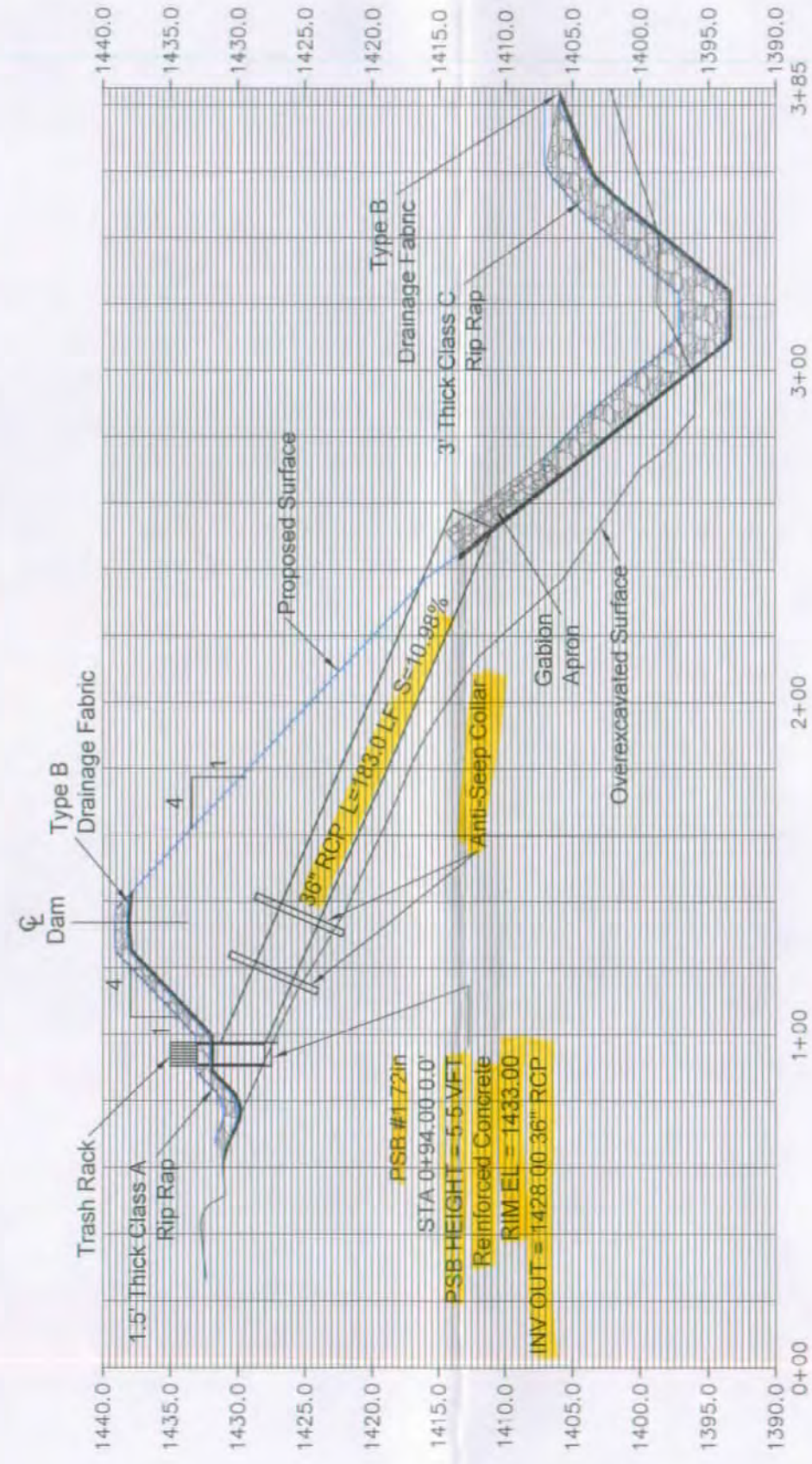
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REVISIONS:

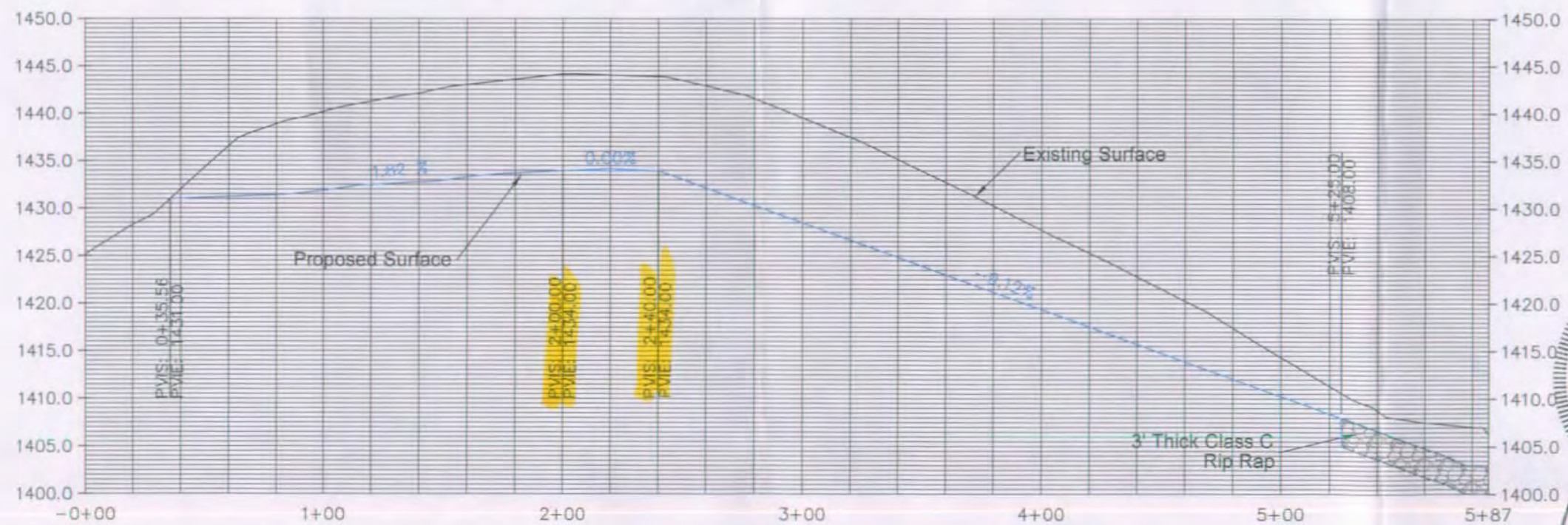
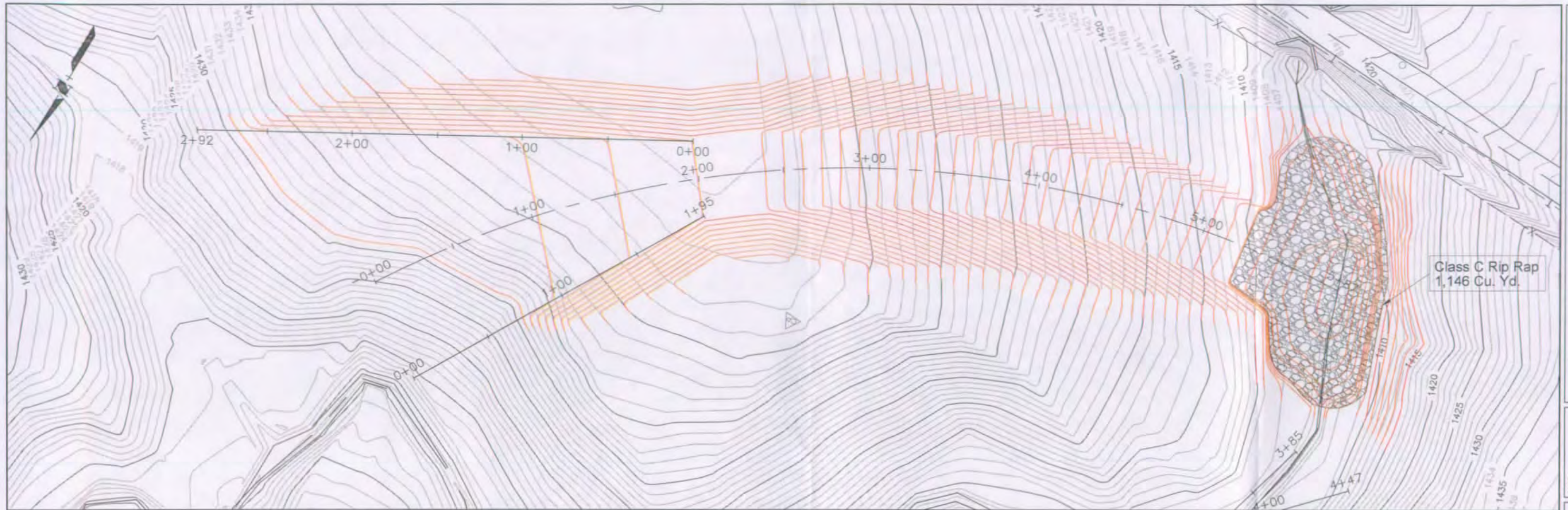
DATE: 02/26/07
SCALE: 1" = 50'

Typical Dam Plan & Profile
Wieman Dam
Marion, South Dakota



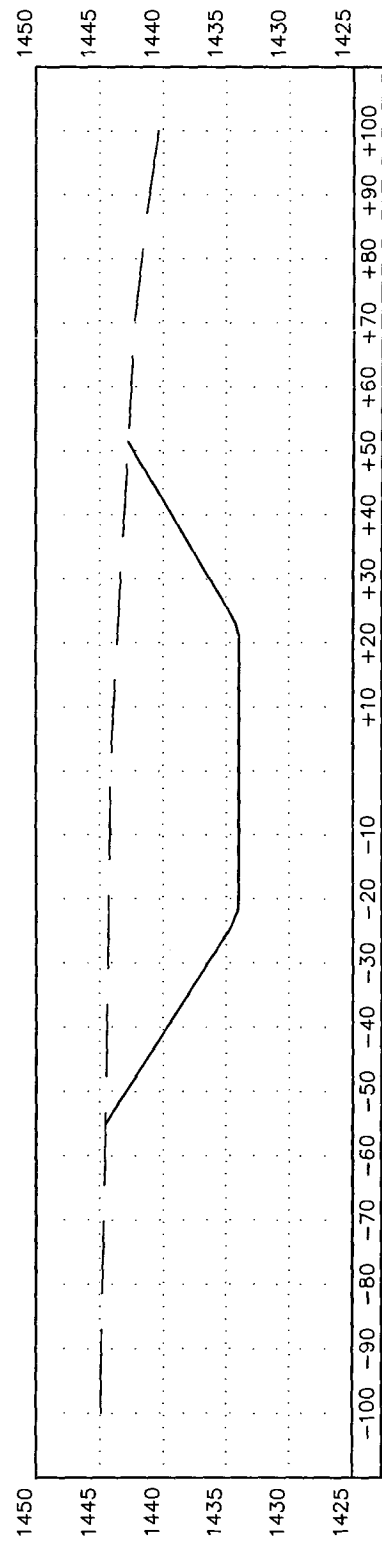
F&I 183 LF OF 36" RCP PRINCIPAL SPILLWAY PIPE
STA. 0+94 (PSB#1) TO STA. 2+77



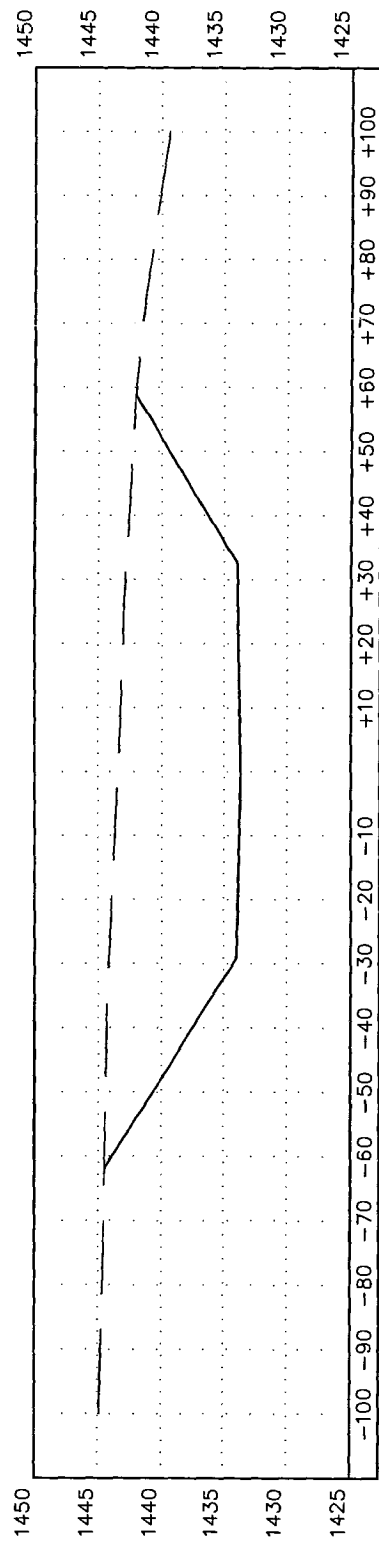


REG. NO. 5382
 REGISTERED PROFESSIONAL ENGINEER
 BRADLEY D. STANGOHR
 SOUTH DAKOTA
 8 March 2007

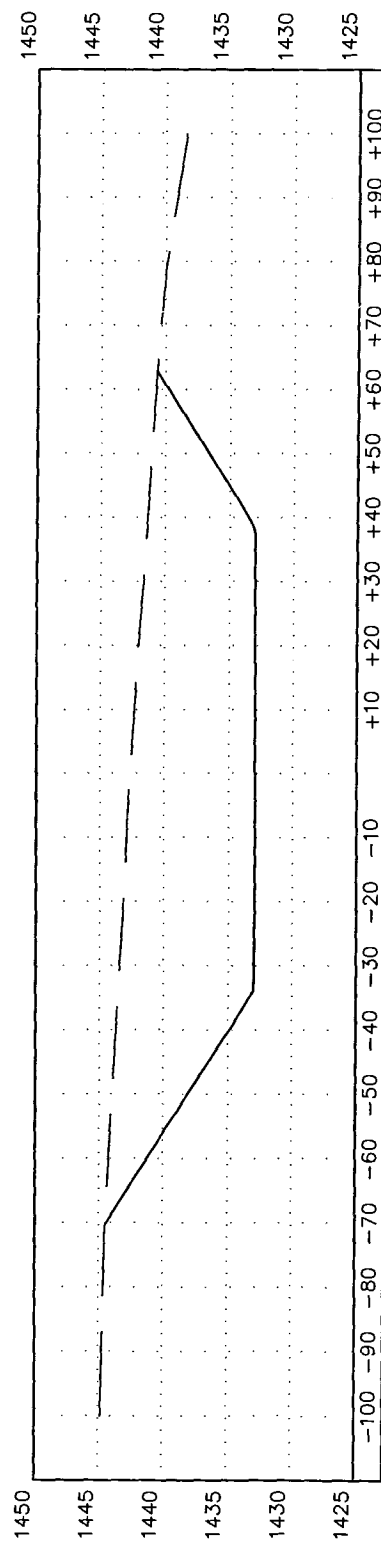
Typical Vegetative Spillway Plan & Profile		DATE: 02/26/07	
Wieman Dam		SCALE: 1" = 60'	
Marion, South Dakota		REVISIONS:	
SHEET 6 OF 14		PROJ. NO. 03031 DRAWN BY: VLY CHECKED BY: BDS REVISIONS:	
CLARK ENGINEERING CORPORATION		Convention Center Plaza 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2505 Fax (605) 331-2602 siouxfalls@clark-eng.com	
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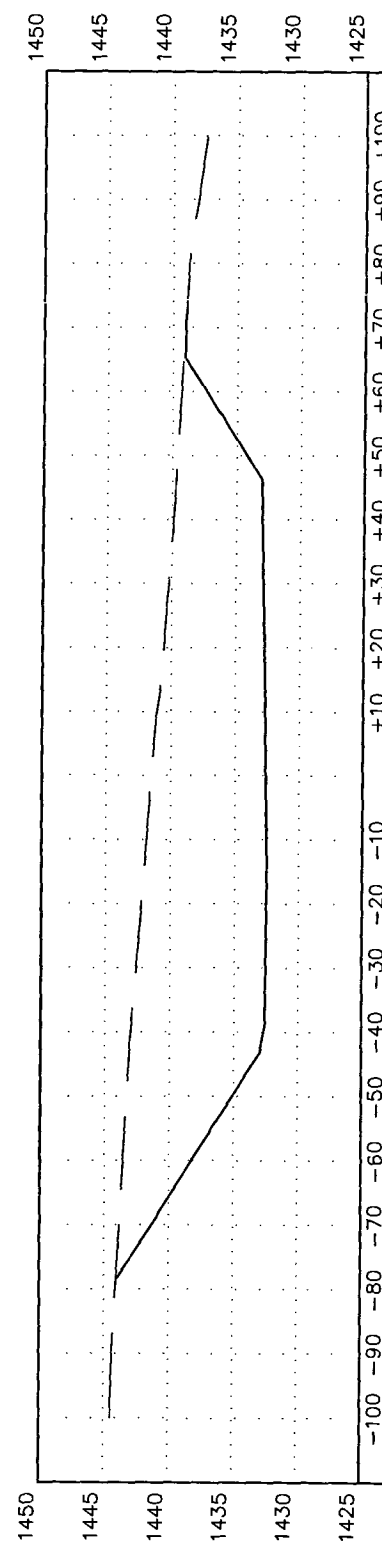
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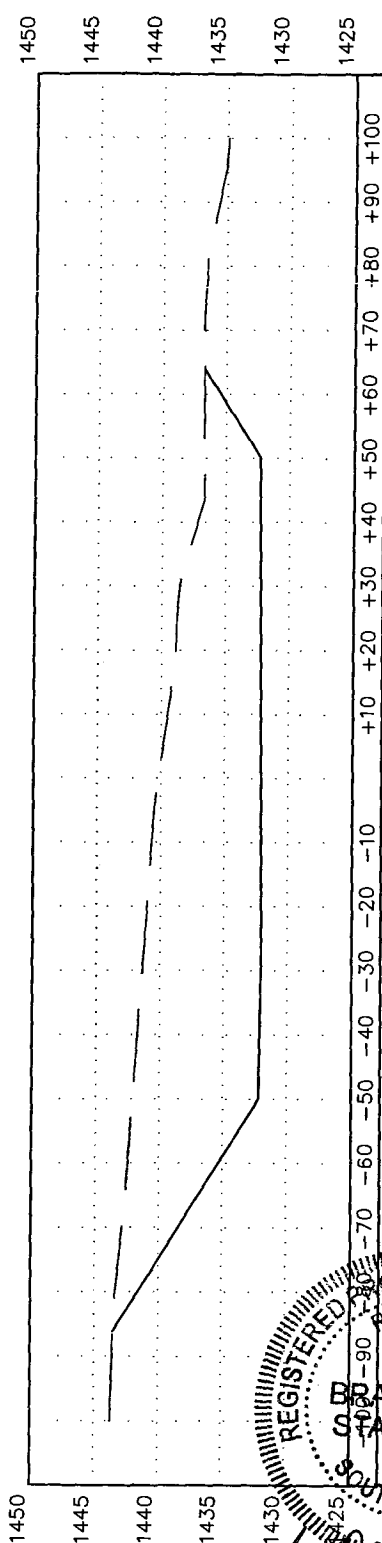
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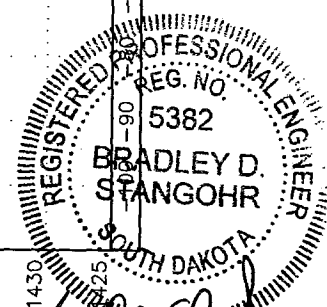
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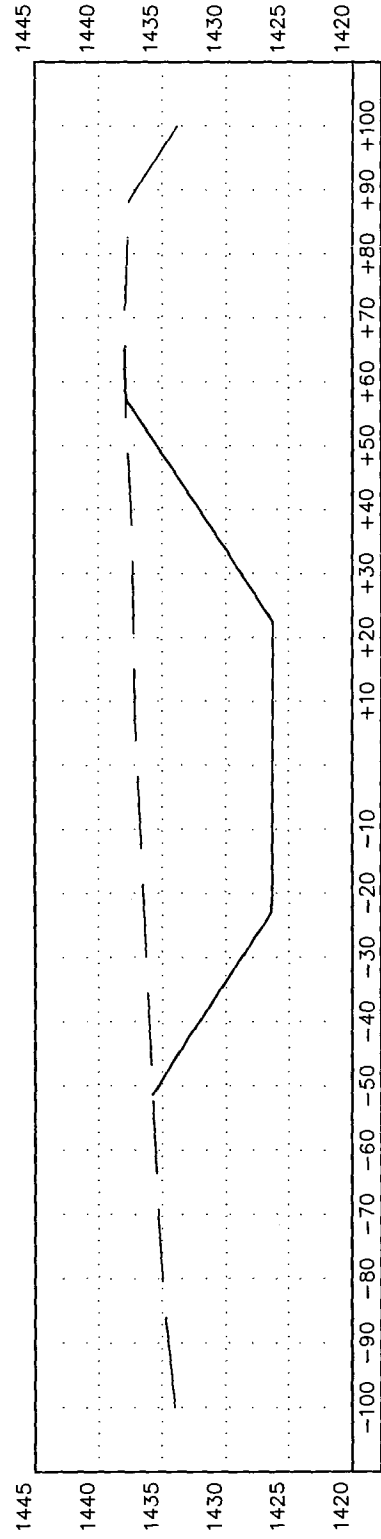


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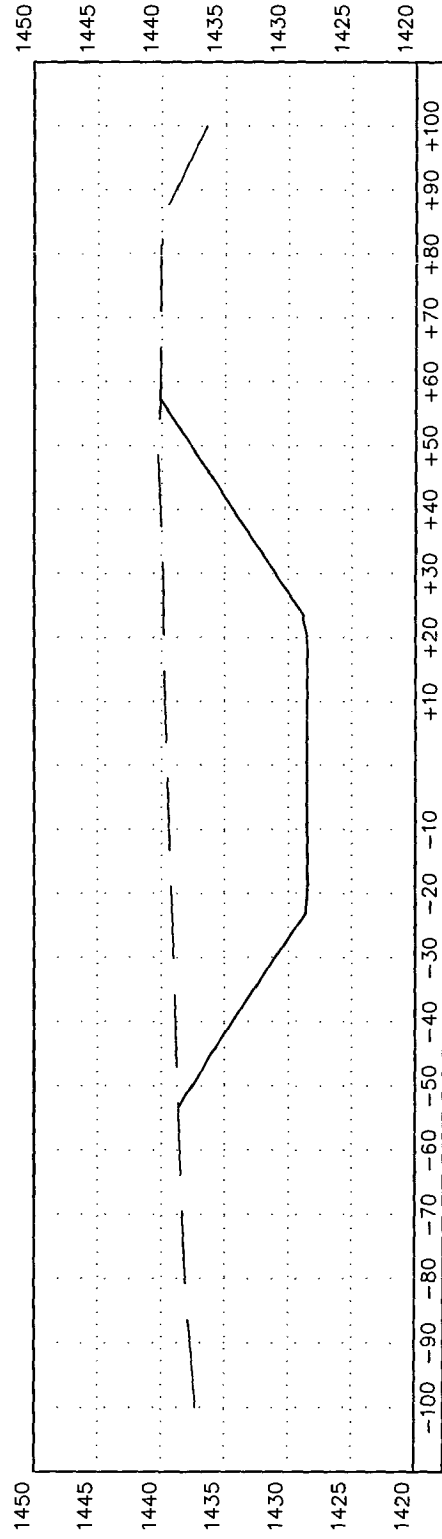


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8 March 2007

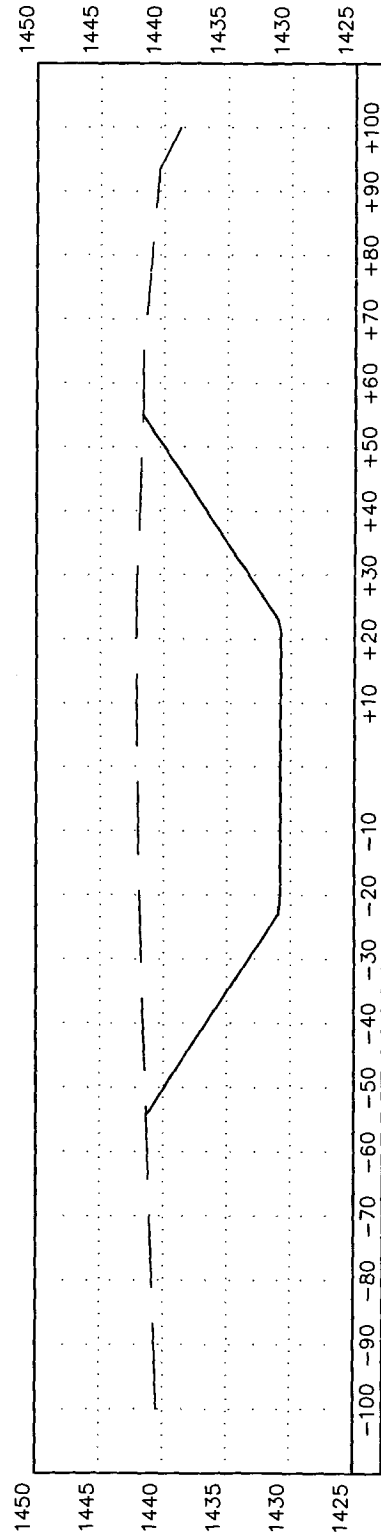
CLARK ENGINEERING CORPORATION Convention Center Plaza 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2505 Fax (605) 331-2602 siouxfalls@clark-eng.com		PROJ. NO. 03031 DRAWN BY: VLV CHECKED BY: BBS REVISIONS:	DATE: 02/26/07 SCALE: 1" = 30'	Vegetated Spillway Cross-sections Wieman Dam Marion, South Dakota
SHEET 7 OF 14				



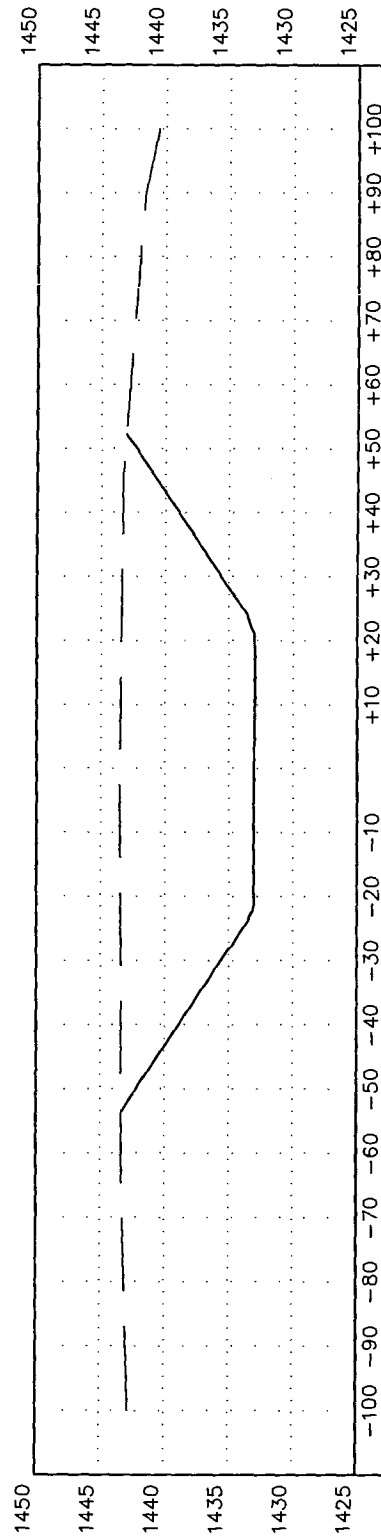
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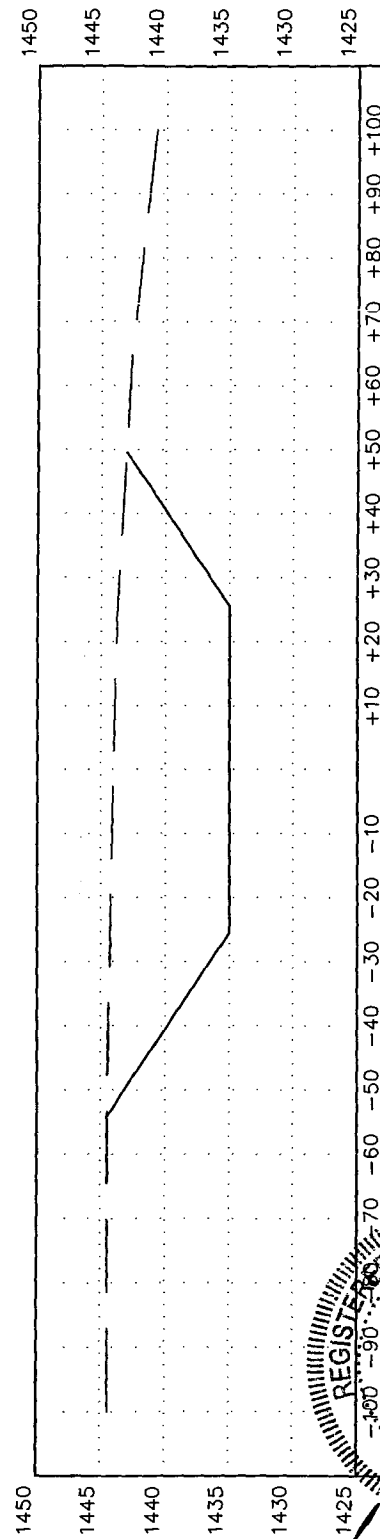
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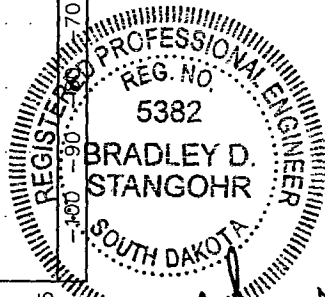
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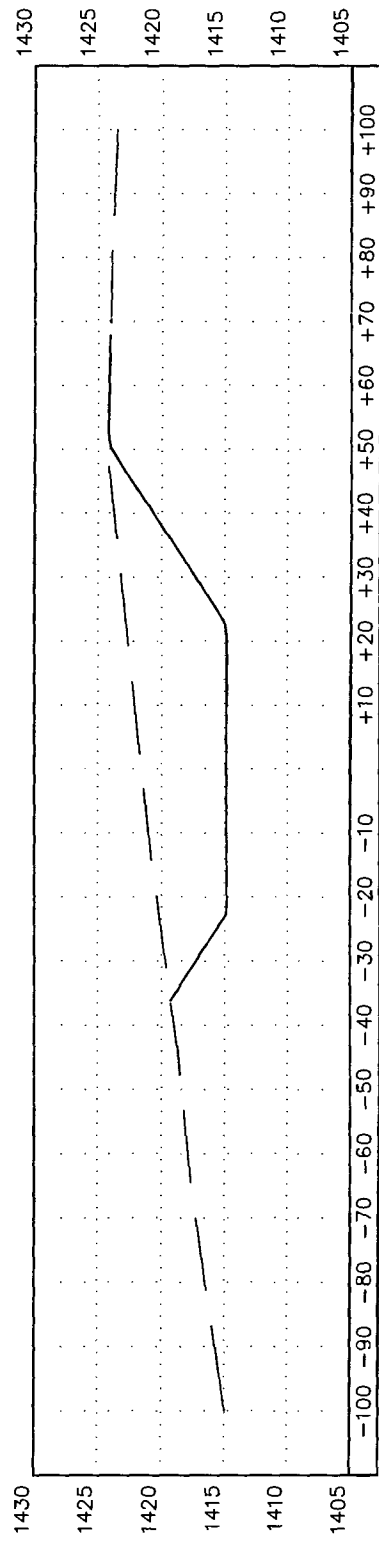


Bradley D. Stango
8 March 2007

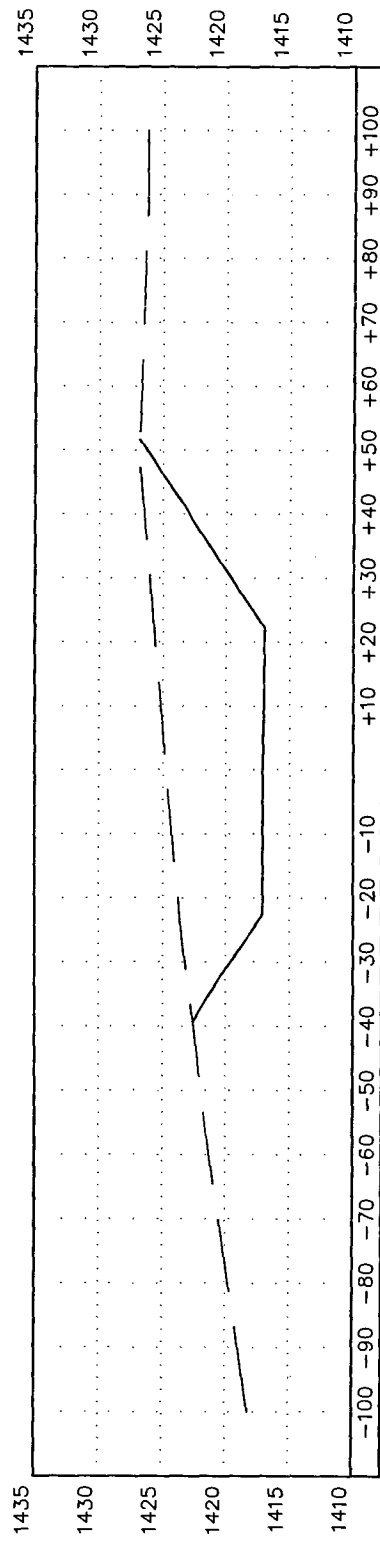
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PROJ. NO.	03031
DRAWN BY:	VLV
CHECKED BY:	BDS
REVISIONS:	
DATE:	02/28/07
SCALE:	1" = 30'

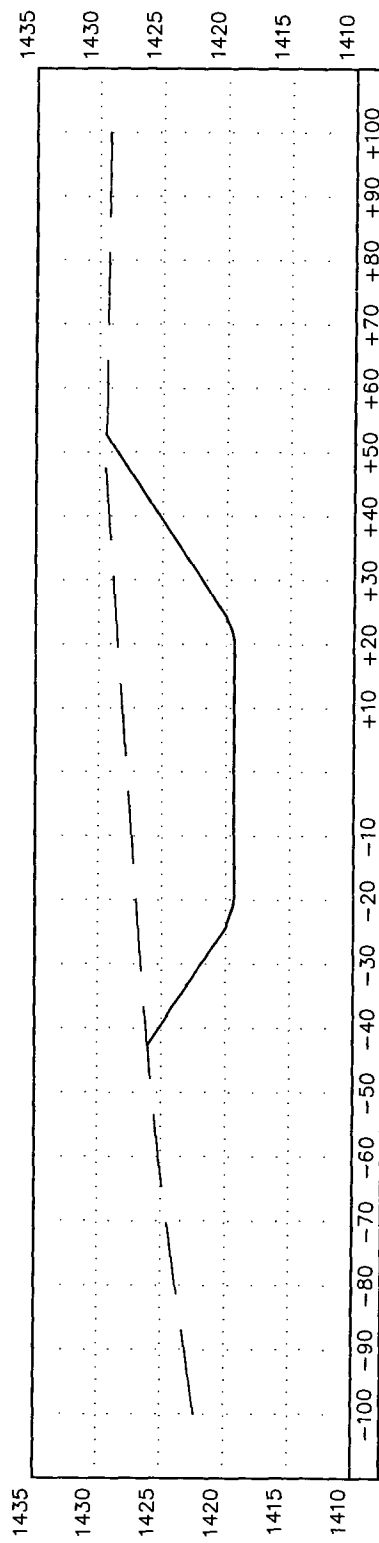
Vegetated Spillway Cross-sections
Wieman Dam
Marion, South Dakota



