# Location Restrictions Demonstration Report

# Flue Gas Desulfurization (FGD) Landfill – Lateral Expansion Phase 1C

## Jeffrey Energy Center

Prepared for: Evergy Kansas Central, Inc.
Jeffrey Energy Center
Pottawatomie County, Kansas

Prepared by:
Haley & Aldrich, Inc.

October 2022

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### APPENDICES

## 1.0 INTRODUCTION AND PURPOSE

The disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule (CCR Rule) 40 CFR 257.60 through 257.64 requires owner/operators of existing CCR units and/or lateral expansions of existing units to evaluate location restrictions relative to the siting of the landfill. The purpose of this report is to demonstrate whether the Flue Gas Desulfurization (FGD) Landfill (Unit) Phase 1C – a lateral expansion after the effective date of the CCR Rule – is located in any of the location restriction areas, as applicable and listed below; and if so, to make certain demonstrations per the CCR Rule that will permit CCR disposal and management operations within this area.

The Unit is located at the Jeffrey Energy Center (JEC) in Pottawatomie County, Kansas approximately 4.5 miles north of Belvue, Kansas. The initial phases of the Unit have existed and been operational at JEC since 2009. The Unit is permitted under Kansas Department of Health and Environment (KDHE) Bureau of Waste Management (BWM) Industrial Waste Landfill Permit No. 359.

Haley & Aldrich, Inc. (Haley & Aldrich) has reviewed sufficient documentation provided by Evergy Kansas Central, Inc. (Evergy, formerly known as Westar) and completed site visit(s) to develop this report. This document provides the demonstrations documenting whether or not the Unit's Phase 1C is constructed:

- with a base that is constructed no less than 5 feet above the upper limit of the uppermost aquifer (40 CFR §257.60);
- in wetlands (40 CFR §257.61);
- within 200 feet of the outermost damage zone of a fault which has been displaced in Holocene time (40 CFR §257.62);
- within a seismic impact zone (40 CFR §257.63); and
- in an unstable area (40 CFR §257.64).

If the Unit's Phase 1C is located within any of the areas above as defined in the CCR Rule, a more detailed demonstration will be provided in the following section(s) as required by 40 CFR §257.60 – 257.64.

Haley & Aldrich reviewed the following information for the Unit's Phase 1C prior to unit construction as provided by Evergy and other available resources:

- Final Permit Update Documents, Volume I and II, Prepared for Jeffrey Energy Center Industrial Waste Landfill Permit No. 359 St. Marys; Burns & McDonnell Engineering Company, Inc. (2009)

- Final Phase II Hydrogeologic Investigation and Bottom Ash Pond Characterization, Permit No. 359 Update Jeffrey Energy Center Westar Energy, Inc. Pottawatomie County, Kansas; Burns & McDonnell Engineering Company, Inc. (2009)

- CCR Groundwater Monitoring Network Description for the Jeffrey Energy Center, Haley & Aldrich, Inc. (2017).

## 2.0 PLACEMENT ABOVE THE UPPERMOST AQUIFER (§257.60(a))

*New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section that the CCR unit meets the minimum requirements for placement above the uppermost aquifer.*

Haley & Aldrich compared the location of the Phase 1C portion of the Unit to the location of the upper limit of the uppermost aquifer by reviewing the site geology as characterized by Burns & McDonnell (2009) and Haley & Aldrich (2017). As described in the reports, the generalized geology underlying the Unit includes the following, from the surface down:

1. Stearns Shale
2. Beattie Limestone
3. Eskridge Shale
4. Grenola Limestone
5. Roca Shale

Based on the definition of *uppermost aquifer* in §257.53, the uppermost aquifer across the site is located in the Grenola Limestone which is located below the Eskridge Shale Formation. This has been determined by Haley & Aldrich to be an unconfined aquifer.

The base liner of the Unit is designed with a minimum elevation of approximately 1175.5 ft MSL, located in the northeast corner of Phase 1C. The highest recorded aquifer water level during the groundwater monitoring program sampling for the Unit in the Grenola Limestone formation within the same area as the minimum base liner elevation in the Phase 1C footprint was approximately 1167 ft MSL. This was confirmed as the highest recorded potentiometric water elevation from a review of the groundwater monitoring data for the Grenola Limestone from 2016 through March 2019, so is currently the known upper limit of the uppermost aquifer.

Based on this review, the base of the Unit is approximately 8 feet above the upper limit of the uppermost aquifer (see Appendix A), therefore the base of the liner was constructed no less than five feet above the upper limit of the uppermost aquifer. Additional demonstration(s) are not required.

## 3.0 WETLANDS (§257.61(a))

*New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in §232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.*

A wetland biologist team with Haley & Aldrich visited the Unit the week of June 11th, 2018 to determine if any areas within the boundaries of the planned Unit were potentially located in existing wetland areas as defined in 40 CFR §232.2. A figure depicting the areas where no wetlands were identified is provided in Appendix B.

Evergy also corresponded with the Army Corps of Engineers to determine that no wetlands were present within the Phase 1C boundary.

Based on this review Haley & Aldrich determined the Unit is not located within a wetland area, as defined in 40 CFR §232.2. Additional demonstration(s) are not required.

## 4.0 FAULT AREAS (§257.62(a))

*New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.*

Haley & Aldrich compared the location of Phase 1C of the Unit to the location of faults as shown in the United States Geologic Survey (USGS) Quaternary Fault and Fold Database for the United States as shown in Appendix C.

Based on this review, Haley & Aldrich determined the site is not located within 200 feet of the outermost damage zone of a fault that has had displacement in the Holocene time. Additional demonstration(s) are not required.

## 5.0 SEISMIC IMPACT ZONES (§257.63(a))

*New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.*

Haley & Aldrich compared the location of Phase 1C of the Unit to the location of seismic impact zones as defined in §257.53, as shown in the United States Geologic Survey (USGS) map “Two Percent Probability of Exceedance in 50 Years Map of Peak Ground Acceleration” which is provided in Appendix D.

Based on this review, Haley & Aldrich determined the site is not located within a seismic impact zone. Additional demonstration(s) are not required.

## 6.0 UNSTABLE AREAS (§257.64(a))

*An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.*

Haley & Aldrich evaluated the location of the Unit (Phase 1C) for the presence of on-site or local unstable areas as defined in §257.53. Evaluations of the conditions listed in §257.64 (b)(1) through (3) were evaluated and are discussed below.

Based on this review, Haley & Aldrich determined the site is not located within an unstable area as defined in §257.53. Additional demonstrations are not required.

*257.64 (b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:*

**6.1 Unstable Factors Considered: Differential Settling §257.64(b)(1)**

*On-site or local soil conditions that may result in significant differential settling;*

Haley & Aldrich has visited the Unit and evaluated site-specific reports (Burns & McDonnell, 2009) detailing the conditions of the on-site and local soils for conditions that could result in significant differential settling. The site was characterized in the Phase II Site Investigation by Burns & McDonnell as limestone and shale formations as shown in Appendix E.1. Based on this description and a review of geotechnical data in the report(s), it is the Haley & Aldrich's professional opinion that the soils on site will not experience significant differential settlement.

Based on this review, Haley & Aldrich determined the site is not located within an area with on-site or local soil conditions that may result in significant differential settling. Additional demonstrations are not required.

**6.2 Unstable Factors Considered: Geologic/Geomorphologic Features §257.64(b)(2)**

*On-site or local geologic or geomorphologic features; and*

Haley & Aldrich has visited the Unit and evaluated published data and site-specific reports for the presence of on-site or local geologic and geomorphologic features, to include karst terrain, steep slopes, and sinkholes. Published data indicate regional areas of Karst terrain as shown in Appendix E.2, however onsite investigations and owner knowledge has not shown localized presence of Karst terrain. Sinkholes are not known to be present near the Unit. Haley & Aldrich visits to the site and a review of terrain at and near the site indicated no excessive steep slopes, terrain features, or other local geologic or geomorphologic features that could feasibly result in an unstable condition (see Appendix E.3 regarding public information regarding landslides).

Based on this review, Haley & Aldrich determined the site is not located within an area with on-site or local geologic or geomorphologic features. Additional demonstrations are not required.

**6.3 Unstable Factors Considered: Human-made Features or Events §257.64(b)(3)**

*On-site or local human-made features or events (both surface and subsurface).*

Haley & Aldrich has visited the Unit and evaluated published data and site-specific reports for the presence of on-site or local human-made features or events (both surface and subsurface) in strata that could feasibly impact the Unit. A map shown known mining activity is provided in Appendix E.4.

Based on this review, Haley & Aldrich determined the site is not located within an

area with on-site or local human-made features or events (both surface and subsurface) that could feasibly result in an unstable condition at the Unit. Additional demonstrations are not required.

## 7.0 REFERENCES


1. Haley & Aldrich, Inc. May 2018. Jeffrey Energy Center FGD Landfill Highest Seasonal Groundwater Elevations.
2. Haley & Aldrich, Inc. August 2018. Westar Energy Jeffrey Energy Center St. Marys, Kansas FGD Landfill Phase 1C Design, Top of Subgrade Plan, Sheet C-103.
3. Cowardin, L.M., et al. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. 131 pp.
4. Haley & Aldrich, Inc. July 2018. Wetland and Stream Delineation Report on Jeffrey Energy Center Pottawatomie County, Kansas.
5. U.S. Army Corps of Engineers. 1987. Corps of Engineers Wetland Delineation Manual. Environmental Laboratory, Vicksburg, MS, 92 pp.
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7. U.S. Fish and Wildlife Service. 2018. National Wetlands Inventory website, U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. Available at: https://www.fws.gov/wetlands/data/Mapper.html
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13. Burns & McDonnell (2008, revised 2009), Phase II Hydrogeologic Investigation and Bottom Ash Characterization, Permit No. 359 Update, Jeffrey Energy Center Westar Energy, Inc. Pottawatomie County, Kansas. January 2008, Revised August 2009.
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15. Dan Suchy, Kansas Geological Survey (personal communication). June 4, 2018.
16. Digital Compilation of Landslide Overview Map of the Conterminous United States By Dorothy H. Radbruch-Hall, Roger B. Colton, William E. Davies, Ivo Lucchitta, Betty A. Skipp, and David J. Varnes, 1982. USGS Open-File Report 97-289, https://pubs.usgs.gov/of/2014/1156/ (online).

17. Digital Engineering Aspects of Karst Map: A GIS Version of Davies, W.E., Simpson, J.H., Ohlmacher, G.C., Kirk, W.S., and Newton, E.G., 1984, Engineering Aspects of Karst: U.S. Geological Survey, National Atlas of the United States of America, Scale 1:7,500,000, https://pubs.usgs.gov/of/2004/1352/data/USA_karst.pdf (online).
18. Kansas Hazard Mitigation Plan (2010) by the Kansas Hazard Mitigation Team, led by the Adjutant General's Department Kansas Division of Emergency Management, 2800 Southwest Topeka Blvd, Topeka, KS 66611-1287, (785) 274 1406, http://www.kansastag.gov/AdvHTML_doc_upload/CompleteKSHMP2.5.11.pdf (online).
19. Kansas Interactive Online Geology Mapper (KIOGM), http://maps.kgs.ku.edu/co2/ (online)
20. USGS Mineral Resources Online Spatial Data, https://mrdata.usgs.gov/general/map.html (online).
21. Weary, D.J., and Doctor, D.H., 2014, Karst in the United States: A digital map compilation and database: U.S. Geological Survey Open-File Report 2014–1156, 23 p., https://dx.doi.org/10.3133/ofr20141156. ISSN 2331-1258 (online).

## 8.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION (§257.64(c))

The undersigned registered professional engineer is familiar with the requirements of the CCR Rule and has visited and examined the Unit and/or has supervised examination of the Unit and development of this report by appropriately qualified personnel. I hereby certify based on a review of available information and observations, that this report meets the requirements of paragraphs §257.60(a), §257.61(a), §257.62(a), §257.63(a), and §257.64(a).

Name of Professional Engineer: Steven F. Putrich, P.E.

Company: **Haley & Aldrich, Inc.**

Signature:

PE Registration State: Kansas

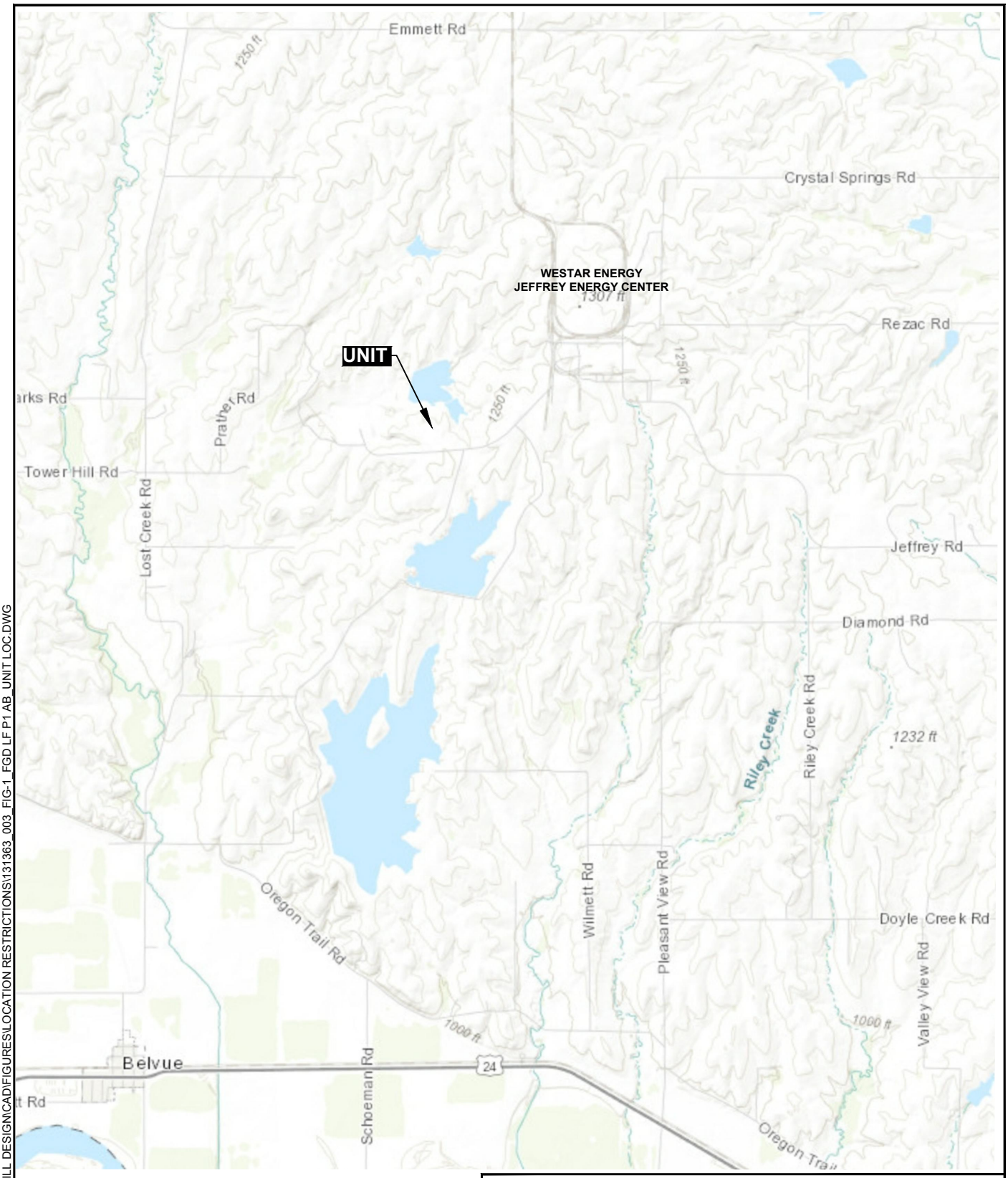
PE Registration Number: PE24363

Professional Engineer Seal:


Steven F. Putrich

Digitally signed by Steven F. Putrich
Date: 2022.10.06 09:58:58 -04'00'

# FIGURES




MAP SOURCE: ESRI

SITE COORDINATES: 39°17'2"N, 96°7'37"W


HALEY ALDRICH

WESTAR ENERGY
JEFFREY ENERGY CENTER - FGD LANDFILL
ST. MARYS, KANSAS

# UNIT LOCATION MAP

APPROXIMATE SCALE: 1IN = 5000 FT
OCTOBER 2018

FIGURE 1

SAUNDERS, LEE Printed: 10/11/2018 3:32 PM Layout: FIGURE 1
G:\131363-WESTAR-JEC FGD LANDFILL DESIGN\CAD\FIGURES\LOCATION RESTRICTIONS\131363_003_FIG-1_FGD LF P1 AB_UNIT LOC.DWG


**LEGEND**

PERMITTED LIMITS OF FGD LANDFILL

PHASE 1C APPROXIMATE LIMITS

**NOTES**

1. AERIAL IMAGERY DATED 12 AUGUST 2014 OBTAINED FROM GOOGLE EARTH PRO.

N

0 500 1000

SCALE IN FEET

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ST. MARYS, KANSAS

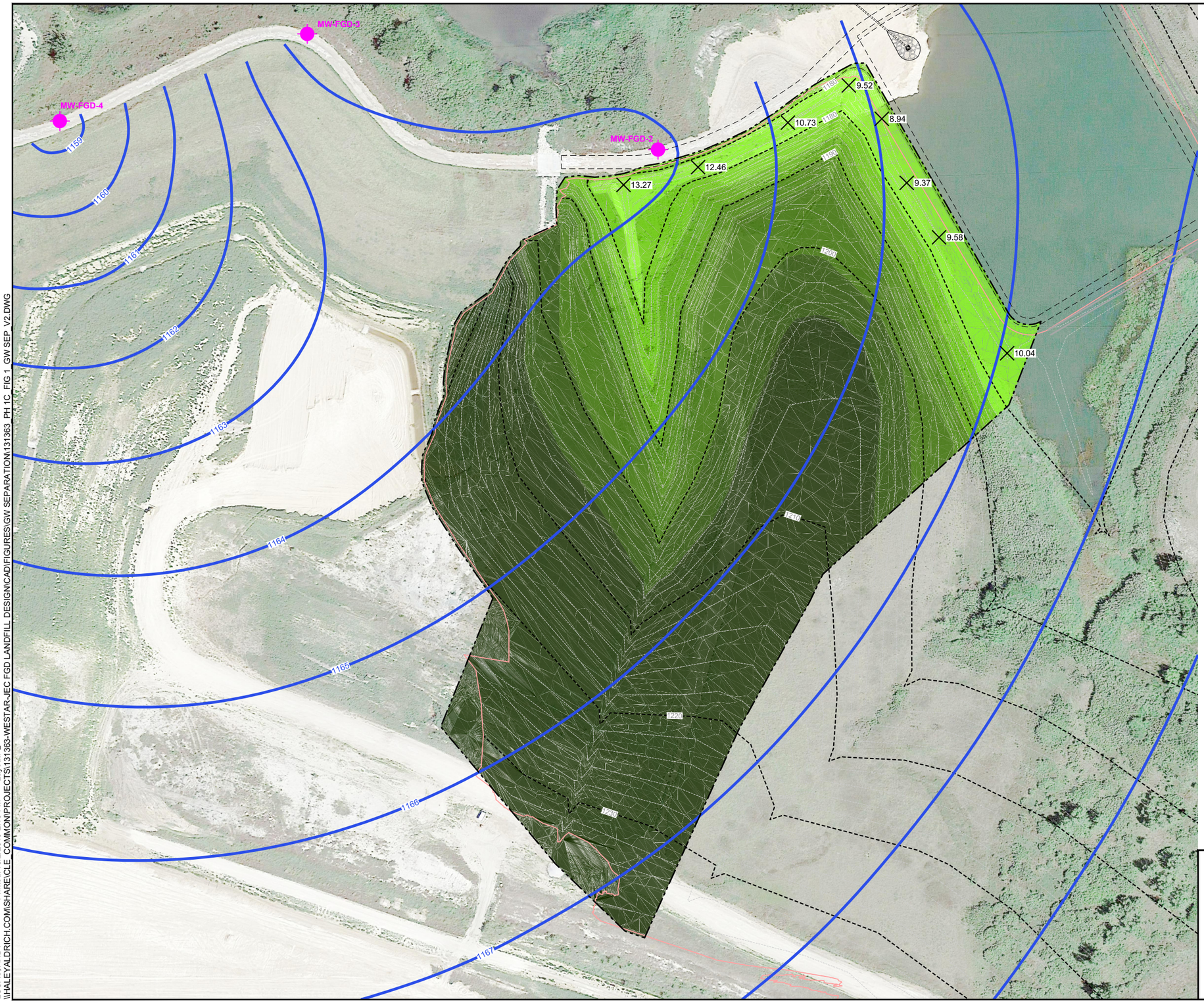
# FGD LANDFILL PHASE 1C LOCATION MAP

SCALE: AS SHOWN
OCTOBER 2018

FIGURE 2

SAUNDERS, LEE Printed: 9/12/2018 8:18 AM Layout: L
G:\131363-WESTAR-JEC FGD LANDFILL DESIGN\CAD\FIGURES\LOCATION RESTRICTIONS\131363_003_FIG-2_FGD LF P1 C.DWG

# APPENDIX A
# PLACEMENT ABOVE THE UPPERMOST AQUIFER




## LEGEND

- UPPER LIMITS OF UPPERMOST AQUIFER AND ASSOCIATED GROUNDWATER CONTOURS
- SUBGRADE CONTOUR MAJOR
- SUBGRADE CONTOUR MINOR
- EXISTING EXPLORATION LOCATION
- × 7.6 — ESTIMATED SEPARATION BETWEEN UPPER LIMITS OF THE UPPERMOST AQUIFER AND THE BOTTOM OF ASH (I.E. BOTTOM OF POND/CCR UNIT) WITHIN THE BOTTOM ASH POND

## NOTES

1. GROUNDWATER CONTOURS TAKEN FROM JEFFREY ENERGY CENTER FGD LANDFILL HIGHEST SEASONAL ELEVATIONS FIGURE, MARCH 2019, BY H&A.
2. GROUNDWATER CONTOURS COMPARED TO FGD LANDFILL SUBGRADE ELEVATIONS.
3. BASE OF UNIT CONTOURS BASED ON FGD LANDFILL PHASE 1C DESIGN, BY HALEY & ALDRICH, DATED MAY 2018.

