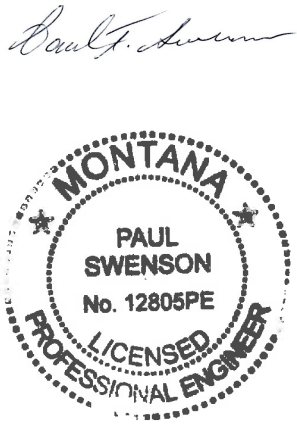
Evaluation of Existing Surface Impoundment Liner, West and East Scrubber Ponds

Lewis and Clark Station

Prepared for
Montana-Dakota Utilities Co.

September 2016



Paul T. Swenson 2016.09.30 16:49:35 -05'00'

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Evaluation of Existing Surface Impoundment Liner, West and East Scrubber Ponds

September 2016

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1.0 Purpose

Montana Dakota Utilities (MDU) retained Barr Engineering Co. (Barr) to evaluate the liners for both the West and East Scrubber Ponds at their Lewis & Clark Station, located near Sidney, Montana (Figure 1), for compliance with the criteria contained in Environmental Protection Agency (EPA) regulation 40 CFR 257, Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule). A description of the investigation and a summary of findings are provided in this report.

The West and East Scrubber Ponds are defined by the CCR Rule to be existing surface impoundments. The CCR Rule requires that liners for existing surface impoundments be evaluated in accordance with the following provisions:

> *"§257.71 Liner design criteria for existing CCR surface impoundments.*
>
> *(a)(1) No later than October 17, 2016, the owner or operator of an existing CCR surface impoundment must document whether or not such unit was constructed with any one of the following:*
>
> *(i) A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1 X 10^{-7} cm/sec;*
>
> *(ii) A composite liner that meets the requirements of § 257.70(b); or*
>
> *(iii) An alternative composite liner that meets the requirements of § 257.70(c).*
>
> *(2) The hydraulic conductivity of the compacted soil must be determined using recognized and generally accepted methods.*

The rule also requires that the owner or operator of the existing surface impoundment obtain a certification from a qualified professional engineer whether the liner documentation is accurate and meets the provisions of paragraph (a). This report is provided in response to this requirement for both the West and East Scrubber Ponds. This report also describes the investigation activities conducted to gather representative information to document current conditions for the liners for the West and East Scrubber Ponds.

1.1 Site Description

Lewis & Clark Station is a 50-MW, coal-fired power plant located approximately 2.5 miles south of Sidney, Montana on the north bank of the Yellowstone River in Richland County (Figure 1). The Scrubber Ponds consist of two basins, the West and East Scrubber Ponds, located near the plant (Figure 1). Each basin is approximately 1.66 acres in size. A berm has been constructed within each of the two scrubber pond basins to separate each into an ash settling cell with an area of approximately 1.33 acres, and an effluent polishing cell with an area of approximately 0.33 acres.

1.2 Background

A construction documentation/certification report could not be located for either the West or East Scrubber Ponds. MDU located record drawings notated "As Constructed 1993," prepared by North Central

Consultants, LTD of Jamestown, North Dakota, drawing date of March 4, 1993 (Appendix 1). The drawings show record information for the extents of the liner and the final elevations for the West and East Scrubber Ponds. The drawings indicate that a 3-foot-thick clay liner was constructed. Two photographs showing the construction of the West Scrubber pond in progress also were located in the facility records (Appendix 2). The photos show that the equipment used in constructing the liner was consistent with recognized and generally accepted methods of compacted clay liner (CCL) construction. The dates of the photos shown in Appendix 2 are unknown, but were presumably taken in or prior to 1993.

1.3 Investigation Scope of Work

Since little design information is available and certified record documentation of the construction of the West or East Scrubber Ponds is not available, a geotechnical investigation was conducted to evaluate physical properties of the liners in both the West and East Scrubber Ponds as required by CCR Rule. The investigation was planned to have testing frequencies consistent with frequencies that would be conducted for new CCL construction. Hydraulic conductivity testing on new CCL construction in the vicinity of the Lewis & Clark station is generally conducted at a frequency of one test per 5,000 cubic yards of liner material, with a minimum of three tests per construction phase. Montana does not publish prescribed quality assurance/quality control testing frequencies, so standards from the North Dakota Department of Health (Guideline 5) were used to establish the basis of test frequency.

For purposes of planning the investigation, it was assumed that both the West and East Scrubber Ponds have a 2-foot-thick (minimum) CCL. The assumed liner thickness multiplied by the area of one pond (1.66 acres) results in an estimated 5,356 cubic yards of liner material in each pond. Therefore, under the standard cited above, at least two permeability tests would be required in each pond based on quantity, and at least three permeability tests would be required in each pond because they were constructed separately. The higher of the two criteria (three tests) was selected to satisfy the CCR evaluation requirement.

Based on the information provided above, the field investigation scope for each pond was determined to include:

- Advancing three (3) soil borings;
- Collecting three (3) Shelby tube samples for laboratory testing; and
- Surveying the soil boring locations.

Laboratory permeability testing of undisturbed samples was conducted in accordance with ASTM D5084, consistent with testing procedures for CCL's at other facilities. Laboratory soil classification according to ASTM D2488 was used to classify the material samples from the borings.

A Barr specialist was on site during all field investigation activities to observe soil boring advancement, to classify soil samples, to collect geotechnical samples, and to observe plugging of the penetrations to repair the liner.

American Engineering Testing, Inc. (AET) of Williston, ND provided soil boring services, which included soil boring advancement, collecting undisturbed soil samples (Shelby tubes), repairing all penetrations to the liner, and soil boring abandonment.

Uintah Engineering & Land Surveying (Uintah) of Sidney, MT conducted the survey that included mapping the soil boring locations and approximate extent of liner.

Soil Engineering Testing (SET) of Richfield, MN conducted hydraulic conductivity testing and soil classifications.

2.0 West Scrubber Pond Investigation

Three soil borings (recorded as B-1-2015, B-2-2015, and B-3-2015) were advanced using hollow-stem auger (HSA) drilling technology in the West Scrubber Pond on August 13, 2015. Soil borings B-1-2015 and B-2-2015 were placed in the larger settling cell in the West Scrubber Pond, and soil boring B-3-2015 was placed in the smaller effluent polishing cell in the West Scrubber Pond (Appendix 3). Appendix 4 provides a photographic log of the investigation; photos 1 thru 4 show the West Scrubber Pond investigation, field work and samples.

2.1.1 Apparent Soil Liner Thickness Verification

Barr's field specialist measured and recorded the depth of the apparent soil liner in the field at each of the soil boring locations prior to collecting the Shelby tube samples, as summarized below:

- B-1-2015 – 3.5 feet apparent soil liner thickness
- B-2-2015 – 4.0 feet apparent soil liner thickness
- B-3-2015 – 2.7 feet apparent soil liner thickness

2.1.2 Site Survey

A field survey was performed to document the locations and elevations of the soil borings and to define the approximate horizontal extent of the soil liner on the West Scrubber Pond. A figure showing the survey results is provided in Appendix 3. The survey results are consistent with the top of liner elevations and extent of liner shown on Sheet No. 2 of the "As Constructed 1993" drawings.

2.1.3 Soil Laboratory Results

SET determined the hydraulic conductivity of the three samples in accordance with ASTM D5084. A Barr representative witnessed the removal of the soil samples from the Shelby tubes in SET's lab. An inspection of the samples was conducted to select the sections of the samples for testing. The upper 2-foot zone of the apparent soil liner was evaluated in three 8-inch thick sections (top to bottom) to determine if a competent, consistent liner system was present. The hydraulic test sample locations were determined after review of all three Shelby tube samples was completed. Based on this evaluation, the three 8-inch-thick zones of the top 2 feet of the samples were tested in the three sample locations shown in Table 1. Permeability test results for these samples are summarized in Table 1.

SET also classified the apparent liner material samples in accordance with ASTM D2488. The soil classification for each sample is provided in Table 1. The laboratory testing results are provided in Appendix 5.

Table 1: Laboratory Test Results

Shelby Tube Test Item	Tested Sample Location (Top 2 Feet)	Soil Type	Coefficient of Permeability (cm/sec)
B-1-2015	Bottom 8 inches	CH	9.4×10^{-9}
B-2-2015	Middle 8 inches	CH	1.7×10^{-8}
B-3-2015	Top 8 inches	CH	1.3×10^{-8}

3.0 East Scrubber Pond Investigation

Three soil borings (recorded as B-4-2015, B-5-2015, and B-6-2015) were advanced using hollow-stem auger (HSA) drilling technology in the East Scrubber Pond on October 28 and 29, 2015. Soil borings B-4-2015 and B-5-2015 were placed in the larger settling cell in the East Scrubber Pond, and soil boring B-6-2015 was placed in the smaller effluent polishing cell in the East Scrubber Pond (Appendix 3). Appendix 4 provides a photographic log of the investigation; photos 5 thru 8 show the East Scrubber Pond investigation field work and samples.

Boring B-4-2015 encountered a total thickness of 2.8 feet of clay. A 0.4-foot-thick zone of non-continuous, slightly cemented, silty sandy clods mixed into the liner soil which was encountered 1.9 feet below the surface of the apparent soil liner. An undisturbed soil sample was collected with a Shelby tube near the soil boring. A similar zone of clods was not identified in the Shelby tube sample. An undisturbed soil sample was tested for permeability to verify conditions in the vicinity of the soil boring. Because the permeability test exceeded the minimum criteria and that more clay was encountered in the boring below the clods, and undisturbed soil samples did not display the zone of clods, it was determined that this was likely an isolated area and does not compromise the integrity of the pond liner.