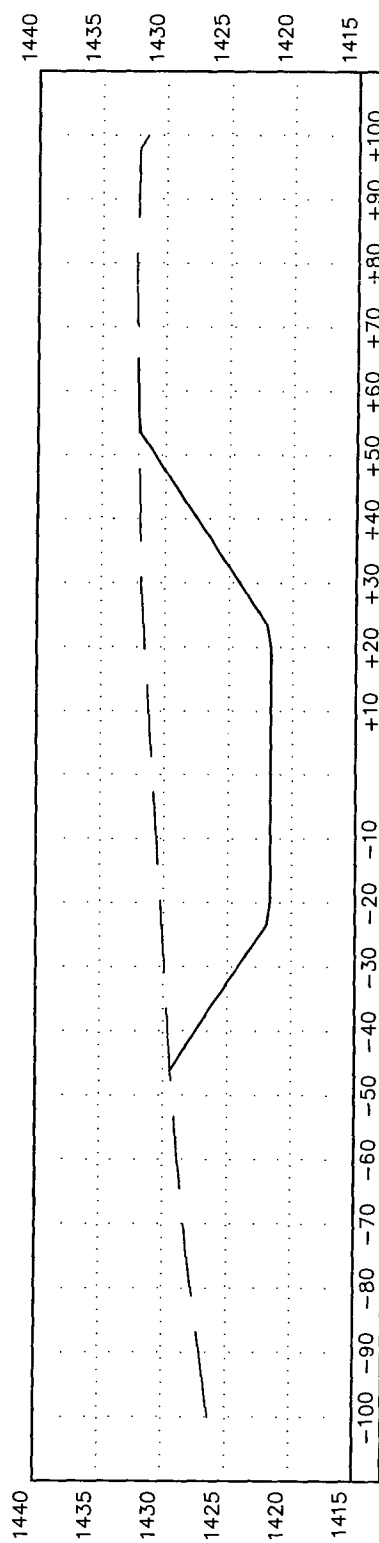
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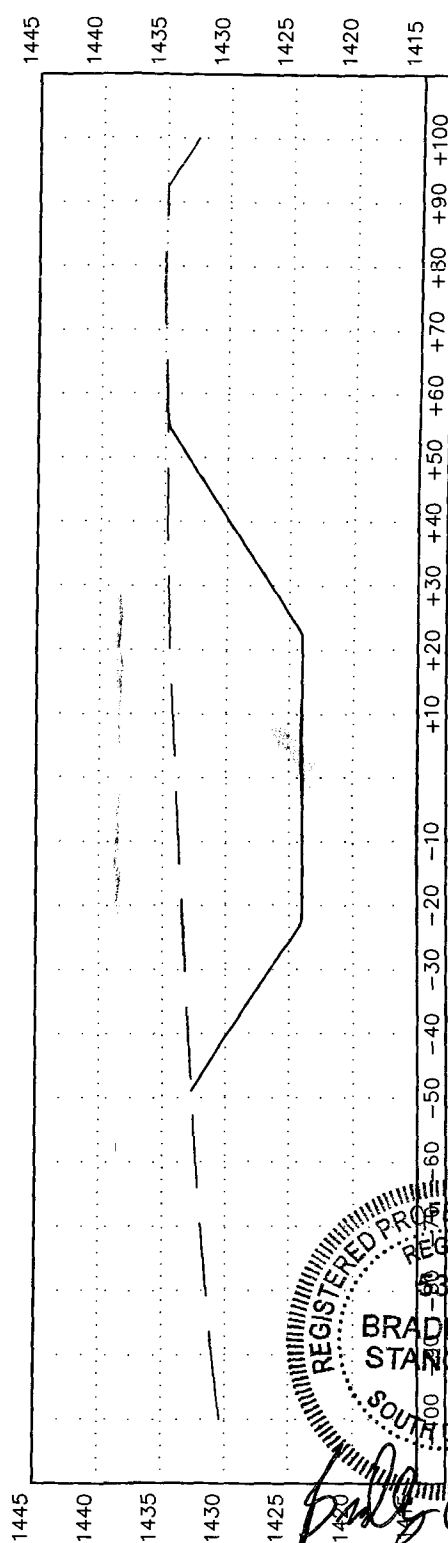
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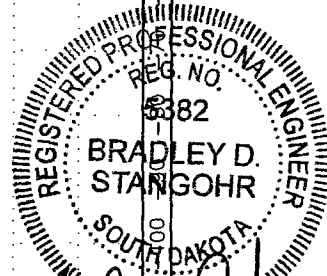
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Sta. 3+50.00



Bradley D. Stangoehr
8 March 2007

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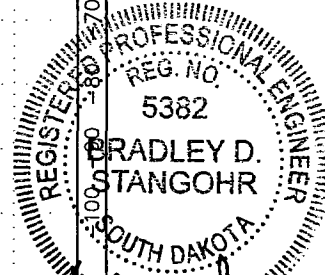
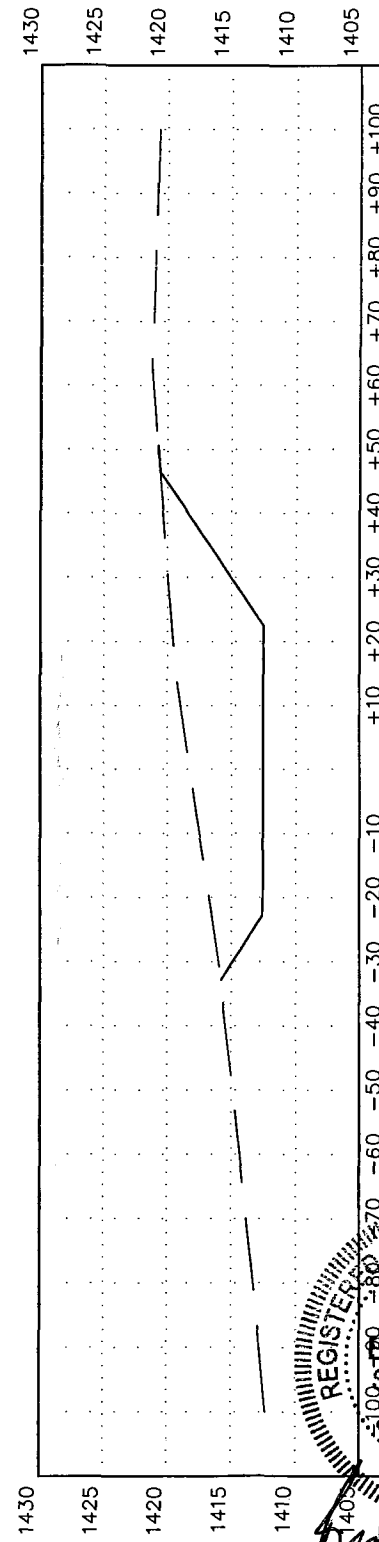
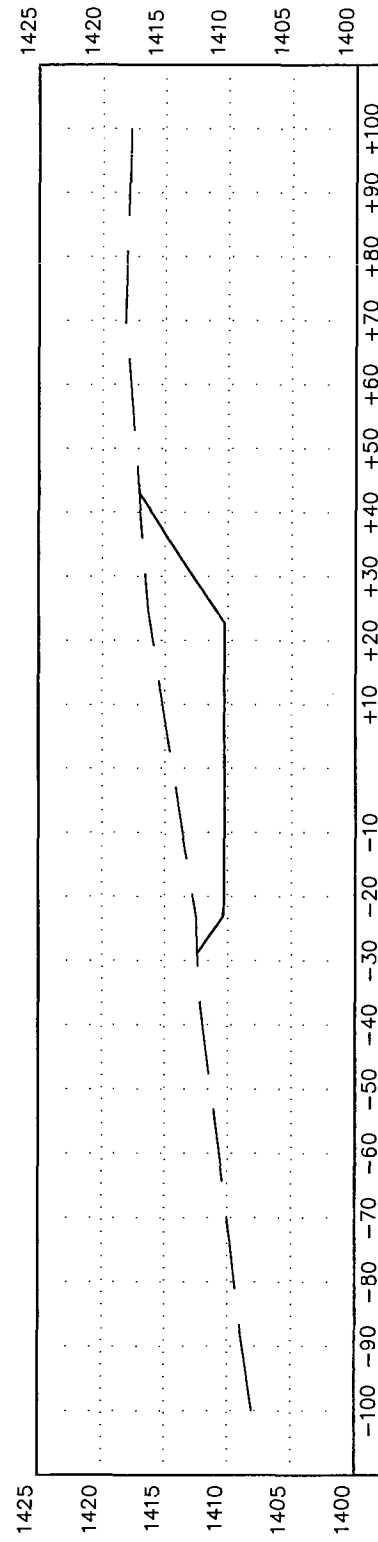
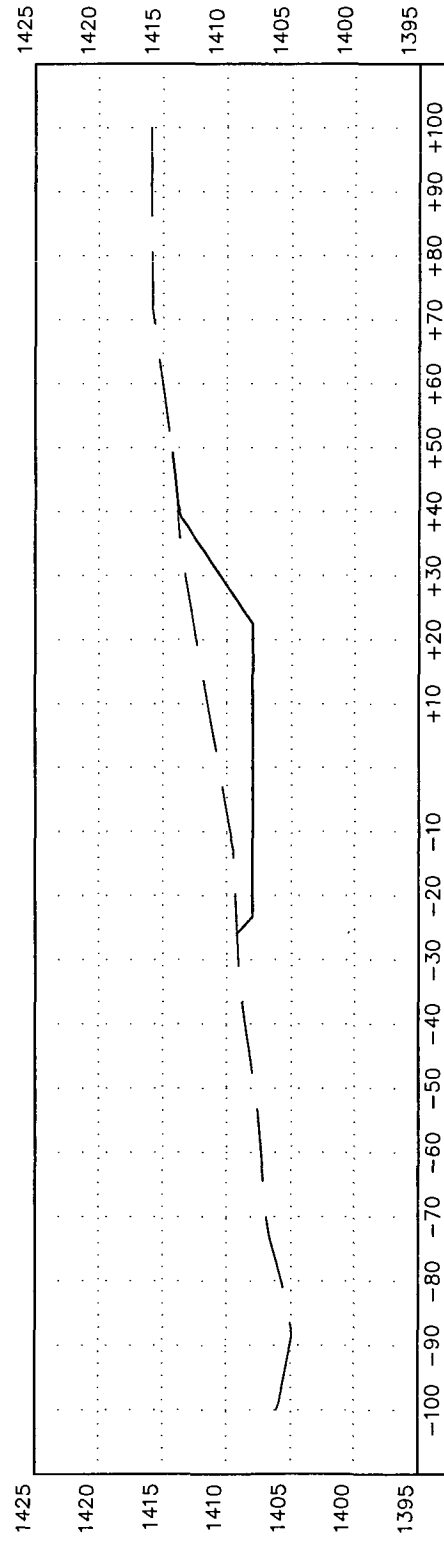
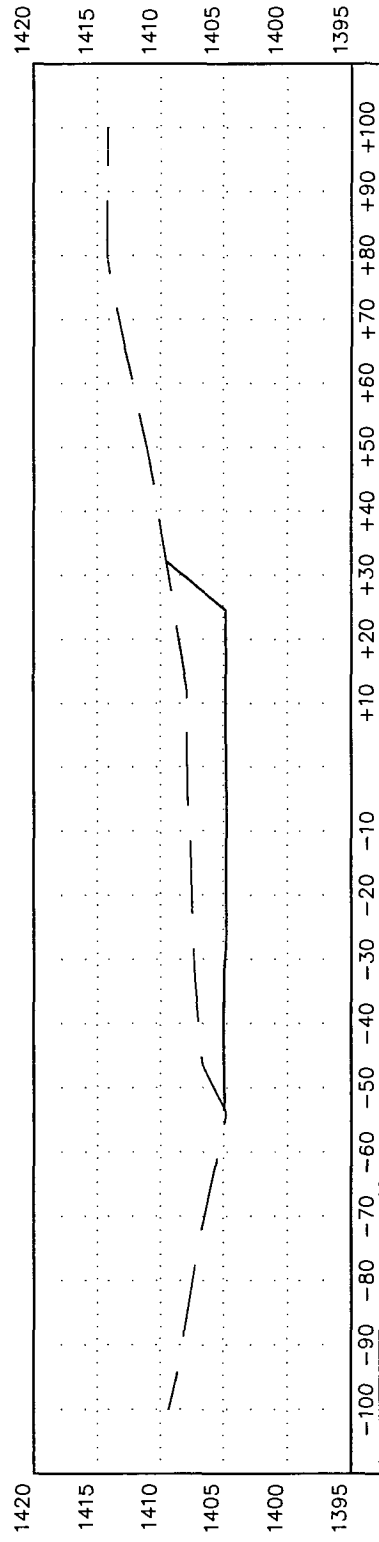
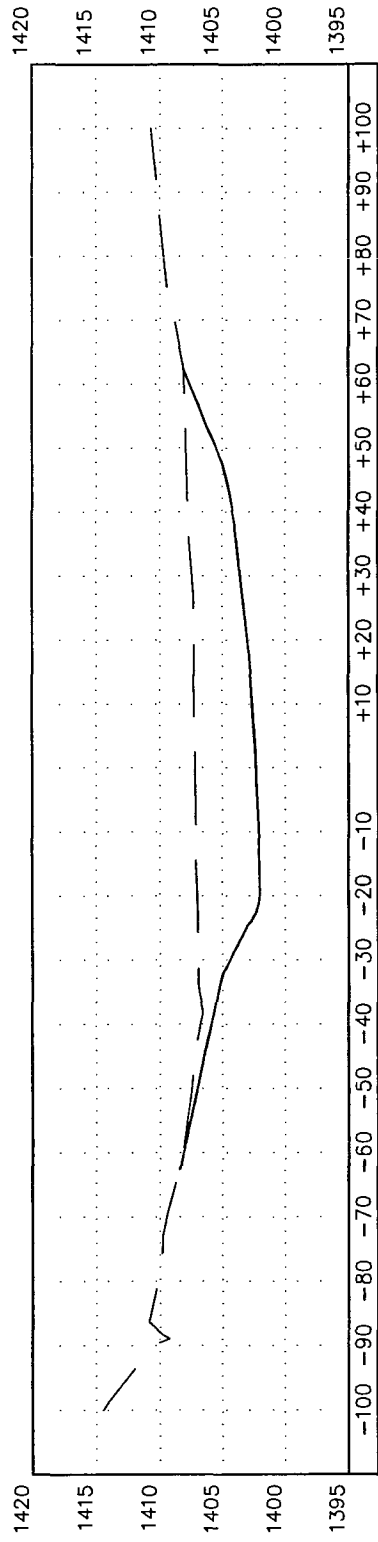
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REVISIONS:	
DATE:	02/26/07
SCALE:	1" = 10'

Vegetated Spillway Cross-sections

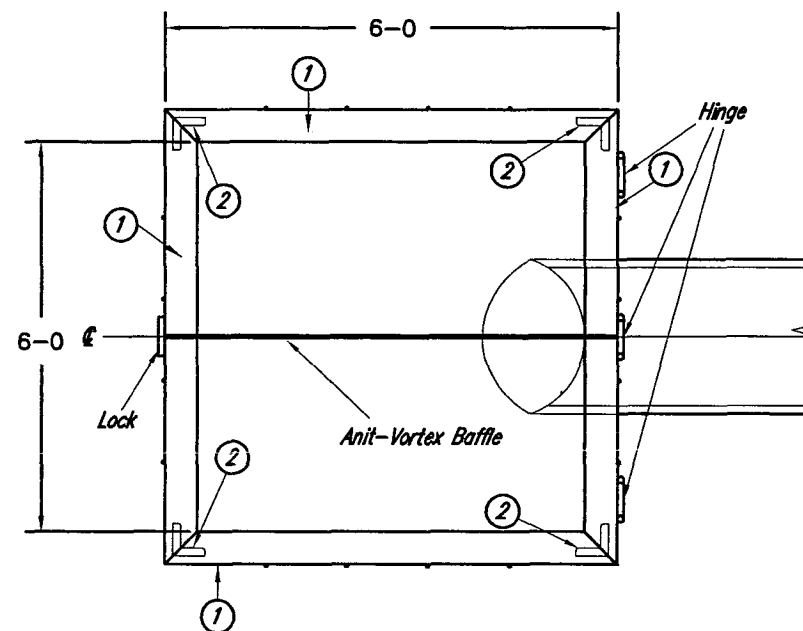
Wieman Dam

Marion, South Dakota

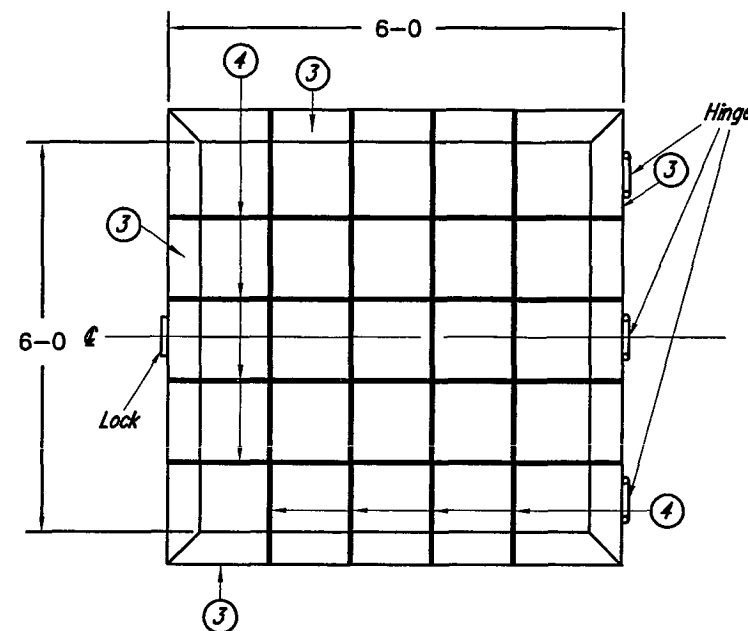


Bradley D. Stangoehr
8 March 2007

Convention Center Plaza 1410 West Russell Street Sioux Falls, SD 57104-1328 (605) 331-2505 Fax (605) 331-2602 siouxfalls@clark-eng.com		PROJECT NO. 03031 DRAWN BY: VLV CHECKED BY: BDS REVISIONS:	DATE: 02/26/07 SCALE: 1" = 30'
CLARK ENGINEERING CORPORATION		Vegetated Spillway Cross-sections Wieman Dam Marion, South Dakota	
SHEET 10 OF 14		BOB	



PLAN WITHOUT HINGED TOP



HINGED TOP PLAN

TRASH RACK DIMENSIONS			
Mark	Quantity	Item	Lengths
1	8	L's 3" X 3" X 3/8"	6-6
2	4	L's 3" X 3" X 3/8"	2-5
3	4	3" X 3/8" Plate	6-6
4	12	3/8" Rod	6-6
5	16	3/8" Rod	2-6

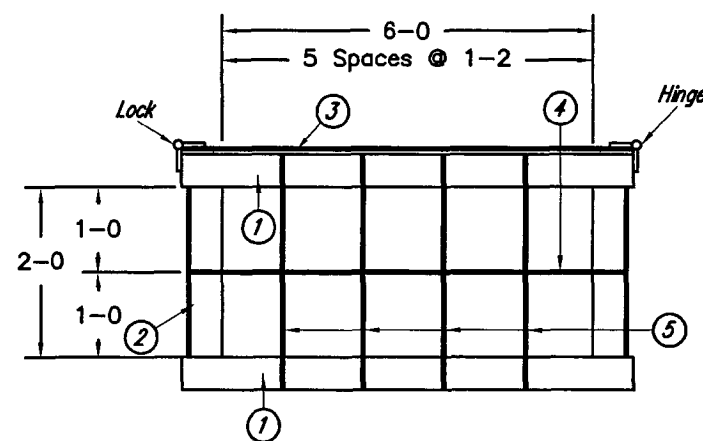
Construction Notes:

Structure is symmetrical about C.

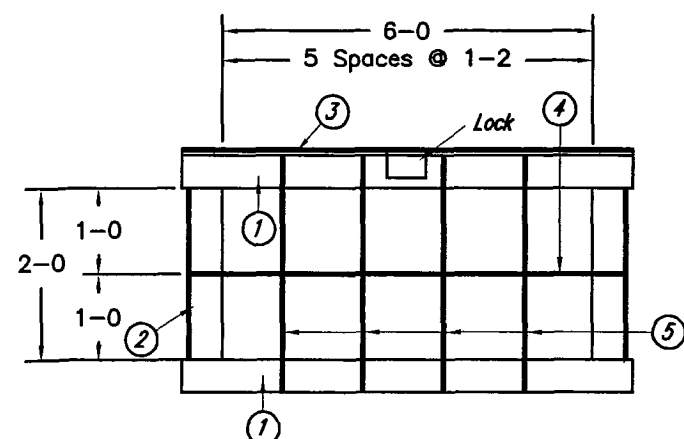
All components shall be of galvanized or stainless steel.

All cuts shall be saw cuts.

Anti-Vortex Baffle shall be constructed using sheet metal. The approximate dimensions are 2'-5" x 6'-6".

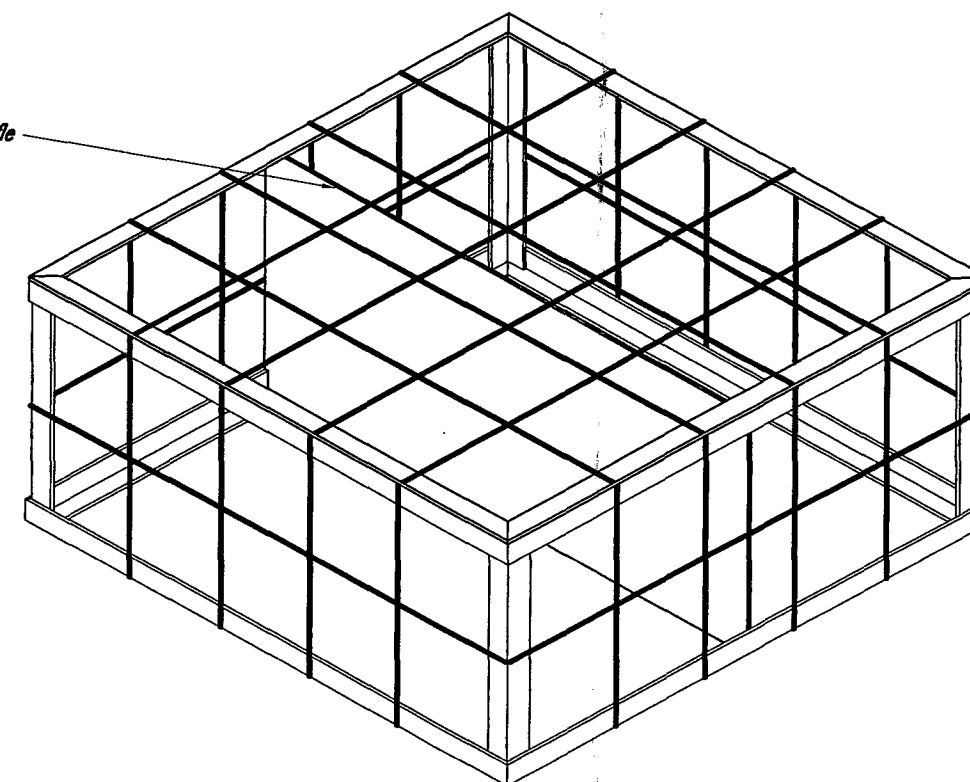


SIDE ELEVATION



UPSTREAM ELEVATION

Anti-Vortex Baffle



ISOMETRIC VIEW



Bradley D. Stango
8 March 2007

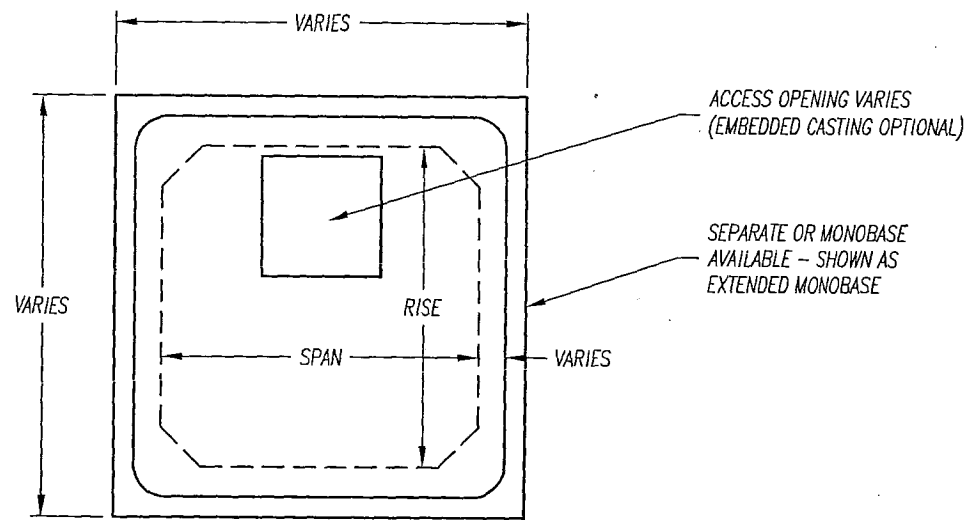
Standard Details
Wieman Dam
Marion, South Dakota

DATE: 02/26/07
SCALE: N. T. S.

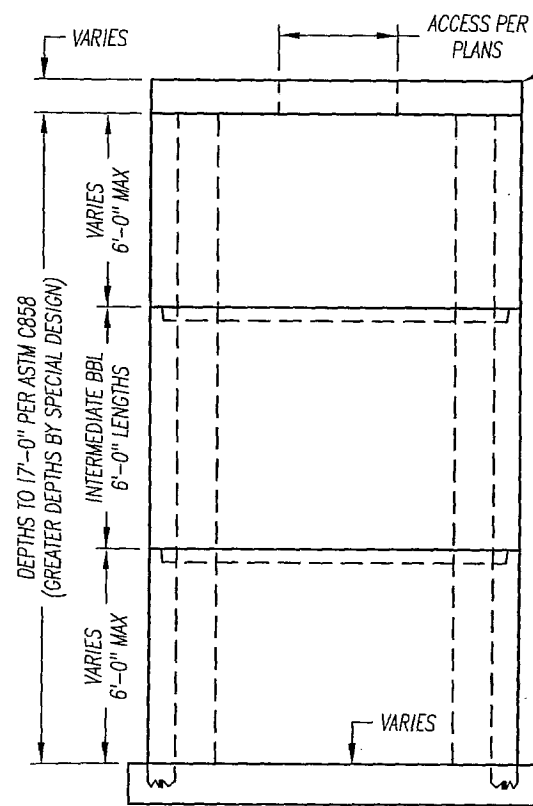
PROJ. NO. 03031
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PLAN VIEW



ELEVATION VIEW

ACCESS OPENING VARIES
(EMBEDDED CASTING OPTIONAL)

SEPARATE OR MONOBASE
AVAILABLE - SHOWN AS
EXTENDED MONOBASE

COVER SLAB - SAME
OUTER DIMENSIONS AS
BOX MANHOLE SECTIONS

Box manholes require special attention to obtain watertight joints because of the tolerance in the joint. The specifier should include joint treatment details in the plans to achieve the degree of watertightness that the project requires. This could include waterstop, mortared joints, joint wrap or all of the above. Contact your SDCP representative for information on the various joint sealing materials and techniques.

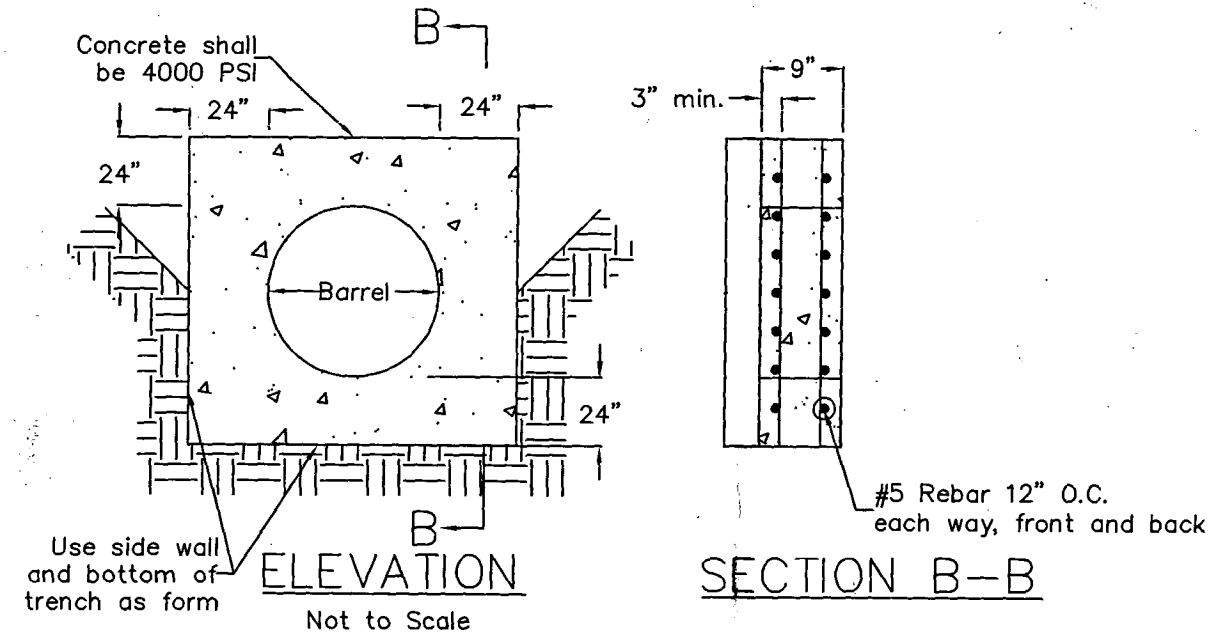
SEPARATE BASE OR MONOBASE
AVAILABLE (MONOBASE SHOWN)

BOX MANHOLE SIZES
6X3 TO 6X6
7X3 TO 7X7
8X4 TO 8X8
9X4
10X4
11X4
12X4
13X6 TO 13X12
14X4 TO 14X14

CreteX Concrete Products West, Inc.		RAPID CITY, SOUTH DAKOTA	
SCALE none		TITTLE	
DATE 6/7/04		BOX MANHOLES	
DR'N. RTF		DETAILS AND SPECIFICATIONS	
REVISION DATE none	DRAWING NUMBER 1540-05		

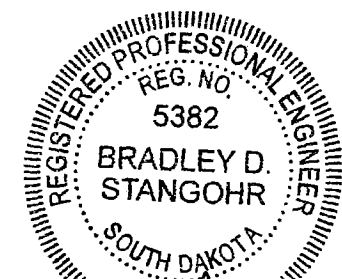
1. Box manholes are produced per ASTM C858.
2. Access hardware can be cast into the cover slab.
3. Contact SDCP for available sizes and joint treatment information.

CONCRETE ANTI-SEEP COLLAR FOR PIPELINE



NOTES:

1. Min. clearance between rebar and outside face of collar shall be 3".
2. Compact over-excavation to 98% density per ASTM D-698.
3. Collars should be placed a minimum of 2' from pipe joints unless flanged pipe joints are used.



Bradley D. Stango
8 March 2007

Standard Details

Wieman Dam

Marion, South Dakota

DATE: 02/26/07

PROJ. NO. 03031
DRAWN BY: VLV
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REVISIONS:

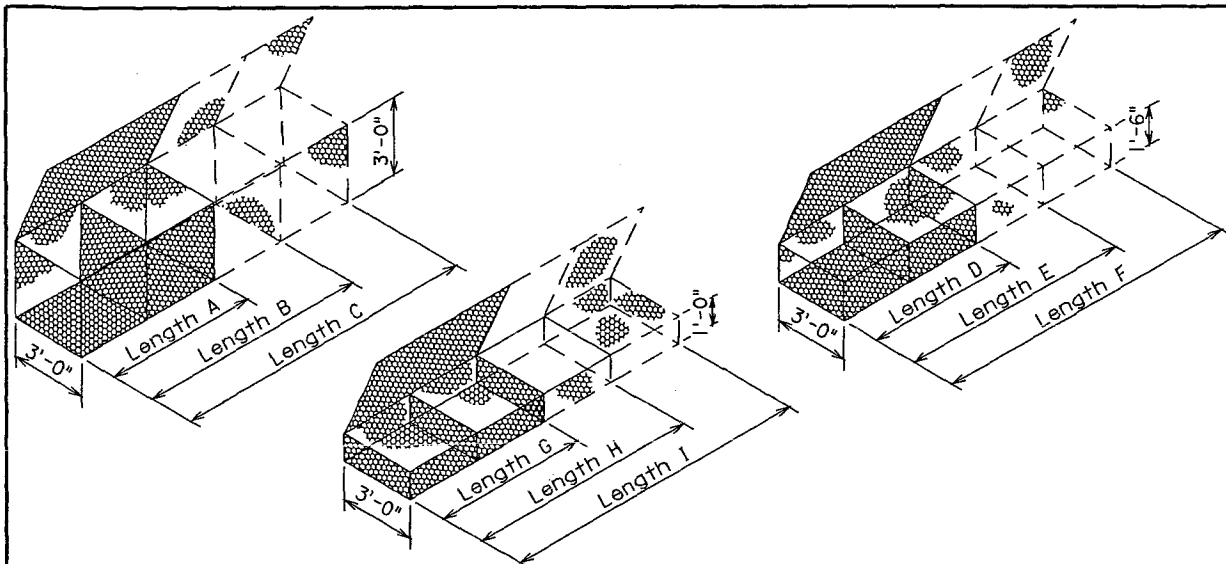
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GABION DETAILS
STANDARD SIZES

SIZE	LENGTH	WIDTH	HEIGHT	NUMBER OF CELLS	CAPACITY, Cu. Yd.
A	6'-0"	3'-0"	3'-0"	2	2.0
B	9'-0"	3'-0"	3'-0"	3	3.0
C	12'-0"	3'-0"	3'-0"	4	4.0
D	6'-0"	3'-0"	1'-6"	2	1.0
E	9'-0"	3'-0"	1'-6"	3	1.5
F	12'-0"	3'-0"	1'-6"	4	2.0
G	6'-0"	3'-0"	1'-0"	2	0.7
H	9'-0"	3'-0"	1'-0"	3	1.0
I	12'-0"	3'-0"	1'-0"	4	1.3

Above Dimensions subject to mill tolerances.

GENERAL NOTES:

Lacing and Internal connecting wire shall be 0.0866 inch diameter steel wire ASTM A641 Class 3 soft temper measured after galvanizing and for PVC coated gabions shall be 0.0866 inch diameter steel wire measured after galvanizing but before PVC coating.

The lacing procedure is as follows:

1. Cut a length of lacing wire approximately $1\frac{1}{2}$ times the distance to be laced but not exceeding 5 feet.
2. Secure the wire terminal at the corner by looping and twisting.
3. Proceed lacing with alternating single and double loops at a spacing not to exceed 6 inches.
4. Securely fasten the other lacing wire terminal.

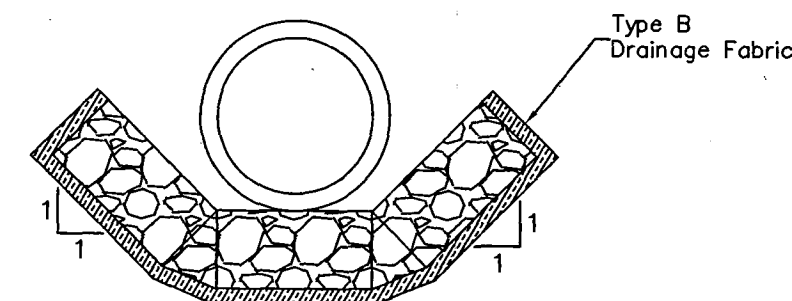
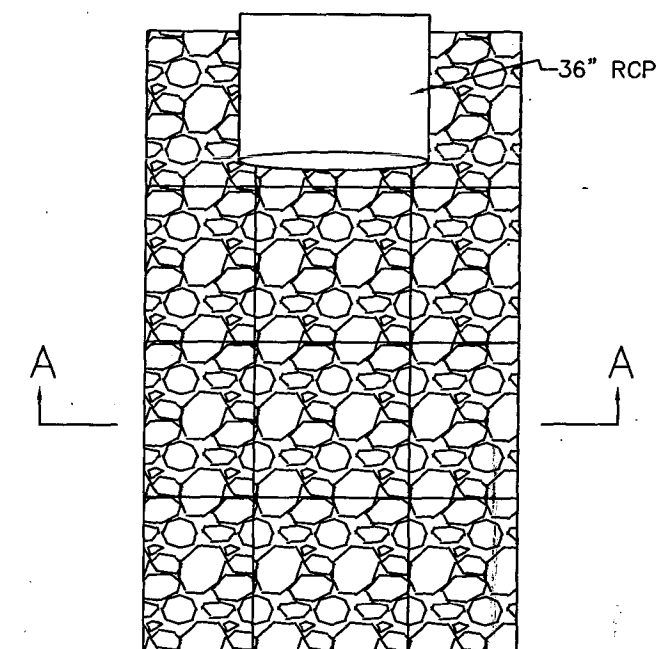
Wire lacing or interlocking type fasteners shall be used for gabion assembly and final construction of gabion structures. Interlocking fasteners for galvanized gabions shall be high tensile 0.120 inch diameter galvanized steel wire measured after galvanizing. The galvanizing shall conform to ASTM A641-92 Class 3 coating. Fasteners shall also be in accordance with ASTM A764, Class II, Type III.

Interlocking fasteners for PVC coated gabions shall be high tensile 0.120 inch diameter stainless steel wire conforming to ASTM A313, Type 302, Class I. The spacing of the interlocking fasteners during all phases of assembly and construction shall not exceed 6 inches. All fasteners shall be placed where the mesh weaves around the selva wire at the vertical and horizontal joints.

