Appendix A

Property Deeds

Form 223 Printed a[pproved by Real Estate Board of Metropolitan St. L]ouis, Mo. Sale by the St. Louis Printing and Legal Forms C[o.] Class 5

Quit-Claim Deed

BOOK 245 PAGE 291

This Deed, Made and entered into this 21st day of September nineteen hundred and sixty-six, by and between

VIRGINIA K. PHLEGER, a single person,

of the City of St. Louis State of Missouri part y of the first part, and

UNION ELECTRIC COMPANY, a Missouri corporation,
315 North Twelfth Boulevard, St. Louis, Missouri 63166

of the City of St. Louis State of Missouri part y of the second part.

1966 OCT -4 PM 3:4[illegible]

Witnesseth, that the said part y of the first part, for and in consideration of the sum of Ten and no/100ths Dollars and other valuable consideration paid by the said part y of the second part, the receipt of which is hereby acknowledged, do es by these presents ***Remise, Release and forever Quit-Claim*** unto the said part y of the second part, the following described Real Estate, situated in the County of Franklin and State of Missouri, to-wit:

Part of Lot Seven (7) of the Subdivision of Miles P. Hinkle Estate in Township 44 North, Range 2 East of the 5th P.M., as per plat of record in Deed Book 74, Page 615 and also accretions thereto located in Sections 7 and 8, Township and Range aforesaid, all being more fully described as follows:

Beginning at the intersection of the west line of said Lot Seven (7), with said north right of way line of the Chicago, Rock Island and Pacific Railroad, said point being North 1° East 283 feet from the Southwest corner of said Lot Seven (7), run thence North 1° East on the west line of Lot Seven (7), and the prolongation thereof, 8422 feet to a point in the center line of a slough, run thence with the centerline of said slough North 56° East 264.5 feet and North 57° East, 164.5 feet to the intersection with the South line of Bull Island, run thence South 77° 10' East on the south line of Bull Island 426 feet to a point in the east line of said Lot Seven (7), if the same were prolonged northwardly, run thence South 1° West on said east line 8161 feet to the North right of way line of the Chicago, Rock Island and Pacific Railroad, run thence Southwestwardly on the North line of said railroad 889.68 feet to the point of beginning, containing 153.35 acres, reference being made to Plat of Survey of record in Surveyor's Record 16, page 4.

Subject to existing easements.

Subject to the right of way of the County Road.

To Have and to Hold the same, together with all rights and appurtenances to the same belonging, unto the said part y of the second part, and to its successors ~~heirs~~ and assigns forever. So that neither the said part y of the First Part, nor her heirs, nor any other person or persons for her or in her name or behalf, shall or will hereafter claim or demand any right or title to the aforesaid premises, or any part thereof, but they and every one of them shall, by these presents, be excluded and forever barred.

In Witness Whereof, the said part y of the first part has executed these presents the day and year first above written.

Virginia K. Phleger

FILE 110
Folder 485.9
Drawer 31

BOOK 246 PAGE 292

State of Missouri, CITY *of* ST. LOUIS } *ss.* On this 21st. day of September , 1966 , before me personally appeared VIRGINIA K. PHLEGER, a single person,

to me known to be the person described in and who executed the foregoing instrument, and acknowledged that she executed the same as her free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the City and State aforesaid, the day and year first above written.

David B. Shire
Notary Public.

My term expires Sept. 22, 1968

"A certified copy of my commission has been filed with the Clerk of The City of St. Louis."

State of Missouri, *of* } *ss.* On this day of , 19 ,

before me appeared
to me personally known, who, being by me duly sworn, did say that he is the
of
a Corporation of the State of , and that the seal affixed to the foregoing instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation, by authority of its Board of Directors; and said
acknowledged said instrument to be the free act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the and State aforesaid, the day and year first above written.

My term expires

Notary Public.

14

QUIT-CLAIM DEED

Approved by REAL ESTATE BOARD OF METROPOLITAN ST. LOUIS

FROM

TO

STATE OF MISSOURI, County of Franklin, } ss

I, Henry J. Tibbe, Recorder of Deeds, within and for said County and S[illegible] do hereby certify that the foregoing instrument of writing was filed for record on the 4 day of Oct 1966, at 3 o'clock 41 minutes P. M. duly received on the 4 day of Oct 1966, in Book 246 [illegible] 291

IN TESTIMONY WHEREOF, I hereunto set my hand and affixed my official seal at my office in Union, the date aforesaid.

Henry J. Tibbe Recorder of Deeds

By Ruth M. Wilson Deputy

SHARON L. BIRKMAN
RECORDER OF DEEDS
FRANKLIN COUNTY
STATE OF MISSOURI

PAGES: 2
FEE: $27.00
DOCUMENT NO: 0726350
DATE: 11/29/2007
TIME: 11:35AM

QUIT CLAIM DEED

This Deed Witnesseth, that on November 29th, 2007

Winston T. Brunjes and Mary Ann Brunjes, as trustees of the Brunjes Family Trust dated March 11, 1997
GRANTOR(S)

County of Franklin, State of Missouri, Grantor for and in consideration of $1.00 and other good and valuable consideration in hand paid, do (does) by these presents, REMISE, RELEASE AND FOREVER QUIT CLAIM UNTO

Ameren UE
GRANTEE(S)

Mailing Address: 1901 Chouteau Ave. St. Louis, Mo. 63103
Of City of St. Louis, State of Missouri, Grantee(s), his/her/their heirs or successors, and assigns, the following land situated in Franklin County, Missouri, towit:

LEGAL DESCRIPTION:
Part of the Southwest qr of Section 8, Township 44 North, Range 2 East of the Fifth Principal Meridian and being the same tract of land conveyed to Winston T. Brunjes and Mary Ann Brunjes, as Trustees of the Brunjes Family Trust dated March 11, 1997 by deed recorded in Book 1012 Page 818 in the Franklin County, Missouri, land records and being more particularly described as follows: Beginning at an iron pin on the Southern boundary line of a tract of land conveyed to Charles H. Brunjes and Carolyn Brunjes, his wife by deed recorded in Book 297 Page 361 in the Franklin County, Missouri, land records, said iron pin being the Northwest corner of Tract I conveyed to Emmet H. Drewel Revocable Living Trust dated September 30, 1996 by deed recorded in Book 1019 Page 115 in the Franklin County, Missouri, land records; thence South 01 degrees 17 minutes 25 seconds West along the West line of said Drewel tract a distance of 481.56 feet to an iron pin, thence South 79 degrees 22 minutes 34 seconds West a distance of 184.39 feet to an iron pin, thence South 81 degrees 28 minutes 24 seconds West a distance of 229.20 feet to an iron pin, thence South 83 degrees 25 minutes 11 seconds West a distance of 229.37 feet to an iron pin, thence South 84 degrees 16 minutes 21 seconds West a distance of 155.56 feet to point on the East line of a tract of land conveyed to Union Electric Company by deed recorded in Book 246 Page 291 in the Franklin County, Missouri, land records from which point an iron pin bears North 84 degrees 16 minutes 21 seconds East a distance of 107.31 feet, and another iron pin bears North 01 degrees 24 minutes 34 seconds East a distance of 236.00 feet, thence North 01 degrees 24 minutes 34 seconds

East along said East line a distance of 783.92 feet to an iron pin on the aforesaid Southern boundary line of the aforesaid Brunjes tract recorded in Book 297 Page 361, thence South 76 degrees 10 minutes 31 seconds East along said Southern boundary line a distance of 805.43 feet to the point of beginning and subject to any easements, reservations or restrictions on record or now in effect.

Containing 11.56 acres. MAB WTB
This description is based on a survey performed by Zahner and Associates, Inc., completed November, 2007.

32903

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said Grantee(s) And to the heirs or successors and assigns of such Grantee(s) Forever; so that neither the Grantor(s) Nor the heirs or successors of the Grantor(s) Nor any other person(s) For or in the name of the Grantor(s), shall or will hereinafter claim or demand any right or title to the aforesaid premises, or any part thereof, but they and every one of them shall by these presents be excluded and forever barred.

Winston T. Brunjes and Mary Ann Brunjes, as Trustees of the Brunjes Family Trust, dated March 1 1997

Winston T. Brunjes Trustee

Mary Ann Brunjes Trustee

STATE OF MISSOURI,)
) SS.
County of Franklin)

On November 29th, 2007 before me personally appeared **Winston T. Brunjes and Mary Ann Brunjes, as trustees of the Brunjes Family Trust dated March 11, 1997,** to me known to be the person(s) described in and who executed the foregoing instrument, and acknowledged that he/she/they executed the same as his/her/their free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year last above written.

NOTARY PUBLIC

Richard J Wurdack - Notary Public
Notary Seal for State of
Missouri - St. Louis County
My Commission Expires 1/24/2008

0903561.001

SHARON L. BIRKMAN
RECORDER OF DEEDS
FRANKLIN COUNTY
STATE OF MISSOURI

PAGES: 2 cp
FEE: $27.00
DOCUMENT NO: 0903561
DATE: 02/23/2009
TIME: 08:48AM

GENERAL WARRANTY DEED (Individual)

File No. W11434 (L9770) **Outlot No.**

This Deed, Made and entered into this 19th day of February, 2009, by and between

Grantor(s): **Winston T. Brunjes and Mary Ann Brunjes, as Trustees *of the Brunjes Family Trust, dated March 11, 1997**

whose mailing address is: 5000 Coleman Road, Villa Ridge, Mo. 63089

Party or parties of the first part, and

Grantee(s): **Union Electric Company d/b/a AmerenUE**

whose mailing address is: One Ameren Plaza, P.O.BOX 66149
St. Louis, Mo. 63166-6149

Party or parties of the second part.

WITNESSETH, that the said party or parties of the first part, for and in consideration of the sum of One Dollar and other valuable considerations paid by the said party or parties of the second part, the receipt of which is hereby acknowledged, does or do by these presents **GRANT, BARGAIN AND SELL, CONVEY AND CONFIRM** unto the said party or parties of the second part, the following described Real Estate, situated in the County of Franklin and State of Missouri, to-wit:

Part of U.S. Survey No. 161 and part of Sections Nine (9) and Sixteen (16), in Township Forty-four (44) North, Range Two (2) East of the 5th P.M., described as follows: Beginning at the Northwest corner of said U.S. Survey No. 161, run thence North on the East line of the Worthington Heirs Subdivision to the Southwest corner of a parcel conveyed to Overschmidt in deed of record in Book 411, page 409 in the office of the Recorder of Deeds, thence South 67° 01° 58" East on the South line of the Overschmidt parcel 1,004.24 feet to a point in the West line of property now or formerly owned by Fries, thence South 0° 15' West on the West line of the Fries property to a point in the North right of way line of the St. Louis Southwestern Railway (formerly the Chicago, Rock Island and Pacific Railroad), thence South 64° West on the North line of said railroad to its intersection with the West line of U.S. Survey No. 161, thence North 53° West on survey line to the point of beginning.

L-9770

The Grantors hereby represent and warrant that they are the duly acting and qualified Trustees under the Brunjes Family Trust, dated March 11, 1997 and that they have full and complete power and authority to

grant this deed and is directed to do so pursuant to said trust and the trust has not been otherwise amended, revoked or cancelled and is in full force and effect as of the date hereof.

Subject to existing easements, conditions and restrictions, if any.

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said party or parties of the second part, and to the heirs and assigns of such party or parties forever.

The said party or parties of the first part hereby covenanting that said party or parties and the heirs, executors, administrators and assigns of such party or parties, shall and will **WARRANT AND DEFEND** the title to the premises unto the said party or parties of the second part, and to the heirs and assigns of such party or parties forever, against the lawful claims of all persons whomsoever, excepting, however, the general taxes for the calendar year **2008** and thereafter, and special taxes becoming a lien after the date of this deed.

IN WITNESS WHEREOF, the said party or parties of the first part has or have hereunto set their hand or hands the day and year first above written.

Winston T. Brunjes
Winston T. Brunjes, Trustee*

Mary Ann Brunjes, Trustee
Mary Ann Brunjes, Trustee*

STATE OF MISSOURI
County of Franklin } ss. On this 19 day of February, 2009.

before me personally appeared **Winston T. Brunjes and Mary Ann Brunjes, as Trustees of the Brunjes Family Trust, dated March 11, 1997,** to me known to be the person or persons described in and who executed the foregoing instrument, and acknowledged that **they** executed the same as **their** free act and deed as said Trustees and that said trust is still in existence and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Robert E Hansen
Notary Public

ROBERT E. HANSEN
NOTARY PUBLIC - NOTARY SEAL
STATE OF MISSOURI
FRANKLIN COUNTY
My Commission Expires: 10-24-2011
Commission # 07466860

My term expires:

0727306.001

SHARON L. BIRKMAN
RECORDER OF DEEDS
FRANKLIN COUNTY
STATE OF MISSOURI

PAGES: 3
FEE: $36.00
DOCUMENT NO: 0727306
DATE: 12/28/2007
TIME: 03:22PM

GENERAL WARRANTY DEED

THIS DEED, made and entered into this 20th day of December, 2007 by and between

Edward G. Heisel and Marilyn Heisel, husband and wife
GRANTOR(S)

Of the County of Franklin, State of Missouri, party (ies) of the first part, and

Union Electric Company d/b/a AmerenUE
GRANTEE(S)

Mailing Address: **1901 Chouteau Ave. St. Louis, Mo. 63103**
of the City of St. Louis, State of Missouri, party (ies) of the second part.

WITNESSETH, that the said party (ies) of the first part, for and consideration of the sum of One Dollar ($1.00) and other good and valuable considerations paid by the said party (ies) of the second part, the receipt of which is hereby acknowledged, do by these presents, GRANT, BARGAIN AND SELL, CONVEY AND CONFIRM unto the said party (ies) of the second part, the following described Real Estate, situated in the County of Franklin, and State of Missouri, to-wit:

LEGAL DESCRIPTION:
Part of the Southwest qr of Section 8 and part of the West half of Section 17, all in Township 44 North, Range 2 East of the Fifth Principal Meridian and being part of Tract I conveyed to Edward G. Heisel and Marilyn Heisel, his wife, by deed recorded in Book 504 Page 667 in the Franklin County, Missouri, land records and being more particularly described as follows: Commencing at an iron pipe at the Southeast corner of Lot Eight of the Subdivision of Miles P. Hinkle Estate per plat as recorded in Book 74 Page 615 in the Franklin County, Missouri, land records; thence North 07 degrees 02 minutes 03 seconds West along the Eastern boundary line of said Lot 8 a distance of 1327.52 feet to an iron pin at the intersection of said Eastern boundary line with the Northwest right of way of the Chicago Rock Island and Pacific Railroad, said iron pin being the point of beginning of the tract herein described, thence along and with said right of way line as follows: Southwesterly along the arc of a curve to the left having a radius of

987.44 feet and a central angle of 04 degrees 06 minutes 18 seconds a distance of 70.75 feet (chord bearing and distance = South 59 degrees 30 minutes 32 seconds West 70.73 feet) to an iron pin at a point of compound curvature, Southwesterly along the arc of a curve to the left having a radius of 4733.88 feet and a central angle of 02 degrees 14 minutes 03 seconds a distance of 184.59 feet (chord bearing and distance = South 56 degrees 20 minutes 21 seconds West, 184.58 feet) to an iron pin at a point of tangent; South 55 degrees 13 minutes 20 seconds West a distance of 652.14 feet to an iron pin at a point of curvature, Southwesterly along the arc of a curve to the right having a radius of 3133.01 feet and a central angle of 01 degrees 35 minutes 43 seconds a distance of 87.23 feet (chord bearing and distance = South 56 degrees 01 minutes 11 seconds West 87.23 feet) to an iron pin at the intersection of said right of way line with the West line of aforesaid Lot 8, thence leaving said right of way line North 01 degrees 24 minutes 34 seconds East along said West line a distance of 7379.45 feet to a point at the Southwest corner of a tract of land conveyed to Winston T. Brunjes and Mary Ann Brunjes, as Trustees of the Brunjes Family Trust, dated March 11, 1997, by deed recorded in Book 1012 Page 818 in the Franklin County, Missouri, land records, from which point an iron pin bears South 01 degrees 24 minutes 34 seconds West a distance of 347.31 feet and from which point another iron pin bears North 84 degrees 16 minutes 21 seconds East a distance of 107.31 feet, thence along and with the Southern boundary line of said Brunjes tract as follows: North 84 degrees 16 minutes 21 seconds East a distance of 155.56 feet to an iron pin; North 83 degrees 25 minutes 11 seconds East a distance of 229.37 feet to an iron pin, North 81 degrees 28 minutes 24 seconds East a distance of 229.20 feet to an iron pin, North 79 degrees 22 minutes 34 seconds East a distance of 184.39 feet to an iron pin on the aforesaid Eastern boundary line of Lot Eight, said iron pin, being the Southeast corner of said Brunjes tract, thence South 01 degrees 17 minutes 25 seconds West along said Eastern boundary line a distance of 6884.88 feet to an iron pin, thence continuing along said Eastern boundary line South 07 degrees 02 minutes 03 seconds East a distance of 45.28 feet to the point of beginning containing 130.45 acres more or less and subject to any easements, reservations or restrictions on record or now in effect.

This description is based on a survey performed by Zahner and Associates, Inc., completed November, 2007.

File No. 16488

Subject to conditions, restrictions, and easements of record, if any.

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said party (ies) of the second part, and to them and their heirs and assigns now and forever.

The said party (ies) of the first part hereby covenant that they and their heirs , executors and administrators, shall and will WARRANT and DEFEND the title to the premises unto the said party (ies) of the second part, and to them and their assigns now and forever against the lawful claims of all persons whomsoever, excepting, however, the general taxes for the calendar year 2007 and thereafter, and the special taxes becoming a lien after the date of this deed.

IN WITNESS WHEREOF, the said party(ies) have hereunto set their hands the day and year first above written.

Edward G. Heisel

Marilyn Heisel

State of Missouri)
of
County of Franklin)

On this 20th day of December, 2007 before me personally appeared Edward G. Heisel and Marilyn Heisel, husband and wife to me known to be the person(s) described in and who executed the foregoing instrument and acknowledged that he/she/they executed the same as his/her/their free act and deed.

IN TESTIMONY WHEREOF I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year last above written.

Notary Public

Richard J Wurdack - Notary Public
Notary Seal for State of
Missouri - St. Louis County
My Commission Expires 1/24/2008

0904166.002

SHARON L. BIRKMAN
RECORDER OF DEEDS
FRANKLIN COUNTY
STATE OF MISSOURI

PAGES: 5
FEE: $36.00
DOCUMENT NO: 0904166
DATE: 02/27/2009
TIME: 03:22PM

ESCROW -36.00

GENERAL WARRANTY DEED (Individual) – This Deed Witnesseth, that on February 27, 2009, Marvin J. Newman and Judy Newman, a/k/a Judith Newman, his wife; Merle L. Newman, and Bernice Newman, his wife, as a consenting party, Jerry D. Newman and Kristi Newman, his wife; and Margaret Eckelkamp and Dennis Eckelkamp, her husband, of Franklin County, hereinafter collectively referred to as "Grantor, " for and in consideration of Ten and 00/100 Dollars ($10.00) and other good and valuable consideration, in hand paid, does by these presents, GRANT, BARGAIN and SELL, CONVEY and CONFIRM unto Union Electric Company d/b/a AmerenUE, a Missouri corporation, of 1901 Chouteau, St. Louis, MO 63166, hereinafter collectively referred to as "Grantee," Grantee's heirs, successors and assigns, the following land situated in Franklin County, Missouri, to-wit:

ONE HUNDRED PERCENT (100%) OF THEIR INTEREST IN:

PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" AS RECORDED IN PLAT BOOK C, PAGE 25 IN THE FRANKLIN COUNTY RECORDS OFFICE BEING PART OF SECTION 8, 9, 16 AND 17 AND PART OF U.S. SURVEY 98 IN TOWNSHIP 44 NORTH, RANGE 2 EAST OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI, DESCRIBED AS FOLLOWS:
BEGINNING AT THE SOUTHWEST CORNER OF LOT 1 OF "WORTHINGTON HEIRS SUBDIVISION" AS RECORDED IN PLAT BOOK C, PAGE 25 IN THE FRANKLIN COUNTY RECORDS, SAID SOUTHWEST CORNER BEING ON THE NORTHERLY RIGHT OF WAY LINE OF THE CHICAGO (100' W) ROCK ISLAND AND PACIFIC RAILWAY COMPANY; THENCE NORTH 01 DEGREE 28 MINUTES 18 SECONDS EAST ON THE WESTERLY LINE OF SAID LOT 1, A DISTANCE OF 7,012.73 FEET; THENCE NORTHEASTERLY ALONG THE NORTH LINE OF A LAND SWAP AS RECORDED IN SURVEYOR'S RECORD 14, PAGE 248 AND ACROSS LOTS 1 THROUGH 8 OF SAID "WORTHINGTON HEIRS SUBDIVISION" NORTH 84 DEGREES 30 MINUTES 28 SECONDS EAST, 3,146.83 FEET TO THE EAST LINE OF LOT 8 OF SAID "WORTHINGTON HEIRS SUBDIVISION"; THENCE SOUTH 01 DEGREE 30 MINUTES 58 SECONDS WEST ALONG THE EASTERLY LINE OF SAID LOT 8, 6,145.04 FEET; THENCE SOUTH 52 DEGREES 23 MINUTES 41 SECONDS EAST, 446.76 FEET THE NORTHERLY RIGHT OF WAY LINE OF THE CHICAGO (100' W) ROCK ISLAND AND PACIFIC RAILWAY COMPANY; THENCE

CONTINUING ON SAID NORTHERLY RIGHT OF WAY LINE THE FOLLOWING FOURTEEN (14) COURSES AND DISTANCES; 1) SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 1.97 FEET, THE CHORD OF SAID SPIRAL CURVE BEARS SOUTH 66 DEGREES 25 MINUTES 08 SECONDS WEST, 1.97 FEET; 2) THENCE SOUTHWESTERLY 214.02 FEET ON A CURVE TO RIGHT, HAVING A RADIUS OF 2,033.68 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 69 DEGREES 27 MINUTES 38 SECONDS WEST, 213.92 FEET; 3) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 163.02 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 73 DEGREES 59 MINUTES 32 SECONDS WEST, 163.01 FEET; 4) THENCE SOUTH 74 DEGREES 44 MINUTES 38 SECONDS WEST, 90.70 FEET; 5) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 244.19 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 73 DEGREES 07 MINUTES 46 SECONDS WEST, 244.11 FEET; 6) THENCE SOUTHWESTERLY 46.15 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,482.68 FEET, THE CHORD OF WHICH BEARS SOUTH 69 DEGREES 03 MINUTES 08 SECONDS WEST, 46.15 FEET; 7) THENCE SOUTHWESTERLY 131.76 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,735.42 FEET THE CHORD OF WHICH BEARS SOUTH 65 DEGREES 59 MINUTES 08 SECONDS WEST, 131.72 FEET 8) THENCE SOUTHWESTERLY 23.29 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,482.68 FEET, THE CHORD OF WHICH BEARS SOUTH 63 DEGREES 21 MINUTES 38 SECONDS WEST, 23.29 FEET; 9) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 122.09 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 61 DEGREES 19 MINUTES 03 SECONDS WEST, 122.08 FEET; 10) THENCE SOUTH 60 DEGREES 30 MINUTES 38 SECONDS WEST 65.10 FEET; 11) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 235.81 FEET, THE CHORD OF WHICH CURVE BEARS SOUTH 62 DEGREES 05 MINUTES 45 SECONDS WEST, 235.74 FEET; 12) THENCE SOUTHWESTERLY 265.50 FEET ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 1,382.68 FEET, THE CHORD OF WHICH BEARS SOUTH 70 DEGREES 48 MINUTES 38 SECONDS WEST, 265.09 FEET; 13) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 238.81 FEET, THE CHORD OF WHICH BEARS SOUTH 79 DEGREES 31 MINUTES 30 SECONDS WEST, 235.74 FEET; 14) THENCE SOUTH 81 DEGREES 06 MINUTES 38 SECONDS WEST, 205.86 FEET; THENCE NORTH 03 DEGREES 15 MINUTES 59 SECONDS EAST, 47.76 FEET; THENCE NORTH 86 DEGREES 46 MINUTES 01 SECOND WEST, 10.00 FEET; THENCE NORTH 03 DEGREES 15 MINUTES 59 SECONDS EAST, 121.01 FEET; THENCE NORTH 02 DEGREES 15 MINUTES 51 SECONDS EAST, 36.03 FEET; THENCE NORTH 01 DEGREE 15 MINUTES 44 SECONDS EAST, 104.00 FEET; THENCE NORTH 88 DEGREES 40 MINUTES 34 SECONDS WEST, 11.67 FEET; THENCE SOUTH 02 DEGREES 07 MINUTES 22 SECONDS WEST, 312.63 FEET TO SAID NORTHERLY RAILROAD RIGHT OF WAY LINE; THENCE SOUTH 81 DEGREES 06

MINUTES 38 SECONDS WEST ON SAID RIGHT OF WAY LINE, 40.75 FEET; THENCE NORTH 02 DEGREES 07 MINUTES 22 SECONDS EAST, 319.87 FEET; THENCE NORTH 88 DEGREES 44 MINUTES 16 SECONDS WEST, 8.33 FEET; THENCE SOUTH 01 DEGREE 15 MINUTES 44 SECONDS WEST, 104.00 FEET; THENCE SOUTHWESTERLY 33.39 FEET ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 970.00 FEET, THE CHORD OF WHICH BEARS SOUTH 02 DEGREES 15 MINUTES 51 SECONDS WEST, 33.93 FEET; THENCE SOUTH 03 DEGREES 15 MINUTES 59 SECONDS WEST, 121.07 FEET; THENCE NORTH 86 DEGREES 44 MINUTES 01 SECOND WEST, 10.0 FEET; THENCE SOUTH 03 DEGREES 15 MINUTES 59 SECONDS WEST, 64.99 FEET TO SAID NORTHERLY RAILROAD RIGHT OF WAY LINE; THENCE CONTINUING ON SAID NORTHERLY RIGHT OF WAY LINE THE FOLLOWING FIVE (5) COURSES AND DISTANCES: 1) SOUTH 81 DEGREES 06 MINUTES 38 SECONDS WEST, 489.20 FEET; 2) THENCE SOUTHWESTERLY 286.27 FEET ON A CURVE TO THE RIGHT HAVING A RADIUS OF 3,075.36 FEET, THE CHORD OF WHICH BEARS SOUTH 83 DEGREES 46 MINUTES 38 SECONDS WEST, 286.16 FEET; 3) THENCE SOUTH 86 DEGREES 26 MINUTES 38 SECONDS WEST, 184.10 FEET; 4) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 176.15 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 85 DEGREES 20 MINUTES 50 SECONDS WEST, 176.12 FEET 5) THENCE SOUTHWESTERLY 386.26 FEET ON A CURVE TO THE LEFT HAVING A RADIUS OF 1,571.40 FEET, THE CHORD OF WHICH BEARS SOUTH 76 DEGREES 08 MINUTES 19 SECONDS WEST, 385.29 FEET TO THE POINT OF BEGINNING.

Subject to easements, restrictions and conditions of record, if any.

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said Grantee and to the heirs, successors and assigns of such Grantee forever. The said Grantor hereby covenanting that said Grantor and the heirs, executors, and administrators of said Grantor shall and will Warranty and Defend the title to the premises unto the said Grantee and to the heirs, successors and assigns of such Grantee, forever, against the lawful claim of all persons, whomsoever, excepting, however, the general taxes for the calendar year 2009 and thereafter, and special taxes becoming a lien after the date of this deed..

IN WITNESS WHEREOF, the Grantor has hereunto set the Grantor's hand the day and year first above written.

Marvin J. Newman

Judy Newman, aka Judith Newman

Margaret Eckelkamp

Dennis Eckelkamp

Jerry D. Newman

Merle L. Newman

Bernice Newman, as a consenting party

Kristi Newman

STATE OF MISSOURI)
) ss
COUNTY OF FRANKLIN)

On February 27, 2009, before me personally appeared Merle L. Newman and Bernice Newman, his wife, as a consenting party; Margaret Eckelkamp and Dennis Eckelkamp, her husband; and Jerry D. Newman and Kristi Newman, his wife, to me known to be the Grantor described in and who executed the foregoing instrument, and acknowledged that the Grantor executed the same as the Grantor's free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year last above written.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

WENDY JO ZICK
My Commission Expires
October 14, 2011
Franklin County
Commission #07493716

Wendy Jo Zick
Notary Public, State of Missouri
Commissioned in Franklin County
Commission #07493716

My Commission Expires:
October 14, 2011.

STATE OF ARIZONA)
) ss
COUNTY OF PINAL)

On February 26, 2009, before me personally appeared Marvin J. Newman and Judith Newman, his wife, to me known to be the Grantor described in and who executed the foregoing instrument, and acknowledged that the Grantor executed the same as the Grantor's free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year last above written.

Notary Public, State of Arizona
Commissioned in MARICOPA County
Commission #

My Commission Expires: 10-8-2009

OFFICIAL SEAL
BEVERLY DIAZ-GONZALEZ
Notary Public - State of Arizona
MARICOPA COUNTY
My Comm. Expires Oct. 8, 2009

W:\Ticor\DRN Farm Ameren UE DEED.DOC

SHARON L. BIRKMAN
RECORDER OF DEEDS
FRANKLIN COUNTY
STATE OF MISSOURI

PAGES: 3
FEE: $30.00
DOCUMENT NO: 0902991
DATE: 02/13/2009
TIME: 02:59PM

ESCROW 30.00

GENERAL WARRANTY DEED (Individual) – This Deed Witnesseth, that on February 13, 2009, Marvin J. Newman, as Trustee of the Marvin J. Newman Trust dated 22 August, 1991, as to an undivided on half (1/2) interest, and Judith A. Newman, as Trustee of the Judith A. Newman Trust dated 22 August, 1991, as to an undivided one half (1/2) interest, as tenants in common, of Franklin County, hereinafter collectively referred to as "Grantor, " for and in consideration of Ten and 00/100 Dollars ($10.00) and other good and valuable consideration, in hand paid, does by these presents, GRANT, BARGAIN and SELL, CONVEY and CONFIRM unto Union Electric Company d/b/a AmerenUE, a Missouri corporation, of 1901 Chouteau Avenue, St. Louis, Missouri 63166, hereinafter collectively referred to as "Grantee," Grantee's heirs, successors and assigns, the following land situated in Franklin County, Missouri, to-wit:

Part of Sections 8 and 17 and part of U.S. Survey 98 in Township 44 North, Range 2 East of the Fifth Principal Meridian, Franklin County, Missouri, described as follows: Beginning at the Southwest Corner of Lot 1 of "Worthington Heirs Subdivision" as recorded in Plat Book C, Page 25 in the Franklin County records, said Southwest corner being on the Northerly right of way line of the Chicago (100' W) Rock Island and Pacific Railway Company; thence continuing on said Northerly right of way line the following five (5) courses and distances: 1) Southwesterly 124.51 feet on a curve to the left, having a radius of 1,571.40 feet, the chord of which bears South 66 degrees 49 minutes 37 seconds West 124.48 feet; 2) thence Southwesterly on a spiral curve to the left, 176.15 feet, the chord of which bears South 62 degrees 23 minutes 25 seconds West, 176.12 feet; 3) thence South 61 degrees 17 minutes 38 seconds West 123.20 feet; 4) thence Southwesterly on a spiral curve to the right, 180.56 feet, the chord of which bears South 62 degrees 13 minutes 03 seconds West 180.55 feet; 5) thence Southwesterly 850.36 feet on a curve to the right, having a radius of 1,828.80 feet, the chord of which bears South 77 degrees 24 minutes 18 seconds West, 842.72 feet to the Southwest corner of a tract of land described in the Deed to Marvin J. Newman and Judith A. Newman Trustees in Deed Book 656, Page 1 in the Franklin County Records; thence North 01 degree 36 minutes 25 seconds East on the Westerly line of said Newman Tract, 4,760.66 feet; thence continuing on said Westerly line, North 02 degrees 15 minutes 01 seconds East, 2,558.94 feet to the Northwesterly corner of said Newman Tract; thence South 89 degrees 36 minutes 37 seconds East, 1,302.74 feet to the Northeast corner of said Newman Tract; thence South 01 degrees 28 minutes 18 seconds West on the Easterly line of said Newman Tract, 6,851.45 feet to the point of beginning.

Subject to easements, restrictions and conditions of record, if any.

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said Grantee and to the heirs, successors and assigns of such Grantee forever. The said Grantor hereby covenanting that said Grantor and the heirs, executors, and administrators of said Grantor shall and will Warranty and Defend the title to the premises unto the said Grantee and to the heirs, successors and assigns of such Grantee, forever, against the lawful claim of all persons, whomsoever, excepting, however, the general taxes for the calendar year 2009 and thereafter, and special taxes becoming a lien after the date of this deed..

GRANTOR further warrants as follows: that the written agreements known as the Marvin J. Newman Trust dated August 22, 1991 and Judith A. Newman Trust dated August 22, 1991, are in full force and effect and has not been amended, revoked or cancelled; that Marvin J. Newman and Judith A. Newman, are the duly appointed and qualified sole trustees of their respective Trusts; that the Trustees have full power and authority to sell and convey the property described herein, and to execute this Warranty Deed and any other documents pertaining to the transaction; and that no consent of any court or other authority, or order from any court or other authority, is necessary for the Trustees to have full power and authority under the terms of the Trust to execute any and all such documents.

IN WITNESS WHEREOF, the Grantor has hereunto set the Grantor's hand the day and year first above written.

Marvin J. Newman Trust dated 22 August, 1991

BY: _____ Trustee
Marvin J. Newman, Trustee

Judith A. Newman Trust dated 22 August, 1991

BY: _____ Trustee
Judith A. Newman, Trustee

STATE OF ARIZONA)
) ss
COUNTY OF MARICOPA)

On February 12, 2009, before me personally appeared Marvin J. Newman, as Trustee of the Marvin J. Newman Trust dated 22 August, 1991, as to an undivided on half (1/2) interest, and Judith A. Newman, as Trustee of the Judith A. Newman Trust dated 22 August, 1991, as to an undivided one half (1/2) interest, as tenants in common, to me known to be the Grantor described in and who executed the foregoing instrument, and acknowledged that the Grantor executed the same as the Grantor's free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year last above written.

Notary Public, State of Arizona
Commissioned in MARICOPA County
Commission # 411541

My Commission Expires:

OFFICIAL SEAL
DEBRA A. JUSKO
Notary Public-State of Arizona
MARICOPA COUNTY
My Commission Expires 01/09/10

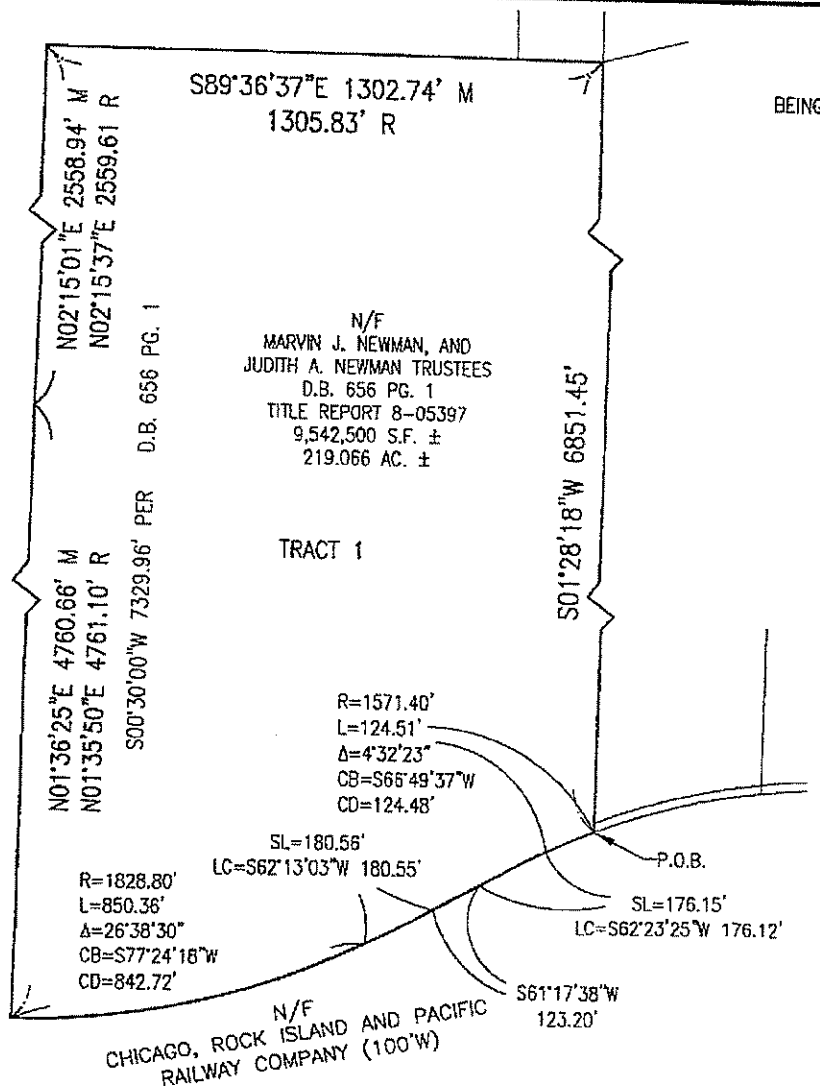
W:\Ticor\22479 GENERAL WARRANTY DEED.DOC

TRACT 1

BEING PART OF SECTIONS 8 AND 17 AND PART OF U.S. SURVEY 98 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI

SURVEY LEGEND

N.T.S.	NOT TO SCALE
———	PROPERTY LINE (MAJOR)
———	PROPERTY LINE (MINOR)
R	RECORD BEARING AND DISTANCE
SL	SPIRAL LENGTH
LC	LONG CHORD
M	MEASURED BEARING AND DISTANCE



N

N.T.S.

DATE: 01-13-09

SHEET 1 OF 2

KdG Kuhlmann Design Group, Inc.

000150-0032

15 East Washington Street
Belleville, Illinois 62220-2149
Tel: (618) 234-8898
(314) 621-8898

St. Louis, Missouri
Belleville, Illinois

TRACT "1"

'EXHIBIT A'

GENERAL WARRANTY DEED

(Limited Liability Company)

THIS DEED, made and entered into February 13th, 2008 by and between

POWELL'S POINT LLC
GRANTOR

Of the County of Franklin, State of Missouri, party (ies) of the first part, and

Union Electric Company d/b/a AmerenUE
GRANTEE

Mailing Address: **1901 Chouteau Ave. MC 700 St. Louis, Mo. 63103**
of the City of St Louis, State of Missouri, party (ies) of the second part.