**ESTIMATED SEPARATION ISOPACHS BETWEEN BASE OF UNIT & TOP OF AQUIFER**

| NO. | MIN. ELEV | MAX. ELEV. | AREA | COLOR |
|---|---|---|---|---|
| 1 | 8.91 | 15.00 | 52,127 | |
| 2 | 15.00 | 20.00 | 44,158 | |
| 3 | 20.00 | 25.00 | 36,061 | |
| 4 | 25.00 | 30.00 | 36,472 | |
| 5 | 30.00 | 35.00 | 77,551 | |
| 6 | 35.00 | 40.00 | 80,145 | |
| 7 | 40.00 | 78.57 | 337,139 | |

N

0 150 300
SCALE IN FEET

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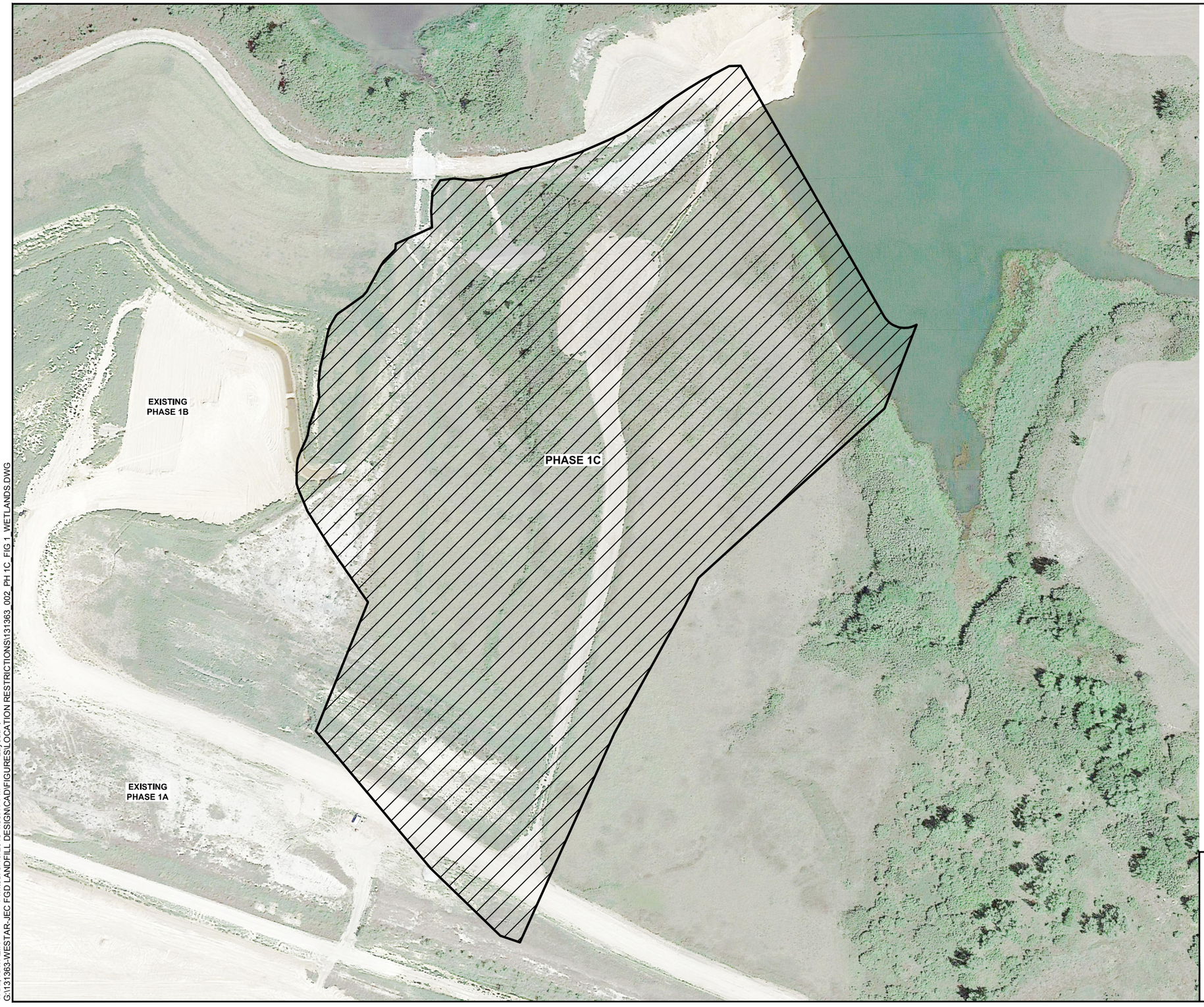
ST. MARYS, KANSAS

# FGD LANDFILL PHASE 1C BASE OF UNIT AND UPPERMOST AQUIFER SEPARATION EVALUATION

SCALE: AS SHOWN
OCTOBER 2019

APPENDIX A

# APPENDIX B
# WETLANDS MAP




## LEGEND

PHASE 1C CCR UNIT BOUNDARY

AREAS THAT WERE FOUND NOT TO INCLUDE JURISDICTIONAL WETLANDS BASED ON REVIEW OF VEGETATION, SOIL TYPE, AND HYDROLOGIC CHARACTERISTICS

## NOTES

1. HORIZONTAL DATUM: PLANT COORDINATES
2. VERTICAL DATUM: 0.31' BELOW NAVD88.
3. THE HORIZONTAL AND VERTICAL CONTROLS ARE A CONTINUATION OF THE EXISTING JEFFREY ENERGY CENTER GRID.
4. GOOGLE EARTH IMAGE (DATED 8/2014) AND BOUNDARY LOCATIONS ARE APPROXIMATE.

N

0 150 300
SCALE IN FEET

HALEY ALDRICH

WESTAR ENERGY
JEFFREY ENERGY CENTER
ST. MARYS, KANSAS

# PHASE 1C
# WETLANDS MAP

SCALE: AS SHOWN
OCTOBER 2018

APPENDIX B

VARI, KATALIN Printed: 9/10/2018 4:50:17 PM Layout: 1
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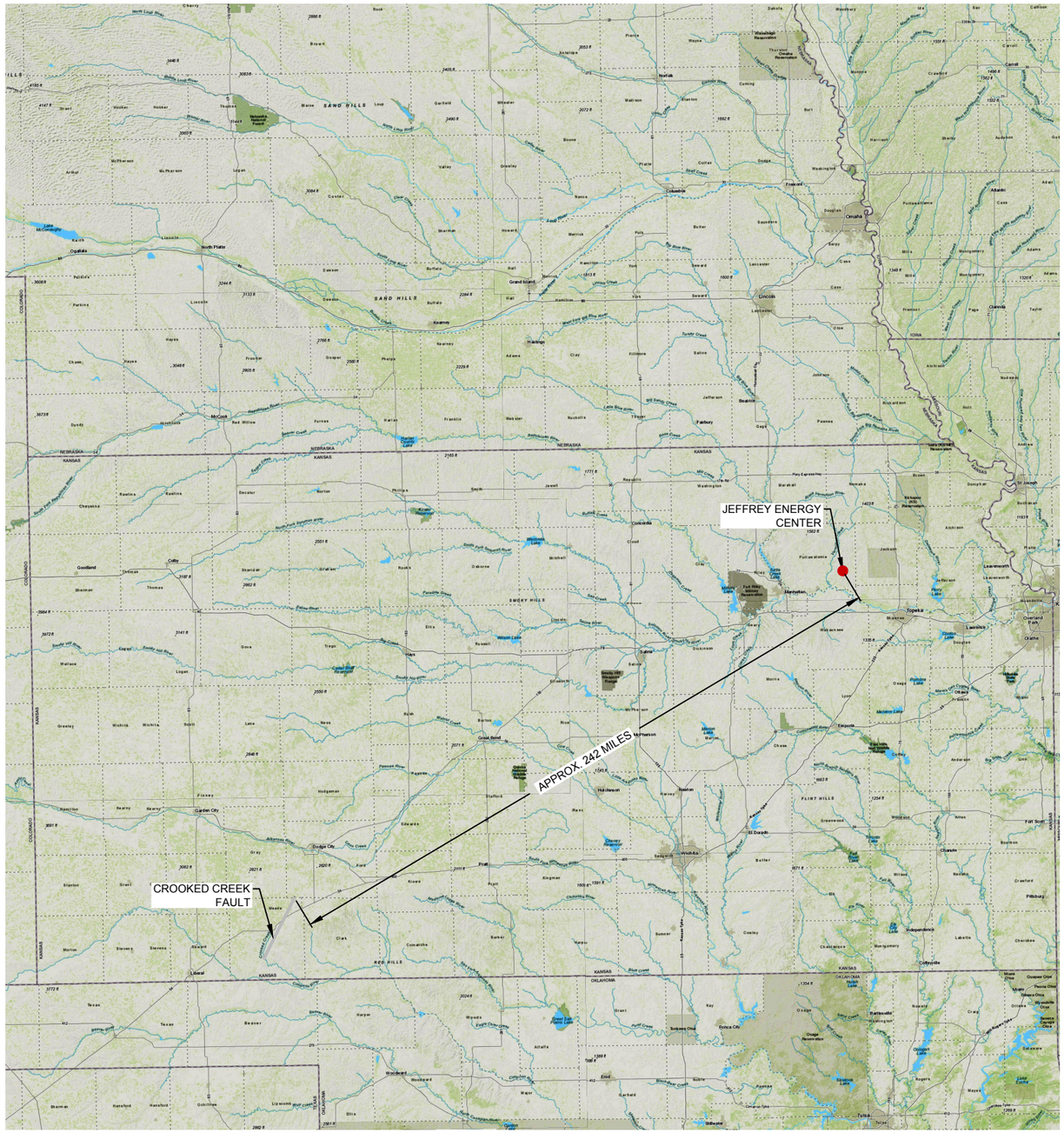
# APPENDIX C
# FAULT AREAS MAP

## USGS QUATERNARY FAULTS AND FOLDS





Quaternary faults

- unspecified age, well constrained location
- unspecified age, moderately constrained location
- unspecified age, inferred location
- undifferentiated Quaternary (< 130,000 years), well constrained location
- undifferentiated Quaternary (< 130,000 years), moderately constrained location
- undifferentiated Quaternary (< 130,000 years), inferred location
- middle and late Quaternary (< 1.6 million years), well constrained location
- middle and late Quaternary (< 1.6 million years), moderately constrained location
- middle and late Quaternary (< 1.6 million years), inferred location
- latest Quaternary (<15,000 years), well constrained location
- latest Quaternary (<15,000 years), moderately constrained location
- latest Quaternary (<15,000 years), inferred location
- late Quaternary (< 130,000 years), well constrained location
- late Quaternary (< 130,000 years), moderately contrained location
- late Quaternary (< 130,000 years), inferred location
- historical (< 150 years), well constrained location
- historical (< 150 years), moderately constrained location
- historical (< 150 years), inferred location
- Class B (various age), well constrained location
- Class B (various age), moderately constrained location
- Class B (various age), inferred location

**NOTE**

1. SOURCE USGS QUATERNARY FAULTS AND FOLDS DATABASE, USGS GEOLOGIC HAZARDS SCIENCE CENTER, GOLDEN, COLORADO. HTTPS://USGS.MAPS.ARCGIS.COM/APPS/WEBAPPVIEWER/

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PHASE 1C
FAULT AREAS MAP

SCALE: AS SHOWN
OCTOBER 2018

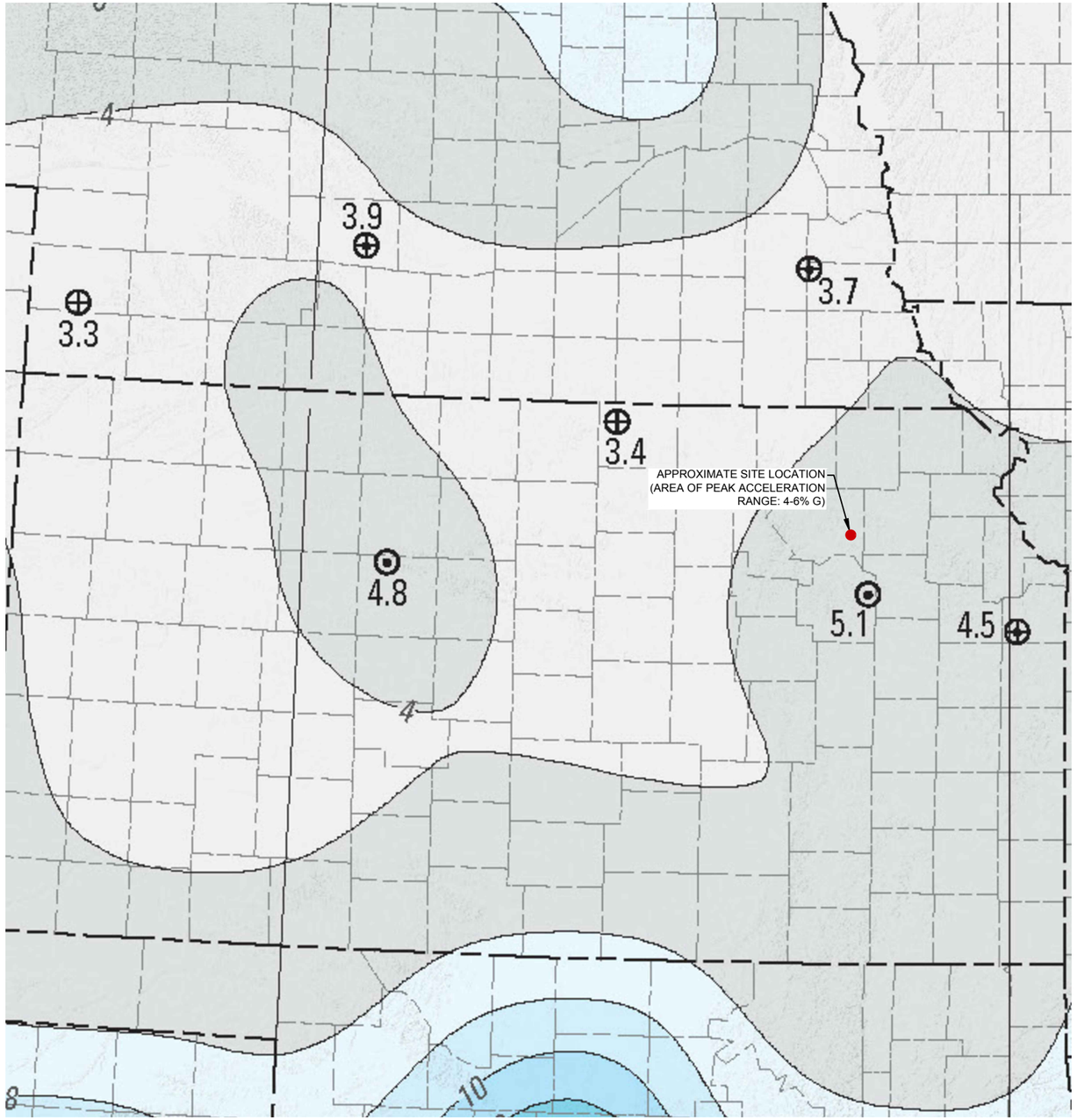
APPENDIX C

VARI, KATALIN Printed: 9/11/2018 3:43:08 PM Layout: 2
G:\131363-WESTAR-JEC FGD LANDFILL DESIGN\CAD\FIGURES\LOCATION RESTRICTIONS\131363_002_PH 1C_FIG 2_FAULT AREAS.DWG

# APPENDIX D
# SEISMIC IMPACT ZONES

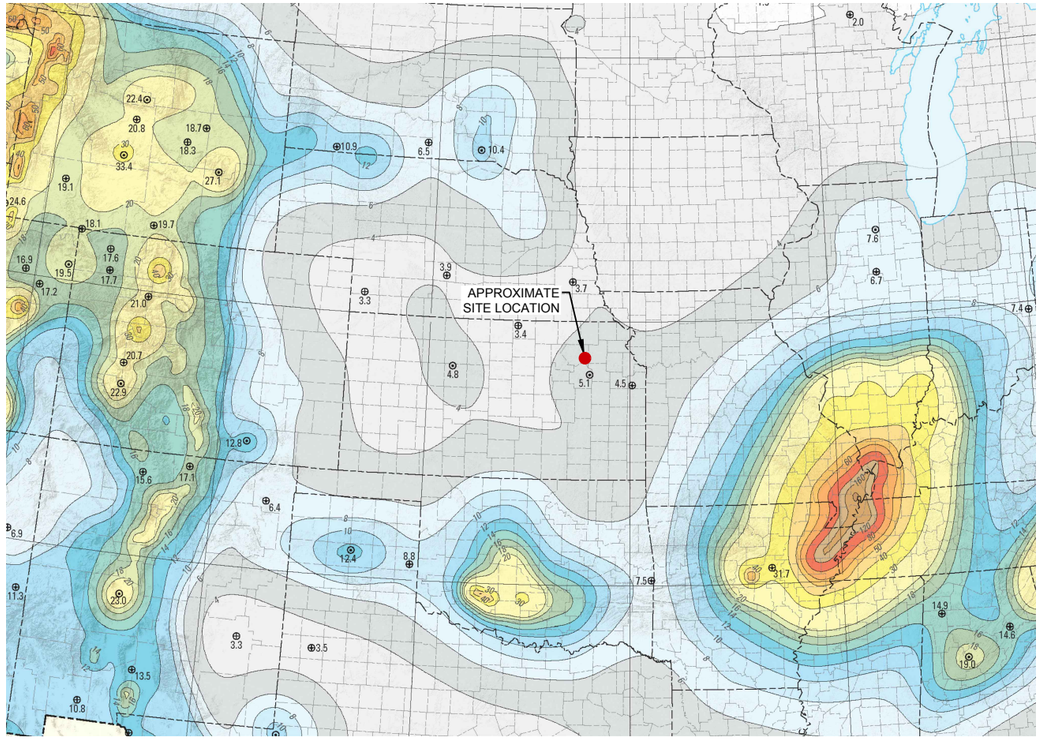
# Seismic-Hazard Maps for the Conterminous United States, 2014

## Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 Years




0 50 100
APPROXIMATE SCALE IN MILES

N




**EXPLANATION**
Peak acceleration expressed as a percer
of gravity (%g)

%g

| %g |
|---|
| ≥200 |
| 160–200 |
| 120–160 |
| 80–120 |
| 60–80 |
| 50–60 |
| 40–50 |
| 30–40 |
| 20–30 |
| 18–20 |
| 16–18 |
| 14–16 |
| 12–14 |
| 10–12 |
| 8–10 |
| 6–8 |
| 4–6 |
| 2–4 |
| ≤2 |

**Contours of peak acceleration expressed as a percent of gravity (%g)**

10 Onshore

10 Offshore

**Point values of peak acceleration expressed as a percent of gravity (%g)**

3.2 Local maximum

6.9 Local minimum

Saddle point

0 200 400
APPROXIMATE SCALE IN MILES

N

**NOTE**

1. SOURCE USGS SEISMIC HAZARD MAPS, SCIENTIFIC INVESTIGATIONS MAP 3325 SHEET 2 OF 6. HTTPS://PUBS.USGS.GOV/SIM/3325/PDF/SIM3325_SHEET2.PDF

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PHASE 1C
HORIZONTAL ACCELERATION MAP

SCALE: AS SHOWN
OCTOBER 2018

APPENDIX D

VARI, KATALIN Printed: 9/10/2018 3:36:15 PM Layout: 3
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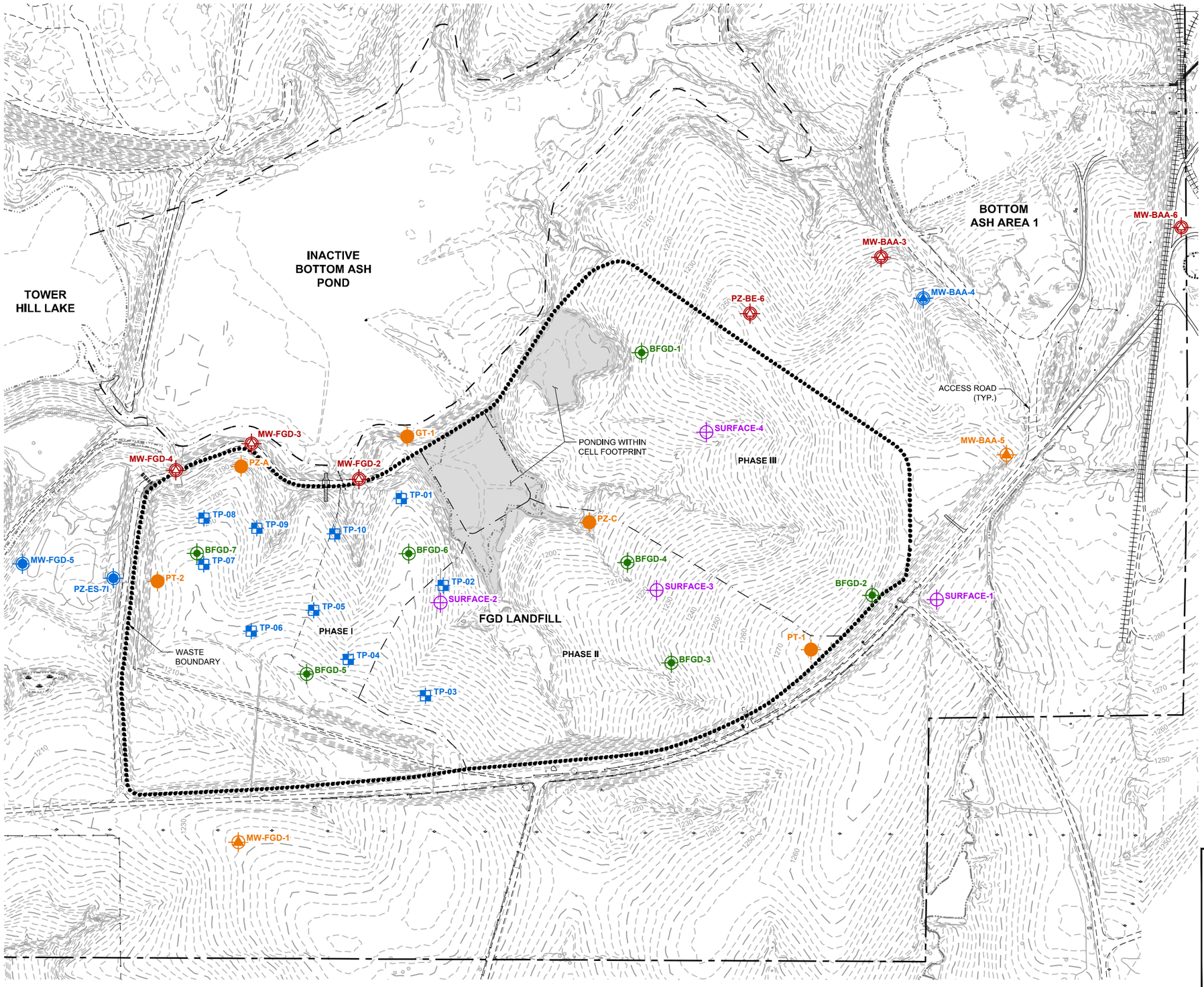
# APPENDIX E
# UNSTABLE AREAS

# APPENDIX E.1
# SUBSURFACE EXPLORATION LOCATION MAP AND BORING LOGS




## LEGEND

- PERMITTED LIMITS OF FGD LANDFILL
- GT-1 — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS PERFORMED BY GEOTECHNOLOGY, INC. OF OVERLAND PARK, KANSAS DURING THE PERIOD OF 25 OCTOBER TO 13 NOVEMBER 2007
- MW-FGD-1 — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELLS PERFORMED BY GEOTECHNOLOGY, INC. OF OVERLAND PARK, KANSAS DURING THE PERIOD OF 27 FEBRUARY TO 20 MARCH 2007.
- MW-FGD-5 — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELLS PERFORMED BY TERRACON OF TOPEKA, KANSAS DURING THE PERIOD OF 25 FEBRUARY TO 26 MARCH 2009.
- TP-01 — DESIGNATION AND APPROXIMATE LOCATION OF TEST PITS PERFORMED BY TERRACON OF TOPEKA, KANSAS ON 4 AUGUST 2008.
- MW-BAA-4 — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL PERFORMED BY TERRACON OF TOPEKA, KANSAS ON 3 JUNE 2016.
- MW-BAA-6 — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELLS PERFORMED BY ASSOCIATED DRILLING, INC. OF OLSBURG, KANSAS DURING THE PERIODS OF 14 MAY 2015, AND 18 MARCH 2016.
- BFGD-1 — DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS PERFORMED BY BURNS AND MCDONNELL OF WICHITA, KANSAS DURING THE YEAR 2007.
- SURFACE-1 — DESIGNATION AND APPROXIMATE LOCATION OF SURFACE SAMPLES PERFORMED BY HALEY & ALDRICH, INC. DURING THE PERIOD OF 1 MARCH TO 5 MARCH 2018.

## NOTES

1. EXISTING TOPOGRAPHY WAS PROVIDED BY WESTAR AND IS A COMBINATION OF A BATHYMETRIC SURVEY CONDUCTED IN 2014 AND AN AERIAL SURVEY CONDUCTED BY PROFESSIONAL ENGINEERING CONSULTANTS FLOWN 2014.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND ARE 0.31' BELOW NAVD 88 DATUM. HORIZONTAL CONTROL IS BASED ON THE PLANT'S COORDINATE SYSTEM.
3. TECHNICAL MONITORING OF SUBSURFACE EXPLORATIONS MW-BAA-3, MW-BAA-4, MW-BAA-6, MWFGD-2, MW-FGD-3, MW-FGD-4, TPZ-BE-6, AND SURFACE SAMPLES WERE PERFORMED BY HALEY & ALDRICH, INC. DURING THE PERIOD 14 MAY TO 3 AUGUST 2015, 17 MARCH TO 3 JUNE 2016 AND 1 MARCH TO 5 MARCH 2018.
4. EXPLORATION LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE. REFER TO THE ORIGINAL BORING LOGS AND REPORTS FOR SPECIFIC ELEVATION INFORMATION.

N

0 500 1000
SCALE IN FEET

HALEY ALDRICH

WESTAR ENERGY
JEFFREY ENERGY CENTER - FGD LANDFILL
ST. MARYS, KANSAS

# SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
MAY 2018

APPENDIX E.1

VARI, KATALIN Printed: 5/18/2018 1:47 PM Layout: L
G:\131363-WESTAR-JEC FGD LANDFILL DESIGN\CAD\FIGURES\GEOTECH\131363_0002_FIG-2_EXPL_LOC.DWG

| | BFGD-1 | BFGD-2 | BFGD-3 | BFGD-4 | BFGD-5 | BFGD-6 | BFGD-7 |
|---|---|---|---|---|---|---|---|
| TD | 4.5 | 1.50 | 1.5 | 5.79 | 7.25 | 0.83 | 3.00 |
| Feet of Soil | 3.5 | 1.33 | 1.42 | 4.29 | 1.50 | 0,83 | 1.50 |
| Feet of Rock | 1 | 0.17 | 0.083 | 1.50 | 5.75 | 0.00 | 1.50 |
| Spoon 1<br>Depth: 0 - 1.5 feet | 6/8/13,4/18, Clay Trace Silt, Very Dark Grayisn Brown, Damp Stiff, Plastic | 20/29/16, 2" of Clay Dark brown, Damp Plastic stiff, weathered limestone beneath clay | 3/4/14, 12/18, 17" of clay, dark grayish Brown, soft, roots present, trace silt, medium plastic, damp, Limestone is beneath clay | 3/6/6, 8/18, Clay, some silt, very organic, grayish black to brownish black, soft, slight plasticity | 3/7/8, 10/18, Black Silt, some clay, top soil followd by soft moderate brown, plastic damp clay | 4/50 for 4, 10/10, Very dark brown, silty clay, roots, organic, bottom 6" is limestone | 7/10/14, 18/18, Top soil, silty clay, grayish brown to moderate brown, damp, non-plastic, Becomes greenish gray at about 16" |
| Spoon 2<br>Depth: 1.5 - 3.0 feet | | | | 3/6/9, 10/18, Clay, Trace slit, yellowish brown, damp, medium stiff, plastic | 4/5/14, 9/18, Stiff Reddish Brown, weathered Shale | | 9,9, 50 for 3, 10/15, greenish gray shale to 2.5' bgs, then LS |
| Spoon 3<br>Depth: 3.0 - 4.5 feet | | | | 4/7/10, 10/18, Clay, yellowish Brown, damp, stiff, plastic, Bottom 3" is a weathered clayey LS | 13/14/17, 10/18, Shale, silty clayey, very Stiff, trace plastic, moderate brown, Damp, trace roots | | |
| Spoon 4<br>Depth: 4.5 - 6.0 feet | | | | 10/14/50 for 3.5", Soft, yellowish gray, weathered limestone | 17/18/22, 16/18, Shale, moderate brown, clayey, trace silt, very stiff, trace plastic, becomes olive gray at bottom | | |
| Spoon 5<br>Depth: 6.0 - 7.5 feet | | | | | 14/48/50 for 3", 14/15, moderate, light gray, silty shale, | | |

12/20

# Drilling Log

| Project Name | Project Number | Boring Number |
|---|---|---|
| Westar | 44432 | GT-1 |

| Ground Elevation | Location | Page |
|---|---|---|
| | Kansas | 1 of 3 |

| Air Monitoring Equipment | Total Footage |
|---|---|
| — | 33.0 |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. of Samples | No. of Core Boxes |
|---|---|---|---|---|---|
| Hollow Stem Auger | 6.5' | ~~33~~ 33.0 | 0.0 | 16 | NA |

| Drilling Company | Driller(s) |
|---|---|
| GeoTechnology | |

| Drilling Rig | Type of Sampler |
|---|---|
| Mobile Track rig | Split spoon |

| Date | To | Field Observer(s) |
|---|---|---|
| 11/13/07 | 11/13/07 | Lewis Turner |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | silt w/ some clay, brown (7.5yr 4/3) trace - low plasticity, mostly dry, stiff, some gravel to cobble size grains throughout | ML | 5<br>6<br>7 | 1.0/2.5 | | GT-1<br>0-2.5 | — | | | Start 1450<br>Low recovery because of gravel also log from cuttings.<br>1453 @ 2.5' |
| 3 | | ML | 5<br>8<br>11 | 0.8/2.5 | | GT-1<br>2.5-5 | | | | |
| 5 | SAME AS ABOVE | | | | | | | | | 1456 @ 5.0' |
| 6 | | ML | 5<br>8<br>8 | 0.8/2.5 | | GT-1<br>5-7.5 | | | | |
| 7 | CLAY w/ trace silt, brown (7.5yr 5/2) trace plasticity, very stiff, damp, gravels present, reacts to acid. | | | | | | | | | 1458 @ 7.5' |
| 8 | | CL | 4<br>5<br>8 | 1.0/2.5 | | GT-1<br>7.5-10 | | | | |
| 10 | | | | | | | | | | 1502 @ 10.0' |
| 11 | SILT w/ trace clay, black (7.5yr 2.5/1) Some plasticity, medium consistency, damp less gravels. | ML | 4<br>11<br>6 | 06/2.5 | | GT-1<br>10-12.5 | | | | |
| 12 | | | | | | | | | | 1506 @ 12.5' |
| 13 | | ML | 15<br>17<br>23 | 0.5/2.5 | | GT-1<br>12.5-15<br>Shelby Tube 01 | | | | hit rock<br>Shelby Tube 01<br>13-15' |
| 14 | Same as ABOVE | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell

051601 Form WCD-2-1

# Drilling Log Continuation

Boring Number GT-1
Project Name Westar
Page 2 of 3
Project Number 44838
Date 11/13/07

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Continued - SILT w/ trace clay | | | | | | | | | |
| 15 | | | | | | | | | | 1515 @15.0' |
| 16 | CLAY w/ trace silt, light yellowish brown (2.5Y 6/3) medium plasticity, stiff, damp, gravels present (limestone) | CL | 5<br>5<br>8 | 1.0/2.5 | | GT-1<br>15-17.5 | | | | also logged from cuttings |
| 17 | | | | | | | | | | 1518 @17.5 |
| 18 | color changes becomes medium consistency black (2.5Y 2.5/1) | CL | 5<br>7<br>7 | 1.0/2.5 | | GT-1<br>17.5-20 | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | 1523 @ 20.0' |
| 21 | CLAY, brown (10YR 4/3) medium plasticity, medium ~~stiff~~ consistency, damp, few coarse grain size clasts throughout. | CL | 3<br>4<br>5 | 1.5/2.5 | | GT-1<br>20-22.5 | | | | in-situ/peat |
| 22 | | | | | | | | | | 1531 @22.5 |
| 23 | Becomes lighter in color brown (10YR 5/3) | CL | 3<br>4<br>6 | 1.0/2.5 | | GT-1<br>22.5-25<br>Shelby Tube 02 | | | | Shelby Tube 02 22-24' |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | 1537 @25.0 |
| 26 | | CL | 4<br>4<br>5 | 1.5/2.5 | | GT-1<br>25-27.5 | | | | |
| 27 | SILTY CLAY w/ coarse grain clasts, olive (5Y 5/4) medium to low plasticity, medium stiff, moist to wet, | | | | | | | | | 1545 @27.5 |
| 28 | | CL | 17<br>28<br>21 | 1.5/2.5 | | GT-1<br>27.5-30<br>Shelby Tube 03 | | | | Shelby Tube 03 28-30' |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | 1551 @30.0 |
| 31 | Becomes silt w/ trace clay, pale olive (5Y 6/3) some shale fragments/clasts. med plasticity, stiff, damp. | ML | 15<br>21<br>17 | 2.0/2.5 | | GT-1<br>30-32.5 | | | | |
| 32 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

# Drilling Log Continuation

| | |
|---|---|
| Project Name | westar |
| Project Number | 44832 |
| Boring Number | GT-1 |
| Page | 3 of 3 |
| Date | 4/13/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | continued | | | | | | | | | 32 |
| 33 | | | | | | | | | | Auger refusal 33 |
| | Complete boring to 33.0' | | | | | | | | | Stop time 1610 |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

**MW-FGD-1**

Formerly MW-GR-1

# Drilling Log

| Project Name | Project No. | Boring Number |
|---|---|---|
| Westar Energy | 44832 | B-1 |
| **Ground Elevation** | **Location** | **Page** |
| 1,237.4 ft. | | 1 of 12 |
| **Air Monitoring Equipment** | | **Total Footage** |
| NA | | 185.5 |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. Of Samples | No. Core Boxes | Depth to Water | Date Measured |
|---|---|---|---|---|---|---|---|
| HSA/Air Rotary | 6"/4" | 5.4 | 180.1 | NA | NA | 76 | 3-10-07 |

| | | | |
|---|---|---|---|
| Drilling Company | Geotechnology | Drillers (s) | Craig Stiener |
| Drilling Rig | CME | Type of Sampler | Split Spoon/2" Core Sampler |
| Date | 2-27-07 To 3-1-07 | Field Observer (s) | Kevin Bolling |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Clay, Very Dark Grayish Brown, Medium Consistency, Medium Plasticity, Damp | CL | 9/ 7/ 8 | 1.34/ 1.5 | 817 | 0 - 1.5 | | | | 2/27/07 0815 Start Drilling |
| 2 | | | 8/ 11/ 13 | 0.75/ 1.5 | 820 | 1.5 - 3 | | | | |
| 3 | | | | | | | | | | |
| 4 | Becomes Light Olive Brown 2.5Y 5/6 | CL | 18/ 16/ 12 | 0.84/ 1.5 | 827 | 3 - 4.5 | | | | |
| 5 | | | 28/ 25/ 30 | 1/ 1.5 | 825 | 4.5 - 6 | | | | |
| 6 | Shale, Weathered, Weak, Yellowish Gray 5Y8/1 | | 50 | | | 6 - 6.4 | | | | |
| 7 | Limestone, Weathered, Pale Yellowish Brown, Fossiliferous, Hard | EI | | | | | | | | |
| 8 | | | RQD 5 | 1.08/ 4 | 1105 | 6.4 - 10.5 | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | Shale, Yellowish Gray 5Y 7/2 to Dark Grey N3, Calcareous, Fissile | ST | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | RQD 36 | 4.92/ 5 | 1120 | 10.5 - 15.5 | | | | |
| 14 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

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# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 2 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Shale, Yellowish Brown 10YR 5/4 to Dark Grey N3, Moderate to Soft | ST | | | | 10.5 - 15.5 | | | | |
| 16 | | | | | | | | | | |
| 17 | Limestone, Yellowish Gray 5Y 8/1, Hard, Fossiliferous | ST | | | | | | | | |
| 18 | Shale, Greenish Grey 5GY 6/1, Moderate to Hard, Calcareous | ST | RQD 10 | 5/ 5 | 1140 | 15.5 - 20.5 | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | RQD 16 | 5/ 5 | 1200 | 20.5 - 25.5 | | | | |
| 24 | Limestone, Yellowish Gray 5Y 7/2, Vuggy, Hard, Fractured | MO | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | Becomes Very Vuggy | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | Becomes Dark Yellowish Orange 10YR 6/6 | | RQD 0 | 2/ 5 | 1217 | 25.5 - 30.5 | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | FL | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 3 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shale, Dark Yellow 5Y 6/4, Hard to Moderate, Calcareous | FL | | | | | | | | |
| 32 | Shale, Dusky Yellow to Medium Gray, Moderate to Hard, Calcareous | FL | RQD 42 | 4/ 5 | 1355 | 30.5 - 35.5 | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 36 | Limestone, Yellowish Gray to Grayish Yellow, Hard, Fossiliferous, Vuggy | CD | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | | | RQD 29 | 3.125/ 5 | 1437 | 35.5 - 40.5 | | | | |
| 39 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | | | RQD 14 | 3.92/ 5 | 1445 | 40.5 - 45.5 | | | | |
| 44 | Shale, Grayish Olive 10Y 4/2, Moderate, Hardness | ES | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