June 26, 2001

Published Date: 1st Qtr. 2007	S D D O T	BANK AND CHANNEL PROTECTION GABIONS	PLATE NUMBER
			720.01
			Sheet 1 of 1

GABION BASKET APRON FOR PIPELINE

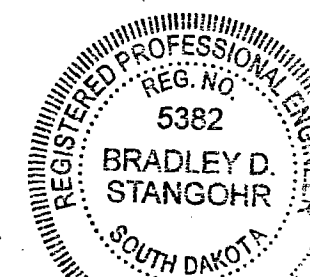


SECTION A-A

Not to Scale

NOTES:

1. Gabion Basket Dimension shall be at least 3'x3'x1.5'.
2. Gabion at outlet shall be placed under the end section of the RCP leaving a maximum of 1' of open gabion reinforcement.



Bradley D. Stangoehr
8 March 2007

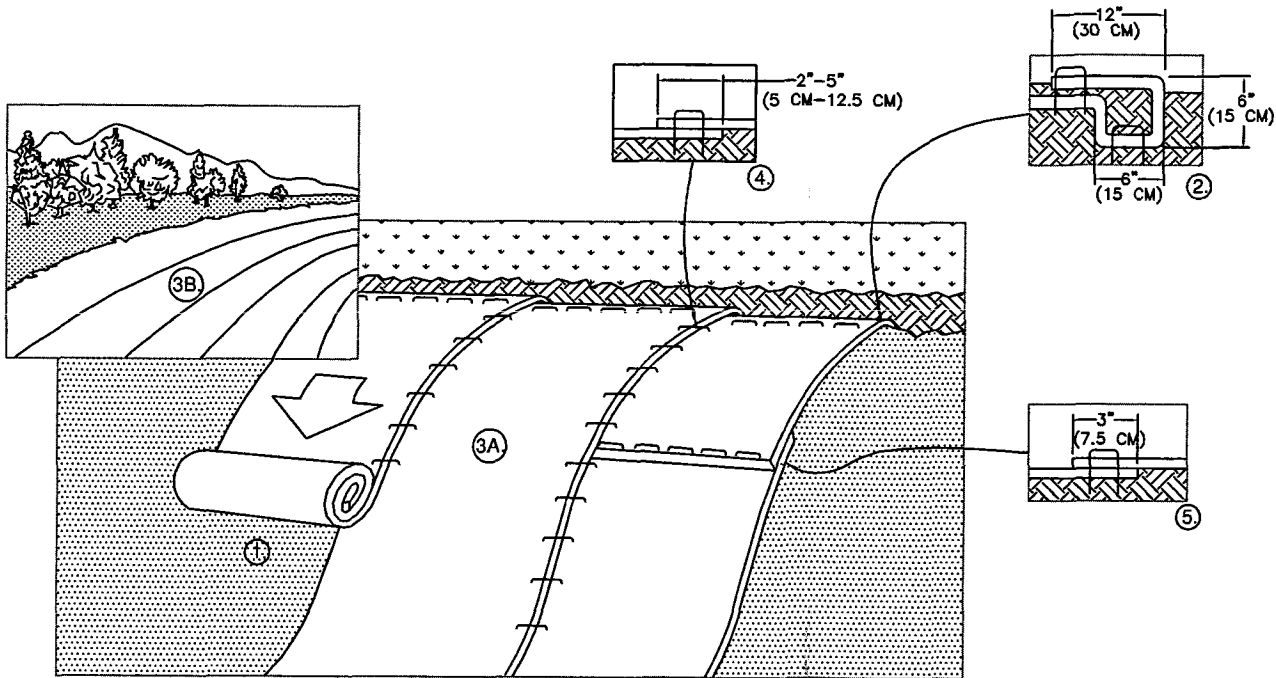
Standard Details
Wieman Dam
Marion, South Dakota

DATE: 02/26/07
SCALE: N. T. S.
PROJ. NO. 03031
DRAWN BY: VLV
CHECKED BY: BOS
REVISIONS:

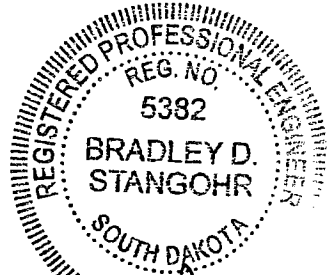
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SLOPE INSTALLATION



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2" - 5" (5 CM - 12.5 CM) OVERLAP DEPENDING ON BLANKET TYPE.
5. CONSECUTIVE BLANKETS SPICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5 CM) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30 CM) APART ACROSS ENTIRE BLANKET WIDTH.
NOTE:
*IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY SECURE THE BLANKETS.



Bradley D. Stango
4 March 2007

REV. 1/2004

Standard Details
Wieman Dam
Marion, South Dakota

DATE: 02/26/07
SCALE: N. T. S.
PROJ. NO. 03031
DRAWN BY: VLV
CHECKED BY: BDS
REVISIONS:

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WIEMAN DAM

RISK ASSESSMENT



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Clark Proj. No: X03031

WIEMAN DAM RISK ASSESSMENT

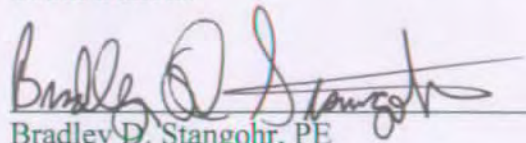
A Project in Marion, South Dakota

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Engineer's Certification:



I, Bradley D. Stangoehr, PE, hereby certify that these Plans, Specifications, and other documents were prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.


Bradley D. Stangoehr, PE
Registration Number 5382

Date: 8 March 2007

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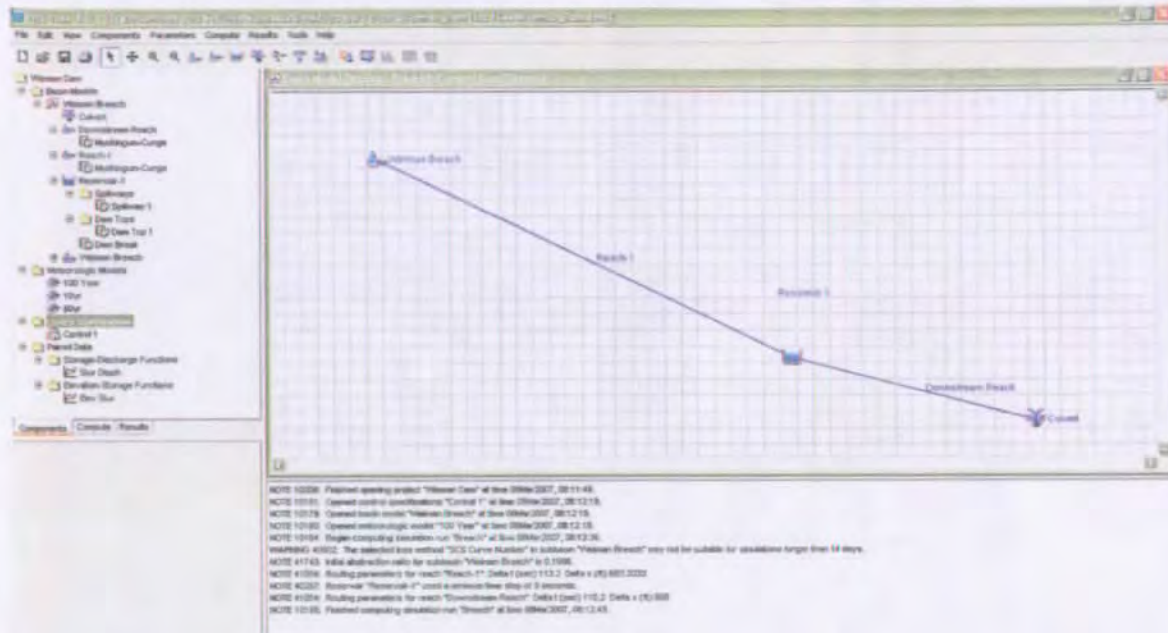
WIEMAN DAM RISK ASSESSMENT

DOCUMENT TITLE	PAGES
Cover Sheet	1
Engineer's Certification	1
Table of Contents	1
Dam Breach Analysis	1
Stage Storage Table and Graph	2
Flood Routing	1
Drainage Area Map	1
General Layout of Dams and Spillways	1
Operation and Maintenance Manual	1 to 2
Drainage Permit Hearing Meeting Minutes	
Geotechnical Report (Soil Technologies, Inc.)	

BREACH ANALYSIS

Using *HEC-HMS* a breach was modeled on the proposed dam. In summary, the dam was able to withstand a 100-year event for 2.5 days before the breach occurred at an elevation approximately 4 feet below the top of the dam resulting from overflow conditions.

The model setup was as follows:



The modeled peak discharge at the downstream culvert after a breach is 523 cfs. The calculated peak discharge for a 100 year event through that culvert using USGS Report 98-4055 without the presence of the dam is 526 cfs.

The hydraulic data for the downstream culvert is as follows:

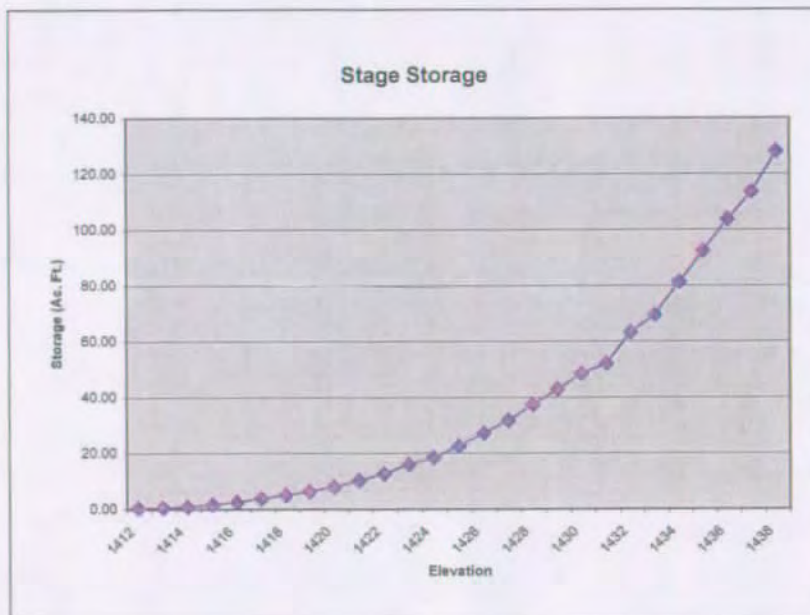
Frequency	Flow (cfs)	Hw (ft)	Depth (ft)
Q2	31	1405.8	2.34
Q5	89	1406.1	2.64
Q10	155	1406.8	3.32
Q25	272	1408.6	5.15
Q50	387	1410.1	6.62
Q100	526	1411.7	8.21
Q500	955	1418.0	14.55

***Note: Overtopping occurs at elevation 1417.5.

Elevation	Stage Storage		
	<i>Cu. Yd.</i>	<i>Cu. Ft.</i>	<i>Ac. Ft.</i>
1412	1,130	30,510	0.70
1413	1,300	35,100	0.81
1414	1,930	52,110	1.20
1415	3,070	82,890	1.90
1416	4,600	124,200	2.85
1417	6,590	177,930	4.08
1418	8,630	233,010	5.35
1419	10,740	289,980	6.66
1420	13,340	360,180	8.27
1421	16,920	456,840	10.49
1422	20,840	562,680	12.92
1423	26,320	710,640	16.31
1424	30,100	812,700	18.66
1425	36,790	993,330	22.80
1426	44,260	1,195,020	27.43
1427	51,610	1,393,470	31.99
1428	60,660	1,637,820	37.60
1429	69,660	1,880,820	43.18
1430	78,620	2,122,740	48.73
1431	84,500	2,281,500	52.38
1432	102,500	2,767,500	63.53
1433	112,520	3,038,040	69.74
1434	131,860	3,560,220	81.73
1435	149,560	4,038,120	92.70
1436	167,870	4,532,490	104.05
1437	183,640	4,958,280	113.83
1438	207,150	5,593,050	128.40

1st Spillway
2nd Spillway

- Top of Dam



FLOOD ROUTING

The earth-fill Wieman Dam near Marion, South Dakota is to be constructed on an unnamed tributary to the West Fork of the Vermillion River. Approximately 41,000 cubic yards of soil fill will be used to create a man-made lake for recreational purposes. This unnamed tributary has a drainage area of 1613 acres. The legal description for the property owned by Mr. Wieman is SE ¼ less lot H-2 & Exc. Tieszen's Tract 19-100-54, which puts the site approximately 2 miles North and 0.5 miles West of Marion.

Soil Borings were performed and are included within this document. The borings provide support to the belief that the likelihood of this dam failing is low. No gravel veins were found during the tests which prove that the dam will remain stable.

If this category 3 dam were to fail, little property damage will result. There are few downstream structures. If the dam were to fail, the first concern would be the culvert located directly downstream. Upon breaching, the road and culvert will be monitored. The culvert is in good enough condition that the wear and tear of normal operations will not have any major effect to the structure and a dam breach will not damage the structure excessively. The only residence downstream of the dam is nearly one mile away and is approximately 20 feet above the bed of the tributary. The likelihood of these citizens to be effected by the fracture of this category 3 earth-fill dam is small.

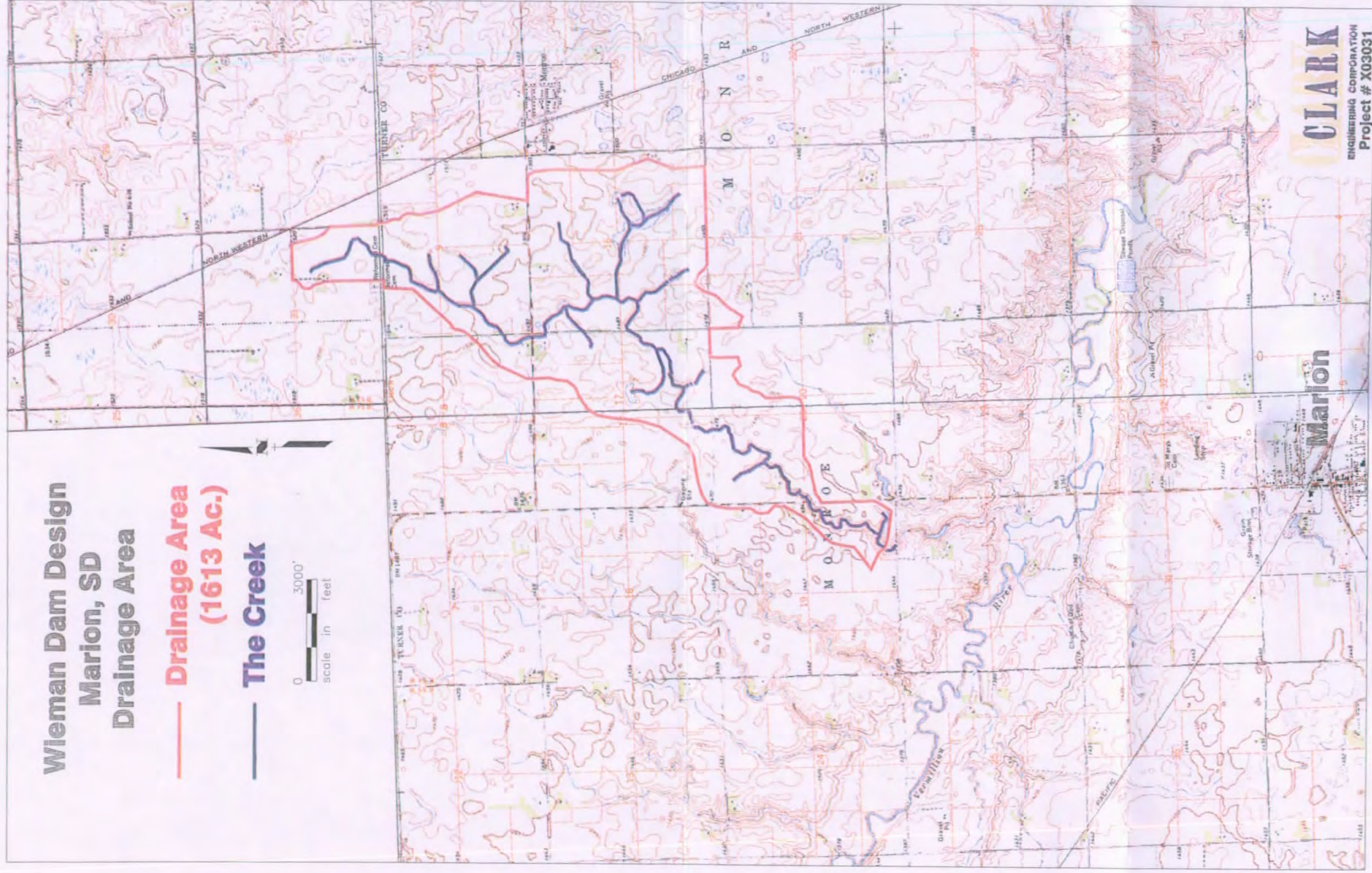
Additionally, the Turner County Drainage Committee approved the drainage permit for this project. A copy of the minutes from this meeting is included in this report.

**Wieman Dam Design
Marion, SD
Drainage Area**

— **Drainage Area
(1613 Ac.)**

— **The Creek**

0 3000'
scale in feet



CLARK
ENGINEERING CORPORATION
Project # X03031

OPERATION AND MAINTENANCE MANUAL FOR THE WIEMAN DAM NEAR MARION, SOUTH DAKOTA

PRINCIPAL SPILLWAY

Spillway structure should be cleared of debris periodically and after any significant rainfall event where inspection reveals a significant blockage.

During low water conditions, concrete spillway structures should be inspected to decide if water is passing through any joints or other structure contacts and to identify any cracks, spalling, broken or loose sections. Any cracked, spalled, broken or loose sections should be cleaned and refilled with an appropriate concrete patching material. A professional engineer should be consulted to repair extensive leakage, spalls or fractures.

Outlet protection and discharge channels should be cleared of brush at least once per year.

Any repairs made to the principal spillway should be reviewed by a professional engineer. Vertical trenching to expose the barrel should not be allowed under any circumstances. The trench side slopes should be stepped back at a 2:1 slope, minimum.

TRASH RACK

Maintenance should include periodic checks of the trash rack for rusted and broken sections and repairing as needed. The trash rack should be checked frequently during and after storm events to ensure that it is functioning properly and to remove accumulated debris. Extreme caution should be used when attempting to remove accumulated debris during periods of high flow.

Trash rack locking and hinge mechanisms should be inspected and tested periodically to make sure they are intact and operative.

VEGETATED SPILLWAY

Vegetated emergency spillway channels should be mowed concurrently with the embankment and should not be cut to less than 6 to 8 inches in height.

The emergency spillway approach and discharge channels should be cleared of brush and other woody growth periodically.

After any flow has passed through the emergency spillway, the spillway crest (control section) and exit channel should be inspected for erosion. All eroded areas should be repaired and stabilized.

To maintain the protective plant cover on the emergency spillway, mow it frequently and fertilize when needed. Mowing prevents the growth of woody plants where undesirable and helps develop a cover and root system more resistant to runoff.

Burrowing animals such as badgers, gophers, beaver, and prairie dogs cause severe damage to spillways. The emergency spillway should be frequently checked for animal related damages. Any destruction caused to the spillway should be immediately repaired.

All seeding repairs should be done with the specified seed mixtures and application guidelines from the original plans.

DAM EMBANKMENT

Fill any rills on the side slopes of the dam immediately with suitable material and compact it thoroughly. Fertilize as needed and reseed or resod these areas.

If seepage through or under the dam is evident, consult an engineer at once so that you can take proper corrective measures before serious damage occurs.

To maintain the protective plant cover on the dam, mow it frequently and fertilize when needed. Mowing prevents the growth of woody plants where undesirable and helps develop a cover and root system more resistant to runoff.

Burrowing animals such as badgers, gophers, beaver, and prairie dogs cause severe damage to dams. The dam embankment should be frequently checked for animal related damages. Any destruction should be immediately repaired.

All seeding repairs should be done with the specified seed mixtures and application guidelines from the original plans.

PROTECTION OF NEWLY GRADED AREAS

Protect newly graded areas from traffic and erosion and keep free of trash and weeds. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.

RIPRAP

Riprap on the face of the dam and in plunge pools will be maintained to original dimensions and thickness as shown on the plan drawings. Any void or disturbed areas will be filled.

Attn: Kevin

From: Sheila, Turner Co. Aud.

RESOLUTION #13-03
PLAT

Motion by Van Hove, seconded by Schmeichel, to adopt the following resolution.
Motion carried.

(INSERT RESOLUTION #13-03)

NEW EMPLOYEE

Motion by Van Hove, seconded by Lounsbery, to hire Chris Daniels for the Hwy. Dept., starting hourly salary with CDL \$9.10. Motion carried.

✱ DRAINAGE PERMIT HEARING Turner Co. 5-6-03 minutes

A hearing was held at 10:30 A.M. on a drainage permit application for Marlo Wieman. Questions & concerns from the public were expressed on what would happen if the proposed dam would break. Motion by Van Hove, seconded by Schmeichel, to approve a drainage permit for the SE1/4 Exc. Lot H2 & Exc. Tieszen's Tract an addn. in the SE1/4 NE1/4 19-100-54 with the conditions two spillways be included when the dam is built & the engineering plans to be filed with the county. Motion carried

AUTOMATIC SUPPLEMENT
TIF DISTRICT FUND

Motion by Lounsbery, seconded by Van Hove, to approve an automatic supplement to the TIF District Fund: \$1,106,870.68 proceeds from sale of bonds & \$25,000.00 for atty. fees. Motion carried.

SECURITY GRANT

Motion by Schmeichel, seconded by Lounsbery, to approve signing a voucher to receive a Security Grant from the State. Motion carried.

COMPROMISE COUNTY AID LIEN CASE #CC10-94

Motion by Schmeichel, seconded by Lounsbery, to accept the recommendations of Credit Collection Services to compromise a county aid lien from \$5,020.16 to \$3,500.00 only if the individual pays the full amount. If full amount is not paid, it will remain at the \$5,020.16. Motion carried.

VETERANS SERVICE OFFICER POSITION INTERVIEWS

The Board held interviews for the Veterans Service Officer position.

**CLARK ENGINEERING CORPORATION
SIOUX FALLS, SD**

**SOIL EXPLORATION PROGRAM
PROPOSED WIEMAN DAM
SIOUX FALLS, SOUTH DAKOTA
STI #03-0611**

July 29, 2003

EXECUTIVE SUMMARY

Based on the test hole data, it is our opinion that the native clay soils encountered at the site are suitable for construction on the dam. Most of the native clay soils at the site consist of lean clay glacial till. However, some of the soils at the bottom of the creek appear to be re-deposited soils placed as part of the creek erosion and surrounding run-off. These re-deposited soils are typically weak, and would not be favorable for use as embankment fill, or in providing a suitable foundation for support of the embankment fill.

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#03-0611

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SOIL EXPLORATION PROGRAM

PROPOSED WIEMAN DAM

NEAR MARION, SOUTH DAKOTA

STI #03-0611

INTRODUCTION

1.1 Project Information

We understand the project will consist of the construction of a small earthen dam north of Marion, SD. The site of the proposed dam is bordered on the south by 271st Street and on the east by 447th Avenue. The dam will be about 350 feet wide and have a maximum height of about 35 feet.

Earthen spillways will be constructed along the outside edges of the dam. Borrow material is anticipated to be obtained from the hillsides adjacent to the dam. The upstream slope of the embankment is planned to be 5:1 while the down stream will be 4:1. We assume that the slopes of the embankment and the spillway sugrade will be seeded or sodded and that the upstream face of the embankment will be protected with rip-rap.

2.0 ENGINEERING REVIEW

The engineering recommendations provided in this report are based on our understanding of the project as described above. The recommendations are valid for a specific set of project conditions. If the characteristics of the project change from those indicated in this report, it is necessary that we be notified so that we can determine whether the new conditions affect our recommendations.

The primary purpose of performing the field and laboratory tests is to determine the general parameters of soils relative to the feasibility of constructing the dam. Other tests (such as triaxial tests) and analysis to determine the safety factors of the dam were not performed at your request. If you determine that these tests and analysis are needed, additional authorization and agreement of fees would be needed.

2.1 Discussion

- **General**

Based on the test hole data, most of the native soils at the site consist of clay till (glacial deposited soils). It is our opinion that most of these clay till soils are suitable for construction on the dam. However, some of the surficial soils encountered at the bottom of the creek consist of clay and sand which appear to have been re-deposited as part of the creek erosion and surrounding run-off processes. These re-deposited soils are typically weak, and would not be favorable for construction of the dam, neither for use as embankment fill nor in providing a suitable foundation for support of the embankment fill.

2.2 General Soil Profiles

- **Bottom of Creek**

The logs of test holes #2, #3, #5, #6, #7, #8 and #9, performed along the bottom of the creek from the site of the dam and extending upstream approximately ½ mile, suggest that the general soil profile consist of about 2 feet of re-deposited topsoil overlying lean clay till (glacial deposited soils). The first few feet of lean clay till soils, encountered immediately below the re-deposited topsoil, appear to have high moisture contents and are somewhat weak. More specifically, the point resistance (qc), shown on the log of test hole #2, suggests that the top 6 feet of clay soil is weak relative to the proposed construction.

- **Borrow Areas**

The logs of test holes #1 and #4, performed in the borrow areas at the top of the hillsides adjacent to the proposed dam, suggest that the general soil profile consist of 0.5 to 0.7 feet of topsoil overlying primarily lean clay till soils. However, some sand alluvium soils were encountered at 15 and 27.5 feet in test hole #1. Also, some lean clay fine alluvium (water deposited soils) was encountered near the surface of test hole #4. Lab test suggest that the upper 6 feet of these borrow soils are somewhat dry with moisture contents of 15% (optimum is 20.9% per the Standard Proctor Test).

2.3 General Recommendations

1. To provide a suitable foundation for placement of the dam embankment, the topsoil, re-deposited and/or other weak soils encountered at the bottom and along the side-slopes of

the creek shall be excavated to expose stiff competent clay till soils. The depth of the competent clay till soils will likely vary, but the log of test hole #2 suggest the depth is up to 10 feet below existing grade. To insure that competent clay soils are exposed, a geotechnical engineer shall periodically observe the bottom of the entire foundation excavation, during and once it is completed.

2. All backfill operations used to construct the dam shall be performed in an engineered and controlled manner, after the environment has been made water free. During the entire time of construction, arrangement shall be made to accommodate the creek's water flow in a manner that it does not adversely affect the construction operations.
3. Only selected lean clays and sandy lean clay till soils, such as encountered in test holes #1 and #4, shall be used for embankment fill in the core of the dam. The use of only the lean or sandy lean clay soils should be closely monitored by the engineer during the entire fill operations. Any pockets of sand encountered in the clay borrow areas shall be distinctly separated from the clay till soils and not used in construction of the embankment. If the design incorporates any retaining structures (wing walls etc.), only non-plastic granular soils shall be placed immediately adjacent to them; and if appropriate, a proper sub-drainage system shall be constructed behind the retaining structure. If lateral earth pressures, sub-drainage gradations or geofabrics are needed for design, please contact us.
4. Clay engineered fill used for construction of the core of the embankment shall be placed in maximum 8 inch loose lifts and compacted to at least 98% of the Standard Proctor Density (ASTM: D698). Granular engineered fill placed behind any retaining structure should be compacted to 70% relative density as per ASTM D4253/4258. The clay engineered fill should be placed at a moisture content ranging from minus 2% to plus 3% of the Standard Proctor.
5. The weak clay and or silt soils excavated from the bottom and side walls of the creek can be placed and used as a stabilizing berm on the outside the embankment core soils, either upstream or downstream of the embankment core soils, however they shall not be used as the core soils of the embankment.

- **Settlements**

Settlement estimates based on the point resistance (qc) values of test hole #2 suggest that the total settlement under the maximum cross-section of the dam (approximately 33 feet) will be on the order of 6 to 8 inches. The settlement will taper to near zero inches at the minimum cross sections. An additional 1 to 2 inches will occur in the fill soils at the maximum cross section of the embankment. The settlements will occur over several years. We suggest that the crest of the dam be built higher than the final grade to account for these settlements.

3.0 CONSTRUCTION CONSIDERATIONS

3.1 Site Excavation

- **Soil Disturbance & Moisture Changes**

The clay soils encountered at the site are sensitive to disturbance and strength loss under the influence of construction traffic and/or additional moisture. Disturbance or any saturation of these soils will require additional excavation and backfilling. Excavation to expose some of these soils at the bottom and side slopes of the creek may require using a backhoe with a smooth bucket. Also, the excavations should be left open a minimal amount of time to prevent strength loss of these soils by ponding of water.

- **OSHA**

All excavations must comply with the requirements of OSHA 29 CFR Part 1926, Subpart P, "Excavations." Reference to this OSHA requirement should be included in the project specifications.

3.2 Excavation Observation and Testing

Performance of the engineered fill at the site is dependent upon removing all unsuitable soils prior to fill placement and maintaining adequate compaction as the fill is placed. The excavations must be observed by a qualified geotechnical engineer or his representative prior to fill placement, and density/moisture testing must be performed within the fill sequence.

4.0 GENERAL EXPLORATION INFORMATION

4.1 Scope of Exploration

Nine test holes (borings) were performed at the site on June 30 and July 2, 2003. The test holes were advanced at the general locations shown on the sketch attached. The subsurface information was obtained using Cone Penetration Testing (CPT) methods as per ASTM: D5778 and Macro-Core sampling methods. A cone factor (N_k) of 18 was used for determination of the undrained shear strength. Some settlement of the soils used to fill the open test holes should be anticipated and final closure of the holes is the responsibility of the client or property owner.

4.2 Site Surface Conditions

The site of the proposed dam is approximately two miles north of Marion, SD, in the creek west of 447th Avenue. The proposed dam is bordered on the south by 271st Street. The site surface consisted mostly of grassland at the time of our soil exploration program. The general topography of the site is hilly. The surface elevations of the test holes were not taken.

4.3 Site Subsurface Conditions

The subsurface conditions encountered at each test hole location are illustrated on logs attached to this report. A review of the test hole logs suggests a general soil profile consisting of surficial topsoil overlying primarily native clay till (glacial deposited soils) with some sand, silt and clay alluvium (water deposited soils). The clay till soils extended to the termination depths of the test holes. We wish to point out that the subsurface conditions at other times and locations on this site may differ from those found at our test locations. If different subsurface conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

4.4 Water Levels

Observations for subsurface groundwater were made at the test hole locations during our field operations. Groundwater was encountered at some of the test hole locations. The levels where the groundwater was measured are shown in the table below and at the bottom of the test hole logs.

Test Hole Number	Groundwater Measurements (feet below surface)
1	None
2	2.3
3	7.0
4	17.0
5	None
6	None
7	None
8	None
9	4.0

It should be noted that in order to accurately determine the static groundwater level, observations over a long period are usually required. Such periods of observation are normally not available in

a typical soil exploration program. Seasonal and annual fluctuations in the groundwater levels can be expected to occur.

4.5 Laboratory Tests

Soil samples were selected for laboratory tests to determine the engineering and index properties. Where applicable, the tests were performed in accordance with the American Society for Testing and Materials (ASTM) procedures. The test results are shown on the test hole logs opposite the samples upon which the tests were made or are shown below.

TEST HOLE	DEPTH (ft.)	% Passing the #200 Sieve	Moisture Content (% by weight)	Dry Density (lbs./ft ³)
2	4.5-5.0	73	30	--

5.0 REVIEW, USE AND PURPOSE OF REPORT

- **Review of Report**

The analyses and recommendations submitted in this report are based upon the data obtained from the test holes performed at the locations indicated on the attached sketch(s). Variations can occur around and between these test holes, the nature and extent of which may not become evident until additional exploration or construction is conducted. Therefore, a review of the recommendations of this report should be made after performing on-site observations during the construction. The variations may result in additional construction costs, and it is suggested that a contingency be provided for this purpose.

This report is based on the design of the proposed construction as submitted to us for preparation of this report. It is recommended that we be retained to briefly review the geotechnical aspects of the final design and specifications to determine whether any changes in design may have had an affect on the validity of the recommendations contained in this report, and whether our recommendations have been correctly communicated to you so that their intent has been implemented in the design and specifications. If we are no permitted to make this recommended review, we will not be liable for losses arising out of such design changes or misinterpretation or misapplication of our recommendations.

- **Use of Report**

This report is for the exclusive use of the addressee and its representatives for use in general design of the proposed construction described herein. The data, analyses and recommendations may not be appropriate for other structures or purposes. All parties contemplating other structures or purposes must contact us for additional review. In the absence of our written review and approval, we make not representation and assume no responsibility to any parties regarding this report.

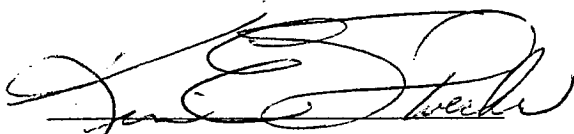
- **Purpose of Report**

The purpose of this report is to present the results of our field and laboratory tests as well as our geotechnical engineering review and recommendations for the project. Our work is intended for geotechnical purposes only and not to verify the presence or extent of any contamination at the site(s).

6.0 STANDARD OF CARE

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted engineering procedures at this time and location. Other than this, no warranty, either expressed or implied, is intended.