WITNESSETH, that the said party (ies) of the first part, for and consideration of the sum of One Dollar ($1.00) and other good and valuable considerations paid by the said party (ies) of the second part, the receipt of which is hereby acknowledged, do by these presents, GRANT, BARGAIN AND SELL, CONVEY AND CONFIRM unto the said party (ies) of the second part, the following described Real Estate, situated in the County of Franklin, and State of Missouri, to-wit:

LEGAL DESCRIPTION:
Part of the Southwest qr of Section 8 and part of the West half of Section 17, all in Township 44 North, Range 2 East of the Fifth Principal Meridian and being the same tract of land as described in Tract I conveyed to the Emmet H. Drewel Revocable Living Trust, dated September 30, 1996 in the Franklin County, Missouri, land records and being more particularly described as follows: Beginning at an iron pin on the South line of a tract of land conveyed to Charles H. Brunjes and Carolyn Brunjes, his wife by deed recorded in Book 297 Page 361 in the Franklin County, Missouri, land records, said iron pin being the Northeast corner of a tract of land conveyed to Winston T. Brunjes and Mary Ann Brunjes as trustees of the Brunjes Family Trust dated March 11, 1997 by deed recorded in Book 1012 Page 818 in said land records, thence South 88 degrees 25 minutes 52 seconds East along said South line a distance of

1157.26 feet to an iron pipe, said iron pipe being the Northwest corner of a tract of land conveyed to Marvin J. Newman, as Trustee of the Marvin J. Newman Trust dated 22 August 1991 and Judith A. Newman, as trustee of the Judith A. Newman Trust dated 22 August 1991 by deed recorded in Book 656 Page 1 in the Franklin County, Missouri, land records; thence South 02 degrees 15 minutes 37 seconds West along the West line of said Newman tract a distance of 2559.61 feet to an iron pipe, thence continuing along said West line South 01 degrees 35 minutes 59 seconds West a distance of 4761.10 feet to an iron pin on the Northern right-of-way line of the Chicago, Rock Island, and Pacific Railroad, said iron pin being the Southwest corner of said Newman tract, thence along and with said right-of-way line as follows: Westerly along the arc of a curve to the right having a radius of 1750.00 feet and a central angle of 04 degrees 18 minutes 13 seconds a distance of 131.45 feet (chord bearing and distance = North 85 degrees 41 minutes 07 seconds West 131.42 feet) to an iron pin at a point of tangent; North 83 degrees 32 minutes 00 seconds West a distance of 373.17 feet to an iron pin at a point of curvature; Southwesterly along the arc of a curve to the left having a radius of 987.44 feet and a central angle of 34 degrees 54 minutes 19 seconds a distance of 601.56 feet (chord bearing and distance = South 79 degrees 00 minutes 50 seconds West 592.30 feet) to an iron pin at the intersection of said right-of-way line with the Eastern boundary line of Lot Eight (8) of the Subdivision of Miles P. Hinkle Estate per plat as recorded in Book 74 Page 615 in the Franklin County, Missouri, land records, said iron pin being the Southeast corner of Tract I conveyed to Edward G. Heisel and Marilyn Heisel, his wife, by deed recorded in Book 504 Page 667 in the Franklin County, Missouri, land records; thence North 07 degrees 02 minutes 03 seconds West along the said Eastern boundary line a distance of 45.28 feet to an iron pin, thence continuing along said Eastern boundary line and the Northerly extension thereof North 01 degrees 17 minutes 25 seconds East a distance of 7366.44 feet to the point of beginning containing 186.82 acres, more or less, and subject to any easements, reservations or restrictions on record or now in effect.

This description is based on a survey performed by Zahner and Associates, Inc., completed November, 2007.

Subject to conditions, restrictions, and easements of record, if any.

File No. 33228

TO HAVE AND TO HOLD the same, together with all rights and appurtenances to the same belonging, unto the said party (ies) of the second part, and to them and their heirs and assigns now and forever.

The said party (ies) of the first part hereby covenant that they and their heirs , executors and administrators, shall and will WARRANT and DEFEND the title to the premises unto the said party (ies) of the second part, and to them and their assigns now and forever against the lawful claims of all persons whomsoever, excepting, however, the general taxes for the calendar year 2008 and thereafter, and the special taxes becoming a lien after the date of this deed.

IN WITNESS WHEREOF, the said party (ies) have hereunto set their hands the day and year first above written.

POWELL'S POINT LLC

Daniel M. Buescher

Daniel M. Buescher Sole Member

State of Missouri)
of
County of Franklin)

On February 13th, 2008 before me personally appeared Daniel M. Buescher, to me known, who being by me duly sworn and say that he/she is the sole member of Powell's Point LLC , a Missouri Limited Liability Company, and that said instrument was signed on behalf of said Limited Liability Company with full authority to do so and said Daniel M. Buescher acknowledges said instrument to be the free act and deed of said Limited Liability Company.
IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Notary Public

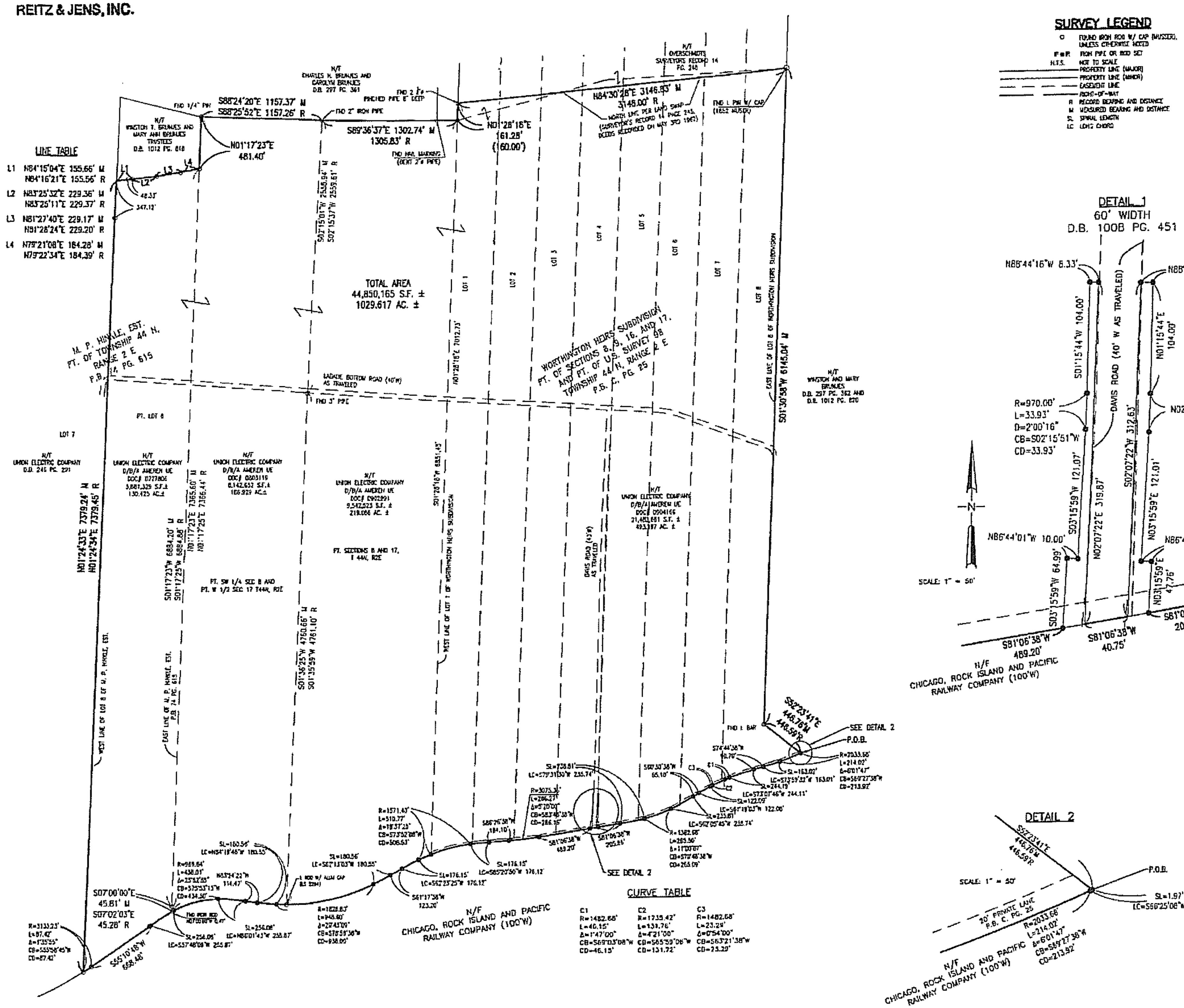
NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI

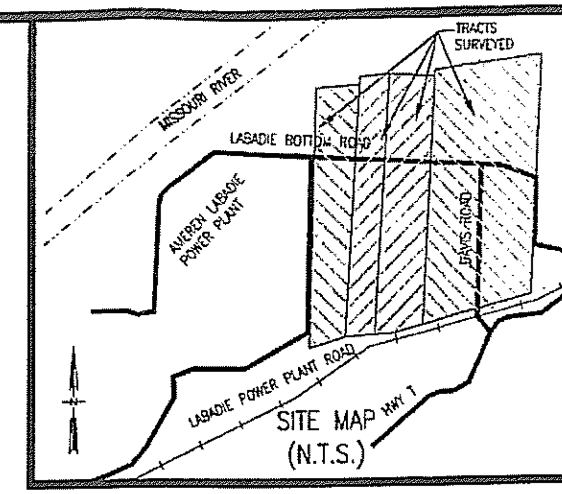
THOMAS WURDACK
My Commission Expires
January 8, 2010
St. Louis County
Commission #06820839

RECEIVED
JUN 23 2009
REITZ & JENS, INC.

BOUNDARY PLAT

BOUNDARY CONSOLIDATION OF PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI





RECEIVED
JUN 23 2009
REITZ & JENS, INC.

NOTE

1.) NO SECTION LINES OR U.S. SURVEY LIMITS HAVE BEEN SHOWN DUE TO LACK OF EVIDENCE AND LACK OF DOCUMENTATION

BASIS OF BEARING

BEARINGS AND MONUMENTATION ARE BASED ON MISSOURI STATE PLANE NAD '83, EAST ZONE.

SURVEYORS STATEMENT

THIS IS TO CERTIFY THAT WHILE IN THE EMPLOY OF REITZ AND JENS, INC., KUHLMANN DESIGN GROUP, INC. PERFORMED A BOUNDARY SURVEY OF PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI. THE RESULTS OF SAID SURVEY ARE FROM RECORD INFORMATION AND AN ACTUAL FIELD SURVEY. THIS SURVEY WAS EXECUTED IN ACCORDANCE WITH THE CURRENT MISSOURI MINIMUM STANDARDS FOR RURAL CLASS PROPERTY BOUNDARY SURVEYS.

June 15 2009 — DATE

MICHAEL S. HUBER, PLS
MO PLS NO. 002491
LICENSE EXPIRES 12-31-2009

BOUNDARY CONSOLIDATION OF PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI

SURVEY DATA:
SURVEY DATE: 03/15/09
FIELD CREW: RSD/BCS/KEM
FIELD BOOK: 736-BB

CLIENT:
REITZ & JENS, INC.
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MO 63132
PHONE: (314) 993-4132

KdG
Kuhlmann Design Group, Inc.
66 Progress Parkway
Maryland Heights, MO 63043
Tel: (314) 621-8898
St. Louis, Missouri
Belleville, Illinois
KDG MO. CORPORATE LIC# 000078, EXP. 12-31-10

DISCLAIMER OF RESPONSIBILITY

LS-2491
MICHAEL SAM
HUBER
PROFESSIONAL LAND SURVEYOR

NO.	DATE	

PROJECT NO. 080086	CONTRACT NO. 0002
DRAWN NPW	CHECKED JPB/MSH
DATE APRIL 2009	

S-1

SHEET 1 OF 2

BOUNDARY PLAT

BOUNDARY CONSOLIDATION OF PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI

OVERALL PARCEL

PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE NORTHERLY RIGHT OF WAY LINE OF THE CHICAGO, (100' W) ROCK ISLAND AND PACIFIC RAILWAY COMPANY AND THE EAST LINE OF WORTHINGTON HEIRS SUBDIVISION AS RECORDED IN PLAT BOOK C, PAGE 25 IN THE FRANKLIN COUNTY RECORDER'S OFFICE; THENCE CONTINUING ON SAID NORTHERLY RIGHT OF WAY LINE THE FOLLOWING FOURTEEN (14) COURSES AND DISTANCES: 1) SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 1.97 FEET, THE CHORD OF SAID SPIRAL CURVE BEARS SOUTH 86 DEGREES 25 MINUTES 08 SECONDS WEST, 1.97 FEET; 2) THENCE SOUTHWESTERLY 214.02 FEET ON A CURVE TO RIGHT, HAVING A RADIUS OF 2,033.68 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 69 DEGREES 27 MINUTES 36 SECONDS WEST, 213.92 FEET; 3) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 163.02 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 73 DEGREES 59 MINUTES 32 SECONDS WEST, 163.01 FEET; 4) THENCE SOUTH 74 DEGREES 44 MINUTES 38 SECONDS WEST, 90.70 FEET; 5) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 244.19 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 73 DEGREES 07 MINUTES 46 SECONDS WEST, 244.11 FEET; 6) THENCE SOUTHWESTERLY 46.15 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,482.68 FEET, THE CHORD OF WHICH BEARS SOUTH 69 DEGREES 03 MINUTES 08 SECONDS WEST, 46.15 FEET; 7) THENCE SOUTHWESTERLY 131.76 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,735.42 FEET, THE CHORD OF WHICH BEARS SOUTH 65 DEGREES 59 MINUTES 08 SECONDS WEST, 131.72 FEET; 8) THENCE SOUTHWESTERLY 23.29 FEET ON A CURVE TO THE LEFT, HAVING A RADIUS OF 1,482.68 FEET, THE CHORD OF WHICH BEARS SOUTH 63 DEGREES 21 MINUTES 38 SECONDS WEST, 23.29 FEET; 9) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 122.09 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 61 DEGREES 19 MINUTES 03 SECONDS WEST, 122.08 FEET; 10) THENCE SOUTH 60 DEGREES 30 MINUTES 38 SECONDS WEST, 65.10 FEET; 11) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 235.81 FEET, THE CHORD OF WHICH BEARS SOUTH 62 DEGREES 05 MINUTES 45 SECONDS WEST, 235.74 FEET; 12) THENCE SOUTHWESTERLY 265.50 FEET ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 1,382.68 FEET, THE CHORD OF WHICH BEARS SOUTH 70 DEGREES 48 MINUTES 38 SECONDS WEST, 265.09 FEET; 13) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 238.81 FEET, THE CHORD OF WHICH BEARS SOUTH 79 DEGREES 31 MINUTES 30 SECONDS WEST, 235.74 FEET; 14) THENCE SOUTH 81 DEGREES 06 MINUTES 38 SECONDS WEST, 205.86 FEET; THENCE NORTH 03 DEGREES 15 MINUTES 59 SECONDS EAST, 47.76 FEET; THENCE NORTH 86 DEGREES 46 MINUTES 01 SECOND WEST, 10.00 FEET; THENCE NORTH 03 DEGREES 15 MINUTES 59 SECONDS EAST, 121.01 FEET; THENCE NORTH 02 DEGREES 15 MINUTES 51 SECONDS EAST, 36.03 FEET; THENCE NORTH 01 DEGREE 15 MINUTES 44 SECONDS EAST, 104.00 FEET; THENCE NORTH 88 DEGREES 40 MINUTES 34 SECONDS WEST, 11.67 FEET; THENCE SOUTH 02 DEGREES 07 MINUTES 22 SECONDS WEST, 312.63 FEET TO SAID NORTHERLY RAILROAD RIGHT OF WAY LINE; THENCE SOUTH 81 DEGREES 06 MINUTES 38 SECONDS WEST ON SAID RIGHT OF WAY LINE, 40.75 FEET; THENCE NORTH 02 DEGREES 07 MINUTES 22 SECONDS EAST, 319.87 FEET; THENCE NORTH 88 DEGREES 44 MINUTES 16 SECONDS WEST, 8.33 FEET; THENCE SOUTH 01 DEGREE 15 MINUTES 44 SECONDS WEST, 104.00 FEET; THENCE SOUTHWESTERLY 33.93 FEET ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 970.00 FEET, THE CHORD OF WHICH BEARS SOUTH 02 DEGREES 15 MINUTES 51 SECONDS WEST, 33.93 FEET; THENCE SOUTH 03 DEGREES 15 MINUTES 59 SECONDS WEST, 121.07 FEET; THENCE NORTH 86 DEGREES 44 MINUTES 01 SECOND WEST, 10.00 FEET; THENCE SOUTH 03 DEGREES 15 MINUTES 59 SECONDS WEST, 64.99 FEET TO SAID NORTHERLY RAILROAD RIGHT OF WAY LINE; THENCE CONTINUING ON SAID NORTHERLY RIGHT OF WAY LINE THE FOLLOWING SIXTEEN (16) COURSES AND DISTANCES: 1) SOUTH 81 DEGREES 06 MINUTES 38 SECONDS WEST, 489.20 FEET; 2) THENCE SOUTHWESTERLY 286.27 FEET ON A CURVE TO THE RIGHT HAVING A RADIUS OF 3,075.36 FEET, THE CHORD OF WHICH BEARS SOUTH 83 DEGREES 46 MINUTES 38 SECONDS WEST, 286.16 FEET; 3) THENCE SOUTH 86 DEGREES 26 MINUTES 38 SECONDS WEST, 184.10 FEET; 4) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 176.15 FEET, THE CHORD OF SAID CURVE BEARS SOUTH 85 DEGREES 20 MINUTES 50 SECONDS WEST, 176.12 FEET; 5) THENCE SOUTHWESTERLY 510.77 FEET ON A CURVE TO THE LEFT HAVING A RADIUS OF 1,571.40 FEET, THE CHORD OF WHICH BEARS SOUTH 73 DEGREES 52 MINUTES 08 SECONDS WEST, 508.53 FEET 6) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 176.15 FEET, THE CHORD OF WHICH BEARS SOUTH 62 DEGREES 23 MINUTES 25 SECONDS WEST, 176.12 FEET; 7) THENCE SOUTH 61 DEGREES 17 MINUTES 38 SECONDS WEST, 123.20 FEET; 8) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 180.56 FEET, THE CHORD OF WHICH BEARS SOUTH 62 DEGREES 13 MINUTES 03 SECONDS WEST, 180.55 FEET; 9) THENCE SOUTHWESTERLY 948.60 FEET ON A CURVE TO THE RIGHT, HAVING A RADIUS OF 1,828.80 FEET, THE CHORD OF WHICH BEARS SOUTH 78 DEGREES 56 MINUTES 38 SECONDS WEST, 938.00 FEET; 10) THENCE NORTHWESTERLY ON A SPIRAL CURVE TO THE RIGHT, 180.56 FEET, THE CHORD OF WHICH BEARS NORTH 84 DEGREES 19 MINUTES 48 SECONDS WEST, 180.55 FEET; 11) THENCE NORTH 83 DEGREES 24 MINUTES 22 SECONDS WEST, 114.47 FEET; 12) THENCE NORTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 256.08 FEET, THE CHORD OF WHICH BEARS NORTH 86 DEGREES 01 MINUTE 43 SECONDS WEST, 255.87 FEET; 13) THENCE A CURVE TO THE LEFT, HAVING A RADIUS OF 969.64 FEET, THE CHORD OF WHICH BEARS SOUTH 75 DEGREES 53 MINUTES 13 SECONDS WEST, 434.30 FEET, AN ARC DISTANCE OF 438.01 FEET; 14) THENCE SOUTHWESTERLY ON A SPIRAL CURVE TO THE LEFT, 256.08 FEET, THE CHORD OF WHICH BEARS SOUTH 57 DEGREES 48 MINUTES 09 SECONDS WEST, 255.87 FEET; 15) THENCE SOUTH 55 DEGREES 10 MINUTES 48 SECONDS WEST, 668.48 FEET; 16) THENCE ALONG A CURVE TO THE RIGHT, HAVING A RADIUS OF 3133.23 FEET, THE CHORD OF WHICH BEARS SOUTH 55 DEGREES 58 MINUTES 45 SECONDS WEST, 87.42 FEET, AN ARC DISTANCE OF 87.42 FEET TO THE WEST LINE OF LOT 8 OF M. P. HINKLE, EST. AS RECORDED IN BOOK OF PLATS 74 PAGE 615 IN THE FRANKLIN COUNTY RECORDER'S OFFICE; THENCE NORTH 01 DEGREE 24 MINUTES 33 SECONDS EAST, ALONG SAID WEST LINE OF LOT 8, 7,379.24 FEET, TO THE SOUTH LINE OF A PARCEL OF LAND FORMERLY CONVEYED TO WINSTON T. BRUNJES AND MARY ANN BRUNJES, TRUSTEES, AS RECORDED IN DEED BOOK 1012 PAGE 818 IN THE FRANKLIN COUNTY RECORDER'S OFFICE; THENCE NORTH 84 DEGREES 15 MINUTES 04 SECONDS EAST, 155.66 FEET; THENCE NORTH 83 DEGREES 25 MINUTES 32 SECONDS EAST, 229.36 FEET; THENCE NORTH 81 DEGREES 27 MINUTES 40 SECONDS EAST, 229.17 FEET; THENCE NORTH 79 DEGREES 21 MINUTES 08 SECONDS EAST, 184.28 FEET TO THE EAST LINE OF SAID A PARCEL OF LAND CONVEYED BY DEED BOOK 1012, PAGE 818 TO WINSTON D. BRUNJES AND MARY ANN BRUNJES; THENCE NORTH 01 DEGREE 17 MINUTES 23 SECONDS EAST, 481.40 FEET TO THE SOUTH LINE OF A PARCEL OF LAND CONVEYED TO CHARLES H. BRUNJES AND CAROLYN BRUNJES, AS RECORDED IN DEED BOOK 297 PAGE 361, IN THE FRANKLIN COUNTY RECORDER'S OFFICE; THENCE SOUTH 88 DEGREES 24 MINUTES 20 SECONDS EAST, 1,157.37 FEET TO THE EAST LINE OF A PARCEL OF LAND FORMERLY CONVEYED TO MARVIN J. NEWMAN, AND JUDITH A. NEWMAN, TRUSTEES, AS RECORDED IN DEED BOOK 656 PAGE 1, IN THE FRANKLIN COUNTY RECORDER'S OFFICE; THENCE SOUTH 89 DEGREES 36 MINUTES 37 SECONDS EAST, 1,302.74 FEET TO THE WEST LINE OF LOT 1 OF SAID WORTHINGTON HEIRS SUBDIVISION; THENCE NORTH 01 DEGREE 28 MINUTES 18 SECONDS EAST, ALONG SAID WEST LINE OF LOT 1 OF SAID WORTHINGTON HEIRS SUBDIVISION, 161.28 FEET; THENCE NORTHEASTERLY ALONG THE NORTH LINE OF A LAND SWAP AS RECORDED IN SURVEYOR'S RECORD 14, PAGE 248 AND ACROSS LOTS 1 THROUGH 8 OF SAID WORTHINGTON HEIRS SUBDIVISION NORTH 84 DEGREES 30 MINUTES 28 SECONDS EAST, 3,146.83 FEET TO THE EAST LINE OF LOT 8 OF SAID "WORTHINGTON HEIRS SUBDIVISION"; THENCE SOUTH 01 DEGREE 30 MINUTES 58 SECONDS WEST ALONG THE EASTERLY LINE OF SAID LOT 8 OF WORTHINGTON HEIRS SUBDIVISION, 6,145.04 FEET; THENCE SOUTH 52 DEGREES 23 MINUTES 41 SECONDS EAST, 446.76 FEET TO THE NORTHERLY RIGHT OF WAY LINE OF THE CHICAGO, (100' W) ROCK ISLAND AND PACIFIC RAILWAY COMPANY, BEING THE POINT OF BEGINNING.

SAID PARCEL CONTAINS 44,850,165 SQUARE FEET OR 1,029.618 ACRES, MORE OR LESS, AND BEING SITUATED IN FRANKLIN COUNTY, MISSOURI.

BASIS OF BEARING

BEARINGS ARE BASED ON MISSOURI STATE PLANE NAD '83, EAST ZONE.

BOUNDARY CONSOLIDATION OF PART OF LOT 8 OF "M. P. HINKLE, EST" (PB 74, PG 615), PART OF LOTS 1 THROUGH 8 OF "WORTHINGTON HEIRS SUBDIVISION" (PB C, PG 25), PART OF U.S. SURVEY 98, AND PARTS OF SECTIONS 8, 9, 16, AND 17 IN T44N, R2E, OF THE 5TH PRINCIPAL MERIDIAN, FRANKLIN COUNTY, MISSOURI

CLIENT:
REITZ & JENS, INC.
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MO 63132
PHONE: (314) 993-4132

SURVEY DATA:
SURVEY DATE: 03/15/09
FIELD CREW: RSO/BGS/KEM
FIELD BOOK: 736-BB

Kuhlmann Design Group, Inc.
66 Progress Parkway
Maryland Heights, MO 63043

KdG

KDG MO. CORPORATE LIC# 000078, EXP. 12-31-10

DISCLAIMER OF RESPONSIBILITY

PROJECT NO. 080086	CONTRACT NO. 0002
DRAWN NPW	CHECKED JPB/MSH
DATE APRIL 2009	

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SHEET 2 OF 2

Appendix B

Articles of Organization

State of Missouri

Robin Carnahan, Secretary of State

File Number: 201025290083

X01083980

Date Filed: 09/09/2010

Expiration Date: 09/09/2015

Robin Carnahan

Secretary of State

Registration of Fictitious Name

This fictitious name filing shall expire 5 years from the date filed unless a renewal filing is submitted within 6 months prior to the expiration date.

This information is for the use of the public and gives no protection to the name being registered. There is no provision in this Chapter to keep another person or business entity from adopting and using the same name. (Chapter 417, RSMo)

The undersigned is doing business under the following name, and at the following address:

Business name to be registered: **Ameren Missouri**

Business address: **One Ameren Plaza, 1901 Chouteau**

City, State and Zip Code: **St. Louis MO 63103**

If all parties are jointly and severally liable, percentage of ownership need not be listed.

Name of Owners, Individual or Business Entity	Street and Number	City and State	Zip Code	If listed, Percentage of ownership must equal 100%
UNION ELECTRIC COMPANY	One Ameren Plaza 1901 Chouteau Ave	St. Louis MO	63103	100%

In Affirmation thereof, the facts stated above are true:

(The undersigned understands that false statements made in this filing are subject to the penalties of a false declaration under Section 575.060, RSMo)

Ronald S. Gieseke — *(Authorized Signature)*

Assistant Secretary — *(Authorized Party Relationship)*

To All to Whom These Presents Shall Come:

I, WALTER H. TOBERMAN, Secretary of State of the State of Missouri, and Keeper of the Great Seal thereof, do hereby certify that

UNION ELECTRIC COMPANY OF MISSOURI

a corporation organized under the Laws of Missouri, has filed in the Office of the Secretary of State its Certificate of Amendment changing the name to

UNION ELECTRIC COMPANY

as provided by Law, and has in all respects complied with the requirements of law governing the

Amendment of Articles of Incorporation

of corporations organized under The General and Business Corporation Act of Missouri.

IN WITNESS WHEREOF, I hereunto set my hand and affix the Great Seal of the State of Missouri. Done at the City of Jefferson, this 23rd day of April, A. D. 1956

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(SEAL)

Walter H. Toberman

Secretary of State.

Chief Clerk.

UNION ELECTRIC COMPANY OF MISSOURI

CERTIFICATE OF AMENDMENT

TO

ARTICLES OF INCORPORATION

Union Electric Company of Missouri, a corporation of the State of Missouri (hereinafter called the "Corporation") by its President, who was chairman of the Meeting of Shareholders referred to below, and its Secretary, DOES HEREBY CERTIFY as follows:

I. The name of the Corporation is Union Electric Company of Missouri. The name under which the Corporation was originally organized was Missouri Electric Light and Power Company, which name was changed to Union Electric Light and Power Company on December 15, 1922. This latter name was changed to the present name on May 29, 1937.

II. The shareholders of the Corporation, at the annual meeting thereof duly convened and held on April 20, 1956 upon notice duly given by mail and by publication as required by Section 351.230, R. S. Mo. 1949, and pursuant to Section 351.090, R. S. Mo. 1949, duly adopted an amendment to the Articles of Incorporation of the Corporation changing the name of the Corporation to Union Electric Company and amending Article First of the Articles of Incorporation to read as follows:

"First.

"That the name of the corporation shall be

UNION ELECTRIC COMPANY."

III. The total number of shares of the Corporation outstanding at the time of such meeting was 10,890,482, each of which was entitled to one vote upon such amendment. The number of shares voted for such amendment was 8,767,244, and the number of shares voted against such amendment was 53,858.

Accordingly, such amendment was adopted by the affirmative vote of the holders of a majority of the outstanding shares of the Corporation entitled to vote.

IN WITNESS WHEREOF, Union Electric Company of Missouri has made this certificate under the hand of its President and Chairman of the Meeting of Shareholders, and the corporate seal of said corporation has been hereunto affixed and attested by its Secretary this 20th day of April, 1956.

UNION ELECTRIC COMPANY OF MISSOURI

By _____
President and Chairman of the Meeting

ATTEST:

_____
Secretary

J. W. McAfee, President of Union Electric Company of Missouri, and Chairman of the Meeting of Shareholders referred to in the foregoing instrument, being duly sworn, says that the matters and things set forth in said instrument are true.

_____
J. W. McAfee

Subscribed and sworn to before me this 20th day of April, 1956.

_____
O. W. Johnson
Notary Public

My commission expires April 19, 1958

STATE OF MISSOURI)
) SS.
CITY OF ST. LOUIS)

On this 20th day of April, 1956, before me appeared J. W. McAfee, to me personally known, who, being by me duly sworn, did say that he is President of Union Electric Company of Missouri, a corporation, that he was Chairman of the Meeting of Shareholders of said corporation referred to in the foregoing instrument, that the seal affixed to the foregoing instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and said J. W. McAfee acknowledged said instrument to be the free act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal at my office, in the City of St. Louis and State aforesaid, the day and year last above written.

O. W. Johnson
Notary Public

My commission expires April 19, 1958

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FILED and CERTIFICATE ISSUED

APR 23 1956

Walter H. Toberman
CORPORATION DEPT. Secretary of State

00040441

STATE OF MISSOURI

Judith K. Moriarty
SECRETARY OF STATE

CORPORATION DIVISION
RESTATED ARTICLES OF INCORPORATION

WHEREAS,

UNION ELECTRIC COMPANY

A CORPORATION ORGANIZED UNDER THE GENERAL AND BUSINESS CORPORATION LAW HAS FILED IN THE OFFICE OF THE SECRETARY OF STATE DUPLICATE ORIGINALS OF RESTATED ARTICLES OF INCORPORATION AND HAS, IN ALL RESPECTS, COMPLIED WITH THE REQUIREMENTS OF THE GENERAL AND BUSINESS CORPORATION LAW GOVERNING RESTATED ARTICLES OF INCORPRATION, AND THAT SAID RESTATED ARTICLES

SUPERCEDE THE ORIGINAL ARTICLES OF INCORPORATION AND ALL AMENDMENTS THERETO.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 12TH DAY OF APRIL, 1994.

Judith K. Moriarty
Secretary of State

$20.00

RESTATED ARTICLES OF INCORPORATION
OF
UNION ELECTRIC COMPANY

Pursuant to the provisions of Section 351.106, R.S.Mo. 1986, as amended, the undersigned Corporation adopts the following Restated Articles of Incorporation.

FIRST

That the name of the Corporation shall be UNION ELECTRIC COMPANY.

SECOND

That the registered office of the Corporation in the State of Missouri shall be 1901 Chouteau Avenue, St. Louis, Missouri 63103, and the name of the registered agent at such address shall be William E. Jaudes.

THIRD

That the aggregate number of shares which the Corporation has the authority to issue is 182,500,000 classified into 25,000,000 shares of Preferred Stock without par value, 7,500,000 shares of Preference Stock with the par value of $1 per share, and 150,000,000 shares of Common Stock with the par value of $5 per share.

(a) The Preferred Stock has heretofore been, or shall be, issued in series as follows:

(1) The Preferred Stock has heretofore been issued and is outstanding in the following amounts and series: 330,000 shares of Preferred Stock, $7.64 Series; 330,001 shares of Preferred Stock, $7.44 Series; 300,000 shares of Preferred Stock, $6.40 Series; 7,020 shares of Preferred Stock, $6.30 Series; 14,000 shares of Preferred Stock, $5.50 Series A; 3,000 shares of Preferred Stock, $5.50 Series B; 20,000 shares of Preferred Stock, $4.75 Series; 200,000 shares of Preferred Stock, $4.56 Series; 213,595 shares of Preferred Stock, $4.50 Series; 40,000 shares of Preferred Stock, $4.30 Series; 150,000 shares of Preferred Stock, $4.00 Series; 40,000 shares of Preferred Stock, $3.70 Series; 130,000 shares of Preferred Stock, $3.50 Series; and 1,657,500 shares of Preferred Stock, $1.735 Series. The respective annual dividend rates per share for such series; the respective dates (hereinafter in this paragraph (1) called "cumulative dates") from which dividends on all shares of such series issued prior to the record date for the first dividend payment date shall be cumulative; the respective redemption prices per share for such series (exclusive of accrued and unpaid dividends); and the respective amounts (hereinafter in this paragraph (1) called "liquidation prices") per share (exclusive of accrued and unpaid dividends) for such series payable to the holders thereof in case of voluntary or involuntary dissolution, liquidation or winding up of the affairs of the Corporation; all as heretofore fixed by the Board of Directors as follows:

Series	Dividend Rate	Cumulative Date	Redemption Price	Voluntary Liquidation Price	Involuntary Liquidation Price	Sinking Fund Provisions
$7.64	7.64	1/19/93	(i)	(i)	100.00	None
$7.44	7.44	12/20/72	101.00	101.00	100.00	None
$6.40	6.40	11/15/67	101.50	101.50	100.00	None
$6.30	6.30	12/30/83	100.00	100.00	100.00	(ii)
$5.50 A	5.50	12/30/83	110.00	110.00	100.00	None
$5.50 B	5.50	12/30/83	103.50	103.50	100.00	None
$4.75	4.75	12/30/83	102.176	102.176	100.00	None
$4.56	4.56	11/15/63	102.47	102.47	100.00	None
$4.50	4.50	5/15/41	110.00	105.50	100.00	None
$4.30	4.30	12/30/83	105.00	105.00	100.00	None
$4.00	4.00	8/15/49	105.625	105.625	100.00	None
$3.70	3.70	8/15/45	104.75	104.75	100.00	None
$3.50	3.50	5/15/46	110.00	110.00	100.00	None
$1.735	1.735	8/11/93	(iii)	(iii)	25.00	None

(i) Not redeemable prior to February 15, 2003; $103.82 if redeemed on February 15, 2003 or thereafter and prior to February 15, 2004; $103.40 if redeemed on February 15, 2004 or thereafter and prior to February 15, 2005; $102.97 if redeemed on February 15, 2005 or thereafter and prior to February 15, 2006; $102.55 if redeemed on February 15, 2006 or thereafter and prior to February 15, 2007; $102.12 if redeemed on February 15, 2007 or thereafter and prior to February 15, 2008; $101.70 if redeemed on February 15, 2008 or thereafter and prior to February 15, 2009; $101.27 if redeemed on February 15, 2009 or thereafter and prior to February 15, 2010; $100.85 if redeemed on February 15, 2010 or thereafter and prior to February 15, 2011; $100.42 if redeemed on February 15, 2011 or thereafter and prior to February 15, 2012; $100.00 if redeemed on February 15, 2012 or thereafter.

(ii) That so long as any shares of Preferred Stock, $6.30 Series, shall be outstanding, the Company shall retire annually by redemption at $100.00 per share plus accrued and unpaid dividends to the date of redemption, on June 1 in each year beginning with June 1, 1984, 260 shares of Preferred Stock, $6.30 Series; that shares of Preferred Stock, $6.30 Series, selected for redemption shall be selected pro rata from the holders thereof; and that shares of Preferred Stock, $6.30 Series, redeemed pursuant to this paragraph shall become authorized and unissued shares of Preferred Stock of the Company.

(iii) Not redeemable prior to August 1, 1998; $25.00 on August 1, 1998 or thereafter.

(2) Additional shares of the Preferred Stock may, subject to the provisions of paragraphs (1) and (6) of subdivision (k) below, be issued as additional shares of Preferred Stock

of any of the series designated above or as shares of one or more other series of Preferred Stock, with such distinctive serial designations as shall be set forth in the resolution or resolutions from time to time adopted by the Board of Directors providing for the issue of such stock or in such other instrument providing for the issue of such stock as may be required by law; and in any such resolution or resolutions or such other instrument, as the case may be, with respect to each particular series of the Preferred Stock (other than the series designated above) the Board of Directors is hereby expressly authorized to fix, to the extent which may be permitted by law,

(i) the annual dividend rate for the particular series which shall not exceed $8 per share, and the date from which dividends on all shares of such series issued prior to the record date for the first dividend payment date shall be cumulative;

(ii) the redemption price per share for the particular series which (exclusive of accrued and unpaid dividends) shall not exceed $120 per share;

(iii) the amount or amounts per share (exclusive of accrued and unpaid dividends) for the particular series payable to the holders thereof in case of dissolution, liquidation or winding up of the affairs of the Corporation, but such amount or amounts shall not exceed $120 per share;

(iv) the terms and conditions, if any, upon which shares of the particular series shall be convertible into, or exchangeable for, shares of any other class, including the price or prices or the rate or rates of conversion or exchange and the terms of adjustment thereof, if any;

(v) the terms and amount of any sinking fund created for the purchase or redemption of the particular series of Preferred Stock; and

(vi) any other characteristics of, and any restrictive or other provisions relating to, the shares of each particular series not inconsistent with the provisions of the Articles of Incorporation, as amended, as the Board of Directors may by law be permitted to fix.

All shares of Preferred Stock of any one series shall be identical with each other in all respects except as to the date from which dividends thereon shall be cumulative; and all shares of all series shall be of equal rank as to dividends and assets with each other, regardless of series, and shall be identical with each other in all other respects except as hereinbefore provided.

(b) Before any dividends on the Common Stock shall be paid or declared or set apart for payment, the holders of the Preferred Stock at the time outstanding shall be entitled to receive, but only when and as declared, out of any funds legally available for the declaration of dividends, cumulative cash dividends at the respective annual rates hereinbefore specified with respect to the series of Preferred Stock designated above, or, in the case of Preferred Stock of any other series, at the annual dividend rate for the particular series theretofore fixed by the Board of Directors as

hereinbefore provided, payable quarter-yearly on the fifteenth days of February, May, August, and November in each year, to stockholders of record on the respective dates, not exceeding forty days preceding such dividend payment dates, fixed for the purpose by the Board of Directors in advance of the payment of each particular dividend. Such dividends on shares of the Preferred Stock shall be cumulative,

(1) if issued prior to the record date for the first dividend on the shares of such series, then, in the case of the series of Preferred Stock designated above, from the respective dates hereinbefore specified with respect thereto, or, in the case of Preferred Stock of any other series, from the date theretofore fixed for the purpose by the Board of Directors as hereinbefore provided;

(2) if issued during the period commencing immediately after a record date for a dividend and terminating at the close of the payment date for such dividend, then from said last mentioned dividend payment date; and

(3) otherwise from the quarter-yearly dividend payment date next preceding the date of issue of such shares;

so that if dividends on all outstanding shares of the Preferred Stock shall not have been paid for all past quarter-yearly dividend periods, and the full dividends thereon for the current quarter-yearly dividend period shall not have been paid, or declared and set apart for payment, the deficiency shall be fully paid or dividends equal thereto declared and set apart for payment, but without interest on cumulative dividends, before any dividends shall be declared or any distribution made on the Common Stock. The holders of the Preferred Stock shall not be entitled to receive any dividends thereon other than the dividends referred to in this subdivision (b).