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# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
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Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | RQD 7 | 3.84/ 5 | 1545 | | | | | |
| | Shaley Limestone, Pale Yellow Brown, Moderately Weathered | ES | | | | 45.5 - 50.5 | | | | |
| 49 | | | | | | | | | | |
| 50 | Limestone, Yellowish Brown 5Y 7/2, Moderate to Hard, Fratured, Vuggy | ES | | | | | | | | |
| 51 | | | | | | | | | | |
| 52 | Shale, Pale Yellowish Brown to Grayish Olive 10Y4/2, Moderate, Calcareous | ES | | | | | | | | |
| 53 | | | RQD 12 | 4.42/ 5 | 1600 | 50.5 - 55.5 | | | | |
| 54 | Shale, Light Greenish Gray 5Y 8/1 to Brownish Gray 5YR 4/1, Soft to Moderately Hard, Calcareous | ES | | | | | | | | |
| 55 | | | | | | | | | | |
| 56 | | | | | | | | | | |
| 57 | | | | | | | | | | |
| 58 | | | RQD 24 | 4.5/ 5 | 1620 | 55.5 - 60.5 | | | | |
| 59 | | | | | | | | | | |
| 60 | | | | | | | | | | |
| 61 | Becomes Pale Brown | ES | | | | | | | | |
| 62 | | | | | | | | | | |
| 63 | Becomes Pale Olive | ES | RQD 23 | 4/ 5 | 1710 | 60.5 - 65.5 | | | | |
| 64 | | | | | | | | | | |
| 65 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

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# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 5 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Becomes Pale Olive | ES | | | | | | | | |
| 66 | | | | | | | | | | |
| 67 | | | | | | | | | | |
| 68 | Shale, Moderate Brown to Gray, Moderate to Hard, Calcareous | ES | RQD 14 | 4.6/ 5 | 1740 | 65.5 - 70.5 | | | | |
| 69 | | | | | | | | | | |
| 70 | | | | | | | | | | |
| 71 | | | | | | | | | | 2/27/07 1740 End Drilling<br>2/28/07 0805 Start Drilling |
| 72 | | | | | | | | | | |
| 73 | | | RQD 47 | 4.75/ 5 | 805 | 70.5 - 75.5 | | | | |
| 74 | | | | | | | | | | |
| 75 | | | | | | | | | | 3/6/07 Water Table<br>TD=85.5' |
| 76 | | | | | | | | | | |
| 77 | | | | | | | | | | |
| 78 | Limestone, Medium Light Gray N6, Hard, Fossiliferous, Vuggy | NE | RQD 33 | 5/ 5 | 845 | 75.5 - 80.5 | | | | |
| 79 | | | | | | | | | | |
| 80 | Shale, Light Gray N7 to Yellowish Gray 5Y 8/7 / Limestone, Medium Light Gray N6, Hard, Fossiliferous, Vuggy | NE / NE | | | | | | | | |
| 81 | | | | | | | | | | |
| 82 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILLING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 6 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 83 | Limestone, Medium Light Gray N6, Hard, Fossiliferous, Vuggy | NE | RQD 41 | 4.5/ 5 | 1035 | 80.5 - 85.5 | | | | |
| 84 | | | | | | | | | | |
| 85 | | | | | | | | | | |
| 86 | | | | | | | | | | |
| 87 | Shale, Greenish Gray 5G 6/1 and Dark Yellowish Orange 10YR 6/6, and Medium Gray N5 to Black N1, Calcareous, Blocky to Fissile | NE | | | | | | | | |
| 88 | | | RQD 48 | 4.17/ 5 | 1037 | 85.5 - 90.5 | | | | |
| 89 | | | | | | | | | | |
| 90 | | | | | | | | | | |
| 91 | | | | | | | | | | |
| 92 | Limestone, Medium Gray N5 to Light Olive Gray 5Y 6/1, Moderate to Hard, Vuggy, Fossiliferous, Blocky to Fissile | SA | | | | | | | | |
| 93 | Shale, Medium Gray N6, Soft to Moderate, Laminated, Fissile to Blocky | SA | RQD 48 | 4.96/ 5 | 1055 | 90.5 - 95.5 | | | | |
| 94 | | | | | | | | | | |
| 95 | | | | | | | | | | |
| 96 | Limestone, Medium Light Gray, Hard, Fossiliferous | SA | | | | | | | | |
| 97 | Shale, Dark Greenish Gray 5GY 4/1 to Light Olive Gray 5Y 6/1, Calcareous, Blocky to Fissele | SA | | | | | | | | |
| 98 | | | RQD 51 | 4.67/ 5 | 1118 | 95.5 - 100.5 | | | | |
| 99 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 7 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 | Shale, Dark Greenish Gray 5GY 4/1 to Light Olive Gray 5Y 6/1, Calcareous, Blocky to Fissele | SA | | | | 95.5 - 100.5 | | | | |
| 101 | Limestone, Yellowish Gray, Hard, Vuggy to Very Vuggy, Fossiliferous | BU | | | | | | | | |
| 102 | | | | | | | | | | |
| 103 | | | RQD 8 | 1.42/ 5 | 1310 | 100.5 - 105.5 | | | | |
| 104 | Limestone, Yellowish Gray, Hard, Vuggy, Fossiliferous | BU | | | | | | | | |
| 105 | | | | | | | | | | |
| 106 | Shale, Medium Dark Gray, Hard, Vuggy, Fossiliferous | BU | | | | | | | | |
| 107 | Limestone, Medium Dark Gray, Fossiliferous, Vuggy | BU | | | | | | | | |
| 108 | | | RQD 33 | 2.9/ 5 | 1410 | 105.5 - 110.5 | | | | |
| 109 | Shale, Dark Gray N3, Moderate to Hard, Calcereous | LN | | | | | | | | |
| 110 | | | | | | | | | | |
| 111 | | | | | | | | | | |
| 112 | Limestone, Light Gray, Hard | SD | | | | | | | | |
| 113 | Shale, Dark Gray to Dusky Yellow 5Y6/4, Moderate to Hard, Calcareous, Fissile to Blocky | RO | RQD 23 | 4.75/ 5 | 1635 | 110.5 - 115.5 | | | | |
| 114 | | | | | | | | | | |
| 115 | | | | | | | | | | |
| 116 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 8 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 117 | Shale, Dark Gray to Dusky Yellow 5Y6/4, Moderate to Hard, Calcareous, Fissile to Blocky | RO | RQD 23 | 2.75/ 5 | 1700 | 115.5 - 120.5 | | | | |
| 118 | | | | | | | | | | |
| 119 | | | | | | | | | | |
| 120 | | | | | | | | | | |
| 121 | | | | | | | | | | |
| 122 | Shale, Dark Gray to Grayish Olive Green, Soft to Moderate, Calcareous | RO | | | | | | | | |
| 123 | | | RQD 52 | 4.6/ 5 | 1730 | 120.5 - 125.5 | | | | |
| 124 | | | | | | | | | | |
| 125 | | | | | | | | | | |
| 126 | Shale, Yellowish Gray 5Y 8/1 to Brownish Gray, Soft, Fissile | RO | | | | | | | | 2/28/07 1730 End Drilling<br>3/1/07 0935 Start Drilling |
| 127 | Shale, Soft to Moderate Hard, Varigated, Calcareous | RO | | | | | | | | |
| 128 | | | RQD 45 | 3.67/ 5 | 1000 | 125.5 - 130.5 | | | | |
| 129 | | | | | | | | | | |
| 130 | | | | | | | | | | |
| 131 | | | | | | | | | | |
| 132 | | | | | | | | | | |
| 133 | | | RQD | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 9 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shale, Soft to Moderate Hard, Varigated, Calcareous | RO | 70 | 4.34/ 5 | 1020 | 130.5 - 135.5 | | | | |
| 134 | | | | | | | | | | |
| 135 | | | | | | | | | | |
| 136 | | | | | | | | | | |
| 137 | | | | | | | | | | |
| 138 | | | RQD 60 | 4.34/ 5 | 1040 | 135.5 - 140.5 | | | | |
| 139 | Limestone, Medium Gray, Hard, Vuggy, Fossiliferous | HE | | | | | | | | |
| 140 | Limestone, Medium Gray, Hard, Vuggy, Fossiliferous | BE | | | | | | | | |
| 141 | | | | | | | | | | |
| 142 | | | | | | | | | | |
| 143 | Shale, Dark Gray N3, Moderate to Hard, Calcareous, Fissile | BE | RQD 87 | 4.75/ 5 | 1100 | 140.5 - 145.5 | | | | |
| 144 | | | | | | | | | | |
| 145 | | | | | | | | | | |
| 146 | | | | | | | | | | |
| 147 | | | | | | | | | | |
| 148 | | | RQD 67 | 4.84/ 5 | 1125 | 145.5 - 150.5 | | | | |
| | Shaley Limestone, Dark Grey | BE | | | | | | | | |
| 149 | Shale, Grayish Black, Moderate to Hard, Calcereous | BE | | | | | | | | |
| 150 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 10 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shale, Grayish Black, Moderate to Hard, Calcereous | BE | | | | | | | | |
| 151 | | | | | | | | | | |
| 152 | | | | | | | | | | |
| 153 | | | RQD 50 | 4.5/ 5 | 1320 | 150.5 - 155.5 | | | | |
| 154 | Limestone, Medium Dark Gray, Hard, Vuggy | GL | | | | | | | | |
| 155 | Shale, Medium Dark Gray to Greenish Gray to Brownish Gray, Moderate to Hard, Slightly Calcareous to Calcareous, Blocky | JO | | | | | | | | |
| 156 | | | | | | | | | | |
| 157 | | | | | | | | | | |
| 158 | Shale with Thin Beds of Limestone, Dark Gray, Hard, Calcareous | JO | RQD 0 | 4/ 5 | 1353 | 155.5 - 160.5 | | | | |
| 159 | | | | | | | | | | |
| 160 | | | | | | | | | | |
| 161 | Shale, Greenish Gray and Brownish Gray, Moderate to Hard, Calcareous | JO | | | | | | | | |
| 162 | | | | | | | | | | |
| 163 | | | RQD 48 | 4.5/ 5 | 1426 | 160.5 - 165.5 | | | | |
| 164 | | | | | | | | | | |
| 165 | Varigated | JO | | | | | | | | |
| 166 | | | | | | | | | | |
| 167 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 11 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 168 | Varigated | JO | RQD 78 | 4.5/ 5 | 1537 | 165.5 - 170.5 | | | | |
| 169 | | | | | | | | | | |
| 170 | | | | | | | | | | |
| 171 | | | | | | | | | | |
| 172 | | | | | | | | | | |
| 173 | Dolomitic Limestone, Gray, Hard, Vuggy with Calcite Growth in Vugs | LC | RQD 49 | 2.67/ 5 | 1550 | 170.5 - 175.5 | | | | |
| 174 | | | | | | | | | | |
| 175 | | | | | | | | | | |
| 176 | Dolomitc Limestone, Medium Light Gray N5, Hard, Vuggy, with Calcite Crystals in Vugs | LC | | | | | | | | |
| 177 | | | | | | | | | | |
| 178 | | | RQD 48 | 4.25/ 5 | 1615 | 175.5 - 180.5 | | | | |
| 179 | | | | | | | | | | |
| 180 | | | | | | | | | | |
| 181 | | | | | | | | | | |
| 182 | Shale, Dark Gray to Greenish Gray, Moderate | HC | | | | | | | | |
| 183 | | | RQD 30 | 4/ 5 | 1643 | 180.5 - 185.5 | | | | |
| 184 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log, continued

Formerly MW-GR-1

Boring Number B-1
Project Name Westar Energy
Page 12 of 12
Project Number 44832
Date 2-27-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 185 | Shale, Dark Gray to Greenish Gray, Moderate<br>Gypsum Present at Bottom | HC | | | | 180.5 - 185.5 | | | | |
| 186 | Total Depth=185.5' bgs | | | | | | | | | 3/1/07 1643 End Drilling |
| 187 | | | | | | | | | | |
| 188 | | | | | | | | | | |
| 189 | | | | | | | | | | |
| 190 | | | | | | | | | | |
| 191 | | | | | | | | | | |
| 192 | | | | | | | | | | |
| 193 | | | | | | | | | | |
| 194 | | | | | | | | | | |
| 195 | | | | | | | | | | |
| 196 | | | | | | | | | | |
| 197 | | | | | | | | | | |
| 198 | | | | | | | | | | |
| 199 | | | | | | | | | | |
| 200 | | | | | | | | | | |
| 201 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILLING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

MW-BAA-5
Formerly MW-BE-2

# Drilling Log

| Project Name | Project No. | Boring Number |
|---|---|---|
| Westar Energy | 44832 | B-2 |
| **Ground Elevation** | **Location** | **Page** |
| 1,280.0 ft. | | 1 of 5 |
| **Air Monitoring Equipment** | | **Total Footage** |
| NA | | 76.75 |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. Of Samples | No. Core Boxes | Depth to Water | Date Measured |
|---|---|---|---|---|---|---|---|
| HSA/Air Rotary | 6" | 4.4 | 72.35 | NA | NA | | |

| | |
|---|---|
| Drilling Company Geotechnology | Drillers (s) C. Steiner, C. Sweet |
| Drilling Rig CME | Type of Sampler Split Spoon |
| Date 3-12-07 To 3-12-07 | Field Observer (s) Kevin Bolling |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Clay, Some Silt, Dark Brown, Trace Plasticity, Damp | CL | 5/ 8/ 8 | 0.833/ 1.5 | 1405 | 0 - 1.5 | | | | 1400 Begin Drilling |
| 2 | Becomes Olive Green | | 7/ 14/ 15 | 1/ 1.5 | 1410 | 1.5 - 3 | | | | |
| 3 | | | | | | | | | | |
| 4 | | | 6/ 15/ 50 | 1/ 1.5 | 1416 | 3 - 4.5 | | | | |
| 5 | Limestone, Gray, Hard | BR | | | | | | | | |
| 6 | Shale, Greenish Olive to Red/Pale Red, Moderate Hardness, Weathered, Varigated | BR | | / 3 | 1436 | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | NA | | | | | | | |
| 10 | | | | / 5 | 1458 | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

MW-BAA-5
Formerly MW-BE-2

# Drilling Log, continued

Boring Number B-2
Project Name Westar Energy
Page 2 of 5
Project Number 44832
Date 3-12-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shale, Greenish Olive to Red/Pale Red, Moderate Hardness, Weathered, Varigated | BR | | | | | | | | |
| 15 | Limestone | CR | | / 5 | 1509 | | | | | |
| | Shale, Greenish Gray to Olive Gray | CR | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| | Limestone | CR | | | | | | | | |
| 18 | Shale, Greenish Gray, Moderate Hardness, Calcareous | CR | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | / 5 | 1512 | | | | | |
| | Shale, Grayish Black, Moderate Hardness | CR | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | NA | | | | | | | |
| 23 | Shale, Dark Gray, Moderate Hardness | EC | | | | | | | | |
| | Limestone, Dark Gray, Moderate Hardness | EC | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | / 5 | 1523 | | | | | |
| | Shale, Red to Pale Brown, Moderate Hardness | EC | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | Limestone, Yellowish Gray, Hard | MI | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | / 5 | 1536 | | | | | |
| | Becomes wet | MI | | | | | | | | |
| 31 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

MW-BAA-5
Formerly MW-BE-2

# Drilling Log, continued

Boring Number B-2
Project Name Westar Energy
Page 3 of 5
Project Number 44832
Date 3-12-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | Becomes wet | MI | | | | | | | | |
| 32 | Shale, Dark Gray, Moderate Hardness | HO | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | / 5 | 1548 | | | | | |
| 36 | | | | | | | | | | |
| 37 | Limestone, Dark Gray, Moderate to Hard | EI | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | | | NA | | | | | | | |
| 40 | | | | / 5 | 1604 | | | | | |
| 41 | Becomes Light Gray | EI | | | | | | | | |
| 42 | | | | | | | | | | |
| | Shale, Medium Dark Gray, Moderate Hardness | ST | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | / 5 | 1619 | | | | | |
| 46 | | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

MW-BAA-5
Formerly MW-BE-2

# Drilling Log, continued

Boring Number B-2
Project Name Westar Energy
Page 4 of 5
Project Number 44832
Date 3-12-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 49 | Shale, Medium Dark Gray, Moderate Hardness | ST | | | | | | | | |
| 50 | Limestone | ST | | / 5 | 1622 | | | | | |
| 51 | Shale, Greenish Gray, Moderate Hardness | ST | | | | | | | | |
| 52 | | | | | | | | | | |
| 53 | | | | | | | | | | |
| 54 | | | | | | | | | | |
| 55 | Limestone, Grayish Yellow to Dark Yellowish Orange, Hard | MO | | / 5 | 1630 | | | | | |
| 56 | | | NA | | | | | | | |
| 57 | Calcite Crystals Present | MO | | | | | | | | |
| 58 | | | | | | | | | | |
| 59 | | | | | | | | | | |
| 60 | | | | / 5 | 1637 | | | | | |
| 61 | Shale, Dark Gray, Moderate Hardness | FL | | | | | | | | |
| 62 | | | | | | | | | | |
| 63 | | | | | | | | | | |
| 64 | | | | | | | | | | |
| 65 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

MW-BAA-5
Formerly MW-BE-2

# Drilling Log, continued

Boring Number B-2
Project Name Westar Energy
Page 5 of 5
Project Number 44832
Date 3-12-07

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID BZ | PID BH | PID S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 66 | Shale, Dark Gray, Moderate Hardness | FL | | / 5 | 1650 | | | | | |
| 67 | | | | | | | | | | |
| 68 | Shale, Medium Dark Gray, Moderate Hardness | FL | | | | | | | | |
| 69 | | | | | | | | | | |
| 70 | Limestone, Medium Gray, Hard | CD | | / 5 | 1658 | | | | | |
| 71 | | | NA | | | | | | | |
| 72 | Wet | CD | | | | | | | | |
| 73 | | | | | | | | | | |
| 74 | | | | | | | | | | |
| 75 | | | | / 4.25 | 1708 | | | | | |
| 76 | Shale, Grayish Blue Green, Hard | ES | | | | | | | | |
| 77 | Total Depth=76.75 | | | | | | | | | 1708 End Drilling |
| 78 | | | | | | | | | | |
| 79 | | | | | | | | | | |
| 80 | | | | | | | | | | |
| 81 | | | | | | | | | | |
| 82 | | | | | | | | | | |

ENVIRONMENTAL LOG DRILING LOGS JEFFREY ENERGY CENTER.GPJ WILLIAMS.GDT 6/27/07

Burns & McDonnell

# Drilling Log

| Project Name | Project Number | Boring Number |
|---|---|---|
| FBC Landfill JEC | 45702 | PT-1 |
| **Ground Elevation** | **Location** | **Page** |
| | Jeffrey Energy Center | 1/5 |
| **Air Monitoring Equipment** | | **Total Footage** |
| NA | | 78' |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. of Samples | No. of Core Boxes |
|---|---|---|---|---|---|
| HSA<br>NQ wire line | 8"<br>3" | 2.2 | 75.8 | NA | 7 |

| Drilling Company | Driller(s) |
|---|---|
| Geotechnology | Craig Stemes & Brad Thornburg |
| **Drilling Rig** | **Type of Sampler** |
| Mobile B-57 | NQ wire line |
| **Date** / **To** | **Field Observer(s)** |
| 10/25/07 / 10/26/07 | Justin Cecil |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SILTY CLAY brown 7.5YR; damp medium, medium plasticity | | | | 1225 | | | | | Logged from cuttings |
| 2 | | | | | | | | | | |
| 3 | SHALE, yellowish gray 5Y 8/1 highly weathered, very weak | EC | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | 1300 | | | | | 1305 Drillers set water |
| 12 | LIMESTONE, yellowish gray 5Y 7/2 slightly weathered, hard, fossil fossils | MI | RQD 65% | 3.7/5 | 1405 | | | | | 1400 Begin Coring |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

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051601 Form WCD-2-1

# Drilling Log Continuation

Boring Number PT-1
Project Name FGD Landfill JEC
Page 2/5
Project Number 45702
Date 10/25/07