This report was prepared by:

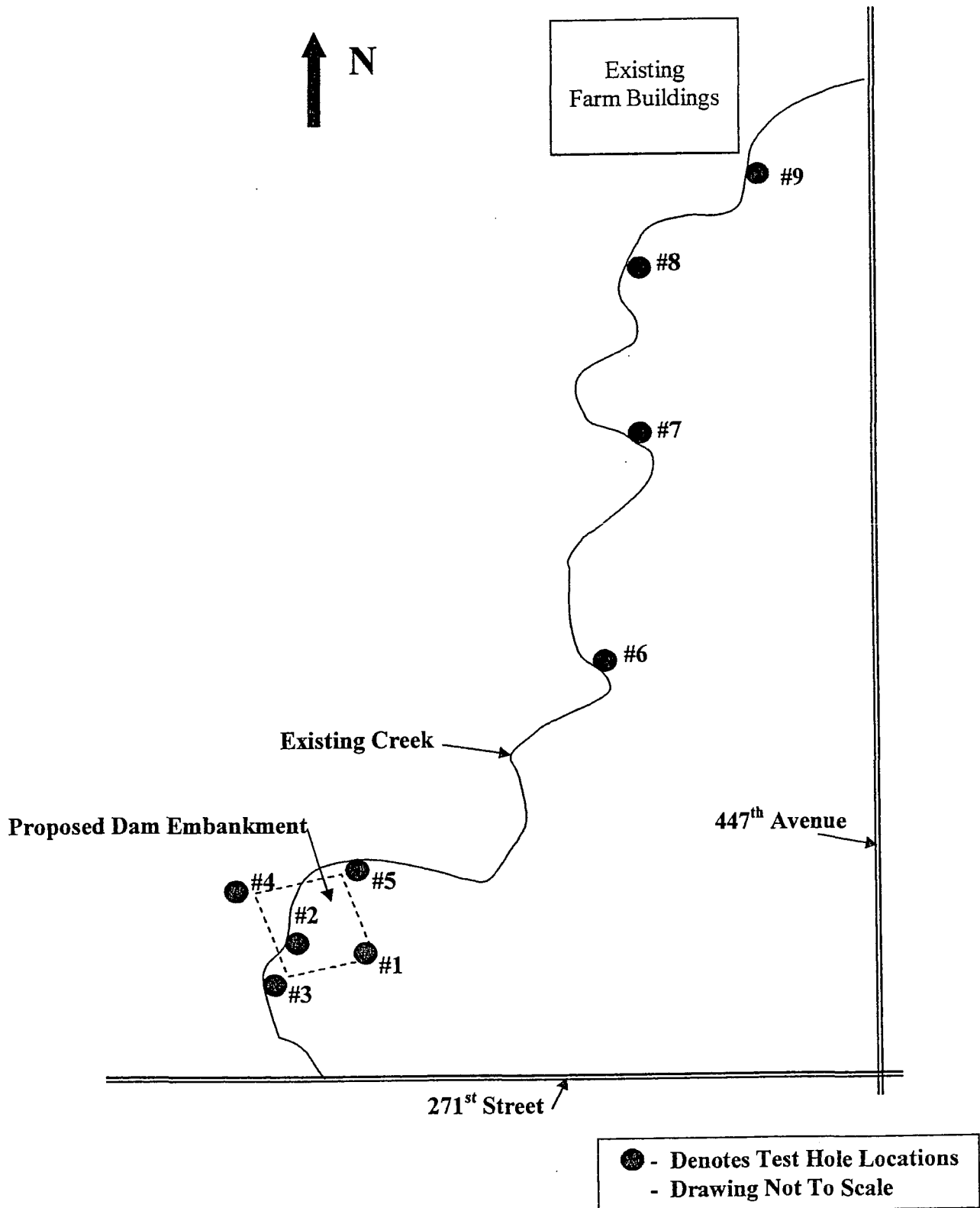


Kim E. Stoecker, PE

Consulting Geotechnical Engineer



**PROPOSED WIEMAN DAM
NEAR MARION, SD
STI #03-0611**



LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam LOCATION: Near Marion, SD		TEST HOLE #1 Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	W	D	LL	PL	QU	
0.7	Lean Clay, black (CL-OL)	TOPSOIL			1	MC						
	Sandy Lean Clay, a little gravel, brown mottled (CL)	TILL										
	** Proctor and permeability performed on soils between 2' and 8', see attached sheets.											**
	** #200 Sieve = 70%				2	MC		15		41	19	**
					3	MC						
15	Silty Sand, fine grained, light brown, moist (SM)	COARSE ALLUVIUM			4	MC						
18.5	Sandy Lean Clay, a little gravel, brown mottled, a layer of silty sand at 23' (CL)	TILL			5	MC						
					6	MC						
27.5	Clayey Sand, fine to coarse grained, brown, wet (SC)	MIXED ALLUVIUM										
30	END OF TEST HOLE											
DATE			WATER LEVEL MEASUREMENTS		START: 06-30-03		COMPLETE: 06-30-03					
6-30	Sampled to: 22', Cave In: 21'	WL=None	METHOD:				at 11:57					
6-30	Sampled to: 30', Cave In: 29.5'	WL=None	Macro Core Sampling to 30'									
7-2	Cave In: 28.8'	WL=None	Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103									
			TELEPHONE: (605) 330-9993 FAX: (605) 330-9994									

TEST HOLE #2

qc [MPa]

Su [psf]



Clay (3)

Silty sand to sandy silt (7)

Clayey silt to silty clay (5)

Sandy silt to clayey silt (6)

Clay (3)

Silty clay to clay (4)

Clayey silt to silty clay (5)

Silty clay to clay (4)

Clayey silt to silty clay (5)

Silty clay to clay (4)

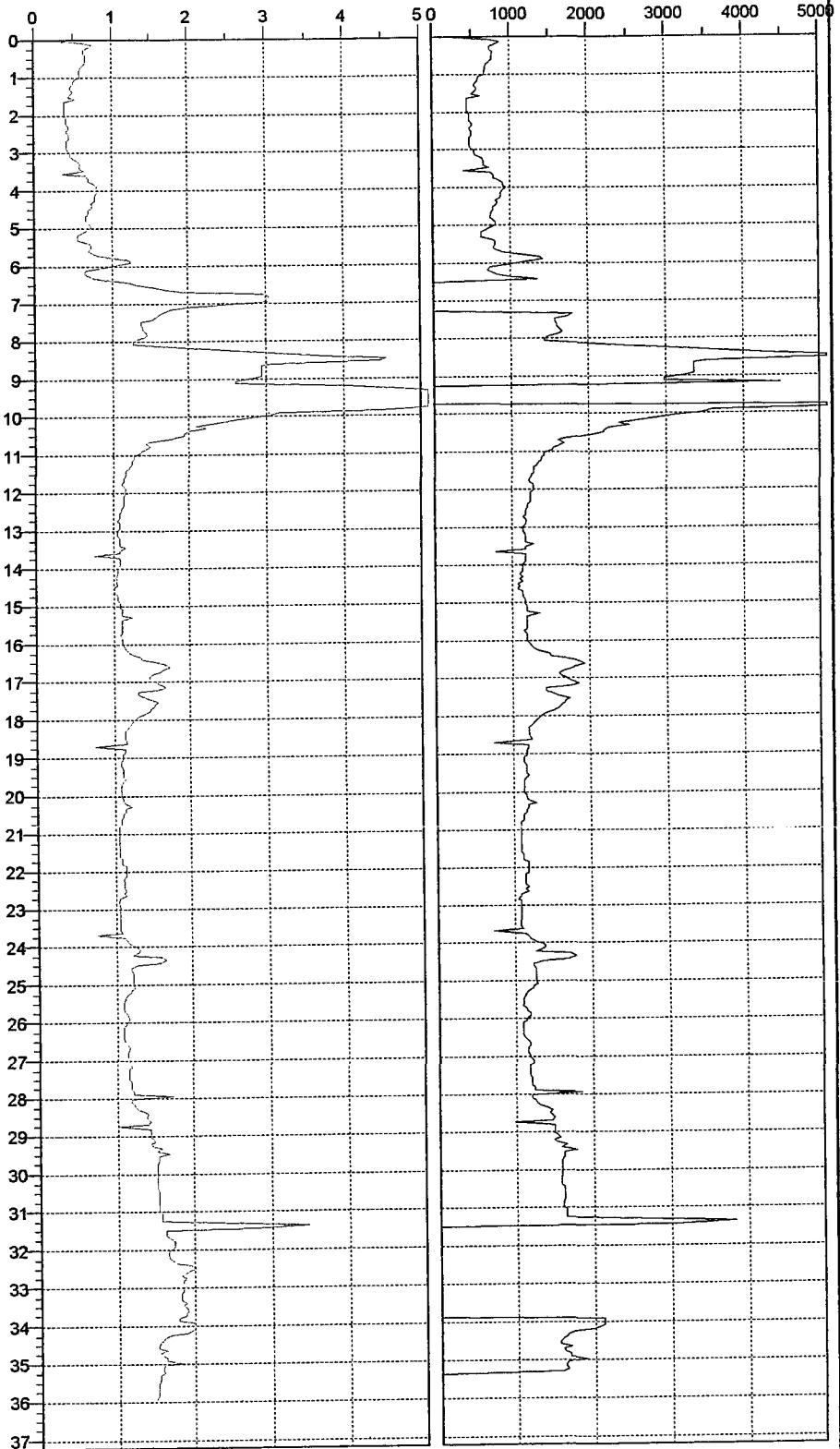
Clayey silt to silty clay (5)

Sandy silt to clayey silt (6)

Clayey silt to silty clay (5)

Sandy silt to clayey silt (6)

Depth [ft]



Cone No: 0
Tip area [cm²]: 10
Sleeve area [cm²]: 150

STI

Test no: 2	Position:	Ground level:	
Client:	Clark Engineering Corp.	Date: 6/30/03	Scale: 1 : 56
Project:	Proposed Wieman Dam, Near Marion, SD	Page: 1/1	Fig:
Water: 2.3'		File:	0611-2.cpd

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #3								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
2	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL			1	MC						
	Lean Clay, a little gravel, gray and brown mottled, lenses of silt at 7'-8' (CL)	TILL			2	MC						
10	Lean Clay, a little gravel, gray (CL)											
	END OF TEST HOLE											
DATE		WATER LEVEL MEASUREMENTS		START: 06-30-03 COMPLETE: 06-30-03								
6-30	At completion of test hole, Sampled to: 5'	WL= 7'		METHOD:								
				Macro Core Sampling to 10'								
				Crew Chief: K.Stoecker (STI)								
SOIL TECHNOLOGIES, INC		401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994										

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #4								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO.	TYPE	W	D	LL	PL	QU	
0.5	Lean Clay, black (CL-OL)	TOPSOIL FINE ALLUVIUM			1	MC						
	Lean Clay, brown (CL)											
3	Sandy Lean Clay, a little gravel, brown mottled, a layer of water bearing silty sand at 18' (CL)	TILL					15		43	19		
					2	MC						
					3	MC						
					4	MC						
					5	MC						
					6	MC						
27	Lean Clay, a little gravel, gray. (CL)											
30												
END OF TEST HOLE												
DATE			WATER LEVEL MEASUREMENTS		START: 07-2-03		COMPLETE: 07-2-03					
7-2	Sampled to: 20', Cave In: 17.7'	WL=17	METHOD:		at 11:58							
7-2	Sampled to: 30', Cave In: 29'	WL=19.1	Macro Core Sampling to 30'									
			Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103									
			TELEPHONE: (605) 330-9993 FAX: (605) 330-9994									

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #5								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
2.5	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL			1	MC						
	Lean Clay, a little gravel, gray and brown mottled (CL)	TILL										
5	END OF TEST HOLE											
			WATER LEVEL MEASUREMENTS		START: 06-30-03 COMPLETE: 06-30-03							
6-30	At completion of test hole, Sampled to: 5'	WL= None	METHOD:									
			Macro Core Sampling to 5'									
			Crew Chief: K.Stoecker (STI)									
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103									
			TELEPHONE: (605) 330-9993					FAX: (605) 330-9994				

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #6							
		LOCATION: Near Marion, SD		Sheet 1 of 1							
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE NO	TYPE	LABORATORY TESTS				
							W	D	LL	PL	QU
	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL				HA					
2.5	Lean Clay, a little gravel, gray and brown mottled, a 4" layer of clayey sand at 4' (CL)	TILL									
5	END OF TEST HOLE										
DATE			WATER LEVEL MEASUREMENTS			START: 07-2-03 COMPLETE: 07-2-03					
7-2	At completion of test hole, Sampled to: 5'	WL= None	METHOD: Hand Auger To 5'								
			Crew Chief: K.Stoecker (STI)								
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994								

LOG OF TEST HOLE

JOB #: 03-0611		PROJECT: Proposed Wieman Dam		TEST HOLE #7								
		LOCATION: Near Marion, SD		Sheet 1 of 1								
DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS					
					NO	TYPE	W	D	LL	PL	QU	
	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL				HA						
3	Sandy Lean Clay, dark brown (CL)	MIXED ALLUVIUM										
5	END OF TEST HOLE											
DATE			WATER LEVEL MEASUREMENTS		START:07-2-03 COMPLETE: 07-2-03							
7-2	At completion of test hole, Sampled to: 5'	WL= None	METHOD:									
			Hand Auger To 5'									
			Crew Chief: K.Stoecker (STI)									

SOIL TECHNOLOGIES, INC
 401 E. 8TH STREET, SIOUX FALLS, SD 57103
 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994

LOG OF TEST HOLE

[illegible]

LOG OF TEST HOLE

JOB #: 03-0611 PROJECT: Proposed Wieman Dam TEST HOLE #9
 LOCATION: Near Marion, SD Sheet 1 of 1

DEPTH (ft.)	DESCRIPTION OF MATERIAL SURFACE ELEVATION =	GEOLOGIC ORIGIN	WL	"N"	SAMPLE		LABORATORY TESTS				
					NO	TYPE	W	D	LL	PL	QU
2	Organic Lean Clay, black (CL-OL)	REDEPOSITED TOPSOIL				HA					
5	Lean Clay, a little gravel, gray and brown mottled (CL)	TILL									
	END OF TEST HOLE										
DATE			WATER LEVEL MEASUREMENTS			START: 07-2-03 COMPLETE: 07-2-03					
7-2	At completion of test hole, Sampled to: 5'	WL= 4'	METHOD: Hand Auger To 5'								
			Crew Chief: K. Stoecker (STI)								
SOIL TECHNOLOGIES, INC			401 E. 8TH STREET, SIOUX FALLS, SD 57103 TELEPHONE: (605) 330-9993 FAX: (605) 330-9994								

STI No. 03-0611, Proposed Wieman Dam

Sample Number 1

TEST RESULTS

Reported To Soil Technologies, Inc.Moisture Content As Received 20.5%Job No. GEO-070309 Date 7/20/2003Maximum Dry Density 103.6 PCF

Location _____

Optimum Water Content 20.9%

Copies To _____

Preparation Method MoistRammer Type ManualSource of Material Boring 1, Minus 2.0' to 8.0'

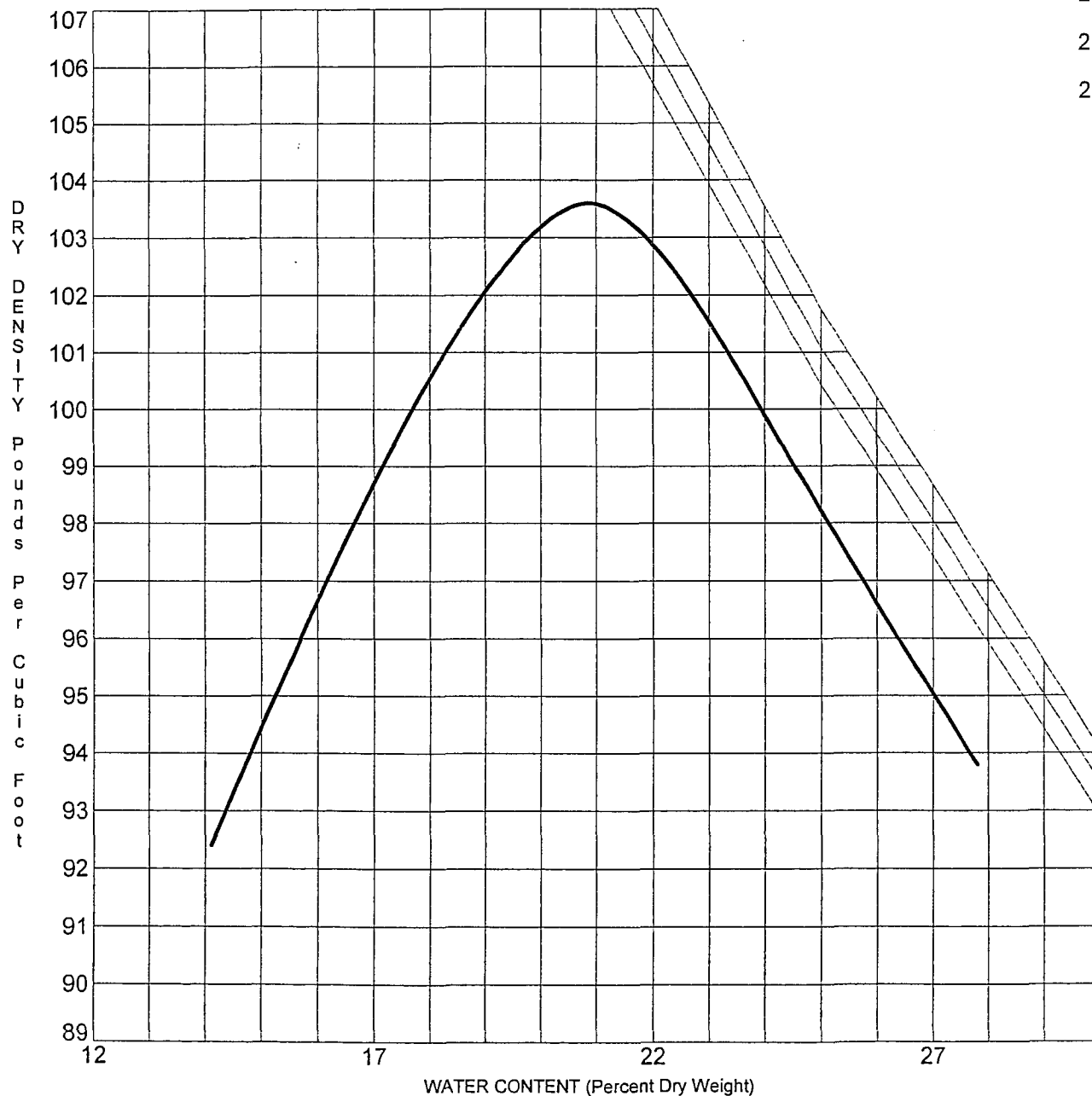
ATTERBERG LIMITS

Description of Material SANDY LEAN CLAY, brown, trace
(ASTM: D 2488 - Visual) of gravel (CL) 1.4% + #4LL PL PITest Methods ASTM: D 698-00a Method AASTM: D2216-98ASTM: D4318-00CURVES OF 100% SATURATION
FOR SPECIFIC GRAVITY
EQUAL TO:

2.75

2.72

2.69



LABORATORY COMPACTION CHARACTERISTICS OF SOIL

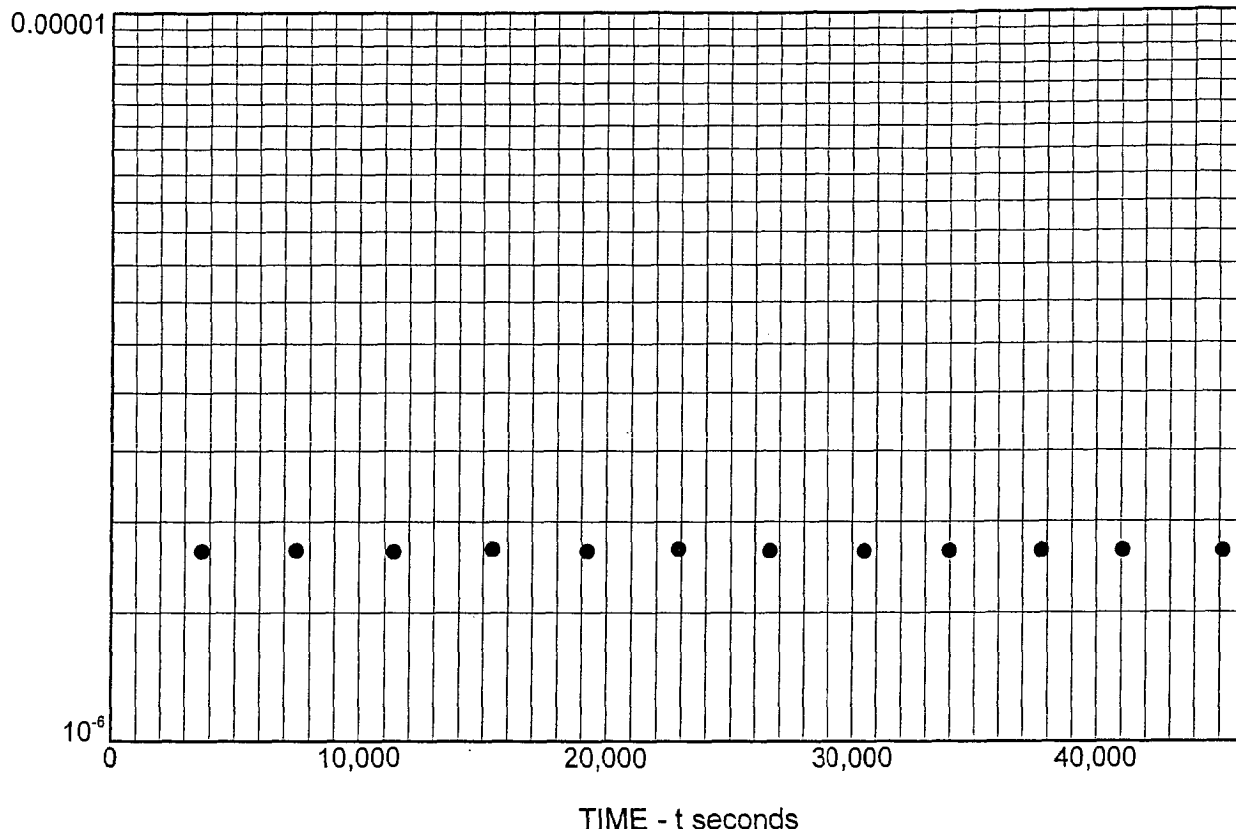
GEO SERV INC Testing - Exploration - Engineering

Bismarck, ND 58501

ASTM: D 5084-00 "MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED
POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER" METHOD B



HYDRAULIC
CONDUCTIVITY
K
20C
cm-sec



Sample Identification: 1 Sample Depth (ft): 8.0 LL: N/T
 Sample Location: B-1 PL: N/T
 Sample Method: Auger PI: N/T
 Remolded Compaction Method: ASTM: D 698-00a Method A Minus #200 Wash (%): N/T
 Maximum Dry Density (pcf): 103.6 Optimum Moisture Content (%): 20.9
 Classification (ASTM: D 2488 - visual): SANDY LEAN CLAY, brown (CL)
 Comments: Initial Percent Compaction: 95.0

	INITIAL	FINAL
Sample Length (cm):	7.23	7.29
Sample Diameter (cm):	7.18	7.29
Sample Moisture Content (%):	21.0	25.3
Sample Unit Weight (pcf):	98.4	95.8
Sample Degree of Saturation (%):	89.5	97.3

Permeant Liquid Used: Deaired Water Cell Pressure (psi): 10.2
 Maximum Effective Stress (psi): 6.2 Maximum Head Pressure (psi): 6.2
 Minimum Effective Stress (psi): 4.0 Maximum Tail Pressure (psi): 4.0
 Range Of Hydraulic Gradient: 1.6248 to 1.6112
 Calculated Hydraulic Conductivity K-20C cm/sec: 1.8271E-06
 Average Hydraulic Conductivity (last 4 readings) K-20C cm/sec: 1.8260E-06
 Average Hydraulic Conductivity (last 4 readings) K-20C in/day: 6.2112E-02

Remarks: Final Percent Compaction: 92.5

PROJECT	STI No. 03-0611, Proposed Wieman Dam,	JOB NO.	GEO-070309
REPORTED TO	Soil Technologies, Inc.	DATE	7/20/2003

FALLING HEAD PERMEABILITY

GEOSERV INC Testing - Exploration - Engineering
 Bismarck, ND 58501

SYMBOLS AND TERMINOLOGY

DRILLING AND SAMPLING SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
B	Bag Sample
CPT	Cone Penetration Test
CR	Core Recovery (percent)
DC	Steel Drive Casing
DM	Drilling Mud
FA	Flight Auger
HA	Hand Auger
HSA	Hollow Stem Auger
JW	Jetting Water
MC	Macro Core Sampler
NSR	No Sample Recovered
_Q	BQ, NQ or PQ Wireline System
RC	Rotary Casing
SB	Split Barrel Sampler
3TW	3" Thin Walled Tube Sampler
3TP	3" Thin Walled Tube (Pitcher Sampler)
_X	AX, BX, Or NX Double Tube Barrel
▼	Water Level Symbol

TEST SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
W	Water Content % of Dry Weight (ASTM: D2216)
D	Dry Density - pounds per cubic foot
LL	Liquid Limit (ASTM: D4318)
PL	Plastic Limit (ASTM: D438)
Qu	Unconfined Compressive Strength - pounds per square foot (ASTM: D2166)
Pq	Penetrometer Reading - tons per square foot
qc	Point resistance - Mpa (megapascals)
fs	Sleeve friction - Mpa (megapascals)
Su	Undrained Shear Strength
ID	Relative density (%)
N	Standard Penetration - blows per foot*
R	Laboratory Resistivity
G	Specific Gravity - ASTM: D854
OC	Organic Content
K	Coefficient of Permeability
VS	Field Vane Shear (ASTM: D2573)
RQD	Rock Quality Designation - percent

WATER LEVELS

Water levels shown on the test hole (boring) logs are the water levels measured in the test holes at the time and under the conditions indicated. In sand soil, the indicated levels may be considered fairly reliable ground water levels. In clay soil, it may not be possible to determine the ground water level within the normal time required for the test hole, except where lenses or layers of more pervious waterbearing soil are present. Even then, an extended period of time may be necessary to reach equilibrium. Therefore, the water levels shown on the test hole logs for cohesive or mixed texture soils may not indicate the true level of the ground water table. Perched water refers to water above an impervious layer, thus impeded in reaching the water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

<u>"N" VALUE*</u>	<u>DENSITY</u>	<u>CONSISTENCY</u>
0 - 4 blows/ft.	Very Loose	Soft
5 - 8 blows/ft.	Loose	Medium
9 - 15 blows/ft.	Medium Dense	Rather Stiff
16 - 30 blows/ft.	Dense	Stiff
Over 30	Very Dense	Very Stiff

*"N" is the Standard Penetration, in blows per foot, of a 140 pound hammer falling 30 inches onto a 2 inch OD split barrel sampler. If CPT equipment is used, the "N" value is derived from the point resistance.

Lamination	Up to 1/2" thick stratum
Layer	1/2" to 6"
Lens	1/2" to 6" discontinuous stratum, pocket
Varved	Alternating laminations of clay, silt and /or fine grained sand, or colors thereof
Dry	Powdery, no noticeable water
Moist	Below saturation
Wet	Saturated, above liquid limit
Waterbearing	Pervious soil below water

RELATIVE GRAVEL PROPORTIONS

<u>CONDITION</u>	<u>TERM</u>	<u>RANGE</u>
Coarse Grained Soils	A little gravel	2 - 14%
	With gravel	15 - 49%
Fine Grained Soils		
	A little gravel	2 - 7%
	With gravel	8 - 29%
	A little gravel	2 - 14%
	With gravel	15 - 24%
	Gravelly	16 - 49%

RELATIVE SIZES

Boulder	Over 12"
Cobble	3" - 12"
Gravel - Coarse	3/4" - 3"
Gravel - Fine	#4 - 3/4"
Sand - Coarse	#4 - #10
Sand - Medium	#10 - #40
Sand - Fine	#40 - #200
Silt & Clay	-#200, Based on Plasticity

Soil Technologies, Inc.

PRECAUTIONS FOR EXCAVATING AND REFILLING DURING COLD WEATHER

The winter season in this area presents specific problems for foundation construction. Soils which are allowed to freeze undergo a moisture volume expansion, resulting in a loss of density. These frost-expanded soils will consolidate upon thawing, causing settlement of any structure supported on them. To prevent this settlement, frost should not be allowed to penetrate into the soils below any proposed structure.

Ideally, winter excavation should be limited to areas small enough to be refilled to a grade higher than footing grade on the same day. Typically, these areas should be filled to floor grade. Trenching back down to unfrozen soils for foundation construction can then be performed just prior to footing placement. The excavated trenches should be protected from freezing by means of insulating or heating during foundation construction. Backfilling of the foundation trenches should be performed immediately after the below-grade foundation construction is finished. In addition, any interior footings, or footings designed without frost protection should be extended below frost depth, unless adequate precautions are taken to prevent frost intrusion until the building can be enclosed and heated.

In many cases, final grade cannot be attained in one day's time, even though small areas are worked. In the event final grade cannot be attained in one day's time, frost can be expected to develop overnight. The depth of frost penetration can be minimized by leaving a layer of loose soil on top of the compacted material overnight. However, any frost which forms in this loose layer, or snow which accumulates, should be completely removed from the fill area prior to compaction and additional soil placement. Frozen soils, or soils containing frozen material or snow should never be used as fill material.

After the structure has been enclosed, all floor slab areas should be subjected to ample periods of heating to allow thawing of the soil system. Alternatively, the frozen soils can be completely removed and be replaced with an engineered fill. The floor slab areas should be checked at random and representative locations for remnant areas of frost, and density tests should be performed to document fill compaction prior to slab placement.

Due to the potential problems associated with fill placement during cold weather, any filling operations should be monitored by a full-time, on-site soils technician. Full-time monitoring aids in detecting areas of frozen material, or potential problems with frozen material within the fill, so that appropriate measures can be taken. The choice of fill material is particularly important during cold weather, since clean granular fill materials can be placed and compacted more efficiently than silty or clayey soils. In addition, greater magnitudes of heaving can be expected with freezing of the more frost susceptible silts and clays.

If more specific frost information or cold weather data concerning other construction materials is required, please contact us.

CONSTRUCTION OBSERVATIONS AND TESTING

The recommendations made in this report have been made based on the subsurface conditions found in the test holes. It is possible that there are soil and water conditions on-site that were not represented by those test holes. Therefore, we recommend that the completed excavation and prepared subgrade be observed and tested by a soils engineer prior to fill placement or construction of any foundation elements. These observations are necessary to judge if all unsuitable materials have been removed from within the planned construction area and that an appropriate degree of lateral oversize has been provided for in those areas where fill will be placed below the bottom of foundation grade.

We recommend a representative number of field density tests be taken in the engineered fill to aid in judging its suitability. At least one density test should be performed for each 2' of fill depth. The tests should be spaced so that there is a minimum of one test for every 2000 square feet of engineered fill placed. Additional tests should be taken in confined areas. The actual number of tests should be left to the discretion of a qualified engineer or his representative. Any proposed fill material should be submitted to the laboratory for tests to check compliance with our recommendations and project specifications.

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration, the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geo-

technical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed un-

der the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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CLARK

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Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505 Phone
(605) 331-2602 Fax
siouxfalls@clark-eng.com
www.clark-eng.com

TRANSMITTAL LETTER

TO: Mr. Tim Schaal
Dept of Environment & Natural Resources
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3182

DATE: March 26, 2007

CLARK-SF PROJECT NUMBER: X03031

REGARDING: Wieman Dam near Marion, SD

TRANSMITTED HERewith are the following items:

NUMBER	DATE	DESCRIPTION
1	3/26/07	Wetland Plan

REMARKS:

Mr. Schaal:

Please include this wetland plan with your file for the Wieman Dam. Any questions concerning the information contained within this plan can be addressed to Paul Clinton with Dakota Land Surveying.

Thank you.

Copies To:



Vanessa Victor, EIT

If this transmittal is incomplete or incorrect, please notify the sender immediately.

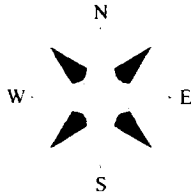
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WATER RIGHTS
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2000 West 42nd Street
Suite B-6
Sioux Falls, SD 57105
Phone 605-334-4882
Fax 605-334-5745

March 22, 2007

WETLAND PLAN FOR WIEMAN DAM, MARION, SOUTH DAKOTA Project 05-022.02

1. ENHANCEMENT GOALS AND OBJECTIVES

Impact site

a. Location/Land use

This proposed dam is a private structure. Its primary use will be for wildlife habitat and recreation. The dam will also perform a flood control function. This dam is located on an unnamed tributary to the West Fork of the Vermillion River. The proposed dam is located north of 271st Street and west of 447th Avenue in the SE ¼ Section 19 Township 100 North, Range 54 West of the 5th Principal Meridian, Turner County. The wetland enhancement portion of this project is in 30 Township 100 North, Range 54 West of the 5th Principal Meridian, Turner County.

b. Summary of Dam and Enhancement Site

The Wieman Dam project is located on both the north sides of 271st Street. The portion of the project that is directly impacted by the dam is in Section 19. The down stream existing wetland is south of 271st Street in Section 30..

The Dam is located on the north side of the 271st in Section 19. The dam will be constructed in a "V" shaped valley of an unnamed tributary of the Vermillion River. The unnamed tributary of the West Fork of the Vermillion River north of 271st. The unnamed tributary is a prairie bed and bank stream with associated wetland on either bank. This unnamed prairie stream has deep incisions three to four feet deep with near vertical sides. This deeply cut channel effectively drains the land on either bank reducing or eliminating the hydrologic conditions need to sustain wetlands on the bank of the stream. The length of this stream segment is 4,125 linear feet. The valley in this part of the unnamed tributary is a "V" shape valley with steep slopes. This unnamed tributary also has minor drainage from the east located in the southeast quadrant of the site. This minor drainage is also part of a smaller "V" shape valley that has a steep grade that allows water to pass through at relatively fast rate. No wetland vegetation was observed in this drainage.

The unnamed tributary crosses 271st Street through a 8'x 8' concrete culvert (photo 1) The unnamed tributary of the Vermillion River changes from an in-trenched stream in a "V" valley to a wider valley with a flood plain at 271st Street. This tributary meanders for approximately 2,100 to an old dam that has been breached (photo 2). The entrenchment of the southern reach of the unnamed tributary varies from one to three feet deep. The wetland south of 271st Street is a meandering stream with 3.5 acres of wetland on either side of the unnamed tributary.



Photo 1 Box Culvert under 271st Street (April 2005)

The attached Topeka Shiner assessment report by Steve Wall indicates this unnamed tributary is generally an unstable tributary. This unstable condition is evident by the large amount degradation that is occurring. Mr. Wall saw bank stumpage, undercutting, incision, and stream undercutting throughout the study area.

2) **BASELINE INFORMATION**

a) **Location**

- i) The Wieman Dam will be located in the Southeast Quarter of Section 19, Township 100 North, Range 54 West of the 5th Principal Meridian, Turner County, South Dakota. The wetland enhancement site is located in Northeast Quarter of Section 30, Township 100 North, Range 54 West of the 5th Principal Meridian, Turner County, South Dakota.

b) **Classification and Quantification of Resources**

- i) The dam north of 271st Street is impacting an unnamed tributary to the West Fork of the Vermillion River. This unnamed tributary is a degraded prairie bed and bank stream. The unnamed tributary is 4,125 feet long. The wetland associated with this unnamed tributary is in the south 730 feet of the tributary. The wetland in the dam portion of the project is 0.35 acre. The dominate vegetation in this wetland is Reed Canarygrass. This wetland

begins at the or near where the soil type changes from Ethan to Betts soil type. Neither of these soils are hydric soils. This wetland is on the bank of the unnamed tributary and is a temporarily flood wetland that is drained by the degraded channel. The wetland is dominated by Reed Canarygrass which is an invasive FACW+ grass with a conservation value of zero which indicates this is wetland with little value. This is a poor quality wetland.

- ii) The wetland south of 271st Street is also adjacent to the unnamed tributary. The unnamed tributary is a meandering stream with 3.5 acres of wetland on either side. The stream is 2,100 feet long. The National Wetland Inventory Map indicates there are two wetland south of 271st Street. The northern most is PEMC which is a Palustrine Emergent Seasonally Flooded wetland. The second wetland is a PABFh which is a Palustrine Aquatic Bed Semi-permanently Flooded dike / impoundment. Since the NWI this dike / dam has been breached. Since the breach, the aquatic bed wetland has been drained and the stream has cut a trench for its channel through the entire site. This channel varies in depth up to two feet deep. The Mr. Mitzel from the SD Regulatory of the Corps of Engineers did a wetland delineation of this site in 2004. In his determination found that there is 3.5 acres of wetland and it is dominated by Reed Canarygrass.
- iii) Wetland 1 is the PEMC wetland and is the first wetland located south of 271st Street. This wetland is a palustrine emergent seasonally flooded wetland with a hydrolologic zone IV (table 5, 87 manual) seasonally inundated or saturated 12.5 to 25% duration for the growing season, which equals 19 to 38 days in Turner County, SD.



Photo 2 Meander of wetland 1 flowing south from the box culvert (April 2005)

- iv) Wetland 2 is PABh wetland and is south of wetland 1. This wetland is directly behind the breached dam. NWI wetland identifier for this wetland is PABh, which means this wetland is palustrine aquatic bed, dike. However, since the breach in the dam is 9' wide, the outflow of the breach is equal to the inflow of this wetland. Therefore, the current condition of wetland 2 is not an aquatic bed. The vegetation indicated this wetland has changed to a drier wetland such a seasonally flooded well-drained wetland. An erosive channel is forming in this wetland. This channel is draining this wetland. Photo 3 below is looking south through the trees at the breach in the old dam. The entrenched channel is caused can also be seen in this photo.



Photo 3 This photo shows the channel meandering through wetland 2. In the background, the breach in the dam /dike is visible. The cutting action of the water erosion and elevation change can be seen at the breach. (April 2005)

c) **Existing hydrology**

- i) The dam's watershed is 1,613 acre watershed.
- ii) The portion of the watershed between the dam and the breached dam is approximately 12 acres.
- iii) There is no indications that there any other ground water source other than seasonal sources associate with the local soil types.

d) **Existing vegetation**

- i) North of the 271st Street the dominate species consists of upland grasses.
- ii) The dominate species in the fringe wetland of the unnamed tributary is Reed Canarygrass.

e) **Existing soils**

- i) Within the unnamed channel there are two soils types. EsD Ethan is located in the northern portion of the channel north of 271st Street. EsD soil type extends to about the half way mark of the unnamed tributary. BhE (Betts) soil type begins and continues south pass the breached dam in section 30. Neither of these soils are classified as hydric soils.

f) **Existing wildlife usage**

- i) An Assessment of the Potential Impacts of the Proposed Dam of an Unnamed Tributary of the West Fork of the Vermillion River to the Endangered Topeka Shiner (*Notropis Topeka*) was completed by Steven K. Wall and Sheila Thomson. No Topeka Shiner were found in the study area. The Wall study findings were that the proposed dam may affect but not likely to adversely affect the Topeka Shiner. It is recommend the following be done to minimize the potential impacts:

- (1) Stocking of sport fish in the impoundment that are:

- (a) Native to eastern South Dakota within the Topeka Shiner range such as yellow perch and walleye
- (b) Fish that are non-predatory to the Topeka Shiner

- (2) Construction of a spillway at the dam site to ensure contribution of water to downstream reaches during precipitation events. A continuous flow of water is not necessary because it does not currently exist.
- (3) Vegetate riparian area with native trees and shrubs to improve bank stabilization, reduce overland flow, and remove sediments, chemicals and other toxins to reduce siltation rates and improve water quality for both the impoundment and downstream reaches.

- ii) The site provides habitat and forage for typical upland species in agricultural lands.

g) **Historic and current land use**

- i) Current land use for the impoundment and the downstream wetland is pasture and hay land.

h) **Current owner**

- i) North of 271st Street (dam)
SE ¼ Section 19 Township 100 North, Range 54 West
Marlo Wieman
PO Box 135
Marion, SD 57043
- ii) South of 271st Street (enhancement)
NE1/4 Section 30 Township 100 North, Range 54 West
Robin R Schmidt
PO Box 147
Marion, SD 57043

i) **Watershed/surrounding land use**

- i) Adjacent land use to the north is agricultural and rural residential.