(c) The Corporation, at the option of the Board of Directors, may redeem the whole or any part of the Preferred Stock at the time outstanding, or the whole or any part of any series thereof, at any time or from time to time, by paying, in the case of the series of Preferred Stock designated above, the respective redemption prices hereinbefore specified with respect thereto, or, in the case of Preferred Stock of any other series, by paying such redemption price therefor as shall have been fixed by the Board of Directors as hereinbefore provided, together with a sum, in the case of each share so to be redeemed, computed at the annual dividend rate for the series of which the particular share is a part from the date from which dividends on such share became cumulative to the date fixed for such redemption, less the aggregate of the dividends theretofore or on such redemption date paid thereon. Notice of every such redemption shall be given by publication, published at least once in each of two calendar weeks in a daily newspaper printed in the English language and published and of general circulation in the Borough of Manhattan, The City of New York, and in a like newspaper published and of general circulation in the City of St. Louis, Missouri, the first publication to be at least thirty days and not more than sixty days prior to the date fixed for such redemption. At least thirty days' and not more

than sixty days' previous notice of every such redemption shall also be mailed to the holders of record of the Preferred Stock to be redeemed, at their respective addresses as the same shall appear on the books of the Corporation; but no failure to mail such notice nor any defect therein or in the mailing thereof shall affect the validity of the proceedings for the redemption of any shares of the Preferred Stock so to be redeemed. In case of the redemption of a part only of any series of the Preferred Stock at the time outstanding, the Corporation shall select by lot or in such other manner as the Board of Directors may determine, the shares so to be redeemed. The Board of Directors shall have full power and authority, subject to the limitations and provisions herein contained, to prescribe the manner in which and the terms and conditions upon which the Preferred Stock shall be redeemed from time to time. If such notice of redemption shall have been duly given by publication, and if on or before the redemption date specified in such notice all funds necessary for such redemption shall have been set aside so as to be available therefor, then, notwithstanding that any certificate for the shares of the Preferred Stock so called for redemption shall not have been surrendered for redemption, the shares represented thereby shall no longer be deemed outstanding in the hands of the persons who are the holders thereof immediately preceding such redemption, the right of such holders to receive dividends thereon shall cease to accrue from and after the date of redemption so fixed, and all rights of such holders with respect to such shares of Preferred Stock so called for redemption shall forthwith on such redemption date cease and terminate, except only the right of such holders to receive the amount payable upon redemption thereof, but without interest; provided, however, that the Corporation may, after giving the first notice by publication of any such redemption, or giving irrevocable instructions therefor, and prior to the redemption date specified in such notice, deposit in trust, for the account of the holders of the Preferred Stock to be redeemed, with a bank or trust company in good standing, organized under the laws of the United States of America or of the State of New York, doing business in the Borough of Manhattan, The City of New York, having a capital, surplus and undivided profits aggregating at least $5,000,000, all funds necessary for such redemption, and thereupon all shares of the Preferred Stock with respect to which such deposit shall have been made shall no longer be deemed to be outstanding in the hands of such holders, and all rights of such holders with respect to such shares of Preferred Stock shall forthwith upon such deposit in trust cease and terminate, except only the right of such holders to receive the amount payable upon the redemption thereof, but without interest. All or any shares of the Preferred Stock redeemed at any time may, in the discretion of the Board of Directors and to the extent permitted by law, be reissued or otherwise disposed of at any time or from time to time subject to the provisions of these Articles of Incorporation, as amended.

(d) In the event of any liquidation, dissolution or winding up of the affairs of the Corporation, then before any distribution shall be made to the holders of the Common Stock, the holders of shares of the Preferred Stock at the time outstanding shall be entitled to be paid in cash, in the case of the

series of Preferred Stock designated above, the respective amounts hereinbefore specified with respect thereto, and, in the case of Preferred Stock of any other series, such amount as shall have been fixed by the Board of Directors as hereinbefore provided, together with a sum in the case of each such share, computed at the annual dividend rate for the series of which the particular share is a part from the date from which dividends on such shares became cumulative to the date fixed for the payment of such distributive amounts, less the aggregate of the dividends theretofore or on such date paid thereon. After such payment to the holders of the Preferred Stock, the remaining assets and funds of the Corporation shall be divided and distributed among the holders of the Common Stock then outstanding according to their respective shares.

(e) Unless and until four quarter-yearly dividends payable on the Preferred Stock shall be in default, in whole or in part, every stockholder shall have one vote for each share of Preferred Stock, and one vote for each share of Common Stock, held by him, on all matters, including the election of Directors, except as otherwise provided by law or by these Articles of Incorporation, as amended. If and when four quarter-yearly dividends (whether or not consecutive) payable on the Preferred Stock shall be in default, in whole or in part, every stockholder shall have one vote for each share of Preferred Stock, and one vote for each share of Common Stock, held by him, on all matters except the election of Directors, and in such case the number of Directors of the Corporation shall thereupon, and until such default shall have been remedied, be two more than the number specified in and pursuant to Article Fifth of the Articles of Incorporation, as amended, the holders of the Preferred Stock at the time outstanding, voting separately as a class, shall become entitled to elect the two additional members of the Board of Directors, and at each annual election of Directors thereafter during the continuance of such default the holders of the Preferred Stock, voting separately as a class, shall be entitled to elect two members of the Board of Directors and the holders of the Common Stock, voting separately as a class, shall be entitled to elect the remaining Directors of the Corporation. However, if and when all dividends then in default on the Preferred Stock then outstanding shall thereafter be paid (and such dividends shall be declared and paid out of any funds legally available therefor as soon as reasonably practicable), the Preferred Stock shall thereupon be divested of such special right herein provided for to elect such members of the Board of Directors, the voting power of the Preferred Stock and the Common Stock shall revert to the status existing before the occurrence of such default, and the number of Directors of the Corporation shall again be the number specified in and pursuant to Article Fifth of the Articles of Incorporation, as amended; but always subject to the same provisions for vesting such special rights in the Preferred Stock in case of any similar future default or defaults. A meeting of the holders of the Preferred Stock, at which the holders of the Preferred Stock shall vote as a class, shall be held at any time after the accrual of such special right to elect such two additional members of the Board of Directors, upon notice similar to that provided in the By-laws for a special

meeting, upon call by the holders of not less than 1,000 shares of the Preferred Stock or upon call by the Secretary of the Corporation at the request in writing of any holder of Preferred Stock addressed to him at the principal office of the Corporation. Upon termination of such special right at any time by reason of the payment of all accumulated and defaulted dividends on such stock, the terms of office of all persons who may have been elected Directors of the Corporation by vote of the holders of the Preferred Stock, as a class, pursuant to such special right shall forthwith terminate.

Whenever Directors are elected by the stockholders by classes, pursuant to this subdivision (e), in case of any vacancy in the Board of Directors, through death, resignation, disqualification or other cause, occurring among the Directors elected by the holders of the Common Stock, as a class, the remaining Directors elected by the vote of the holders of the Common Stock, as a class, by affirmative vote of the majority thereof, may elect a successor to hold office for the unexpired term of the Director whose place shall be vacant; and in case of any such vacancy in the Board of Directors occurring among the Directors elected by the holders of the Preferred Stock, as a class, the holders of the Preferred Stock then outstanding and entitled to vote may, at a meeting of such holders called in the manner provided by this subdivision (e), elect a successor to hold office for the unexpired term of the Director whose place shall be vacant. In all other cases any such vacancy shall be filled by the affirmative vote of the majority of the remaining Directors, and the Directors so elected shall hold office until their successors shall be elected and qualified.

(f) In all elections for Directors, each shareholder shall have the right to cast as many votes in the aggregate as shall equal the number of voting shares held by him multiplied by the number of Directors to be elected, and may cast the whole number of votes, either in person or by proxy, for one candidate or distribute such votes among two or more candidates; provided, however, that in case the Directors are to be elected by particular classes of stock as provided in the Articles of Incorporation, as amended, in the event of default in the payment of dividends on the Preferred Stock, each holder of the particular class of stock shall have the right to cast as many votes in the aggregate as shall equal the number of shares of such class held by him multiplied by the number of Directors to be elected by such class, and may cast the whole number of such votes for one candidate for Director to be elected by such class or may distribute such votes among two or more candidates for Directors to be elected by such class.

(g) Except as otherwise provided by law or by the Articles of Incorporation, as amended, the holders of record of a majority of the outstanding shares of capital stock of the Corporation entitled to vote at any meeting of shareholders, present in person or represented by proxy, shall constitute a quorum at such meeting; provided, that in no event shall a quorum consist of less than a majority of the outstanding shares entitled to vote, but less than such quorum shall have the right successively to

adjourn the meeting to a specified date not longer than ninety days after such adjournment, without notice other than announcement at the meeting.

(h) No holder of Preferred Stock shall be entitled as such as a matter of right to subscribe for or purchase any part of any new or additional issue of stock or securities convertible into stock, of any class whatever, whether now or hereafter authorized, and whether issued for cash, property, services or otherwise.

(i) Upon the issuance for money or other consideration of any shares of capital stock of the Corporation or of any securities convertible into shares of capital stock of the Corporation, of any class whatever which may be authorized from time to time, no holder of shares of Common Stock of the Corporation shall be entitled as such as a matter of right to subscribe for, purchase or receive any proportionate or other share of the capital stock or securities so issued, but all or any portion of such capital stock may be disposed of by the Corporation, as and when determined by the Board of Directors, free of any such rights, whether by offering the same to shareholders or by sale or other disposition as the Board of Directors may deem advisable; provided, however, that if the Board of Directors shall determine to issue and sell any shares of Common Stock (including, for the purposes of this paragraph, any security convertible into Common Stock, but excluding shares of such Common Stock and securities convertible into such Common Stock theretofore reacquired by the Corporation after having been duly issued, or issued to satisfy any conversion or option rights theretofore granted by the Corporation) solely for money and other than by:

(1) a public offering thereof, or

(2) an offering thereof to or through underwriters or dealers who shall agree promptly to make a public offering thereof, or

(3) The issue thereof in connection with (a) any dividend reinvestment, stock purchase or other plan in which the holders of the Common, Preferred or Preference Stock or customers of the Corporation or of any subsidiary of the Corporation may participate or (b) any stock ownership, stock purchase, stock option, stock bonus, savings, pension or other plan in connection with which employees or former employees (including officers and directors) of the Corporation or any subsidiary of the Corporation may purchase or acquire Common Stock (or securities of the Corporation convertible into or exchangeable for Common Stock) or any trust related to, or any agent acting with respect to, any such plan may purchase or acquire Common Stock (or securities of the Corporation convertible into or exchangeable for Common Stock) on behalf of, or for the account or benefit of, such employees or former employees or, in case of any such trust, for the purpose of investing the funds of the trust, or

(4) any other offering thereof which shall have been authorized or approved by the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for such

purpose) of the holders of a majority of the shares of Common Stock then outstanding and entitled to vote,

such shares of Common Stock shall first be offered pro rata to the holders of record of the then outstanding shares of Common Stock (excluding outstanding shares of such Common Stock held for the benefit of holders of scrip certificates or other instruments representing fractional interests in a full share of such Common Stock) upon terms which, in the judgment of the Board of Directors, shall be not less favorable (without deduction of such reasonable compensation for the sale, underwriting or purchase of such shares by underwriters or dealers as may lawfully be paid by the Corporation) to the purchaser than the terms upon which such shares are offered to others than such holders of the Common Stock; provided that the Corporation shall not be obligated to offer or to issue any fractional interest in a full share of Common Stock; and provided further that the time within which such preemptive rights shall be exercised may be limited to such time as to the Board of Directors may seem proper, not less, however, than fourteen days after the mailing of notice that such preemptive rights are available and may be exercised.

(j) So long as any shares of the Preferred Stock are outstanding, no amendment to the Articles of Incorporation which would change the express preferences, priorities or character of the Preferred Stock or the rate of dividend to be paid thereon in any manner substantially prejudicial to the holders thereof shall be made, except as hereinafter in subdivisions (k) and (n) provided and except an amendment changing the number of the Board of Directors, without the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for the purpose) of the holders of at least three-fourths of the aggregate number of shares of the Preferred Stock then outstanding; but such amendment may be made with such affirmative consent, together with such additional vote or consent of stockholders as from time to time may be required by law.

(k) So long as any of the shares of Preferred Stock are outstanding, the Corporation shall not, without the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for the purpose) of the holders of at least two-thirds of the aggregate number of shares of the Preferred Stock then outstanding:

(1) sell or otherwise dispose of any shares of the Preferred Stock or of stock of any other class ranking on a parity with or having any preference over the Preferred Stock as to assets or dividends, unless the net earnings of the Corporation available for the payment of dividends on the Preferred Stock and on all such other classes of stock, computed in accordance with good accounting practice, for a period of any twelve consecutive calendar months within the fifteen calendar months immediately preceding the first day of the month in which such additional stock is issued are at least two and one-half times the annual dividend requirements on all shares of the Preferred Stock and of all other classes of stock ranking on a parity with or having any preference

over the Preferred Stock as to assets or dividends, to be outstanding immediately after such proposed additional issue; and, in determining such net earnings available for the payment of dividends on the Preferred Stock and on all such other classes of stock, any dividend received by the Corporation during such period on stock of any subsidiary of the Corporation in excess of the net earnings of such subsidiary for such period available therefor, computed in accordance with good accounting practice, shall be included only to the extent of such net earnings of such subsidiary; or

(2) create any class of stock which shall be preferred as to dividends or assets over the Preferred Stock; or

(3) increase the authorized number of shares of the Preferred Stock; or

(4) reclassify outstanding shares of stock of any class ranking junior to the Preferred Stock as to assets or dividends, wholly or partially, into shares of stock of any class ranking on a parity with or having any preference over the Preferred Stock as to assets or dividends; or

(5) make any distribution out of capital or capital surplus (other than dividends payable in stock ranking junior to the Preferred Stock as to assets and dividends) to holders of stock of the Corporation ranking junior to the Preferred Stock as to assets or dividends; or

(6) issue any shares of the Preferred Stock or any other stock ranking on a parity with or having any preference over the Preferred Stock as to assets or dividends, if the stated capital to be represented by the Preferred Stock and such other stock outstanding immediately after such issue would exceed the stated capital to be represented by shares of stock to be then outstanding ranking junior to the Preferred Stock as to assets and dividends, increased by the amount of any capital surplus or reduced by the amount of any deficit. For the purpose of this subdivision (6), stated capital represented by any preferred stock having a par value shall be the par value thereof, and stated capital represented by any preferred stock without par value shall be the amount of stated capital fixed by the Board of Directors with respect thereto at the time of issue thereof, or the amount payable to the holders thereof (exclusive of accrued and unpaid dividends) in preference to the Common Stock upon involuntary liquidation, dissolution or winding up of the affairs of the Corporation, whichever is greater;

but any such action requiring such affirmative consent of the holders of the Preferred Stock, as provided in this subdivision (k), may be taken with such vote or consent of stockholders as may at the time be required by law, but with at least the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for the purpose) of the holders of two-thirds of the aggregate number of shares of Preferred Stock then outstanding. Stock shall not be considered to be outstanding for any of the purposes of this subdivision (k) or of subdivision (j) above, if the Board of Directors shall have determined to redeem such stock and if the first publication of notice of redemption shall have been

made, or irrevocable instructions given therefor, and all funds necessary for such redemption shall have been deposited in trust for such purpose.

(l) No amendment to the Articles of Incorporation which would change the provisions of the foregoing subdivisions (f), (g) or (i) in any manner substantially prejudicial to the holders of any class of stock, shall be made without the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for such purpose) of the holders of at least two-thirds of the aggregate number of shares of capital stock of the Corporation then outstanding and entitled to vote; but such amendment may be made with such affirmative consent, together with such additional vote or consent of shareholders as from time to time may be required by law.

(m) No amendment to the Articles of Incorporation providing for the creation or increase of Preferred Stock of any class shall be made without the affirmative consent (given in writing without a meeting or by vote at a meeting duly called for such purpose) of the holders of at least a majority of the aggregate number of shares of Common Stock of the Corporation then outstanding; but such amendment may be made with such affirmative consent, together with such additional vote or consent of holders of Preferred Stock of the Corporation as shall at the time be required by the Articles of Incorporation, as amended.

(n) Subject to the provisions of subdivisions (j), (k), (l) and (m) hereof, the Corporation reserves the right to amend, alter, change or repeal, to the extent now or hereafter permitted by law, any provision in its Articles of Incorporation, as amended, (including the authorizing of preferred stock junior to the Preferred Stock as to dividends and assets and the changing of any authorized but unissued shares of the Preferred Stock to shares of another class or classes of preferred stock ranking on a parity with the Preferred Stock as to assets and dividends but which may have different dividend rates, redemption prices and other terms and provisions as may at the time be permitted by law) with such vote or consent of stockholders as from time to time may be required by law, and all rights herein conferred upon the shareholders are granted subject to this reservation.

(o) Subject to the provisions of subdivision (k) hereof, the Corporation may issue and dispose of its authorized but unissued shares without par value, from time to time, for such consideration as may from time to time be prescribed by the Board of Directors, and authority is hereby expressly conferred on the Board of Directors so to fix such consideration. The Board of Directors is also hereby expressly authorized to determine, at or before the time of issue thereof, what part of the consideration which shall be received by the Corporation upon the issue from time to time of shares of its capital stock without par value shall be capital, and, in the absence of any such determination, the entire consideration received for any particular shares shall be capital. Any and all shares without par value issued for the consideration so fixed shall be deemed fully paid and be non-assessable, and the holder of such shares shall not be liable thereon to the Corporation or its creditors.

(p) The Preference Stock shall have, or be subject to, as the case may be, the following preferences, rights, privileges and restrictions:

Manner of Issue - Series - The Board of Directors is empowered to cause the Preference Stock to be issued from time to time as shares of one or more series of Preference Stock, and in the resolution or resolutions providing for the issue of each particular series, before issuance, the Board of Directors is expressly authorized to fix:

(1) the distinctive serial designation of the shares of such series and the number of shares which shall constitute such series;

(2) the annual dividend rate for the particular series, the dates of payment of dividends on shares of such series and the dates from which they are cumulative;

(3) the redemption price per share and the terms of redemption for the shares of a particular series;

(4) the amount or amounts per share (exclusive of accrued and unpaid dividends) for the particular series payable to the holders thereof in case of dissolution, liquidation or winding up of the affairs of the Corporation;

(5) the terms and conditions, if any, upon which shares of the particular series shall be convertible into, or exchangeable for, shares of any stock of junior rank, with respect to dividends and assets, including the price or prices or the rate or rates of conversion or exchange and the terms of adjustment thereof, if any;

(6) the terms and amount of any sinking fund created for the purchase or redemption of the shares of any particular series; and

(7) any other characteristics of, and any restrictive or other provisions relating to, the shares of each particular series not inconsistent with the provisions of the Articles of Incorporation, as amended, as the Board of Directors may by law be permitted to fix.

All shares of Preference Stock shall be of junior rank, with respect to dividends and assets, to all shares of Preferred Stock and of senior rank in such respects to all shares of Common Stock. All shares of Preference Stock of any one series shall be identical with each other in all respects except, in the event portions of the shares of a single series are issued at different times, the date from which dividends thereon shall be cumulative; and all shares of all series shall be of equal rank as to dividends and assets with each other, regardless of series, and shall be identical with each other in all respects except as hereinabove provided.

Dividends - Dividends on Preference Stock of any series shall be payable at annual rates and on dates fixed by the Board of Directors at the time of the creation of such series, payable quarter-yearly on such dates as shall be fixed for such payments by the Board of Directors. The right of holders of Preference Stock to receive dividends shall be subject to the dividend and sinking fund

provisions of the Preferred Stock. Dividends on the Preference Stock shall be cumulative, and no dividends shall be declared or paid, or any distribution made, on Common Stock, other than a dividend payable in Common Stock, unless and until full dividends on the outstanding Preference Stock shall have been paid, or declared and a sum sufficient for the payment thereof set aside, with respect to all past dividend periods and the current dividend period. Dividends on shares of any series of Preference Stock shall accrue from and be cumulative from such date as may be fixed by the Board of Directors at the time of the creation of such series, except that dividends on shares of Preference Stock of any series, which are issued after the initial issue of shares of such series, shall accrue from and be cumulative from such date as may be fixed by the Board of Directors at the time of issuance of such additional shares.

Redemption - If so provided by the Board of Directors upon the creation of any series of Preference Stock, the Corporation, at the option of the Board of Directors, or in accordance with the requirements of any sinking fund for the Preference Stock or any series thereof, may redeem the whole or any part of the Preference Stock at any time outstanding, or the whole or any part of any series thereof, at such time or times and from time to time as may be determined by the Board of Directors and at such redemption price or prices as may have been fixed by the Board of Directors at the time of the creation of the shares so to be redeemed, together with an amount equal to all unpaid dividends accrued thereon to the date fixed for such redemption, and otherwise upon the terms and conditions fixed by the Board of Directors for any such redemption; provided, however, that no redemption of any Preference Stock shall be effected unless (1) full dividends on all outstanding shares of Preferred Stock and Preference Stock for all past dividend periods shall have been paid, or declared and a sufficient sum set apart for the payment thereof, and (2) all obligations of the Corporation, if any, with respect to the redemption or purchase of shares of Preferred Stock and Preference Stock in accordance with the requirements of any sinking fund have been met.

Liquidation, Dissolution and Winding Up of the Affairs of the Corporation - In the event of any liquidation, dissolution or winding up of the affairs of the Corporation, whether voluntary or involuntary, but only after full payment has been made to the holders of the Preferred Stock of all amounts to which they are entitled by these Articles of Incorporation, as amended, or a sufficient sum set apart for such payment, the holders of shares of each series of Preference Stock then outstanding shall be entitled to receive out of the assets of the Corporation, before any distribution or payment shall be made to the holders of the Common Stock, the amount fixed by the Board of Directors in creating such series, plus an amount equal to all unpaid dividends accrued thereon to the date fixed for such payment to the holders of Preference Stock.

Voting Rights - Except as otherwise provided in these Articles of Incorporation, as amended, each holder of Preference Stock shall be entitled at all meetings of shareholders of the

Corporation to one vote for each share of such stock held by him; and the holders of Preference Stock shall vote together with the holders of the Preferred Stock and the Common Stock as a single class, except in those instances where these Articles of Incorporation, as amended, grant to the holders of Preferred Stock or Common Stock the right to vote as a separate class. The voting rights of the holders of Preference Stock in an election of directors shall be identical with the voting rights of the holders of Common Stock in such election, as set forth in these Articles of Incorporation, as amended, and the provision for filling vacancies in the Board of Directors that are by said amended Articles applicable to holders of the Common Stock shall be equally applicable to holders of the Preference Stock.

Whenever four quarter-yearly dividends payable on the Preference Stock shall be in default, and during the continuance of such default, the Common Stock and the Preferred Stock, voting together as a single class, shall be entitled to elect the same number of directors as was authorized by the Articles of Incorporation immediately prior to such default, and the Preference Stock, as a class, shall be entitled to elect two additional directors.

Notwithstanding any other provision in those Articles of Incorporation, as amended, the affirmative approval of the holders of at least two-thirds of the Preference Stock of all series thereof then outstanding present and voting at a meeting, voting as a single class without regard to series, shall be required for any amendment of these Articles of Incorporation, as amended, altering adversely any existing provision of the Preference Stock or for an increase in the authorized amount of the Preference Stock or the creation, or an increase in the authorized amount of any class of stock ranking, as to dividends and assets, on a parity with or prior to the Preference Stock.

Preemptive Rights - No holder of shares of any series of the Preference Stock shall, as such, have any preemptive or preferential right to subscribe to or purchase shares of any class or series of stock of the Corporation, now or hereafter authorized, or any securities convertible into, or warrants or other evidences of optional rights to purchase, or subscribe to, shares of any class or series of stock of the Corporation, now or hereafter authorized.

FOURTH

That the name and place of residence of each incorporator are:

NAME	RESIDENCE
L. H. Egan	St. Louis, Missouri
F. J. Boehm	St. Louis, Missouri
L. E. Young	St. Louis, Missouri
H. Spoehrer	St. Louis, Missouri
Wm. Avery	St. Louis, Missouri
C. E. Michel	St. Louis, Missouri
H. W. Eales	St. Louis, Missouri
G. K. Miltenberger	St. Louis, Missouri
R. S. King	St. Louis, Missouri

FIFTH

That, except as otherwise provided by the Articles of Incorporation, as amended, the number of the Board of Directors shall be fixed at eleven or at the number and in the manner provided by the By-laws of the Company, as amended, and written notice shall be given to the Secretary of State of Missouri of the number of the Board of Directors within thirty (30) calendar days of the fixing of such number. The Board of Directors shall have the power to make, alter, amend or repeal the By-laws of the Company.

SIXTH

That the Corporation shall have perpetual existence.

SEVENTH

That the purposes for which the Corporation is formed are:

To acquire the properties, rights, privileges, franchises, business and other assets of Union Electric Company, a corporation of the State of Missouri;

To manufacture, produce, develop, generate, store, acquire, lease, purchase, sell, control, use, dispose of, transmit, distribute and supply or otherwise utilize electricity and electrical energy or any other power or force in any form and for any purpose whatsoever;

To purchase or otherwise acquire, hold, use, operate, sell, pledge, mortgage, lease or otherwise dispose of machinery, generators, motors, lamps, plants, apparatus, devices, supplies and articles of every kind pertaining to or in anywise connected with the production, use, distribution, regulation, control or application of electricity or electrical energy for any and all purposes;

To construct, purchase or otherwise acquire, hold, develop, use, operate, sell, lease, mortgage or otherwise dispose of hydraulic, electric and other works, water powers and the sites thereof, plants, power houses, buildings, machinery, equipments, apparatus, devices, processes, transmission and distribution lines, transforming and distributing stations and any and all rights of way and lands connected therewith or useful therefore; and to acquire any and all rights, or other property necessary and useful in connection with acquiring, owning and operating any or all of said works, water powers or plants;

To construct, purchase or otherwise acquire, hold, use, operate, sell, lease, mortgage or otherwise dispose of reservoirs, dams, diversion structures, canals, ditches, flumes, water conduits, pipe lines, distributing or transmission lines and systems, and such other works, plants, equipments, appliances and appurtenances as may be necessary, useful or appropriate for impounding, storing, conveying, distributing and utilizing water for power, irrigation, fire, sanitary, domestic, manufacturing and other uses, and to appropriate, divert, use, apply, sell and otherwise dispose of water for such uses; to make applications, locations, entries, selections or filings in connection therewith;

To apply for, purchase or otherwise acquire, hold, use, operate, sell, mortgage, or otherwise dispose of permits or licenses issued by the United States or any state, territory or subdivision thereof for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, power houses, transmission or distribution lines, or other works or projects necessary or convenient for the development and improvement of navigation, and for the development, transmission and utilization of power across, along, from or in any of the navigable waters of the United States, or upon any part of the public lands and reservations of the United States, or for the purpose of utilizing the surplus water or water power from any dam of the United States or any state, territory or subdivision thereof;

To transform power generated by hydraulic or other plants into electrical or other energy and to transmit or otherwise dispose thereof for any and all purposes;

To purchase or otherwise acquire, hold, use, operate, sell, pledge, mortgage, lease, or otherwise dispose of all water rights, water powers and water privileges;

To manufacture, acquire, purchase, sell and distribute for all purposes, natural and artificial gas, and to acquire, construct, purchase, own, maintain, operate, sell and lease all necessary and convenient works, conduits, plants, apparatus and connections for holding, receiving, purifying, manufacturing, selling, utilizing and distributing natural or artificial gas; to manufacture and sell or otherwise dispose of chemicals or other products derived wholly or in part from gas or gas works;

To manufacture, purchase, sell and distribute steam and hot water for heating and other purposes, and to acquire, construct, purchase, own, maintain, operate, sell and lease all necessary and convenient works, plants, apparatus and connections for manufacturing, selling and distributing steam and hot water;

To manufacture, purchase, sell and distribute ice and refrigeration; and to construct, purchase or otherwise acquire, hold, use, operate, sell, lease, mortgage or otherwise dispose of ice and refrigerating plants;

To purchase or otherwise acquire, hold, use, operate, sell, mortgage, pledge, lease, or otherwise dispose of such real and personal estate, property rights, rights of way, easements, privileges, grants, consents and franchises, as may be necessary, appropriate or useful in connection with the business, objects and purposes of the Corporation;

To engage as a public utility in furtherance of each and all of the foregoing purposes, which are now or may hereafter become subject to the laws governing or regulating public utilities, and to that end to be authorized to transmit, conduct or distribute, for public or private use, electrical energy, water, gas, steam and/or refrigeration under or over, along or across highways, streets, alleys, bridges and other public places;

To apply for, purchase or otherwise acquire, and to hold, use, own, operate and to sell, assign or otherwise dispose of, and to grant or receive licenses in respect of or otherwise to turn to account any and all inventions, improvements, patents, patent rights, processes, trademarks, and trade-names, secured by or issued under the laws of the United States of America or of any other government or country;

To purchase, hold, sell, assign, transfer, mortgage, pledge or otherwise hold and possess or otherwise dispose of, shares of capital stock, or any bonds, securities or evidence of indebtedness created by any other corporation or corporations of this state, country, nation or government, and while owner of said stock to exercise all the rights, powers and privileges of ownership including the right to vote thereon; and, to the extent now or hereafter permitted by law, to acquire by purchase, subscription, contract or otherwise, and to hold, sell, exchange, mortgage, pledge or otherwise dispose of, or turn to account or realize upon, and generally deal in and with, all forms of securities, including, but not by way of limitation, shares, stocks, bonds, debentures, notes, scrip, mortgages, evidences of indebtedness, commercial paper, certificates of indebtedness and certificates of interest issued or created in any and all parts of the world by corporations, associations, partnerships, firms, trustees, syndicates, individuals, governments, states, municipalities and other political and governmental divisions and subdivision, or by any combinations, organizations or entities whatsoever, or issued or created by others, irrespective of their form or the name by which they may be described, and all trust, participation and other certificates of and receipts evidencing interest in any such securities, and to issue in exchange therefor or in payment thereof, in any manner permitted by law, its own stock, bonds, debentures or its other obligations or securities, or to make payment therefor by any other lawful means of payment whatsoever; to exercise any and all rights, powers and privileges of individual ownership or interest in respect of any and all such securities or evidences of interest therein, including the right to vote thereon and to consent and otherwise act with respect thereto; to do any and all acts and things for the preservation, protection, improvement and enhancement in value of any and all such securities or evidences of interest therein, and to aid by loan, subsidy, guaranty or otherwise those issuing, creating or responsible for any such securities or evidences of interest therein; to acquire or become interested in any such securities or evidences of interest therein, as aforesaid by original subscription, underwriting, loan, participation in syndicates or otherwise and irrespective of whether or not such securities or evidences of interest therein be fully paid or subject to further payments; to make payments thereon as called for or in advance of calls or otherwise, and to underwrite or subscribe for the same conditionally or otherwise and either with a view to investment or for resale or for any other lawful purpose;

To borrow money, to issue bonds, notes, debentures, or other obligations, secured or unsecured, of the Corporation, from time to time, for moneys borrowed or in payment for property

acquired or for any of the other objects or purposes of the Corporation; to secure the same by mortgage or mortgages upon, or by deed or deeds of trust of, or by a pledge of, or other lien upon any or all of the property real or personal, rights, privileges and franchises of the Corporation wheresoever situated, acquired or to be acquired; and to sell or otherwise dispose of any or all such bonds, notes, debentures or obligations in such manner and upon such terms as may be deemed judicious, but only to the extent then permitted to the Corporation under the laws of the State of Missouri;

In general, to do any and all of the things hereinbefore set forth, and such other things as are incidental or conducive to the attaining of the objects and purposes of the Corporation; and in carrying on its business and for the purpose of attaining or furthering any of its objects, to enter into, make, perform and carry out contracts of every kind with any person, partnership, association, corporation, government, governmental subdivision or other body whatsoever; and to do such acts and things, and to exercise any and all such powers to the same extent as a natural person might or could lawfully do in so far as the same are authorized by the laws of the State of Missouri, now or hereafter applicable to the Corporation;

To conduct its business in all or any of its branches so far as permitted by law, in the State of Missouri and elsewhere; and, for and in connection with such business, to acquire, hold, possess, purchase, lease, mortgage and convey real and personal property to the extent permitted by law; and

To purchase, hold, sell and transfer shares of its own capital stock to such extent and in such manner as may now or hereafter be permitted by law.

EIGHTH

That the Restated Articles of Incorporation correctly set forth without change the corresponding provisions of the Articles of Incorporation as heretofore amended, and supersede the original Articles of Incorporation and all amendments thereto.

Dated April 7, 1994

FILED AND CERTIFICATE ISSUED
APR 12 1994
Judith K. Moriarty
SECRETARY OF STATE

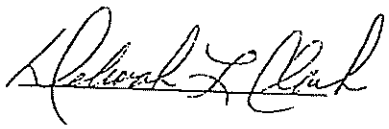
UNION ELECTRIC COMPANY

By William E. Jaudes
Vice President and General Counsel

And James F. Lingman
Secretary

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

On this 7th day of April, 1994, before me appeared William E. Jaudes, to me personally known, who, being by me duly sworn did say that he is Vice President and General Counsel of Union Electric Company, and that the seal affixed to the foregoing instrument is the corporate seal of said Corporation and that said instrument was adopted by the Board of Directors of said Corporation on February 11, 1994, and was signed and sealed on behalf of said Corporation by authority of its Board of Directors, and said William E. Jaudes verified said instrument to be the free act and deed of said corporation.



DEBORAH L. CLARK
NOTARY PUBLIC - STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXPIRES APR. 18, 1994

JCW
CF

Office of Secretary of State
State of Missouri
Jefferson City
65101

Judith K. Moriarty
Secretary of State

May 11, 1994

James C. Thompson
Union Electric
1901 Chouteau Ave., PO Box 149
St. Louis, MO 63166

Re: UNION ELECTRIC COMPANY (00040441)

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from TWELVE (12) to TEN (10). (Pursuant to Chapter 351.055(6) and 351.085.2(4) RSMo.)

Very truly yours,

JUDITH K. MORIARTY
Secretary of State

Corporation Division
Amendment Desk

Ltr.#62

ROY D. BLUNT
SECRETARY OF STATE

STATE OF MISSOURI
OFFICE OF SECRETARY OF STATE
JEFFERSON CITY 65102

314 / 751-4609

STATEMENT OF CHANGE IN NUMBER OF DIRECTORS
Sections 351.055(6), 351.085.1(4) and 351.315.3 RSMo
No filing fee - File one copy

Corporate Charter No. 40441

1. The name of the corporation is UNION ELECTRIC COMPANY

The name under which it was originally organized was MISSOURI ELECTRIC LIGHT AND POWER COMPANY

2. Effective APRIL 26, 1994, the number of persons constituting its board of directors was changed from TWELVE to TEN.

Corporate Officer
JAMES C. THOMPSON
SECRETARY

MAY 10, 1994
Date

Form 61
1/85

NO- 00040441

STATE OF MISSOURI

Rebecca McDowell Cook
Secretary of State

CORPORATION DIVISION
CERTIFICATE OF RETIREMENT

I, REBECCA McDOWELL COOK, SECRETARY OF STATE OF THE STATE OF MISSOURI, DO HEREBY CERTIFY THAT DUPLICATE COPIES OF A RESOLUTION OF

UNION ELECTRIC COMPANY

A MISSOURI CORPORATION RELATING TO RETIREMENT OF PREFERRED STOCK, HAVE BEEN RECEIVED IN THIS OFFICE.

THE SUBSTANCE THEREOF IS:

RETIREMENT OF 260 SHARES OF PREFERRED STOCK, $6.30 SERIES

SAID RESOLUTION IS FOUND TO CONFORM TO LAW. ACCORDINGLY, I, BY THE VIRTUE OF THE AUTHORITY VESTED IN ME BY LAW, HEREBY ISSUE THIS CERTIFICATE OF RETIREMENT.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 29TH DAY OF JUNE, 1995.

Rebecca McDowell Cook
Secretary of State

$25.00

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF PREFERRED STOCK
AND REDUCTION OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company.

2. The corporation, having from time to time redeemed shares of its Preferred Stock, $6.30 Series, retired 260 shares on June 1, 1994.

3. The corporation has applied $100.00 per share, being the stated value of the Preferred Stock, $6.30 Series, or a total of $26,000, out of its stated capital to the retirement of 260 shares of Preferred Stock, $6.30 Series.

4. As a result of Union Electric Company's retirement of 260 shares of Preferred Stock, the number of outstanding shares of preferred stock of the corporation has decreased from 3,435,116 to 3,434,856 and the preferred stock stated capital has been reduced from $219,199,100 to $219,173,100.

5. The assets of the corporation remaining after said retirement of the aggregate of 260 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by DONALD E. BRANDT, Senior Vice President, and attested by G. L.

WATERS, Assistant Secretary, and its corporate seal to be hereto affixed, all on this 28th day of June, 1995.

UNION ELECTRIC COMPANY

By _____
Senior Vice President

ATTEST:

_____
Assistant Secretary

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

DONALD E. BRANDT, first being duly sworn, upon his oath states that he is a Senior Vice President of Union Electric Company, that as such he executed the above certificate on behalf of Union Electric Company, and that the statements contained therein are true to the best of his knowledge, information and belief.

_____
Donald E. Brandt

BARBARA LUNGWITZ NOTARY PUBLIC 1995 NOTARY SEAL STATE OF MISSOURI

Subscribed and sworn to before me this 28th day of June, 1995.

_____
Notary Public

BARBARA LUNGWITZ
NOTARY PUBLIC — STATE OF MISSOURI
MY COMMISSION EXPIRES SEPT. 2, 1997
CITY OF ST. LOUIS

STATE OF MISSOURI

Rebecca McDowell Cook
Secretary of State

CORPORATION DIVISION
CERTIFICATE OF RETIREMENT

I, REBECCA McDOWELL COOK, SECRETARY OF STATE OF THE STATE OF MISSOURI, DO HEREBY CERTIFY THAT DUPLICATE COPIES OF A RESOLUTION OF

UNION ELECTRIC COMPANY

A MISSOURI CORPORATION RELATING TO RETIREMENT OF PREFERRED STOCK, HAVE BEEN RECEIVED IN THIS OFFICE.

THE SUBSTANCE THEREOF IS:

RETIREMENT OF 260 SHARES OF
PREFERRED STOCK, $6.30 SERIES

SAID RESOLUTION IS FOUND TO CONFORM TO LAW. ACCORDINGLY, I, BY THE VIRTUE OF THE AUTHORITY VESTED IN ME BY LAW, HEREBY ISSUE THIS CERTIFICATE OF RETIREMENT.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 7TH DAY OF MAY, 1996.

Rebecca McDowell Cook
Secretary of State

$25.00

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF PREFERRED STOCK
AND REDUCTION OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company.

2. The corporation, having from time to time redeemed shares of its Preferred Stock, $6.30 Series, retired 260 shares on June 1, 1995.

3. The corporation has applied $100.00 per share, being the stated value of the Preferred Stock, $6.30 Series, or a total of $26,000, out of its stated capital to the retirement of 260 shares of Preferred Stock, $6.30 Series.

4. As a result of Union Electric Company's retirement of 260 shares of Preferred Stock, the number of outstanding shares of preferred stock of the corporation has decreased from 3,434,856 to 3,434,596 and the preferred stock stated capital has been reduced from $219,173,100 to $219,147,100.