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | SHALE, pale olive 10Y6/2, slightly weathered medium | HO | | | | | | | | |
| 16 | SHALE, dusky red 5R 3/4, moderately weathered, ~~very weak~~. | | | | | | | | | |
| 17 | SHALE, yellowish gray 5Y 7/2, highly weathered, very weak; | | | | | | | | | |
| 18 | SHALE, Pale red 5R 6/2, moderately weathered, ~~weak~~, very weak, | | RQD ~~80%~~ 92% | ~~R40~~ 4.6/5 | 1428 | | | | | |
| 19 | SHALE, pale greenish olive 10Y 6/2 highly weathered, very weak, | | | | | | | | | |
| 20 | SHALE, PALE Red 5R 6/2 moderately weathered, very weak | | | | | | | | | |
| 21 | SHALE, dusky red 5R3/4, moderately weathered, weak, | HO | | | | | | | | |
| 22 | | | RQD 50% | 4.4/5 | 1448 | | | | | |
| 23 | SHALE, pale olive 10Y 6/2 w/ | | | | | | | | | |
| 24 | inclusions of pale red, moderately to highly weathered, very weak | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | LIMESTONE, yellowish gray 5Y 7/2 moderately weathered, strong, ~~poor~~ highly porous; | EI | | | | | | | | |
| 27 | SHALE, black N1, highly weathered, very weak, | | RQD 28% | 2.9/5 | 1509 | | | | | |
| 28 | LIMESTONE, medium - medium lt. gray N5-N6, slightly weathered, very strong | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | some fracturing | | | | | | | | | |
| 31 | very ~~poor~~ highly porosity | EI | RQD 74% | 5/5 | 1528 | | | | | |
| 32 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log Continuation

Boring Number PT. 1
Project Name FGD Landfill JEC
Page 3/5
Project Number 45702
Date 10/25/07

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 34 | SHALE, med gray N5, slightly weathered, strong, laminated<br>SHALE, med dark gray N4, highly weathered weak, fractured w/ laminations | | | | | | | | | Lost Circulation |
| 35 | LIMESTONE, light gray N7, strong slightly weathered | | | | | | | | | 1530 Drillers to get water |
| 36 | | | RQD 100% | 4.8/5 | 1555 | | | | | 1542 Begin Drilling |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | |
| 39 | LIMESTONE, grayish red 5R 4/2, strong slightly weathered | | | | | | | | | |
| 40 | SHALE, pale red 10R 4/2 strong slightly weathered | ST | | | | | | | | |
| 41 | | | RQD 43% | 5/5 | 1608 | | | | | |
| 42 | LIMESTONE, med gray - light gray N5-N7 strong, slightly weathered w/ high porosity, intermitten fossils | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | SHALE, medium gray N5, strong slightly weathered | | RQD 60% | 4.2/5 | 1623 | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |
| 49 | | | | | | | | | | |
| 50 | LIMESTONE, med dark gray N4, strong moderately weathered, foss. liferous | | | | | | | | | |
| 51 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log Continuation

| | |
|---|---|
| Project Name | FGD Landfille JEC |
| Project Number | 45702 |
| Boring Number | PT-1 |
| Page | 4/5 |
| Date | 10/25/07 & 10/26/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 52 | | | | | | | | | | 1630 Drillers to get water |
| 53 | LIMESTONE, med. light gray N6 strong, slightly weathered | | RQD 100% | 4.1/5 | 1706 | | | | | 1645 Begin Drilling |
| 54 | | | | | | | | | | |
| 55 | | | | | | | | | | |
| 56 | SHALE, dark gray - med. gray N3-N5, weak, moderately weathered, laminated | FL | RQD 34% | 4.5/4.5 | 1730 | | | | | |
| 57 | | | | | | | | | | |
| 58 | | | | | | | | | | |
| 59 | | | | | | | | | | |
| 60 | LIMESTONE, Greenish gray 5GY 6/1 strong, slightly weathered | | | | | | | | | 10/26/07 0745 Begin drilling |
| 61 | SHALE light olive gray 5Y 6/1 weak - strong, moderately weathered | | | | | | | | | |
| 62 | | | RQD 100% | 4.3/5 | 0813 | | | | | |
| 63 | | | | | | | | | | |
| 64 | | | | | | | | | | |
| 65 | LIMESTONE, very light gray N8 strong, highly weathered w/ fracturing | CD | | | | | | | | |
| 66 | | | RQD 58% | 3.9/5 | 0828 | | | | | |
| 67 | LIMESTONE, yellowish gray 5Y 7/2 strong, moderately weathered, w/ fractures | | | | | | | | | |
| 68 | LIMESTONE, yellowish gray - dusky yellow 5Y 7/2 - 5Y 6/4, highly weathered strong, highly fractured, heavy calcite deposition | | | | | | | | | |
| 69 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

# Drilling Log Continuation

| | |
|---|---|
| Project Name | FGD Landfill JEC |
| Project Number | 45702 |
| Boring Number | PT-1 |
| Page | 5/5 |
| Date | 12/26/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 70 | | | | | | | | | | |
| | SHALE med light gray NH, hard, slightly weathered | ES | | | | | | | | Est water 0838 |
| 71 | | | | | | | | | | |
| | SHALE, med dark gray NH, hard slightly weathered, slightly fractured | | RQD 100% | 4.1/5 | 0830 | | | | | |
| 72 | | | | | | | | | | |
| 73 | | | | | | | | | | |
| 74 | | | | | | | | | | |
| 75 | | | | | | | | | | |
| | | | | | | | | | | 0847 Driller return w/H2O 0850 Begin drilling |
| 76 | | | RQD 83% | 1.6/3 | 0901 | | | | | |
| 77 | | | | | | | | | | |
| 78 | BOTTOM OF HOLE | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log

| Project Name | Project Number | Boring Number |
|---|---|---|
| FGD Landfill JEC | 45702 | PT-2 |
| **Ground Elevation** | **Location** | **Page** |
| | JEFFREY ENERGY CENTER | 1/3 |
| **Air Monitoring Equipment** | | **Total Footage** |
| NA | | 49' |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. of Samples | No. of Core Boxes |
|---|---|---|---|---|---|
| HSA<br>NQ wireline | 8"<br>3" | 0.6 | 48.4 | NA | 5 |

| | |
|---|---|
| **Drilling Company**: Geotechnology | **Driller(s)**: Craig Steiver + Brad Thornburg |
| **Drilling Rig**: Mobile B-57 | **Type of Sampler**: NQ Wire line |
| **Date**: 11/2/07 **To**: 11/2/07 | **Field Observer(s)**: Justin Corker |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Top Soil<br>LIMESTONE, medium light gray N6 | | | | | | | | | Begin drilling 0756 |
| 2 | | | | | | | | | | |
| 3 | LIMESTONE very light gray N8 | | | | 0801 | | | | | |
| 4 | LIMESTONE, very light gray N8 slightly weathered, Hardy porous | | RQD 73% | 1.5/1.5 | | | | | | Begin coring 0810 |
| 5 | | | | | 0813 | | | | | |
| 6 | | | | | | | | | | |
| 7 | SHALE light olive gray 5Y 6/1, highly weathered, very weak, fractured, iron spots + clayey | ES | RQD 65% | 4/5 | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | 0829 | | | | | |
| 11 | SHALE, light brownish gray 5YR 6/1 highly weathered, very weak-weak, | | RQD 40% | 3.3/5 | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | 0842 | | | | | |
| 14 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell

# Drilling Log Continuation

| | |
|---|---|
| Project Name | FCD ~~Landfill~~ Landfill JEC |
| Project Number | 45702 |
| Boring Number | PT-2 |
| Page | 2/3 |
| Date | 11/2/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | | | | | | | | | | |
| 16 | SHALE, medium gray N5, slightly weathered, strong, fractured & laminated | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | SHALE, greenish gray 5G 6/1 moderately weathered, weak, | | RQD 43% | 3/5 | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | 0935 | | | | | 0925 Drillers to get water |
| 21 | | | | | | | | | | 0929 Drillers return w/ water |
| 22 | | | | 4.8/5 | | | | | | 0929 Begin drilling |
| 23 | SHALE, Brownish gray 5YR 4/1 moderately weathered, weak Fractured, | | RQD 100% | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | SHALE, greenish gray 5G 5/1, | | | | 0940 | | | | | |
| 26 | moderately weathered, very weak laminated | | | | | | | | | |
| 27 | | | RQD 61% | 4.2/5 | | | | | | |
| 28 | Fractured | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | SHALE, Grayish red 5R 4/2 slightly weathered, very weak | | | | 1003 | | | | | |
| 31 | Becomes highly weathered | | | | | | | | | |
| 32 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log Continuation

| | |
|---|---|
| Project Name | FGD Landfill JEC |
| Project Number | 45702 |
| Boring Number | PF-2 |
| Page | 3/3 |
| Date | 11/2/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 33 | SHALE, light brownish gray 5YR 6/1, slightly weathered, weak, laminated. | | RQD 50% | 4.8/5 | | | | | | 1025 Drillers to get water<br>1045 Drillers Return w/water<br>1050 Begin drilling |
| 34 | | | | | | | | | | |
| 35 | | | | | 1021 | | | | | |
| 36 | | | | | | | | | | |
| 37 | | | RQD 74% | 5/5 | | | | | | |
| 38 | | | | | | | | | | |
| 39 | SHALE, grayish green 5GY 5/1 moderately weathered, very weak to weak, some limestone mixed in | | | | | | | | | |
| 40 | | | | | 1104 | | | | | |
| 41 | LIMESTONE very light gray N8 moderately - highly weathered, strong, very thinly bedded NE | | RQD 76% | 4.2/5 | | | | | | |
| 42 | LIMESTONE greenish gray 5GY 6/1 moderately - highly weathered weak, fractured | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | LIMESTONE, medium light gray N6 slightly weathered, strong | | | | | | | | | |
| 45 | | | | | 1110 | | | | | |
| 46 | | | RQD 49% | 3.1/3.5 | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |
| 49 | | | | | 1127 | | | | | |
| | BOTTOM OF HOLE | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log

| Project Name | Project Number | Boring Number |
|---|---|---|
| FGD Landfill JEC | 45702 | PZ-A |
| **Ground Elevation** | **Location** | **Page** |
| | Jeffrey Energy Center | 1/2 |
| **Air Monitoring Equipment** | | **Total Footage** |
| NA | | 27' |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. of Samples | No. of Core Boxes |
|---|---|---|---|---|---|
| HSA<br>Air hammer | 8"<br>4" | 0 | 27' | 0 | 0 |

| | |
|---|---|
| **Drilling Company** | **Driller(s)** |
| Geotechnology | Craig Steiner & Brad Thornburg |
| **Drilling Rig** | **Type of Sampler** |
| Dietrich D-50 | NA |
| **Date** 11/7/07 **To** 11/7/07 | **Field Observer(s)** Justin Carter |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SHALE light brown 5YR 6/1 reworked | ES | | | 1059 | | | | | Begin drilling 1059 logged from cuttings |
| 2 | becomes more competent | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | SHALE medium gray N3 | ES | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | SHALE greenish gray 5GY 6/1 | ES | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | SHALE brownish gray 5YR 4/1 | ES | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell

051601 Form WCD-2-1

# Drilling Log Continuation

| | |
|---|---|
| Project Name | FGD Landfill JEC |
| Project Number | 45702 |
| Boring Number | PZ-A |
| Page | 2/2 |
| Date | 11/7/07 |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | SHALE greenish gray 5GY 5/1 | ES | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | SHALE, grayish red 5R 4/2 | ES | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | SHALE, light brownish gray 5YR 6/1 | ES | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | SHALE greenish gray 5GY 5/1 | ES | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | Limestone very light gray N8 | NE | | | 1140 | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell SINCE 1898

051601 Form WCD-KC-2-2

# Drilling Log

| Project Name | Project Number | Boring Number |
|---|---|---|
| FGD Landfill JEC | 45702 | PZ-E |

| Ground Elevation | Location | Page |
|---|---|---|
| | Jeffrey Energy Center | 1/1 |

| Air Monitoring Equipment | Total Footage |
|---|---|
| NA | 10' |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. of Samples | No. of Core Boxes |
|---|---|---|---|---|---|
| HSA | 8" | 10' | NA | NA | NA |

| Drilling Company | Driller(s) |
|---|---|
| Geotechnology | Craig Steiner & Brad Thornburg |

| Drilling Rig | Type of Sampler |
|---|---|
| Dietrich D-50 | NA |

| Date | To | Field Observer(s) |
|---|---|---|
| 11/9/07 | 11/9/07 | Justin Carter |

| Depth (feet) | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CLAY brown 5/3 10YR, damp medium, medium plasticity | | | | 1154 | | | | | Begin drilling 1154 |
| 2 | CLAY yellowish brown 5/6 10YR damp, medium medium plasticity | | | | | | | | | Logged from cuttings |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | CLAY ~~yo~~ dark yellowish brown 4/6 10YR, damp, medium highly plastic | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | becomes moist | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |

BZ=Breathing Zone BH=Bore Hole S=Sample

Burns & McDonnell

051601 Form WCD-2-1

# LOG OF TEST PIT NO. TP-01



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10" Root Zone<br><br>FAT CLAY, dark brown | | CH | 1 | BS | | | 38.4 | | |
| | 1.75<br>2 **LIMESTONE, slight weathering, light tan | | | | | | | | | |
| | BOTTOM OF TEST PIT<br><br>Test Pit Refusal at 2 feet.<br><br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-02



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1197.77 ft | | | | | | | | | |
| | 7" Root Zone<br>LEAN TO FAT CLAY, dark brown | 0.8 / 1197 | CL CH | 1 | BS | | | 26.3 | | |
| | SILTY LEAN CLAY, with gravel, light brown | 2.8 / 1195 | CL ML | 2 | BS | | | 22.7 | | |
| | **LIMESTONE, slight weathering, tan | 3 / 1195 | | | | | | | | |
| | BOTTOM OF TEST PIT<br><br>Test Pit Refusal at 3 feet.<br><br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-03



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1221.08 ft | | | | | | | | | |
| | 5" Root Zone<br><br>LEAN CLAY, brown | | CL | 1 | BS | | | 23.7 | | |
| | 2 1219 | | | | | | | | | |
| | **SHALE, very severe weathering, gray | | | 2 | BS | | | 14.7 | | |
| | 3 1218 | | | | | | | | | |
| | **SHALE, moderate weathering, gray | 5 | | 3 | BS | | | 16.1 | | |
| | 6 1215 | | | | | | | | | |
| | BOTTOM OF TEST PIT<br><br>Test Pit Refusal at 6 feet.<br><br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-04



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1221.08 ft | | | | | | | | | | |
| | 9" Root Zone | | CH | 1 | BS | | | 35.4 | | | |
| | FAT CLAY, dark brown | | CH | 2 | BS | | | 30.8 | | | |
| | 3 1218 | | | | | | | | | | |
| | LEAN CLAY, gray | | CL | 3 | BS | | | 30.9 | | | LL=35 PL=22 PI=13 |
| | | | CL | 4 | BS | | | 20.3 | | | |
| | 5 1216 | 5 | | | | | | | | | |
| | **SHALE, severe weathering, gray | | | 5 | BS | | | 12.6 | | | |
| | 6.5 1214.5 | | | | | | | | | | |
| | BOTTOM OF TEST PIT | | | | | | | | | | |
| | Test Pit Refusal at 6.5 feet. | | | | | | | | | | |
| | **Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-05



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1216.96 ft | | | | | | | | | |
| | 9" Root Zone<br>LEAN CLAY, dark brown<br>1 1216 | | CL | 1 | BS | | | 31.2 | | |
| | FAT CLAY, dark brown | | CH | 2 | BS | | | 28.2 | | |
| | 4 1213 | | CH | 3 | BS | | | 27.9 | | |
| | **SHALE, severe weathering, gray | 5 | | 4 | BS | | | 7.4 | | |
| | 7.5 1209.5 | | | 5 | BS | | | 11.7 | | |
| | BOTTOM OF TEST PIT<br>Test Pit Refusal at 7.5 feet.<br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-06



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1221.53 ft | | | | | | | | | |
| | 12" Root Zone | | CH | 1 | BS | | | 26.6 | | |
| | FAT CLAY, dark brown | | CH | 2 | BS | | | 22.6 | | |
| | 4 1217.5 | | | | | | | | | |
| | **SHALE, severe weathering, gray | 5 | | 3 | BS | | | 20.2 | | |
| | 5.8 1215.5 | | | | | | | | | |
| | 6 **LIMESTONE, moderate weathering, light tan 1215.5 | | | | | | | | | |
| | BOTTOM OF TEST PIT | | | | | | | | | |
| | Test Pit Refusal at 6 feet. | | | | | | | | | |
| | **Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-07



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1217.98 ft | | | | | | | | | | |
| | 9" Root Zone | | | | | | | | | | |
| | 0.75 FAT CLAY, dark brown 1217 | | CH | 1 | BS | | | 32.9 | | | |
| | FAT CLAY, brown | | CH | 2 | BS | | | 27.6 | | | LL=64 PL=27 PI=37 |
| | 2 1216 | | | | | | | | | | |
| | LEAN CLAY, gray | | CL | 3 | BS | | | 17.1 | | | LL=39 PL=24 PI=15 |
| | 3 1215 | | | | | | | | | | |
| | 3.5 **SHALE, moderate weathering, gray 1214.5 | | | 4 | BS | | | 1.3 | | | LL=30 PL=17 PI=13 |
| | BOTTOM OF TEST PIT | | | | | | | | | | |
| | Test Pit Refusal at 3.5 feet. | | | | | | | | | | |
| | **Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | 8-4-08 | | |
| BORING COMPLETED | 8-4-08 | | |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-08



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1206.2 ft | | | | | | | | | | |
| | 12" Root Zone<br>LEAN CLAY, with gravel, dark brown | | CL | 1 | BS | | | 18.3 | | | |
| | 1 1205 | | | | | | | | | | |
| | LEAN CLAY, grayish brown | | CL | 2 | BS | | | 19.1 | | | LL=46<br>PL=22<br>PI=24 |
| | 2 1204 | | | | | | | | | | |
| | LEAN TO FAT CLAY, grayish brown | | CL<br>CH | 3 | BS | | | 28.3 | | | |
| | 4 1202 | | | | | | | | | | |
| | SANDY LEAN CLAY, with gravel, light brown, grayish brown ▽ | 5 | CL | 4 | BS | | | 15.8 | | | LL=37<br>PL=18<br>PI=19 |
| | 7 1199 | | CL | 5 | BS | | | 23.0 | | | |
| | 7.5 **SHALE, moderate weathering, gray 1198.5 | | | 6 | BS | | | 5.6 | | | |
| | BOTTOM OF TEST PIT<br><br>Test Pit Refusal at 7.5 feet.<br><br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ 6.5 | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-09



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1200.17 ft | | | | | | | | | |
| | 10" Root Zone | | CL | 1 | BS | | | 27.6 | | |
| | LEAN CLAY, with gravel, dark brown | 1.2 | | | | | | | | |
| | **LIMESTONE, slight weathering, light tan | 1.3 (1199) | | | | | | | | |
| | BOTTOM OF TEST PIT | | | | | | | | | |
| | Test Pit Refusal at 1.3 feet. | | | | | | | | | |
| | **Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | 8-4-08 | | |
| BORING COMPLETED | 8-4-08 | | |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

# LOG OF TEST PIT NO. TP-10



CLIENT **Westar Energy**

**DRAFT LOGS**

SITE **Jeffrey Energy Center**
**St. Marys, Kansas**

PROJECT **FGD Scrubber Gypsum Landfill**

| GRAPHIC LOG | DESCRIPTION | DEPTH, ft. | USCS SYMBOL | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY, in. | SAMPLES SPT - N BLOWS / ft. | TESTS WATER CONTENT, % | TESTS DRY UNIT WT pcf | TESTS UNCONFINED STRENGTH, psf |
|---|---|---|---|---|---|---|---|---|---|---|
| | Approx. Surface Elev.: 1196.26 ft | | | | | | | | | |
| | 7" Root Zone<br>FAT CLAY, with gravel, brown | 1 | CH | 1 | BS | | | 31.1 | | |
| | **LIMESTONE, slight weathering, tan | 1195.5 | | | | | | | | |
| | BOTTOM OF TEST PIT<br><br>Test Pit Refusal at 2.5 feet.<br><br>**Descriptions estimated from disturbed samples. Core samples and petrographic analysis may indicate other rock types. | 2.5 | | | | | | | | |
| | | 1194 | | | | | | | | |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft | | |
|---|---|---|
| WL | ▽ NONE | ▼ |
| WL | ▼ | ▼ |
| WL | | |