3.1.1 Apparent Soil Liner Thickness Verification

Barr's field specialist measured and recorded the depth of the apparent soil liner in the field at each of the soil boring location prior to collecting the Shelby tube samples, as summarized below:

- B-4-2015 – 2.8 feet apparent soil liner thickness
- B-5-2015 – 2.0 feet apparent soil liner thickness
- B-6-2015 – 3.1 feet apparent soil liner thickness

3.1.2 Site Survey

A field survey was performed to document the locations and elevations of the soil borings and to define the approximate horizontal extent of the soil liner in the East Scrubber Pond. A figure showing the survey results is provided in Appendix 3. The survey results are consistent with the top of liner elevations and extent of liner shown on Sheet No. 2 of the "As Constructed 1993" drawings.

3.1.3 Soil Laboratory Results

SET determined the hydraulic conductivity of the three samples in accordance with ASTM D5084. A Barr representative witnessed the removal of the soil samples from the Shelby tubes in SET's lab. An inspection of the samples was conducted to select the sections of the samples for testing. The upper 2-foot zone of the apparent soil liner was evaluated in three 8-inch sections (top to bottom) to determine if a competent, consistent liner system was present. The hydraulic test sample locations were determined after review of all three Shelby tube samples was completed. Based on this evaluation, the three 8-inch-thick zones of the top 2 feet of the samples were tested in the three sample locations shown in Table 2. Permeability test results for these samples are summarized in Table 2.

SET also classified the apparent liner material samples in accordance with ASTM D2488. The soil classification for each sample is provided in Table 2. The laboratory testing results are provided in Appendix 5.

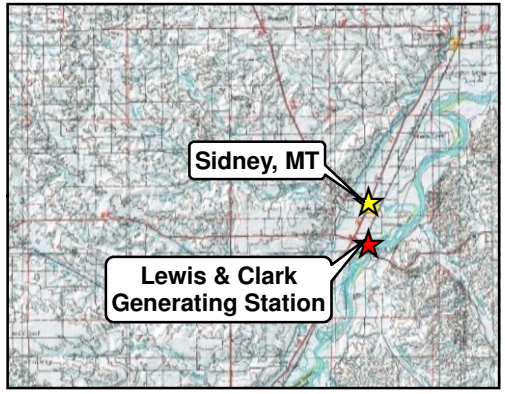
Table 2: Laboratory Test Results

Shelby Tube Test Item	Tested Sample Location (Top 2 Feet)	Soil Type	Coefficient of Permeability (cm/sec)
B-4-2015	Middle 8 inches	CH	7.7×10^{-9}
B-5-2015	Top 8 inches	CH	7.1×10^{-8}
B-6-2015	Bottom 8 inches	CH	1.0×10^{-8}

4.0 Conclusion

The investigation found there is a consistent soil liner with a permeability of no more than 1 x 10^{-7} cm/sec and a thickness of two feet or more at the locations that were tested. Based upon laboratory test results, survey results that corroborate with the "As Constructed 1993" drawings, construction record photographs, observations made at the site, and interviews with MDU personnel, it is my professional opinion that the liner in both the West and East Scrubber Ponds meets or exceeds the criteria presented in §257.71, to the extents of the area shown on the figure in Appendix 3.

Figures



N

Feet

500 0 500

BARR

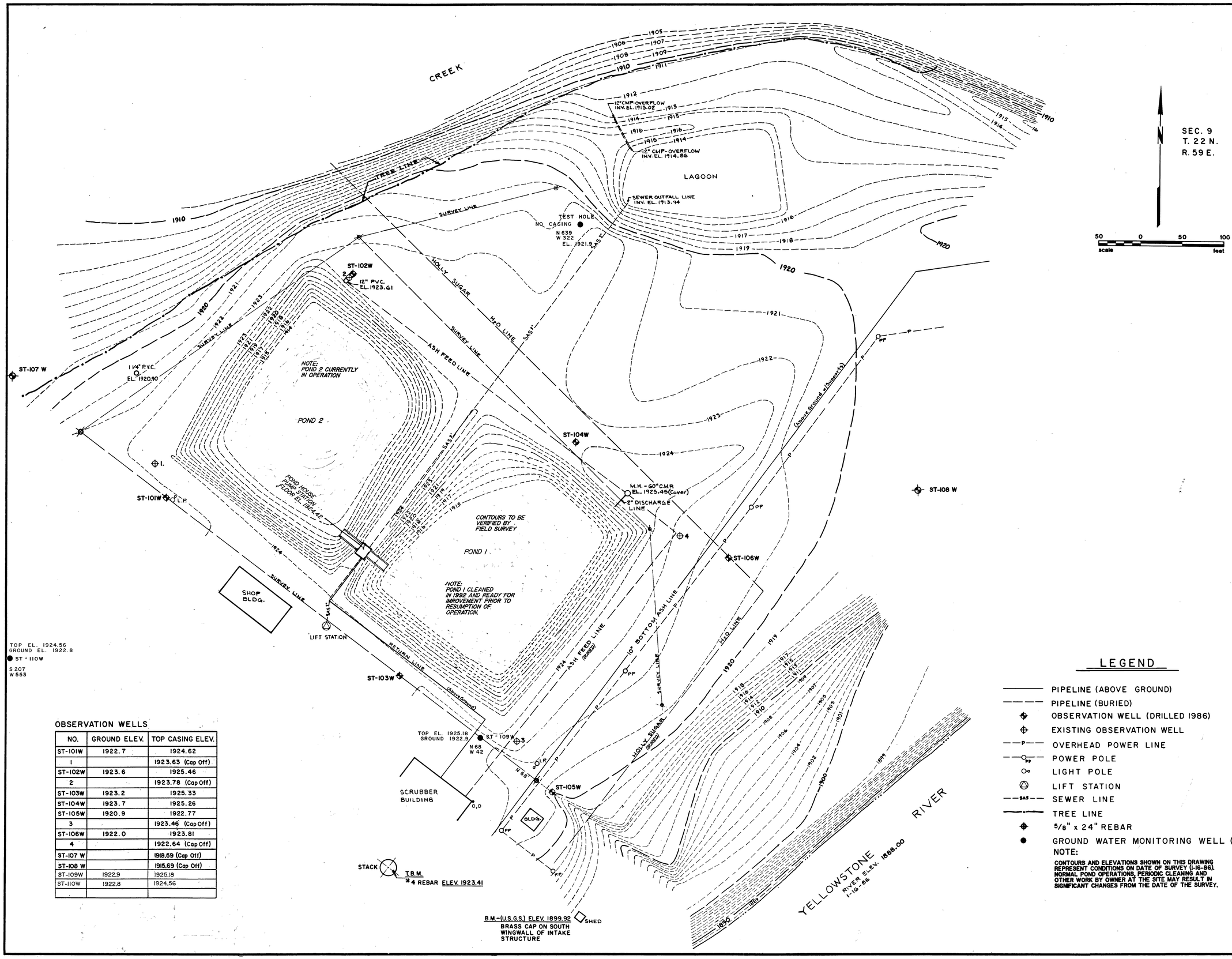
Figure 1

Site Location
Lewis & Clark Generating Station
Montana Dakota Utilities
Richland County, Montana

Barr Footer: ArcGIS 10.3.1, 2015-08-04 15:09 File: I:\Projects\26\41\1002\Maps\Reports\Task 2\Fig01 Site Location Monitoring Wells Map_update.mxd User: MRQ

Appendix 1

As Constructed Drawings 1993



OBSERVATION WELLS

NO.	GROUND ELEV.	TOP CASING ELEV.
ST-101W	1922.7	1924.62
1		1923.63 (Cap Off)
ST-102W	1923.6	1925.46
2		1923.78 (Cap Off)
ST-103W	1923.2	1925.33
ST-104W	1923.7	1925.26
ST-105W	1920.9	1922.77
3		1923.46 (Cap Off)
ST-106W	1922.0	1923.81
4		1922.64 (Cap Off)
ST-107 W		1918.59 (Cap Off)
ST-108 W		1915.69 (Cap Off)
ST-109W	1922.9	1925.18
ST-110W	1922.8	1924.56

LEGEND

- PIPELINE (ABOVE GROUND)
- PIPELINE (BURIED)
- OBSERVATION WELL (DRILLED 1986)
- EXISTING OBSERVATION WELL
- OVERHEAD POWER LINE
- POWER POLE
- LIGHT POLE
- LIFT STATION
- SEWER LINE
- TREE LINE
- 5/8" x 24" REBAR
- GROUND WATER MONITORING WELL (1991)

NOTE:

CONTOURS AND ELEVATIONS SHOWN ON THIS DRAWING REPRESENT CONDITIONS ON DATE OF SURVEY (1-16-86). NORMAL POND OPERATIONS, PERIODIC CLEANING AND OTHER WORK BY OWNER AT THE SITE MAY RESULT IN SIGNIFICANT CHANGES FROM THE DATE OF THE SURVEY.