3) **SITE SELECTION AND JUSTIFICATION**

a) **Site-Specific Objectives**

i) **Dam**

- (1) The first objective is to create a deep water fish habitat by creating a dam on the unnamed tributary of the West Fork of the Vermillion River.
- (2) Impoundment will have varying water depth for sport fish habitat.
- (3) Enhance the side slopes of the impoundment will be planted with Facultative and Facultative Wetland and Obligate (wetland) species that will tolerate the fluctuation in the water elevation of the lake.
- (4) The wetland enhancement of the impoundment side slopes will provide approximately 5.18 acres of facultative wetland and facultative vegetation above the 1433 elevation (normal elevation of the impoundment).
- (5) There will be approximately 2.42 acres of facultative wetland and obligate wetland species below the 1433 elevation. This of portion of the impoundment will be continually inundated or saturated.
- (6) This wetland band around the impoundment will provide habitat for wildlife, improve water quality, and provide shoreline protection once the vegetation is established.
- (7) The planting plan also includes tree planting along the bank at select locations. Once these trees mature they will provide and improve habitat for both aquatic and terrestrial wildlife.
- (8) The emergency spillway will be vegetated and the slope of the spill is 3% grade.
- (9) The normal pool elevation of the impoundment will be an elevation of 1433. All rain events that will increase the pool elevation over 1433 will flow to the wetland south of 271st Street. See planned hydrology section for a more detailed explanation.

ii) **Wetland south of 271st Street**

- (1) Enhance the existing down stream wetland south of 271st Street by temporarily holding water to create a seasonally flooded wetland behind the existing dike.
- (2) The existing wetland south of 271st will be to enhance the wetland by plugging the breached dam. Modifications to the breached dam with gabion baskets and matting will reduce the erosion which is occurring at the dam. The gabion baskets will partially plugged the existing breach. The baskets will be to feet above the existing toe of the dam. Gabion baskets were chosen for this system because they are porous will allow water flow through the structure at a slower rate.

- (3) The side slopes of the breach dam will be widened and protected with gabion matting to allow high flows to cross the breach without the erosive effect that is occurring currently. The gabion matting is placed on the side slope to control erosion.
- (4) Smaller gabion structures will be placed at three severely eroded locations in the stream channel of the unnamed tributary. These small structures will serve as check dams to reduce the degradation of the channel. Photo 4 shows how the channel is in an entrenched condition and is draining the wetland.
- (5) Placing these small check dams in the channel will slow the velocity of water of small events allowing pooling of water behind the check dams.
- (6) The gabions will also allow a slower continual release of water downstream reducing erosion of the channel and extending the saturation of the soil downstream and upstream of the gabion.
- (7) Holding the water for an extended period of time will allow sedimentation behind the gabion improving the water quality of the unnamed tributary.
- (8) In addition to the water quality aspects of these gabions the small pools of water will provide shallow water habitat for various aquatic species. One species that will potentially be found in the small pools is Topeka Shiner.



Photo 4 Typical condition of the stream where a gabion will be placed (April 2005)

north of the breached dam.

4) ENHANCEMENT WORK PLAN

a) Construction methods

- i) Grading of the banks of the impoundment area adjacent to the dam structure will consist of using earthmovers, bucket loaders, bulldozers and skid steers.
- ii) The banks of the impoundment areas north of the dam structure will not be graded. The work will consist of preparing a seed bed between 1430 and 1438 contours. This work will be done using tractor with tillage equipment and no-till native grass seeder.
- iii) The enhancement area south of 271st Street will consist of installing gabion type weirs in the entrenched channel of the unnamed tributary. This work will consist of excavating a trench perpendicular to the channel. This trench will extend two or three feet beyond the channel banks. This work will utilize backhoe and trucks to haul the material to the site.
- iv) Repair to the breach at the dam will consist of placing gabion baskets and mats to plug the breach and to protect the side slopes from high flow events. This work will be done with backhoe, small dozer, bucket loaders, skid steer, trucks for hauling material, tractor with tillage and no-till native planter for seeding.
- v) The erosion control measures will consist of straw mulch, and annual grass cover crops (such as annual rye or oats).

b) Planned hydrology

- i) The watershed for the Wieman Dam project is 1,613 acres. The planned hydrology is 1,613 acres.
- ii) The water budget for the wetlands south of 271st Street consists mostly of pass through water. The existing control structure north of the wetlands is the 8'x8' box culvert that is under 271st Street. After the water passes through the box culvert it spreads out into a wide shallow meandering channel for approximately 1,980 feet to the breach in the dam.
- iii) The southern reach of the unnamed tributary has two surface water sources. The first is the area south of 271st Street and is approximately 12 acres. This area will continue to contribute to the enhancement area prior to the construction of the dam.
- iv) The dam's predicted normal water elevation of is 1433. The surface area at this elevation is 11.5 acres. One hundred percent of any rain event will runoff through the primary spillway to the wetland enhancement site south of 271st Street. This occurs because the water surface is an impervious surface. This condition will add more water to the down stream in relationship to the rain event.
- v) The dam's primary spill way is a 36" pipe with a box inlet structure is sized up for a 10 year event. Under normal full conditions this structure will allow all events to pass through as normal 10 years events. Thus having minimal impact to pre-dam conditions. The pre-dam/existing conditions turbulent events have breached the down stream dam. Ten year events will overflow to vegetative spillway. The vegetated spillway will have sheet down its 45 feet wide channel with 3 to 1 slopes. This water will enter a plunge pool to dissipate the energy at the outflow of each of the spillways.

c) **Planned vegetation**

- i) Once the impoundment is full the water regime will change from an upland condition to a saturated condition. To help prevent erosion and to facilitate the change in the new bank condition a wetland plant mix will be planted that will tolerate fluctuations in water level.
- ii) No new planting will occur in the wetland enhancement area south of 271st Street. The rationale for not changing the vegetation type is to minimize the site exposure to soil erosion.
- iii) All newly created and disturbed areas shall be seeded to protect against erosion. The planting mix for the newly established wetland has an FQI of 20. It is anticipated that other wetland species will be introduced into the wetland by nature. It is understood that not all species in this proposed mix will survive. The FQI of the planted portion of this site will likely range between 15 and 20. The proposed Wetland Mix species are listed below:

Scientific name	Common name	Indicator		
		Status	Habit	C-Value
1 Andropogon gerardii	Big Bluestem	FACU	PNG	5
2 Aster novae-angliae L.	New England Aster	FACW	PNF	8
3 Elymus virginicus	Virginia wild rye	FAC	PNG	4
4 Eupatorium maculatum	Spotted Joe-pye weed	FACW	PNF	9
5 Eupatorium perfoliatum	Boneset	OBL	PNF	9
6 Fraxinus pennsylvanica	Green ash	FAC	NT	5
7 Glyceria striate	Fowl manna grass	OBL	PNEGL	6
8 Lobelia siphilitica	Blue Lobelia	OBL	PNF	7
9 Panicum virgatum	Switch grass	FAC	PNG	5
10 Populus deltoides	Plains cottonwood	FAC	NT	3
11 Scirpus atrovirens	Green Bullrush	OBL	PNEGL	5
12 Spartina pectinata	Prairie Cord grass	FACW	PNG	5
Sum				71
C=Sum C/N				6
FQI=C(SQTRT N)				20

d) **Planned soils**

- i) Existing topsoil will be stripped from the disturbed wetland areas and stockpiled separately on-site to be replaced in the enhancement wetland areas once grading is complete. The "A" horizon varies from 0 inches to 10 inches. The B horizon varies in depth from 8 inches to 40 inches. Re-using the "A" horizon soils with existing organic matter and the addition of straw mulch for erosion control aids soil characteristics that will provide a seed bed for wetland vegetation.
- ii) Although the Betts and Ethan soils are not ideal wetland soils additional organic matter and saturation will change these soils over time. The existing Betts soils in the

lower 730 feet of the unnamed tributary of the dam site have hydric soil characteristics.

5) SITE MAINTENANCE

- i) The maintenance plan for the site will consist of the monitoring and repair of erosion control devices and replanting or replacing vegetation.
- ii) During the establishment period the site will be inspected for weeds monthly during the growing season.
- iii) Vegetation will be clipped to a height of 8 to 12 inches as needed until
- iv) Invasive species control will utilize chemical or mechanical methods. The standards for weed control will generally follow the policies and practices in use by NRCS Conservation Reserve Program (CRP).

6) MONITORING PLAN

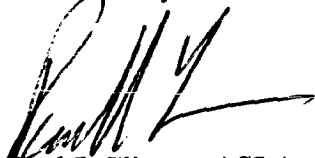
- i) The owner is responsible to hire a qualified individual or consultant to complete wetland monitoring.
- ii) Monitoring data will be collected annually and reported to the South Dakota Regulatory Office, US Army Corps of Engineers, 28563 Powerhouse Road, Room 118, Pierre, SD 57501. The standard for accepting the wetland enhancement is the Corps of Engineers 1987 Wetland Delineation Manual, and field experience in wetland enhancement monitoring. The first annual report and consecutive reports will be due to the South Dakota Regulatory Office November 30th of each year. Submission of annual monitoring reports will be to the South Dakota Regulatory Office, for up to 5 years or until the enhancement is accepted in writing by the Corps of Engineers, Omaha District.
- iii) Monitoring will consist of establishing transects and photo points for each of the wetlands in the development. Sampling of vegetation, soils and hydrology will occur along the identified transects. The goal of the monitoring is to determine that the enhancement site meets the three standard criteria for wetlands: hydrophytic vegetation, wetland hydrology and hydric soils. Monitoring as part of the annual report will occur during the months of September and October.

7) ADAPTIVE MANAGEMENT PLAN

- i) Potential management challenges of this site are invasive species. Weeds or invasive species control will utilize one of the following three methods: mechanically, chemically or manually. The method will be determined based on the location, species and season. The standards for weed control will generally follow the control weeds policy and practices in use by NRCS Conservation Reserve Program (CRP).
- ii) Remedial measures for the modifications of performance standards. The key players for this site are the landowner, Corps of Engineers, and project engineer. The landowner, project engineer and SD Regulatory Office of the Corps of Engineers shall jointly agree to

all changes to performance standards or remedial measures taken on this site. The landowner to point of contact is Marlo Wieman. Paul Clinton of Dakota Land Surveying & Engineering is the wetland consultant land project point of contact. All other federal or state agency comments or correspondence will go through and be reviewed by the SD Regulatory Office of the US Army Corps of Engineers. Remedial measures could include but not limited to over seeding, and/or plugging of plant material.

Submitted By:

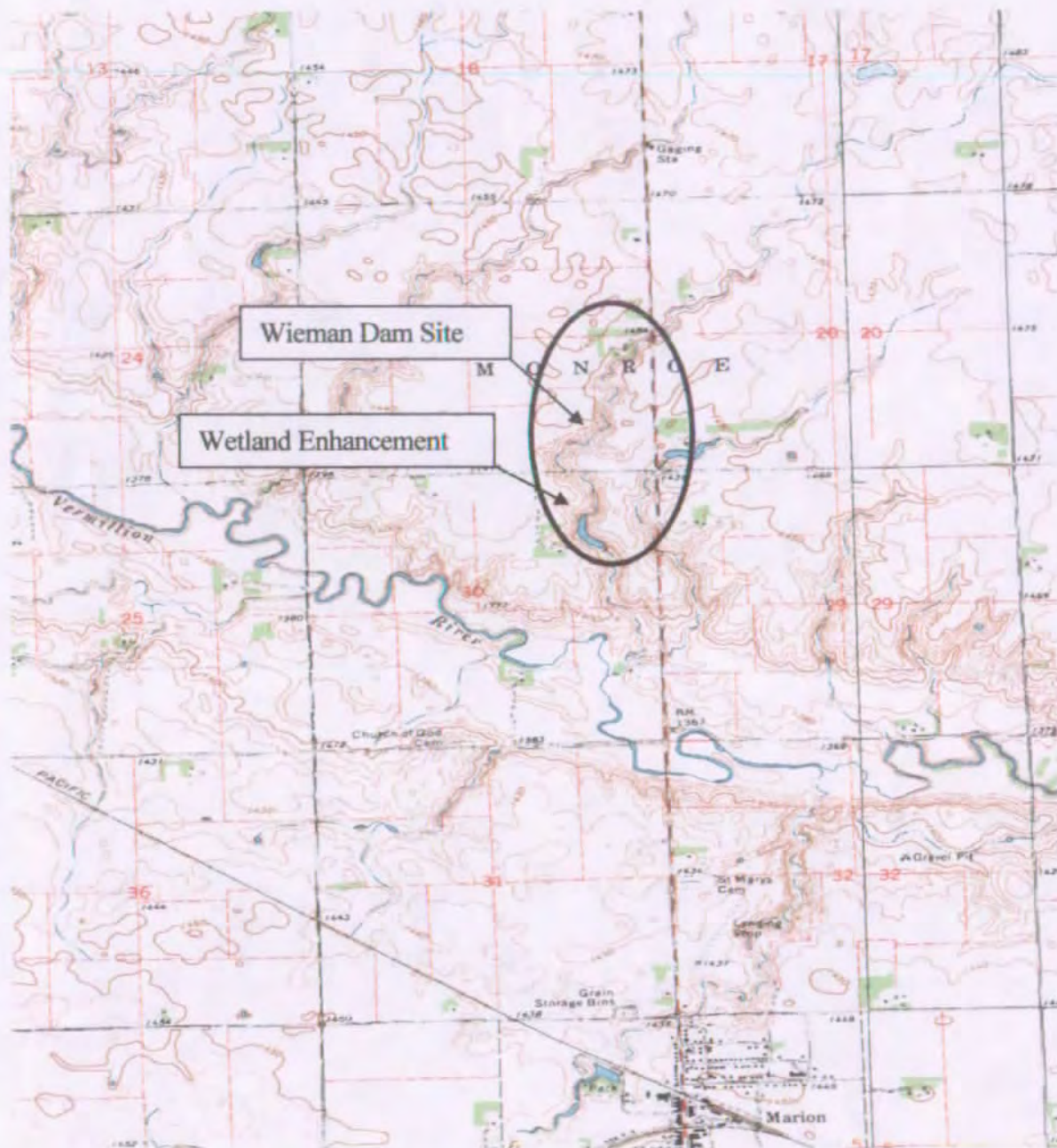


Paul J. Clinton, ASLA
Landscape Architect

Attachments:

- 1) USGS Map,
- 2) 2004 County FSA Air Photo
- 3) 2003 County FSA Air Photo
- 4) County Soil Survey
- 5) Topeka Shiner Assessment
- 6) Corps of Engineers Wetland Delineation

Attachment 1
USGS Quad Marion, SD 1990



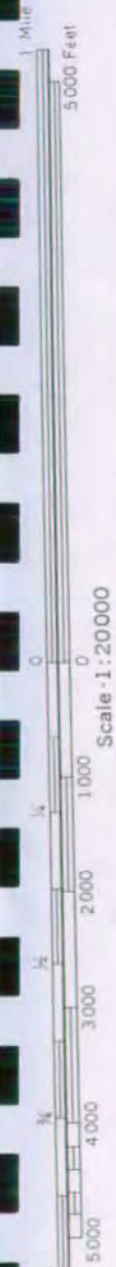
Attachment 2
2003 FSA Air Photo



Attachment 3
2004 FSA Air Photo



(Joins sheet 2)



(Joins sheet 7)



(Joins sheet 13)

2 815 000 FEET

**Assessment of the Potential Impacts of a Proposed Dam on an
Unnamed Tributary of the West Fork of the Vermillion River
to the Endangered Topeka Shiner (*Notropis topeka*)**

June 5, 2006

Prepared For:

Mr. M. Wieman
and
Clark Engineering

CLARK ENGINEERING
CORPORATION

JUL 03 2006

SIOUX FALLS, S.D.

Prepared By:

Sheila K. Thomson
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List of Abbreviations

dd – decimal degrees	BIS – bigmouth shiner
m – meters	BRM – brassy minnow
mm – millimeter	BRS – brook stickleback
cm/s – centimeters per second	CNS – common shiner
" – inch	CRC – creek chub
P – pool	FHM – fathead minnow
RU – run	GSF – green sunfish
RI – riffle	OSF – orange-spotted sunfish
BS – bank slumpage	RES – red shiner
IB – bank incision	SAS – sand shiner
UB – bank undercutting	STR – central stoneroller
OV – overhanging vegetation	TOS – Topeka shiner
GR/F – grasses/forbes	R – stream reach
WR – riparian woody vegetation	WD – woody debris
EV – emergent vegetation	
SV – submergent vegetation	
FA – filamentous algae	
S/C – silt/clay	
Sa – sand	
Gr – gravel	
Co – cobble	
Bo – boulder	

Introduction

Problem Statement

A proposal to construct an impoundment by damming an unnamed tributary to the West Fork of the Vermillion River (Figure 1) has caused concern as to the effect this structure may have on the Topeka shiner, a federally endangered species. Topeka shiners inhabit the West Fork of the Vermillion River and have been found in its headwaters. Although the unnamed tributary where dam construction has been proposed is classified as "low-probability" to support the Topeka shiner (Wall et al. 2001), the species has been found in similar "low-probability" tributaries within its range. Construction of impoundments on streams inhabited by Topeka shiners were correlated to decreased numbers of the species and in some cases extirpation of local meta-populations (Layer 1993; Mammoliti 1995; Stark et al. 1999; Winston 1999; Schrank et al. 2001). Cause and effect have not been established, but it has been suggested that altered habitat, barriers to migration, altered hydrology, and the introduction of exotic piscivores (i.e. largemouth bass) may be the cause of the local extirpations. The purpose of this study was to determine the potential use of the tributary by Topeka shiners and possible impacts the proposed dam may have on this species. Specific objectives of this study were to: 1) Sample stream reaches to determine the presence or absence of the Topeka shiner in this tributary; 2) Conduct habitat surveys to determine potential use of the tributary by Topeka shiners; and, 3) Assess accessibility of the tributary by Topeka shiners inhabiting the mainstem of the West Fork of the Vermillion River.

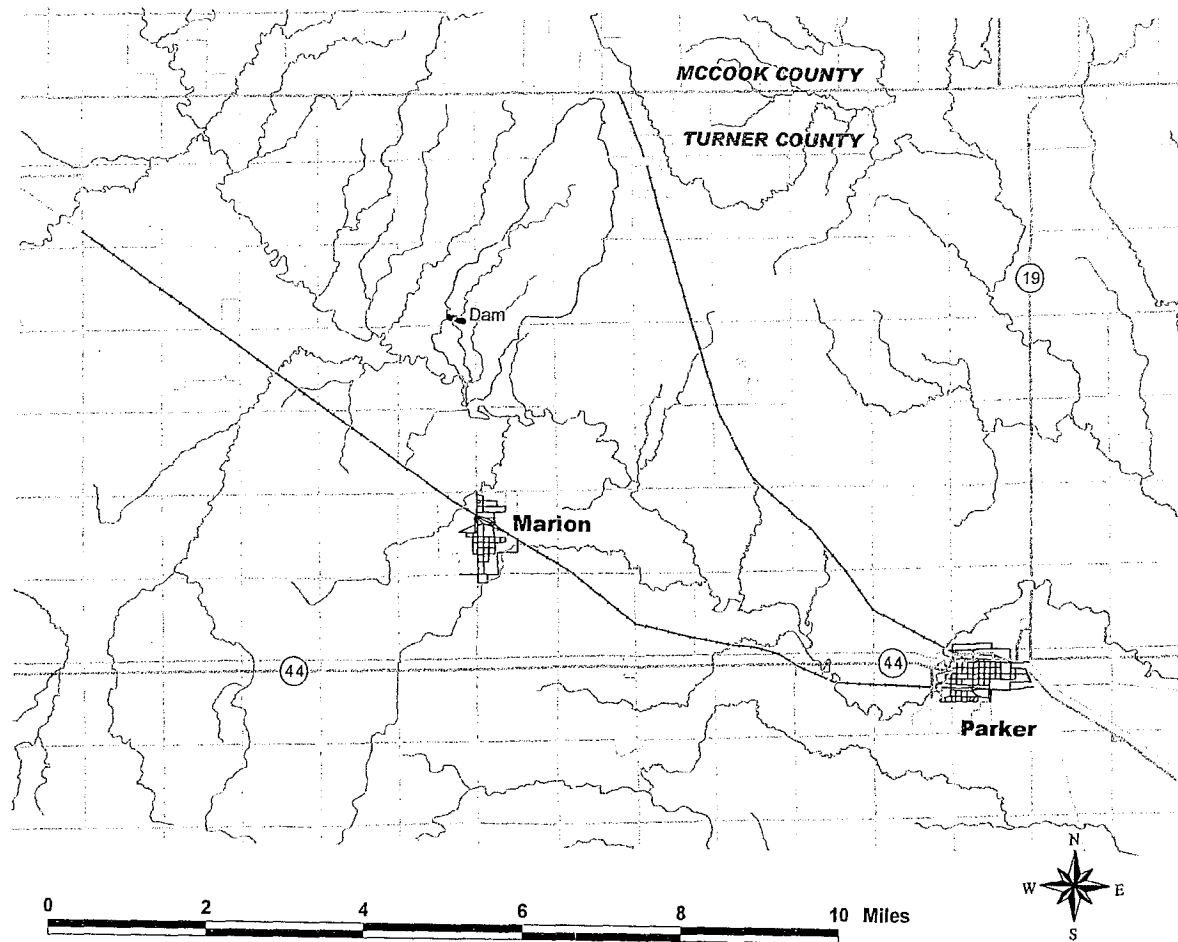


Figure 1. Location of proposed dam on an unnamed tributary to the West Fork of the Vermillion River. Gray area indicates tributary watershed.

Topeka shiner

The Topeka shiner is a small Cyprinid found in six states: South Dakota, Minnesota, Nebraska, Iowa, Kansas, and Missouri (Bailey and Allum 1962). It has a three-year life expectancy (Cross and Collins 1995; Pflieger 1997) and reaches a maximum length of approximately 75 mm (Hatch 2001; Shearer 2003; Wall and Berry 2004). Characteristics of the Topeka shiner include a dusky lateral band, a dark wedge-shaped caudal spot, prominent pigmentation outlining scales above the lateral line, and

crowding of the dorsal scales posterior to the head (Wall and Berry 2004). Breeding males have orange-red colored fins and a copper-hue to their heads.

Topeka shiner habitat includes pools of low order streams (Kerns and Bonneau 2002; Minkley and Cross 1959; Wall and Berry 2004) and clear, vegetated backwaters (Kiutinen 2001) with substrates varying from gravel and sand to silt-covered hardpan clay (Minckley and Cross 1959; Wall and Berry 2004). The Topeka shiner is intolerant of high velocity water and resorts to oral grasping to avoid being swept downstream in strong currents, although flows > 55 cm/s likely exceed the Topeka shiner's ability to grasp and maintain their position within stream reaches (Adams et al. 2000).

The Topeka shiner was listed as federally endangered in 1999 due to an 80% reduction across its historical distribution (Wall and Berry 2004). Reasons for the species' decline include altered stream hydrology and reduced water quality due to wetland drainage, stream channelization, tiling, groundwater withdrawal, and water impoundment (Wall and Berry 2004). Largemouth bass (a non-native predator) has also been linked to local extirpation of Topeka shiner populations (Schrank et al. 2001), although Knight and Gido (2005) found that largemouth bass opportunistically (rather than preferentially) feed on the Topeka shiner.

Methods

Fish Community

Reconnaissance surveys of the tributary above and below the proposed dam were conducted to select suitable sample sites. To maximize our ability to detect Topeka shiners in the tributary, we used statewide data from records at South Dakota State University (SDSU), of the prevalence of Topeka shiners in streams and determined that, if present, Topeka shiners were detected on average in one out of 10 reaches sampled within a stream (S. Wall; unpublished data). Applying detection probabilities (i.e. the number of samples to catch a target fish at the same site; Hayer et al. 2006) to the SDSU data showed that Topeka shiners were captured in a stream reach on average within three sampling efforts. Basing our sampling effort on this data, 10 stream reaches (Table 1; Appendix A) were sampled and were numbered 1 through 10 from downstream to upstream (Figure 2). Reach lengths were based on 40 mean stream widths measured

Table 1. The latitudes (dd), longitudes (dd), and lengths (m) of the 10 stream reaches sampled.

Reach #	DOWNSTREAM		UPSTREAM		Length (m)
	Latitude	Longitude	Latitude	Longitude	
1	43°26.894'	97°15.849'	43°26.957'	97°15.787'	170
2	43°27.002'	97°15.749'	43°27.064'	97°15.745'	170
3	43°27.120'	97°15.800'	43°27.177'	97°15.825'	170
4	43°27.306'	97°15.860'	43°27.362'	97°15.925'	170
5	43°27.395'	97°15.919'	43°27.460'	97°15.882'	170
6	43°27.562'	97°15.982'	43°27.615'	97°15.962'	150
7	43°27.644'	97°15.947'	43°27.652'	97°15.870'	150
8	43°27.675	97°15.865'	43°27.730'	97°15.837'	150
9	43°27.773	97°15.816'	43°27.823'	97°15.835'	150
10	43°28.028	97°15.605'	43°28.074'	97°15.554'	150

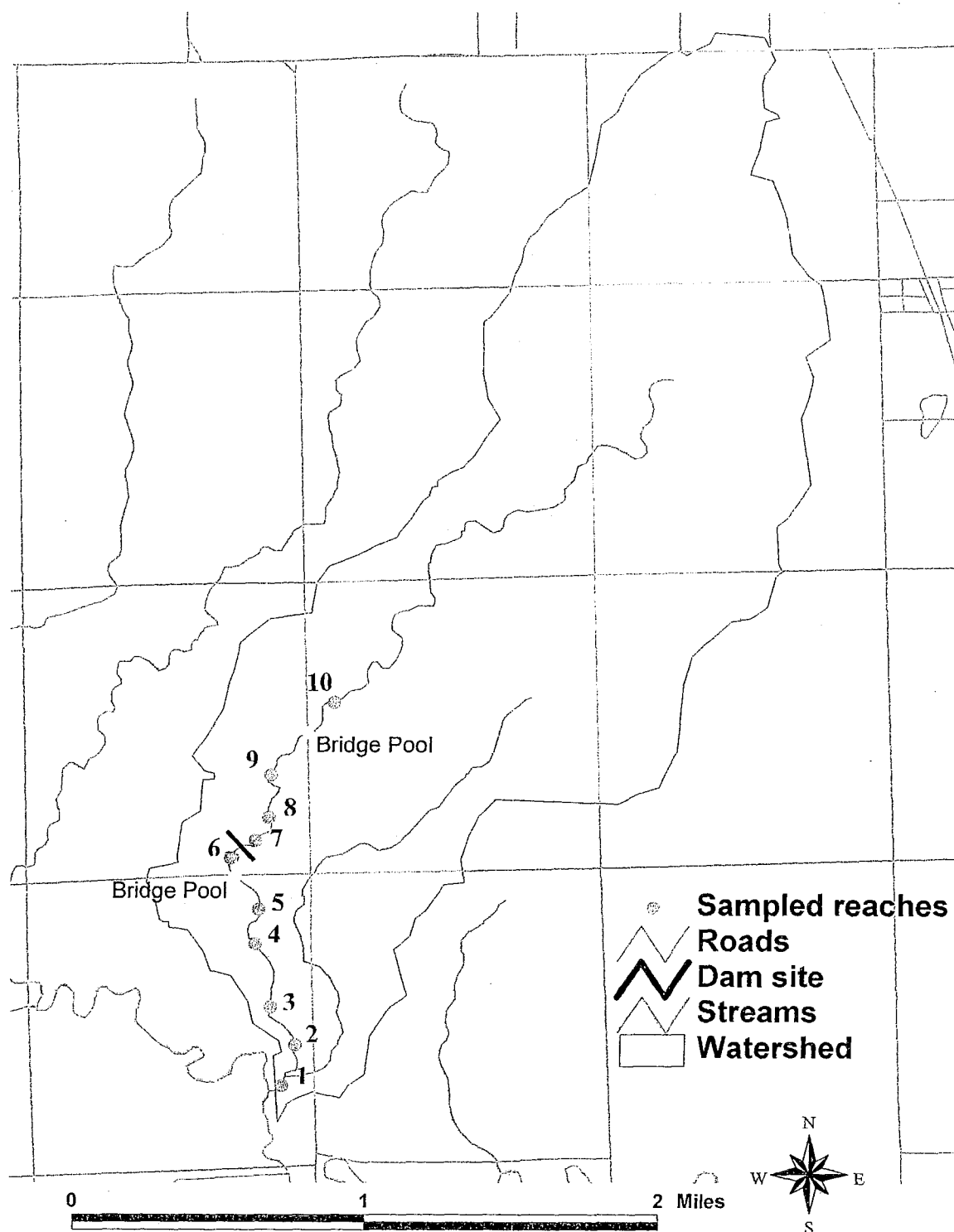


Figure 2. Location of sampled reaches (red) and bridge pools (yellow).

from bankfull to bankfull, with a minimum reach length of 150 meters. In addition, two pools located under bridges were sampled (Figure 2). If Topeka shiners were not found during initial sampling, then stream reaches were sampled an additional two times (over a 3-week period) to account for detection probability. Sampling took place early to mid-May when the stream was likely to contain the most water. The watershed above Reach 10 was dominated by row-crop agriculture (Figure 4) where the stream was plowed under and no longer discernable, making Reach 10 the furthest sampled upstream site. Stream reaches were sampled for fishes using a 3/16" mesh seine, and all captured fish species were identified, recorded, and released on site.

Habitat

The following habitat variables were assessed for each reach:

1. macrohabitat - pool, run, riffle;
2. stream banks – bank slumpage, bank incision, bank undercutting, overhanging vegetation;
3. riparian zone – grasses/forbes, sedges, woody vegetation;
4. aquatic vegetation – emergent vegetation, submergent vegetation, filamentous algae;
5. substrate composition – silt/clay, sand, gravel, cobble, boulder;
6. instream woody debris;
7. % wetted and dry stream

Habitat variables 2 – 6 were quantified according to the following categories:

0 – 0%

1 – >0 - 10%

2 – 10 - 40%

3 – 40 - 75%

4 – 75 - 100%

Results

Fish Community

A total of 12 fish species were found within the ten sampled reaches (Table 2; Appendix B). All species were found downstream of the proposed dam location, whereas only two species were found upstream of the proposed dam site.

Two stream reaches (1 and 3) contained the Topeka shiner. Reach 1 was the furthest downstream reach that directly adjoins to the West Fork of the Vermilion River (Figure 2) and contained the highest number of Topeka shiners (180). The majority of the Topeka shiners occurred at the junction of the tributary with the West Fork. Seven other fish species were found within the same reach: bigmouth shiner, brassy minnow, common shiner, fathead minnow, orange-spotted sunfish, sand shiner, and red shiner. Reach 3 contained 43 Topeka shiners and five other species: brassy minnow, common shiner, creek chub, fathead minnow, and green sunfish. All remaining reaches (2, 4-10) were sampled three times; no Topeka shiners were found. No Topeka shiners were found in the pools located under the bridges.

Reaches 1 and 3 had the highest species richness, with eight and six species, sequentially (Figure 3). Reaches 6 and 7 had the lowest richness, with no fish species present. Only low abundances of fathead minnows and green sunfish were found in the three upper-most reaches (Table 2).

Table 2. The presence/absence of each fish species within each stream reach. Abbreviations: spp = fish species; BIS = bigmouth shiner; BRM = brassy minnow; BRS = brook stickleback; CNS = common shiner; CRC = creek chub; FHM = fathead minnow; GSF = green sunfish; OSF = orange-spotted sunfish; RES = red shiner; SAS = sand shiner; STR = central stoneroller; TOS = Topeka shiner; R = reach; + = fish presence; # spp. = total number of species found in each reach.

<i>Spp.</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
BIS	+									
BRM	+	+	+	+	+					
BRS					+					
CNS	+		+							
CRC		+	+							
FHM	+	+	+	+	+			+	+	+
GSF			+		+			+	+	
OSF	+									
RES	+									
SAS	+									
STR		+								
TOS	+		+							
# Spp.	8	4	6	2	4	0	0	2	2	1

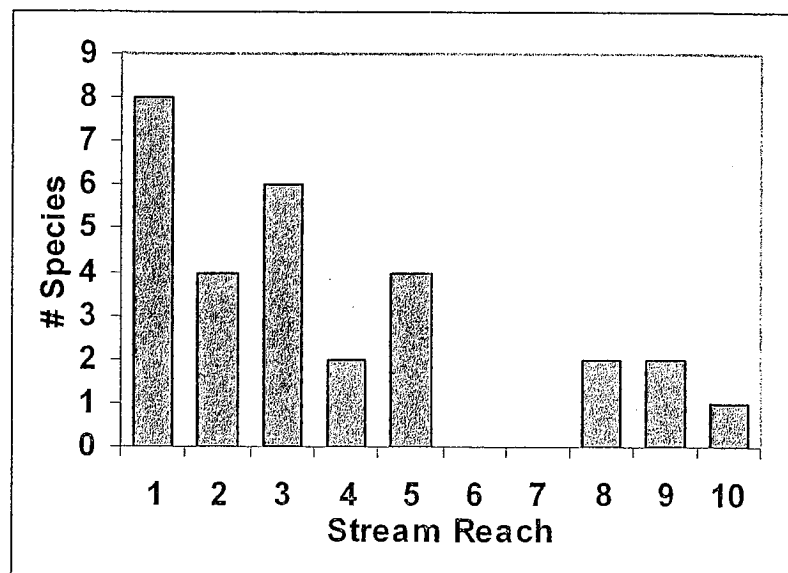


Figure 3. Species richness of each sampled stream reach.

Habitat

It should be noted that habitat was assessed in reaches up to two weeks after sampling for fish. During this time span, portions of many reaches (particularly downstream Reaches 1 and 2 and upstream Reach 10) had dried out in this ephemeral tributary. Water was no longer flowing. Macrohabitats were classified according to geomorphic characteristics and what would have been conditions during water flow. For example, geomorphic characteristics of a riffle were sections of the reach that were shallow (i.e. raised elevations) and contained coarse substrates. Pools were deep sections adjoined downstream to riffles. Runs, although now dry or having some stagnant water, were likely to have a positive water velocity under conditions of normal water flow.

Runs were the most common macrohabitat type of every stream reach, representing 69.9 - 100% of the stream reaches (Table 3). Reaches 5, 6, and 10 were entirely composed of runs. Instream pools were found in 3 downstream reaches and 2 upstream reaches, representing 2.4 - 19.6% of macrohabitats. Riffles were the least common, representing 4.4 - 10.5% of 3 downstream and 2 upstream reaches.

Eight of the 10 reaches had dry segments, ranging from 6.2 - 91.3% of the total stream reach length (Table 3). Reaches 1 (the furthest downstream) and 10 (the furthest upstream) were the driest stream segments sampled.

Extensive bank slumpage, incision, undercutting, and stream downcutting was evident across most stream reaches (Table 4). All reaches had dense overhanging vegetation. Riparian zones were primarily composed of grasses and forbes, with sedges in the 5 downstream reaches, and intermittent woody vegetation. Filamentous algae occurred in every reach, ranging from categories 1 to 3 (i.e. >0 - 75%). Emergent aquatic

Table 3. The percentage of pools, runs, riffles, wetted stream, and dry stream for each stream reach. Note: The percentages in reach #8 do not sum to 100% because a portion of the reach was filled in with bank slumpage and could not be classified.

<i>Variable</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
% Pool	3.5	0	4.4	2.4	0	0	0	12.2	19.6	0
% Run	88.7	92.6	91.3	97.6	100	100	92.4	83.1	69.9	100
% Riffle	4.7	7.4	4.4	0	0	0	7.6	0	10.5	0
% Wet	18.3	43.5	93.8	85.5	75.3	100	93.1	95.3	89.5	8.7
% Dry	81.7	56.5	6.2	14.5	24.7	0	6.9	0	10.5	91.3

Table 4. The estimated categories for habitat variables within each stream reach. Estimations are based on the average of all scores (0-4; Appendix C) obtained within a reach and rounded to the nearest whole number. Abbreviations: R = stream reach; BS = bank slumpage; IB = incised banks; UB = undercut banks; OV = overhanging vegetation; Rip. Zone = riparian zone; GR/F = grasses/forbes; SE = sedges; WR = riparian woody vegetation; Aq. Veg. = aquatic vegetation; EV = emergent vegetation; SV = submergent vegetation; FA = filamentous algae; S/C = silt/clay; Sa = sand; Gr = gravel; Co = cobble; Bo = boulder; WD = instream woody debris. See *Methods* for details on scoring variables.

	<i>Variable</i>	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>	<i>R7</i>	<i>R8</i>	<i>R9</i>	<i>R10</i>
<i>Banks</i>	BS	2	2	4	2	4	4	3	3	1	1
	IB	4	1	4	1	3	4	3	3	2	3
	UB	3	2	2	1	3	3	3	3	1	2
	OV	3	3	3	4	4	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	2	3	2	3	4	4	4	4	4	4
	SE	3	2	4	1	1	0	0	0	0	0
	WR	1	0	1	3	1	0	1	1	1	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0	0	0	0
	SV	1	0	0	0	0	0	0	0	1	0
	FA	2	1	2	3	2	3	2	3	1	2
<i>Substrate</i>	S/C	3	1	2	4	4	4	2	3	3	4
	Sa	2	2	2	0	1	1	1	1	1	0
	Gr	1	3	3	0	1	2	3	2	1	0
	Co	2	1	1	1	0	1	1	1	1	0
	Bo	1	1	0	0	0	0	0	1	1	0
<i>Other</i>	WD	1	1	1	2	4	4	0	1	1	0

vegetation was non-existent, while submergent vegetation was minimal (>0 - 10%), occurring only in Reaches 1 and 9. Substrates were primarily clay or hardpan clay and

silt with sand and gravel. Cobble and boulders were sporadic. Instream woody debris was found in 8 out of 10 reaches, with reaches 5 and 6 containing the most.