Terracon

| | | | |
|---|---|---|---|
| BORING STARTED | | | 8-4-08 |
| BORING COMPLETED | | | 8-4-08 |
| RIG | | FOREMAN | |
| APPROVED | SBP | JOB # | 14081039 |

BOREHOLE 14081039.GPJ TERRACON.GDT 8/14/08

MW-FGD-5

# Drilling Log

| Project Name | Project No. | Boring Number |
|---|---|---|
| Jeffrey Energy Center Industrial Landfill | 52123 | MW-GR-7D |
| **Ground Elevation** | **Location** | **Page** |
| - - ft. St. Mary's, Kansas | St. Mary's, Kansas | 1 of 3 |
| **Air Monitoring Equipment** | | **Total Footage** |
| | | 45.21 |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. Of Samples | No. Core Boxes | Depth to Water | Date Measured |
|---|---|---|---|---|---|---|---|
| HSA | 6.25-inch | 45.21 | 0 | NA | NA | 28.89 | 3-27-09 |

| | | | |
|---|---|---|---|
| Drilling Company | Terracon | Drillers (s) | John Johnson Curtis Akin |
| Drilling Rig | CME 75 | Type of Sampler | HSA |
| Date | 2-25-09 To 2-25-09 | Field Observer (s) | C. Hoglund |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | CLAY with some SILT and little very fine-med. SAND - Black (N 2.5/), low consistency, med.-high plastic, sand grians are subrounded, Moist. Fill Material? | FILL | | | | | | | | START DRILLING @ 1142 |
| 1 | SAA; Damp. Fill Material? | FILL | | | | | | | | |
| 5 | SAA; little pebble sized limestone/grave fragments (subangular to subrounded), very low consistecny, high plastic, Moist. Fill Material? | FILL | NA | | | | | | | |
| 11 | SAA; Damp. Fill Material? | FILL | | | | | | | | |

ENVIRONMENTAL LOG JEC LANDFILL DRILL LOG.GPJ WILLIAMS.GDT 4/1/09

Burns & McDonnell SINCE 1898

# Drilling Log, continued

Boring Number MW-GR-7D
Project Name Jeffrey Energy Center Industrial Landfill
Page 2 of 3
Project Number 52123
Date 2-25-09

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAA; Damp. Fill Material? | FILL | | | | | | | | Water coming up with cuttings @ 14 ft bgs |
| 15 | | | | | | | | | | Driller says "very soft zone" from 15-20 ft bgs. |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | CLAY with some fine gravel to pebble sized limestone fragments, and little SILT - Black (N 2.5/), very low consistency, high plastic, WET. Rock fragments are Light Gray (5Y 7/2) to Pale Yellow (5Y 7/3). | FILL | | | | | | | | |
| 21 | | | | | | | | | | Driller says "hit hard rock/gravel zone @ 21-22.5 ft bgs. |
| 22 | | | | | | | | | | |
| 23 | | | NA | | | | | | | Cutting come up as wet Black soupy muck @ 23.0 ft bgs. |
| 24 | | | | | | | | | | |
| 25 | CLAY with little very fine to fine SAND - Dark Gray (N 4/), very low consistency, high plastic, little pebble to fine gravel sized limestone fragments, WET. | FILL | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | Cuttings come up as Dark Brown soupy muck @ 28.0 ft bgs. |
| 29 | SAA; Large limestone fragments, dense/hard, Dry. Limestone is Gray (5Y 5/1) to Light Gray (5Y 7/1). | LIMESTONE | | | | | | | | Hit hard rock @ 28.5 ft bgs. |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | Driller says "broke through hard rock |

ENVIRONMENTAL LOG JEC LANDFILL DRILL LOG.GPJ WILLIAMS.GDT 4/1/09

Burns & McDonnell SINCE 1898

# Drilling Log, continued

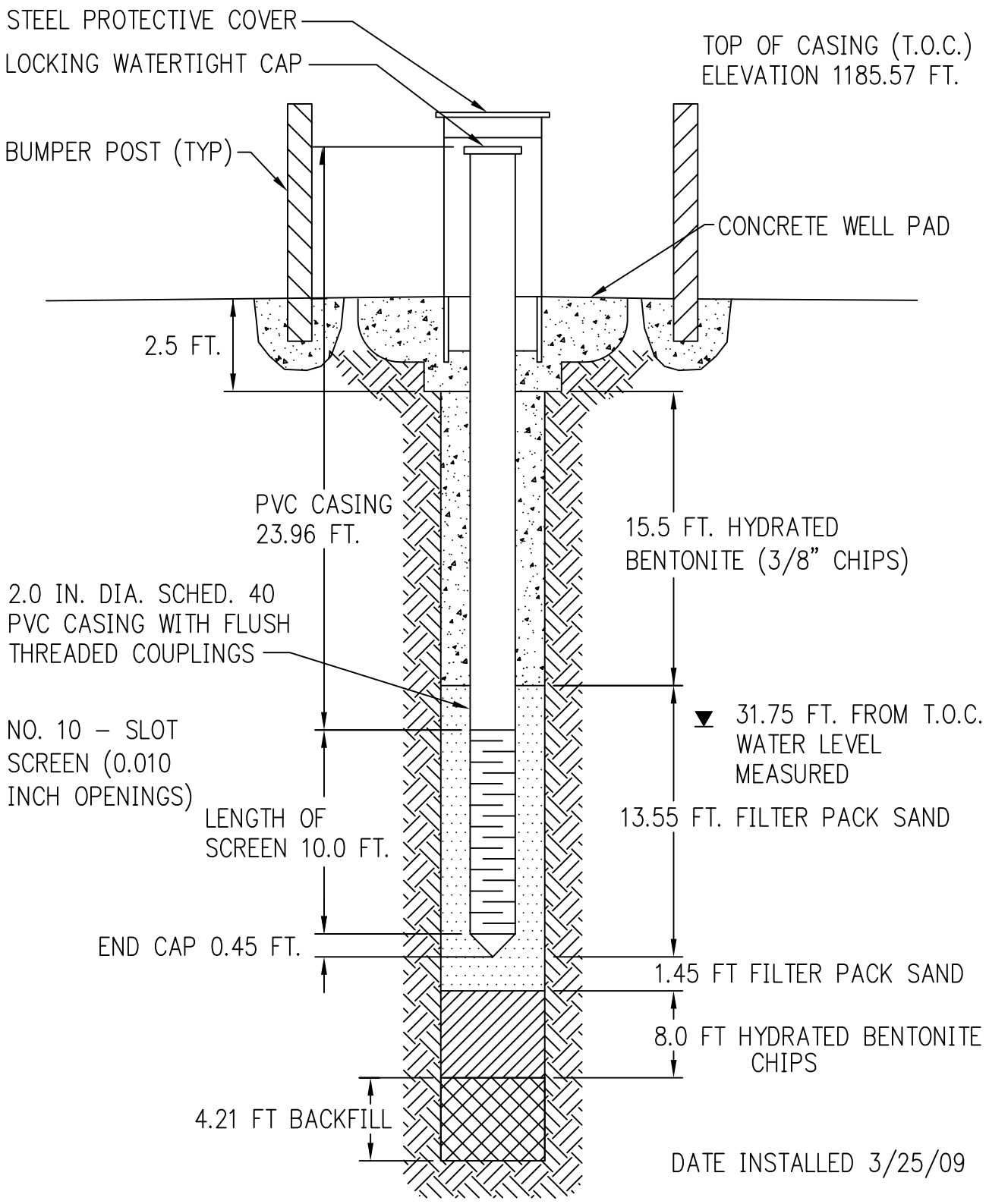
**MW-FGD-5**

| | |
|---|---|
| Project Name | Jeffrey Energy Center Industrial Landfill |
| Project Number | 52123 |
| Boring Number | MW-GR-7D |
| Page | 3 of 3 |
| Date | 2-25-09 |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAA; Large limestone fragments, dense/hard, Dry. Limestone is Gray (5Y 5/1) to Light Gray (5Y 7/1). | LIMESTONE | | | | | | | | zone @ 30.5 ft bgs". |
| 32 | | | | | | | | | | |
| 33 | | | | | | | | | | |
| 34 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 36 | | | | | | | | | | Hit hard rock @ 35.5 ft bgs to 38.0 ft bgs. Drillers run out of Hex-Rod. Pull Hex -Rods and change to threaded AW rods to drill deeper. |
| 37 | | | | | | | | | | |
| 38 | SHALE/MUDSTONE - Dark Gray (5Y 4/1), small subrounded chips, med. consistency, low-med. plastic, trace Light Gray (N 7/) limestone fragments, DRY. | SHALE | NA | | | | | | | |
| 39 | | | | | | | | | | |
| 40 | SHALE/MUDSTONE - Gray (5Y 6/1) to Olive Gray (5Y 5/2), little Light Gray (N 7/) pebble sized limestone fragments (subangular to subrounded), Dry. | SHALE | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | STOP DRILLING @ 1515. Borehole TD = 45.21 ft bgs. |
| 43 | | | | | | | | | | Cave-in slough to 41.0 ft bgs, backfill with hydrated bentonite to 33 ft bgs, backfill with filter pack sand to 31.55 ft bgs, install well. Well TD = 34.41 TOC = 31.55 ft bgs. |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | End Cap = 0.45 ft, 10 ft factory slotted screen (0.010-inch), top of filter pack at 18.0 ft bgs, hydrated bentonite chips to 2.5 ft bgs. |
| 46 | | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |

ENVIRONMENTAL LOG JEC LANDFILL DRILL LOG.GPJ WILLIAMS.GDT 4/1/09

Burns & McDonnell SINCE 1898




BOTTOM OF BORING 45.21 FT. BELOW GRADE.

BOTTOM OF WELL 34.41 FT. BELOW T.O.C.

NOT TO SCALE

Burns & McDonnell
SINCE 1898

MW-GR-7D
**MW-FGD-5**
MONITORING WELL
CONSTRUCTION DIAGRAM

K:\ENV\WESTAR ENERGY\Site\52123\Cad\MW-GR-7D.dwg 04-10-2009 14:39 GSTARK

# Drilling Log

| Project Name | Project No. | Boring Number |
|---|---|---|
| JEC Landfill | 52123 | PZ-ES-7I |
| **Ground Elevation** | **Location** | **Page** |
| - - ft. St. Mary's, Kansas | St. Mary's, Kansas | 1 of 3 |
| **Air Monitoring Equipment** | | **Total Footage** |
| | | 34.65 |

| Drilling Type | Hole Size | Overburden Footage | Bedrock Footage | No. Of Samples | No. Core Boxes | Depth to Water | Date Measured |
|---|---|---|---|---|---|---|---|
| HSA | 6.25-inch | 34.65 | 0 | NA | NA | 15.25 | 3-27-09 |

| | | | |
|---|---|---|---|
| Drilling Company | Terracon | Drillers (s) | John Johnson Curtis Akin |
| Drilling Rig | CME 75 | Type of Sampler | HSA |
| Date | 3-26-09 To 3-26-09 | Field Observer (s) | C. Hoglund |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CLAY and SILT - Yellow 5Y 7/6), low consistency, loose-granular, no plastic, damp. Fill Material? | FILL | | | | | | | | START DRILLING @ 1110 |
| 2 | CLAY with some SILT - Yellow (5Y 7/6), med. consistency, low-med. plastic, little hard/dense limestone/gravel fragments, damp. Fill Material? | FILL | | | | | | | | |
| 3 | CLAY with some SILT - Black (5Y 2.5/), very low consistency, high plastic, damp. Approx. 6-inch thick zone at top of hard/dense limestone/gravel fragments, subangular. Fill Material? | FILL | | | | | | | | Hit Hard Rock - 6-inch thick zone |
| 4 | SAA; CLAY with some SILT - Black (5Y 2.5/), low consistency, breaks into small-med. colloids, low-med. plastic, damp. Fill Material? | FILL | | | | | | | | |
| 5 | SAA; with little hard/dense limestone/small gravel fragments, Gray (5Y 5/1), slightly damp. Fill Material? | FILL | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | NA | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | SAA; | FILL | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | SAA; CLAY with some SILT - Black (5Y 2.5/1), very low consistency, high plastic, with some small pebble sized hard/dense limestone/gravel fragments, Olive (5Y 4/4), trace small gravel, Moist. Fill Material. | FILL | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |

ENVIRONMENTAL LOG JEC LANDFILL DRILL LOG.GPJ WILLIAMS.GDT 5/27/09

Burns & McDonnell SINCE 1898

# Drilling Log, continued

| | |
|---|---|
| Project Name | JEC Landfill |
| Project Number | 52123 |
| Boring Number | PZ-ES-7I |
| Page | 2 of 3 |
| Date | 3-26-09 |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAA; WET | FILL | | | | | | | | WET - cutting coming up as soupy muck |
| 15 | SAA; with some SILT and very fine SAND. WET. | FILL | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | Cutting not soupy muck |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | SHALE/MUDSTONE - Gray to Light Gray (N 5/ to N 6/), mottled with LIght Olive Brown (2.5Y 5/3) and Greenish Gray (10GY 5/1), med. consistency, Moist to WET. | CL-ML | | | | | | | | Driller says hit tight shale |
| 22 | | | NA | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | SHALE/MUDSTONE with some very fine SAND - Light Gray to Gray (N 7/ to N6/), WET, and mucky. | CL-ML | | | | | | | | WET - cutting coming up as soupy muck |
| 25 | SHALE/MUDSTONE with some very fine SAND - Weak Red (10R 5/2), very low consistency, WET and mucky. | CL-ML | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | Driller says tight shale; tough drilling. |
| 31 | | | | | | | | | | |

ENVIRONMENTAL LOG JEC LANDFILL DRILL LOG.GPJ WILLIAMS.GDT 5/27/09

Burns & McDonnell SINCE 1898

# Drilling Log, continued

| | |
|---|---|
| Project Name | JEC Landfill |
| Project Number | 52123 |
| Boring Number | PZ-ES-7I |
| Page | 3 of 3 |
| Date | 3-26-09 |

| Depth | Description | Class | Blow Count | Recov. | Run/ Time | Sample Desig. | PID (ppm) BZ | PID (ppm) BH | PID (ppm) S | Remarks/ Water Levels |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | SHALE/MUDSTONE with some very fine SAND - Weak Red (10R 5/2), very low consistency, WET and mucky. | CL-ML | NA | | | | | | | |
| 33 | SHALE/MUDSTONE with some SILT and very fine SAND - mottled Weak Red (10R 5/2), Greenish Gray (10GY 5/1), and Gray (N 6/), low-med. consistency, low-med. plastic, Dry. | CL-ML | | | | | | | | |
| 34 | LIMESTONE - Weak Red (10R 5/5) to Gray (N 6/), hard/dense. | LIMESTONE | | | | | | | | |
| 35 | | | | | | | | | | STOP DRILLING @ 1350. Borehole TD = 34.65 ft bgs. |
| 36 | | | | | | | | | | Backfill with hydrated bentonite chips to 28 ft bgs, backfill with sand from 28 ft to 26 ft bgs, install MW. Well TD = 29.47 ft TOC = 26.55 ft bgs. |
| 37 | | | | | | | | | | |
| 38 | | | | | | | | | | Install MW - 0.45 end cap, 10 ft screen, 19.02 ft casing, top of filter pack @ 13.5 ft bgs, hydrated bentonite to 3 ft bgs. TOC is ~ 2.92 ft above ground surface. |
| 39 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 41 | | | | | | | | | | |
| 42 | | | | | | | | | | |
| 43 | | | | | | | | | | |
| 44 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 46 | | | | | | | | | | |
| 47 | | | | | | | | | | |
| 48 | | | | | | | | | | |

HALEY& ALDRICH

# BORING LOGS

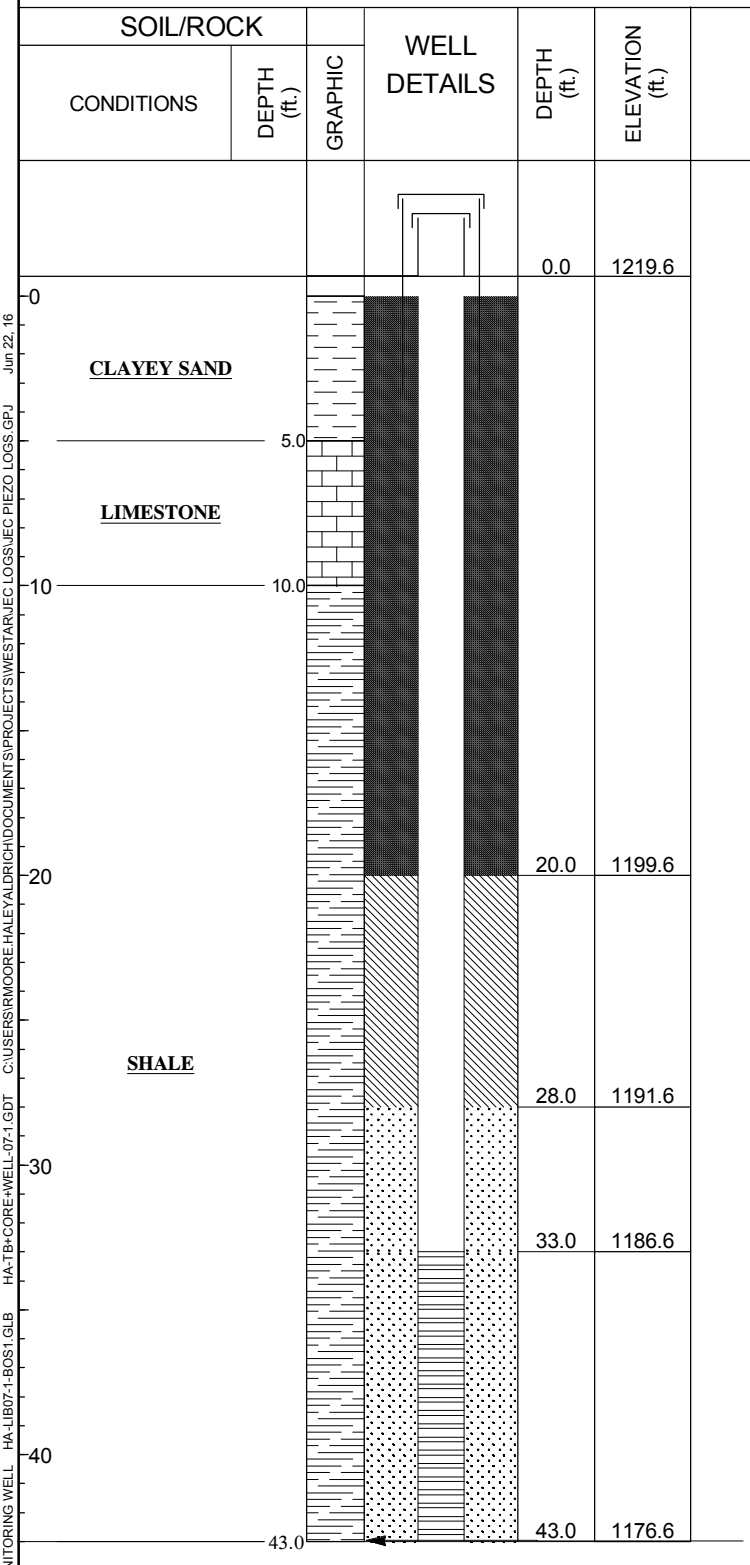
**Well No.** MW-BAA-3

| | |
|---|---|
| Project | Jeffrey Energy Center Temporary Piezometer Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |
| Driller | W. Pressley |

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

| | |
|---|---|
| File No. | 41938-003 |
| Date Installed | 03 Aug 2015 |
| H&A Rep. | D. Andersen |
| Location | See Plan |
| Ground El. | 1219.6 |
| Datum | NAVD 88 |




## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Locking Lid |
| Height of Guard Pipe above ground surface | 2.5 ft |
| Height of top of riser above ground surface | 2.0 ft |
| Type of protective casing | Guard Pipe |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Guard Pipe | 2.5 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 33.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Grout | 0.0 ft | 20.0 ft |
| Bentonite | 23.0 ft | 8.0 ft |
| | - | - |

| | |
|---|---|
| Diameter of borehole | 4.5 in. |
| Depth to top of well screen | 33.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.020 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 43 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 43.0 ft |