CERTIFICATION

I HEREBY CERTIFY THAT THESE DRAWINGS 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 MONTANA. NUMBER 03979 E

JAMES A. SKARET P.E. REG. NO. 3979E

SCRUBBER SLUDGE STORAGE POND IMPROVEMENTS
LEWIS & CLARK STATION
SIDNEY, MONTANA

EXISTING CONDITIONS

DRAWN BY mms | PROJECT NO 92-07
CHECKED BY JAS | DATE 3-4-93

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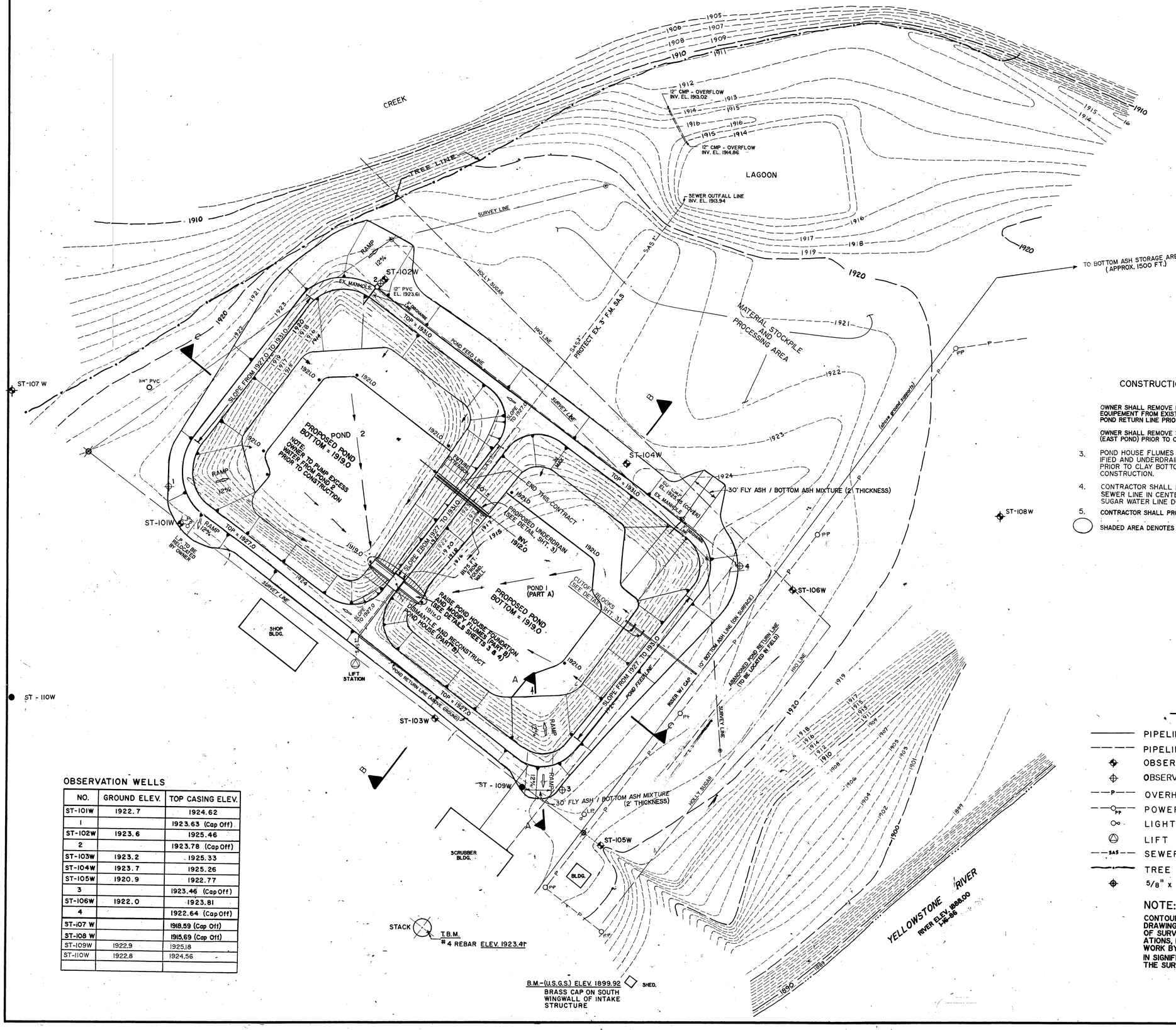
SHEET NO. 1



CONSTRUCTION NOTES

OWNER SHALL REMOVE ELECTRICAL & MECHANICAL EQUIPEMENT FROM EXISTING POND HOUSE AND REMOVE POND RETURN LINE PRIOR TO CONSTRUCTION.

OWNER SHALL REMOVE 3" DISCHARGE LINE TO POND 1 (EAST POND) PRIOR TO CONSTRUCTION.

3. POND HOUSE FLUMES / SPILLWAY SHALL BE MODIFIED AND UNDERDRAINS SHALL BE INSTALLED PRIOR TO CLAY BOTTOM AND SIDEWALL LINER CONSTRUCTION.
4. CONTRACTOR SHALL PROTECT EXISTING SANITARY SEWER LINE IN CENTER DIKE AND THE HOLLY SUGAR WATER LINE DURING CONSTRUCTION.
5. CONTRACTOR SHALL PROTECT OBSERVATION WELLS.

SHADED AREA DENOTES FUTURE CONSTRUCTION.

OBSERVATION WELLS

NO.	GROUND ELEV.	TOP CASING ELEV.
ST-101W	1922.7	1924.62
1		1923.63 (Cap Off)
ST-102W	1923.6	1925.46
2		1923.78 (Cap Off)
ST-103W	1923.2	1925.33
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3		1923.46 (Cap Off)
ST-106W	1922.0	1923.81
4		1922.64 (Cap Off)
ST-107 W		1918.59 (Cap Off)
ST-108 W		1915.69 (Cap Off)
ST-109W	1922.9	1925.18
ST-110W	1922.8	1924.56

LEGEND

- PIPELINE (ABOVE GROUND)
- PIPELINE (BURIED)
- OBSERVATION WELL (DRILLED 1986)
- OBSERVATION WELL (DRILLED PRIOR TO 1986)
- OVERHEAD POWER LINE
- POWER POLE
- LIGHT POLE
- LIFT STATION
- SEWER LINE
- TREE LINE
- 5/8" x 24" REBAR (SURVEY CONTROL POINTS)

NOTE:

CONTOURS AND ELEVATIONS SHOWN ON THIS DRAWING REPRESENT CONDITIONS ON DATE OF SURVEY (1-16-86). NORMAL POND OPERATIONS, PERIODIC CLEANING AND OTHER WORK BY OWNER AT THE SITE MAY RESULT IN SIGNIFICANT CHANGES FROM THE DATE OF THE SURVEY.

AS CONSTRUCTED 1993

CERTIFICATION

I HEREBY CERTIFY THAT THESE DRAWINGS 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 MONTANA.

JAMES A. SKARET P.E.
REG. NO. 6999E

SCRUBBER SLUDGE STORAGE POND IMPROVEMENTS
LEWIS & CLARK STATION
SIDNEY, MONTANA

SITE LAYOUT AND GRADING

DRAWN BY mac
CHECKED BY JS

PROJECT NO. 92-07
DATE 3-4-93

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JAMESTOWN, NORTH DAKOTA

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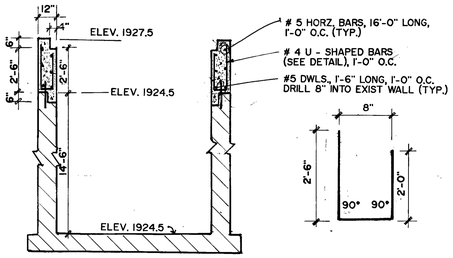

SECTION D-D
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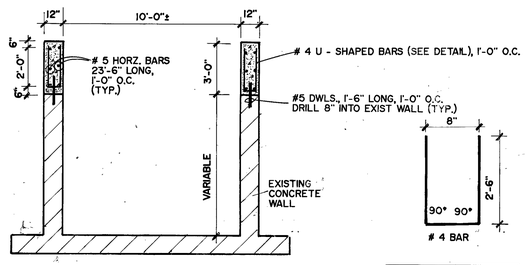

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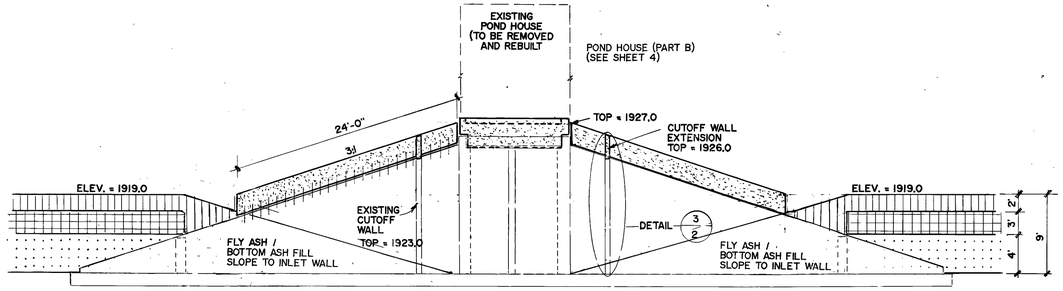