Discussion

Topeka shiners were found only in two downstream reaches (1 and 3; Table 2; Appendix B), near the West Fork of the Vermillion River where this species is commonly found (Wall et al. 2001). No Topeka shiners were found in reaches sampled above the proposed dam site. Reaches containing Topeka shiners had the highest species richness of all 10 stream reaches sampled (Figure 3). Fish species commonly associated with the Topeka shiner include green sunfish, orange-spotted sunfish, red shiner, sand shiner, bigmouth shiner, common shiner, and creek chub (Wall and Berry 2006; Minckley and Cross 1959), all of which occurred in one or both of the stream reaches containing the Topeka shiner. Reaches sampled above the proposed dam site contained simple fish communities not typical of those associated with Topeka shiners, which are associated with more diverse communities (Wall and Berry 2006; S. Thomson unpublished data).

Overall, the stream habitat was very unstable as evident by the high proportion of bank slumpage, undercutting, incision, and stream downcutting throughout the tributary (Table 4). In addition, a segment of Reach 8 was completely filled in with bank slumpage (Appendix C). The stream reaches containing Topeka shiners were the only two downstream reaches that contained all three macrohabitat types (pools, riffles, and runs; Table 3). Being a species intolerant of high velocity waters (Adams et al. 2000), Topeka shiners prefer pool habitat, resorting to riffle habitat only in the presence of predators (Kerns and Bonneau 2002; Knight and Gido 2005).

Reach 1 (where most Topeka shiners [180] were found) was desiccated within a week, and did not provide any significant habitat for the Topeka shiner, which likely returned to the mainstem with receding water. The Topeka shiners in Reach 3 were found in two isolated, instream pools. These pools had a constant water depth throughout the three week survey and were likely groundwater fed because no water was flowing from upstream, and these isolated pools were more resilient than those downstream that had dried out. Topeka shiners only inhabited downstream reaches and were not found in reaches above the proposed dam site, likely because the natural high gradient of mid-reaches (Appendix A) and the absence of permanent pools make the mid-upper reaches of this tributary inaccessible and inhabitable by the Topeka shiner.

The north portion of the watershed is dominated by row-crop agriculture (Figure 4) and the natural, headwater, stream channels no longer exist (observed during site reconnaissance). Due to the loss of the stream network, riparian zones, and wetlands that likely existed prior to agricultural development, overland flow with high velocity and excessive sediment loads result (Leopold et al. 1964; Jacobson et al. 2000). This causes extensive disruption and destruction of the stream channel and natural hydrology, creating a highly unstable environment with a high degree of bank slumpage and incision (Schumm 1960). The instability of the stream, riparian zone, and aquatic habitat due to increased water volume, water velocity, and sediment load has reduced habitat quality for Topeka shiners and other stream fishes in downstream reaches. In addition, high sediment loads in the tributary are deposited in the West Fork of the Vermillion River, thus reducing habitat quality for Topeka shiners in this stream also. Reduced water quality due to such activities as wetland drainage, stream channelization, and tiling,

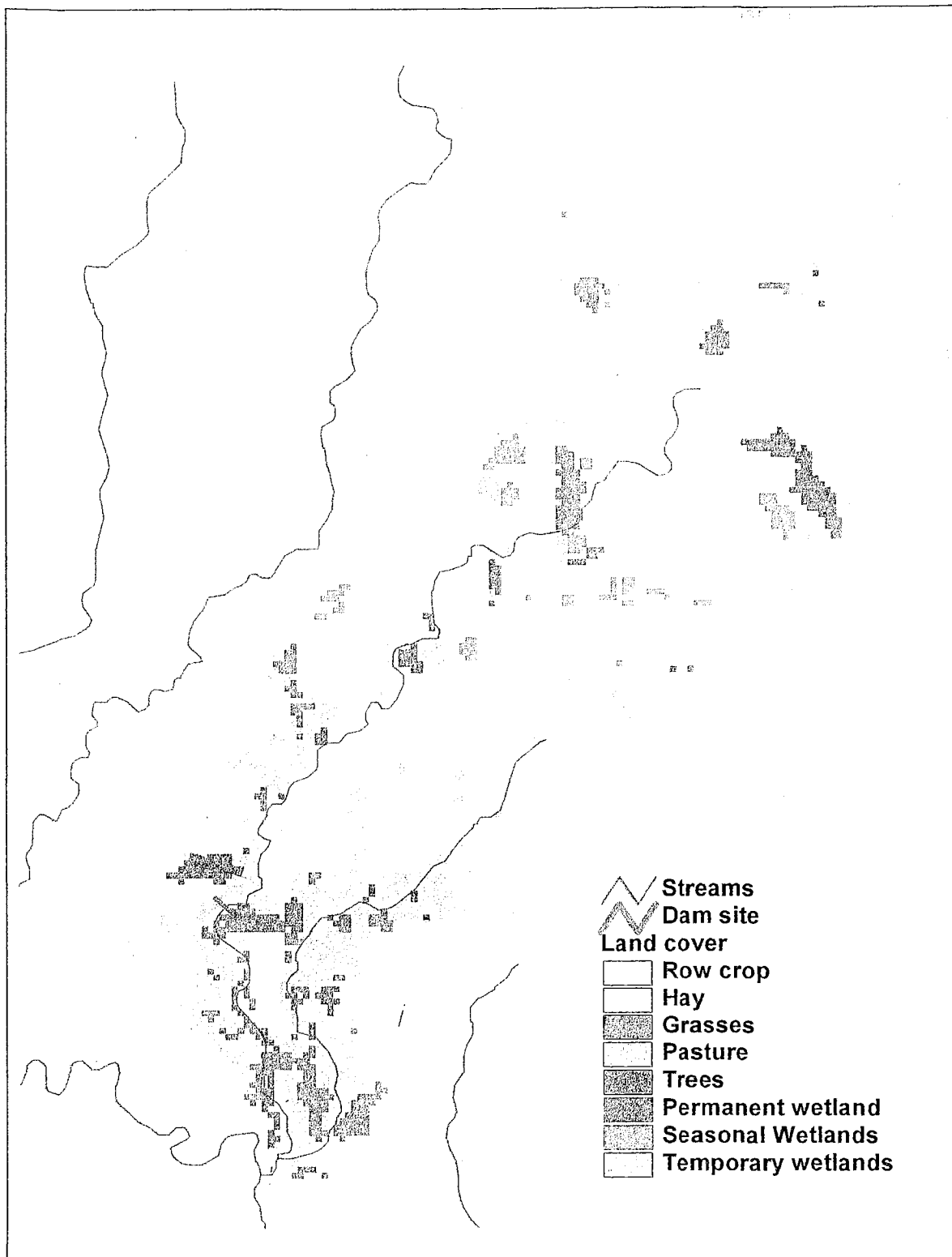


Figure 4. Land cover within unnamed tributary watershed.

has been attributed to Topeka shiner decline in other areas of its distribution (Wall and Berry 2004).

Impoundments have been correlated to the decline, and in some cases, extirpation of local meta-populations of Topeka shiners (Layer 1993; Mammoliti 1995; Stark et al. 1999; Winston 1999; Schrank et al. 2001). Possible impacts caused by impoundments include: 1) barrier to migration upstream and downstream of dam resulting in habitat fragmentation, population isolation and decreased genetic diversity, 2) altered hydrology, and 3) introduction of exotic piscivores that prey upon Topeka shiners and/or cause displacement. In the case of the Wieman dam project, the Topeka shiner was not found upstream of the proposed dam, nor was suitable habitat for the species found, thus eliminating the problem of a barrier and its possible impacts. The hydrology of the stream has already been severely altered by agricultural activities that have essentially wiped out the ability of the upper watershed to retain water and sediment resulting in high velocity water flows as indicated by extensive downcutting, bank incision and bank slumpage. The proposed impoundment could benefit the Topeka shiner and other stream fishes by functioning in a similar manner to previously-existing, headwater wetlands (Shearer 2003). The proposed impoundment may improve overall stream health for both the unnamed tributary and the West Fork of the Vermillion River by: 1) retaining sediments, thus, significantly reducing the sediment load of waters contributing to downstream segments; 2) reducing water volume to segments downstream of the impoundment; and, 3) reducing water velocity to downstream segments, thereby, reducing stream downcutting, stabilizing stream banks, stabilizing riparian zone habitat,

improving water quality, and allowing the downstream segments to return to their natural state.

Summary

The proposed dam may affect but is not likely to adversely affect the Topeka shiner for the following reasons.

1. Topeka shiners were not found in the stream above the proposed dam site, nor in the three stream reaches immediately below the proposed dam site. Our sampling effort was based upon statewide data of the prevalence of Topeka shiners within inhabited streams and detection probability within sites, and should have detected the species if present.
2. Habitat was unsuitable for Topeka shiners above the proposed dam site, and in the three stream reaches immediately below the proposed dam site.
3. Fish community found above the proposed dam site, and in the three reaches immediately below the proposed dam site, was not indicative of Topeka shiner presence.
4. The furthest downstream reach where most Topeka shiners were found was immediately adjacent to the mainstem. This reach dried up within a week and does not provide any significant habitat for the shiner, which likely returned to the mainstem with receding water.
5. Isolated pools downstream of the proposed dam site (Reach 3) where Topeka shiners were found are maintained by groundwater influx and not dependant on surface flows.
6. Stream hydrology has been altered by agricultural activities evident by extensive bank erosion, bank slumpage and downcutting.
7. The proposed impoundment may benefit the Topeka shiner by functioning similar to wetlands that would filter out sediments and restore downstream reaches to a more natural, stable hydrology.

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Appendix A. Photographs of the ten stream reaches sampled from the unnamed tributary of the West Fork of the Vermillion River.



Reach 1 – Downstream



Reach 1 – Dry run



Reach 1 – Upstream



Reach 2 - Downstream



Reach 2 – Upstream



Reach 3 - Downstream



Reach 3 – Upstream



Reach 4 – Downstream



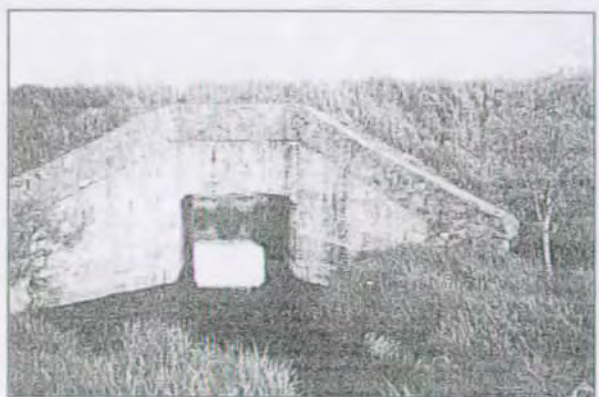
Reach 4 – Upstream



Reach 5 - Downstream



Reach 5 – Upstream



Pool under bridge



Reach 6 – Upstream



Reach 7 – Downstream



Reach 7 – Upstream



Reach 8 – Downstream



Reach 8 – Upstream



Reach 9 – Downstream



Reach 9 – Gradient



Reach 9 - Upstream



Reach 10 – Downstream



Reach 10 - Midreach



Reach 10 – Midreach



Reach 10 – Upstream



Pool upstream of bridge

Appendix B. Aquatic species seined and recorded from each stream reach. Highlighted reaches are those that contained Topeka shiners. Abbreviations: m = meters; spp. = species; BIS = bigmouth shiner; BRM = brassy minnow; BRS = brook stickleback; CNS = common shiner; CRC = creek chub; FHM = fathead minnow; GSF = green sunfish; OSF = orange-spotted sunfish; RES = red shiner; SAS = sand shiner; STR = central stoneroller; TOS = Topeka shiner.

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/5/2006	1	1	10	Seine	BIS
5/5/2006	1	1	10	Seine	CNS
5/5/2006	1	1	10	Seine	FHM
5/5/2006	1	1	10	Seine	OSF
5/5/2006	1	1	10	Seine	RES
5/5/2006	1	1	10	Seine	SAS
5/5/2006	1	1	10	Seine	TOS
5/5/2006	1	2	30	Kick	-
5/5/2006	1	3	5	Seine	-
5/5/2006	1	4	20	Kick	FHM
5/5/2006	1	4	20	Kick	OSF
5/5/2006	1	4	20	Kick	RES
5/5/2006	1	4	20	Kick	SAS
5/5/2006	1	4	20	Kick	TOS
5/5/2006	1	5	15	Seine	BIS
5/5/2006	1	5	15	Seine	BRM
5/5/2006	1	5	15	Seine	FHM
5/5/2006	1	5	15	Seine	OSF
5/5/2006	1	5	15	Seine	RES
5/5/2006	1	5	15	Seine	SAS
5/5/2006	1	5	15	Seine	TOS
5/5/2006	1	6	20	Kick	-
5/5/2006	1	7	30	Seine	FHM
5/5/2006	1	7	30	Seine	RES
5/5/2006	1	7	30	Seine	SAS
5/5/2006	1	7	30	Seine	TOS
5/5/2006	1	8	20	Seine	RES
5/6/2006	2	1	10	Seine	CRC
5/6/2006	2	2	25	Seine	STR
5/6/2006	2	3	25	Seine	BRM
5/6/2006	2	4	30	Seine	CRC
5/6/2006	2	5	40	Seine	FHM
5/6/2006	2	5	40	Seine	CRC
5/6/2006	2	6	25	Seine	-
5/6/2006	3	1	40	Seine	BRM
5/6/2006	3	1	40	Seine	CNS
5/6/2006	3	1	40	Seine	FHM

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/6/2006	3	1	40	Seine	TOS
5/6/2006	3	2	30	Seine	FHM
5/6/2006	3	3	15	Seine	BRM
5/6/2006	3	3	15	Seine	CNS
5/6/2006	3	3	15	Seine	FHM
5/6/2006	3	3	15	Seine	TOS
5/6/2006	3	4	15	Seine	FHM
5/6/2006	3	4	15	Seine	GSF
5/6/2006	3	5	30	Seine	BRM
5/6/2006	3	5	30	Seine	FHM
5/6/2006	3	5	30	Seine	TOS
5/6/2006	3	6	20	Kick	-
5/6/2006	3	7	40	Seine	BRM
5/6/2006	3	7	40	Seine	CRC
5/6/2006	3	7	40	Seine	FHM
5/6/2006	3	7	40	Seine	TOS
5/6/2006	4	1	50	Seine	FHM
5/6/2006	4	2	35	Kick	-
5/6/2006	4	3	25	Kick	-
5/6/2006	4	4	15	Seine	BRM
5/6/2006	4	4	15	Seine	FHM
5/6/2006	4	5	15	Seine	BRM
5/6/2006	4	5	15	Seine	FHM
5/6/2006	5	1	20	Seine	BRS
5/6/2006	5	1	20	Seine	FHM
5/6/2006	5	1	20	Seine	GSF
5/6/2006	5	2	45	Kick	FHM
5/6/2006	5	3	3	Seine	BRM
5/6/2006	5	3	3	Seine	FHM
5/6/2006	5	4	30	Seine	FHM
5/6/2006	5	5	20	Seine	FHM
5/6/2006	5	6	10	Kick	-
5/6/2006	5	7	20	Seine	-
5/6/2006	5	8	20	Kick	-
5/7/2006	2	1	10	Seine	-
5/7/2006	2	2	25	Seine	-
5/7/2006	2	3	25	Seine	-
5/7/2006	2	4	30	Seine	-
5/7/2006	2	5	40	Seine	FHM
5/7/2006	2	6	25	Seine	FHM
5/7/2006	4	1	50	Seine	BRM
5/7/2006	4	1	50	Seine	FHM
5/7/2006	4	2	35	Kick	-

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/7/2006	4	3	25	Kick	-
5/7/2006	4	4	15	Seine	BRM
5/7/2006	4	4	15	Seine	FHM
5/7/2006	4	5	15	Seine	BRM
5/7/2006	4	5	15	Seine	FHM
5/7/2006	5	1	20	Seine	BRS
5/7/2006	5	1	20	Seine	BRM
5/7/2006	5	1	20	Seine	FHM
5/7/2006	5	2	45	Kick	-
5/7/2006	5	3	3	Seine	FHM
5/7/2006	5	4	30	Seine	FHM
5/7/2006	5	5	20	Seine	-
5/7/2006	5	6	10	Kick	-
5/7/2006	5	7	20	Seine	-
5/7/2006	5	8	20	Kick	-
5/12/2006	Pool under bridge			Seine	BRM
5/12/2006	Pool under bridge			Seine	FHM
5/12/2006	6	1	20	Seine	-
5/12/2006	6	2	15	Kick	-
5/12/2006	6	3	25	Seine	-
5/12/2006	6	4	30	Kick	-
5/12/2006	6	5	25	Seine	-
5/12/2006	6	6	30	Seine	-
5/12/2006	7	1	40	Seine	-
5/12/2006	7	2	10	Kick	-
5/12/2006	7	3	10	Seine	-
5/12/2006	7	4	20	Seine	-
5/12/2006	7	5	10	Kick	-
5/12/2006	7	6	15	Seine	-
5/12/2006	7	7	20	Seine	-
5/12/2006	7	8	20	Kick	-
5/12/2006	7	8	20	Kick	-
5/12/2006	8	1	35	Seine	-
5/12/2006	8	2	10	Seine	-
5/12/2006	8	3	15	Seine	-
5/12/2006	8	4	10	Seine	FHM
5/12/2006	8	5	15	Seine	-
5/12/2006	8	6	55	Seine	FHM
5/12/2006	9	1	30	Seine	-
5/12/2006	9	2	20	Seine	-
5/12/2006	9	3	12	Seine	FHM

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/12/2006	9	3	12	Seine	GSF
5/12/2006	9	4	25	Seine	FHM
5/12/2006	9	5	10	Seine	FHM
5/13/2006	10	1	20	Seine	-
5/13/2006	10	2	30	Seine	FHM
5/13/2006	Pool upstream of bridge			Seine	-
5/13/2006	9	1	30	Seine	-
5/13/2006	9	2	20	Seine	-
5/13/2006	9	3	12	Seine	FHM
5/13/2006	9	4	25	Seine	FHM
5/13/2006	9	5	10	Seine	FHM
5/13/2006	8	1	20	Seine	-
5/13/2006	8	2	20	Seine	-
5/13/2006	8	3	15	Seine	-
5/13/2006	8	4	10	Seine	FHM
5/13/2006	8	5	15	Seine	-
5/13/2006	8	6	55	Seine	FHM
5/13/2006	7	1	40	Seine	-
5/13/2006	7	2	10	Kick	-
5/13/2006	7	3	10	Seine	-
5/13/2006	7	4	20	Seine	-
5/13/2006	7	5	10	Kick	-
5/13/2006	7	6	15	Seine	-
5/13/2006	7	7	20	Seine	-
5/13/2006	7	8	20	Kick	-
5/13/2006	6	1	20	Seine	-
5/13/2006	6	2	15	Kick	-
5/13/2006	6	3	25	Seine	-
5/13/2006	6	4	30	Kick	-
5/13/2006	6	5	25	Seine	-
5/13/2006	6	6	30	Seine	-
5/13/2006	5	1	20	Seine	FHM
5/13/2006	5	2	45	Kick	-
5/13/2006	5	3	3	Seine	-
5/13/2006	5	4	30	Seine	-
5/13/2006	5	5	20	Seine	-
5/13/2006	5	6	10	Kick	-
5/13/2006	5	7	20	Seine	-
5/13/2006	5	8	20	Dry	-
5/13/2006	4	1	50	Seine	-
5/13/2006	4	2	35	Kick	-
5/13/2006	4	3	25	Kick	-

Appendix B (cont.).

Date	Reach	Haul	Length (m)	Method	Fish Spp.
5/13/2006	4	4	15	Seine	BRM
5/13/2006	4	4	15	Seine	FHM
5/13/2006	4	5	15	Seine	BRM
5/13/2006	4	5	15	Seine	FHM
5/14/2006	10	1	20	Seine	-
5/14/2006	10	2	30	Seine	FHM
5/14/2006	9	1	30	Seine	-
5/14/2006	9	2	20	Seine	GSF
5/14/2006	9	3	12	Seine	FHM
5/14/2006	9	4	25	Seine	FHM
5/14/2006	9	5	10	Seine	FHM
5/14/2006	8	1	20	Seine	-
5/14/2006	8	2	20	Seine	-
5/14/2006	8	3	15	Seine	-
5/14/2006	8	4	10	Seine	-
5/14/2006	8	5	15	Seine	-
5/14/2006	8	6	55	Seine	FHM
5/14/2006	8	6	55	Seine	GSF
5/14/2006	7	1	40	Seine	-
5/14/2006	7	2	10	Seine	-
5/14/2006	7	3	10	Seine	-
5/14/2006	7	4	20	Seine	-
5/14/2006	7	5	10	Kick	-
5/14/2006	7	6	15	Seine	-
5/14/2006	7	7	20	Seine	-
5/14/2006	7	8	20	Kick	-
5/14/2006	6	1	20	Seine	-
5/14/2006	6	2	15	Kick	-
5/14/2006	6	3	25	Seine	-
5/14/2006	6	3	25	Seine	-
5/14/2006	6	4	30	Seine	-
5/14/2006	6	5	25	Seine	-
5/14/2006	6	6	30	Seine	-
5/14/2006	2	1	10	Seine	-
5/14/2006	2	2	25	Seine	-
5/14/2006	2	3	25	Seine	-
5/14/2006	2	4	30	Seine	-
5/14/2006	2	5	40	Seine	-
5/14/2006	2	6	25	Seine	-

Appendix C. Habitat data collected from each stream reach on 05/20/2006 and 05/21/2006. Abbreviations: S = site (sequentially from downstream to upstream for each stream reach); P = pool; RU = run; RI = riffle; BS = bank slumpage; IB = incised banks; UB = undercut banks; OV = overhanging vegetation; Rip. Zone = riparian zone; GR/F = grasses/forbes; SE = sedges; WR = riparian woody vegetation; Aq. Veg. = aquatic vegetation; EV = emergent vegetation; SV = submergent vegetation; FA = filamentous algae; S/C = silt/clay; Sa = sand; Gr = gravel; Co = cobble; Bo = boulder; WD = instream woody debris; ft = feet. See *Methods* for details on scoring variables.

REACH 1; 05/21/06

	Variable	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
<i>Habitat</i>	P			X						X			
	RU	X	X		X		X		X		X		X
	RI					X		X				X	
<i>Banks</i>	BS	2	2	2	2	2	3	0	1	3	4	4	1
	IB	2	3	4	4	4	3	3	4	4	4	4	4
	UB	3	2	2	2	2	2	1	3	3	3	4	4
	OV	4	3	3	3	3	3	2	3	3	3	4	4
<i>Rip. Zone</i>	GR/F	2	0	1	1	1	4	2	4	1	2	0	3
	SE	4	0	4	4	4	2	3	1	4	3	4	3
	WR	0	0	1	1	1	0	0	0	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0	0	0	0	0	0
	SV	3	0	0	0	0	0	0	0	0	0	0	0
	FA	1	0	3	3	3	1	1	3	4	0	1	2
<i>Substrate</i>	S/C	4	3	4	3	0	3	1	4	4	1	1	3
	Sa	1	2	3	2	2	1	1	0	1	4	1	3
	Gr	1	2	0	2	2	2	2	0	0	1	1	1
	Co	1	0	1	1	3	1	3	1	0	2	4	1
	Bo	0	0	0	1	0	1	0	1	0	2	0	1
<i>Other</i>	WD	1	1	1	1	1	1	0	0	1	1	1	1
	% Wet	100	0	90	0	0	51	5	50	100	5	0	5.4
	% Dry	0	100	10	100	100	49	95	50	0	95	100	94.6
	Length (ft)	17	4	8	103	11	55	5	42	11	24	10	277

Appendix C (cont).

REACH 2; 05/21/06

	Variable	S1	S2	S3	S4	S5	S6	S7
<i>Habitat</i>	P							
	RU							X
	RI	X	X	X	X	X	X	
<i>Banks</i>	BS	4	2	1	1	1	1	4
	IB	1	1	0	0	1	0	4
	UB	3	3	1	1	1	1	4
	OV	4	3	3	2	4	1	4
<i>Rip. Zone</i>	GR/F	3	3	1	4	4	1	3
	SE	2	3	4	1	1	3	3
	WR	0	0	0	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0	0
	SV	0	0	0	0	0	0	0
	FA	0	0	0	0	0	1	1
<i>Substrate</i>	S/C	0	0	2	0	1	2	3
	Sa	0	2	2	1	3	3	1
	Gr	4	4	3	2	3	2	3
	Co	0	0	0	0	0	0	1
	Bo	0	2	0	0	0	0	1
<i>Other</i>	WD	0	0	0	0	0	1	1
	% Wet	0	0	0	0	0	10	47
	% Dry	100	100	100	100	100	90	53
	Length (ft)	12	11	5	5	3	5	509

Appendix C (cont).

REACH 3; 05/21/06

	Variable	S1	S2	S3	S4
<i>Habitat</i>	P		X		
	RU				X
	RI	X		X	
<i>Banks</i>	BS	3	4	4	4
	IB	3	4	4	4
	UB	0	2	3	4
	OV	1	2	4	4
<i>Rip. Zone</i>	GR/F	1	2	3	1
	SE	4	3	3	4
	WR	0	0	0	1
<i>Aq. Veg.</i>	EV	0	0	0	0
	SV	0	0	0	0
	FA	1	3	0	2
<i>Substrate</i>	S/C	2	4	1	2
	Sa	2	1	2	1
	Gr	2	1	3	4
	Co	0	0	0	1
	Bo	0	0	0	0
<i>Other</i>	WD	0	0	0	1
	% Wet	100	100	0	95
	% Dry	0	0	100	5
	Length (ft)	14	24	10	502

Appendix C (cont).

REACH 4; 05/21/06

	Variable	S1	S2
<i>Habitat</i>	P		X
	RU	X	
	RI		
<i>Banks</i>	BS	3	0
	IB	2	0
	UB	2	0
	OV	4	4
<i>Rip. Zone</i>	GR/F	4	2
	SE	1	0
	WR	3	3
<i>Aq. Veg.</i>	EV	0	0
	SV	0	0
	FA	3	3
<i>Substrate</i>	S/C	4	4
	Sa	0	0
	Gr	0	0
	Co	1	0
	Bo	0	0
<i>Other</i>	WD	2	2
	% Wet	85	100
	% Dry	15	0
	Length (ft)	537	13

Appendix C (cont).

REACH 5; 05/21/06

	Variable	S1
<i>Habitat</i>	P	
	RU	X
	RI	
<i>Banks</i>	BS	4
	IB	3
	UB	3
	OV	4
<i>Rip. Zone</i>	GR/F	4
	SE	1
	WR	1
<i>Aq. Veg.</i>	EV	0
	SV	0
	FA	2
<i>Substrate</i>	S/C	4
	Sa	1
	Gr	1
	Co	0
	Bo	0
<i>Other</i>	WD	0
	% Wet	75.3
	% Dry	24.7
	Length (ft)	550

Appendix C (cont).

REACH 6; 05/20/06

	Variable	S1
<i>Habitat</i>	P	
	RU	X
	RI	
<i>Banks</i>	BS	4
	IB	4
	UB	3
	OV	4
<i>Rip. Zone</i>	GR/F	4
	SE	0
	WR	0
<i>Aq. Veg.</i>	EV	0
	SV	0
	FA	3
<i>Substrate</i>	S/C	4
	Sa	1
	Gr	2
	Co	1
	Bo	0
<i>Other</i>	WD	0
	% Wet	100
	% Dry	0
	Length (ft)	485

Appendix C (cont).

REACH 7; 05/20/2006

	Variable	S1	S2	S3	S4	S5
<i>Habitat</i>	P					
	RU	X		X		X
	RI		X		X	
<i>Banks</i>	BS	3	4	3	2	3
	IB	4	4	4	0	4
	UB	3	3	4	0	3
	OV	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4
	SE	0	0	0	0	0
	WR	1	0	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0	0	0
	SV	0	0	0	0	0
	FA	2	2	3	0	3
<i>Substrate</i>	S/C	3	3	3	0	3
	Sa	1	1	0	0	1
	Gr	2	3	2	4	3
	Co	0	0	1	0	0
	Bo	0	0	0	0	0
<i>Other</i>	WD	0	0	0	0	0
	% Wet	100	10	100	0	100
	% Dry	0	90	0	100	0
	Length (ft)	88	34	243	3	117

Appendix C (cont).

REACH 8; 05/20/2006

	Variable	S1	S2*	S3	S4	S5	S6
<i>Habitat</i>	P		-	X		X	
	RU	X	-		X		X
	RI		-				
<i>Banks</i>	BS	4	4	1	4	2	4
	IB	3	4	3	4	2	4
	UB	3	-	3	3	2	3
	OV	4	4	4	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4	4
	SE	0	-	0	0	0	0
	WR	1	-	0	1	0	1
<i>Aq. Veg.</i>	EV	0	-	0	0	0	0
	SV	0	-	0	0	0	0
	FA	3	-	3	2	3	2
<i>Substrate</i>	S/C	4	-	3	4	4	2
	Sa	1	-	0	0	0	0
	Gr	2	-	2	1	0	4
	Co	0	-	0	1	1	1
	Bo	0	-	1	1	0	0
<i>Other</i>	WD	0	-	0	1	1	1
	% Wet	100	-	100	100	100	100
	% Dry	0	-	0	0	0	0
	Length (ft)	202	23	27	56	32	145

* The channel of S2 was filled in with bank slumpage.

Appendix C (cont).

REACH 9; 05/20/06

	Variable	S1	S2	S3	S4	S5	S6
<i>Habitat</i>	P		X		X		X
	RU	X				X	
	RI			X			
<i>Banks</i>	BS	4	2	1	1	0	0
	IB	4	2	1	1	3	0
	UB	2	2	1	1	2	0
	OV	4	4	4		4	4
<i>Rip. Zone</i>	GR/F	4	4	4	4	4	4
	SE	0	0	0	0	0	0
	WR	1	0	0	1	0	1
<i>Aq. Veg.</i>	EV	0	0	0	0	0	0
	SV	1	1	0	0	0	0
	FA	0	0	0	1	0	0
<i>Substrate</i>	S/C	4	4	2	1	4	4
	Sa	0	0	0	4	1	0
	Gr	2	1	2	1	1	0
	Co	0	1	1	0	0	1
	Bo	0	0	1	0	0	1
<i>Other</i>	WD	1	0	0	1	0	1
	% Wet	100	100	0	100	100	100.0
	% Dry	0	0	100	0.0	0.0	0.0
	Length (ft)	231	13	51	38	108	44

Appendix C (cont).

REACH 10; 05/20/2006

	Variable	S1	S2*	S3
<i>Habitat</i>	P			
	RU	X	X	X
	RI			
<i>Banks</i>	BS	2	0	2
	IB	4	0	4
	UB	2	0	4
	OV	4	4	4
<i>Rip. Zone</i>	GR/F	4	4	4
	SE	0	0	0
	WR	0	0	0
<i>Aq. Veg.</i>	EV	0	0	0
	SV	0	0	0
	FA	3	0	3
<i>Substrate</i>	S/C	4	4	4
	Sa	0	0	0
	Gr	0	0	0
	Co	0	0	0
	Bo	0	0	0
<i>Other</i>	WD	0	0	0
	% Wet	0	0	26
	% Dry	100	100	74
	Length (ft)	31	175	279

* S2 had a poorly defined channel (see photograph _ in Appendix A).

Site Visit for Weiman Dam, Turner County, South Dakota

Prepared by Andy Mitzel

In response to a wetland delineation submitted to the South Dakota Regulatory Office by Clark Engineering Corporation, it was determined that a site investigation and field jurisdictional determination would be conducted. On 14 July 2004 Andy Mitzel and Tom Lowin of the South Dakota Regulatory Office, Omaha District, US Army Corps of Engineers (Corps) conducted a site visit to review the wetland delineation conducted by Clark Engineering Corporation on 20 May 2004.

The site is located in the Southeast Quarter of Section 19, Township 100 North, Range 54 West, Turner County, South Dakota. The site is being reviewed as part of an action to permit the construction of a dam. Clark Engineering Corporation originally delineated the site, and the Corps determined that some irregularities were present in the information presented and concluded that a site visit would be required to verify the findings. The purpose of Corps visit to the site was to determine if information in the on site wetland delineation was indeed correct. The area of interest is a large floodplain dominated by reed canary grass (*Phalaris arundinacea*) located on in a small valley. The site is a gentle undulating landscape with a palustrine wetland. The site has been and is currently being used for livestock grazing.

Methods

The fieldwork was done 14 July 2004, in accordance with the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (Technical Report Y-87-1; U.S. Army Engineer Waterways Experiment Station; Vicksburg, MS) (87 Manual) procedures. Before performing the onsite assessment, an office review of available data relevant to site conditions was conducted. The following sources of information were reviewed:

- USGS 7.5-minute quadrangle map (Marion Quad, SD)
- National Wetland Inventory
- NRCS Official Wetland Determination
- Soil Survey of Turner County, South Dakota
- List of Hydric Soils in Turner County, South Dakota
- Aerial Photos of the area

The onsite assessment involved verifying the findings of the wetland delineation conducted July 12, 2003. Rather than developing our own unique transects and vegetation areas, we used the sites that had been used during the original delineation. The 87 Manual normal method was adapted to determine if site was a wetland.

Routine method

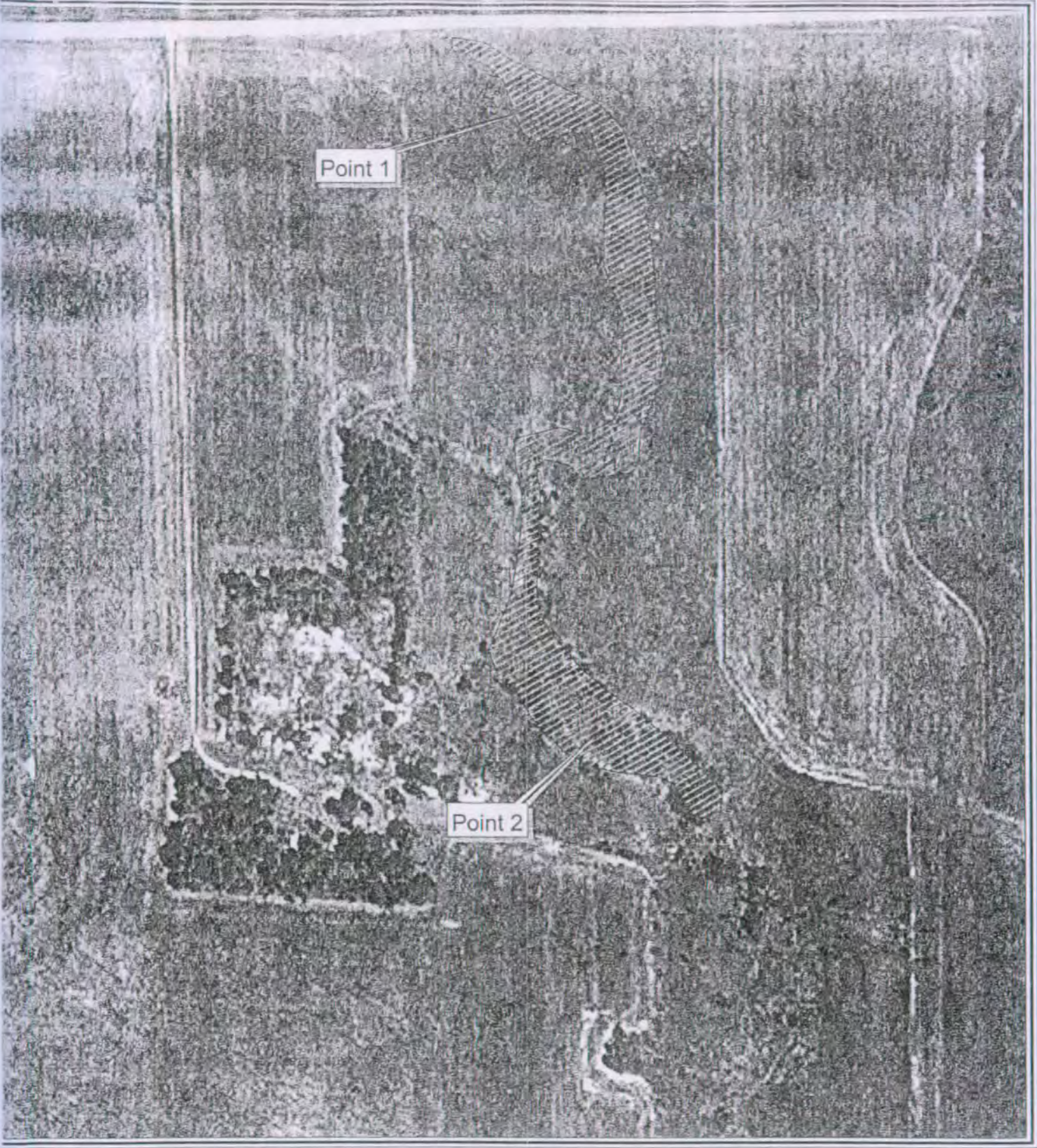
Wetland indicator parameters (i.e., hydric soils, predominance of hydrophytic vegetation, wetland hydrology) were assessed within each of these areas, as necessary, to determine whether wetland criteria were met. Soil pits were dug by hand and soil profiles were analyzed to determine whether hydric soils were present. The manual, *Field indicators of Hydric Soils in the United States* (NRCS, 2003) was used to review the soils in greater detail to determine if the soils were hydric. Soil profiles were dug and indicators of hydrology and hydric soils were reviewed. Percent cover of each species was determined. Plant species were compared to the *National List of Vascular Plant Species that Occur in Wetlands: Northern Plains* (Reed, 1988), to determine each species' indicator status. Any indicators of wetland hydrology, as defined by the COE Wetland Delineation Manual, were identified and recorded. Data forms completed for each sample area are provided in Attachment 3. When boundaries of wetlands were located in the field.