HALEY & ALDRICH

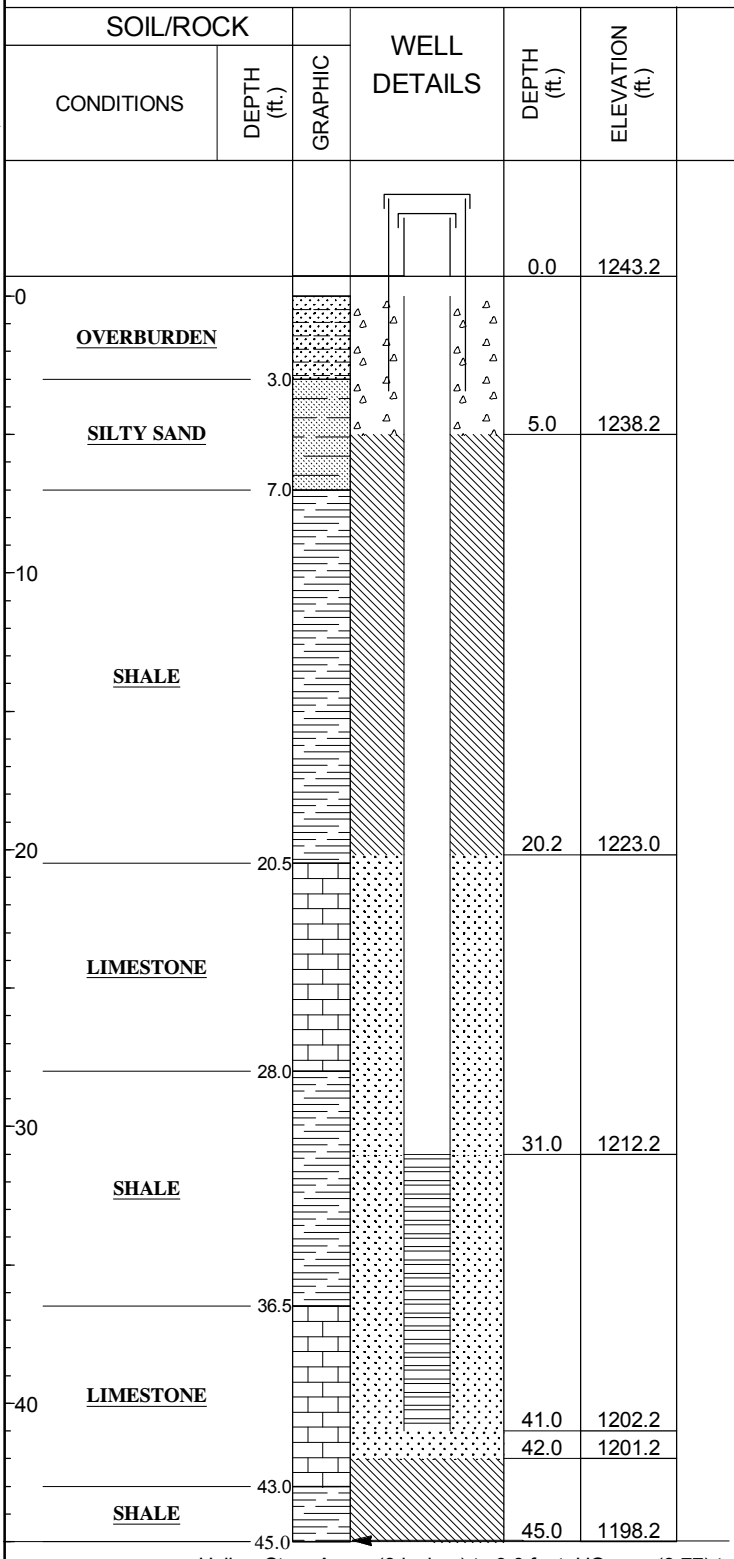
# BORING LOGS

**Well No.** MW-BAA-4

| | |
|---|---|
| Project | Jeffrey Energy Center Monitoring Well Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Terracon |
| Driller | Dave |

Well Diagram: Riser Pipe; Screen; Filter Sand; Cuttings; Grout; Concrete; Bentonite Seal

| | |
|---|---|
| File No. | 41938-003 |
| Date Installed | 03 Jun 2016 |
| H&A Rep. | C. Price |
| Location | See Plan |
| Ground El. | 1243.2 |
| Datum | NAVD 88 |




## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Locking Lid |
| Height of Guard Pipe above ground surface | 2.5 ft |
| Height of top of riser above ground surface | 2.0 ft |
| Type of protective casing | Guard Pipe |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Guard Pipe | 2.5 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 31.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Concrete | 0.0 ft | 5.0 ft |
| Bentonite | 5.0 ft | 15.2 ft |
| Bentonite | 42.0 ft | 3.0 ft |

| | |
|---|---|
| Diameter of borehole | 8.0 in. |
| Depth to top of well screen | 31.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.010 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 41 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 45.0 ft |

COMMENTS: Hollow Stem Auger (8 inches) to 9.0 feet, HQ core (3.77) to 45.0 feet.

HALEY& ALDRICH

# BORING LOGS

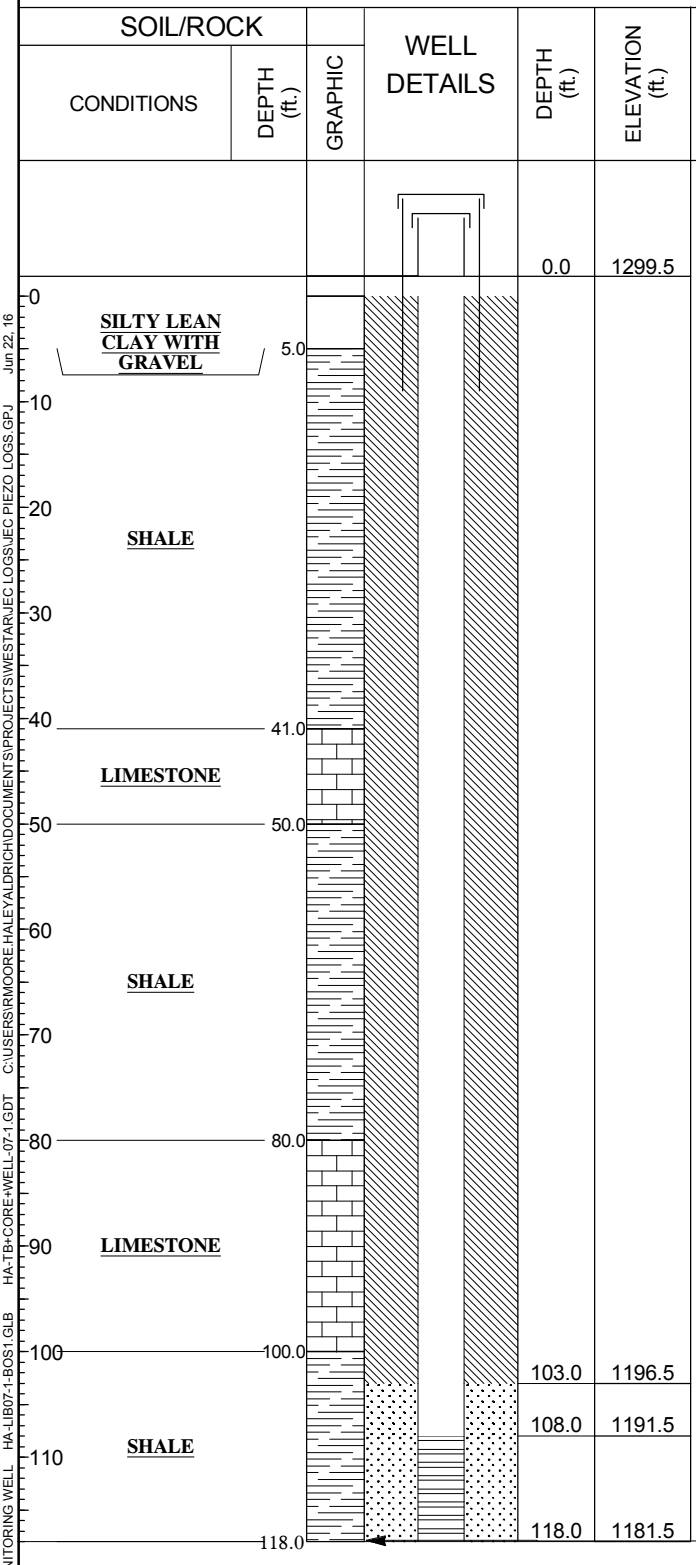
**Well No.** MW-BAA-6

| | |
|---|---|
| Project | Jeffrey Energy Center Temporary Piezometer Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |
| Driller | W. Pressley |

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

| | |
|---|---|
| File No. | 41938-003 |
| Date Installed | 14 May 2015 |
| H&A Rep. | J. Knightly |
| Location | See Plan |
| Ground El. | 1299.5 |
| Datum | NAVD 88 |




## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Locking Lid |
| Height of Guard Pipe above ground surface | 2.5 ft |
| Height of top of riser above ground surface | 2.0 ft |
| Type of protective casing | Guard Pipe |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Guard Pipe | 2.5 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 108.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Bentonite | 0.0 ft | 103.0 ft |
| | - | - |
| | - | - |

| | |
|---|---|
| Diameter of borehole | 4.5 in. |
| Depth to top of well screen | 108.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.020 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 118 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 118.0 ft |

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# BORING LOGS

**Well No.** MW-FGD-2

| | |
|---|---|
| Project | Jeffrey Energy Center Monitoring Well Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |
| Driller | Jeffery |

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

| | |
|---|---|
| File No. | 41938-300 |
| Date Installed | 18 Mar 2016 |
| H&A Rep. | C. Price |
| Location | See Plan |
| Ground El. | 1181.1 |
| Datum | NAVD 88 |

| SOIL/ROCK CONDITIONS | DEPTH (ft.) | GRAPHIC | WELL DETAILS | DEPTH (ft.) | ELEVATION (ft.) |
|---|---|---|---|---|---|
| | | | | 0.0 | 1181.1 |
| **COAL ASH AND ROAD DEBRIS** | 0 | | | | |
| **LIMESTONE** | 3.0 | | | 5.0 | 1176.1 |
| | 5.0 | | | | |
| **SHALE** | 10 | | | | |
| | 20 | | | | |
| | 23.0 | | | | |
| **LIMESTONE** | | | | | |
| | 30 | | | | |
| | 30.0 | | | | |
| **SHALE** | | | | | |
| | 35.0 | | | | |
| **LIMESTONE** | | | | 39.0 | 1142.1 |
| | 40 | | | 41.0 | 1140.1 |
| | 40.0 | | | | |
| **SHALE WITH LIMESTONE** | | | | | |
| | 45.0 | | | | |
| **LIMESTONE** | | | | | |
| | 50 | | | 51.0 | 1130.1 |
| | | | | 52.0 | 1129.1 |
| | 52.0 | | | | |
| **SHALE** | | | | 54.0 | 1127.1 |
| | 54.0 | | | | |

## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Flush Mounted |
| Depth of Subgrade Vaulting below ground surface | 0.0 ft |
| Depth of top of riser below ground surface | 0.0 ft |
| Type of protective casing | Subgrade Vaulting |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Subgrade Vaulting | 5.0 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 41.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Concrete | 0.0 ft | 4.0 ft |
| Bentonite | 5.0 ft | 34.0 ft |
| Bentonite | 52.0 ft | 2.0 ft |

| | |
|---|---|
| Diameter of borehole | 6.0 in. |
| Depth to top of well screen | 41.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.010 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 51 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 54.0 ft |

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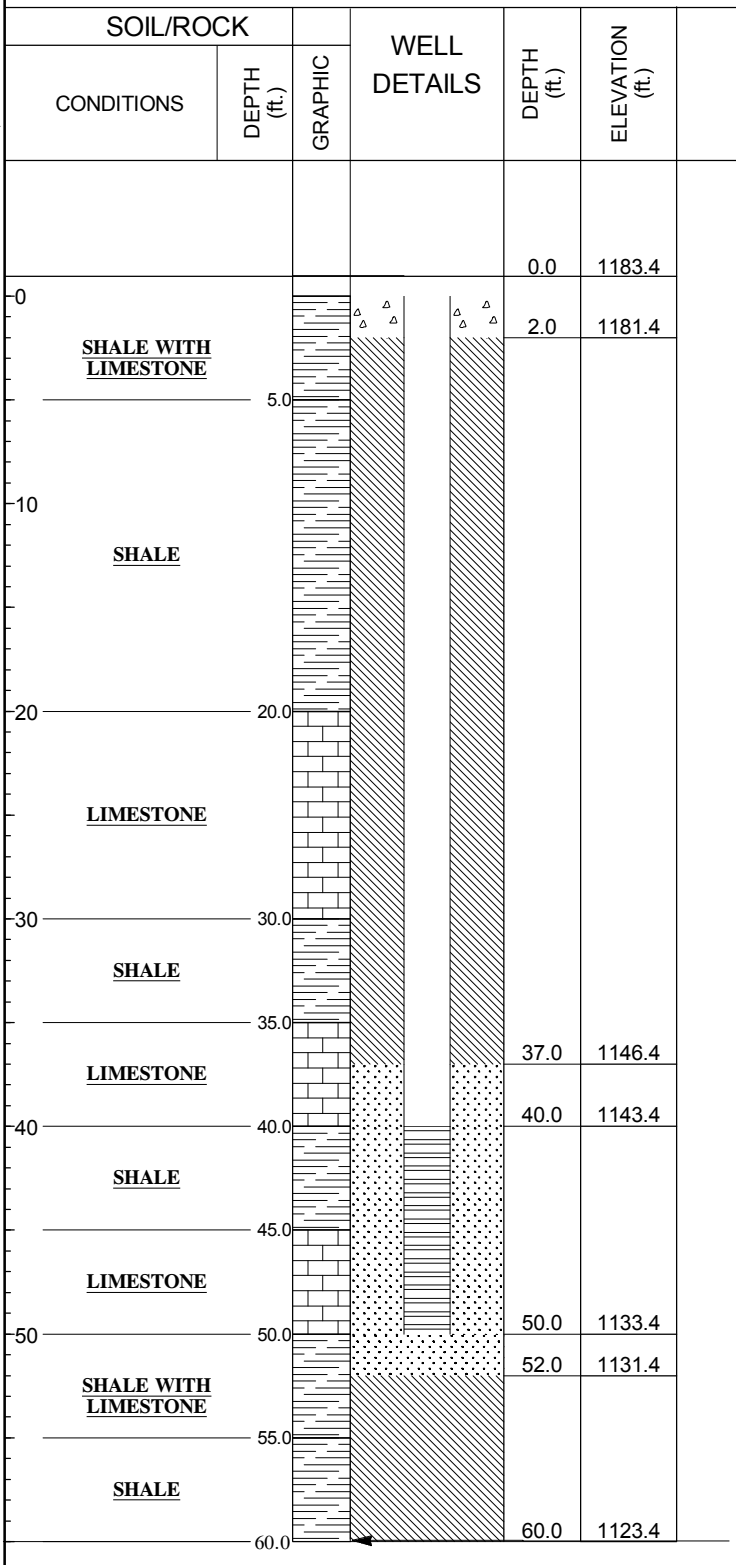
# BORING LOGS

**Well No.** MW-FGD-3

| | |
|---|---|
| Project | Jeffrey Energy Center Monitoring Well Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |
| Driller | Jeffery |

Well Diagram: Riser Pipe; Screen; Filter Sand; Cuttings; Grout; Concrete; Bentonite Seal

| | |
|---|---|
| File No. | 41938-300 |
| Date Installed | 17 Mar 2016 |
| H&A Rep. | C. Price |
| Location | See Plan |
| Ground El. | 1183.4 |
| Datum | NAVD 88 |




## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Flush Mounted |
| Depth of Subgrade Vaulting below ground surface | 0.0 ft |
| Depth of top of riser below ground surface | 0.0 ft |
| Type of protective casing | Subgrade Vaulting |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Subgrade Vaulting | 5.0 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 40.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Concrete | 0.0 ft | 2.0 ft |
| Bentonite | 2.0 ft | 35.0 ft |
| Bentonite | 52.0 ft | 8.0 ft |

| | |
|---|---|
| Diameter of borehole | 6.0 in. |
| Depth to top of well screen | 40.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.010 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 50 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 60.0 ft |

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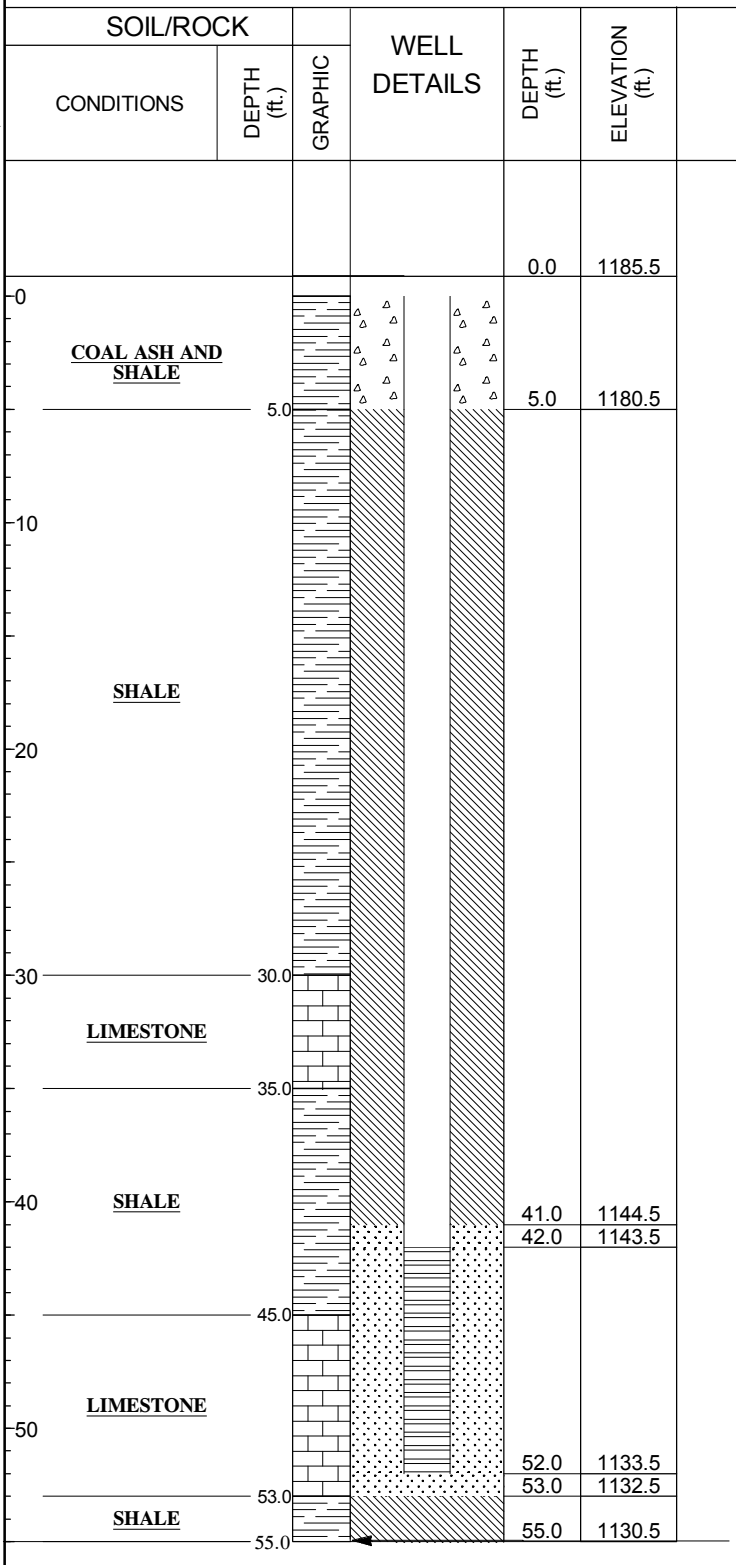
# BORING LOGS