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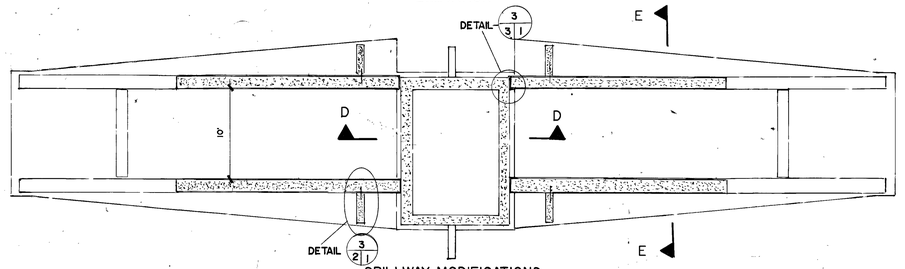
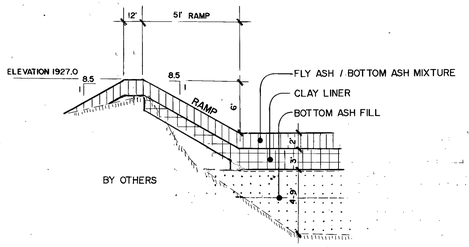


SPILLWAY MODIFICATIONS
PLAN VIEW



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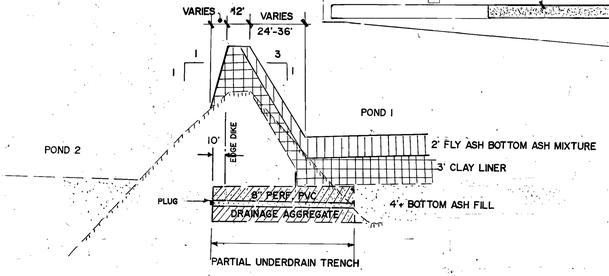
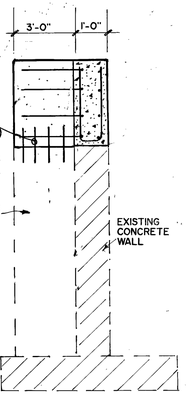


1993 CONSTRUCTION
CENTER DIKE



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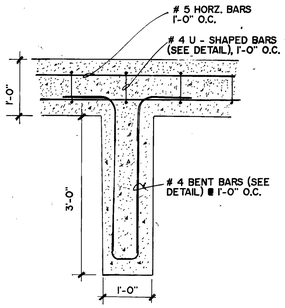

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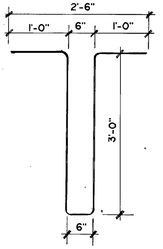

BENT BAR DETAIL
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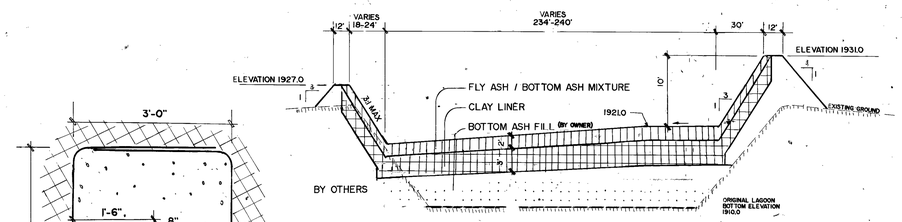

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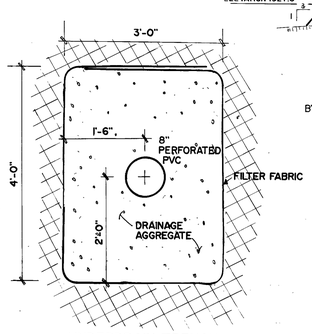

UNDERDRAIN TRENCH
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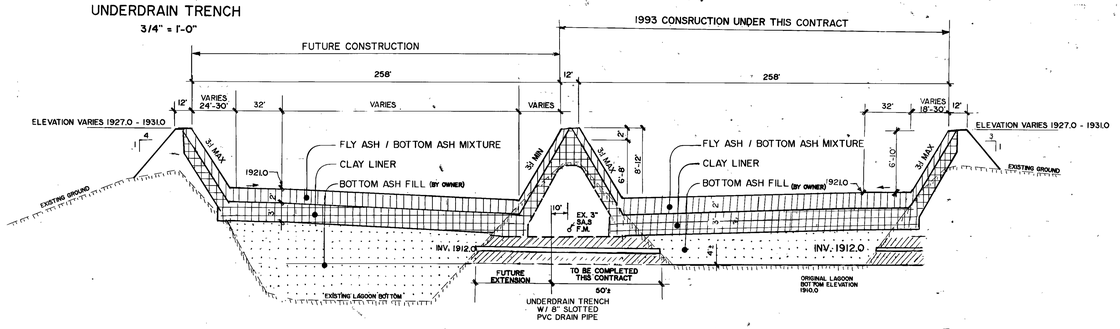

SECTION C-C

AS CONSTRUCTED 1993

CERTIFICATION
I HEREBY CERTIFY THAT THESE DRAWINGS 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 MONTANA.
JAMES A. SKARET P.E.
REG. NO. 8939PE

SCRUBBER SLUDGE STORAGE
POND IMPROVEMENTS
LEWIS & CLARK STATION
SIDNEY, MONTANA

LINER AND MISC. DETAILS

DRAWN BY mcm | PROJECT NO 92-07
CHECKED BY JAS | DATE 3-4-93

NORTH CENTRAL CONSULTANTS, LTD.
ENGINEERING * PROJECT MANAGEMENT * ARCHITECTURE
BISMARCK, NORTH DAKOTA * JAMESTOWN, NORTH DAKOTA

ncc

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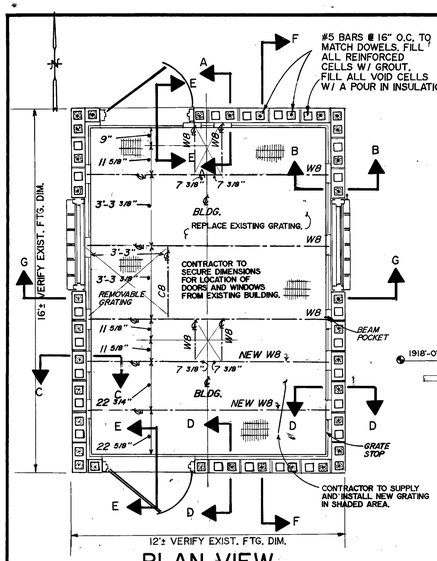
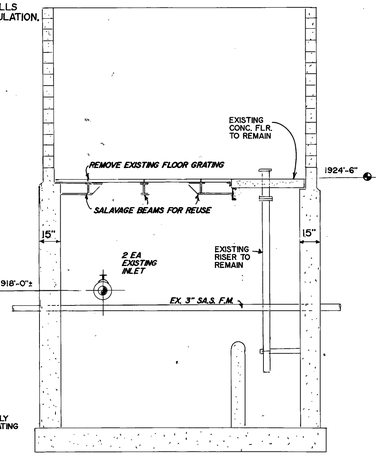
3



PLAN VIEW

NO SCALE



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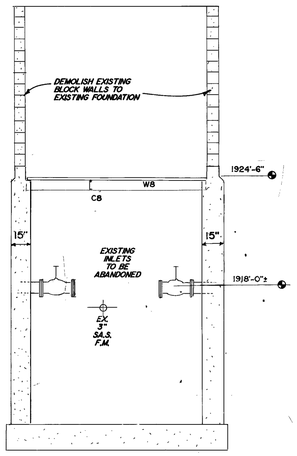

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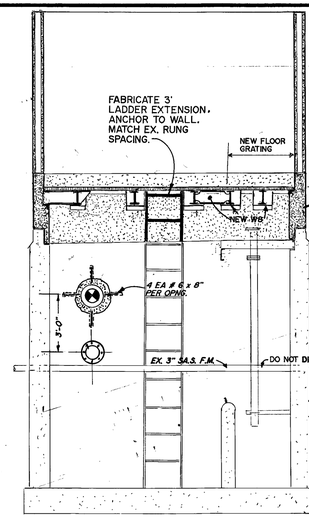

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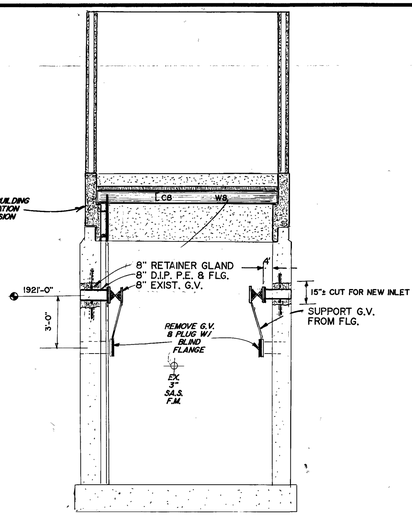
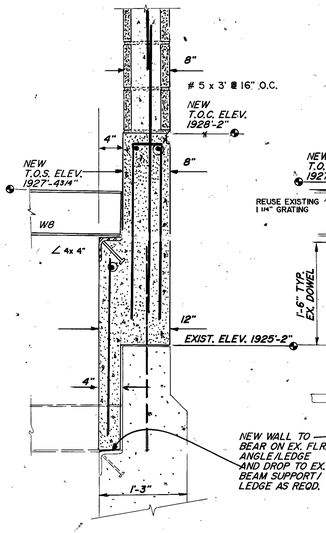


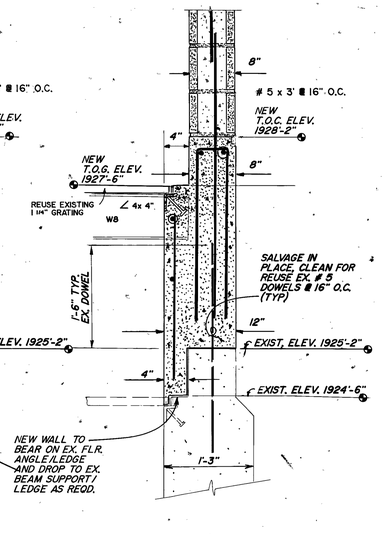
PROPOSED
SECTION G-G

NO SCALE



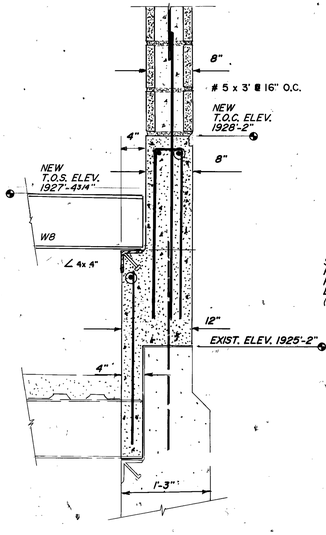
SECTION A-A

N.T.S.