5. The assets of the corporation remaining after said retirement of the aggregate of 260 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by DONALD E. BRANDT, Senior Vice President, and attested by JAMES C.

THOMPSON, Secretary, and its corporate seal to be hereto affixed, all on this 6th day of May, 1996.

UNION ELECTRIC COMPANY

By _____
Senior Vice President

ATTEST:

_____
Secretary

FILED AND CERTIFICATE
ISSUED
MAY 07 1996
Rebecca McDowell Cook
SECRETARY OF STATE

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

DONALD E. BRANDT, first being duly sworn, upon his oath states that he is a Senior Vice President of Union Electric Company, that as such he executed the above certificate on behalf of Union Electric Company, and that the statements contained therein are true to the best of his knowledge, information and belief.

_____
Donald E. Brandt

Subscribed and sworn to before me this 6th day of May, 1996.

BARBARA LUNGWITZ
Notary Public — Notary Seal
STATE OF MISSOURI
City of St. Louis
My Commission Expires: September 24, 1999

_____
Notary Public

STATE OF MISSOURI

Rebecca McDowell Cook
Secretary of State

CORPORATION DIVISION
CERTIFICATE OF RETIREMENT

I, REBECCA McDOWELL COOK, SECRETARY OF STATE OF THE STATE OF MISSOURI, DO HEREBY CERTIFY THAT DUPLICATE COPIES OF A RESOLUTION OF

UNION ELECTRIC COMPANY

A MISSOURI CORPORATION RELATING TO RETIREMENT OF PREFERRED STOCK, HAVE BEEN RECEIVED IN THIS OFFICE.

THE SUBSTANCE THEREOF IS:

RETIREMENT OF 260 SHARES OF
PREFERRED STOCK, $6.30 SERIES

SAID RESOLUTION IS FOUND TO CONFORM TO LAW. ACCORDINGLY, I, BY THE VIRTUE OF THE AUTHORITY VESTED IN ME BY LAW, HEREBY ISSUE THIS CERTIFICATE OF RETIREMENT.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 7TH DAY OF JUNE, 1996.

Rebecca McDowell Cook
Secretary of State

$25.00

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF PREFERRED STOCK
AND REDUCTION OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company.

2. The corporation, having from time to time redeemed shares of its Preferred Stock, $6.30 Series, retired 260 shares on June 1, 1996.

3. The corporation has applied $100.00 per share, being the stated value of the Preferred Stock, $6.30 Series, or a total of $26,000, out of its stated capital to the retirement of 260 shares of Preferred Stock, $6.30 Series.

4. As a result of Union Electric Company's retirement of 260 shares of Preferred Stock, the number of outstanding shares of preferred stock of the corporation has decreased from 3,434,596 to 3,434,336 and the preferred stock stated capital has been reduced from $219,147,100 to $219,121,100.

5. The assets of the corporation remaining after said retirement of the aggregate of 260 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by DONALD E. BRANDT, Senior Vice President, and attested by JAMES C.

THOMPSON, Secretary, and its corporate seal to be hereto affixed, all on this 6th day of June, 1996.

UNION ELECTRIC COMPANY

By _____
Senior Vice President

ATTEST:

_____
Secretary

FILED AND CERTIFICATE ISSUED

JUN 0 7 1996

Rebecca McDowell Cook
SECRETARY OF STATE

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

DONALD E. BRANDT, first being duly sworn, upon his oath states that he is a Senior Vice President of Union Electric Company, that as such he executed the above certificate on behalf of Union Electric Company, and that the statements contained therein are true to the best of his knowledge, information and belief.

_____
Donald E. Brandt

Subscribed and sworn to before me this 6th day of June, 1996.

_____
Notary Public

DEBORAH L. ANZALONE
NOTARY SEAL
NOTARY PUBLIC
STATE OF MISSOURI

DEBORAH L. ANZALONE
NOTARY PUBLIC—STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXPIRES APR. 18, 1998

No. 00040441

STATE OF MISSOURI

Rebecca McDowell Cook
Secretary of State

CORPORATION DIVISION
CERTIFICATE OF RETIREMENT

I, REBECCA McDOWELL COOK, SECRETARY OF STATE OF THE STATE OF MISSOURI, DO HEREBY CERTIFY THAT DUPLICATE COPIES OF A RESOLUTION OF

UNION ELECTRIC COMPANY

A MISSOURI CORPORATION RELATING TO RETIREMENT OF PREFERRED STOCK, HAVE BEEN RECEIVED IN THIS OFFICE.

THE SUBSTANCE THEREOF IS:

RETIREMENT OF 330,001 SHARES OF PREFERRED STOCK, $7.44 SERIES, 300,000 SHARES OF $6.40 SERIES, 6,240 SHARES OF $6.30 SERIES & 3,000 SHARES OF $5.50 SERIES B.

SAID RESOLUTION IS FOUND TO CONFORM TO LAW. ACCORDINGLY, I, BY THE VIRTUE OF THE AUTHORITY VESTED IN ME BY LAW, HEREBY ISSUE THIS CERTIFICATE OF RETIREMENT.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 15TH DAY OF APRIL, 1997.

Rebecca McDowell Cook
Secretary of State

$25.00

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF
PREFERRED STOCK AND REDUCTION
OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company (hereinafter referred to as "Union Electric").

2. (a) On January 21, 1997, Union Electric redeemed the 330,001 outstanding shares of its Preferred Stock, $7.44 Series.

(b) Union Electric has applied $100.00 per share, being the stated value of the Preferred Stock, $7.44 Series, or a total of $33,000,100, out of its stated capital to the retirement of the 330,001 shares of Preferred Stock, $7.44 Series.

3. (a) On January 21, 1997, Union Electric redeemed the 300,000 outstanding shares of its Preferred Stock, $6.40 Series.

(b) Union Electric has applied $100.00 per share, being the stated value of the Preferred Stock, $6.40 Series, or a total of $30,000,000 out of its stated capital to the retirement of the 300,000 shares of Preferred Stock, $6.40 Series.

4. (a) On January 21, 1997, Union Electric redeemed the 6,240 outstanding shares of its Preferred Stock, $6.30 Series.

(b) Union Electric has applied $100.00 per share, being the stated value of the Preferred Stock, $6.30 Series, or a total of $624,000, out of its stated capital to the retirement of the 6,240 shares of Preferred Stock, $6.30 Series.

5. (a) On January 21, 1997 Union Electric redeemed the 3,000 outstanding shares of its Preferred Stock, $5.50 Series B.

(b) Union Electric has applied $100.00 per share, being the stated value of the Preferred Stock, $5.50 Series B, or a total of $300,000, out of its stated capital to the retirement of the 3,000 shares of Preferred Stock, $5.50 Series B.

6. As a result of the retirement of 639,241 aggregate number of shares of Preferred Stock as described above, the number of outstanding shares of preferred stock of Union Electric has decreased from 3,434,336 to 2,795,095 and the preferred stock stated capital has been reduced from $219,121,100 to $155,197,000.

7. The assets of Union Electric remaining after said retirement of the aggregate of 639,241 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by DONALD E. BRANDT, Senior Vice President, and attested by JAMES C. THOMPSON, Secretary, and its corporate seal to be hereto affixed, all on this 14th day of April, 1997.

UNION ELECTRIC COMPANY

By _____
Senior Vice President

ATTEST:

_____
Secretary

FILED AND CERTIFICATE
ISSUED
APR 15 1997
Rebecca McDowell Cook
SECRETARY OF STATE

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

DONALD E. BRANDT, first being duly sworn, upon his oath states that he is a Senior Vice President of Union Electric Company, that as such he executed the above certificate on behalf of Union Electric Company, and that the statements contained therein are true to the best of his knowledge, information and belief.

Donald E. Brandt

Subscribed and sworn to before me this 14th day of April, 1997.

DEBORAH L. ANZALONE NOTARY SEAL NOTARY PUBLIC STATE OF MISSOURI

Notary Public

DEBORAH L. ANZALONE
NOTARY PUBLIC—STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXPIRES APR. 18, 1998

STATE OF MISSOURI
OFFICE OF SECRETARY OF STATE
JEFFERSON CITY 65102
January 8, 1998

Re: UNION ELECTRIC COMPANY (00040441)

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from ten (10) to eleven (11). (Pursuant to Chapter 351.055(6) and 351.085.2(4) RSMo.)

Very truly yours,

REBECCA M. COOK
Secretary of State

Corporation Division
Amendment Desk

Ltr.#62

ROY D. BLUNT
SECRETARY OF STATE

STATE OF MISSOURI
OFFICE OF SECRETARY OF STATE
JEFFERSON CITY 65102

314 / 751-4609

STATEMENT OF CHANGE IN NUMBER OF DIRECTORS
Sections 351.055(6), 351.085.1(4) and 351.315.3 RSMo
No filing fee - File one copy

Corporate Charter No. 40441

1. The name of the corporation is UNION ELECTRIC COMPANY

The name under which it was originally organized was MISSOURI ELECTRIC LIGHT AND POWER COMPANY

2. Effective December 31, 1997, the number of persons constituting its board of directors was changed from TEN (10) to ELEVEN (11).

Corporate Officer
James C. Thompson
Secretary

January 6, 1998
Date

Form 61
1/95

#00040441

STATE OF MISSOURI

Rebecca McDowell Cook
Secretary of State
CORPORATION DIVISION

CERTIFICATE OF MERGER
MISSOURI CORPORATION SURVIVING

WHEREAS, Articles of Merger of the following corporations:
ARCH MERGER INC. (#00414846)
INTO:
UNION ELECTRIC COMPANY (#00040441)
Organized and Existing Under Law of Missouri
have been received, found to conform to law, and filed.

NOW, THEREFORE, I, REBECCA MCDOWELL COOK, Secretary of State of Missouri, issue this Certificate of Merger, certifying that the merger of the aforenamed corporations is effected with

UNION ELECTRIC COMPANY (#00040441)

as the surviving corporation.

IN TESTIMONY WHEREOF, I HAVE SET MY HAND AND IMPRINTED THE GREAT SEAL OF THE STATE OF MISSOURI, ON THIS, THE 31st Day of December, 1997.

Rebecca McDowell Cook
Secretary of State

$30.00

STATE OF MISSOURI . . . OFFICE OF SECRETARY OF STATE
REBECCA COOK, Secretary Of State

ARTICLES OF MERGER
MERGING
ARCH MERGER INC.
WITH AND INTO
UNION ELECTRIC COMPANY

FILED AND CERTIFICATE ISSUED
DEC 31 1997
Rebecca McDowell Cook
SECRETARY OF STATE

HONORABLE REBECCA COOK
SECRETARY OF STATE
STATE OF MISSOURI
P.O. BOX 778
JEFFERSON CITY, MO. 65102

Pursuant to the provisions of the General and Business Corporation Law of Missouri, the undersigned corporations certify the following:

1. That Arch Merger Inc. of Missouri

2. That Union Electric Company of Missouri

are hereby merged and that the above named Union Electric Company is the surviving corporation.

3. That the Board of Directors of Arch Merger Inc. met on August 11, 1995 and by resolution adopted by a majority vote of the members of such board approved the Agreement and Plan of Merger attached hereto as Exhibit 1.

4. That the Board of Directors of Union Electric Company met on August 11, 1995 and by resolution adopted by a majority vote of the members of such board approved the Agreement and Plan of Merger attached hereto as Exhibit 1.

5. The Agreement and Plan of Merger was approved by unanimous written consent of the two shareholders of Arch Merger Inc. dated August 16, 1995.

6. The Plan of Merger thereafter was submitted to a vote at the special meeting of the shareholders of Union Electric Company held on December 20, 1995. At such meeting there were 102,123,834 shares of common stock and 3,434,596 shares of preferred stock outstanding and entitled to vote and 75,091,584 voted in favor and 1,972,890 voted against said plan, with 28,493,956 shares abstaining or not voting.

7. **PLAN OF MERGER**

a. Union Electric Company of Missouri is the survivor.

b. All of the property, rights, privileges, leases, and patents of Arch Merger Inc. are to be transferred to and become the property of Union Electric Company, the survivor. The officers and board of directors of the above named corporations are authorized to execute all deeds, assignments, and documents of every nature which may be needed to effectuate a full and complete transfer of ownership.

c. The officers and board of directors of Union Electric Company shall continue in office until their successors are duly elected and qualified under the provisions of the by-laws of the surviving corporation.

d. The outstanding shares of Arch Merger Inc. shall be exchanged for shares of Union Electric Company on the following basis: Each share of common stock of Arch Merger Inc. shall be converted into one share of common stock of Union Electric Company.

e. The articles of incorporation of Union Electric Company shall be the articles of incorporation of the surviving corporation, until thereafter amended as provided by law and in such articles of incorporation.

IN WITNESS WHEREOF, these Articles of Merger have been executed in duplicate by the aforementioned corporations as of the day and year hereafter acknowledged.

(NO SEAL)

ARCH MERGER INC.

Donald E. Brandt
President

ATTEST:

William E. Jaudes
Secretary

CORPORATE SEAL

UNION ELECTRIC COMPANY

C. W. Mueller
President & Chief Executive Officer

ATTEST:

James C. Thompson
Secretary

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

I, Deborah L. Anzalone, a Notary Public, do hereby certify that on the 31st day of December, 1997, personally appeared before me DONALD E. BRANDT, who being by me first duly sworn, declared that he is the President of Arch Merger Inc., that he signed the foregoing document as President of the corporation, and that the statements therein contained are true.

Deborah L. Anzalone
Notary Public

My Commission Expires:
DEBORAH L. ANZALONE
NOTARY PUBLIC—STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXPIRES APR. 18, 1998

DEBORAH L. ANZALONE NOTARY SEAL NOTARY PUBLIC STATE OF MISSOURI

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

I, Deborah L. Anzalone, a Notary Public, do hereby certify that on the 31st day of December, 19 97, personally appeared before me C. W. MUELLER, who being by me first duly sworn, declared that he is President and Chief Executive Officer of Union Electric Company, that he signed the foregoing document as President and Chief Executive Officer of the corporation, and that the statements therein contained are true.

Deborah L. Anzalone
Notary Public

My Commission Expires:
DEBORAH L. ANZALONE
NOTARY PUBLIC—STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXPIRES APR. 18, 1998

DEBORAH L. ANZALONE NOTARY SEAL NOTARY PUBLIC STATE OF MISSOURI

STATE OF MISSOURI
OFFICE OF SECRETARY OF STATE
JEFFERSON CITY 65102
May 4, 1998

Re: UNION ELECTRIC COMPANY (00040441)

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from eleven (11) to five (5). (Pursuant to Chapter 351.055(6) and 351.085.2(4) RSMo.)

Very truly yours,

REBECCA M. COOK
Secretary of State

Corporation Division
Amendment Desk

Ltr.#62

STATE OF MISSOURI

ROY D. BLUNT
SECRETARY OF STATE

OFFICE OF SECRETARY OF STATE
JEFFERSON CITY 65102

314 / 751-4609

STATEMENT OF CHANGE IN NUMBER OF DIRECTORS
Sections 351.055(6), 351.085.1(4) and 351.315.3 RSMo
No filing fee - File one copy

Corporate Charter No. 40441

1. The name of the corporation is UNION ELECTRIC COMPANY

The name under which it was originally organized was MISSOURI ELECTRIC LIGHT AND POWER COMPANY

2. Effective April 28, 1998, the number of persons constituting its board of directors was changed from ELEVEN to FIVE.

Corporate Officer
James C. Thompson
Secretary

April 30, 1998
Date

Form 61
7/95

CF

State of Missouri

Rebecca McDowell Cook, Secretary of State
P.O. Box 778, Jefferson City, Mo 65102

Corporation Division

RECEIVED
JUL 0 6 1998

Statement of Change of Registered Agent or Registered Office

Rebecca McDowell Cook
SECRETARY OF STATE

INSTRUCTIONS

1. The filing fee for this change is $10.00. Change must be filed in DUPLICATE.
2. P.O. Box may only be used in conjunction with Street, Route or Highway.
3. Agent and address must be in the State of Missouri.
4. If a corporation, officers (president or vice president and secretary or assistant secretary) must sign, and president's or vice president's signature must be notarized.
5. If limited partnership, general partner must sign and have their signature notarized.

Charter No. 40441

The undersigned corporation or limited partnership, organized and existing under the laws of the State of Missouri for the purpose of changing its registered agent "The General and Business Corporation Act of Missouri," or the "Missouri Uniform Limited Partnership Law," represents that:

(1) The name of the corporation/ltd. partnership is:

Union Electric Company

(2) The name of its registered agent before this change is:

William E. Jaudes

(3) The name of the new registered agent is: James J. Cook

(4) The address, including street number, if any, of its registered office before this change is:

1901 Chouteau Avenue, St. Louis, Missouri 63103

5) Its registered office (including street number, if any change is to be made) is hereby CHANGED TO:

No Change

5) The address of its registered office and the address of the business office of its registered agent, as changed will be identical.

') Such change was authorized by resolution duly adopted by the board of directors of the corporation or by the limited partnership.

rp. =58 (12-94)

IN WITNESS WHEREOF, the undersigned corporation or limited partnership has caused this report to be executed in its name by its President or Vice President of the corporation, or General Partner of the limited partnership, and attested to by the assistant secretary if a corporation on the 1st day of July, 19 98.

Union Electric Company
Name of corporation or limited partnership

(CORPORATE SEAL)
If no seal, state "none"

By Steve Sullivan
President or Vice President of corporation
or
General Partner of limited partnership

Attest:
Secretary or Assistant Secretary of corporation

FILED
JUL 06 1998
SECRETARY OF STATE

State of Missouri
City
County of St. Louis } ss.

I, Barbara Lungwitz, a Notary Public, do hereby certify that on the 1st day of July, 19 98, personally appeared before me Steve Sullivan who declares he/she is the President or Vice President of the corporation, or a General Partner of the limited partnership, executing the foregoing document, and being first duly sworn, acknowledged that he/she signed the foregoing document in the capacity therein set forth and declared that the statements therein contained are true.

IN WITNESS WHEREOF, I have hereunto set my hand and seal the day and year before written.

Barbara Lungwitz
Notary Public

(Notarial Seal)

My commission expires 9/2/99

My County of Commission

BARBARA LUNGWITZ
Notary Public — Notary Seal
STATE OF MISSOURI
City of St. Louis
My Commission Expires: September 2, 1999

No. 00040441

STATE OF MISSOURI

Matt Blunt
Secretary of State

CORPORATION DIVISION

CERTIFICATE OF CORPORATE RECORDS

UNION ELECTRIC COMPANY

I, MATT BLUNT, Secretary of State of the State of Missouri and Keeper of the Great Seal thereof, do hereby certify that the annexed pages contain a full, true and complete copy of those certain original documents on file and of record in this office for which certification has been requested.

IN TESTIMONY WHEREOF, I have set my hand and imprinted the GREAT SEAL of the State of Missouri, on this, the 5th day of DECEMBER, 2002.

Matt Blunt
Secretary of State

No. 00040441

STATE OF MISSOURI

Matt Blunt
Secretary of State

CORPORATION DIVISION
CERTIFICATE OF RETIREMENT

I, REBECCA McDOWELL COOK, Secretary of State of the State of Missouri, do hereby certify that duplicate copies of a resolution of

UNION ELECTRIC COMPANY

a Missouri corporation relating to RETIREMENT OF PREFERRED STOCK, have been received in this office.

The substance thereof is:

RETIRING 1,657,500 SHARES OF ITS PREFERRED STOCK, $1.735 SERIES

Said resolution is found to conform to law. ACCORDINGLY, I, by the virtue of the authority vested in me by law, hereby issue this Certificate of RETIREMENT.

IN TESTIMONY WHEREOF, I have set my hand and imprinted the GREAT SEAL of the State of Missouri, on this, the 2nd day of DECEMBER, 2002.

Matt Blunt

$25.00 Secretary of State

#30 (1-01)

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF
PREFERRED STOCK AND REDUCTION
OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company.

2.(a) On September 23, 2002, Union Electric Company redeemed the 1,657,500 outstanding shares of its Preferred Stock, $1.735 Series.

(b) Union Electric Company has applied $25.00 per share, being the stated value of the Preferred Stock, $1.735 Series, or a total of $41,437,500, out of its stated capital to the retirement of the 1,657,500 shares of Preferred Stock, $1.735 Series.

3. As a result of the retirement of 1,657,500 shares of Preferred Stock as described above, the number of outstanding shares of preferred stock of Union Electric Company has decreased from 2,795,095 to 1,137,595 and the preferred stock stated capital has been reduced from $155,197,000 to $113,759,500.

4. The assets of Union Electric Company remaining after said retirement of the 1,657,500 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by Jerre E. Birdsong, Vice President and Treasurer, and attested by Steven R. Sullivan, Secretary, and its corporate seal to be hereto affixed, all on this 25th day of November, 2002.

UNION ELECTRIC COMPANY

By _____
Vice President and Treasurer

ATTEST:

_____
Secretary

FILED

DEC 02 2002

_____
SECRETARY OF STATE

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

JERRE E. BIRDSONG, first being duly sworn, upon his oath states that he is the Vice President and Treasurer of Union Electric Company, that as such he executed the above certificate on behalf of Union Electric Company, and that the statements contained therein are true to the best of his knowledge, information and belief.

Jerre E. Birdsong

Subscribed and sworn to before me this 25 day of November, 2002.

Notary Public

CAROL A. HEAD
Notary Public - Notary Seal
STATE OF MISSOURI
St. Charles County
My Commission Expires: Sept. 23, 2006

RECEIVED

FEB 2 1 2003

SECRETARY OF STATE

State of Missouri

Matt Blunt, Secretary of State

Corporations Division
P.O. Box 778, Jefferson City, MO 65102

James C. Kirkpatrick State Information Center
600 W. Main Street, Rm 322, Jefferson City, MO 65101

Statement of Change of Registered Agent and/or Registered Office By a Foreign or Domestic For Profit or Nonprofit Corporation

Instructions

1. This form is to be used by either a for profit or nonprofit corporation to change either or both the name of its registered agent and/or the address of its existing registered agent.
2. There is a $10.00 fee for filing this statement. It must be filed in DUPLICATE.
3. P.O. Box may only be used in conjunction with a physical street address.
4. Agent and address must be in the State of Missouri.
5. The corporation may not act as its own agent.

Charter No. 00040441

(1) The name of the corporation is: Union Electric Company

(2) The address, including street and number, of its **present** registered office (before change) is:
1901 Chouteau Avenue, St. Louis, MO 63103
Address City/State/Zip

(3) The address, including street and number, of its registered office is hereby **changed to**:
One Ameren Plaza, 1901 Chouteau Avenue, St. Louis, MO 63103
Address (P.O. Box may only be used in conjunction with a physical street address) City/State/Zip

(4) The name of its **present** registered agent (before change) is: James J. Cook

(5) The name of the **new** registered agent is: Ronald K. Evans

Authorized signature of **new** registered agent must appear below:

(May attach separate originally executed written consent to this form in lieu of this signature)

(6) The address of its registered office and the address of the office of its registered agent, as changed, will be identical.

(7) The change was authorized by resolution duly adopted by the board of directors.

In affirmation of the facts stated above,

(Authorized signature of officer or, if applicable, chairman of the board) — Steven R. Sullivan *(Printed Name)*

Secretary *(Title)* — 2-14-03 *(month/day/year)*

Corp. #59 (11/00)

Office of the Secretary of State
State of Missouri
Jefferson City
65101

MATT BLUNT
SECRETARY OF STATE

CORPORATIONS DIVISION
(866) 223-6535 TOLL FREE

May 28, 2004

Ameren Services
One Ameren Plaza 1901 Chouteau Avenue
St. Louis, MO 63166-6149

RE: UNION ELECTRIC COMPANY
00040441

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from five (5) to eleven (11).

(Pursuant to Chapter 351.055 (6) and 351.085.2 (4) RSMo.)

Denise Gerlt
P. O. Box 778
Jefferson City, MO 65102
(866) 223-6535
www.sos.mo.gov

File Number: 200415421101
00040441
Date Filed: 05/28/2004
Matt Blunt
Secretary of State

Corporations Division
P.O. Box 778 / 600 W. Main Street, Rm 322
Jefferson City, MO 65102

Statement of Change in Number of Directors

Sections 351.055(6), 351.085.1(4) and 351.315.3 RSMo

No filing fee – File one copy

Corporate Charter No. 00040441

1. The name of the Corporation is Union Electric Company

2. Effective April 22, 2003 (month/day/year), the number of persons constituting its board of directors was changed from five (5) to eleven (11).

Signature

Ronald K. Evans, Assistant Secretary
Printed Name — Title — Date

Form 61B
12/02

State of Missouri
Statement of Correction 1 Page(s)
T0415307024

Office of the Secretary of State
State of Missouri

MATT BLUNT
SECRETARY OF STATE

Jefferson City
65101

CORPORATIONS DIVISION
(866) 223-6535 TOLL FREE

May 28, 2004

UNION ELECTRIC COMPANY
One Ameren Plaza 1901 Chouteau Ave
St. Louis, MO 63103

RE: UNION ELECTRIC COMPANY
00040441

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from eleven (11) to six (6).

(Pursuant to Chapter 351.055 (6) and 351.085.2 (4) RSMo.)

Denise Gerlt
P. O. Box 778
Jefferson City, MO 65102
(866) 223-6535
www.sos.mo.gov

File Number: 200415421104
00040441
Date Filed: 05/28/2004
Matt Blunt
Secretary of State

Corporations Division
P.O. Box 778 / 600 W. Main Street, Rm 322
Jefferson City, MO 65102

Statement of Change in Number of Directors

Sections 351.055(6), 351.085.1(4) and 351.315.3 RSMo

No filing fee – File one copy

Corporate Charter No. 00040441

1. The name of the Corporation is Union Electric Company

2. Effective April 27, 2004 (month/day/year), the number of persons constituting its board of directors was changed from eleven (11) to six (6).

Signature | Ronald K. Evans, Assistant Secretary (Printed Name / Title) | Date

State of Missouri
Amend/Restate - Other 1 Page(s)
T0415415589

Form 61B
12/02

File Number: 200524153806
00040441
Date Filed: 08/29/2005
Robin Carnahan
Secretary of State

State of Missouri

Robin Carnahan, Secretary of State

Corporations Division
P.O. Box 778 / 600 W. Main Street, Rm 322
Jefferson City, MO 65102

Statement of Change of Registered Agent and/or Registered Office
By a Foreign or Domestic For Profit or Nonprofit Corporation or a Limited Liability Company

Instructions

1. This form is to be used by either a for profit or nonprofit corporation or a limited liability company to change either or both the name of its registered agent and/or the address of its existing registered agent.
2. There is a $10.00 fee for filing this statement.
3. P.O. Box may only be used in conjunction with a physical street address.
4. Agent and address must be in the State of Missouri.
5. The corporation may not act as its own agent.

Charter No. 00040441

(1) The name of the business entity is: Union Electric Company

(2) The address, including street and number, of its present registered office (before change) is:

One Ameren Plaza, 1901 Chouteau Avenue — St. Louis, MO 63103
Address — *City/State/Zip*

(3) The address, including street and number, of its registered office is hereby changed to:

500 East Independence Drive — Union, MO 63084
Address — *(P.O. Box may only be used in conjunction with a physical street address)* — *City/State/Zip*

(4) The name of its **present** registered agent (before change) is: Ronald K. Evans

(5) The name of the **new** registered agent is: Kenneth L. Schmidt

Authorized signature of **new** registered agent **must** appear below:

Kenneth L. Schmidt
(May attach separate originally executed written consent to this form in lieu of this signature)

(6) The address of its registered office and the address of the office of its registered agent, as changed, will be identical.

(7) The change was duly authorized by the business entity named above.

In Affirmation thereof, the facts stated above are true and correct:
(The undersigned understands that false statements made in this filing are subject to the penalties provided under Section 575.040, RSMo)

Ronald K. Evans
Authorized signature of officer or, if applicable, chairman of the board — *Printed Name*

Assistant Secretary — 8-29-2005
Title — *month/day/year*

Name and address to return filed document:

Name: _____
Address: _____
City, State, and Zip Code: _____

State of Missouri
Change/Resignation of Agent 1 Page(s)

T0524155831

50869

CHESTER J. CULVER
Secretary of State
State of Iowa

STATEMENT OF CHANGE OF REGISTERED OFFICE AND/OR REGISTERED AGENT

Pursuant to Iowa law, the undersigned submits this Statement to change the business entity's registered office and/or registered agent in Iowa. **Read the INSTRUCTIONS on the back of this form before completing the information and signing below.**

1. The **NAME** of the business entity is: Union Electric Company

2. The street address of the **CURRENT** registered **OFFICE** as indicated on the Secretary of State's records is:

523 No. Water Street (street) Keokuk (city) IA (state) 52832-5960 (zip)

3. The street address of the **NEW** registered **OFFICE** is:

523 No. Water Street (street) Keokuk (city) IA (state) 52832-5960 (zip)

4. The name of the **CURRENT** registered **AGENT** as indicated on the Secretary of State's records is:

K. P. Blank

(If more than one AGENT is registered, indicate which one is being replaced.)

5. The name of the **NEW** registered **AGENT** is: Larry A. Weiman

6. If the **REGISTERED AGENT** has changed, the **NEW** Registered Agent must sign here, consenting to their appointment, or attach their written consent to this form.

L. A. Weiman
Signature of NEW Registered Agent

Complete **ONLY** if the Registered Agent changes.

7. If the **REGISTERED AGENT** changes the street address of their business office on this form here indicating that NOTICE of the change has been given to the business entity.

Signature of Registered Agent

Complete **ONLY** if the Registered Agent changes the street address of their business office.

FILED
IOWA
SECRETARY OF STATE
3-23-2006
11:14 PM
W457510

8. After any/all change(s) are made, the street address of the registered office and the street a the registered agent will be identical.

9. Signature by authorized* representative: [signature] Date: 3-23-2006
*See instruction #9 on back

PRINT Name and Title: Ronald K. Evans, Assistant Secretary (314) 554-2156
Name and Title Telephone Number

TOTAL P.02

CORP. FILE

Office of the Secretary of State
State of Missouri

ROBIN CARNAHAN
SECRETARY OF STATE

Jefferson City
65101

CORPORATIONS DIVISION
(866) 223-6535 TOLL FREE

March 14, 2011

Ameren Energy
1901 Chouteau Ave., PO Box 66149
St. Louis, MO 63166

RE: UNION ELECTRIC COMPANY
00040441

Dear Corporation:

This is to advise that on the above date we have filed for record in this office a Statement of Change in the number of directors from six (6) to five (5).

(Pursuant to Chapter 351.055 (6) and 351.085.2 (4) RSMo.)

Secretary of State
Business Services Division
P. O. Box 778
Jefferson City, MO 65102
(866) 223-6535
www.sos.mo.gov

RECEIVED
MAR 23 2011
LEGAL DEPT.

CORP. FILE

May 12, 2011

Missouri Secretary of State
Business Services Division
P.O. Box 778
Jefferson, Missouri 65101

Re: UNION ELECTRIC COMPANY
Charter No.: 40441

Dear Sir or Madam:

This is to inform you that effective April 21, 2011, the number of persons constituting its board of directors for Union Electric Company, Charter No.: 40441, was changed from five (5) to seven (7). I understand Form 61B no longer exists and a form filing is no longer required for this change; that it is strictly optional information. By way of this letter, we are simply notifying you of this change.

If you have any questions, please contact me at (314) 554-2021 or cflinn@ameren.com.

Yours very truly,

Carla J. Flinn

Carla J. Flinn
Corporate Paralegal
Legal Department

Ameren

File Number:
00040441
Date Filed: 03/14/2011
Robin Carnahan
Secretary of State

March 9, 2011

Missouri Secretary of State
Business Services Division
P.O. Box 778
Jefferson, Missouri 65101

Re: UNION ELECTRIC COMPANY
Charter No.: 40441

Dear Sir or Madam:

This is to inform you that effective March 2, 2011, the number of persons constituting its board of directors for Union Electric Company, Charter No.: 40441, was changed from six (6) to five (5). I understand Form 61B no longer exists and a form filing is no longer required for this change; that it is strictly optional information. By way of this letter, we are simply notifying you of this change.

If you have any questions, please contact me at (314) 554-2021 or cflinn@ameren.com.

Yours very truly,

Carla J. Flinn
Corporate Paralegal
Legal Department

State of Missouri
Amend/Restate - Gen Bus 1 Page(s)

T1107511620

Ameren

File Number:
00040441
Date Filed: 05/16/2011
Robin Carnahan
Secretary of State

May 12, 2011

Missouri Secretary of State
Business Services Division
P.O. Box 778
Jefferson, Missouri 65101

Re: UNION ELECTRIC COMPANY
Charter No.: 40441

Dear Sir or Madam:

This is to inform you that effective April 21, 2011, the number of persons constituting its board of directors for Union Electric Company, Charter No.: 40441, was changed from five (5) to seven (7). I understand Form 61B no longer exists and a form filing is no longer required for this change; that it is strictly optional information. By way of this letter, we are simply notifying you of this change.

If you have any questions, please contact me at (314) 554-2021 or cflinn@ameren.com.

Yours very truly,

Carla J. Flinn

Carla J. Flinn
Corporate Paralegal
Legal Department

State of Missouri
Amend/Restate - Other 1 Page(s)

T1113616537

00040441

CERTIFICATE OF CORPORATE RECORDS

UNION ELECTRIC COMPANY

I, ROBIN CARNAHAN, Secretary of the State of the State of Missouri and Keeper of the Great Seal thereof, do hereby certify that the annexed pages contain a full, true and complete copy of the original documents on file and of record in this office for which certification has been requested.

IN TESTIMONY WHEREOF, I have set my hand and imprinted the GREAT SEAL of the State of Missouri, on this, the 6th day of June, 2011

Robin Carnahan

Secretary of State

Certification Number: 13886459-1 Reference: 6886-1
Verify this certificate online at https://www.sos.mo.gov/businessentity/soskb/verify.asp

File Number:
00040441
Date Filed: 06/03/2011
Robin Carnahan
Secretary of State

UNION ELECTRIC COMPANY
CERTIFICATE OF RETIREMENT OF
PREFERRED STOCK AND REDUCTION
OF STATED CAPITAL

Union Electric Company, a corporation organized and existing under the laws of the State of Missouri, does hereby certify as follows:

1. The name of this corporation is Union Electric Company.

2. (a) On August 10, 2010, Union Electric Company redeemed the 330,000 outstanding shares of its Preferred Stock, $7.64 Series.

(b) Union Electric Company has applied $100.85 per share, being the stated value of the Preferred Stock, $7.64 Series, or a total of $33,280,500, out of its stated capital to the retirement of the 330,000 shares of Preferred Stock, $7.64 Series.

3. As a result of the retirement of 330,000 shares of Preferred Stock as described above, the number of outstanding shares of preferred stock of Union Electric Company has decreased from 1,137,595 to 807,595 and the preferred stock stated capital has been reduced from $113,759,500.00 to $80,759,500.00.

4. The assets of Union Electric Company remaining after said retirement of the 330,000 shares of Preferred Stock were and now are sufficient to pay any debts of this corporation, the payment of which has not been otherwise provided for.

[remainder of page left intentionally blank – signature page follows]

State of Missouri
Amend/Restate - Gen Bus 2 Page(s)
T1115417515

IN WITNESS WHEREOF, Union Electric Company has caused this certificate to be executed, acknowledged and sworn to by Gregory L. Nelson, Senior Vice President, General Counsel and Secretary, and attested by Craig W. Stensland, Assistant Secretary, and its corporate seal to be hereto affixed, all on this 3rd day of June, 2011.

UNION ELECTRIC COMPANY

By _____
Gregory L. Nelson, SVP, GC & Secy.

ATTEST:

_____
Craig W. Stensland, Asst. Secy.

STATE OF MISSOURI)
) SS
CITY OF ST. LOUIS)

On this 3rd day of June in the year 2011, before me, Carla J. Flinn, a Notary Public in and for said State, personally appeared Gregory L. Nelson, the Senior Vice President, General Counsel and Secretary of Union Electric Company, a Missouri corporation, known to me to be the person who executed the within document, and did state that the seal affixed to the within instrument is the corporate seal of said corporation and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Directors, and acknowledged to me that he executed the same for the purposes therein stated.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the City and State aforesaid, the day and year first above written.

_____
Notary Public

My Commission Expires: 4/20/2014

Carla J. Flinn - Notary Public
Notary Seal, State of
Missouri - St. Louis City
Commission #10399906
My Commission Expires 4/20/2014

STATE OF MISSOURI

Robin Carnahan
Secretary of State

CERTIFICATE OF RETIREMENT

I, ROBIN CARNAHAN, Secretary of State of the State of Missouri, do hereby certify a resolution of

UNION ELECTRIC COMPANY
00040441

a Missouri corporation relating to RETIREMENT OF PREFERRED STOCK, have been received in this office

The substance thereof is:

RETIRING 330,000 SHARES OF ITS PREFERRED STOCK, $7.64 SERIES

Said resolution is found to conform to law. Accordingly, I, by the virtue of the authority vested in me by law, hereby issue this Certificate of RETIREMENT.

IN TESTIMONY WHEREOF, I hereunto set my hand and cause to be affixed the GREAT SEAL of the State of Missouri. Done at the City of Jefferson, this 3rd day of June, 2011.

Robin Carnahan
Secretary of State

SOS #30 (01-2005)

Appendix C

Good Standing Certificate

STATE OF MISSOURI

Jason Kander
Secretary of State

CORPORATION DIVISION

CERTIFICATE OF GOOD STANDING

I, JASON KANDER, Secretary of the State of Missouri, do hereby certify that the records in my office and in my care and custody reveal that

UNION ELECTRIC COMPANY
00040441

was created under the laws of this State on the 21st day of November, 1922, and is in good standing, having fully complied with all requirements of this office.

IN TESTIMONY WHEREOF, I have set my hand and imprinted the GREAT SEAL of the State of Missouri, on this, the 22nd day of January, 2013

Secretary of State

Certification Number: 15145783-1 Reference:
Verify this certificate online at https://www.sos.mo.gov/businessentity/soskb/verify.asp

Appendix D

Violation History Disclosure Form
Revised August 2013

Ameren

Ameren Services

Violation History Disclosure Statement dated March 25, 2013 replaces previously submitted statement dated June 15, 2013, as required.

March 25, 2013

Ms. Brenda Ardrey, Chief, Operations Section
Missouri Department of Natural Resources
Attn: Violation Disclosure History Statement/Annual Update
P.O. Box 176
Jefferson City, MO 65102-0176

RE: Violation Disclosure History Statement Amendment

Dear Ms. Ardrey:

On behalf of Ameren Missouri, I am submitting documents to satisfy the requirements of 10 CSR 80-2.020, and 2.070, Violation History. Attached is a signed Violation History Disclosure Statement, an Officer/Management Summary Sheet, a figure showing Ameren's corporate structure, a CD containing an electronic copy (PDF file) of Ameren Missouri's most recently filed 10-K, and a Violation History Summary Sheet.

The following is a list of all facilities as defined in 10 CSR 80-2.070(5)(A), owned and operated by the applicant as required under 10 CSR 80-2.070(7)(B).