Conclusions

During the review of the site, we determined that wetland delineation conducted on 20 May 2004 was an inaccurate description of the wetland boundaries. The delineation report showed no wetlands present. Our field visit showed that approximately 3.5 acres of palustrine wetland are present on the site. The wetland at the site is characterized by hydric vegetation, hydrologic indicators (saturated soils, oxidized root channels and soil survey data), and hydric soil indicators (e.g., low-chroma colors, redoximorphic features).

Appendix 1

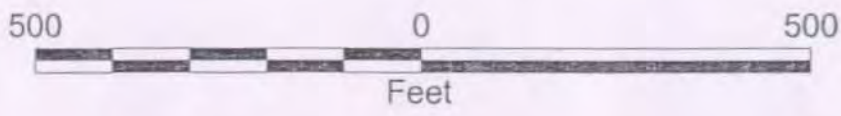
Site Maps



Weiman Dam Wetland Delineation

Legend

 Wetland



Figures 1 thru 4

Figure 5

Figure 6

Figure 7

Figure 8 & 9

Photo Point Map

Appendix 2

Soils Descriptions

IIC4—50 to 60 inches; light gray (2.5Y 7/2) loamy sand, light brownish gray (2.5Y 6/2) moist; common fine and medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; few pebbles; common shale chips; few fine dark concretions (iron and manganese oxide); sand grains coated with calcium carbonate; strong effervescence (about 6 percent calcium carbonate); moderately alkaline.

The depth to gravelly sand ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches and corresponds to the thickness of the solum. The soils contain free carbonates throughout.

The A horizon has value of 3 to 5 (2 or 3 moist). It typically is clay loam but in some pedons is loam. It ranges from neutral to moderately alkaline. The Cca horizon has hue of 10YR, 2.5Y, or 5Y and value of 5 to 7 (4 to 6 moist). It dominantly is loam, sandy clay loam, or clay loam but in some pedons is sandy loam in the lower part. It is mildly alkaline or moderately alkaline. Few or common nests of gypsum are in some pedons. The IIC horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is stratified gravelly loamy sand, gravelly sand, sand, or loamy sand. It is mildly alkaline or moderately alkaline.

Baltic series

The Baltic series consists of deep, very poorly drained, slowly permeable soils formed in calcareous, silty and clayey alluvium on flood plains and in depressions on uplands. Slopes are less than 1 percent.

Baltic soils are similar to Tetonka and Worthing soils and are near Davison, Lamo, Salmo, and Wakonda soils. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises. The somewhat poorly drained Lamo soils contain less clay than the Baltic soils. Salmo soils also contain less clay and have visible salts at or near the surface. Tetonka soils have a light gray subsurface layer. Worthing soils are deeper to carbonates than the Baltic soils.

Typical pedon of Baltic silty clay loam, 1,700 feet west and 80 feet north of the southeast corner of sec. 15, T. 100 N., R. 52 W.

A1—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

B21g—12 to 24 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine accumulations of carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

B22g—24 to 32 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; common gypsum crystals; nests of gypsum; few fine accumulations of carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

C1gs—32 to 49 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; very hard, firm, sticky and plastic; many fine and medium nests of gypsum; slight effervescence; mildly alkaline; gradual wavy boundary.

C2g—49 to 60 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; very hard, firm, sticky and plastic; few gypsum crystals; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 30 to 45 inches. The soils contain free carbonates throughout and are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or less. It typically is silty clay loam but in some pedons is silty clay. The B2g horizon has hue of 5Y or is neutral in hue. It has value of 3 to 5 (2 or 3 moist) and chroma of 1 or less. It typically is silty clay but in some pedons is clay or silty clay loam. The Cg horizon has hue of 2.5Y or 5Y and value of 4 to 7 (3 to 6 moist). It is silty clay loam, silty clay, or clay loam.

Betts series

The Betts series consists of deep, well drained soils formed in loamy glacial till on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 6 to 40 percent.

Betts soils are similar to Ethan soils and are near Clarno, Ethan, and Talmo soils. The nearby soils have a mollic epipedon. Clarno soils are less sloping than the Betts soils. Talmo soils have gravelly material within a depth of 14 inches. They are on knolls.

Typical pedon of Betts loam, in an area of Betts-Ethan loams, 15 to 40 percent slopes, 325 feet south and 1,800 feet west of the northeast corner of sec. 17, T. 100 N., R. 53 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; gradual smooth boundary.

ACca—4 to 9 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few pebbles; common fine accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

C1ca—9 to 26 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct olive yellow (2.5Y 6/6) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few pebbles; common fine accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—26 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The solum is less than 10 inches thick. Free carbonates are within a depth of 3 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline. The mottles in this horizon are inherited from the parent material.

Blendon series

The Blendon series consists of deep, well drained soils formed in loamy and sandy alluvium on terraces. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid or rapid in the lower part. Slopes range from 0 to 6 percent.

Blendon soils are similar to Henkin soils and are near Davis, Delmont, Dempster, Enet, and Henkin soils. Davis, Delmont, Dempster, and Enet soils contain more clay in the subsoil than the Blendon soils. They are in positions on the landscape similar to those of the Blendon soils. Also, Delmont, Dempster, and Enet soils are underlain by gravelly material. Henkin soils have a mollic epipedon that is less than 20 inches thick.

Typical pedon of Blendon fine sandy loam, in an area of Blendon-Henkin fine sandy loams, 2 to 6 percent slopes, 85 feet east and 240 feet north of the center of sec. 35, T. 96 N., R. 52 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; medium acid; abrupt smooth boundary.

B2—8 to 26 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; soft, very friable; slightly acid; gradual wavy boundary.

B3—26 to 36 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; soft, very friable; neutral; clear wavy boundary.

C1—36 to 54 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable; neutral; clear wavy boundary.

C2—54 to 60 inches; very pale brown (10YR 7/3) loamy sand, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 45 inches. The depth to free carbonates ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 20 to 45 inches. The clay content of the control section averages as low as 10 percent in some pedons and as high as 18 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is fine sandy loam but in some pedons is loam. It ranges from medium acid to neutral. The B2 horizon has value of 3 or 4 (2 or 3 moist). It is fine sandy loam or sandy loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4. It is loamy sand, loamy fine sand, fine sandy loam, or sandy loam. It ranges from neutral to moderately alkaline.

Bonilla series

The Bonilla series consists of deep, moderately well drained soils formed in loamy glacial till in swales on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 2 percent.

Bonilla soils are similar to Alcester, Davis, and Trent soils and are near Clarno, Crossplain, Ethan, and Tetonka soils. The subsoil of Alcester and Trent soils contains less sand than that of the Bonilla soils. The well drained Clarno and Ethan soils have a mollic epipedon that is less than 20 inches thick. They are higher on the landscape than the Bonilla soils. The somewhat poorly drained Crossplain soils are in positions on the landscape similar to those of the Bonilla soils. The well drained Davis soils formed in alluvium on foot slopes and stream terraces. The poorly drained Tetonka soils are in depressions.

Typical pedon of Bonilla loam, in an area of Clarno-Bonilla loams, 1 to 6 percent slopes (fig.9), 1,420 feet north and 115 feet west of the southeast corner of sec. 5, T. 98 N., R. 54 W.

gravelly loamy sand or gravelly sand is at a depth of 40 to 60 inches.

Clarno series

The Clarno series consists of deep, well drained and moderately well drained soils formed in loamy glacial till on uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 0 to 9 percent.

Clarno soils are near Bonilla, Crossplain, Davison, Ethan, and Tetonka soils. Bonilla soils have a mollic epipedon that is more than 20 inches thick. They are in swales. The somewhat poorly drained Crossplain soils are in swales and drainageways. Davison soils have a calcic horizon. They are on slight rises above swales and depressions. Ethan soils have free carbonates at or near the surface. They are on knolls and the more sloping parts of the landscape. The poorly drained Tetonka soils are in depressions.

Typical pedon of Clarno loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 620 feet south and 115 feet east of the northwest corner of sec. 32, T. 99 N., R. 54 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B21—9 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

B22—15 to 20 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.

B3ca—20 to 30 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—30 to 40 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—40 to 60 inches; light gray (2.5Y 7/2, yellowish brown (2.5Y 6/4) clay loam gray (2.5Y 6/2) and light olive brown moist; massive; slightly hard, friable, and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 2 inches. The depth to free carbonates ranges from 26 inches. The thickness of the mollic epipedon from 8 to 20 inches. The clay content of the section averages as low as 25 percent in soil and as high as 30 percent in others.

The A horizon has value of 3 or 4 (2 or 3 in chroma of 1 or 2. It typically is loam but in some is silt loam. It is slightly acid or neutral. The B₁ has hue of 10YR or 2.5Y and value of 4 or 5 (moist). It is clay loam or loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam or loam. It is mildly alkaline or moderately alkaline. Accumulations of gypsum crystals are below a depth of 40 inches in some pedons.

Crossplain series

The Crossplain series consists of deep, somewhat poorly drained soils formed in a thin mantle of loamy and clayey alluvium over loamy glacial till. The soils are in swales and shallow drainageways on uplands. Permeability is slow. Slopes range from 0 to 9 percent.

Crossplain soils are similar to Chancellor and Clarno soils and are near Bonilla, Clarno, Davison, Tetonka, and Worthing soils. The moderately well drained Bonilla soils are in positions on the landscape similar to those of the Crossplain soils. The poorly drained Chancellor soils contain less sand than the Crossplain soils. The well drained Clarno soils are on flood plains. The moderately well drained Crossplain soils are higher on the landscape than the Crossplain soils. The moderately well drained Davison soils have a calcic horizon. They are on slight rises above the Crossplain soils. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

Typical pedon of Crossplain clay loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 240 feet south and 2,400 feet west of the northeast corner of sec. 21, T. 100 N., R. 54 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak medium granular structure; hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

g—9 to 19 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; neutral; gradual wavy boundary.

g—19 to 26 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, firm, sticky and plastic; neutral; clear wavy boundary.

—26 to 38 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine nests of gypsum; few dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; neutral; gradual wavy boundary.

cs—38 to 46 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium nests of gypsum; common fine dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

16 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine dark concretions (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline.

Thickness of the solum ranges from 25 to 40 inches. The depth to free carbonates ranges from 20 to 36 inches. The thickness of the mollic epipedon ranges from 20 to 36 inches. The clay content of the control horizon averages as low as 35 percent in some pedons and as high as 45 percent in others.

A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or less. It typically is clay loam but in some pedons is loam. It is slightly acid or neutral. The B2tg horizon has value of 3 to 5 (2 to 4 moist) and chroma of 2. It is clay or clay loam. It is slightly acid or neutral. The B3 horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 moist), and chroma of 1 to 4. It is clay loam or loam. It ranges from neutral to moderately alkaline.

Davis series

The Davis series consists of deep, well drained soils formed in loamy and silty alluvium on foot slopes, fans, flood plains, and low terraces. Permeability is moderate. Slopes range from 0 to 6 percent.

Davis soils are similar to Alcester, Bonilla, Graceville, and Roxbury soils and are near Alcester, Chaska, Clamo, Ethan, and Roxbury soils. Alcester soils contain less sand throughout than the Davis soils. The moderately well drained Bonilla soils are in swales on uplands. The somewhat poorly drained Chaska soils are in narrow drainageways. The poorly drained Clamo soils contain more clay throughout than the Davis soils. Ethan soils have a mollic epipedon that is less than 10 inches thick. They are on uplands. Graceville soils are underlain by gravelly material at a depth of 40 to 60 inches. Roxbury soils contain less sand than the Davis soils and have free carbonates within 15 inches of the surface.

Typical pedon of Davis loam, 2 to 6 percent slopes, 2,062 feet east and 80 feet south of the northwest corner of sec. 7, T. 100 N., R. 53 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear smooth boundary.

B21—14 to 29 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B22—29 to 40 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B3ca—40 to 48 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; slight effervescence; neutral; gradual wavy boundary.

Cca—48 to 60 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 60 inches. The thickness of the mollic epipedon and the depth to free carbonates range from 20 to 50 inches. The clay content of the control section averages as low as 18 percent in some pedons and as high as 30 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is loam or silt loam. It is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is loam, silt loam, or clay loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. It dominantly is loam or silt loam. In some pedons, however, it is stratified with fine sandy loam or clay loam, and in others gravelly loamy sand, gravelly sand, loamy sand, and sand are at a depth of 40 to 60 inches.

Davis loam, sandy substratum, 0 to 2 percent slopes, is a taxadjunct to the Davis series because it is underlain by gravelly material at a depth of 30 to 40 inches. This difference, however, does not greatly alter the use or behavior of the soil.

Davison series

The Davison series consists of deep, moderately well drained soils formed in loamy glacial till. These soils are on low rises above swales and depressions on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 5 percent.

Davison soils are similar to Wakonda soils and are near Clarno, Crossplain, Tetonka, and Worthing soils. The nearby soils do not have a calcic horizon. The well drained and moderately well drained Clarno soils are on side slopes. The somewhat poorly drained Crossplain soils are in swales and drainageways. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. Wakonda soils contain less sand throughout than the Davison soils.

Typical pedon of Davison loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 1,630 feet north and 400 feet east of the southwest corner of sec. 18, T. 100 N., R. 55 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; (about 8 percent calcium carbonate); mildly alkaline; abrupt smooth boundary.

ACca—10 to 14 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; violent effervescence (about 18 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C1ca—14 to 25 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many medium accumulations of carbonate; violent effervescence (about 23 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C2—25 to 36 inches; light yellowish brown (2.5Y 6/3) clay loam, dark olive brown (2.5Y 4/3) moist; few fine faint yellowish brown (10YR 5/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence (about 14 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C3cs—36 to 48 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct brownish yellow (10YR 6/6) and grayish brown (10YR 5/2) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common medium nests of gypsum; few fine accumulations of carbonate; strong effervescence (about 10 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C4—48 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; common medium distinct brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine nests of gypsum; common medium dark stains (iron and manganese oxide); strong effervescence (about 10 percent calcium carbonate); mildly alkaline.

The depth to free carbonates is less than 6 inches. The thickness of the mollic epipedon ranges from 7 to 15 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but in some pedons is silt loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline.

Delmont series

The Delmont series consists of somewhat excessively drained soils that are shallow over gravelly sand. These soils formed in loamy alluvium over gravelly sand. They

are on terraces. Permeability is moderate in the solum and rapid in the underlying material. Slopes range from 0 to 6 percent.

Delmont soils are similar to Enet soils and are near Baltic, Blendon, Dempster, Dimo, Enet, and Talmo soils. The very poorly drained Baltic soils are in depressions. Blendon soils contain less clay in the subsoil than the Delmont soils and are not underlain by gravelly material. They are in positions on the landscape similar to those of the Blendon soils. Dempster and Enet soils are more than 20 inches deep over gravelly material. They are lower on the landscape than the Delmont soils. The somewhat poorly drained Dimo soils are in swales. Talmo soils have gravelly material within a depth of 14 inches. They are on knolls and ridges.

Typical pedon of Delmont loam, in an area of Delmont-Enet loams, 0 to 2 percent slopes, 80 feet south and 99 feet west of the northeast corner of sec. 19, T. 98 N., R. 52 W.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.
- 321—8 to 12 inches; very dark grayish brown (10YR 3/2) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium and coarse subangular blocky; soft, very friable; neutral; clear wavy boundary.
- 322—12 to 18 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; clear smooth boundary.
- IC1ca—18 to 23 inches; multicolored gravelly sand; single grain; loose; calcium carbonate coatings on the underside of pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.
- IC2ca—23 to 60 inches; multicolored gravelly sand; single grain; loose; calcium carbonate coatings on the underside of some pebbles; strong effervescence; moderately alkaline.

The depth to gravelly material ranges from 14 to 20 inches. The thickness of the solum and the depth to free carbonates range from 14 to 20 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The clay content in the part of the control section above the gravelly material averages as low as 18 percent in some pedons and as high as 27 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. The B2 horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. It typically is loam in some pedons and is sandy loam in the lower part. The C horizon is multicolored, stratified gravelly sand or

gravelly loamy sand. It is mildly alkaline or moderately alkaline.

Dempster series

The Dempster series consists of well drained soils that are moderately deep over sandy and gravelly material. These soils are on terraces. Permeability is moderate in the solum and rapid in the underlying material. Slopes range from 1 to 5 percent.

Dempster soils are similar to Enet soils and are near Blendon, Graceville, Henkin, and Wentworth soils. Blendon and Henkin soils are higher on the landscape than the Dempster soils. Also, they contain more sand and less clay in the solum. Egan and Wentworth soils do not have gravelly material within a depth of 60 inches. They are in positions on the landscape similar to those of the Dempster soils. Enet soils contain more sand in the solum than the Dempster soils. Graceville soils have gravelly material 40 to 60 inches from the surface. They are slightly lower on the landscape than the Dempster soils.

Typical pedon of Dempster silty clay loam, in an area of Dempster-Graceville silty clay loams, 1 to 5 percent slopes, 400 feet north and 495 feet east of the southwest corner of sec. 25, T. 96 N., R. 52 W.

- Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.
- B21—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear wavy boundary.
- B22—14 to 26 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.
- B3ca—26 to 34 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.
- IIIC1ca—34 to 52 inches; brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 4/3) moist; single grain; loose; common fine accumulations of carbonate; calcium carbonate coatings on the underside of gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C1gs—28 to 36 inches; dark gray (N 4/0) silty clay loam, black (N 2/0) moist; massive; very hard, friable, sticky and plastic; common gypsum crystals; strong effervescence (about 10 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C2g—36 to 60 inches; dark gray (N 4/0) clay loam, black (N 2/0) moist; massive; very hard, friable, sticky and plastic; strong effervescence (about 9 percent calcium carbonate); mildly alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 24 to 45 inches. Visible salts or gypsum crystals are at or near the surface. The soils have free carbonates throughout. The clay content of the control section averages as low as 24 percent in some pedons and as high as 35 percent in others.

The A horizon is neutral in hue or has hue of 10YR or 5Y. It has value of 3 or 4 (2 or 3 moist) and chroma of 1 or less. It typically is silty clay loam but in some pedons is silt loam. It is mildly alkaline or moderately alkaline. It has few to many accumulations of salt. The C horizon is neutral in hue or has hue of 5Y or 2.5Y, value of 3 to 6 (2 to 4 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. It is silty clay loam, silt loam, silty clay, clay loam, or loam. Sand and gravel are below a depth of 40 inches in some pedons.

Talmo series

The Talmo series consists of excessively drained, rapidly permeable soils that are very shallow over sand and gravel. These soils formed in gravelly outwash on uplands. Slopes range from 12 to 25 percent.

Talmo soils are near Betts, Delmont, and Ethan soils. Betts and Ethan soils are loamy throughout. They are in positions on the landscape similar to those of the Talmo soils. Delmont soils are deeper to sand and gravel than the Talmo soils. They are on the less sloping parts of the landscape.

Typical pedon of Talmo gravelly loam, in an area of Betts-Talmo complex, 12 to 40 percent slopes, 2,129 feet north and 100 feet west of the southeast corner of sec. 33, T. 100 N., R. 54 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) gravelly loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; calcium carbonate coatings on pebbles; slight effervescence; mildly alkaline; clear smooth boundary.

A2ca—7 to 41 inches; pale brown (10YR 6/3) gravelly loamy sand, brown (10YR 4/3) moist; single grain; loose; calcium carbonate coatings on pebbles; strong effervescence; mildly alkaline; gradual smooth boundary.

A3—41 to 45 inches; multicolored very gravelly sand; single grain; loose; calcium carbonate coatings on the underside of pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

IIc3—45 to 60 inches; very pale brown (10YR 7/3) gravelly loamy sand, brown (10YR 5/3) moist; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum, or the depth to gravelly sand, ranges from 5 to 14 inches. The thickness of the mollic epipedon ranges from 7 to 14 inches. The depth to free carbonates is 0 to 10 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is gravelly loam but in some pedons is loam or sandy loam. It is neutral or mildly alkaline. The IIc horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It dominantly is gravelly loamy sand or gravelly sand but has layers of very gravelly loamy sand or very gravelly sand. It is mildly alkaline or moderately alkaline.

Tetonka series

The Tetonka series consists of deep, poorly drained soils formed in local silty and clayey alluvium in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Tetonka soils are similar to Baltic and Worthing soils and are near Chancellor, Clarno, Crossplain, Davison, Wakonda, and Wentworth soils. Baltic and Worthing soils are very poorly drained. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The well drained and moderately well drained Clarno and Wentworth soils are higher on the landscape than the Tetonka soils. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises above the Tetonka soils.

Typical pedon of Tetonka silt loam, 1,205 feet west and 710 feet north of the southeast corner of sec. 16, T. 100 N., R. 53 W.

A11—0 to 9 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear smooth boundary.

A12—9 to 12 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; gradual smooth boundary.

A2—12 to 18 inches; light gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak thin and medium platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

B21tg—18 to 27 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; slightly acid; gradual wavy boundary.

have a mollic epipedon that is more than 20 inches thick. They are in swales. Wakonda soils have a calcic horizon. They are on slight rises above swales.

Typical pedon of Wentworth silty clay loam, in an area of Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes, 2,627 feet south and 327 feet west of the northeast corner of sec. 12, T. 96 N., R. 52 W.

- Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.
- B21—9 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.
- B22—16 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); neutral; clear wavy boundary.
- B3ca—22 to 30 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine faint very dark grayish brown (2.5Y 3/2) and few fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.
- C1ca—30 to 42 inches; pale yellow (2.5Y 7/4) silty clay loam, light yellowish brown (2.5Y 6/4) moist; few fine distinct very dark brown (10YR 2/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.
- IIc2cacs—42 to 60 inches; light gray (2.5Y 7/2) clay loam, light yellowish brown (2.5Y 6/4) moist; common fine distinct yellowish red (5YR 4/6) and common fine distinct light gray (2.5Y 6/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); common fine and medium accumulations of gypsum; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 40 inches. The depth to free carbonates ranges from 20 to 32 inches. The depth to clay loam glacial till ranges from

40 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 19 inches. The clay content of the control section averages as low as 25 percent; some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam. It ranges from medium acid to neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silty clay loam or silt loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or silt loam. It is mildly alkaline or moderately alkaline. The IIC horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is clay loam or loam.

Worthing series

The Worthing series consists of deep, very poorly drained soils formed in local silty and clayey alluvium in depressions on uplands. Permeability is slow. Slopes are less than 1 percent.

Worthing soils are similar to Baltic and Tetonka soils and are near Chancellor, Crossplain, Davison, and Wakonda soils. Baltic soils have free carbonates at the surface. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises above the Worthing soils. The poorly drained Tetonka soils have an A2 horizon.

Typical pedon of Worthing silty clay loam, 1,735 feet east and 140 feet north of the southwest corner of sec. 10, T. 100 N., R. 53 W.

- A11—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; medium acid; gradual smooth boundary.
- A12—9 to 16 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.
- B21tg—16 to 26 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; neutral; gradual wavy boundary.
- B22tg—26 to 42 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, firm, sticky and plastic; few fine dark stains (iron and manganese oxide); neutral; clear wavy boundary.

B3gca—42 to 48 inches; gray (5Y 6/1) silty clay, gray (5Y 5/1) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine dark stains (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

Cgca—48 to 60 inches; light gray (5Y 7/1) silty clay loam, gray (5Y 6/1) moist; common fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; common medium dark stains (iron and manganese oxide); violent effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The depth to free carbonates is 35 to 60 inches. The mollic epipedon is 35 to more than 60 inches thick.

The A horizon is neutral or has hue of 10 YR or 5Y and value of 3 or 4 (2 or 3 moist). It typically is silty clay loam but in some pedons is silt loam or silty clay. It ranges from medium acid to neutral. The B2t horizon has hue of 10YR or 5Y and value of 3 to 5 (2 or 3 moist). It is clay or silty clay. It is slightly acid or neutral. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 or 2. It is silty clay loam, clay loam, or silty clay. It is neutral to moderately alkaline.

Appendix 3

Survey Data Sheets

VEGETATION

Total Number of Species:	1	Total Dominants:	1		
Percent of Dominants that are Wetland Species:	50/20:	100.00		FAC(minus)- applied:	100.00
Prevalence Index:	2.00			FAC Neutral:	Yes

HYDROLOGY

Recorded Data: ☐ Stream, Lake, or Tide Gauge ☒ Aerial Photographs ☐ Other ☐ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ☐ Inundated ☒ Saturated in Upper 12 inches ☐ Water Marks ☐ Drift Lines ☐ Sediment Deposits ☐ Drainage Patterns in Wetlands Secondary Indicators (2 or more required): ☒ Oxidized Root Channels in Upper 12 inches ☐ Water-Stained Leaves ☐ Local Soil Survey Data ☒ FAC-Neutral Test ☐ Other (Explain in Remarks)
Field Observations: Depth of Surface Water: (in.) Depth to Free Water in Pit: 12<18 (in.) Depth to Saturated Soil: 0<1 (in.)	

[illegible]

<u>Yes</u>	Hydrophytic Vegetation Present?	<u>Yes</u>	Is this Sampling Point Within a Wetland?
<u>Yes</u>	Wetland Hydrology Present?	<u>No</u>	Is this Sampling Point a Waters of the US?
<u>Yes</u>	Hydric Soils Present?	<u>No</u>	Have the determination results been overridden by the user?

--

1	Species Richness
2.00	Prevalence Index

VEGETATION

Total Number of Species:	1	Total Dominants:	1		
Percent of Dominants that are Wetland Species:	50/20:	100.00		FAC(minus)- applied:	100.00
Prevalence Index:	2.00			FAC Neutral:	Yes

Recorded Data:

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☒ No Recorded Data Available

Depth of Surface Water:	<u> </u>	(in.)
Depth to Free Water in Pit:	<u>10<12</u>	(in.)
Depth to Saturated Soil:	<u>0<1</u>	(in.)

☐	Inundated
☒	Saturated in Upper 12 inches
☐	Water Marks
☐	Drift Lines
☐	Sediment Deposits
☐	Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):	
☒	Oxidized Root Channels in Upper 12 inches
☐	Water-Stained Leaves
☐	Local Soil Survey Data
☒	FAC-Neutral Test
☐	Other (Explain in Remarks)

SOILS

Map Unit Name: Betts - Talmo Complex, 12 to 40% slop BhE Drainage Class: somewhat poorly drained
 (Series and Phase): Field Observations
 Taxonomy (Subgroup): Confirm Mapped Type? No

Profile Description:

Depth (inches)	Hz	Matrix Color (Munsell Moist)	Texture, Concretions, Structure	Redox Feature Abundance/Contrast	Redox Color (Munsell Moist)
0-8	A	10YR2-2.5/1	Silt loam	Common/Prominent (5.00%)	5YR4/6
8+	A/B	10YR2-2.5/1	Silt loam	Common/Prominent (20.0	5YR3/4

Hydric Soil Indicators:

☐ Histosol
☐ Histic Epipedon
☐ Sulfidic Odor
☐ Aquic Moisture Regime
☐ Reducing Conditions
☐ Gleyed or Low-Chroma Colors
☐ Concretions
☐ High Organic Content in Surface Layer in Sandy Soils
☐ Organic Streaking in Sandy Soils
☐ Listed on Local Hydric Soils List
☐ Listed on National Hydric Soils List
☐ Organic Pan

NRCS Field Indicators: F6 Redox Dark SurfaceX Other (Explain in Remarks)

WETLAND DETERMINATION

Yes Hydrophytic Vegetation Present?Yes Is this Sampling Point Within a Wetland?Yes Wetland Hydrology Present?No Is this Sampling Point a Waters of the US?Yes Hydric Soils Present?No Have the determination results been overridden by the user?