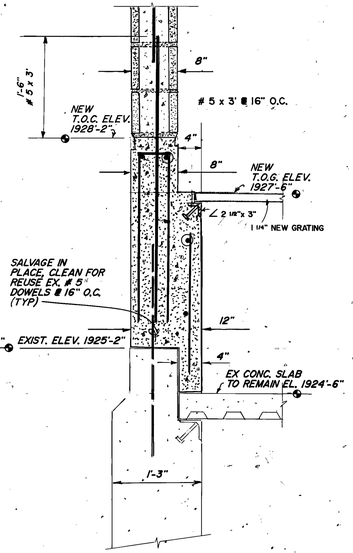
SECTION B-B

N.T.S.



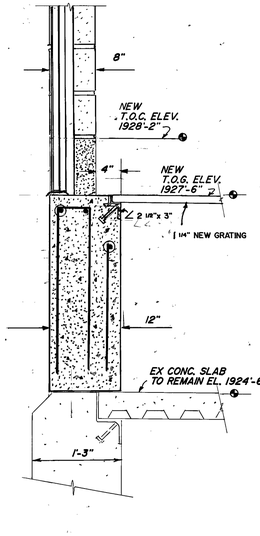
SECTION C-C

N.T.S.



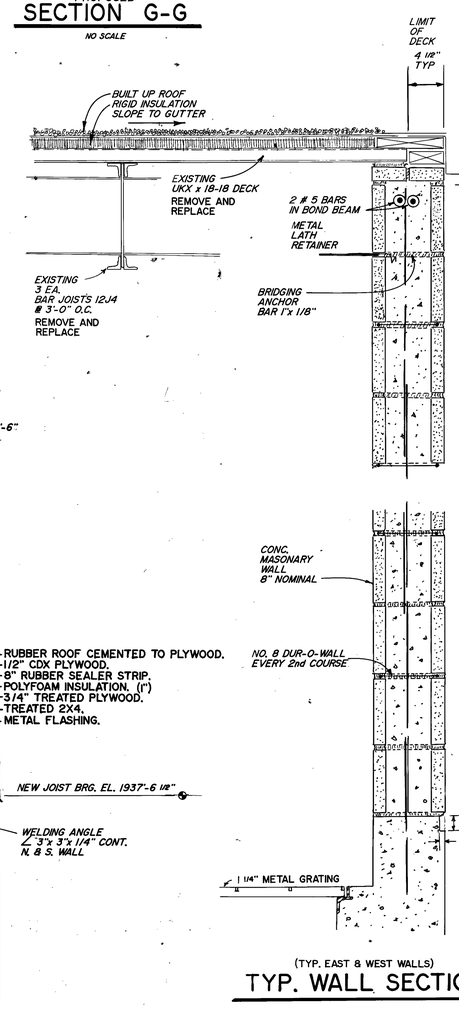
SECTION D-D

N.T.S.



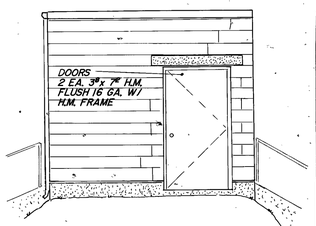
SECTION E-E

N.T.S.



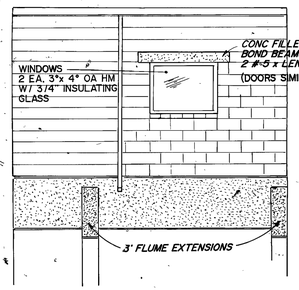
(TYP. EAST & WEST WALLS)
TYP. WALL SECTION

NO SCALE



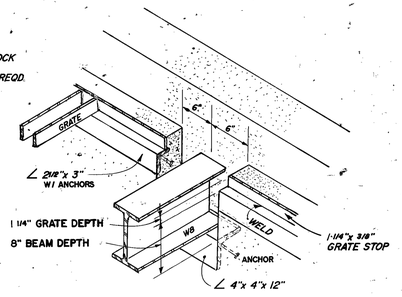
SOUTH ELEV. SIMILAR
NORTH ELEV.

NO SCALE



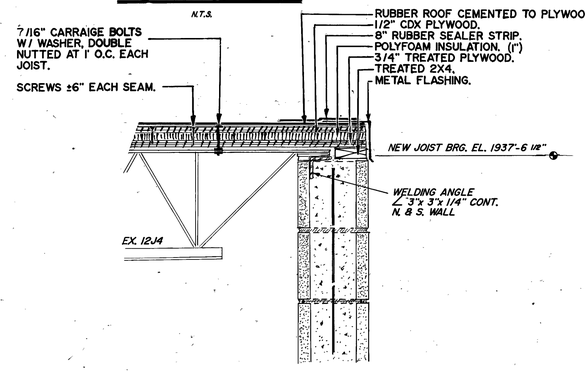
WEST ELEV. SIMILAR
EAST ELEV.

NO SCALE



BEAM POCKET

NO SCALE



(TYP. NORTH & SOUTH WALLS)
JOIST CONNECTION

NO SCALE

AS CONSTRUCTED 1993

SCRUBBER SLUDGE STORAGE POND IMPROVEMENTS
LEWIS & CLARK STATION
SIDNEY, MONTANA

POND HOUSE RECONSTRUCTION

DRAWN BY mns | PROJECT NO 92-07
CHECKED BY JAS | DATE 3-4-93

CERTIFICATION
I HEREBY CERTIFY THAT THESE DRAWINGS 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 MONTANA.
JAMES A. SKARET P.E.
REG. NO. 9999E

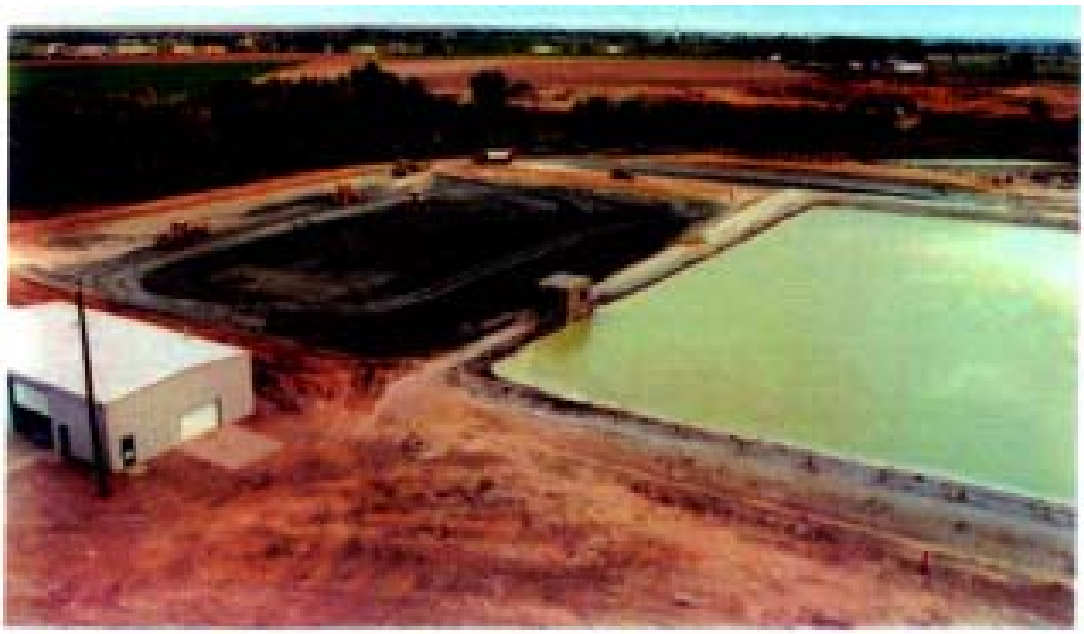
NORTH CENTRAL CONSULTANTS, LTD.
ENGINEERING • PROJECT MANAGEMENT
ARCHITECTURE
BISMARCK, NORTH DAKOTA
JAMESTOWN, NORTH DAKOTA

SHEET NO. 4

Appendix 2

MDU West Scrubber Pond Liner Construction Photos

Photograph 1 – West Scrubber Pond Liner Construction



Photograph 2 – West Scrubber Pond Liner Construction

Appendix 3

Uintah Site Plan

N

TRUE NORTH

100' 50' 0' 100'