Facility Name	Permit or Identification Number	Type of Permit or equivalent document and dates held	Name under which the permit or equivalent document was issued	Address or location of the facility	Issuing Agency
Callaway Plant	Federal: MOD000687392 Missouri: 003518	Hazardous Waste Storage Facility Part A Interim Authorization, May 12, 1993 to present	Union Electric Company (now d.b.a. as Ameren Missouri)	Highway CC, PO Box620, Fulton, MO 65251	MDNR
Labadie Plant	Federal: MOD000687392 Missouri: 003518	Proposed Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	226 Labadie Power Plant Rd, Labadie, MO 63055	MDNR
Sioux Plant	Federal: MOD086817954 Missouri: 001378	Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	8501 N. State Route 94, West Alton, MO 63386	MDNR

If you have any questions or require additional information, I can be reached at (314) 554-2388.

Sincerely,

Paul R. Pike
Environmental Science Executive

Enclosures

cc: Glen Mieir
Missouri Dept. of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Darrell Hartley
Missouri Dept. of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
(5 copies of letter and forms)

Ryan Tilley, Director
St. Charles County Div. of Environmental Health & Protection
1650 Boone's Lick Rd.
St. Charles, MO 63301
(w/o enclosure)

Ameren

Ameren Services

June 15, 2012

Ms. Brenda Ardrey, Chief, Operations Section
Missouri Department of Natural Resources
Attn: Violation Disclosure History Statement/Annual Update
P.O. Box 176
Jefferson City, MO 65102-0176

RE: Violation Disclosure History Statement Amendment

Dear Ms Ardrey:

On behalf of Ameren Missouri, I am amending the documents submitted on March 27, 2012 to satisfy the requirements of 10 CSR 80-2.020, and 2.070, Violation History. We are including the plant manager for the Labadie Energy Center to our Officer/Management Summary Sheet. Attached are a newly signed Violation History Disclosure Statement, and a Violation History Summary Sheet. The previously submitted figure showing Ameren Missouri's corporate structure, and most recently filed 10-K are still applicable and have not been included.

The following is a list of all facilities as defined in 10 CSR 80-2.070(5)(A), owned and operated by the applicant as required under 10 CSR 80-2.070(7)(B).

Facility Name	Permit or Identification Number	Type of Permit or equivalent document and dates held	Name under which the permit or equivalent document was issued	Address or location of the facility	Issuing Agency
Callaway Plant	Federal: MOD000687392 Missouri: 003518	Hazardous Waste Storage Facility Part A Interim Authorization, May 12, 1993 to present	Union Electric Company (now d.b.a. as Ameren Missouri)	Highway CC, PO Box620, Fulton, MO 65251	MDNR
Labadie Plant	Federal: MOD000687392 Missouri: 003518	Proposed Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	226 Labadie Power Plant Rd, Labadie, MO 63055	MDNR
Sioux Plant	Federal: MOD086817954 Missouri: 001378	Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	8501 N. State Route 94, West Alton, MO 63386	MDNR

If you have any questions or require additional information, I can be reached at (314) 554-2388.

Sincerely,

Paul R. Pike
Environmental Science Executive

Enclosures

cc: Glen Meir, MDNR

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

VIOLATION HISTORY DISCLOSURE STATEMENT

This worksheet is to be used to satisfy the requirements of 10 CSR 80-2.070 and 2.020 to submit a disclosure statement as part of an application for a construction permit, a change of ownership and annual updates. The completed worksheet must be submitted with the applicable attachments.

1. Does there exist any corporation or business which owns an interest in the applicant, permittee or any business which is owned either wholly or in part by any person, corporation or business which owns an interest in the applicant or permittee?
   Check one: ☑ YES ☐ NO If no, skip 1b and 1c.

   a. The names, social security number and date of birth of each officer or management employee (as defined by 10 CSR 80-2.070(5)(C)) of the applicant or the corporations or businesses as described in 1 of this worksheet must be submitted. Provide this information on the attached Officer/Management Employee Summary Sheet.
   b. Attach the structure of the applicant or permittee firm in relation to the corporations or businesses as described in 1 of this worksheet.
   c. Does there exist a parent firm of the applicant or permittee? Check one: . . . . . ☑ YES ☐ NO
      If yes, attach a copy of the most recent annual Securities and Exchange Report Form 10-K for the parent firm. If no annual Securities and Exchange Report Form 10-K is required, please explain.

2. Do there exist any facilities (as defined by 10 CSR 80-2.070(5)(A)) which had or have held any environmental permit within the last five (5) years in Missouri or in the United States? Check one: . . . . . ☑ YES ☐ NO

   If yes, attach a list of all such facilities and for each identify the following:

   a. Permits or identification numbers;
   b. Type of permit, license, certification or equivalent document and dates held;
   c. Name under which the permits or equivalent documents were issued;
   d. Address or location of the facility; and
   e. Issuing agency.

3. Have there been any environmental violations (as defined by 10 CSR 80-2.070(5)(D)) cited within the last five (5) years incurred by the applicant (permittee) or persons as defined by 10 CSR 80-2.070(5)(B).
   Check one: . . . . . ☐ YES ☑ NO

   If yes, attach a list of all such violations and include the following information:

   a. Dates of violations;
   b. A brief description of the violation;
   c. Citations to each specific statute of other regulation that was violated;
   d. Name and location of the facility cited;
   e. Name and address of issuing agency; and
   f. Identification of those violations having an appeal pending.

4. Have there been any restraint of trade convictions (as defined by 10 CSR 80-2.070(5)(E)) within the last five (5) years of the applicant, permittee or persons as defined by 10 CSR 80-2.070(5)(B)? Check one: . . . ☐ YES ☑ NO

   If yes, attach a list of all such convictions and include the following information:

   a. Dates of convictions;
   b. A brief description of the conviction;
   c. Citations to each specific statute of other regulation that was violated;
   d. Identification of the court and case number; and
   e. Identification of convictions having an appeal pending.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

VIOLATION HISTORY DISCLOSURE STATEMENT

5. Is this pertaining to an application or permit for a commercial solid waste processing facility or solid waste disposal area? Check one: . . . . . ☑ YES ☐ NO
If no, skip to 6.

   a. Has the applicant, permittee, or persons as defined by 10 CSR 80-2.070(5)(B) had any environmental permit denied by a state or federal agency within the last five (5) years? Check one: . . . . . ☐ YES ☑ NO

      If yes, for each denial attach the following:

      (1) Date of denial;
      (2) A brief description of the reason(s) for denial;
      (3) Type of permit denied; and
      (4) A certified copy of each denial letter or court order

   b. Have there been any convictions by state or federal agencies occurring within the last five (5) years incurred by the applicant, permittee, or persons as defined by 10 CSR 80-2.070(5)(B)? Check one: . ☐ YES ☑ NO

      If yes, attach a list of all such convictions and include the following information:

      (1) Date of convictions;
      (2) A brief description of each conviction;
      (3) Citations to each specific statute or other regulation that was violated;
      (4) Identification of the court and cast number; and
      (5) Identification of convictions having an appeal pending.

6. Has the applicant, permittee or persons as defined by 10 CSR 80-2.070 (5)(B) had any convictions in this state of municipal or county public health or land use ordinances related to the management of solid waste occurring within the last five (5) years? Check one: . . . . . ☐ YES ☑ NO

   If yes, attach a list of all such convictions and include the following information:

   (1) Date of convictions;
   (2) A brief description of each conviction;
   (3) Citations to each specific statute or other regulation that was violated;
   (4) Identification of the court and cast number; and
   (5) Identification of convictions having an appeal pending.

7. Has the applicant (permittee) or persons as defined by 10 CSR 80-2.070(5)(B) been adjudged in contempt of any court order enforcing the provisions of the Missouri solid waste or hazardous waste management laws? Check one: . . . . . ☐ YES ☑ NO

8. Summarize the information in 2 through 7 above on the attached Violation History Summary Sheet.

I, the undersigned, certify that the information supplied herein is correct. I understand that the Missouri Department of Natural Resources (MDNR) shall deny or revoke a permit for failure of the applicant or permittee to provide the required information or for submission of false information. In addition, I understand that the MDNR may, for good cause, deny or revoke a permit for failure of the applicant to provide complete information when the submission of such information is required by 10 CSR 80-2.070. I understand that the MDNR or its representative shall verify the information provided on the disclosure statement as required by section 260.205.19, RSMo.

SIGNATURE OF APPLICANT, PERMITTEE OR AUTHORIZED REPRESENTATIVE	DATE
Michael L. Menne	6/15/12
PRINT NAME AND TITLE OF INDIVIDUAL WHO SIGNED ABOVE	
Michael L. Menne, Vice President - Environmental Services	

MO 780-1250 (10-11)

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

VIOLATION HISTORY SUMMARY SHEET

APPLICANT

Ameren Missouri

VIOLATION HISTORY INFORMATION

NAME OF FACILITY – AS PER 10 CS4 80-2.070(5) (A) (IF SEVERAL NAMES ARE USED FOR THE SAME FACILITY, IDENTIFY THE MOST CURRENT NAME.)	VIOLATIONS – AS PER 10 CSR 80-2.070(5)(D)	
	TOTAL NUMBER OF VIOLATIONS	NUMBER OF CRIMINAL CONVICTIONS
	0	0
TOTALS	0	0

NUMBER OF CONVICTIONS

	WITHIN A COURT OF THE U.S. OR OF ANY STATE OTHER THAN MISSOURI	WITHIN MISSOURI
Restraint of Trade Convictions – as per 10 CSR 80-2.070(5)(E) (If applicant is not required to submit this information, write N/A.)	0	0
Felony Convictions – as per 10 CSR 80-2.070(7)(H) (If applicant is not required to submit this information, write N/A.)	0	
Convictions in Missouri of Municipal or County Public Health or Land use Ordinances – as per 10 CSR 80-2.070(7)(I) (If applicant is not required to submit this information, write N/A.)	0	

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

OFFICER/MANAGEMENT EMPLOYEE SUMMARY SHEET

APPLICANT

Ameren Missouri

NAME OF OFFICER OR MANAGEMENT EMPLOYEE (Last Name)	(First Name)	(Middle Initial)	SOCIAL SECURITY NUMBER	DATE OF BIRTH
Baxter	Warner	L.		
Nastund	Chuck	D.		
Fox	David	V.		
Blank	Karl	P.		
Menne	Michael	L.		
Strubberg	David	L.		

MO 780-1042 (11-11)

Ameren

Ameren Services

March 25, 2013

Ms. Brenda Ardrey, Chief, Operations Section
Missouri Department of Natural Resources
Attn: Violation Disclosure History Statement/Annual Update
P.O. Box 176
Jefferson City, MO 65102-0176

RE: Violation Disclosure History Statement Amendment

Dear Ms. Ardrey:

On behalf of Ameren Missouri, I am submitting documents to satisfy the requirements of 10 CSR 80-2.020, and 2.070, Violation History. Attached is a signed Violation History Disclosure Statement, an Officer/Management Summary Sheet, a figure showing Ameren's corporate structure, a CD containing an electronic copy (PDF file) of Ameren Missouri's most recently filed 10-K, and a Violation History Summary Sheet.

The following is a list of all facilities as defined in 10 CSR 80-2.070(5)(A), owned and operated by the applicant as required under 10 CSR 80-2.070(7)(B).

Facility Name	Permit or Identification Number	Type of Permit or equivalent document and dates held	Name under which the permit or equivalent document was issued	Address or location of the facility	Issuing Agency
Callaway Plant	Federal: MOD000687392 Missouri: 003518	Hazardous Waste Storage Facility Part A Interim Authorization, May 12, 1993 to present	Union Electric Company (now d.b.a. as Ameren Missouri)	Highway CC, PO Box620, Fulton, MO 65251	MDNR
Labadie Plant	Federal: MOD000687392 Missouri: 003518	Proposed Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	226 Labadie Power Plant Rd, Labadie, MO 63055	MDNR
Sioux Plant	Federal: MOD086817954 Missouri: 001378	Utility Waste Landfill	Union Electric Company (now d.b.a. as Ameren Missouri)	8501 N. State Route 94, West Alton, MO 63386	MDNR

If you have any questions or require additional information, I can be reached at (314) 554-2388.

Sincerely,

Paul R. Pike
Environmental Science Executive

Enclosures

cc: Glen Mieir
Missouri Dept. of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Darrell Hartley
Missouri Dept. of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
(5 copies of letter and forms)

Ryan Tilley, Director
St. Charles County Div. of Environmental Health & Protection
1650 Boone's Lick Rd.
St. Charles, MO 63301
(w/o enclosure)

Bcc: w/o enclosure
W. L. Baxter
C. D. Naslund
S. B. Knowles
K. DeGraw
K. P. Blank
D. L. Strubberg
C. J. Giesmann
M. J. Tomasovic
M. L. Menne
S. C. Whitworth
File: WM 2.4

Appendix E

Request for Recommendation from East Central Solid Waste Management District, Region I

Ameren

Ameren Services

June 13, 2012

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Lon Little
Chairperson of Executive Board
East Central SWMD
2611 N. Business Hwy 54
Fulton, MO 65251

Dear Mr. Little:

Pursuant to Missouri Statute 260.205.7, this letter informs the East Central Solid Waste Management District that it is the intent of Ameren Corporation to obtain a construction permit for a utility waste disposal area located in your solid waste management district and requests a recommendation in support of the construction permit application. The proposed location is within Township 44 North, Range 2 East, Franklin County, approximately two and one-half miles northeast of the town of Labadie and immediately east of the Labadie Power Plant. The utility waste disposal area is proposed to be located on property that is currently owned by Ameren Corporation and is contiguous to the Labadie Power Plant. The Department of Natural Resources approved the Preliminary Site Investigation for the area on February 2, 2009. The Department of Natural Resources approved the Detailed Geologic and Hydrologic Site Investigation for the area on April 8, 2011.

The proposed facility is to be used for the management of coal combustion products (CCPs) generated by the Labadie Power Plant beginning in 2015. Ameren Missouri will develop and operate the facility in compliance with applicable local, state and federal requirements for utility waste disposal areas.

If you have any questions or concerns regarding this project, please contact me at (314) 554-2249 or email at *bskitt@ameren.com*.

Yours very truly,

Barbara S. Skitt

Barbara S. Skitt
Real Estate Managing Supervisor

BSS/rst

cc: Steve Etcher, Executive Director
Boonslick Regional Planning Commission
P.O. Box 429
Warrenton, MO 63383

Conn B. Roden, Director
Franklin County Department of Health
15 South Oak Street
Union, MO 63084

David L. Strubberg, P.E., PMP, Manager, Labadie Power Plant (LBD-645)
Kevin J. Gerhardt, P.E., Project Engineer, Ameren Power Operation Services

Appendix F

Franklin County Requirements
Revised August 2013

Documents Included:

Zoning Verification Letter

Preliminary Design Review Letter

Labadie Bottom Road Relocation Letter

FRANKLIN COUNTY

PLANNING & ZONING DEPARTMENT
PUBLIC WORKS DIVISION

400 EAST LOCUST STREET
ROOM 003B
UNION, MO 63084
MAIN LINE (636) 583-6369
FAX (636) 583-7911
www.franklinmo.org

August 21, 2012

Union Electric Co.
d/b/a Ameren Missouri
1901 Chouteau
St. Louis, MO 63103

Re: Zoning Verification – Ameren Labadie Plant

To Whom It May Concern:

Mr. Tim Tryniecki of Armstrong Teasdale has requested that this office provide you with zoning information for the property located along the Labadie Bottom Road in Labadie, MO. This property is further identified by parcel numbers 08-4-17.0-0-002-004.000, 08-4-17.0-0-000-003.000, 08-4-17.0-0-000-002.000, and 08-4-17.0-0-001-001.000. The zoning description for the property is Agricultural Non-Urban (ANU). By virtue of the use currently made of the property and Franklin County Zoning Regulations, constructing and operating a utility waste landfill on the subject property is a permitted use subject to compliance with all County, State and Federal regulations regarding utility waste landfills and all other applicable regulations.

You have indicated that Ameren would like to establish a utility waste landfill on the subject property. As state above, such use is permitted subject to compliance with all applicable laws and regulations. In accordance with the County regulations regarding utility waste landfills, all plans must be pre-approved by the Independent Registered Professional Engineer selected by the County for such purpose. For the purpose of this stage of the project, Andrews Engineering will serve in such capacity. Please insure that you coordinate all activity with this firm.

If you have any questions regarding this letter, please contact the Planning and Zoning office at 636-583-6369.

Sincerely,

Scottie C. Eagan

Mrs. Scottie C. Eagan
Planning Director

Cc: Kenneth Liss - Andrews Engineering
Joe Feldman

ANDREWS
ENGINEERING, INC.

January 7, 2013

Craig J. Giesmann, P.E., P.M.P.
Managing Supervisor, Hydro Engineering
Ameren Missouri
3700 S. Lindbergh Boulevard, MC F-604
St. Louis, Missouri 63127

Re: Preliminary Design Review

Dear Mr. Giesmann:

Andrews Engineering, Inc. (Andrews Engineering) acting as Franklin County's Independent Registered Professional Engineer, has met with Ameren Missouri and its consultants to discuss the preliminary design for fulfillment of the requirements listed in Franklin County's Article 10 "Supplementary Use Regulations", Section 238 – "Landfill Uses".

Andrews Engineering agrees with your conceptual designs that were discussed in meetings held between Ameren Missouri and its consultants, along with Andrews Engineering acting as Franklin County's Independent Registered Professional Engineer. No formal approvals may be granted until a formal submittal has been provided for review and approval.

If you have any further questions concerning this preliminary design review, please contact me at (636) 456-6387.

Sincerely,

Karl Finke

Karl Finke, P.E., R.G.
Branch Office Director

131 West Booneslick Road, Warrenton, Missouri 63383 • 636.456.6387 fax 636.456.6389 www.andrews-eng.com
Corporate Office 3300 Ginger Creek Drive, Springfield, Illinois 62711 • 217.787.2334

FRANKLIN COUNTY

Franklin County Highway Department
Eva Gadcke, Highway Administrator

400 EAST LOCUST STREET
ROOM 003A
UNION, MO 63084
MAIN LINE (636) 583-6361
FAX (636)584-0902
www.franklinmo.org

July 24, 2013

Craig Giesmann, PE, PMP
Managing Supervisor
Ameren – Power Operations Service
3700 S. Lindbergh Blvd., MC F-604
St. Louis, MO 63127

RE: Labadie Bottom Road Relocation

Dear Mr. Giesmann,

As part of the proposed landfill plans Labadie Bottom Road, a county road, will need to be relocated and an overpass from the plant to the landfill will need to be installed. I have been in contact with your engineer, Reitz & Jens, to review the county design requirements for these improvements. The traffic on this county road is mainly Ameren employees on the asphalted west end, and agricultural traffic on the graveled east end. We have not worked through final details of the roadway design or determined the extent of hard surfacing and gravel roadway. Our intent is to work with Reitz & Jens to come up with final plans for the roadway and submit them to the County Commission for approval.

Conceptually, the proposed relocation and overpass is accepted. The county reserves the right to approve the final plan details before construction can begin. Please let me know if you need additional information on this subject.

Sincerely,

Joe Feldmann
Franklin County Highway Dept.
County Engineer

CC: Mark Vincent
Paul Reitz, Reitz & Jens

Appendix G

Adjacent Landowners or
Landowners within 1000 feet

Ameren Missouri Labadie Energy Center
Construction Permit Application for a
Proposed Utility Waste Landfill
Franklin County, MO

December 2012

Appendix G Summary

As required by 10 CSR 80-2.020(2)(A)2.F., an application shall consist of "The names and addresses of all recorded owners of real property located either adjoining or within one thousand feet (1,000') of the (proposed) solid waste disposal area;".

A property ownership map of the recorded owners of real property adjoining or within 1,000 feet of the Ameren Missouri Labadie Energy Center proposed utility waste landfill site was obtained from the Franklin County Information Technology Department in December of 2012.

The attached Figure 1 was developed for illustrative purposes and shows the proposed solid waste disposal area and a boundary drawn 1,000 feet from the disposal area. Table 1 (attached) lists the real property owners within the 1,000 foot boundary.

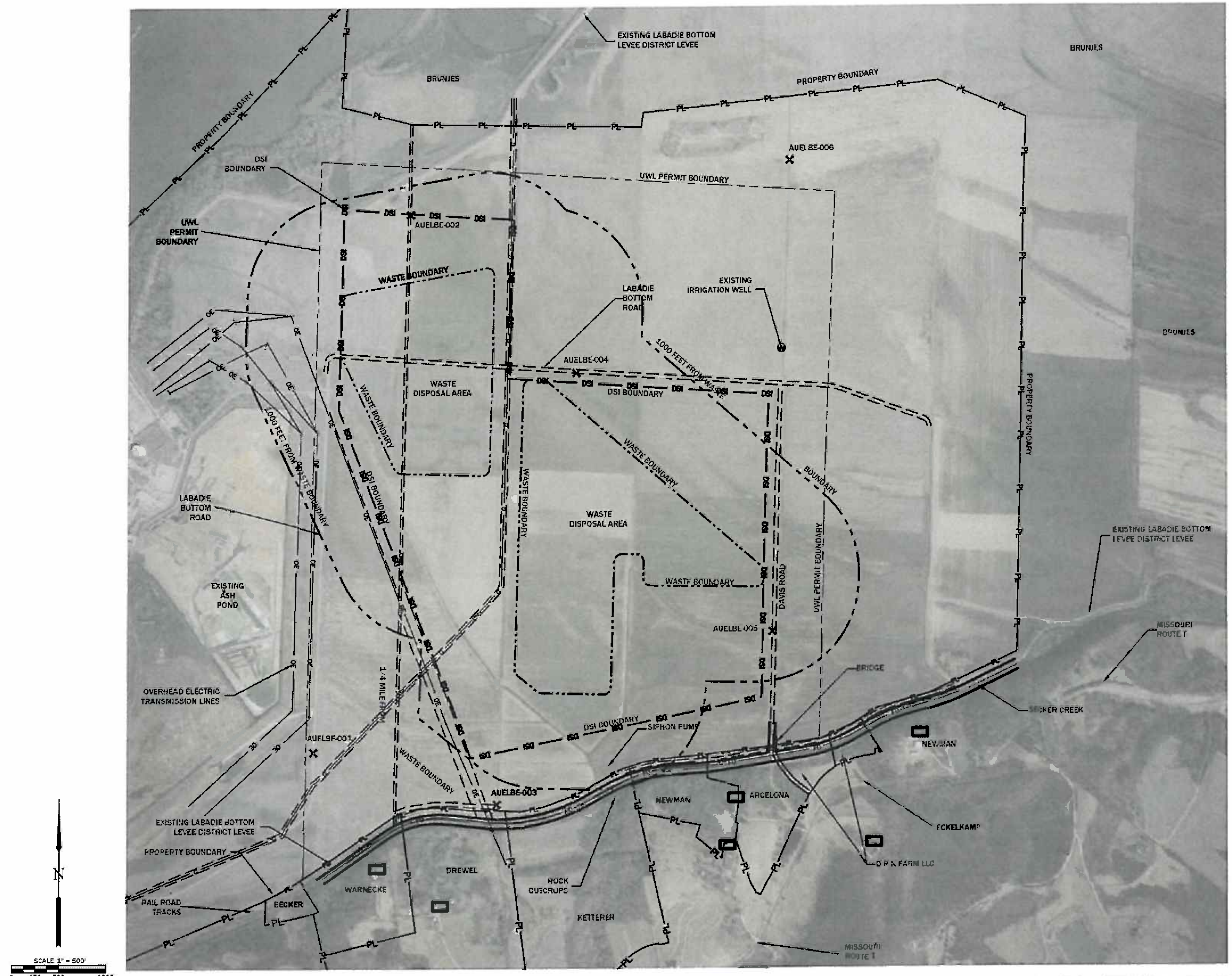
Ameren Missouri Labadie Energy Center
Construction Permit Application for a
Proposed Utility Waste Landfill
Franklin County, Missouri

Appendix G - Table 1
Recorded Owners of Real Property Within 1000 Feet of Waste Disposal Boundary

Parcel ID	Owner Name	Mailing Address	Mailing City	Mailing State	Mailing Zip
08-4-20.0-0-000-004.000	Ketterer, Thomas G.	90 B Sunbeam Drive	Highland	IL	62249
08-4-17.0-0-000-007.000	MO Central Railroad Company	PO Box 66149 (MC210)	St. Louis	MO	63166
08-4-20.0-0-000-010.100	MO Central Railroad Company	PO Box 66149 (MC210)	St. Louis	MO	63166
08-4-20.0-0-000-010.600	MO Central Railroad Company	PO Box 66149 (MC210)	St. Louis	MO	63166
08-5-16.0-0-000-031.000	MO Central Railroad Company	PO Box 66149 (MC210)	St. Louis	MO	63166
08-4-20.0-0-000-002.200	Newman, Merel L.	PO Box 811	Union	MO	63084

Notes:

1 - Information in the above table was obtained from a property ownership map provided by the Franklin County, Missouri, Information Technology Department on December 3, 2012.


EXISTING LABADIE BOTTOM LEVEE DISTRICT LEVEE
BRUNJES
PROPERTY BOUNDARY
AUELBE-006
UWL PERMIT BOUNDARY
DSI BOUNDARY
UWL PERMIT BOUNDARY
AUELBE-002
WASTE BOUNDARY
LABADIE BOTTOM ROAD
EXISTING IRRIGATION WELL
1000 FEET FROM WASTE
AUELBE-004
DSI BOUNDARY
WASTE DISPOSAL AREA
BRUNJES
PROPERTY BOUNDARY
WASTE BOUNDARY
DSI BOUNDARY
1000 FEET FROM WASTE BOUNDARY
LABADIE BOTTOM ROAD
WASTE DISPOSAL AREA
BOUNDARY
UWL PERMIT BOUNDARY
DAVIS ROAD
EXISTING LABADIE BOTTOM LEVEE DISTRICT LEVEE
EXISTING ASH POND
AUELBE-005
MISSOURI ROUTE T
OVERHEAD ELECTRIC TRANSMISSION LINES
1/4 MILE
BRIDGE
BECKER CREEK
SIPHON PUMP
AUELBE-001
NEWMAN
AUELBE-003
NEWMAN
ARCELONA
ECKELKAMP
EXISTING LABADIE BOTTOM LEVEE DISTRICT LEVEE
PROPERTY BOUNDARY
D P N FARM LLC
DREWEL
WARNECKE
ROCK OUTCROPS
RAIL ROAD TRACKS
BECKER
KETTERER
MISSOURI ROUTE T
N
SCALE: 1" = 500'
0 250 500 1000

NOTES

1. ALL PROPERTY BOUNDARIES AND LOCATIONS ARE APPROXIMATE
2. AERIAL PHOTOGRAPH PROVIDED BY REITZ AND JENS INC AERIAL DATE MARCH 13 2009 AERIAL PHOTOGRAPH MAY BE DISTORTED

CALL BEFORE YOU DIG DRILL BLAST 1-800-344-7483 (TOLL FREE)

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REITZ & JENS, INC. CONSULTING ENGINEERS

GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING

PREPARED FOR Ameren

APPENDIX G
PROPOSED UTILITY WASTE LANDFILL
RECORDED OWNERS OF REAL
PROPERTY WITHIN 1000 FEET

001009	LABADIE ENERGY CENTER	02010
Ameren ST. LOUIS, MISSOURI	NOVEMBER 30, 2012	0

Appendix H

Floodplain Documentation
Revised August 2013

Documents Included:

Missouri River Floodplain Analysis

Floodplain Development Permit

ANDREWS
ENGINEERING, INC.

January 22, 2013

Joe Feldman, P.E., L.S.
Franklin County Highway Department
400 East Locust, Room 003A
Union, MO 63084

Re: Ameren – Labadie Power Plant
Missouri River Floodplain Analysis
Franklin County, Missouri

Dear Mr. Feldman,

We have received and reviewed the following documents from CDG Engineers:

- "Floodplain Analysis of the Missouri River for the Ameren Missouri Labadie Energy Center", dated November 11, 2012
- January 11, 2013 response to Comments

The purpose of CDG's report is in support of a proposed coal waste landfill to be placed in the floodway of the Missouri River, just downstream of Ameren's existing site. CDG defined an ineffective flow area, in which Ameren's landfill will be located.

Based on the alignment of the ineffective area, the construction of the proposed landfill will result in a "No Rise" condition during flooding in the river.

As such, we concur the analysis and methodology provided by CDG Engineers to result in a "No Rise" condition within the river and recommend the approval of the No Rise certificate.

Our review did not include field verification of existing conditions, elevations, grades, and/or topography as shown on the plans, and we disclaim any responsibility for errors and omissions. The developer and his engineer are not relieved of any responsibility for correctness of the existing field conditions and the design of the project improvements because of our reviews and subsequent approval of the plans and specifications by the County.

If you have any questions or require further information, please feel free to call.

Sincerely,

Conrad Moore, P.E.

CSM:dkr

cc: Terry Entwistle, P.E., CFM (CDG)
Mark Bircher, P.E., R.L.S., CFM (CDG)
Kevin Gerhardt (Ameren)
Craig Giesmann (Ameren)
Doug Mauntel, P.E., (Andrews Engineering, Inc.)
Karl Finke, P.E., (Andrews Engineering, Inc.)

RECEIVED
MAR 18 2013
FRANKLIN COUNTY MO
PLANNING & ZONING DEP

FLOODPLAIN DEVELOPMENT PERMIT/APPLICATION

Application No. 120219 Date: _____

TO THE ADMINISTRATOR: The undersigned hereby makes application for a permit to develop in a floodplain. The work to be performed, including flood protection works, is as described below and in attachments hereto. The undersigned agrees that all such work shall be in accordance with the requirements of the Floodplain Management Ordinance and with all other applicable county/city ordinances, federal programs, and the laws and regulations of the State of Missouri.

AMEREN MISSOURI	_____	NOT DETERMINED	_____
Owner or Agent	Date	Builder	Date
10 LABADIE POWER PLANT RD. LABADIE, MO 63055		_____	
Address		Address	
(314) 554-2249		_____	
Phone		Phone	

SITE DATA

1. Location: — 1/4; — 1/4; Section 17, 20 ; Township 44N ; Range 2E
   Street Address 10 LABADIE POWER PLANT RD. LABADIE, MO 63055
2. Type of Development: Filling X Grading _____ Excavation _____ Minimum Improvement _____
   Routine Maintenance _____ Substantial Improvement _____ New Construction X Other _____
3. Description of Development: CONSTRUCTION OF UTILITY WASTE LANDFILL
4. Premises: Structure Size N/A ft. By N/A ft. Area of Site 10,092,852 Sq Ft
   Principal Use UTILITY WASTE STORAGE Accessory Uses (storage, parking, etc.) —
5. Value of Improvement (fair market) $ 14,000,000 * Pre-Improvement/Assessed Value of Structure $ 0
6. Property Located in a Designated FLOODWAY? Yes ✓ No _____
   * COST ESTIMATE FOR FIRST PHASE
   IF ANSWERED YES, CERTIFICATION MUST BE PROVIDED PRIOR TO THE ISSUANCE OF A PERMIT TO DEVELOP, THAT THE PROPOSED DEVELOPMENT WILL RESULT IN NO INCREASE IN THE BASE (100-YEAR) FLOOD ELEVATIONS.
7. Property Located in a Designated Floodplain FRINGE? Yes ✓ No _____
8. Elevation of the 100-Year Flood (ID source) 482.5 - 483.5 FRANKLIN CO FIS, OCT 18, 2011 NAVD88 NGVD/NAVD
9. Elevation of the Proposed Development Site 465 NGVD29 GROUND ELEVATION. HIGHEST POINT 564. NGVD29 NGVD/NAVD
10. Local Ordinance Elevation/Floodproofing Requirement N/A NGVD/NAVD
11. Other Floodplain Elevation Information (ID and describe source) N/A
12. Other Permits Required?

Corps of Engineer 404 Permit:	Yes _____	No ✓	Provided _____
State Department of Natural Resources 401 Permit:	Yes _____	No ✓	Provided _____
Environmental Protection Agency NPDES Permit:	Yes _____	No ✓	Provided _____

All Provisions of Ordinance Number _____, the "Floodplain Management Ordinance", shall be in Compliance.

PERMIT APPROVAL/DENIAL

Plans and Specifications Approved/~~Denied~~ this 19th Day of MARCH, 2013

Barbara Skitt	_____
Signature of Developer/Owner	Authorizing Official
BARBARA SKITT, MANAGING SUPERVISOR, REAL ESTATE	TORI KARIM FLOODPLAIN MANAGER
Print Name and Title	Print Name and Title

THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT FLOOR) OF ANY NEW OR SUBSTANITALLY IMPROVED RESIDENTIAL BUILDING WILL BE ELEVATED 2 FOOT/FEET ABOVE THE BASE FLOOD ELEVATION. IF THE PROPOSED DEVELOPMENT IS A NON-RESIDENTIAL BUILDING, THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT) OF A NEW OR SUBSTANITALLY IMPROVED NON-RESIDENTIAL BUILDING WILL BE ELEVATED OR FLOODPROOFED 2 FOOT/FEET ABOVE THE BASE FLOOD ELEVATION.

THIS PERMIT IS USED WITH THE CONDTION THAT THE DEVELOPER/OWNER WILL PROVIDE CERTIFICATION BY A REGISTERED ENGINEER, ARCHITECT, OR LAND SURVEYOR OF THE "AS-BUILT" LOWEST FLOOR (INCLUDING BASEMENT) ELEVATION OF ANY NEW OR SUBSTANTIALLY IMPROVED BUILDING COVERED BY THIS PERMIT.

II. THIS PERMIT IS CONTINGENT UPON AMEREN UE MISSOURI OBTAINING A "CONSTRUCTION PERMIT" FROM THE DEPARTMENT OF NATURAL RESOURCES. WITHOUT THE DNR PERMIT, THIS APPROVAL WILL BECOME NULL AND VOID

(MISSOURI) November 28, 2007

OFFICE OF ZONING ENFORCEMENT
Franklin County Courthouse
Union, MO 63084

Appendix I

Wetland Assessment

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
STATE REGULATORY PROGRAM OFFICE - MISSOURI
221 BOLIVAR STREET, SUITE 103
JEFFERSON CITY, MISSOURI 65101

September 10, 2012

REPLY TO
ATTENTION OF:
Missouri State Regulatory Office
(2010-02097)

Ameren Missouri
Attn: Barbara Skitt
1901 Chouteau Avenue
P.O. Box 66149
St. Louis, Missouri 63166-6149

Dear Ms. Skitt:

This letter is in follow up to our August 15, 2012, site visit with Ameren Missouri regarding the 1,100 acre area on Ameren Missouri's property adjacent to the Labadie Power Plant in Franklin County, Missouri, for a potential coal ash waste landfill project. We previously provided Ameren Missouri with a Preliminary Jurisdictional Determination (PJD) for this area by letter dated May 23, 2012. The wetlands identified in the May 23 PJD remain jurisdictional waters of the United States.

During the site visit, we documented two additional wetlands totaling 9.58 acres, and have documented these new sites in the enclosed revised PJD as w13 (5.04 acres) and w14 (4.54 acres), shown on the aerial photo attached to the PJD (Attachment 1). This revised PJD consolidates and replaces the PJD of May 23, 2012.

Upon review of Ameren Missouri's revised drawings received on July 23, 2012, and our August 15, 2012 site visit, we conclude that jurisdictional wetlands are located within the revised project area. The Corps of Engineers has jurisdiction over all waters of the United States. Discharges of dredged or fill material in waters of the United States, including the wetlands identified in the enclosed PJD, require prior authorization from the Corps under Section 404 of the Clean Water Act (33 USC 1344). The implementing regulation for this Act is found at 33 CFR 320-332.

The enclosed PJD was prepared at Ameren Missouri's request and in accordance with Corps regulations at 33 CFR Part 331. PJDs, while sufficient for permit determinations, are not appealable. If you wish, you may request an Approved Jurisdictional Determination (which may be appealed) by contacting our office for further instructions. To continue with review of your project using the PJD, please sign the PJD signature block, and return the form to our office.

This determination has been conducted to identify the limits of the Corps Clean Water Act jurisdiction for the particular site identified in this request. This determination may not be valid

for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

Additionally, we received an August 28, 2012 letter from Daniel J. Deeb (Shiff Hardin LLP – representing Ameren Missouri) addressed to Mr. Matt Jeppson with our Office of Counsel. The subject letter indicates concern with a reevaluation of the May 23, 2012, PJD. As discussed in our June 29, 2012, conference call, we reported that we had learned of a piezometer study prepared for the Missouri Department of Natural Resources, and requested a copy of that report in addition to our information request of June 27, 2012. We concluded that the piezometer study was new information, information not considered in our original PJD, and that reevaluation of the PJD was necessary to ensure that it was a complete and accurate jurisdictional determination. We thank you for your cooperation in providing a copy of the piezometer study/report for our review.

The August 28, 2012 letter also requests that the Corps consider the applicability of "prior converted cropland" (PC) in any reevaluation. The USDA PC classification is an agricultural use classification, and generally, lands with a Certified PC determination, that remain in agricultural use, are not jurisdictional for Clean Water Act purposes. For lands not used for agricultural purposes, or proposed for a new use, the Corps provides Clean Water Act jurisdictional determinations using the Corps wetland delineation manual and applicable regional supplement. We will consider any information contained in a prior USDA determination when available. However, we note that the Natural Resources Conservation Service (NRCS), in a letter furnished to us as part of your December 2011 consultant prepared wetland delineation report, stated that NRCS had not made any certified determinations inside the boundary of the study area. A copy of the NRCS letter is enclosed (Attachment 2).

We are interested in your thoughts and opinions concerning your experience with the Kansas City District, Corps of Engineers Regulatory Program. We have placed an automated version of our Customer Service Survey form on our website at: http://per2.nwp.usace.army.mil/survey.html which can be filled in and submitted online. At your request, we will mail a paper copy that you may complete and return to us by mail or fax.

If you have any questions concerning this matter, please feel free to write or call me at 816-389-3833.

Sincerely,

Kenny Pointer

Kenny Pointer
Regulatory Project Manager
Missouri State Regulatory Office

Enclosures

Copies Furnished (w/enclosures):

Natural Resources Conservation Service
Attn: Ms. Rhonda Davault
10820 Hwy. 21, Suite 100
Hilsboro, MO 63050-5208

Mr. and Mrs. Edward G. Heisel
1776 Highway T
Labadie, MO 63055

DRN FARMS, LLC
Mr. and Mrs. Marvin J. Newman
929 Cobblestone Drive
Washington, MO 63090
Mr. Merle Newman
1352 Highway K
St. Clair, MO 63077
Mr. and Mrs. Dennis Eckelkamp
33 South Oak Street
Union, MO 63084
Mr. and Mrs. Jerry Newman
1702 Highway T
Labadie, MO 63055

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 7/23/2012.

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD: Barbara Skitt (Ameren Missouri), 1901 Chouteau Avenue, P.O. Box 66149, St. Louis, MO 63166-6149

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: NWK, Ameren Missouri, NWK-2010-02097.

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: Wetlands adjacent to the Missouri River on a 1,110 acre site adjacent to Ameren Missouri's Labadie Power Plant in Franklin, County Missouri.

State: Missouri County/parish/borough: Franklin City:
Center coordinates of site (lat/long in degree decimal format): Lat. 38.558638° N, Long. -90.815669° E.

Name of nearest waterbody: Missouri River.

Identify (estimate) amount of waters in the review area: **See attached table for multiple waterbodies at different locations**.