REMARKS

Wetland

X Yes No

WoUS

 YesX No1

Species Richness

2.00

Prevalence Index

Appendix 4

Site Photos



Figure 1 - Facing NNE



Figure 2 - Facing SSE, location of soil pit #1



Gleyed Soils
with
redoxomorphic
features

07 14 2004 11:01

Figure 3 - Soil Pit #1

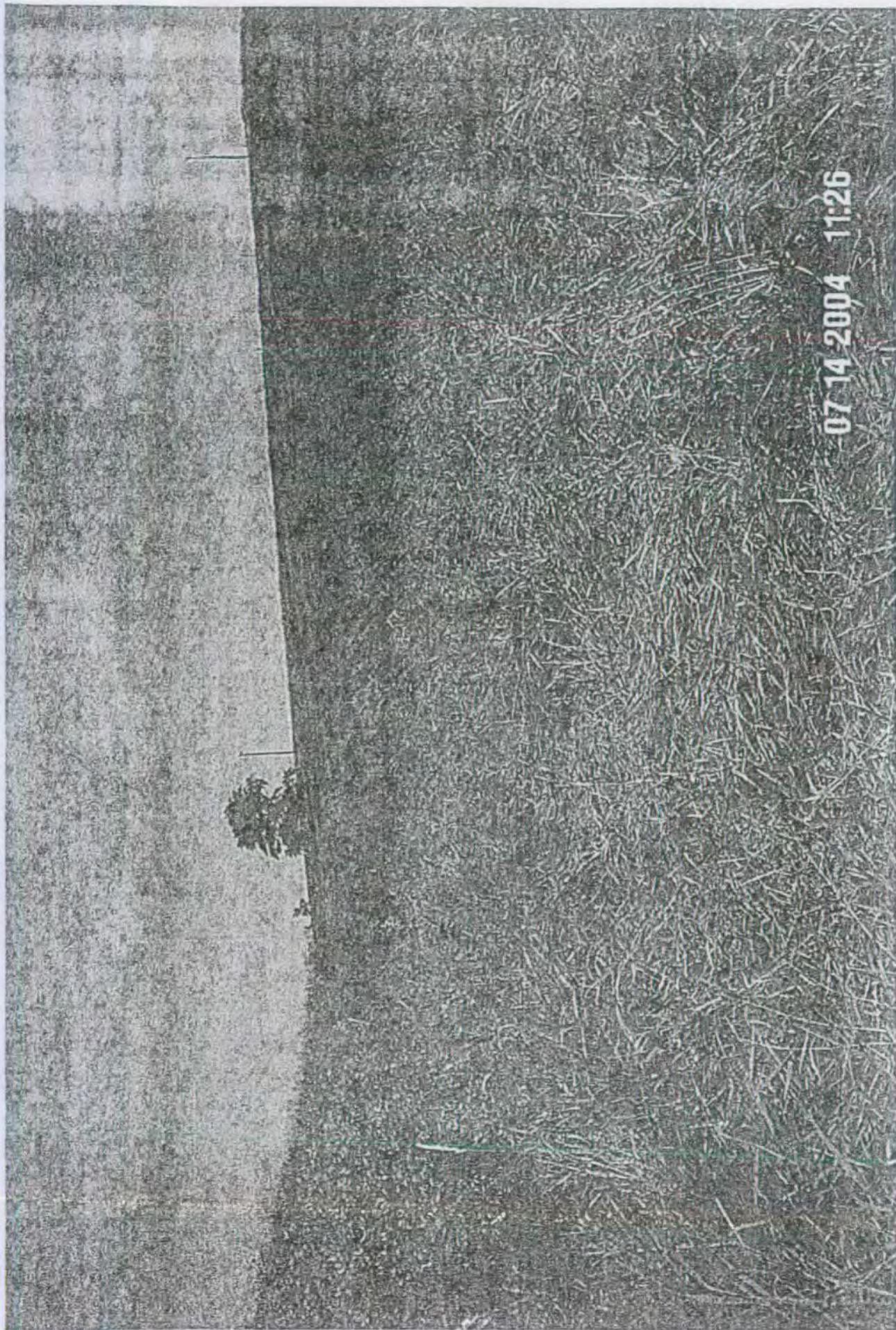


Figure 4 - Facing North, wetland area dominated by reed canary grass

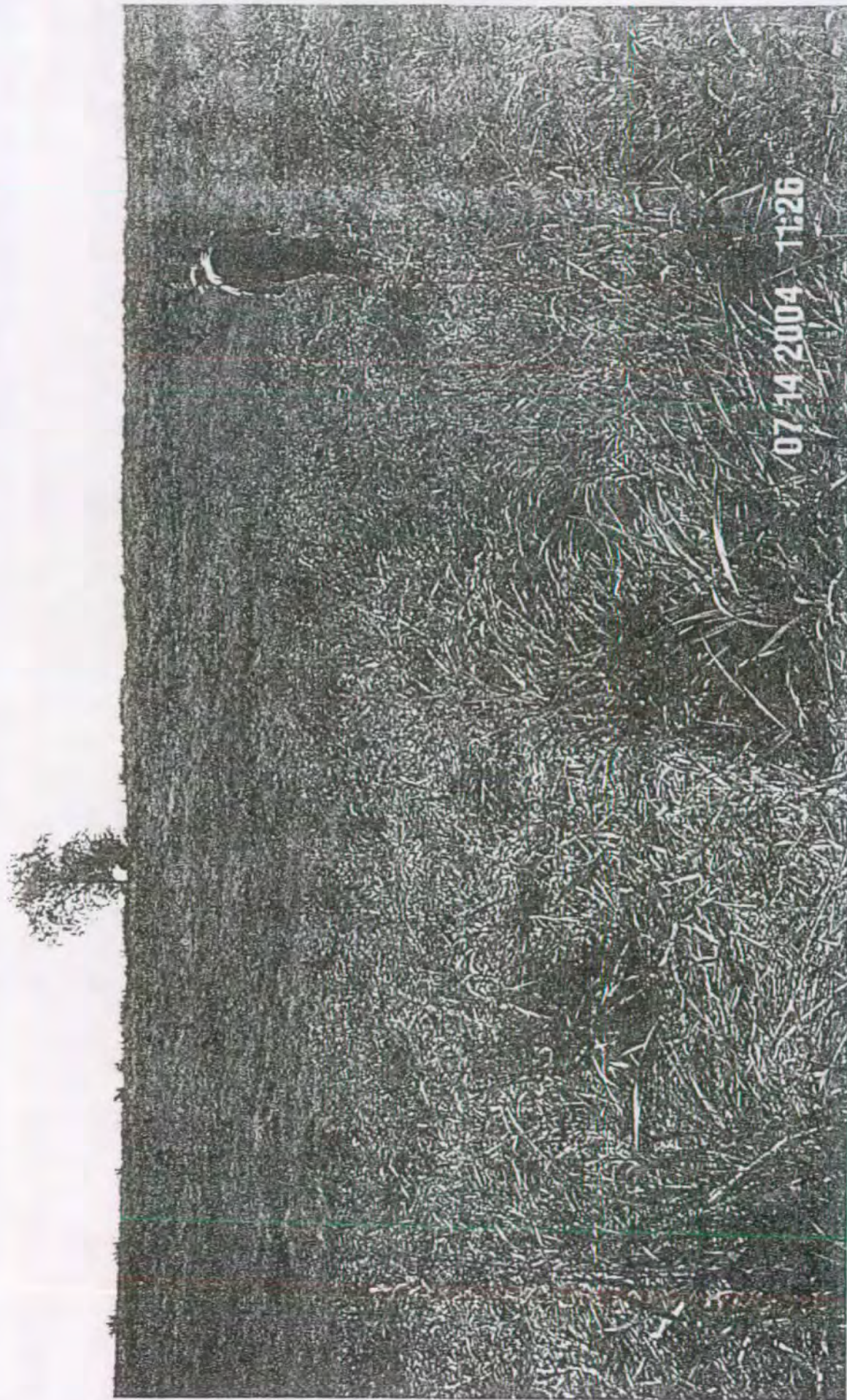


Figure 5 - Facing SE



07/14/2004 11:28

Figure 6 - Facing South

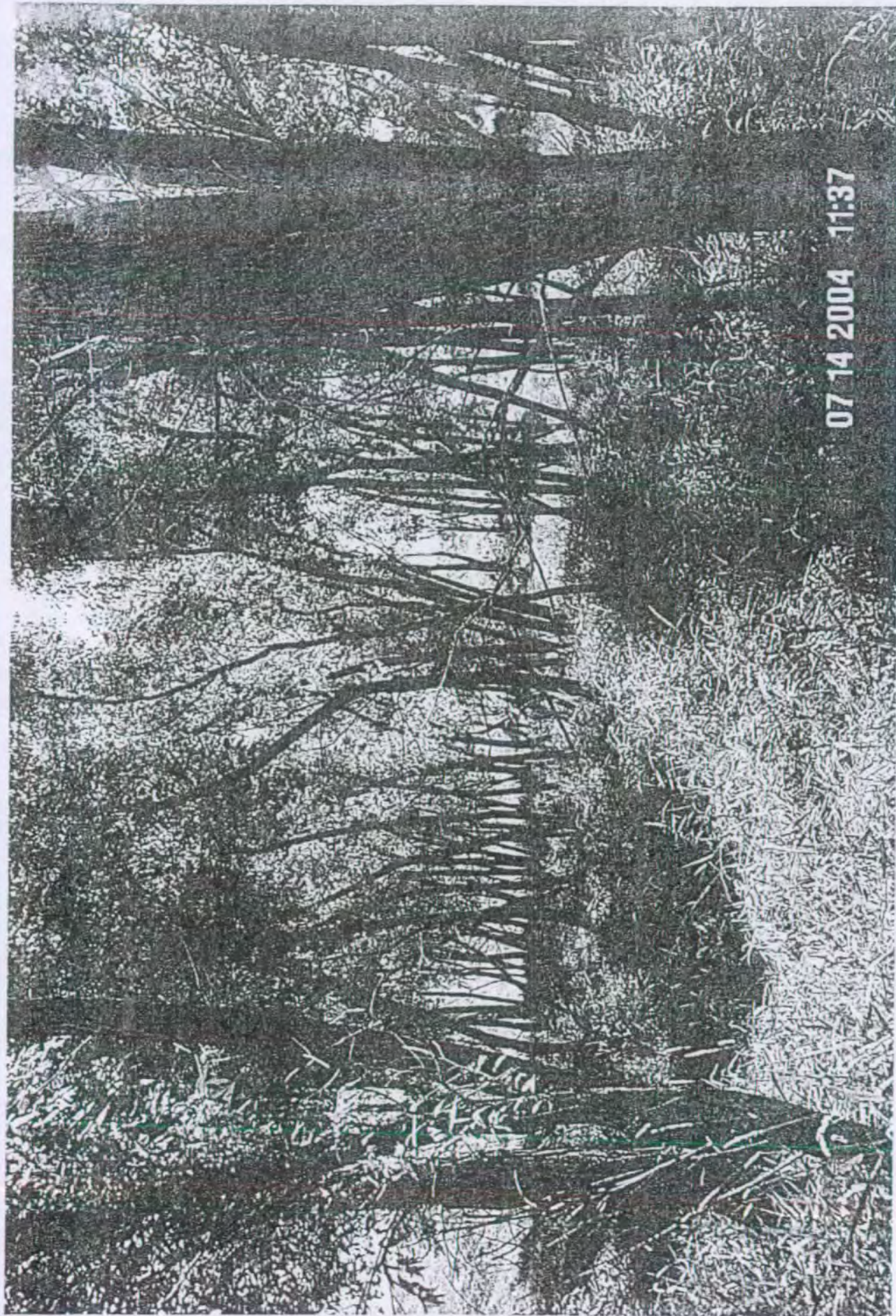


Figure 7 - Facing SE

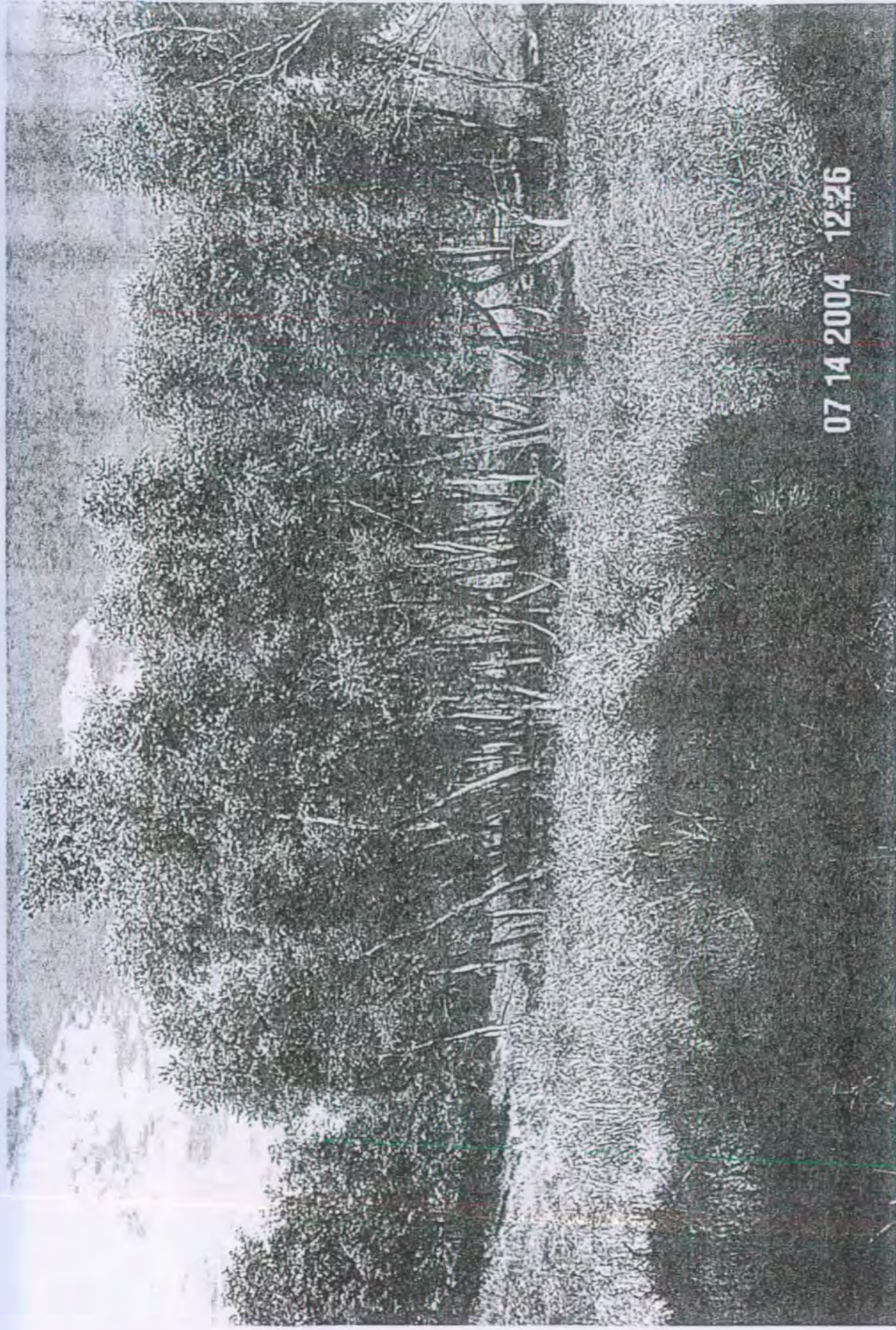


Figure 8 - Facing NW



Figure 9 - Facing SE, location of breached dam

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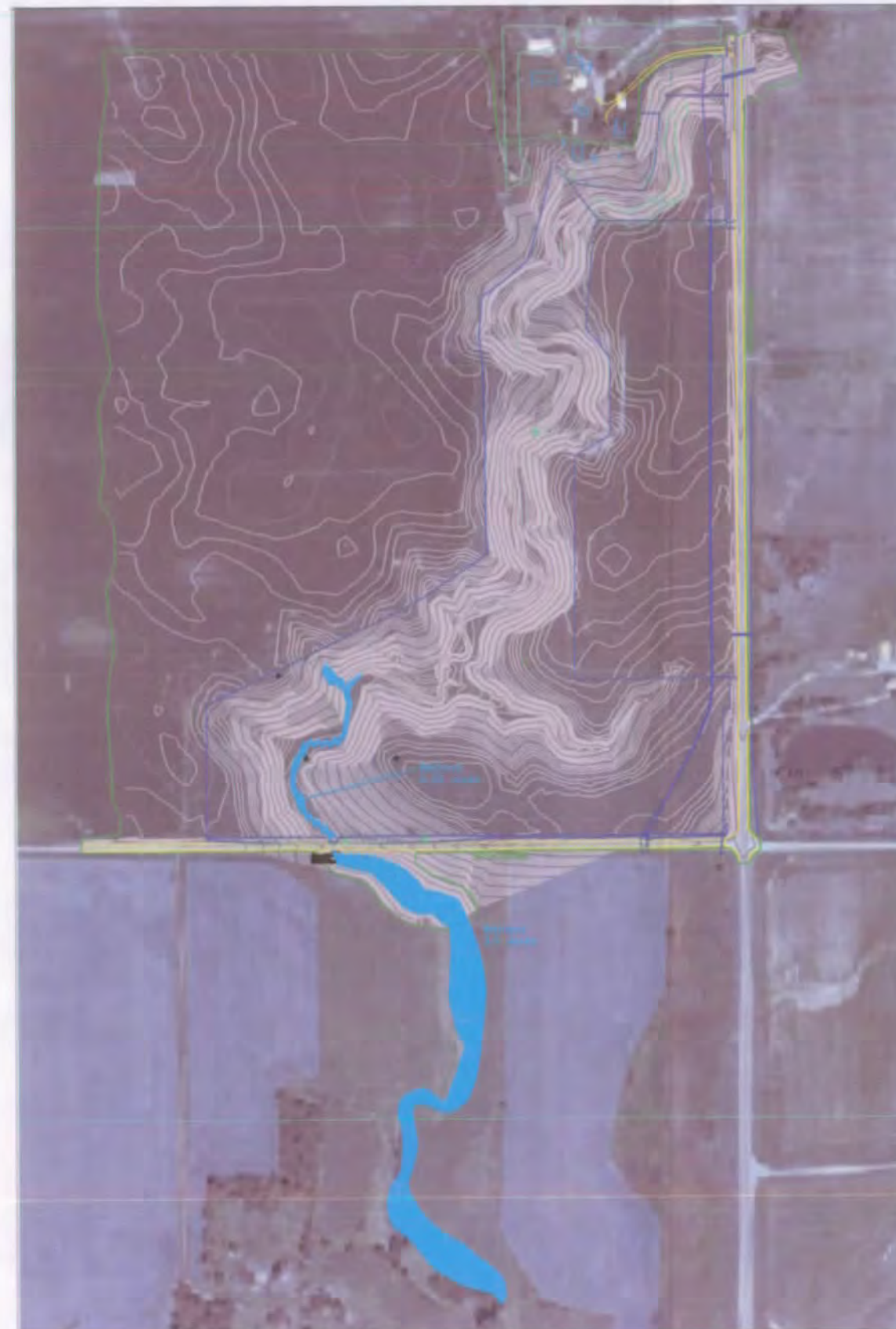
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WIEMAN DAM

Wetland Mitigation Plan



PROJECT
LOCATION

LOCATION

SE Quarter of Section 19, T100N, R54W
NE Quarter of Section 30, T100N, R54W

OWNER INFORMATION

Marlo Wieman
PO Box 135
Marion, SD 57043

SHEET INDEX

Sheet 1	Cover Sheet
Sheet 2	Wetland Delineation
Sheet 3	Wetland Mitigation



VICINITY MAP (n.t.s.)

Dakota Land Surveying and Engineering Inc.

2000 W 42nd St. Suite B-6
Sioux Falls, SD 57105
605 334 4882 phone
605 334 5745 fax



Paul J. Clinton, ASLA
Landscape Architect

Project Engineer is:

Clark Engineering
Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505
Fax (605) 331-2602
siouxfalls@clark-eng.com



North

Project # 05-022.2,07
Cover Sheet
Wetland Mitigation

**Dakota Land Surveying
and Engineering Inc.**

2000 W 42nd St. Suite B-6
Sioux Falls, SD 57105
605 334 4882 phone
605 334 5745 fax

Paul J. Clinton, ASLA
Landscape Architect

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WIEMAN DAM

Wetland Delineations

LEGEND:
WETLAND AREA

Notes

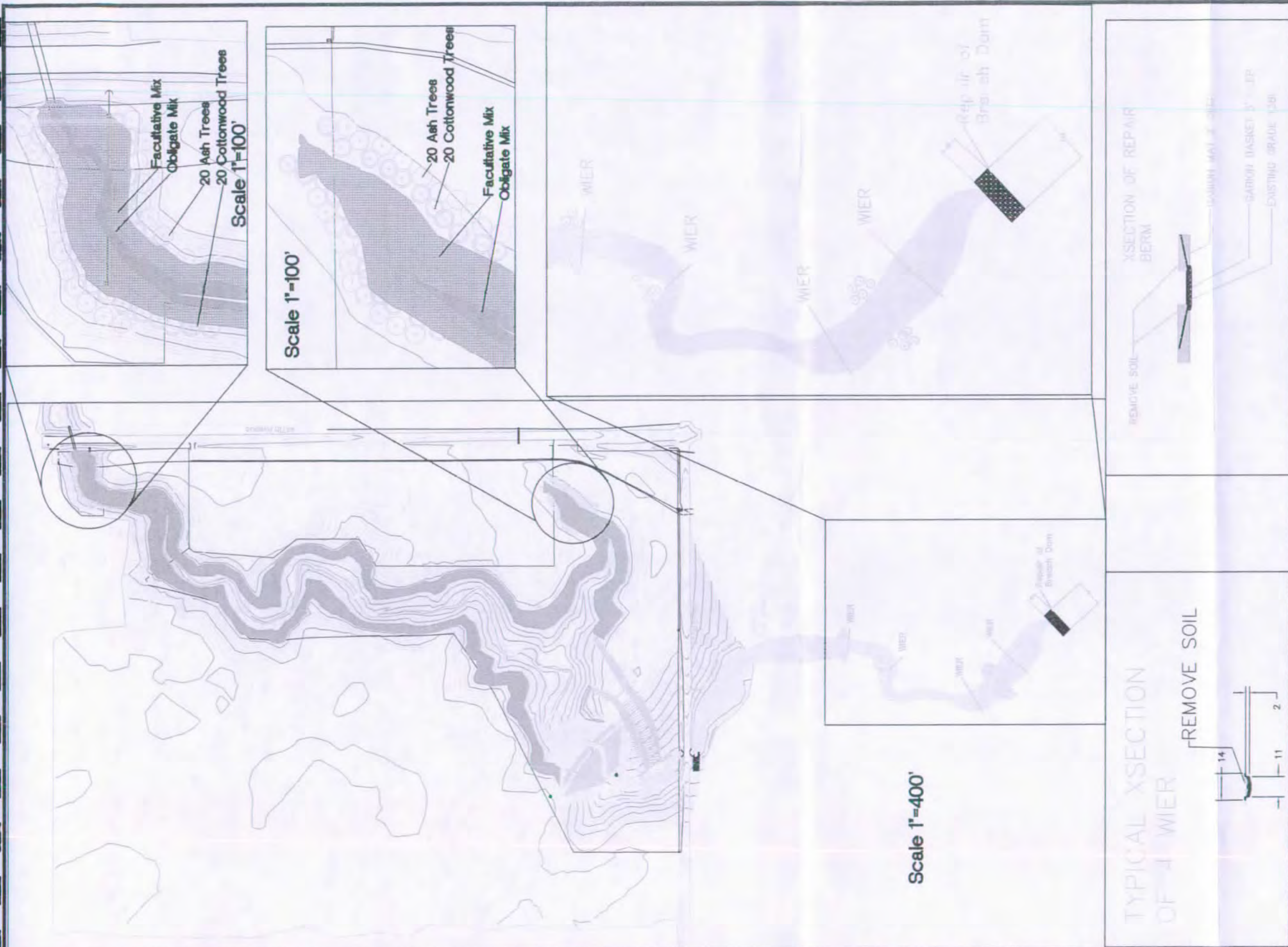
Wetland north of 271st Street 0.35 acre
(P. Clinton DLS+E 2005)

Wetland south of 271st Street 3.5 acres
(A. Mitzel COE 2004)



North
Scale 1"=300'

Project # 05-022.2,07
Sheet 2
Wetland Delineations



Dakota Land Surveying and Engineering Inc.

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Sioux Falls, SD 57105
605 334 4882 phone
605 334 5745 fax

Paul J. Clinton, ASLA
Landscape Architect

Project Engineer is:

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Sioux Falls, SD 57104-1328
(605) 331-2505
Fax (605) 331-2602
siouxfalls@clark-eng.com



North

Project # 05-022.2,07
Sheet 2
Wetland Mitigation

Clark Engineering Corporation
1410 West Russell Street
Sioux Falls, SD 57104

April 2, 2007

Regarding: Wieman Dam Project

Clark Engineering has contacted me in regards to the Wieman Dam Project. The proposed dam will create a lake south of and adjacent to my property. Clark made arrangements to meet with me to explain how this will affect my property. During our meeting we reviewed the plans and showed me an aerial photo with the proposed lake on it. I am indicating by my signature below that I am in favor of this project.

Dean Schoenwald 4-2-07
Dean Schoenwald Dated

CC: Tim Schaal SDDENR,
Marlo Wieman



RECEIVED
APR - 5 2007
WATER RIGHTS
PROGRAM

Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505 Phone
(605) 331-2602 Fax
siouxfalls@clark-eng.com
www.clark-eng.com

TRANSMITTAL LETTER

TO: Mr. Tim Schaal
Dept of Environment & Natural Resources
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3182

DATE: April 3, 2007

CLARK-SF PROJECT NUMBER: X03031

REGARDING: Wieman Dam near Marion, SD

TRANSMITTED HERewith are the following items:

NUMBER	DATE	DESCRIPTION
1	4/2/07	Letter of understanding

REMARKS:

Mr. Schaal:

We went and talked to the upstream neighbor about the impact of the reservoir and dam to his property. He is in favor of this project (as indicated by the enclosed letter).

Thank you.

Copies To: Marlo Wieman

Vanessa Victor, EIT

If this transmittal is incomplete or incorrect, please notify the sender immediately.

Minneapolis
Minnesota

Aberdeen
South Dakota

Sioux Falls
South Dakota

An Equal Opportunity Employer



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

April 20, 2007

Marlo Wieman
PO Box 135
Marion, SD 57043

Dear Mr. Wieman:

We have reviewed the plans and specifications for your dam project located in the S ½ SE ¼ of Sec. 19-T100N-R54W, in Turner County. The plans and specifications for the construction of your dam 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. 6825-3 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 you, 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 Wieman Dam will be classified as a small size Category 3, Low Hazard dam with a dam height of 30 ft. and a normal storage capacity of 69.7 acre-feet and a maximum storage capacity of 129 acre-feet.

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

Sincerely,

Timothy G. Schaal, P.E.
Natural Resources Engineering Specialist
for Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

c: Vanessa Victor, Clark Engineering



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 6825-3, Marlo Wieman**

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. 6825-3, Marlo Wieman, PO Box 135, Marion SD 57043.

The Chief Engineer is recommending APPROVAL of Application No. 6825-3 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. 6825-3 authorizes a dam with a storage capacity of 69.7 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,433.0 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
April 17, 2007

REPORT ON
WATER PERMIT APPLICATION No. 6825-3
Marlo Wieman
March 30, 2007

Water Permit Application No. 6825-3 has been filed by Marlo Wieman to impound 69.7 acre-feet of water by constructing a dam located in the S $\frac{1}{2}$ SE $\frac{1}{4}$ of Section 19-T100N-R54W, in Turner County. The application also requests impoundment of sufficient water to maintain water at the outlet elevation of 1433 feet mean sea level (fmsl). The water will be used for fish and wildlife production, recreation and livestock water.

Discussion:

The dam will be classified as a small size, Category 3, Low Hazard dam. The dam has been designed by Clark Engineering Corporation. The plans and specifications have been reviewed and will be approved; however, construction of the dam can not begin until Water Permit Application No. 6825-3 is approved.

The dam will be 30 feet high with a normal storage capacity of 69.7 acre-feet with a reservoir level at the primary spillway elevation, and a maximum storage capacity of 129 acre-feet with a reservoir level at the top of dam elevation. A dam of this size and hazard classification is required to have a minimum spillway design capable of passing a 25-year frequency event.

The dam has a drainage area of 1613 acres or 2.52 square miles. The dam is designed to have a 6 foot by 6 foot box RCP manhole riser with a 36 inch diameter RCP barrel as the primary spillway drop inlet structure with 5 feet of available freeboard and a 45 foot wide earthcut spillway with four feet of freeboard as the secondary spillway. A 25 year frequency event produces a peak runoff of approximately 280 cfs and a 100 year frequency event produces a peak runoff of approximately 550 cfs. The 45 foot wide secondary spillway will have a capacity of approximately 930 cfs.

The annual yield for this drainage area with an 80 percent chance of occurrence, or 8 out of 10 years, is expected to be 20 acre-feet. The annual yield with a 50 percent chance of occurrence, or 1 out of 2 years, is expected to be 56 acre-feet and the annual yield with a 10 percent chance, or 1 out of 10 years, is expected to be 323 acre-feet.

The Wieman Dam is located in the S $\frac{1}{2}$ SE $\frac{1}{4}$ of Section 19-T100N-R54W on an unnamed tributary to the West Fork of the Vermillion River, about one mile upstream of the confluence of the unnamed tributary and the West Fork of the Vermillion River. There are no existing Water Rights/Permits located on the unnamed tributary between the proposed dam and the West Fork of the Vermillion River. However, Location Notice No. 899-3 was filed in 1950 for 7.2 acre-feet of storage in a dam located in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ of Sec. 30-T100N-R54W, about one-half mile downstream of the proposed dam. This dam has been breached for some time and as part of Mr. Wieman's Wetland Mitigation Plan, the downstream dam will be repaired with rock gabions to temporary store runoff water and create wetland conditions.

page 2
Application No 6825-3
March 30, 2007

Conclusions:

1. Water Permit Application No. 6825-3 should be approved since unappropriated water is available and approval should not have any adverse effect on existing Water Permits/Rights.
2. If approved, the low flow bypass requirement for downstream domestic use should be a qualification on Water Permit Application No. 6825-3.

for *Timothy G. Schaal PE*

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

Affidavit of Publication

STATE OF SOUTH DAKOTA } :SS
COUNTY OF TURNER }

RECEIVED

MAY 23 2007

WATER RIGHTS
PROGRAM

I, **Donna Rumbaugh** City of Parker, County of Turner, State of South Dakota, being first duly sworn on oath, deposes and says:

The New Era is a weekly legal newspaper of general circulation, printed and published in the City of Parker, in said County of Turner, by The New Era, Lyon Sioux Press, publishers, and has been such legal newspaper during the times hereinafter mentioned; that the said newspaper has been in existence as such legal newspaper for more than one year prior to the publication of the notice hereunto attached, and has during all of said publication of the notice hereunto attached, and has during all of said time had, and now has, more than 200 bona fide subscribers; that the undersigned, The affiant, is the **Office Manager** of the said newspaper, in charge of the advertisement department thereof and has personal knowledge of all the facts stated in this affidavit and the advertisement headed:

Notice of Application No. 6825-3 to Appropriate water

printed copy of hereto attached, is printed and published in the said newspaper for two successive weeks, once each week and on the same day of the week, on the following dates, to-wit:

On Thursday, the 26th day of April, 2007

On Thursday, the 3rd day of May, 2007

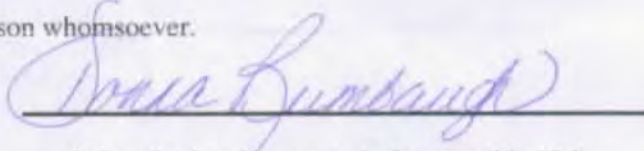
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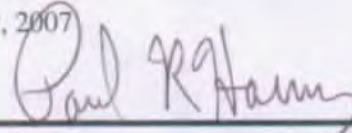
That \$51.97 being the full amount of the fees for publication

of the attached notice insures solely for the benefits of the publishers of the said newspaper, that no arrangement or understanding for a division thereof has been made with any other person and that no part thereof has been agreed to be paid to any other person whomsoever.



Subscribed and sworn to before me this 18th

Day of May, 2007



Notary Public, Turner County, South Dakota

My Commission
Expires:

02/10
2012



Notice of Application No. 6825-3 to Appropriate water

Notice is given that Marlo Wieman, P.O. Box 135, Marion, S.D. 57043 has filed an application for a water permit to impound 69.70 acre-feet of water from an unnamed tributary to the West Fork of the Vermillion River by constructing a dam located in the S 1/2 SE 1/4 Section 19 with water impounded in the S 1/2 SE 1/4, NE 1/4 SE 1/4 Section 19; all in T100N-R54W. This application requests impoundment of sufficient water to maintain water to the outlet elevation of 1433.0 feet mean sea level. The water is for fish and wildlife propagation, recreation and livestock water purposes.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 6825-3 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 these applications, 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 this 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 recommendations 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, S.D. 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 May 14, 2007.

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.
(605) 227-4267, 4/26/07, 5/03/07.
The New Era)

Received Payment Date,

\$51.97



April 18, 2007

THE NEW ERA
PO BOX 579
PARKER SD 57053

ATTENTION: Legal Public Notice

Enclosed is a Notice on Application No. 6825-3 to Appropriate Water to be published twice. Please publish the first notice on April 26, 2007 with the second publication 7 days later. The text of the notice can be e-mailed to your paper by contacting Karen Schlaak at (605) 773-3352.

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 Marlo Wieman, Po Box 135, Marion SD 57043 (Ph # 605-648-3536).

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. 6825-3

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

Date _____

We are in receipt of your letter of April 18, 2007 enclosing Notice to Appropriate Water by Application No. 6825-3 which was first published in our issue of _____. **ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.**

Name

Newspaper



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

PMB 2020
JOE FOSS BUILDING
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.

April 18, 2007

MARLO WIEMAN
PO BOX 135
MARION SD 57043

Dear Mr. Wieman:

Water Permit Application No. 6825-3 for irrigation use has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice has been sent to the Publisher of the New Era printed at Parker SD (Ph # 605-297-4419). You will need to contact the newspaper and authorize publication of this notice. For your information, a copy of the notice, the recommendations of the Chief Engineer and reports on the applications 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 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. 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 applications.

Sincerely,

Eric Gronlund
Natural Resources Engineer
(605) 773-3352

enclosures

cc: Vanessa Victor, Clark Engineering

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.

Instruction to Newspaper - Publish first Notice on April 26, 2007 with the second publication 7 days later. The applicant is responsible for payment.

NOTICE OF APPLICATION NO. 6825-3 to Appropriate Water

Notice is given that Marlo Wieman, PO Box 135, Marion SD 57043 has filed an application for a water permit to impound 69.70 acre-feet of water from an unnamed tributary to the West Fork of the Vermillion River by constructing a dam located in the S ½ SE ¼ Section 19 with water impounded in the S ½ SE ¼, NE ¼ SE ¼ Section 19; all in T100N-R54W. This application requests impoundment of sufficient water to maintain water to the outlet elevation of 1433.0 feet mean sea level. The water is for fish and wildlife propagation, recreation and livestock water purposes.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 6825-3 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 these applications, 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 this 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 recommendations 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 May 14, 2007.

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.



JUN 20 2007

DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

Marlo Wieman
PO Box 135
Marion SD 57043

Dear Mr. Wieman:

Enclosed is Water Permit No. 6825-3 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. 6825-3
Vermillion 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, September 1, 2010, made a thorough examination of the water use system constructed by Marlo Wieman of PO Box 135, Marion SD 57043 holder of Permit No. 6825-3, bearing the priority of March 9, 2007 authorizing the storage of 69.70 acre-feet of the waters of unnamed tributary to West Fork Vermillion River for recreation purposes, in Turner County.

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

A. Works used to divert the water:

A 30 foot high earthen dam with a normal storage capacity of 69.70 acre-feet

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

N/A

C. Works used to apply water to beneficial use:

A 30 foot high earthen dam with a normal storage capacity of 69.70 acre-feet

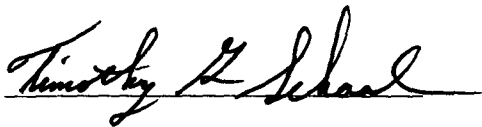
The system is in the following condition good. The point of diversion is located 450 ft. north & 1320 ft. west of the SE corner of Sec. 19-T100N-R54W (S ½ SE ¼) (Lat. 43.46029 & Long. -97.26620). The works are capable of storing 69.70 acre-feet of water which is to be used for recreation use. Water has been put to beneficial use to the maximum extent as follows:

A 30 foot high earthen dam with a normal storage capacity of 69.70 acre-feet

and the license should be issued for 69.70 acre-feet of storage.

Applicable permit qualifications have been complied with: Yes X

Exceptions to compliance are: none Date Report Completed: February 18, 2011



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

REPORT ON INSPECTION OF PERMIT NO. 6825-3

DATE OF INSPECTION: September 1, 2010

NAME & ADDRESS OF PERMIT HOLDER: Marlo Wieman, PO Box 135, Marion, SD 57043

DIVERSION POINT LEGAL LOCATION: 450 ft. north & 1320 ft. west of the SE corner of Sec. 19-T100N-R54W (S ½ SE ¼) (Lat. 43.46029 & Long. -97.26620).

DAM INFORMATION:

- 1) Height to crest 30 feet
- 2) Height to primary spillway 25 feet
- 3) Height to secondary spillway 26 feet
- 4) Crest width 16 feet
- 5) Crest length 350 feet
- 6) Spillway length XXX feet
- 7) Spillway width 45 feet
- 8) Approx. storage (Normal) 69.70 acre-feet
- 9) Approx. storage (Maximum) 129 acre-feet
- 10) Date constructed: 2007

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. 6825-3



0 0.25 0.5 1 Miles



South Dakota



Timothy G. Schaal

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

2/18/11



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

MAR 03 2011

6825-3

Marlo Wieman
PO Box 135
Marion SD 57043

Dear Mr. Wieman:

Enclosed is your Water License No. 6825-3. Water License No. 6825-3 is the final document which completes the process of obtaining a water right. Included with the water license is a map prepared by the staff engineer who conducted the field investigation.

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

STATE OF SOUTH DAKOTA

WATER LICENSE NO. 6825-3

(1) Marlo Wieman, PO Box 135, Marion SD 57043 made Application No. 6825-3, March 9, 2007 for a water permit to impound 69.7 acre feet of water from an unnamed tributary on the West Fork of the Vermillion River, Turner County, South Dakota for fish & wildlife propagation, recreation and domestic purposes. Permit No. 6825-3, with a priority date of March 9, 2007 was approved May 14, 2007 and issued to the applicant for impoundment of water with construction of the storage dam to be completed on or before May 14, 2012 and for the application to beneficial use of said water on or before May 14, 2016.

(2) It is certified that the permit holder has complied with the provisions of South Dakota State Law relating to completion of the project and is entitled to impound 69.7 acre feet for beneficial use with sufficient water annually to maintain the water level to the outlet elevation of 1,433.0 feet mean sea level.

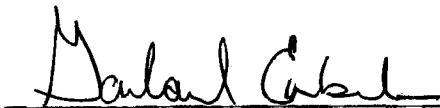
The location of the storage dam (outlet) is 450 feet north and 1,320 feet west of the SE corner of Section 19, T100N, R54W (S ½ SE ¼).

(3) The permit holder has complied with the provisions of South Dakota State Law relating to the application of water to beneficial use.

(4) Pursuant to South Dakota Water Law 46-5-30.1 Marlo Wieman, PO Box 135, Marion SD 57043-0135 the holder and/or owner of Water Right No. 6825-3 is issued a license to appropriate water, the right to impound 69.7 acre feet of water in a storage dam on an unnamed tributary on the West Fork of the Vermillion River with a priority date of March 9, 2007 from the location specified in (2) of this license for fish & wildlife propagation, recreation and domestic livestock watering purposes.

This license is subject to South Dakota Water Law, any limitations or conditions listed in Water Right No. 6825-3 and subject to the following qualifications:

- Water Right No. 6825-3 authorizes a dam with a storage capacity of 69.7 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation of 1,433.0 feet mean sea level.
- Low flows as needed for downstream domestic use, including livestock water and prior water rights must be bypassed.

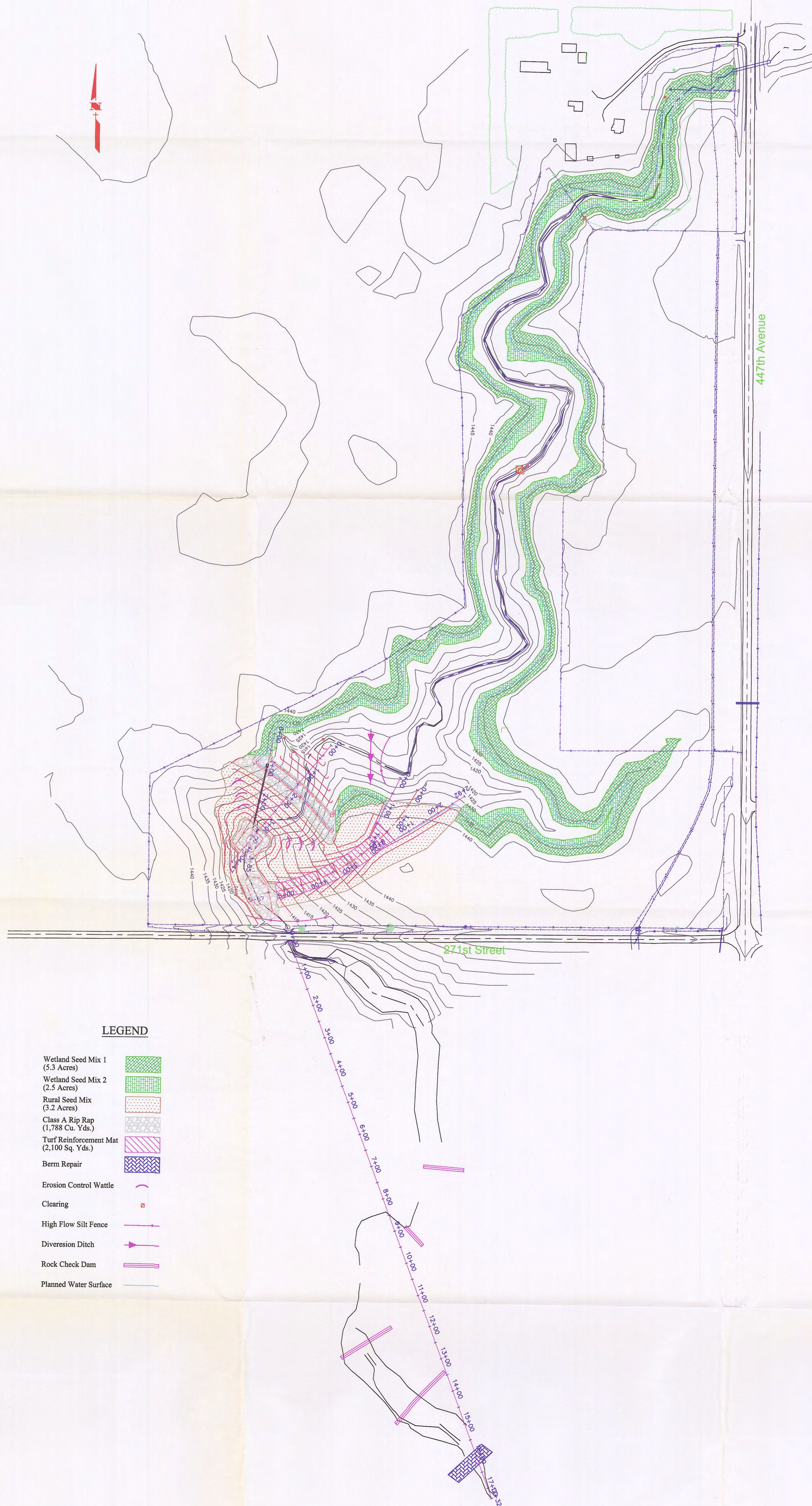


Garland Erbele, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

MAR 03 2011

date





LEGEND

- | | |
|--|---|
| Wetland Seed Mix 1
(5.3 Acres) |  |
| Wetland Seed Mix 2
(2.5 Acres) |  |
| Rural Seed Mix
(3.2 Acres) |  |
| Class A Rip Rap
(1,788 Cu. Yds.) |  |
| Turf Reinforcement Mat
(2,100 Sq. Yds.) |  |
| Berm Repair |  |
| Erosion Control Wattle |  |
| Clearing |  |
| High Flow Silt Fence |  |
| Diversions Ditch |  |
| Rock Check Dam |  |
| Planned Water Surface |  |

Wetland Seed Mix 1
(5.3 Acres)
Wetland Seed Mix 2
(2.5 Acres)
Rural Seed Mix
(3.2 Acres)
Class A Rip Rap
(1,788 Cu. Yds.)
Turf Reinforcement M
(2,100 Sq. Yds.)

Berm Repair

Erosion Control Wattle

Clearing

High Flow Silt Fence

Diveresion Ditch

Rock Check Dam

Planned Water Surface

SHEET
8
OF 8

CLARK
ENGINEERING CORPORATION

Convention Center Plaza
1410 West Russell Street
Sioux Falls, SD 57104-1328
(605) 331-2505
Fax (605) 331-2602
siouxfalls@clark-eng.com

2201 NO 2554

DRAWN BY: _____

CHECKED BY: BDC

REVISIONS:

DATE:

03/01/07

SCALE:

 $1^{\circ} = 150'$

Erosion Control & Seeding Plan

Wieman Dam

Marion, South Dakota