BASIS OF BEARINGS

BASIS OF BEARINGS IS A G.P.S. OBSERVATION

VERTICAL CONTROL DATUM: NAVD88

Berm

Bench Mark
Control Point 3
Alum. Cap
El. 1913.76'

Sewage Lagoon

Berm

Berm

B-1-2015
El. 1921.2'
(Top of Liner)

West Scrubber Pond

Top of PVC Pipe
El. 1929.1'

B-2-2015
El. 1920.0'
(Top of Liner)

Top of PVC Pipe
El. 1928.6'

Ash Pile

New
Berm

Edge of Liner

Wall

Wall

El. 1923.9'
ST4A
ST4X
El. 1924.0'
ST4B
El. 1924.1'
ST4C
El. 1923.3'

BORE 5
El. 1922.4'
ST5B
El. 1922.2'
ST5A
El. 1922.0'

BORE 4
El. 1924.1'

B-3-2015
El. 1918.8'
(Top of Liner)

Building

East Scrubber Pond

El. 1922.6'
ST6A
BORE 6
El. 1922.5'
ST6B
El. 1922.7'

Top of PVC Pipe
El. 1929.6'

Top of PVC Pipe
El. 1929.2'

Bench Mark
Control Point 5
Alum. Cap
El. 1924.29'

Bench Mark
Control Point 4
Alum. Cap
El. 1921.93'

S25°56'08"W
493.26'

Bench Mark
Gauge Station, USGS
Brass Cap
El. 1893.20'

NOTES:

- Contours shown at 2' intervals.

UINTAH ENGINEERING & LAND SURVEYING

UELS, LLC
Corporate Office * 85 South 200 East
Vernal, UT 84078 * (435) 789-1017

BARR ENGINEERING COMPANY

MDU - LEWIS & CLARK STATION
N 1/2 SW 1/4, SECTION 9, T22N, R59E, P.M.M.
RICHLAND COUNTY, MONTANA

DRAWN BY: E.C.	DATE DRAWN: 03-21-16
SCALE: 1" = 100'	REVISED: 03-23-16 E.C.

SITE PLAN - B

N

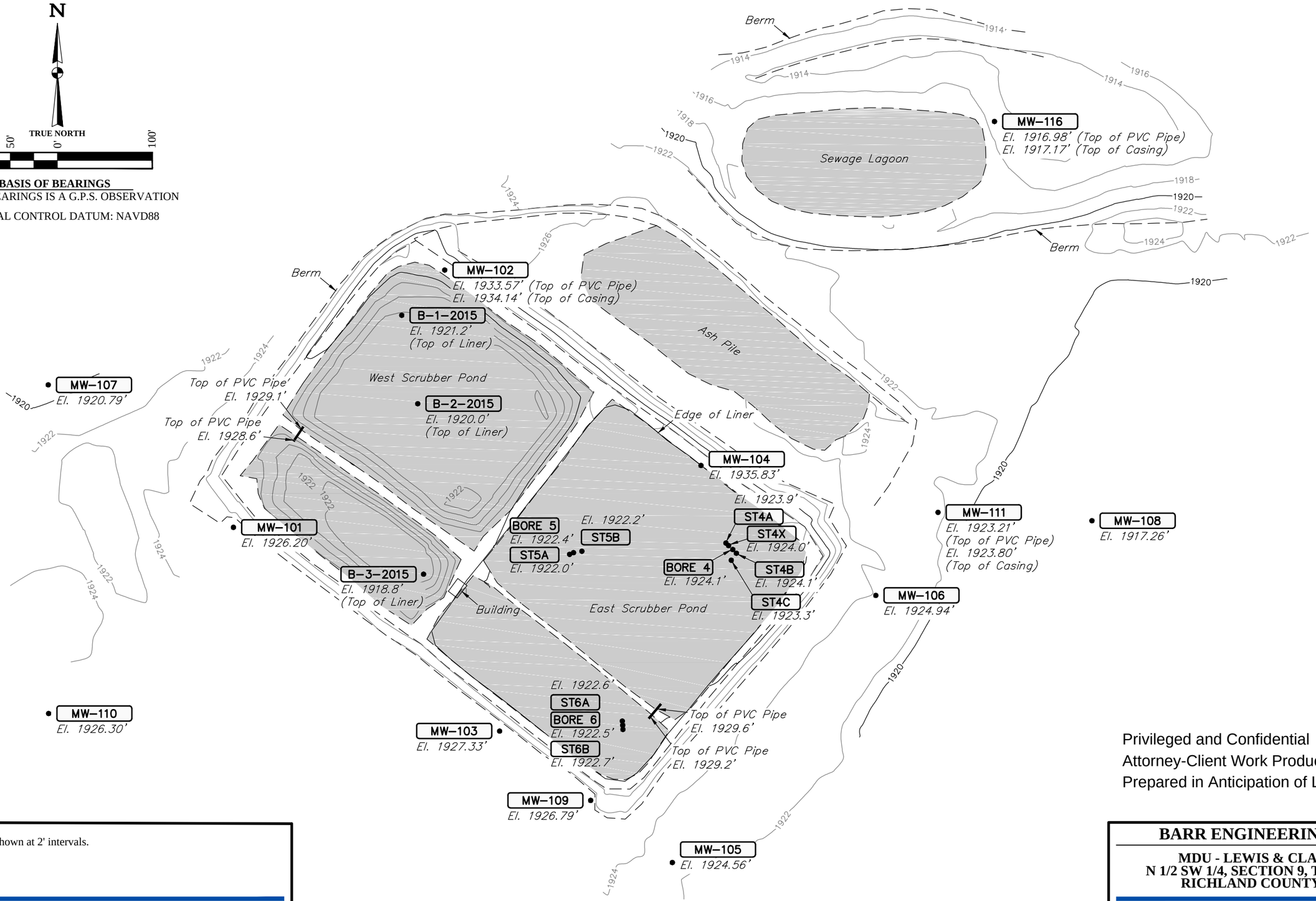
TRUE NORTH

100' 50' 0' 100'

BASIS OF BEARINGS

BASIS OF BEARINGS IS A G.P.S. OBSERVATION

VERTICAL CONTROL DATUM: NAVD88



Privileged and Confidential
Attorney-Client Work Product
Prepared in Anticipation of Litigation

NOTES:

- Contours shown at 2' intervals.

UINTAH ENGINEERING & LAND SURVEYING

UELS, LLC
Corporate Office * 85 South 200 East
Vernal, UT 84078 * (435) 789-1017

BARR ENGINEERING COMPANY

MDU - LEWIS & CLARK STATION
N 1/2 SW 1/4, SECTION 9, T22N, R59E, P.M.M.
RICHLAND COUNTY, MONTANA

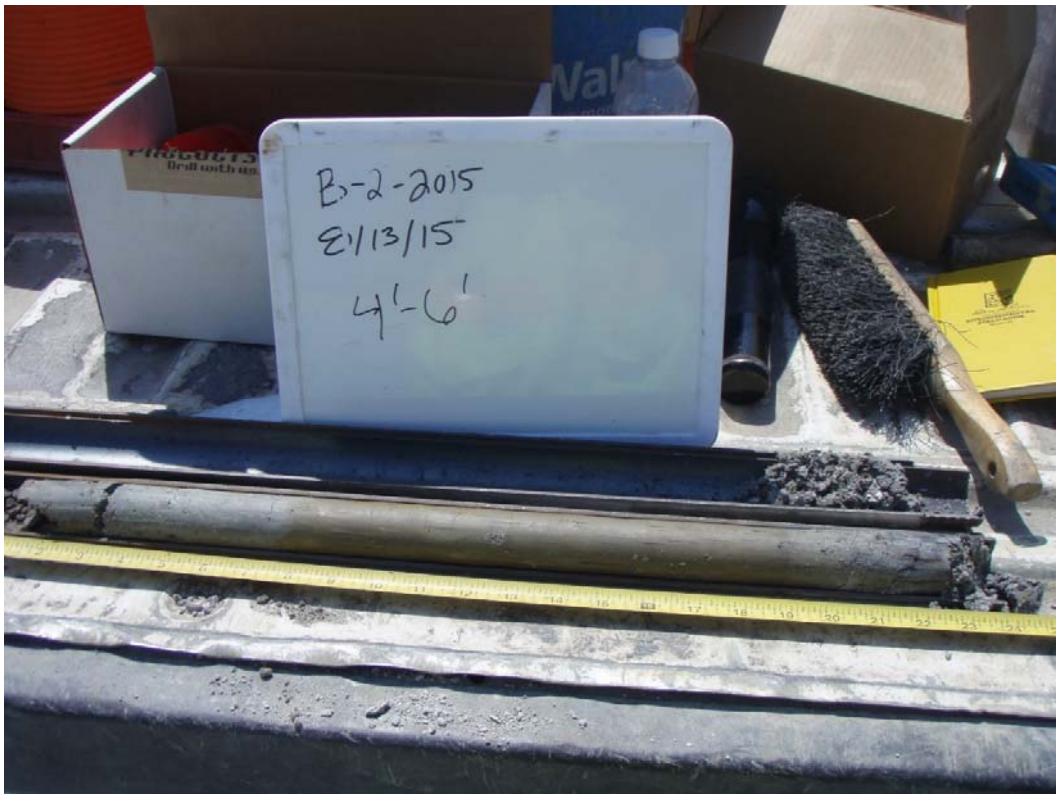
DRAWN BY: M.F.D.	DATE DRAWN: 08-18-15
SCALE: 1" = 100'	REVISED: 11-02-15