Non-wetland waters: linear feet: width (ft) and/or acres.
Cowardin Class:
Stream Flow:
Wetlands: **See attached table** acres.
Cowardin Class:

Name of any water bodies on the site that have been identified as Section 10 waters:

Tidal:

Non-Tidal:

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:
☒ Field Determination. Date(s): 4/24/2012 and 8/15/2012.

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: information submitted by Ameren Missouri.

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant. (March 2011, December 2011 and March 2012 reports)

☐ Office concurs with data sheets/delineation report.

☒ Office does not concur with data sheets/delineation report. There are additional wetlands on the property in addition to the wetlands identified in the reports prepared by the consultant.

☐ Data sheets prepared by the Corps: .

☒ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

☐ USGS NHD data.

☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name: 7.5 minute U.S.G.S. topographic map, Labadie, Missouri Quadrangle.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Franklin County Soil Survey.

☒ National wetlands inventory map(s). Cite name: USFWS NWI mapping.

☐ State/Local wetland inventory map(s): .

☐ FEMA/FIRM maps: .

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date): Google Earth (2002-2011) and USDA/NRCS aerial photos included in consultant prepared reports.

or ☐ Other (Name & Date): .

☒ Previous determination(s). File no. and date of response letter: 2010-02097, 5/23/2012.

☒ Other information (please specify): 8/17/2011, 4/24/2012 and 8/15/2012 site visits.

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Kenny Pounds 8/30/2012

Signature and date of
Regulatory Project Manager

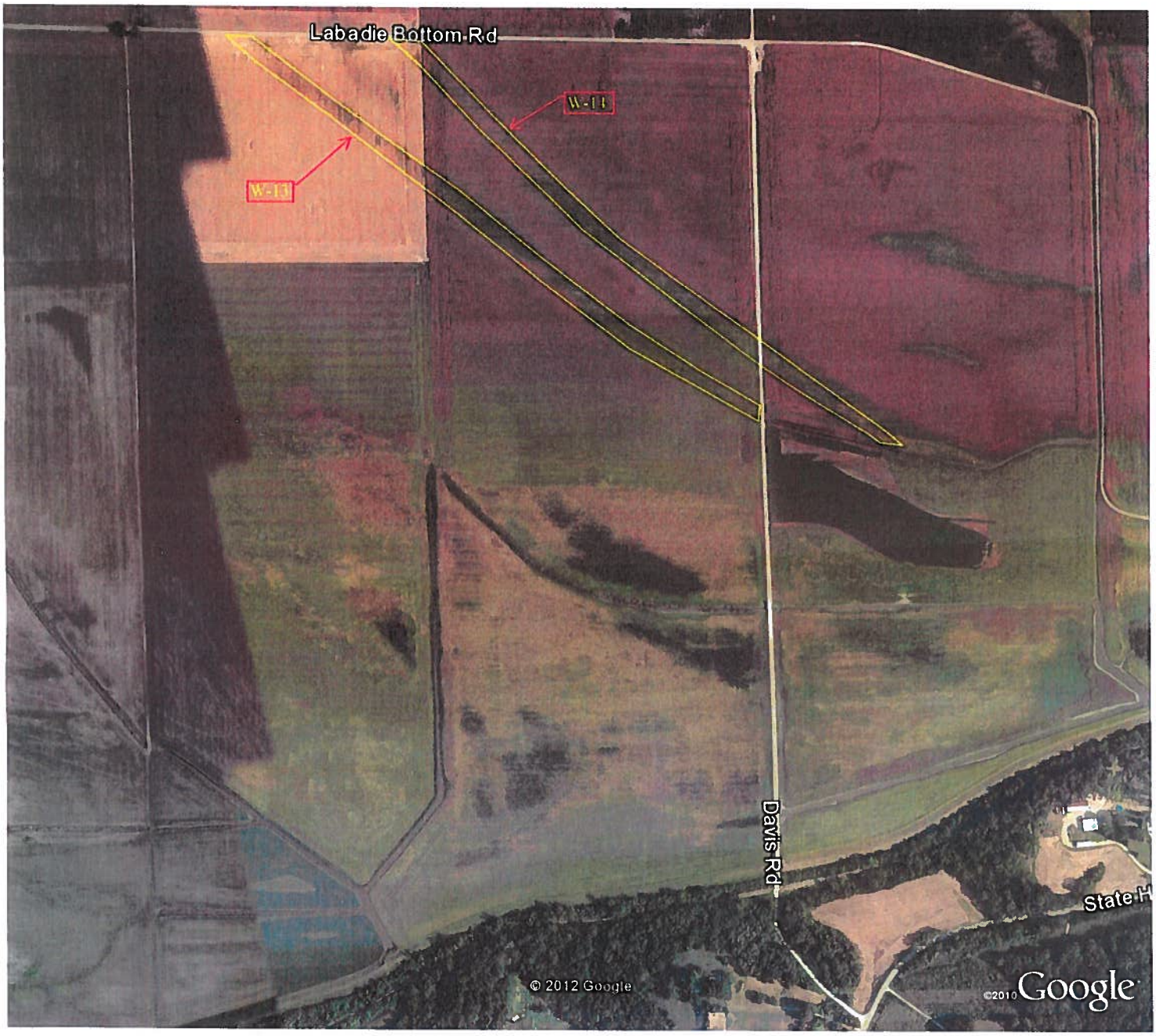
Signature and date of
person requesting preliminary JD

(REQUIRED)

(REQUIRED, unless obtaining the signature is impracticable)

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
1 wetlands adjacent to Missouri River – w1	38.559695 ° N	-90.823825 ° E	PEM – Palustrine, Emergent	2.75 acres	non-section 10 – wetland
2 Wetlands adjacent to Missouri River – w2	38.555153 ° N	-90.825708 ° E	PEM – Palustrine, Emergent	1.3 acres	non-section 10 – wetland
3 Wetlands adjacent to Missouri River – w3	38.553148 ° N	-90.820124 ° E	PEM – Palustrine, Emergent	0.67 acres	non-section 10 – wetland
4 Wetlands adjacent to Missouri River – w4	38.557749 ° N	-90.815697 ° E	PEM – Palustrine, Emergent	1.76 acres	non-section 10 – wetland
5 Wetlands adjacent to Missouri River – w5	38.561567 ° N	-90.804698 ° E	PEM – Palustrine, Emergent	1.17 acres	non-section 10 – wetland
6 Wetlands adjacent to Missouri River – w6	38.556807 ° N	-90.811979 ° E	PEM – Palustrine, Emergent	8.11 acres	non-section 10 – wetland

7 Wetlands adjacent to Missouri River – w7	38.554125 ° N	-90.810176 ° E	PEM – Palustrine, Emergent	0.87 acres	non-section 10 – wetland
8 Wetlands adjacent to Missouri River – w8	38.560733 ° N	-90.821406 ° E	PEM – Palustrine, Emergent	1.08 acres	non-section 10 – wetland
13 Wetlands adjacent to Missouri River – w13	38.560732 ° N	-90.813483 ° E	PEM – Palustrine, Emergent	5.04 acres	non-section 10 – wetland
14 Wetlands adjacent to Missouri River – w14	38.561222 ° N	-90.812759 ° E	PEM – Palustrine, Emergent	4.54 acres	non-section 10 – wetland



Attachment 1

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
10820 Hwy. 21, Suite 100
Hillsboro, Missouri 63050-5208
Fax: 636-789-2175

Phone: 636-789-2441 ext. 3

Subject: Ameren Property in Franklin Co. Date: May 24, 2011

To: Barbara Skitt
Ameren Services

Barbara-

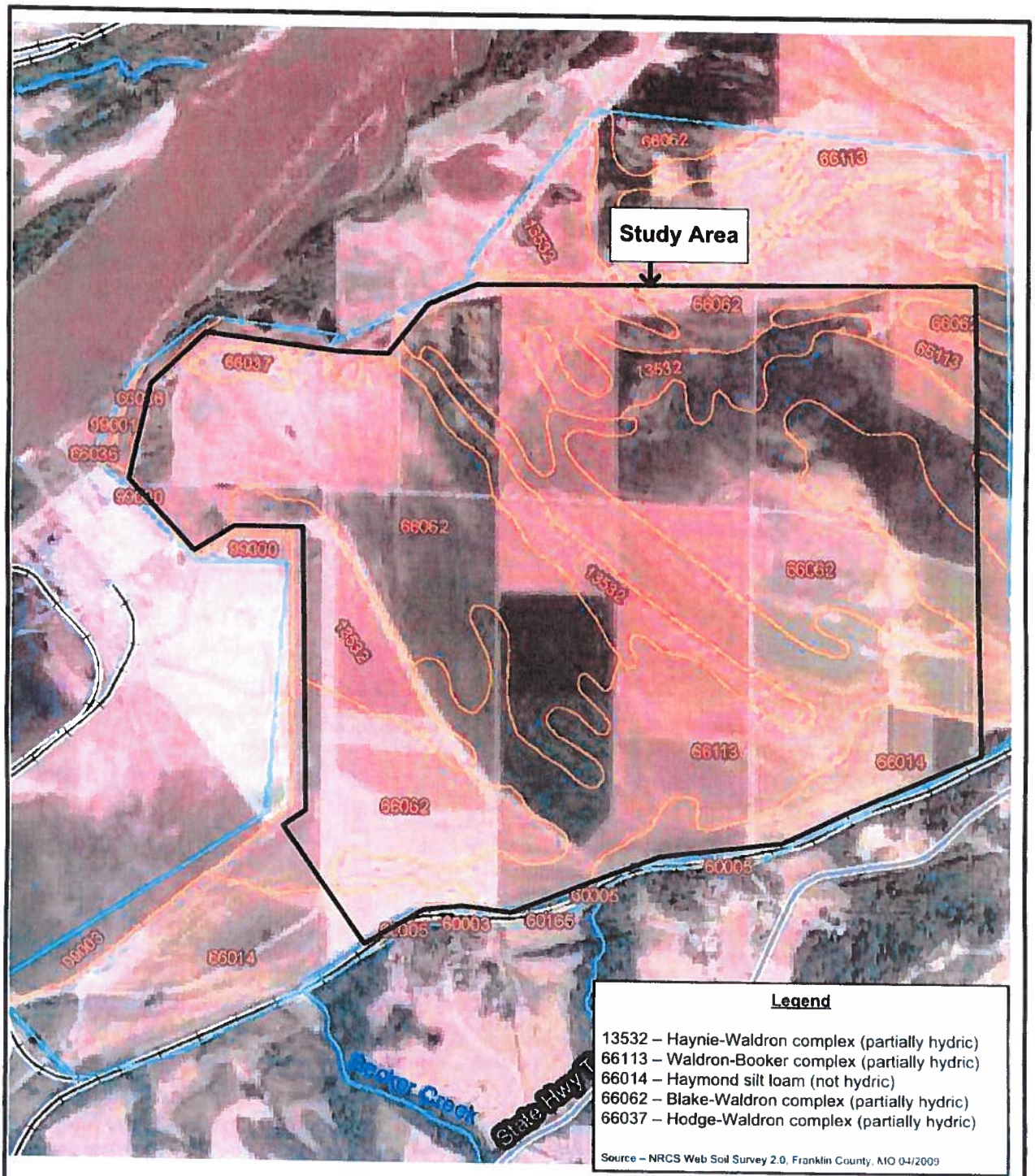
I have examined the maps for certified wetland determinations in the area outlined on the map received from you. NRCS has not made any certified determinations inside the boundary of the area.

If you need additional information feel free to call.

David Skaer
NRCS ARSS

Cc Rhonda Davault, NRCS District Conservationist

Attachment 2, pg. 1



Source: NRCS Web Soil Survey, Franklin County, Missouri

HANSON
HANSON PROFESSIONAL SERVICES INC.

NRCS Soil Map

Reitz & Jens, Inc
1,198-Acre Labadie Site
Franklin County, Missouri

JOB NO. 08E0229 FIGURE 4

Attachment 2, pg. 2

REPORT
2008012455

AMEREN MISSOURI LABADIE ENERGY CENTER
UTILITY WASTE LANDFILL (UWL)
SOLID WASTE DISPOSAL AREA
FRANKLIN COUNTY, MISSOURI

APPENDIX J
GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION PERMIT APPLICATION

Prepared for

Ameren MISSOURI

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

STATE OF MISSOURI
JEFFREY LYNN FOUSE
NUMBER E-21043
8/1/2013
REGISTERED PROFESSIONAL ENGINEER

November 30, 2012
Revised August 2013

The Professional whose signature and personal seal appear hereon assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, estimates, specifications, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

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Ameren Missouri Labadie Energy Center
Proposed Utility Waste Landfill
Franklin County, Missouri

Table of Revisions for Appendix J and Sub-Appendices
August 2013

Main Report		Revised	Not Revised	Instructions
Appendix J - Geotechncial Investigation		X		Replace cover, Table of Contents and text with revised versions
CD with PDF Copies of Report and Calculations		X		Replace original with Revised version
List of Figures				
Figure 1	Plan of Site, Proposed UWL, Borings and CPT Soundings…		X	No Change
Figure 2	Generalized Soil Profile, Section A-A'		X	No Change
Figure 3	Generalized Soil Profile, Section B-B'		X	No Change
Figure 4	Generalized Soil Profile, Section C-C'		X	No Change
Figure 5	Generalized Soil Profile, Section D-D'		X	No Change
Figure 6	Graphic Depiction of Materials for Stability Analyses	X		New
Figure 7	Graphic Depiction of Materials for Seismic Analyses	X		New
Figure 8	Graphic Depiction of Materials for Settlement Analyses	X		New
Figure 9	Proposed Concrete Erosion Protection for Permanent Ext. Berms	X		Changed figure number (previously Figure 6)
Figure 10	Calculation of Factor of Safety Against Heave …Uplift	X		Revised figure and changed no. (previously Figure 7)
List of Appendices				
Appendix A	Investigation of Potential Clay Liner Borrow Site at Callaway	X		Replace boring logs and Figure 3
Appendix A1	Supplemental Testing of Potential Clay Borrow from Callaway		X	No Change
Appendix B	Laboratory Testing of Coal Combustion Products	X		Replace Appendix B Table of Contents
		X		Add new Figures B-17 through B-26
Appendix C	Results of Seismic Risk Analyses		X	No Change
Appendix D	Results of Liquefaction Analyses	X		Replace Figure D-3 with revised version
Appendix E	Results of Slope Stability Analyses	X		Replace Appendix E Table of Contents
		X		Replace Table E-1 with revised version
		X		Replace Table E-2 with revised version
		X		Replace Figure E-6 and output
		X		Replace Figure E-13 and output
		X		Replace Figure E-20 and output
		X		Replace Figure E-27 and output
		X		Replace Figure E-30 and output
		X		Replace Figure E-31
		X		Replace Figure E-32 and output
		X		Replace Figure E-33 and output
		X		Replace Figure E-34 and output
		X		Replace Figure E-35 and output
		X		Replace Figure E-36 and output
		X		Replace Figure E-37 and output
		X		Replace Figure E-38 and output
		X		New Figure E-43 and output
		X		New Figure E-44 and output
		X		New Figure E-45 and output
		X		New Figure E-46 and output
		X		New Figure E-47 and output
		X		New Figure E-48 and output
		X		New Figure E-49 and output
		X		New Figure E-50 and output
Appendix F	Results of Settlement Analyses	X		New Figure F-8, Plan of Loading Stresses
Appendix G	Design of Fabric-Formed Concrete Mat (FCM)	X		Replace calculation sheet with corrected version

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AMEREN MISSOURI LABADIE ENERGY CENTER
UTILITY WASTE LANDFILL (UWL) SOLID WASTE DISPOSAL AREA
FRANKLIN COUNTY, MISSOURI

APPENDIX J
GEOTECHNICAL ENGINEERING REPORT FOR CONSTRUCTION PERMIT APPLICATION
(Revised August 2013)

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AMEREN MISSOURI LABADIE ENERGY CENTER
UTILITY WASTE LANDFILL (UWL) SOLID WASTE DISPOSAL AREA
FRANKLIN COUNTY, MISSOURI

APPENDIX J
GEOTECHNICAL ENGINEERING REPORT FOR CONSTRUCTION PERMIT APPLICATION
(Revised August 2013)

1.0 SCOPE OF GEOTECHNICAL INVESTIGATION

Reitz & Jens, Inc. (R&J) completed a geotechnical investigation for the design of the proposed Utility Waste Landfill (UWL) for the Ameren Missouri Labadie Energy Center in Franklin County, Missouri. The UWL will be used for disposal of coal combustion products (CCP) from the Labadie Energy Center in a utility waste landfill as defined in 10 CSR 80-2.020(119). R&J leads the design team for the UWL that includes GREDELL Engineering Resources, Inc. (GER). This investigation provides supporting geotechnical information, testing results, results of analyses, and documentation to be incorporated with the Construction Permit Application for this UWL. The scope of this geotechnical investigation included the following main tasks which are described in detail in this report.

1.1 Field Investigation

The field investigation was completed in conjunction with the Detailed Site Investigation, using drilled exploratory borings and cone penetrometer testing (CPT), and laboratory testing to characterize the geotechnical engineering properties of the subsurface soils strata at the site. It is not feasible to obtain suitable clay on site for the compacted clay liner. Therefore, most, if not all, of the clay liner material will be obtained from an off-site borrow source(s) that will be identified prior to construction. A preliminary field investigation with laboratory testing was completed to characterize the subsurface soils at a borrow site on Ameren Missouri's Callaway Energy Center property proposed for use as clay materials for the liner and cap construction at the Labadie UWL. Appropriate engineering properties were assumed for the compacted clay liner in our analyses. These properties will be confirmed after the borrow source(s) are identified and prior to construction.

1.2 Laboratory Testing of CCP

Laboratory tests were run on samples of CCP materials from the Labadie Energy Center to determine parameters for use in the design of the UWL. The materials tested included fly ash from the existing pond at the Labadie Energy Center, dry fly ash collected from the precipitators ("non-ponded fly ash"), and bottom ash. The CCP placed in the UWL may be a mixture of fly ash, bottom ash and flue gas desulphurization gypsum in the future. Since gypsum is not available from the Labadie Plant, a sample of dry gypsum from Ameren's Duck Creek Plant was used in our testing.

1.3 Seismic Risk Assessment and Analyses

The peak horizontal ground acceleration (PHGA) for the Labadie site was analyzed by two methods: 1) the PHGA obtained from the latest available USGS hazard map; and 2) a site specific seismic analysis using the seismic model program SHAKE2000. The PHGA from the USGS map was higher.

than that from our site-specific seismic analysis. Therefore, the PHGA from the USGS map was used in analyses of embankment stability under seismic load, potential for liquefaction, the potential effect of liquefaction on embankment stability, and potential for settlement induced by liquefaction. The derived time-histories of seismic accelerations for the St. Louis area that are built into SHAKE2000 were used for deformation analyses, to satisfy the requirements of Missouri sold-waste regulations.

We analyzed the potential of liquefaction of the subsurface strata at each boring and CPT sounding using the latest published method (Idress and Boulanger, 2008). We mapped areas of potential liquefaction under the existing site. Our analyses demonstrate that the potential for liquefaction beneath the UWL becomes negligible after the CCP fill is 20 feet thick. We also determined the residual shear strengths of potentially liquefiable natural strata using several published methods, for slope stability analyses and the horizontal ground accelerations that result in the onset of liquefaction.

1.4 Slope Stability Analyses

We analyzed the stability of the side slopes of the perimeter berms and the CCP fill at five sections which had slightly varying subsurface soil profiles. We analyzed each section for the intermediate height of CCP fill using both short-term and long-term soil properties, and with the potential liquefaction; and for the full height of CCP fill using long-term soil properties, and with potential liquefaction. We also analyzed potential sliding block failures along the interface with the composite liner, and the stability of the final cover. All of these analyses demonstrate that the proposed design meets or exceeds the slope stability requirements.

The Missouri solid-waste regulations do not state a minimum factor of safety for the stability of the slopes under seismic load. Rather, the regulations state that the expected deformation cannot exceed a maximum of 6 inches (for a sanitary landfill). Our analyses demonstrate that the maximum anticipated lateral deformation due to the design PHGA would be negligible.

The stability analyses included the calculation of bearing capacity of the foundation soils in accordance with 80-11.010(5)(A)(4.A).

1.5 Settlement Analyses

The settlement of the subsurface soils under the final CCP landfill was estimated for the subsurface strata at groups of borings and CPT soundings. The results were graphed to produce the estimated settlement of the subgrade along four cross-sections of the completed landfill and along the existing Explorer pipeline. These estimates of settlement were used for the design of the leachate collection system. The results also demonstrate that the composite liner will not be subjected to damaging strains due to settlement.

1.6 Impacts Due to Flooding

Because the site is located in a floodplain, the Missouri solid-waste regulations require that the design of the UWL prevent damage to the composite liner that could result from hydrostatic uplift due to flooding. This requirement is satisfied by the initial operation of the UWL, during which sufficient CCP fill will be placed in each cell to resist the hydrostatic uplift. Also, we provide a design for a fabric-formed concrete

mat (FCM) for the exterior berms to prevent erosion of the slopes due to the velocity of flows that may occur if the existing agricultural levee along the Missouri River were to be overtopped or fail during a flood event. The design of the exterior berms prevents flood water from contacting the CCP in the cells up to the 500-year flood in accordance with Franklin County ordinances.

1.7 Recommendations

Other recommendations are presented in this report for bearing capacity of subsurface soils, construction quality assurance procedures, impact of ground water in contact with the bottom composite liner, and the investigation and remediation of potential liquefaction damage during the initial operation of the UWL, in fulfillment of the requirements of the Missouri UWL regulations.

Our professional engineering judgment is that the Labadie UWL design and operating procedures described in this geotechnical report for the CPA are in accordance with generally accepted engineering practice and utilize conservative assumptions where necessary, and therefore meet or exceed all of the requirements of the Missouri Solid Waste Management Law and Regulations, as well as those of applicable Franklin County ordinances.

2.0 EXPLORATORY FIELD INVESTIGATION

2.1 Detailed Site Investigation (DSI)

The field and laboratory work for this investigation was completed as a component of the Detailed Site Investigation (DSI) for the proposed Labadie UWL. The DSI workplan utilized the 100 "temporary" or non-piezometer borings required for the DSI to provide data of subsurface conditions for the subsequent geotechnical analyses and design of the UWL. This work was completed in accordance with the workplan entitled, *Ameren Missouri Labadie Power Plant Utility Waste Landfill Detailed Site Investigation Work Plan*. The workplan was originally submitted to the Missouri Department of Natural Resources-Division of Geology and Land Survey (MDNR-DGLS) on May 14, 2009, and was approved on June 15, 2009. The results of the field and laboratory work are presented in Appendix 2, "Geotechnical Investigation Report," of the report *Detailed Site Investigation Report for Ameren Missouri Labadie Power Plant Proposed Utility Waste Disposal Area, Franklin County, Missouri*, dated February 4, 2011. The DSI report was subsequently revised on March 30, 2011, in response to questions from the Geological Survey Program (GSP). The GSP approved the DSI and report in a letter dated April 8, 2011.

The field investigation consisted of 119 borings and 93 Cone Penetrometer Test (CPT) soundings for a total of 212 test locations. Of the 119 borings, 22 were temporary geotechnical borings (labeled "B-"), and 97 were piezometer borings (labeled "P-"). The CPT soundings (labeled "C-") were alternated with the piezometer borings on a regular grid-like pattern. The plan of the borings and CPT soundings is shown in **Figure 1**. Some locations were moved from a linear pattern due to geographic restrictions or to better characterize the subsurface conditions. Confirmation borings were made for some of the CPT soundings. Confirmation CPT soundings were also made at randomly selected locations. The 119 borings were in addition to the preliminary geotechnical investigation by Reitz & Jens in 2007, which included the installation of three piezometers and five temporary geotechnical borings. The report of this investigation was included in the Preliminary Site Investigation (PSI) request submitted to MDNR-DGLS in December 2008, and in the approved DSI workplan.

The CPT soundings were made using a 1.5-inch diameter, 100-MPa capacity, electronic piezocone, which records tip pressure, sleeve friction and porewater pressure every 20 millimeters as the cone is hydraulically pushed into the ground at a specified rate. The testing was carried out according to ASTM D5778 "Electronic Friction Cone and Piezocone Penetration Testing of Soils". The final CPT sounding logs are presented in the DSI report. The analysis of the raw data from the CPT soundings is presented in Appendix D of the DSI report, which includes the side by side comparisons between the CPT soundings and other borings to validate the classification of subsurface soil strata developed from the CPT soundings, and comparisons between CPT soundings performed side-by-side in the field to demonstrate the reproducibility of the CPT results.

Details of the field work completed for the DSI and all of the results are presented in the DSI report referenced above.

2.2 Preliminary Investigation of Off-Site Borrow Material at Callaway Plant

Twelve borings made at the potential clay borrow site located at Ameren Missouri's Callaway Power Plant. The borrow site is located in Callaway County approximately one mile east of the Callaway Power Plant on County Road 448 (see **Figure 1** in **Appendix A**). The borrow site was subdivided into areas based upon the present land use and topography. The purpose of these borings was to provide data on the subsurface conditions and to quantify the clay borrow that could be used for construction of clay liner and cover at Labadie UWL. Details of the field investigation and laboratory testing are presented in **Appendix A**. The borings were drilled to termination depths ranging from 14 feet to 31 feet, with some borings terminating on intact bedrock.

Reitz & Jens' report of the preliminary investigation for Ameren Missouri, dated May 25, 2011, is reproduced in **Appendix A**. Subsequent to submittal of our report to Ameren Missouri, Reitz & Jens' performed additional laboratory testing of the high plastic clay to obtain properties for the stability analyses of the liner and perimeter berm. The additional tests included consolidated-undrained (CU) triaxial compression tests with pore pressure measurements on composite samples of the clay compacted to 89% of the maximum dry unit weight obtained from a standard Proctor moisture-density test (ASTM D698-00a), and a direct shear test of the compacted clay with a double-textured 60-mil HDPE membrane. The results of these tests are included in **Appendix A-1**. The results of the CU triaxial tests were: a total cohesion (c) of 420 psf and total internal friction angle (ϕ) of 9.6º; and an effective cohesion (c') of 440 psf and an effective internal friction angle (ϕ') of 14.6º.

We ran direct shear tests of a molded sample of the clay, at a dry unit weight of 99 pcf, with a sample of textured HDPE liner on the bottom plate. This was run in a standard direct shear apparatus with a sample diameter of 2 inches. The peak shear strength properties were: c of 320 psf and ϕ of 29º. The residual shear strength properties were: c of 290 psf and ϕ of 26.9º (see results in **Appendix A-1**).

3.0 LABORATORY TESTING

3.1 Tests on Natural Soil Deposits

All laboratory testing was completed in accordance with the latest applicable ASTM procedures as contained in Reitz & Jens' Quality Manual. Reitz & Jens' soils laboratory maintains an AASHTO Materials Research Laboratory (AMRL) certification from National Institute for Standards and Technology (NIST). Details of the laboratory testing program on soil samples from the site of the proposed UWL and all of the results are presented in the DSI report.

The general purpose of the testing program was to obtain soil properties for the determination of: bearing capacity, short-term and long-term slope stability, seepage characteristics of the top stratum fine-grain soils and the underlying sand strata, liquefaction potential, settlement characteristics, and soil classifications for the potential use of soils for fill materials.

Grain-size analyses (ASTM D422) were performed on selected cohesionless samples (Unified Soil Classifications of SW, SP, SM, GW, GP, or GP-SP). Hydrometer analyses (ASTM D422) were run on 3 selected samples which had a high percentage of fine-grain soils (passing U.S. #200 sieve).

The shear strength properties of a soil mass are dependent about the mineralogy, size and shape of the particles; the density of the soil particles; and the pressure of the water in the pores of the soil mass. When the dry density of a soil is increased, the shear strength generally increases – more for a granular soil (gravels, sands and silts) and less for clays. If a laboratory test is performed on the soil sample at the dry density under existing field conditions, then sample is "unconsolidated." If the first step of a laboratory test is to apply a known pressure to densify the soil sample while draining off the increase in pore pressure under the applied load, then the soil is "consolidated" which more accurately estimates the properties in the field after a period of time under the added weight of the landfill. Pore water pressures in a soil mass also generally increase as the soil is sheared if the soil densifies or consolidates during shearing. If the shear stress is applied quickly, or the pore pressures are not allowed to dissipate, then the measured shear strength properties are "undrained." If the shear stress is applied slowly such that the pore pressures can dissipate during shearing, then the shear strength properties are "drained." This type of test represents the shear strength properties of the soil mass over a long time. Pore pressures dissipate very rapidly in large-grain soils (gravels and sands), so the measured shear strength is always considered to be "drained." If the pore water pressures are measured during shearing, then the pore pressure can be subtracting from the measured stress on the soil mass (called "total" stress) resulting in the "effective" stress. The "effective" shear strength properties are essentially the same as the drained or long-term properties, and are the actual shear strength properties of the soil mass.

Unconsolidated-undrained (UU) triaxial shear strength tests, ASTM D2850 "Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils", were performed on selected Shelby tube samples from each major cohesive soil stratum. The UU tests were performed at the estimated confining pressure of the sample in the field conditions, to measure the *in situ* undrained shear strength of the soil. Nine UU tests were performed.

Series of consolidated-undrained (CU) triaxial compression tests, ASTM D4767 "Consolidated Undrained Triaxial Compression Test for Cohesive Soils," were performed on each major cohesive soil stratum from different locations around the proposed disposal area. The tests were performed with the measurement of internal pore water pressures so that the effective strength properties of the soil could be determined. Each series has a minimum of two points, and three points where possible. Five series of CU tests were performed.

Three one-dimensional consolidation tests, ASTM D2435 "One-Dimensional Consolidation Properties of Soil Using Incremental Loading," were performed on selected relatively undisturbed Shelby tube samples from each major cohesive soil stratum beneath the UWL.

Two flexible-wall hydraulic conductivity tests, ASTM D5084 "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter," were performed on selected relatively undisturbed Shelby tube samples of the upper clays. Also, two flexible-wall hydraulic conductivity tests were performed on samples from the preliminary Boring B-4: one on high plastic clay and one on sandy silt, both of which were obtained from 3.5 to 5.5 feet deep. The data from the hydraulic conductivity tests are included in Appendix B of the DSI Report and are summarized in the following table:

Boring No.	Sample	Depth, feet	Soil Description	k, cm/sec
B-4	ST-2	3.5 – 5.5	High Plastic Clay (CH)	1.2×10^{-8}
B-4	ST-2	3.5 – 5.5	Sandy Silt (SM)	2.0×10^{-3}
B-52	ST-2	4 – 6	High Plastic Clay (CH)	5.6×10^{-9}
P-175	ST-0	1 – 3	High Plastic Clay (CH)	5.5×10^{-8}

3.2 Tests on CCP from Labadie Energy Center

We tested different samples of CCP from the Labadie Energy Center to determine engineering properties to use in the design of the UWL. Samples included: CCP (fly ash) which was collected from the precipitators prior to wetting; CCP from the fly ash pond which had been mixed with water to form a slurry and then was deposited in the pond by sedimentation; and bottom ash. These were tested because the method of transporting the CCP to the UWL may change over time. Initially, the CCP from the existing pond will be excavated, partially dried, and then hauled to the UWL by truck. In the future, Ameren may choose to convey dry CCPs directly to the UWL for moisture conditioning and disposal. The results of the lab testing are reproduced in **Appendix B**.

3.2.1 Tests on Non-Ponded Fly Ash

Bucket samples of dry fly ash were collected at the Labadie Energy Center on December 13, 2008, and again on February 2, 2009. The particle-size distribution was determined using ASTM D422 "Standard Test Method for Particle-Size Analysis of Soils." The fly ash tended to form clumps (i.e. flocculate) in the hydrometer test, so a second sample was mixed with sodium hexametaphosphate (SHMP) which is a dispersing agent to prevent the flocculation of particles. We ran the fly ash with SHMP and without SHMP, to determine the effect on the particle-size distribution. The reports of particle-size distribution

results are presented in **Appendix B.** The reports give the uniformity coefficient (c_u) which is defined at D_{60}/D_{10}, where D_{60} is the particle-size or diameter for which 60% of the dry material by weight is smaller, and D_{10} is the diameter for which 10% of the material by weight is smaller. A c_u of 1 is perfectly uniform, and a c_u greater than 6 may be well-graded by the Unified Soil Classification System (USCS). The reports also give the percentage by weight finer than a U.S. #30 sieve (0.60mm). The plots of particle-size distribution clearly show the flocculation of the sample: without SHMP, the distribution is almost uniform (c_u = 1.69); with SHMP, the distribution is well-graded (c_u = 10.86). The fly ash sample had about 93% finer than a #200 sieve (0.075 mm).

The bulk specific gravity (SG) was determined using ASTM D854 "Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer." The SG of the non-ponded fly ash sample was 2.87.

The fly ash sample was very pozzolanic and hardened in a few minutes after it was mixed with water. To run a standard Proctor Moisture-Density Test (ASTM D698), we mixed five samples of the fly ash at selected moisture contents (MC) between 8.5% and 20%, and then grated the moistened fly ash before it had completely hardened. Thus, the methodology does not mimic field procedures, and would be expected to create a sample with lower measured strength than will occur in the field. The results are presented in **Appendix B**. The maximum dry unit weight ($\gamma_{d,max}$) was 107.9 lbs/ft^3 (pcf) and the optimum moisture content (w_{opt}) was 17.3%. The cylinders molded from the Proctor test were trimmed immediately to a diameter of 2 inches and appropriate height, and then were broken the next day in unconfined compression tests. The results are presented in **Appendix B**. The moist unit weights and 24-hour unconfined compressive strengths (Q_u) were:

Molded Moisture Content %	Moist Unit Weight lbs/ft^3	Unconfined Compressive Strength, Q_u Psi
11.3	116	158
15.5	127	156
16.3	127	108
20.0	127	71

This testing shows that the non-ponded fly ash when wetted and semi-compacted will achieve much greater cohesive shear strength than soil. However, a lower strength was used for the non-ponded fly ash in the analyses for the UWL to eliminate the need for construction quality control during routine placement of non-ponded fly ash in the UWL. Also, this means that the stability and seismic analyses completed for the UWL and reported herein are very conservative with regard to the placement of non-ponded fly ash in the UWL.

We ran a flexible-wall hydraulic conductivity test on the non-ponded fly ash. A sample was molded at 22.5% moisture, that is about 5% wetter than optimum. The initial dry unit weight of the sample was 101.4 pcf, or a moist unit weight of 124.2 pcf. The results of the hydraulic conductivity test are presented in **Figure B-5** in **Appendix B**. The hydraulic conductivity (k) was 8.3×10^{-6} cm/sec.

A one-dimensional consolidation test was run on a molded sample of the non-ponded fly ash to determine its compressibility. The moist unit weight of the sample was 117.5 pcf. The fly ash was mixed at a moisture content of 22.5%; however, due to the pozzolanic action the measured moisture content after molding was 8.2%. The coefficient of consolidation (C_c) was 0.02. The calculated previous consolidation pressure (P_c) was 1.0 tons/ft^2. The results are presented in **Appendix B, Figure B-6.**

To estimate the probable moist unit weight of the non-ponded fly ash if it were wetted and lightly compacted in the UWL, we determined the dry unit weight of a sample of non-ponded fly ash that was densified in a mold using a vibratory table similar to the maximum density test (ASTM D4254) but without using a confining weight. The dry unit weight was 92 pcf. We then determined the maximum moisture content that would pass the paint filter test (Environmental Protection Agency Method 9095B, Rev. 2, November 2004), which was 21.6%. It would not be necessary nor desirable to add this much water to the dry fly ash for handling and placement in the UWL. However, this represents the probable moist unit weight (112 pcf) that might be achieved in the UWL without applying a controlled compaction effort. Therefore, this moist unit weight was used for the non-ponded fly ash in the various analyses.

3.2.2 Tests on Ponded Fly Ash

We ran a series of tests on a bucket sample of fly ash from the operating pond at the Labadie Energy Center. The sample was saturated when it arrived at our lab. The sample was air dried to a moisture content of 8%. We assumed that the fly ash would be excavated and dried at the pond until it would pass the paint filter test. A dry sample of fly ash was run through a U.S. #4 sieve (4.75mm opening). Water was added to achieve a specific moisture content. The water and dry sample were mixed by hand to obtain a uniform consistency. The duration of mixing was not more than 1 minute. Then, a 100-gram sample was placed in the #60-mesh conical paint filter and a timer was started. If no water dripped from the filter in 5 minutes, then the wetted sample passed the test. We determined that the ponded fly ash could pass the paint filter test if dried to a moisture content of 55%.

A sample of ponded fly ash was molded with light compaction to a dry unit weigth of 60 pcf and at a moisture content of 55%. The light compaction was to simulate placing the fly ash in the UWL using only compaction by tracked earth moving equipment, that is not compacting the fly ash to a specified dry unit weight. We determined that the minimum dry unit weight is about 60 pcf (moist unit weight of about 90 pcf). A staged consolidated-undrained triaxial compression tests with pore pressure measurements was run on the molded sample. The results are presented in **Figure B-7**. The effective friction angle (ϕ') was 36.4°.

Each cell of the UWL will be filled initially using fly ash from the existing pond. Therefore, the ponded fly ash will be in contact with a portion of the HDPE membrane of the top cover. We ran direct shear tests of a molded sample of the fly ash, at a dry unit weight of 60 pcf, with a sample of textured HDPE liner on the bottom plate. This was run in a standard direct shear apparatus with a sample diameter of 2 inches. We also ran direct shear tests of a molded fly ash sample against smooth HDPE liner. The peak interface friction angles (δ) were 35.2° against the textured HDPE liner, and 21.0° against the smooth HDPE liner. The residual interface friction angles were 35.2° against the textured HDPE liner, and 17.5° against the smooth HDPE liner (see results in **Appendix B**). The peak and residual interface friction

angles are similar to those reported by Koerner and Narejo (2005) for granular soil and textured HDPE liner from numerous direct shear tests:

Interface	Peak Shear Strength		Residual Shear Strength	
	Interface Friction Angle	Cohesive Shear Strength	Interface Friction Angle	Cohesive Shear Strength
Textured HDPE / Granular Soil	34º	0	31º	0
Textured HDPE / Cohesive Soil	18º	200 psf	16º	0
Textured HDPE / NW-NP* Geotextile	25º	160 psf	17º	0
NW-NP Geotextile / Granular Soil	33º	0	33º	0
NW-NP Geotextile / Cohesive Soil	30º	100 psf	21º	0

*Non-woven – Needle-punched

We ran a flexible-wall hydraulic conductivity test on the ponded fly ash. A sample was molded at 55% moisture content (the maximum moisture content that will pass the paint filter test). The initial dry unit weight of the sample was 59.2 pcf, or a moist unit weight of 90.4 pcf. The results of the hydraulic conductivity test are presented in **Figure B-10**. The hydraulic conductivity (k) was 4.5×10^{-5} cm/sec.

A one-dimensional consolidation test was run on a molded sample of the ponded fly ash to determine its compressibility. The moist unit weight of the sample was 94.9 pcf. The coefficient of consolidation (C_c) was 0.25, with an apparent pre-consolidation pressure (P_c) of 2.46 tons/ft^2. The results are presented in **Figure B-11.**

3.2.3 Tests on Bottom Ash

A sample of the bottom ash from the Labadie Energy Center was collected from the pond on December 17, 2009. The particle-size distribution results are presented in **Appendix B**. The bottom ash is poorly-graded with particle-sizes ranging from fine gravel to fine sand, with only 1% fines (passing a #200 sieve or 0.075 mm). The Specific Gravity of the bottom ash sample was 2.80.