**Well No.** MW-FGD-4

| | |
|---|---|
| Project | Jeffrey Energy Center Monitoring Well Installation |
| Location | St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |
| Driller | Jeffery |

Well Diagram: Riser Pipe; Screen; Filter Sand; Cuttings; Grout; Concrete; Bentonite Seal

| | |
|---|---|
| File No. | 41938-300 |
| Date Installed | 18 Mar 2016 |
| H&A Rep. | C. Price |
| Location | See Plan |
| Ground El. | 1185.5 |
| Datum | NAVD 88 |




## WELL CONSTRUCTION DETAILS

| | |
|---|---|
| Type of protective cover | Flush Mounted |
| Depth of Subgrade Vaulting below ground surface | 0.0 ft |
| Depth of top of riser below ground surface | 0.0 ft |
| Type of protective casing | Subgrade Vaulting |
| Length | 5.0 ft |
| Inside diameter | 4.0 in. |
| Depth of bottom of Subgrade Vaulting | 5.0 ft |
| Type of riser pipe | Schedule 40 PVC |
| Inside diameter of riser pipe | 2.0 in. |
| Depth of bottom of riser pipe | 52.0 ft |

| Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---|---|---|
| Concrete | 0.0 ft | 5.0 ft |
| Bentonite | 5.0 ft | 36.0 ft |
| Bentonite | 53.0 ft | 2.0 ft |

| | |
|---|---|
| Diameter of borehole | 6.0 in. |
| Depth to top of well screen | 52.0 ft |
| Type of screen | Machine slotted Sch 40 PVC |
| Screen gauge or size of openings | 0.010 in. |
| Diameter of screen | 2.0 in. |
| Type of Backfill around Screen | 8-12 Silica Sand |
| Depth to bottom of well screen | 52 ft |
| Bottom of silt trap | NA |
| Depth of bottom of borehole | 55.0 ft |

HALEY ALDRICH

# LITHOLOGIC LOG

**TPZ-BE-6**

| | |
|---|---|
| Project | Jeffrey Energy Center Temporary Piezometer Installation, St. Mary's, Kansas |
| Client | Westar Energy |
| Contractor | Associated Drilling, Inc. |

ADWR Registration Number

Cadastral Location

| | | | | | |
|---|---|---|---|---|---|
| Drilling Method | Direct Rotary | Elevation | 1263.2 | Start | May 14, 2015 |
| Borehole Diameter(s) | 4 inch | Datum | NAVD 88 | Finish | May 14, 2015 |
| Rig Make & Model | Speedstar 30K | Location | See Plan | H&A Rep. | D. Andersen |

| Depth (ft) | Water Sample | TCE (µg/l) | Well Diagram | USCS Symbol | Stratum Change Depth (ft) | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION | COMMENTS |
|---|---|---|---|---|---|---|---|
| 0 | | | | SC | | | |
| 5 | | | | | 5 | **SHALE** Light-tan to reddish-brown colored, weathered. | |
| 10 | | | | | 10 | **LIMESTONE** Light-tan and brown colored. | |
| 15 | | | | | 15 | **SHALE** White to tan colored, highly weathered. | |
| 20 | | | | | | | |

NOTE: Lithologic descrptions, group symbols, and grain-size determinations based on the USCS visual-manual method (Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description).

HALEY ALDRICH

# LITHOLOGIC LOG

**TPZ-BE-6**

| Depth (ft) | Water Sample | TCE (µg/l) | Well Diagram | USCS Symbol | Stratum Change Depth (ft) | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION | COMMENTS |
|---|---|---|---|---|---|---|---|
| 20 | | | | | 20 | **LIMESTONE** Light tan and brown colored. | |
| 25 | | | | | 25 | **SHALE** Dark-grey colored, weathered. | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

NOTE: Lithologic descrptions, group symbols, and grain-size determinations based on the USCS visual-manual method (Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description).

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# LITHOLOGIC LOG

**TPZ-BE-6**

| Depth (ft) | Water Sample | TCE (µg/l) | Well Diagram | USCS Symbol | Stratum Change Depth (ft) | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION | COMMENTS |
|---|---|---|---|---|---|---|---|
| 45 | | | | | 45 | **LIMESTONE** Tan-grey colored. | BEATTIE LIMESTONE |
| 55 | | | | | 55 | **SHALE** Dark-grey to black colored, competent. | |

NOTE: Lithologic descrptions, group symbols, and grain-size determinations based on the USCS visual-manual method (Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description).

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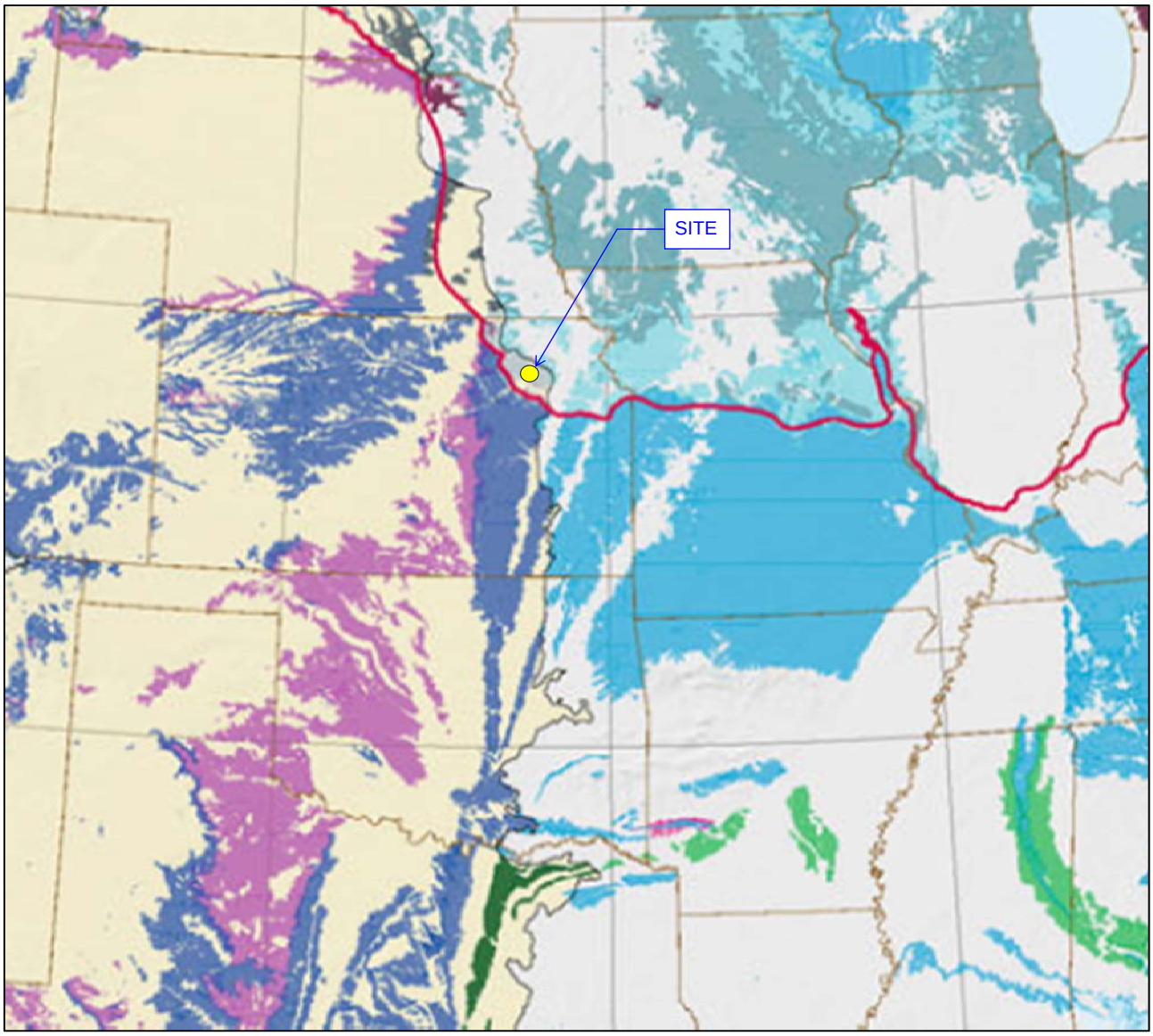
# LITHOLOGIC LOG

**TPZ-BE-6**

| Depth (ft) | Water Sample | TCE (µg/l) | Well Diagram | USCS Symbol | Stratum Change Depth (ft) | VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION | COMMENTS |
|---|---|---|---|---|---|---|---|
| 70 | | | | | 72.8 | | |

NOTE: Lithologic descrptions, group symbols, and grain-size determinations based on the USCS visual-manual method (Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description).

# APPENDIX E.2
# USGS KARST MAP AND POTENTIAL KARST MAP




**EXPLANATION OF MAP UNITS**

Humid climate region (>30 inches (in.) average annual precipitation)

Dry climate region (≤30 in. average annual precipitation)

Approximate maximum extent of Pleistocene ice

**Humid Climate Karst**

- Carbonate rocks at or near the land surface
- Carbonate rocks buried beneath <300 feet (ft) of insoluble sediments
- Carbonate rocks buried beneath ≤50 ft of glacially derived insoluble sediments
- Carbonate rocks buried beneath >50 ft of glacially derived insoluble sediments
- Unconsolidated calcareous or carbonate rocks at or near the land surface
- Unconsolidated calcareous or carbonate rocks buried beneath <300 ft of insoluble sediments
- Evaporite rocks at or near the land surface
- Evaporite rocks buried beneath ≤50 ft of glacially derived insoluble sediments
- Evaporite rocks buried beneath >50 ft of glacially derived insoluble sediments
- Quartz sandstone buried beneath ≤50 ft of glacially derived insoluble sediments
- Quartz sandstone buried beneath >50 ft of glacially derived insoluble sediments

**Dry Climate Karst**

- Carbonate rocks at or near the land surface
- Carbonate rocks buried beneath ≤50 ft of glacially derived insoluble sediments
- Carbonate rocks buried beneath >50 ft of glacially derived insoluble sediments
- Unconsolidated calcareous or carbonate rocks at or near the land surface
- Evaporite rocks at or near the land surface
- Evaporite rocks buried beneath ≤50 ft of glacially derived insoluble sediments
- Evaporite rocks buried beneath >50 ft of glacially derived insoluble sediments

**NOTE:**

1. THIS FIGURE IS BASED ON FIGURE 1 FROM "KARST IN THE UNITED STATES: A DIGITAL MAP COMPILATION AND DATABASE," WRITTEN BY DAVID J. WEARY AND DANIEL H. DOCTOR AND PUBLISHED BY THE USGS IN 2014.

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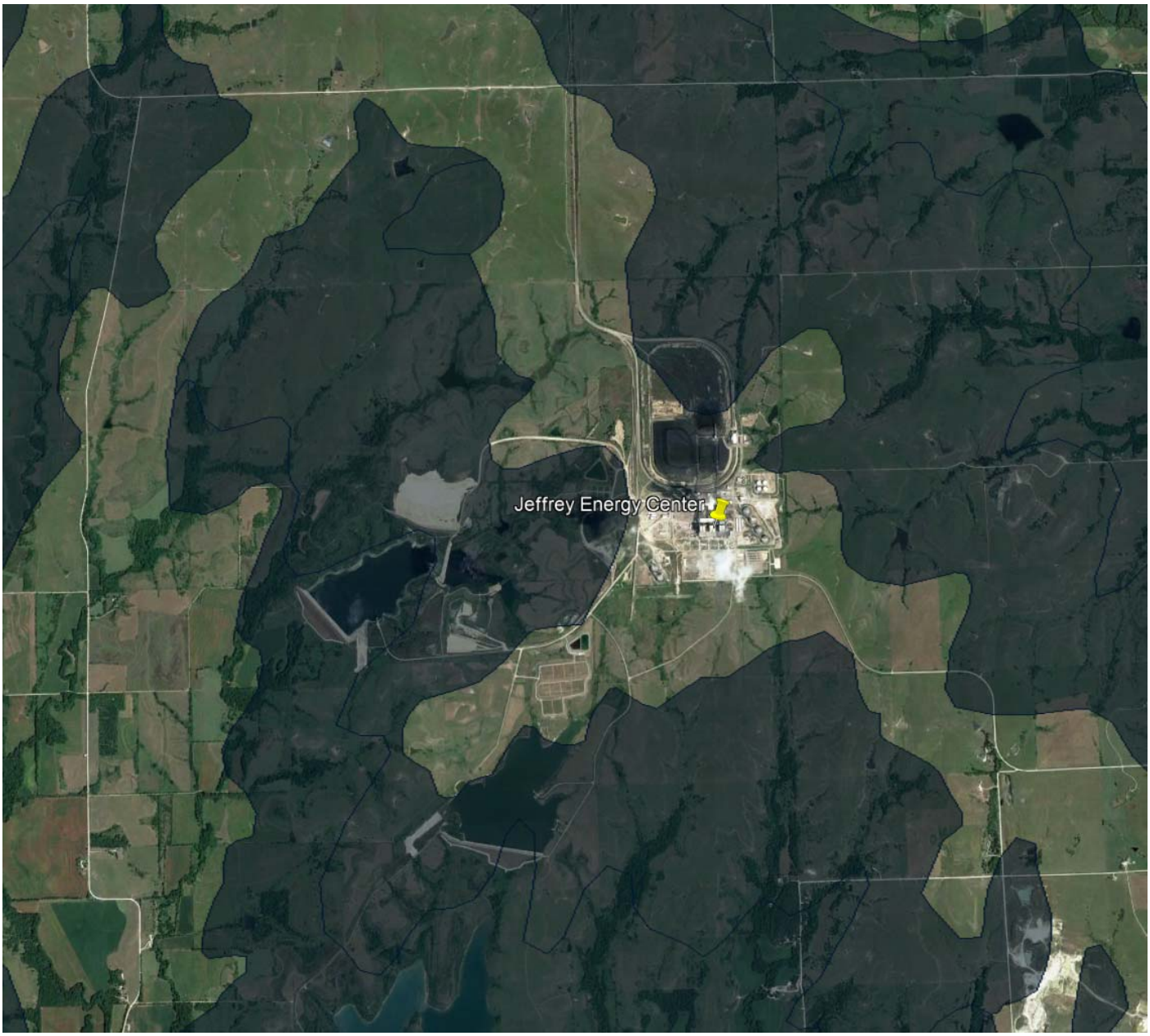
ST. MARYS, KANSAS

# USGS KARST MAP

SCALE: NOT TO SCALE

MAY 2018

APPENDIX E.2-1




**Legend**

CARBONATE ROCKS OF COUNCIL GROVE GROUP (EARLY PERMIAN GEARYAN) BURIED UNDER <50 FT OF GLACIALLY DERIVED INSOLUBLE SEDIMENTS IN A DRY CLIMATE.

**NOTE:**

1. THIS FIGURE WAS DEVELOPED USING KEYHOLE MARKUP LANGUAGE ZIPPED FILE "MO_KS.KMZ" ASSOCIATED WITH "WEARY D.J., AND DOCTOR, D.H., 2014, KARST IN THE UNITED STATES: A DIGITAL MAP COMPILATION AND DATABASE: U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 2014–1156, 23 P, *HTTPS://DX.DOI.ORG/10.3133/OFR20141156,* ISSN 2331-1258 (ONLINE)".

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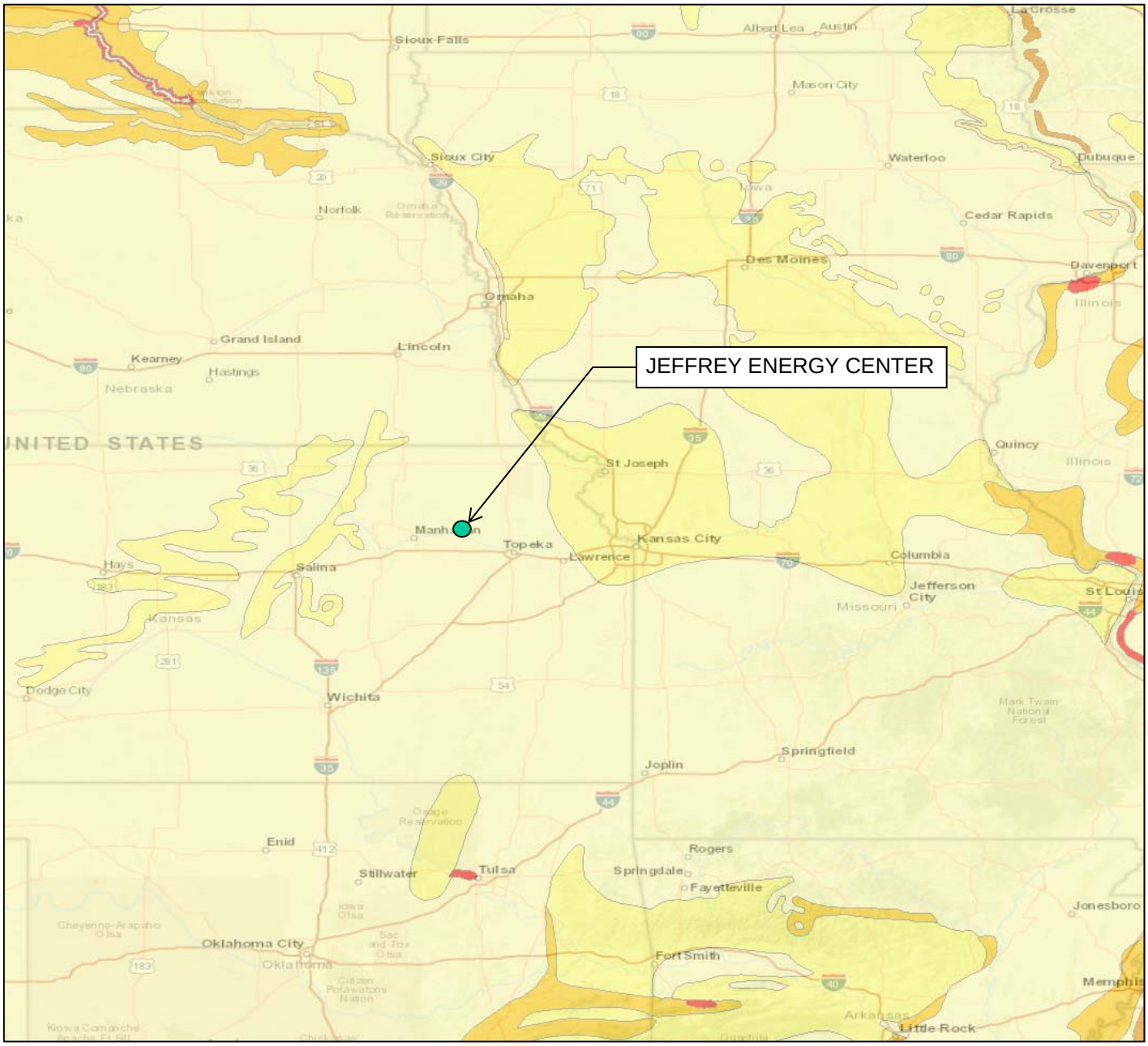
POTENTIAL KARST MAP

SCALE: NOT TO SCALE

MAY 2018

APPENDIX E.2-2

# APPENDIX E.3
# LANDSLIDE SUSCEPTIBILITY MAP




**Landslide Incidence and Susceptibility**

- High incidence
- High susceptibility, moderate incidence
- High susceptibility, low incidence
- Moderate incidence
- Moderate susceptibility, low incidence
- Low incidence
- No data

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ST MARYS, KANSAS

LANDSLIDE SUSCEPTIBILITY MAP

SCALE: NOT TO SCALE

MAY 2018

APPENDIX E.3

**NOTE:**

1. SOURCE: LANDLSIDE OVERVIEW MAP OF THE CONTERMINOUS UNITED STATES, U.S. GEOLOGICAL SURVEY, 1982.

# APPENDIX E.4
# MINES IN THE VICINITY OF JEFFREY ENERGY CENTER


**Legend**

Gravel Pit

**NOTE:**

1. USGS Mineral Resources Online Spatial Data available at: https://mrdata.usgs.gov/general/map.html.

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ST. MARYS, KANSAS

# MINES IN THE VICINITY OF JEFFREY ENERGY CENTER

SCALE: NOT TO SCALE

MAY 2018

APPENDIX E.4