SITE PLAN

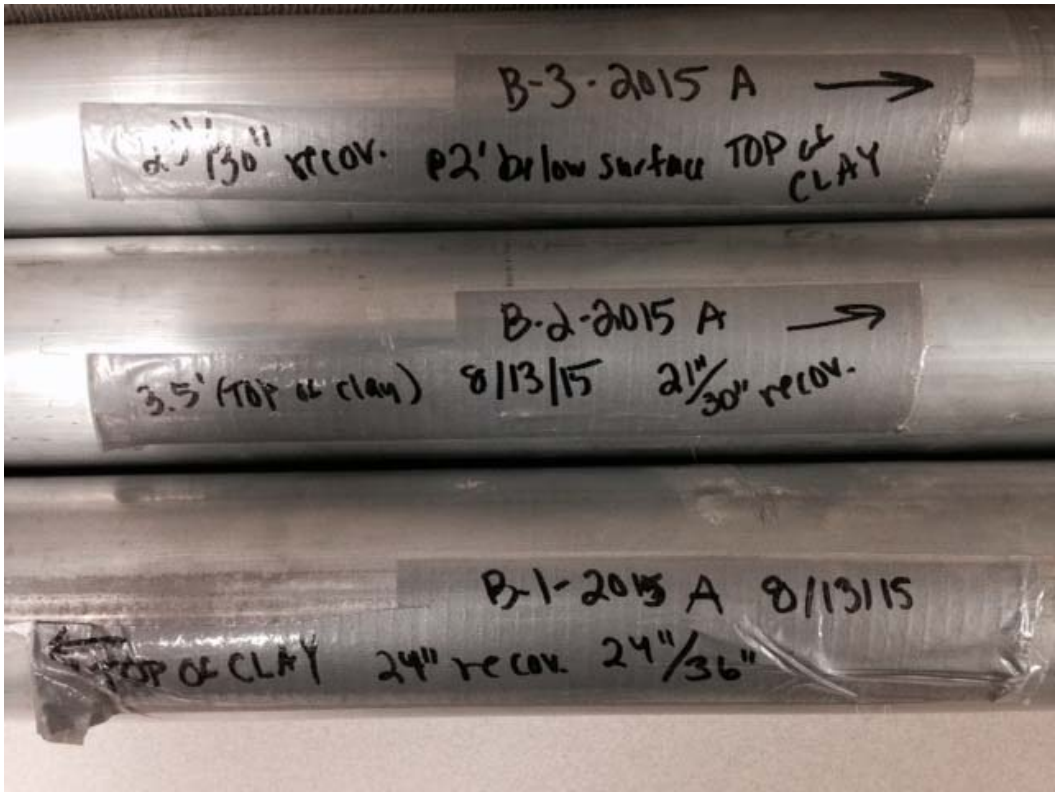
Appendix 4

Liner Investigation Photos

Photograph 1– AET setting up to conduct drilling in the West Scrubber Pond



Photograph 2 – Split spoon sample from Boring B-2-2015 in the West Scrubber Pond

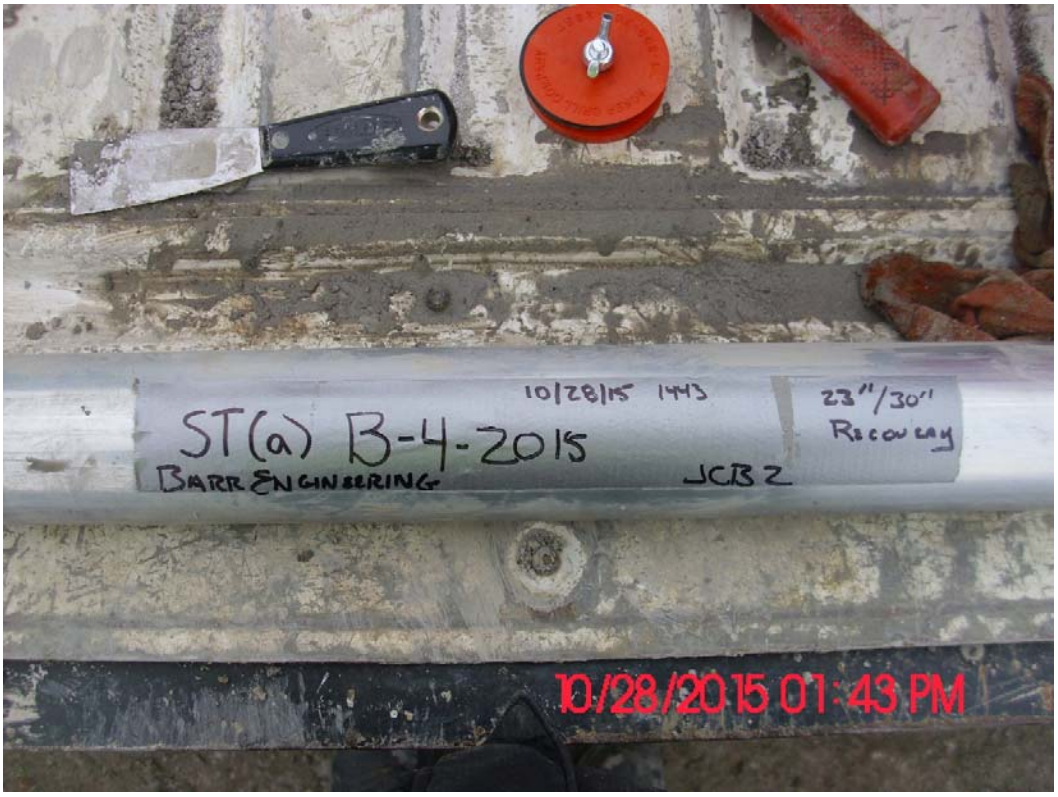


Photograph 3 – Shelby tubes with undisturbed liner material samples collected in the West Scrubber Pond for analysis

Photograph 4 – West Scrubber Pond liner sample extruded from Shelby tube prior to testing

Photograph 5 – AET setting up to conduct drilling in the East Scrubber Pond

Photograph 6 – Split spoon sample from Boring B-6-2015 in the East Scrubber Pond



Photograph 7 – Shelby tube with undisturbed liner material samples collected in the East Scrubber Pond for analysis

Photograph *8* – East Scrubber Pond Liner sample extruded from Shelby tube prior to testing

Appendix 5

SET Laboratory Reports

Hydraulic Conductivity Test Data ASTM D5084-10

Project: E Liner Evaluation Date: 11/20/2015

Reported To: Barr Engineering Company Job No.: 10109

Boring No.:	ST-B4(a)-2015	ST-B5(a)-2015	ST-B6(a)-2015				
Sample No.:							
Depth (ft):	Mid 8"-16"	Top 0"-8"	Bot 16"-24"				
Sample Date:	10/28/2015	10/28/2015	10/29/2015				
Sample Type:	3T	3T	3T				
Soil Type:	Fat Clay (CH)	Fat Clay (CH)	Fat Clay (CH)				
Atterberg Limits							
LL							
PL							
PI							
Permeability Test	Intact	Intact	Intact				
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	2.73	2.74	2.74				
Dia. (in):	2.87	2.87	2.87				
Dry Density (pcf):	110.8	108.8	110.2				
Water Content:	18.9%	19.8%	19.1%				
Test Type:	Falling Head	Falling Head	Falling Head				
Max Head (ft.):	5.0	5.0	5.0				
Confining press. (Effective-psi):	2.0	2.0	2.0				
Trial No.:	8-12	8-12	8-12				
Water Temp °C:	22.0	22.0	22.0				
% Compaction							
% Saturation (After Test)	97.1%	99.4%	98.6%				
Coefficient of Permeability							
K @ 20 °C (cm/sec)	**7.7×10^{-9}**	**7.1×10^{-9}**	**1.0×10^{-8}**				
K @ 20 °C (ft/min)	**1.5×10^{-8}**	**1.4×10^{-8}**	**2.0×10^{-8}**				
Notes:							

2401 W 66th Street
SOIL ENGINEERING TESTING, INC.
Richfield, Minnesota 55423-2031

Hydraulic Conductivity Test Data ASTM D5084

Project: Liner Evaluation Date: 9/1/2015

Reported To: Barr Engineering Company Job No.: 9987

Boring No.:	B-1-2015	B-2-2015	B-3-2015				
Sample No.:							
Depth (ft):	0-2	0-3.5	0-2				
Location:	Bottom	Middle	Top				
Sample Type:	3T	3T	3T				
Soil Type:	Fat Clay w/ a few lenses of silt (CH)	Fat Clay w/ a few lenses of silt (CH)	Fat Clay w/ a few lenses of silt (CH)				
Atterberg Limits							
LL							
PL							
PI							
Permeability Test	Intact	Intact	Intact				
Before Test Conditions: Saturation %:							
Porosity:							
Ht. (in):	2.04	2.73	2.72				
Dia. (in):	2.88	2.87	2.87				
Dry Density (pcf):	107.9	108.4	107.0				
Water Content:	20.1%	20.7%	21.3%				
Test Type:	Falling Head	Falling Head	Falling Head				
Max Head (ft.):	5.0	5.0	5.0				
Confining press. (Effective-psi):	2.0	2.0	2.0				
Trial No.:	8-12	8-12	8-12				
Water Temp ℃:	22.0	22.0	22.0				
% Compaction							
% Saturation (After Test)	99.3%	99.9%	98.6%				
Coefficient of Permeability							
K @ 20 ℃ (cm/sec)	**9.4×10^{-9}**	**1.7×10^{-8}**	**1.3×10^{-8}**				
K @ 20 ℃ (ft/min)	**1.9×10^{-8}**	**3.3×10^{-8}**	**2.6×10^{-8}**				
Notes:							