The compaction of granular materials is based on the minimum and maximum densities determined by laboratory tests (ASTM D4253 and D4254). The minimum dry unit weight of the bottom ash is 83.6 pcf, and the maximum dry unit weight is 109.6 pcf, based upon our tests. Relative densities (D_r) of compacted granular fill in the field typically range from about 55% to 75%, which for the bottom ash sample would be dry unit weights of about 96 pcf to 102 pcf.

A staged unconsolidated-undrained triaxial compression test was run using an applied vacuum to hold the sample until the triaxial cell could be assembled. The results are presented in **Figure B-15**. The bottom ash had a ϕ' of 40.3° at a dry unit weight of about 90 pcf (D_r = 30%). There was no cohesion.

A constant-head permeability test was run on a sample of bottom ash molded at a dry unit weight of 81.7 pcf. The permeability (K) at 20°C was 0.50 cm/sec. A second sample molded at a dry unit weight of 96.3 pcf had a K at 20°C of 0.07 to 0.10 cm/sec.

3.2.4 Tests on Mixtures of CCP

We ran tests on possible combinations of fly ash, FGD gypsum and bottom ash. The ponded fly ash and bottom ash were from Ameren's Labadie Energy Center. Because it is not currently produced at the Labadie Energy Center, the gypsum was obtained from Ameren's Duck Creek Energy Center. We made cylinders of 3 different ratios of materials in the same manner described above for the fly ash alone. The 3 ratios were: 1) 46% fly ash, 20% bottom ash, 34% gypsum; 2) 30% fly ash, 25% bottom ash, 45% gypsum; and 3) 36% fly ash and 64% gypsum. The dry unit weights of the mixtures varied from 99 pcf to 87 pcf – compared to the 92 pcf dry unit weight which we determined for the non-ponded fly ash alone. The primary assumption that impacts the moist unit weight is how much water will be added to the mix prior to placement in the UWL. If only 13% water were added – which is reasonable – then the 112 pcf for the moist unit weight is appropriate for the heaviest dry mix (46% fly ash, 20% bottom ash and 34% gypsum). If we were to assume that Ameren added as much water as possible to the heaviest dry mix, then the maximum moist unit weight is estimated to be 120.4 pcf. The addition of more water to the CCP than is necessary is a time-consuming and costly activity. Therefore, it is unlikely that the in-place moist unit weight will reach 120.4 pcf and is not representative of what will occur during landfilling operations. Therefore, we used a moist unit weight of 112 pcf for the non-ponded CCP in our analyses, but ran sensitivity stability and settlement analyses to determine the possible impact of this extreme maximum moist unit weight for the combined CCP.

Gypsum and bottom ash both have larger grain-size particles than fly ash. The addition of gypsum or bottom ash to the CCP will increase the shear strength properties of the mixed CCP. Therefore, we used the shear strength properties of the fly ash alone in our stability analyses, which is conservative.

3.3 Tests on Samples from Callaway Plant Borrow Site

Details of the laboratory testing on samples from the clay borrow site at the Callaway Plant are presented in **Appendix A.** Geotechnical soil tests performed included water content (ASTM D2216) and dry unit weight, Atterberg Limits (ASTM D4318), soil finer than the #200 sieve (ASTM D1140), and grain size analysis of soil (ASTM D422). The grain size analyses were performed on samples where more than 10% by weight was retained on the #200 sieve. The results of the sieve analyses are reported in **Appendix A**. Additional tests for shear strength properties were run as described in Section 2.2 and presented in **Appendix A-1**.

3.3.1 Regulatory Requirements for Clay Liner Material

Soils for the liner must have the following properties from 10 CSR 80-11.01(10):

- Have particles with 30% or more passing a #200 U.S. sieve
- Have a liquid limit $\geq$ 20%
- Have a plasticity index $\geq$ 10%
- USCS Soil Classification of CL, CH or SC

3.3.2 Hydraulic Conductivity Tests

We collected the leftover materials from the Shelby tubes and produced two composite samples for further laboratory testing. The first composite contains silt and low plastic silty clay, and the second contained high plastic clay. Compaction tests were performed on both composites using the Standard Proctor procedure according to ASTM D698. A hydraulic conductivity test according to ASTM 5084 was completed using the silty clay Proctor point compacted nearest to 95% of the maximum dry unit weight and on the wet side of the optimum moisture content. We selected the sample with the lower liquid limit of the two clays that were compacted. The test results determined that the silty clay sample had a hydraulic conductivity (k) of $1.1x10^{-8}$ cm/sec. Clays with liquid limits greater than that tested (37%) and compacted to a similar degree will have hydraulic conductivities equal to or less than the composite sample that was tested.

3.3.3 Suitability of Callaway Plant Borrow Site

The results of the laboratory testing are summarized in **Figure 3** in **Appendix A**. Liquid Limits ranged from 28% to 101%. Plasticity indices ranged from 16% to 33%. All of the samples had 40% or more passing the #200 sieve. Therefore, all the soils described in the boring logs as low plastic silty clay, low plastic clay, medium to high plastic clay, and high plastic clay without significant amounts of sand and gravel, satisfy the requirements to be used for the compacted clay liner at the Labadie UWL.

3.3.4 Estimate of Quantities of Borrow Materials

Calculations of the estimated quantities of borrow materials are presented in **Appendix A**. The linear footage of liner quality clay in each boring was estimated using only clay with a liquid limit greater than 40 and which did not have a significant amount of sand and gravel. We estimated that clays with these parameters will result in hydraulic conductivities of less than $1x10^{-7}$ cm/sec when compacted. The total estimated amount of liner quality clay available is roughly 4.5 million cubic yards.

A second calculation was made in the same manner as the first, but using all fine-grain soils (silts and low plastic clays) that did not have significant amounts of sand and gravel. The total estimated amount of available fine-grain soil is roughly 5.7 million cubic yards. All of the fine-grain soils that do not have significant amounts of sand and gravel are expected to be suitable for the compacted clay liner; however, the additional 1.2 million cubic yards would also be suitable for final cover.

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 General Stratigraphy

The site of the UWL is located in the flood plain of the Missouri River. Soil deposition in the flood plain of a river is dependent on the velocity of the water – as the flood waters slow the larger size particles are deposited first, and then the finer particles. The velocities of the water vary over the flood plain and with each flood as the topography changes. Therefore, soil deposits in a flood plain ("alluvial" deposits) vary greatly both with depth and in horizontal extent. The borings and CPT soundings at the site revealed a typical alluvial stratigraphy.

The generalized logs are illustrated in the profiles in **Figures 2 through 5**. The graphic logs for the CPT soundings were derived from the detailed logs in the DSI Report. The surface soils are generally clays and silty clays with scattered seams and layers of low plastic silt, underlain by silts. The thicknesses of these fine-grain deposits ranged from 2 to 13 feet. Profile D-D' (**Figure 5**) is from the Missouri River to the southern boundary of the site. There is not an overall pattern to the stratification of the upper fine-grain soils, except for the presence of clayey sandy silt at the surface near the southern end. Section B-B' (**Figure 3**) is west to east across the site. Section B-B' also does not show an overall pattern in the upper fine-grain soils.

The upper fine-grain soils are underlain by sandy silts, silty fine sands, and fine sands, generally to depths of 22 to 36 feet. These upper sandy soils are generally loose to medium-dense. The upper sandy soils are underlain by fine to coarse, poorly-graded sands (SP), with some silty sands (SM) and gravelly sands at greater depths. These lower sands generally ranged from medium dense to very dense, increasing in density with increasing depth.

Three deep borings were extended to drilling or sampler refusal on bedrock or boulders. The final depths of the deep borings were: 91.5 feet in P-1, 104.5 feet in B-7, and 107.6 feet in B-100.

4.2 On-Site Materials Available for Liner and Final Cover

The stratification of the upper fine-grain soils makes it very problematic to consistently obtain suitable clay liner material within the DSI boundaries. We judge that there is a low probability of obtaining sufficient quantity of clay liner material.

The surface fine-grain soils are suitable for intermediate or final cover material even though it would contain some fine sand. However, the high ground water levels will hinder deep borrow excavations.

4.3 Materials for Berm Construction

The surface soils within the DSI limits would be suitable for the construction of the perimeter berms. The only requirements for the perimeter berms would be the shear strength properties that were used for design, which are presented in **Table E-1** and summarized in Section 10.1.

4.4 Groundwater Levels

The existing ground surface ranges from about el. 471 to el. 465[1] below the current planned footprint of the bottom of the UWL. The areas of lower ground surface elevations (below about el. 464) located in the southeast region of the site have been excluded from the proposed developed area of the UWL.

The ground water levels at the site were monitored monthly for the DSI from December 2009 through November 2010. The data show that the alluvial aquifer discharges toward the Missouri River during periods of relatively low flow, during which time the ground water levels below the site will be 1 to 3 feet above the Missouri River level. However, when the Missouri River is above about el. 461 for a sustained period, the ground water flow reverses and the ground water levels approach the level of the Missouri River near the river (in the northwest portion of the site) and about 5 feet or more below the river level over the majority of the site. There is still a slight downward gradient toward the northeast, that is downstream.

An analysis of the observed ground water levels correlated with the Missouri River levels at the Labadie Energy Center is presented in Appendix Z of the Construction Permit Application. Based upon the 12 months of monitoring of ground water levels at the site and almost 11 years of daily Missouri River level readings at the Labadie Energy Center, using el. 464 as the average "Natural Water Table" at the site would appear to be an extreme event that occurs for a relatively short duration only about two times in a 10-year period. While it is rare that groundwater levels will ever reach the existing ground surface beneath the UWL, due to the variability of the ground water levels and to be conservative, the ground water was assumed to be at the ground surface in our stability analyses.

[1] Elevations herein refer to the North American Vertical Datum of 1988 (NAVD88) which is the datum used in FEMA's new Flood Insurance Rate Maps (FIRM). NAVD88 corrects many of the problems with the earlier NGVD of 1929.

5.0 SEISMIC RISK ANALYSES

5.1 Peak Horizontal Ground Acceleration (PHGA)

Several approaches were taken to determine the peak horizontal ground acceleration (PHGA) for the proposed UWL. The PHGA is critical for determination of slope stability under seismic loading, liquefaction potential, liquefaction settlement, potential of lateral spreading, and slope deformation. The design earthquake for this project is a 2475-year reoccurrence earthquake, or 2% probability of exceedance in 50 years (approximately equivalent to 10% probability of exceedance in 250 years). The procedure that was used followed EPA 1995 Manual *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*, and the 1998 *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by the MDNR Solid Waste Management Program and Timothy Stark, Ph.D., P.E. of the University of Illinois at Urbana-Champaign.

5.1.1 PHGA from USGS Maps

The published 2008 USGS hazard map for the project site is reproduced in **Figure C-1** in **Appendix C**. This is the latest map available from the USGS website. The probabilistic PHGA for the design earthquake at the Labadie site is 0.179g (that is, 17.9% of standard gravity acceleration of 32.2 feet/sec^2). This value takes into account attenuation of bedrock shaking with distance from the probable sources and general soil interactions such as damping for a hypothetical soil profile. This value is meant to be a conservative estimate.

USGS deaggregation data were used to determine the approximate hard bedrock "outcrop" acceleration and earthquake magnitude. These data were found on the USGS website and are shown in **Figures C-2 and C-3** for St. Louis and for Labadie, respectively. The 2475-year earthquake peak hard bedrock acceleration for St. Louis and Labadie are 0.153g and 0.111g, respectively. The peak hard bedrock acceleration at Labadie is less than that for St. Louis due to attenuation of the wave from the epicenter of the probable earthquakes. Based upon the data, the most probable earthquake magnitudes (M_w) for these accelerations are between 7.0 and 8.0.

5.1.2 PHGA from SHAKE2000 Analyses

A site-specific seismic analysis was completed using the program SHAKE2000. Whereas the other procedures use generalized parameters for the soil properties and earthquake motions, this procedure is more site-specific because it uses lab and field data for the soils, coupled with earthquake acceleration time histories. A site-specific seismic analysis has two components – to determine the probable seismic acceleration (or "time history") for the bedrock beneath the site, and to determine the impact or amplification of the seismic acceleration at the ground surface due to the soils.

Ten pseudo bedrock acceleration time-histories specific to St. Louis were used in the analyses. These bedrock time-histories are provided with SHAKE2000 and illustrate the variety of earthquakes that affect this area. The development of these pseudo earthquakes is documented in the Chiun-Lin Wu and Y.K. Wen (1999) report "Uniform Hazard Ground Motions and Response Spectra for Mid-American Cities." Their method of simulation is based on the latest seismicity information in the region, and the most recent

ground motion and simulation models that are appropriate for engineering applications in this region. The seismological data are mainly from the USGS open-file Report 96-532. The sets of ground motions were selected from a large pool of simulated ground motions such that the median of the response spectra matched those of the 10% and 2% exceedance in 50 years. Wu and Wen generated 8290 ground motions for St. Louis centered at 38.667º north latitude and -90.190º east longitude, which corresponds to about 6000 years of records. This point is about 35 miles closer to the probable sources of seismic events than is the Labadie UWL site. Therefore, this is considered a conservative assumption in that the bedrock accelerations at the site are expected to be less than those in the pseudo time-histories generated by Wu and Wen. All 10 provided pseudo earthquakes that had a 2% probability of exceedance in 50 years were used in our analyses. The earthquake magnitudes ranged from 5.9 to 8.0, with most being of magnitude 8. Bedrock peak accelerations averaged 0.104g, which is approximately equal to the deaggregated peak bedrock acceleration of 0.111g from the USGS data for the Labadie site. Plots of the earthquake pseudo bedrock acceleration time histories from Wu and Wen are shown in **Appendix C**.

The second step in the site specific seismic analyses – determination of the impact or amplification of the seismic acceleration at the ground surface due to the soils – was completed using the SHAKE2000 computer program. The seismic soil properties were determined based upon Boring B-100 and CPT sounding C-100. Boring B-100 was chosen because it is centrally located on the site and it extended to refusal on firm bedrock. The CPT data from C-100 were used for the top 5 feet of silts and clays. The seismic properties (shear wave velocities, damping and shear modulus) were derived from SHAKE2000 using input soil classifications, unit weights and shear strength properties from Boring B-100 and CPT sounding C-100. The inputs and outputs are included in **Appendix C**. From the analysis of these 10 pseudo bedrock time-histories, the calculated average PHGA is 0.144g for the existing site conditions, compared to 0.179g from the USGS website. Because the PHGA from the USGS hazard map is greater than that derived from our SHAKE2000 analyses for the existing site conditions, we chose to use the more conservative published USGS PHGA of 0.179g in our analyses. The SHAKE2000 time-histories were used in the Newmark analyses of deformation as described in Section 5.3.

Subsequent SHAKE2000 analyses were performed using a long-duration and a short-duration earthquake in order to determine the PHGA of the proposed landfill. These analyses were run for a 24-foot high embankment placed on the native soil, and for 100 feet of compacted CCP fill placed on the native soil. In both cases, the PHGA was found to be significantly less than the existing site conditions. This was anticipated due to the additional vertical compressive stresses in the soils created by the imposed weight of the landfill. These analyses are conservative in that they do not take into consideration the densification of the soils and the resultant increase in shear strength properties. After placement of the earthen embankment, PHGA was estimated to be 0.08g at the top of the berm and 0.12g at the bottom. After completion of the CCP fill, PHGA are anticipated to be 0.07g to 0.08g at the top of the fill and 0.10g to 0.11g at the bottom.

5.2 Liquefaction Analyses

Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that nearly all the strength of the soil is lost. After ground shaking has stopped, the soil will potentially reconsolidate to denser configuration, which results in settlement. Liquefaction is most problematic in loose sandy soils with less than about 35 percent fines

(soils which are finer than standard sieve size #200), but can occur in very loose soils with up to 50 percent fines, and soils up to the size of fine gravel. Because these types of soils are present throughout the site, analyses were run on every geotechnical boring and CPT hole made on site. These results are included in **Appendix D**.

Factors of Safety (FS) against liquefaction were calculated for both CPT and SPT borings using the cyclic stress approach outlined in Idress and Boulanger (2008). The SPT borings were analyzed using N-values for clean sand and corrected for vertical overburden stress, termed $(N_1)_{60\text{-}cs}$ and the fines contents of the soils determined from laboratory grain size tests. The CPT soundings were analyzed using the cone tip pressure, which was corrected for overburden pressure and fines content, termed $(q_{1N})_{CS}$. The content of fine-grain soils in the CPT soundings were determined from correlation soundings and borings that were performed at the same location. We conservatively determined from these tests the following fines contents associated with the descriptions used on the CPT Logs:

CPT Log Descriptive Phrase	Fines Content (%)
Sand	1
Sand to Silty Sand	10
Silty Sand to Sandy Silt	36

The above values were the smallest fines contents found in a boring adjacent to the CPT sounding for the same CPT description, in all cases.

The design earthquake used for the calculations had a PHGA of 0.179g and magnitude (M_w) of 7.5. We used the PHGA from the USGS for the existing conditions, rather than 0.144g, because this is more conservative.

The borings and CPTs were analyzed for current ground surface conditions and for cases involving the addition of CCP fill up to 100 feet. For the cases with this additional overburden, only the effective and total overburden stresses were modified on the cyclic stress side of the liquefaction equation. We conservatively did not consider the higher resistance to liquefaction that would be gained by densification of the underlying sands due to consolidation. For each boring, in order to quantify the boring's liquefaction potential as a whole; the incremental depth factors of safety were inverse averaged together. The inverse average weighs the factors of safety with much greater weight placed on the lower values. (This same averaging procedure is used in the International Building Code 2009 for the development of the seismic site classification.) The borings and CPTs with factors of safety less than or equal to 1.0 are shown in **Figure D-3** along with those with factors of safety less than 1.0 after 10 feet of CCP fill is placed. This figure shows the effectiveness of adding fill to decrease liquefaction potential. After 20 feet of CCP has been placed, there are no cases which still have an inverse average factor of safety less than or equal to 1.0. Additionally for demonstration purposes, the inverse averaged factors of safety were averaged together across the site, and plotted versus the height of CCP fill. This is shown in **Figure D-1**.

5.3 Estimate of Yield Acceleration and Lateral Spreading

The criterion for the seismic stability analyses of a landfill is based upon the estimated lateral deformation or spreading that may occur, rather than a factor of safety against failure with a pseudo-static seismic load (MDNR-SWMP and Stark, 1998). The procedure described by MDNR-SWMP and Stark is to calculate the yield acceleration (K_y) for the landfill geometry for which the pseudo-static seismic load results in a minimum factor of safety against slope failure of 1.0. The K_y is compared to the ground accelerations in a time-history. When the ground acceleration exceeds the K_y the associated lateral displacement is calculated using the empirical relationship developed by Makdisi and Seed (1978). Therefore, the lower the K_y of the landfill geometry with respect to the PHGA, the greater the deformation or displacement. The guidance document (MDNR-SWMP and Stark, 1998) provides an empirical graph of displacement versus the ratio of PHGA to K_y. The lateral displacement is more accurately calculated by summing over the time-history all of the displacements in the same direction. The procedure, developed by Newmark (1965), is part of the SHAKE2000 program. The proposed geometry of the berm and CCP fill was analyzed in SHAKE2000 for both a short-duration time-history (#10, M_w = 5.9, Peak rock acceleration = 0.17g, PHGA = 0.19g) and a long-duration time-history (#3, M_w = 7.1, Peak rock acceleration = 0.08g, PHGA = 0.16g). The estimated cumulative displacements for a range of yield accelerations are given in the following table:

Calculated Cumulative Lateral Deformations from SHAKE2000 Analyses

Yield Acceleration K_y	Deformation for Short-Duration Event, inch	Deformation for Long-Duration Event, inch
0.165g	0.0004	0.0
0.15g	--	0.001
0.10g	0.02	0.05
0.05g	0.73	1.02
0.04g	1.28	2.16
0.03g	2.32	4.43
0.025g	3.14	6.12

When the calculated K_y is greater than the ground acceleration in the time-history, there is no deformation. The Missouri regulations for a utility waste landfill (10 CFR 80-11.010) do not specify the maximum allowed deformation. The regulations for a sanitary landfill (10 CFR 80-3.010) stipulate that the cumulative lateral deformation must be less than 6 inches. From the above SHAKE2000 analyses, the maximum allowable cumulative lateral deformation is estimated to occur when the calculated K_y is about 0.025g.

6.0 STABILITY ANALYSES

6.1 Stability of Final CCP Landfill

Slope stability analyses were performed on the proposed UWL profile. Generalized soil profiles were developed for 5 widely-spaced sections, the locations of which are shown in **Figure E-1** in **Appendix E**. The soil and CCP properties used in the slope stability analyses are shown in **Table E-1** and depicted graphically in **Figures 6** and **7**. These were based upon the laboratory soil testing and field testing (SPT N-values and CPT soundings) described in the DSI Report, and the laboratory testing of the CCP summarized in Section 3.2.

The slope stability analyses were performed using the computer program SLIDE 5.0. This program uses the Spencer method, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum factor of safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points. The input to the slope stability analyses and graphical representations of the results are included in **Appendix E**. The results of the stability analyses are summarized in **Table E-2**.

6.1.1 Static Analyses

Stability analyses were run for each of the five cross-sections of the UWL and subsurface soil stratification for the initial filling of the CCP and for the final configuration of the CCP, for: 1) static, 2) with seismic load (horizontal pseudo-static seismic load) and 3) with residual shear strength in potential liquefied subsurface soil strata. The appropriate shear strength properties for the CCP, compacted liner, and subsurface soils were used for each case, as previously discussed and as listed in **Table E-1**.

The DSI determined that clay will have to be imported for the compacted clay liner. Therefore, the properties of the clay liner will have to be determined by laboratory testing after the clay borrow sources are identified. For these analyses, we used conservative properties for the compacted clay liner, and interface shear properties, based upon previous testing on appropriate clays and representative published values. We used a minimum moist unit weight for the clay liner of 115 pcf, an unconsolidated-undrained cohesive shear strength (c) of 600 psf and a $\phi = 0$, and an effective ϕ' of 25° for drained conditions. We did not include the slightly higher unit weight and ϕ of the leachate collection layer (if used) and the protective aggregate layer for the global stability analyses because we used circular failure surfaces for the global stability analyses and the impact of an interface plane in the composite liner would be insignificant for a circular failure surface.

To analyze the impact of the interfaces of the HDPE and geocomposite on the slope stability, we also ran "sliding block" analyses. For the minimum shear strength along an interface in the composite liner or the geocomposite, we used a ϕ of 15° along the base of the block and no cohesion. We used a slightly higher unit weight of 120 pcf for the leachate collection layer (if used) or the protective aggregate layer that

would be above the composite liner. These minimum design values should be confirmed by laboratory testing on the identified borrow clays, HDPE and geocomposite at the time of construction.

The MDNR-SWMP regulations do not specify a minimum factor of safety. The guidance document (MDNR-SWMP and Stark, 1998) recommends a minimum factor of safety of 1.5 for static stability analyses.

When each phase is constructed and authorized to accept CCP, it will be initially filled with about 18 feet of ponded CCP (approximately el. 483), for protection against heave of the liner during Missouri River flooding. This "initial" configuration was analyzed using short-term (i.e. "undrained") shear strength properties. The minimum FS ranged from 2.30 to 3.19, which is greater than the minimum required factor of safety (FS) of 1.5. The initial configuration was also analyzed using long-term (i.e. "drained") shear strength properties. The minimum FS ranged from 1.45 to 2.70, which are essentially 1.5 or greater. The actual FS in the long-term will be greater because the "initial" configuration is temporary and the fully drained shear strength properties are conservative.

It may happen in later phases of the project that previously-ponded fly ash will not be available. The laboratory tests on non-ponded fly ash described in Section 3.2.1 show that the shear strength properties of the non-ponded, moisture-conditioned fly ash are greater than that of the previously-ponded fly ash. Therefore, using the lower shear strength properties of the previously-ponded fly ash is conservative. A greater moist unit weight of 112 pcf was used for the CCP above the initial height of 18 feet in anticipation of the use of non-ponded CCP in the future.

The global stability of the completed UWL was analyzed using drained strength properties. The FS of the global stability of the CCP and berm varied from 1.46 to 2.27. The actual FS would be greater because these analyses did not incorporate the compressive strength of the CCP due to cementation, nor the gain in shear strength of the foundation soils due to consolidation.

The static analyses of a non-circular failure surface along the composite liner had a static FS of 1.99. A interface friction angle (d) of 15º was used, to represent the minimum shear strength properties of the clay liner and textured HDPE interface, the HDPE-drainage layer interface, or the interface between the lightly-compacted CCP and the drainage layer.

6.1.2 Seismic Analyses

Numerous stability analyses were completed to determine the yield acceleration (K_y) for both the initial configuration and the final or full configuration of the landfill, as well as failure along the interface of the composite liner. For seismic analyses, we used the consolidated-undrained shear strengths of the CCP and the compacted clay liner because seismic loading is an undrained condition. The results of the stability analyses are shown in **Appendix E** and the calculated yield accelerations are summarized in **Table E-2**. The calculated K_y ranged from 0.13g to 0.17g for the full cell. The minimum K_y of 0.13g was found for the long-term conditions for the full landfill at Section B-B' and for sliding along the interface of the composite liner. From the table in Section 5.3, the calculated cumulative deformation is less than 0.05 inch, much less than the maximum of 6 inches allowed under 10 CFR 80-3.010. As a check, we also determined the lateral deformation for this section and K_y utilizing the pseudo bedrock

short time-history #2 (see **Appendix C**), which had a lower magnitude than pseudo bedrock short time-history #3 but a slightly higher peak bedrock acceleration. The calculated cumulative deformation was 0.016 inch. For comparison, MDNR-SWMP and Stark (1998) state that when the K_y is equal to or greater than 80% of the PHGA, then the lateral spreading should be less than 1 cm (approximately 0.4 inch).

6.1.3 Impact of Potential Liquefaction

At the locations where the liquefaction analyses indicated a high potential for liquefaction in existing soil strata prior to the construction of the berm and CCP fill, residual cohesive shear strengths were input for the liquefied soil strata. The residual cohesive shear strengths were interpolated from the empirical relationships recommended by Gutierrez, et al (2004), Stark and Mesri (1992), H. Bolton Seed (1987), and Seed and Harder (1990), based on corrected N-values with corrections for fines content.

Both the initial configuration of the CCP and perimeter berm and that of the full UWL were analyzed using the post-liquefied shear strengths of the subject soil strata and no applied horizontal acceleration in accordance with the draft technical guidance document from MDNR-SWMP and Stark (1998). The results are summarized in **Table E-2**. The minimum factor of safety against the onset of liquefaction (FS_{liq}) ranged from 1.76 to 1.98 for the initial configuration, and from 1.46 to 1.77 for the completed UWL. A minimum FS_{liq} of 1.2 to 1.3 is recommended by Idriss and Boulanger (2008) to allow for errors in estimation of residual shear strengths and to limit shear strains. MDNR-SWMP and Stark (1998) suggest the same minimum FS_{liq}. Therefore, the stability of the UWL is shown to be adequate when anticipated liquefaction is present. As a sensitivity check of the conservative nature of our assumptions, we also ran the stability analyses of the five UWL sections with the fully liquefied soil strata without consideration of the impact of the overburden stress due to construction of the berms and CCP fill, as shown in Figure D-3. The FS_{liq} for this conservative assumption ranged from 1.13 to 1.72, which are slightly less than the above criterion but greater than 1.1 which is acceptable.

Before sufficient CCP fill has been placed in the UWL to eliminate the risk of liquefaction, there may be a slight risk of damage to the partially completed berms and composite liner as a result of lateral spreading, settlement or formation of sand boils. We back-calculated the "threshold" ground acceleration for the onset of liquefaction for select critical locations. The minimum back-calculated threshold ground acceleration is 0.10g. Therefore, if a seismic event would occur with a ground acceleration greater than 0.10 g before sufficient berm or CCP fill had been placed, then an investigation would have to be completed to determine whether the composite liner had been damaged. This investigation could be completed in stages. The initial stage would be a survey of the perimeter berms in those areas indicated in **Figure D-3** as the highest potential areas of liquefaction. The survey would determine whether settlement or lateral movement had occurred. Also, the area outside of the perimeter berms should be visually examined for evidence of settlement, lateral movement or sand boils. If there were evidence of liquefaction from the initial investigation, then the adjacent storm water pond would be drained for visual examination, and the bottom composite liner would be surveyed to compare with the final survey of the completed liner. If there were evidence of heave (due to sand boils), water under the HDPE liner, differential settlement, or damage to the liner, then the final stage would be to remove CCP in the affected area of the cell to examine the composite liner for similar evidence of damage. Any damaged area of the composite liner in either the storm water pond or the cells would have to be removed and replaced.

6.1.4 Stability Analyses with Potential Clay Liner Material from Callaway Plant

The potential borrow source for clay liner material at the Callaway Energy Center was identified after the initial stability analyses were completed. Subsequently, we used the shear strength properties for the Callaway clay liner material to check our stability analyses. The shear strength properties are summarized in Section 2.2 and are presented in **Appendix A-1**. The impact of the shear strength properties on the global circular stability analyses is minimal due to the thickness of the compacted clay liner. We ran a sliding block stability analysis with a failure surface through the clay liner. The results are presented in **Figure E-44**. The minimum global stability FS is 1.98, compared to the FS of 1.99 for the assumed clay liner material properties. The minimum K_y for the Callaway clay liner material is 0.145g (see Figure E-45) compared to K_y of 0.13g for the assumed clay liner material properties. Therefore, the use of the clay liner material from the Callaway Energy Center would result in the same calculated FS and greater K_y compared to the assumed clay liner material properties.

6.2 Stability of Interior CCP Berms

Interior berms are proposed to be constructed using compacted CCP from the existing ash pond. These berms would be temporary and between cells, and will eventually be buried by the CCP fill. The composite clay liner and drainage layer would extend under the interior berm, to permit extension of the liner and drainage layer for the next cell. The FS for the slope stability of the interior berm was analyzed using the drained shear strength properties of compacted CCP. The CCP should be compacted to a minimum 95% of the maximum dry unit weight from a standard Proctor moisture-density test. The minimum FS for a global circular slope failure and the full height of CCP fill is 1.91. The minimum FS for a sliding block failure along the extension of the composite clay liner and drainage layer beneath the interior berm is 1.59. The K_y is 0.06g for a sliding block failure. From the table in Section 5.3, the calculated lateral deformation is about 1 inch, which is less than the maximum allowable 6 inches.

6.3 Stability of Final Cover

The stability analysis of the final cover on the side slopes is shown in **Appendix E**, using 2 foot of nominally compacted soil over a double-textured HDPE membrane. The shear strength along the interface between the soil cover and the HDPE is based upon an interface friction angle of 15º and an adhesion of 246 psf, which governs the minimum FS. The calculated FS for the saturated soil cover with seepage parallel to the slope is 3.78. The FS with a pseudo-static horizontal force of 0.179g is 2.61.

6.4 Bearing Capacity Analysis

The bearing capacity of the stratified foundation soils was analyzed using SLIDE 5.0 with an uniform load applied to the surface and assuming a circular failure surface. The results of the analysis are shown in **Figure E-43**. The ultimate bearing capacity of a semi-infinite continuous load on the surface is 5000 psf. For a factor of safety of 2.0, the allowable bearing pressure is 2500 psf. This bearing capacity is applicable to the unconfined, original (unconsolidated) soil strata at the end of the perimeter berm. The bearing capacity below the CCP fill is much greater due to the confinement of the soil strata by the perimeter berms.

6.5 Stability Analyses with Maximum Unit Weight of Non-Ponded CCP

As explained under Section 3.2.1 and 3.2.4, our analyses used an average in-place unit weight of the non-ponded CCP of 112 pcf, whether for wetted fly ash or moistened combined CCP. If the combined CCP were mixed with as much water as possible without failing the paint filter test, an unlikely and more costly option, the maximum unit weight of the combined CCP could be as high as 120.4 pcf (see Section 3.2.4). To check the sensitivity of our assumed unit weight of 112 pcf, we ran the stability analyses for the full CCP fill with 120.4 pcf for the non-ponded mixed CCP above el. 483. These results are shown in **Table E-2**. The factors of safety were 0.04 lower for profiles B-B' and D-D', but were unchanged for the other sections.

7.0 SETTLEMENT ANALYSES

7.1 Estimated Settlements

Settlement analyses were completed using one-dimensional consolidation theory (Terzaghi and Peck, 1948) using the computer program SETTLE3D. The program calculates the effective vertical stress at depths for a uniform surface load on an assumed elastic half-space using the Boussinesq stress distribution. SETTLE3D does not allow for variations in subsurface soil conditions. Therefore, the program was run for multiple soil profiles. The soil profiles were developed for circles as shown in **Figure F-1,** combining the data from the pertinent borings and CPT soundings for each circle. The development of the soil profile for each circle is shown in hand calculations in **Appendix F**. The settlement values were calculated at the circles for the final configurations of full Cells 1 and 2, and full Cells 3 and 4. The configuration of the CCP fill is represented by a combination of uniform surface loads of varying dimensions. The profile used to calculate the surface loads is illustrated in **Figure 8**. The input loads are presented in the output for each circle in **Appendix F.** The plan view of the cumulative surface loads are depicted in the output from SETTLE3D in **Figure F-8**. The soil stratification at a given circle is modeled, and the settlement at the surface is computed for each load configuration. The results were graphed to produce the estimated settlement of the subgrade along four cross-sections of the completed landfill and along the existing Explorer pipeline.

Consolidation coefficients (C_C and C_R) for cohesive materials were obtained from load increment consolidation tests run on representative undisturbed samples from the DSI. The stress-strain modulus (E_S) for granular materials was estimated using cone penetration test (CPT) data obtained from the DSI. E_S is approximately 4 times the measured CPT q_c-value of resistance (Lunne et al, 1997). This multiplier of 4 was the minimum that was applicable for recent normally-consolidated sands or "aged" normally-consolidated sands for an average axial strain of 0.1%, which is applicable to this site. The calculated values of Es from the CPT data and the range of values used in the settlement analyses are plotted in **Figure F-6** in **Appendix F.**

Settlements of the natural subsurface soils were calculated along four profile lines, as shown in **Figures F-2 through F-5**. Generally, the calculated settlement at the top of the perimeter berms varied from 5.5 inches to 9 inches. The calculated settlement at the inside toe of the perimeter berms, where the leachate collection sumps will be located, ranged from 10 to 17 inches.

The calculated settlements at the midpoint of the CCP slope ranged from 14 to 20 inches, and at the top of the 1(v)-to-3(h) slope ranged from 18 to 26 inches. The maximum calculated settlement in the center of the CCP fill was 26 inches.

7.2 Liquefaction-Induced Settlement

Liquefaction settlement for the SPT borings was determined using the procedure outlined in Idress and Boulanger 2008, which determines the post-liquefaction volumetric strain based upon the corrected-normalized N-value $(N_1)_{60}$ and the calculated factor of safety against liquefaction. For CPT soundings, volumetric strain was determined using the procedure outlined in Zhang et. al. (2004) which uses the corrected-normalized-clean sand equivalent-point resistance $(q_{C1N})_{CS}$. The average liquefaction-induced

settlement associated with different quantities of fly ash fill are shown in **Figure D-2**. These values do not account for settlement and are in addition to the normal consolidation settlement or immediate settlement. As can be seen in this figure, the addition of fill significantly reduces the estimated liquefaction induced settlement. There is one location along the southern edge of Cell 1 where there is a potential for liquefaction beneath the perimeter berm with the addition of 10 feet of CCP fill. The estimated liquefaction-induced settlement is 3 inches. This amount of settlement creates inconsequential additional strain on the HDPE liner. After 20 feet of CCP fill has been placed, there are no potential areas of liquefaction beneath the landfill, so there is no potential liquefaction-induced settlement.

Prior to the placement of sufficient CCP to mitigate the liquefaction potential, an investigation would be completed if a seismic event with a PHGA of 0.10g or greater would occur, as explained in Section 6.1.3.

7.3 Strain of HDPE Liner and Leachate Collection System

The estimated settlements will occur over long distances, such that the differential settlement will be small, at a slope of about 1%. The liner will undergo a maximum differential settlement of about 5 inches between the crest of the perimeter berm to the inside toe of the berm (a horizontal distance of 69 feet), and about 11 inches from the inside toe of the berm to a point below the crest of the CCP fill (206 feet). The increase in lengths of the slopes after full settlement has occurred compared to the initial lengths will be 0.002% and 0.001%, respectively. A strain of less than 1% is acceptable since the yield strength of most HDPE liners occurs at more than 12%. Therefore, the strain in the HDPE liner resulting from the estimated differential settlements will not negatively impact the liner.

7.4 Impact of Settlement on Existing Explorer Pipeline

Cells 1 and 2 will be constructed along the west side of the existing Explorer pipeline. Cells 3 and 4 will be constructed along the east side of the pipeline. The plan leaves a 100-foot buffer between the pipeline and the toe of the berms. We calculated the settlement along the pipeline that would result from completing the CCP fill for Cells 1 through 4, and from construction of the two roadway berms if nothing were done to mitigate the settlement. The calculated settlements are plotted in **Figure F-7** in **Appendix F.** The maximum calculated settlement is less than about ¼-inch except in the vicinity of the two roadway berms, which is within the error of the method of analysis. We judge that this amount of settlement is inconsequential. The maximum calculated settlement beneath the two roadway berms is about 4.5 inches, over a distance of about 140 feet, which is a rotation of about 0.3º. As stated in the CPA Report, this issue will be resolved with Explorer Pipeline during the final design of the future expansion to Cells 3 and 4.

7.5 Settlement Analyses with Maximum Unit Weight of Non-Ponded CCP

As explained under Section 3.2.1, our analyses used an average in-place unit weight of the non-ponded CCP of 112 pcf, whether for wetted fly ash or moistened combined CCP. If the combined CCP were mixed with as much water as possible, an unlikely and more costly option, the maximum unit weight of the combined CCP could be as high as120.4 pcf (see Section 3.2.4). To check the sensitivity of our assumed unit weight of 112 pcf, we ran settlement analyses for the full CCP fill with 120.4 pcf for the non-ponded CCP above el. 483. For the settlement in the central area of a given cell, the increase in the

anticipated settlement is an average of 1 to 1.5 inches, or about 4.5% to 6.6%. The maximum increase in settlement is 1.3 to 2 inches, or about 4.9% to 7.1%. Given the inherent variations in properties of both the CCP and the natural soils, and the accepted method of estimating settlement, no revision to our original settlement estimates is necessary to accommodate the unexpectedly higher unit weight of mixed, saturated CCP.

8.0 HYDROSTATIC PRESSURES

8.1 Flood Levels for Design

The UWL site is currently protected from regular Missouri River flooding by the Labadie Bottom Levee District agricultural levee with heights at or near the 100-year flood elevation. In the unlikely event that the agricultural levee is overtopped or breached, the UWL site is further protected from direct Missouri River flood currents by the Labadie Energy Center itself which is upstream and higher than the 500-year flood elevation, creating a low velocity shadow, or ineffective flow area, over the entire UWL site. The regulatory 100-year base flood elevation (BFE) of 483.98 at the upstream end of the UWL site became effective on October 18, 2011. The 500-year flood elevation at this river station is reported by FEMA to be 487.55. By comparison, the flood crest at this location in August 1993 was about el. 483.6. The planned top of the constructed perimeter berms of the Labadie UWL will be at el. 488.