2401 W 66th Street
SOIL ENGINEERING TESTING, INC.
Richfield, Minnesota 55423-2031

Appendix 6

Boring Logs

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-1-2015

Project:West Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,248,406.7 ft E 3,584,401.6 ft
Datum:NAVD88

Surface Elevation:1921.2 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:8.6 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0				GP		0-0.3': FILL (GP): fine grained; light gray; moist.	
						0.3-2': FILL (GP): fine to medium grained; medium gray; moist; clayey.	
				GP			1920.0
2.5						2-5.5': CLAY (CH): greenish gray (6/5GY/Gley 1); moist; high plasticity.	
			2-3-3-5.	CH			1917.5
5.0			1-3-3-5.			At 5.5': Some color change to olive brown (2.5Y 4/3).	
						5.5-8.6': FILL (GP): medium to coarse grained; olive brown (4/3 2.5Y); moist; gravely, clayey.	1915.0
			7-10-12-13.	GP			
7.5						At 8': Gravel.	
			16-50/1"-.			End of boring 8.6 feet	
10.0							
12.5							
15.0							
17.5							
20.0							

Date Boring Started: 8/13/15 9:45 am
Date Boring Completed: 8/13/15 10:25 am
Logged By: AMK2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Sunny, calm, 100 degrees Fahrenheit

O:\GINT\PROJECTS\26411006 WEST POND.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-2-2015

Project:West Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,248,322.4 ft E 3,584,398.4 ft
Datum:NAVD88

Surface Elevation:1920.0 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:7.4 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0			3-2-3-5.	GP		0-1.5': FILL (GP): fine grained; light gray; moist.	1920.0
2.5			1-3-4-5.	CH		1.5-5.5': CLAY (CH): greenish gray (5/5GY/Gley 1); moist; high plasticity; very stiff at top.	1917.5
5.0			1-4-6-23.			At 4.5': Color change to olive brown (4/3 2.5Y).	1915.0
			11-29-50/5"-.	GP		5.5-7.4': FILL (GP): medium to coarse grained; olive brown (4/3 2.5Y); moist.	
7.5						End of boring 7.4 feet	
10.0							
12.5							
15.0							
17.5							
20.0							

Date Boring Started: 8/13/15 11:55 am
Date Boring Completed: 8/13/15 12:20 pm
Logged By: AMK2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Sunny, calm, 100 degrees Fahrenheit

O:\GINT\PROJECTS\26411006 WEST POND.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-3-2015

Project:West Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,248,170.8 ft E 3,584,395.1 ft
Datum:NAVD88

Surface Elevation:1918.2 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:3.9 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0			2-2-3-3.	CH		0-2.7': CLAY (CH): fine grained; greenish gray (6/10Y/Gley 1); moist; high plasticity.	1917.5
2.5			1-9-33-50/4".	GP		2.7-3.9': FILL (GP): medium to coarse grained; dark gray; moist.	1915.0
						End of boring 3.9 feet	
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							

Date Boring Started: 8/13/15 1:25 pm
Date Boring Completed: 8/13/15 4:00 am
Logged By: AMK2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Sunny, calm, 100 degrees Fahrenheit

O:\GINT\PROJECTS\26411006 WEST POND.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-4-2015

Project:East Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,248,180.9 ft E 3,584,746.1 ft
Datum:NAVD88

Surface Elevation:1924.1 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:12.0 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0				GP		0-2': FILL (GP): fine grained; dark gray; dry to moist.	1922.5
2.5				GP		2-3': FILL (GP): fine to medium grained; dark gray; dry.	
			12-3-4-6.	CH		3-4': CLAY (CH): fine grained; light gray (6/5GY/Gley 1); moist; high plasticity; firm.	
				CH		4-4.9': CLAY (CH): fine grained; light gray (2.5Y 4/3); moist; high plasticity; firm.	1920.0
5.0			3-4-22-25.	CH		4.9-5.3': CLAY MIXED WITH SLIGHTLY CEMENTED SILTY SANDY LUMPS (CH): light brown (7.5YR 6/6); not continuous.	
				CH		5.3-5.75': CLAY (CH): fine grained; light gray; moist; mixed with sand (SW).	
				CH		5.75-6': CLAY (CH): light to dark gray; high plasticity; firm.	
			30-25/0.5-.	GP		6-6.75': FILL (GP): coarse grained; light to dark gray; dry.	1917.5
7.5							
			18-26-21-.	GP		8-9.5': FILL (GP): fine to medium grained; light to dark gray; dry.	1915.0
10.0				GP		10-10.2': FILL (GP): fine grained; light to dark gray; dry.	
				SW		10.2-11.2': SAND (SW): fine grained; brown; wet.	
			6-7-13-28.	SW		11.2-12': SAND (SW): fine grained; gray; moist.	1912.5
12.5						End of boring 12.0 feet	
15.0							
17.5							
20.0							

Date Boring Started: 10/28/15 9:30 am
Date Boring Completed: 10/28/15
Logged By: JCB2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Overcast, windy, 35 degrees Fahrenheit

O:\GINT\PROJECTS\26411006 EAST POND.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-5-2015

Project:East Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,247,994.8 ft E 3,584,629.6 ft
Datum:NAVD88

Surface Elevation:1922.4 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:18.0 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0			3-12-41-22.	GP		0-2': FILL (GP): fine grained; dark gray to black; dry to moist.	
2.5			11-7-3-6.	GP		2-3.6': FILL (GP): fine to medium grained; dark gray; moist.	1920.0
				CH		3.6-4': CLAY (CH): light gray; moist; high plasticity; hard.	
5.0			2-4-7-32.	CH		4-5.6': CLAY (CH): fine grained; light gray; moist; high plasticity; firm.	1917.5
				GP		5.6-6': FILL (GP): fine to coarse grained; light to dark gray; dry; some clay; hard.	
7.5			21-34-64/0.9-.	GP		6-7.5': FILL (GP): coarse grained; dark gray to black; dry.	1915.0
			25-34-48/0.5-.	GP		8-9.25': FILL (GP): fine to coarse grained; gray; dry; hard.	
10.0			9-11-11-9.	GP		10-12': FILL (GP): fine to coarse grained; light gray; dry.	1912.5
12.5			22-18-27-22.	GP		12-12.8': FILL (GP): fine to coarse grained; light gray; moist to wet.	1910.0
						12.8-13.25': LIGNITE: coarse grained; black; wet; loose.	
				SP		13.25-14': SAND WITH GRAVEL (SP): fine grained; gray; wet; gravel.	
15.0			7-16-17-21.	SP		14-16': SAND (SP): fine grained; gray; moist to wet.	1907.5
17.5			3-9-15-29.	SP		16-18': SAND (SP): fine grained; gray; moist to wet.	1905.0
20.0						End of boring 18.0 feet	

Date Boring Started: 10/28/15 11:15 am
Date Boring Completed: 10/28/15 2:00 pm
Logged By: JCB2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Overcast, windy, 35 degrees Fahrenheit

O:\GINT\PROJECTS\26411006 EAST POND.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

Barr Engineering Company
234 West Century Avenue
Bismarck, ND 58503
Telephone: 701-255-5460

LOG OF BORING B-6-2015

Project:East Scrubber Pond Investigation
Project No.:26411006
Location:Lewis & Clark Station
Coordinates:N 2,248,177.5 ft E 3,584,577.5 ft
Datum:NAVD88

Surface Elevation:1922.5 ft
Drilling Method:HSA
Sampling Method:SS
Completion Depth:12.0 ft

Depth, feet	Sample Type & Recovery	Sample No.	Blows/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0.0				GP		0-2': FILL (GP): fine grained; dark gray; dry.	1922.5
2.5			1-3-4-7.	CH		2-4': CLAY (CH): fine to medium grained; light gray; moist; high plasticity; firm.	1920.0
				CH		4-5.08': CLAY (CH): fine grained; light gray; moist; high plasticity; firm.	
5.0			2-4-22-20/0.25.	GP		5.08-6': FILL (GP): fine grained; dark gray; dry.	1917.5
			51-.	GP		6-6.5': FILL (GP): fine grained; dark gray; dry.	
7.5			48-.	GP		8-8.5': FILL (GP): fine grained; dark gray; dry.	1915.0
10.0				GP		10-11': FILL/SAND GRAVEL MIX (GP): fine to coarse grained; gray; wet; gravel mixed with sand.	1912.5
			11-12-19-14.	SW		11-12': SAND (SW): fine grained; gray; moist.	
12.5						End of boring 12.0 feet	
15.0							
17.5							
20.0							

Date Boring Started: 10/29/15 3:00 pm
Date Boring Completed: 10/29/15 5:40 pm
Logged By: JCB2
Drilling Contractor: AET
Drill Rig: CME 45

Remarks:

Additional data may have been collected in the field which is not included on this log.
Weather: Sunny, calm, 40 degrees Fahrenheit