8.2 Protection of Liner from Hydrostatic Uplift

A flood condition surrounding the UWL would impose a hydrostatic uplift pressure on the bottom of the composite liner. This uplift pressure is initially only resisted by the weight of the composite liner, specifically the compacted clay, before the leachate collection layer or any fill is placed in the cell. To maintain a factor of safety (FS) of 1.1 against upward displacement and rupture of the liner, the 2 feet of clay can resist an upward pressure equal to about 3.3 feet of water. Therefore, the level of the flood water surrounding the cell must remain no more than 3.3 feet above the clay liner before CCP fill is placed. If the 12-inch gravel leachate collection layer is used, then the flood water surrounding the cell must remain no more than 5.25 feet above the gravel layer before CCP fill is placed. Once the 12-inch thick protective sand layer is in place, the maximum allowable difference in height between the water level outside of the berm and top of the protective sand layer is 7.0 feet for a FS of 1.1.

CCPs from the existing ash pond will be placed immediately after receipt of authorization to operate the UWL to protect the compacted clay liner against heave from hydrostatic uplift. The required height of the CCP fill may be calculated using the equation illustrated in **Figure 10**. We have assumed that the initial CCPs will be placed at a moist unit weight of 90 pcf. For simplicity in the calculation, we assumed that the bottom of the clay liner is at the top of the sand or permeable layer. For example, if the base of the clay liner were at el. 466 at the lowest point, then the uplift hydrostatic head (H_w) for the 100-year flood level (el. 484) would be 18 feet. The required height of the CCP (H_{CCP}) for a FS of 1.1 is 8.1 (el. 478.1) feet with the 12-inch gravel leachate collection layer, or 9.5 (478.5) feet if a light weight geo-composite is used in lieu of the gravel layer. These are examples to illustrate the calculation; the actual calculations of the heights of CCP required are included in **Appendix Y.**

9.0 EROSION PROTECTION FROM LEVEE OVERTOPPING OR FAILURE

Franklin County amended their Unified Land Use Regulations on October 25, 2011 to add regulations concerning Non-Utility Waste and Utility Waste Landfills (UWL) in Franklin County, Missouri. Article 10, Section 238(C)(3) of these amended regulations requires in part that:

d.) All "cells" shall be designed and constructed so that they shall be protected by an exterior berm meeting the following criteria:

i.) The top of the berm at a minimum shall be equal to the five hundred (500) year flood level in the area of the proposed Utility Waste Landfill.

ii) … All berms shall be constructed of concrete or cement-based material sufficiently thick for the purpose intended and approved by the Independent Registered Professional Engineer.

Some exterior berms may infrequently be in contact with flood water from the Missouri River, but only if the Labadie Bottom Levee District levee is overtopped or breached. A floodplain analysis performed by CDG for Ameren Missouri estimated that the maximum velocity that may occur is less than 2 feet/second along the west berm of Cells 1 and 2. The interior berms may also infrequently come in contact with flood water, but the water velocities will be too low to cause erosion. In both instances a vegetated cover alone would provide sufficient erosion protection, as with standard levee design. To meet Franklin County regulations, concrete and/or cement-based material will be used to prevent possible erosion of the exposed slopes of perimeter berms that may be subject to the flow of flood water.

The exterior slopes of permanent perimeter berms will be covered with a fabric-formed concrete mat (FCM) as illustrated in **Figure 9**. The design of the FCM is presented in **Appendix G**. A 56mm thick FCM, such as Hydrotex FP220, will provide adequate protection for flows up to 11.4 feet/second when placed on a 1(v)-to-3(h) slope of cohesive soil. A non-woven filter geofabric will be placed between the FCM and the compacted soil of the berm to prevent loss of soil through the drainage openings in the FCM. The 56mm thickness is the minimum required for the anticipated velocity of flow. However, a thicker FCM may be used for constructability and durability. The final design of the FCM may include anchor rods.

10.0 CONSTRUCTION RECOMMENDATIONS

10.1 Field and Laboratory Classification of Soils

As discussed previously, the clay for the liner and top cover will be imported. While preliminary tests have been completed on the clay borrow material from Ameren's Callaway Plant, additional tests will be needed before these soils can be placed as the clay soil component of the composite liner system. As an alternate, the contractor for each phase may be permitted to import clay liner material from another off site source. If this alternate is accepted, the contractor will be required to identify and provide access to the off-site borrow sites for geotechnical materials testing of the proposed clay liner quality soils with sufficient lead time to complete exploratory investigation, sampling and testing prior to transporting the off-site soil materials onto the UWL site. Hydraulic conductivity tests on compacted clay samples may require 2 months to complete. We suggest stockpiling an adequate volume of clay liner material for each phase on site prior to the start of the clay liner construction. This would provide adequate time to perform the required test pad construction and testing prior to the start of construction, and would help ensure that an adequate supply is on hand throughout the liner construction. Clay soil materials to be used for clay liner construction must be tested and subsequently placed in accordance with the site specific state-approved CQA Plan for the UWL. Section 10.2 below describes the testing and placement criteria. To verify that future, constructed compacted clay liners meet the minimum criteria used in our above analyses, the clay should have a minimum undrained shear strength of 600 psf, a moist unit weight of 115 pcf, a drained internal friction angle of 25º, and a minimum interface friction angle with the HDPE liner of 15º, in addition to meeting the other requirements established in 10 CSR 80-11.01(10).

The requirements for the soil to be used to construct the perimeter berm are less stringent. Off-site sources may be tested several days prior to use of the fill material on site. Continuous monitoring by a geotechnical engineer or a qualified soils technician working under the direction of a geotechnical engineer will be required to ensure that the imported soil fill has consistent properties, such as grain-size, plasticity, and compaction characteristics. The general berm fill when compacted should have a minimum undrained shear strength of 1000 psf, an approximate moist unit weight of 120 pcf, and a drained internal friction angle of 30º or greater.

10.2 Compaction Criteria

Grab samples of liner material will be tested for grain-size distribution (i.e. hydrometer test), and liquid and plastic limits. If any volume of the stockpile differs significantly in these index properties, then that volume can be delineated, and a separate compaction criteria can be developed for that material, or it can be rejected as liner material. Compaction criteria for clay liner material will be developed using the "Daniel Method." Daniel and Benson (1990) have determined that compaction criterion as a percentage of the maximum dry unit weight alone is not sufficient to assure the required minimum hydraulic conductivity. They recommend a series of compaction tests and hydraulic conductivity tests on each soil type to determine the acceptable "window" of dry density and moisture content that will meet the hydraulic conductivity requirements which will require up to 3 months to complete.

The stability of the perimeter berm requires higher shear strength than for the liner. Therefore, the average compaction of the materials in the perimeter berm should be no less than 95% of the maximum

dry unit weight determined by the standard Proctor moisture-density test, with no tests less than 92% of the same maximum dry unit weight. The moisture content at the time of compaction should be at optimum or a maximum of 4% above optimum. The engineering properties of the berm materials compacted to the above minimum criterion must meet or exceed the following: moist unit weight of 120 pcf, undrained shear strength of 1000 psf, drained cohesion of 0, and a drained internal friction angle of 30º.

Fills should be placed in horizontal lifts not exceeding 8 inches in loose thickness and compacted by uniform coverage with a suitable compactor. Cohesive fill should be compacted using a heavy tapered-foot compactor, with or without vibration. The final lift of cohesive fill should be compacted by a smooth-drum roller. Cohesionless fill, if any, such as the silty sand or fly ash, should be compacted by a heavy vibratory compactor.

10.3 Construction Quality Assurance

10.3.1 Test Pad

The plasticity index of some of the clay liner material from the Callaway Plant exceeded 30%. Therefore, a test pad will be required prior to construction to test the materials to be used for the liner, and the construction methods. The test pad must be large enough to accommodate the actual construction methods and equipment that will be used for the construction of the liner. The compaction criteria previously developed for the liner material will be used to construct the test pad. In accordance with MDNR-SWMP regulations, the geotechnical testing agency is required to take undisturbed samples of the fill to measure the density and hydraulic conductivity. Bulk samples of the fill material must be taken to perform LL and PI tests and standard Proctor tests. Also, a minimum of two test pits are required to examine the interface between lifts of materials, to verify bonding of the lifts. A field permeability test is also required. A test pad is not necessary for the fill to be placed in other areas, such as the perimeter berm.

10.3.2 Quality Assurance during Construction

The successful completion of the test pad will verify the acceptable construction methods for the liner for the known material from the liner materials stockpiled on site. **Appendix P** of the CPA Engineering Report provides a construction quality assurance plan for the composite liner system which will be followed to document adequate minimum construction of the composite liner system.

10.4 Investigation and Remediation of Possible Liquefaction Damage

As discussed in 6.1.3, there is potential for damage to the composite liner during construction before a sufficient amount of CCP fill had been placed in the UWL, which is about 20 feet. A procedure for an investigation is presented in Section 6.1.3. A topographic survey of the liner will have been completed for the CQA of the liner. Permanent benchmarks will need to be installed along the perimeter berms to perform an accurate horizontal survey to detect movements that may have occurred, since the calculated lateral deformations are very small.

11.0 RECOMMENDATIONS FOR INITIAL OPERATION

The initial filling of each cell must take into consideration protection against heave of the bottom composite liner due to flooding outside of the cell, and possible damage to the liner due to liquefaction resulting from a seismic event with a PHGA of 0.10g or greater.

Protection against heave of the bottom composite liner due to flooding has been discussed in Section 8.2. The placement of CCP in each cell will have to be expedited to minimize the risk of a significant flood or high water event occurring before the cell has sufficient CCP fill. This will include a stand-by plan to flood the cell with flood water pumped over the perimeter berm.

The potential for damage due to a seismic event has been discussed in Section 6.1.3. The initial filling of Cell 1 should begin on the west side where liquefaction potential remains after the construction of the berm, and on the east aide (see **Figure D-3**). Similarly, the initial filling of Cells 3 and 4 should begin on the west and south sides, respectively, to mitigate the potential for liquefaction.

There is risk of liquefaction beneath storm water Ponds 1 and 3 after completion of the berms for Cells 1 and 4, unless the ponds are filled with water at the time of a significant seismic event. This would not impact the stability of the CCPs in Cells 1 and 4 or the composite liner. If this occurs, an investigation of Ponds 1 and 3 should be completed, as outlined in Section 6.1.3.

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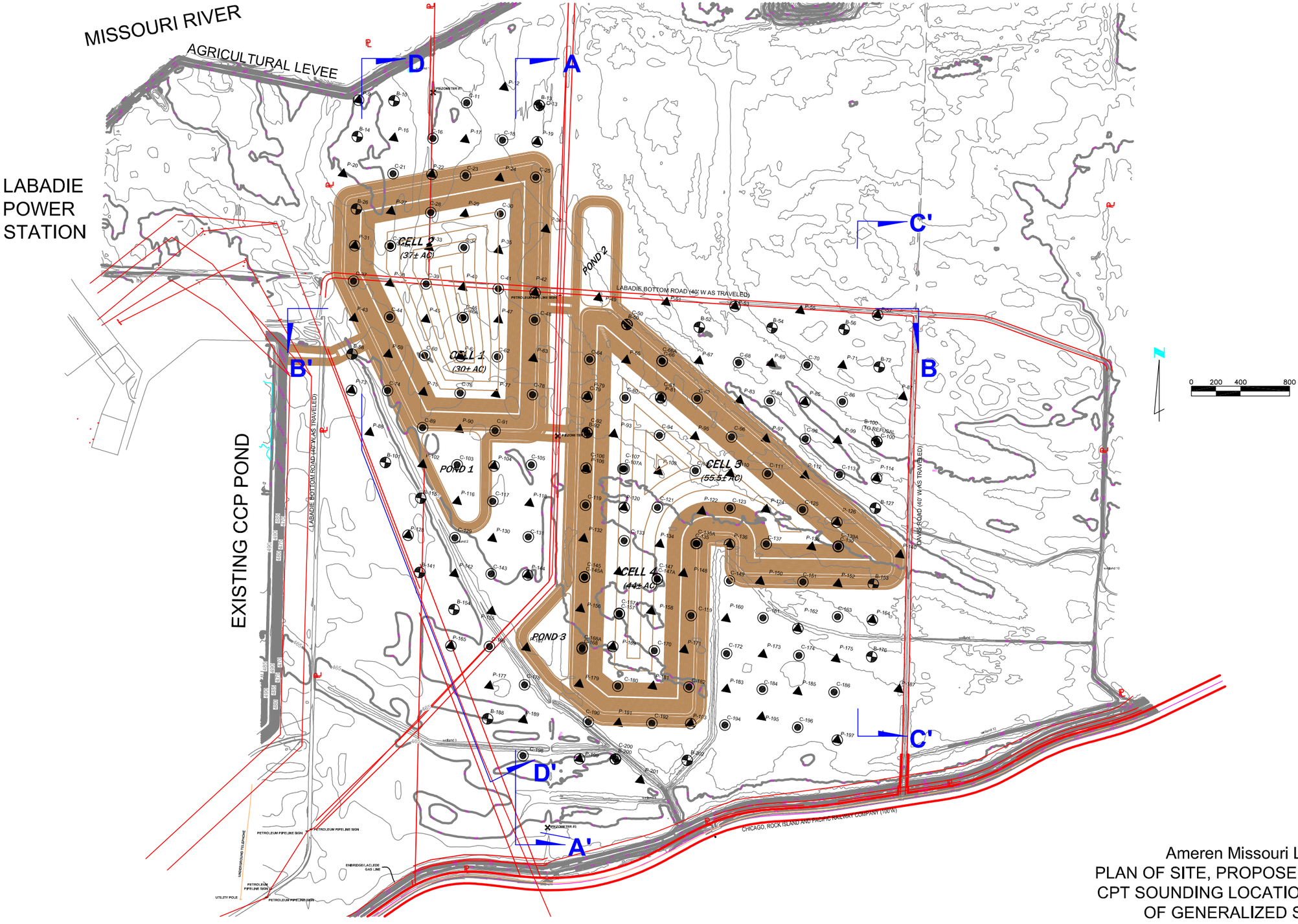
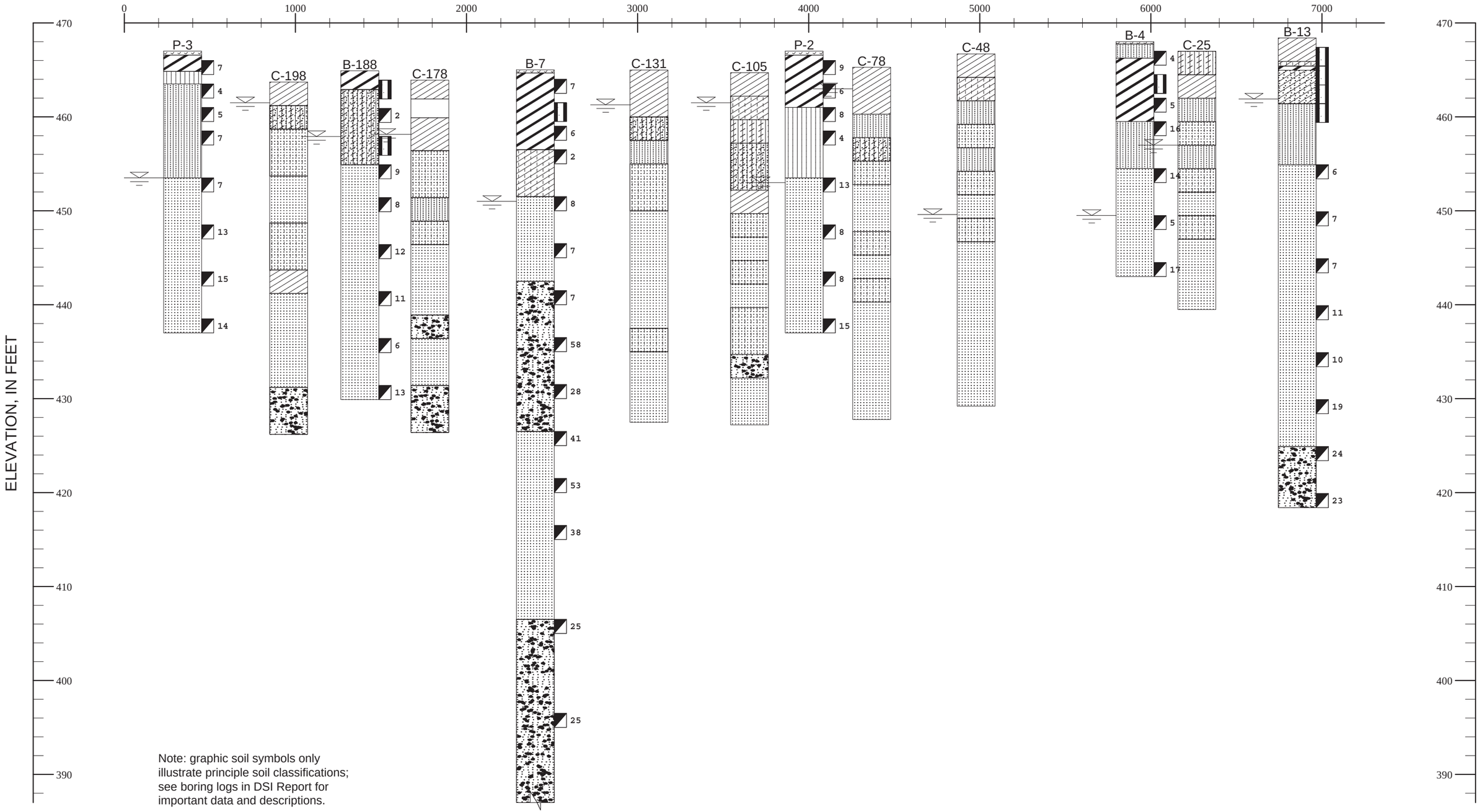


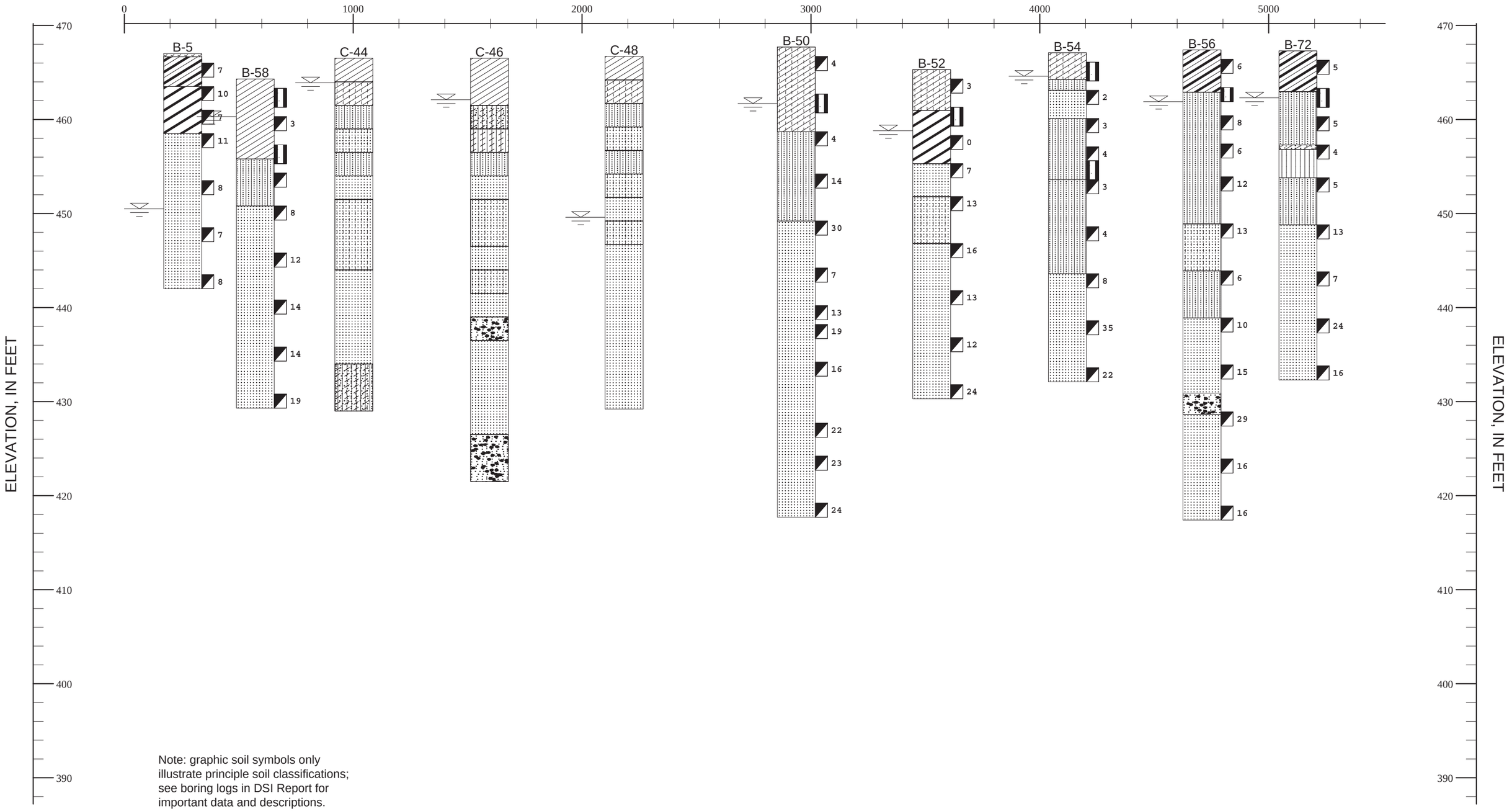
Ameren Missouri Labadie UWL
PLAN OF SITE, PROPOSED UWL, BORING AND CPT SOUNDING LOCATIONS AND LOCATIONS OF GENERALIZED SOIL PROFILES

REITZ & JENS, INC.

Figure 1



Ameren Missouri Labadie UWL
GENERAL SOIL PROFILE
A-A'



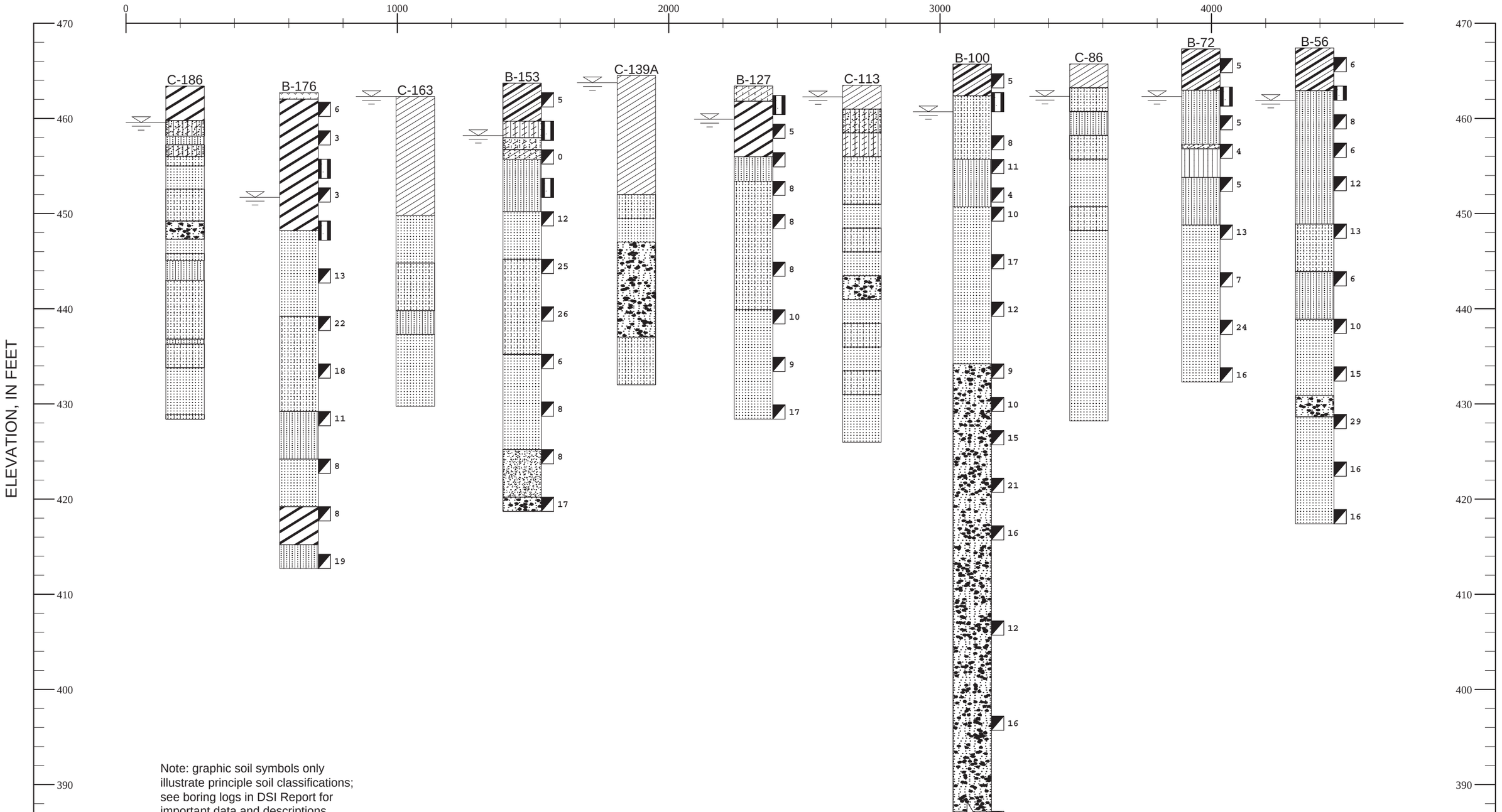
Note: graphic soil symbols only illustrate principle soil classifications; see boring logs in DSI Report for important data and descriptions.

- Topsoil
- Medium to high plastic CLAY
- High plastic CLAY (CH)
- Poorly-graded SAND (SP)
- Low plastic CLAY (CL)
- Silty SAND or Sandy SILT (SM)
- Low plastic Silty CLAY (CL)
- Poorly-graded SAND with traces of fines
- Clayey Sandy SILT (ML)
- Low plastic Clayey SILT (ML)
- Poorly-graded SAND & GRAVEL (GP)
- Clayey SAND or Sandy CLAY (SC)
- Inorganic, non-plastic SILT (ML)
- Depth of ground water observed during drilling

Ameren Missouri Labadie UWL
GENERAL SOIL PROFILE
B-B'

REITZ & JENS, INC.

Figure 3



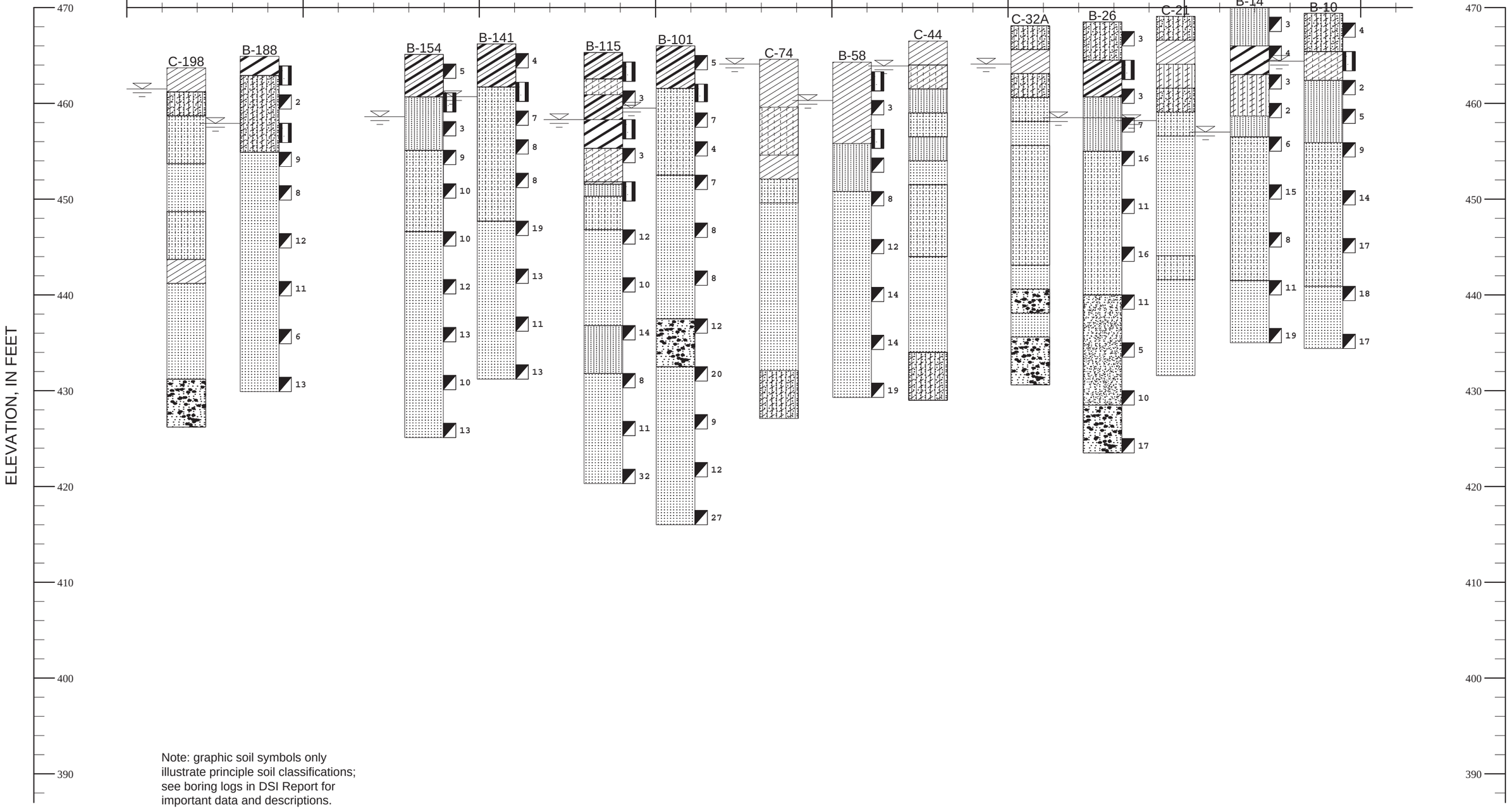
Note: graphic soil symbols only illustrate principle soil classifications; see boring logs in DSI Report for important data and descriptions.

- High plastic CLAY (CH)
- Clayey Sandy SILT (ML)
- Silty SAND or Sandy SILT (SM)
- Poorly-graded SAND with traces of fines
- Poorly-graded SAND (SP)
- Poorly-graded SAND & GRAVEL (GP)
- Topsoil
- Low plastic CLAY (CL)
- Medium to high plastic CLAY
- Low plastic Clayey SILT (ML)
- Clayey Silty SAND (SC-SM)
- Clayey SAND or Sandy CLAY (SC)
- Well-graded SAND with no fines (SW)
- Low plastic Silty CLAY (CL)
- Inorganic, non-plastic SILT (ML)
- Depth of ground water observed during drilling

Ameren Missouri Labadie UWL
GENERAL SOIL PROFILE
C-C'

REITZ & JENS, INC.

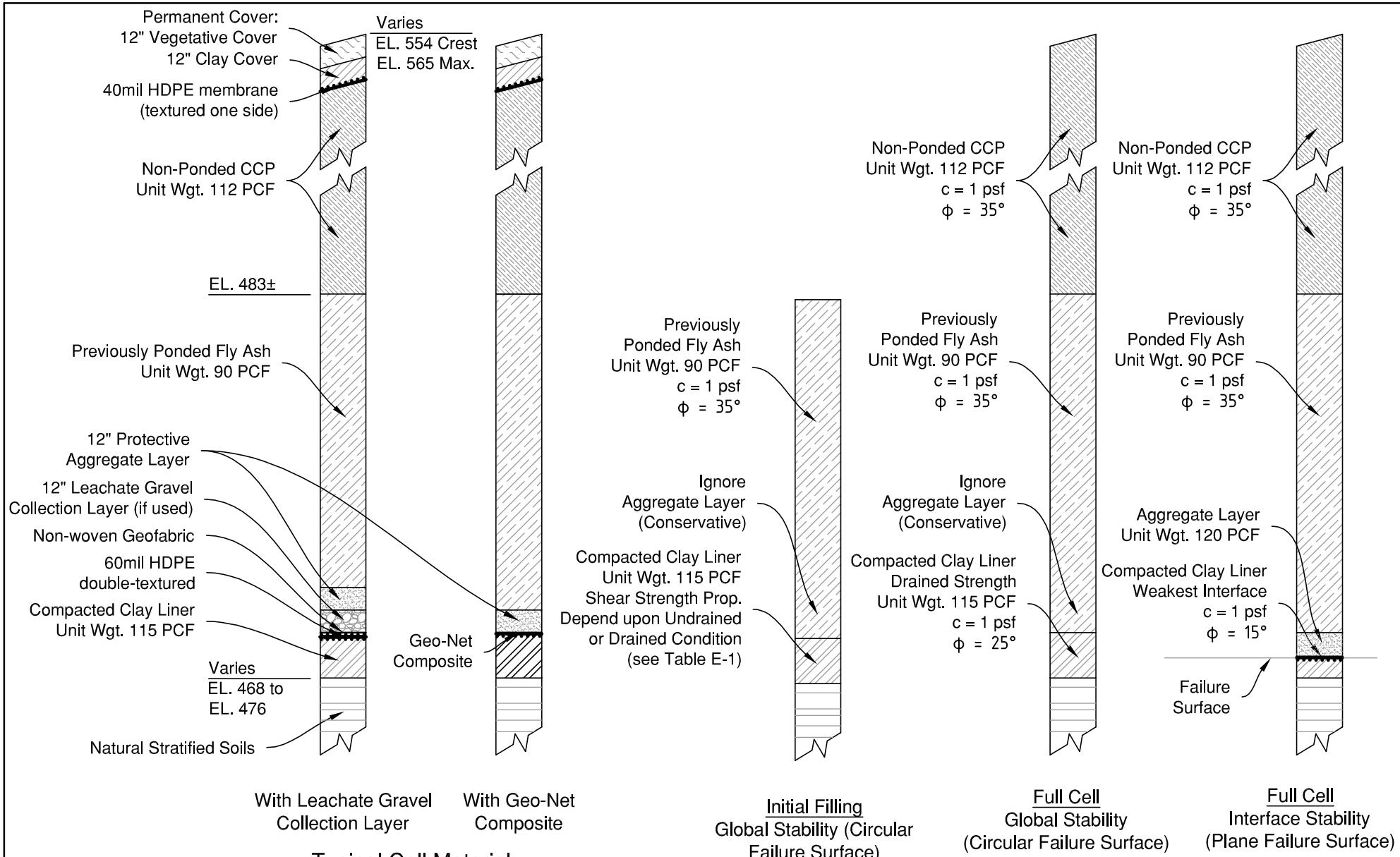
Figure 4



Note: graphic soil symbols only illustrate principle soil classifications; see boring logs in DSI Report for important data and descriptions.

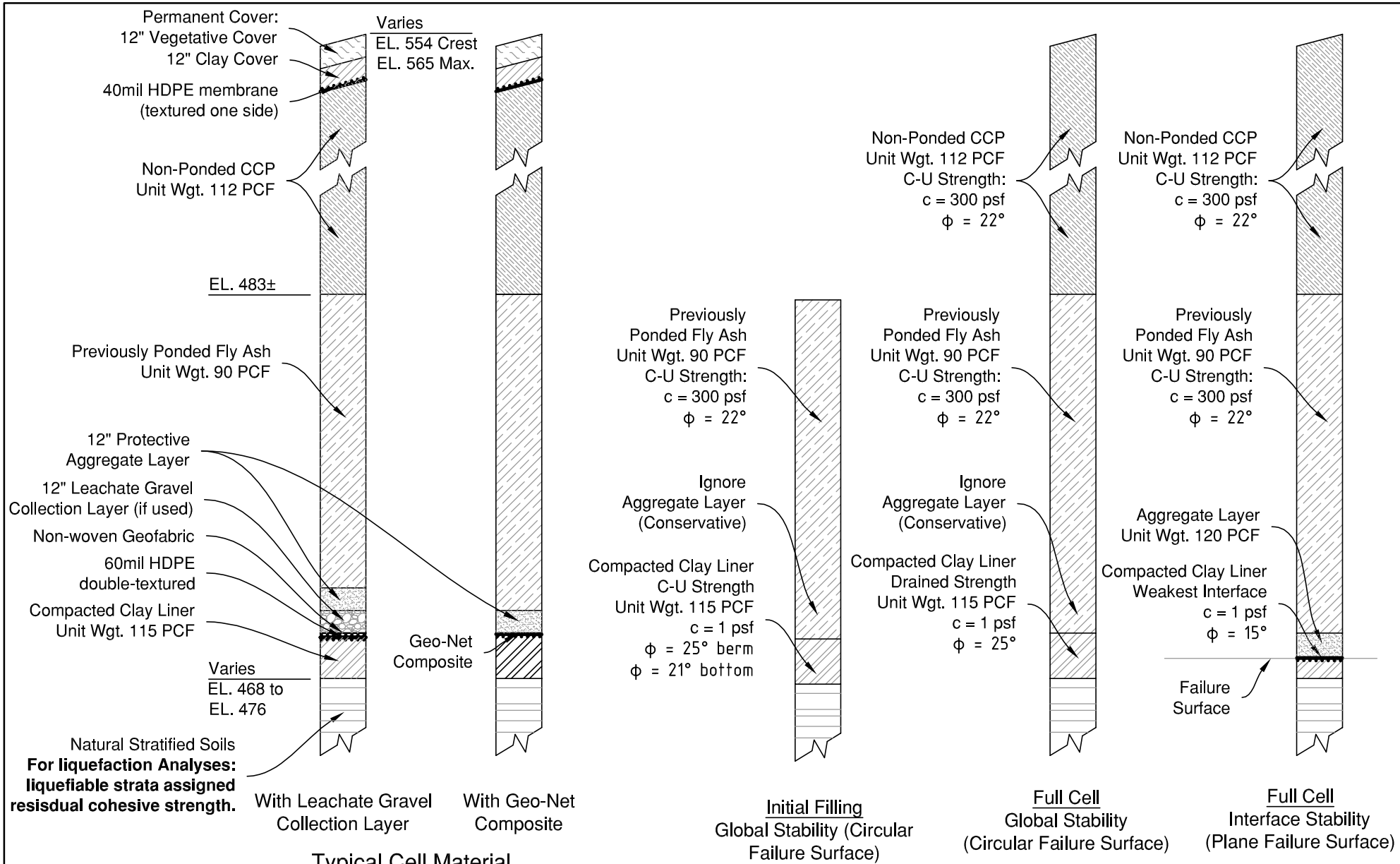
- Low plastic CLAY (CL)
- Clayey Sandy SILT (ML)
- Poorly-graded SAND with traces of fines
- Poorly-graded SAND (SP)
- Poorly-graded SAND & GRAVEL (GP)
- High plastic CLAY (CH)
- Medium to high plastic CLAY
- Silty SAND or Sandy SILT (SM)
- Low plastic Silty CLAY (CL)
- Clayey SAND or Sandy CLAY (SC)
- Well-graded SAND with no fines (SW)
- Low plastic Clayey SILT (ML)
- Depth of ground water observed during drilling

Ameren Missouri Labadie UWL
GENERAL SOIL PROFILE
D-D'



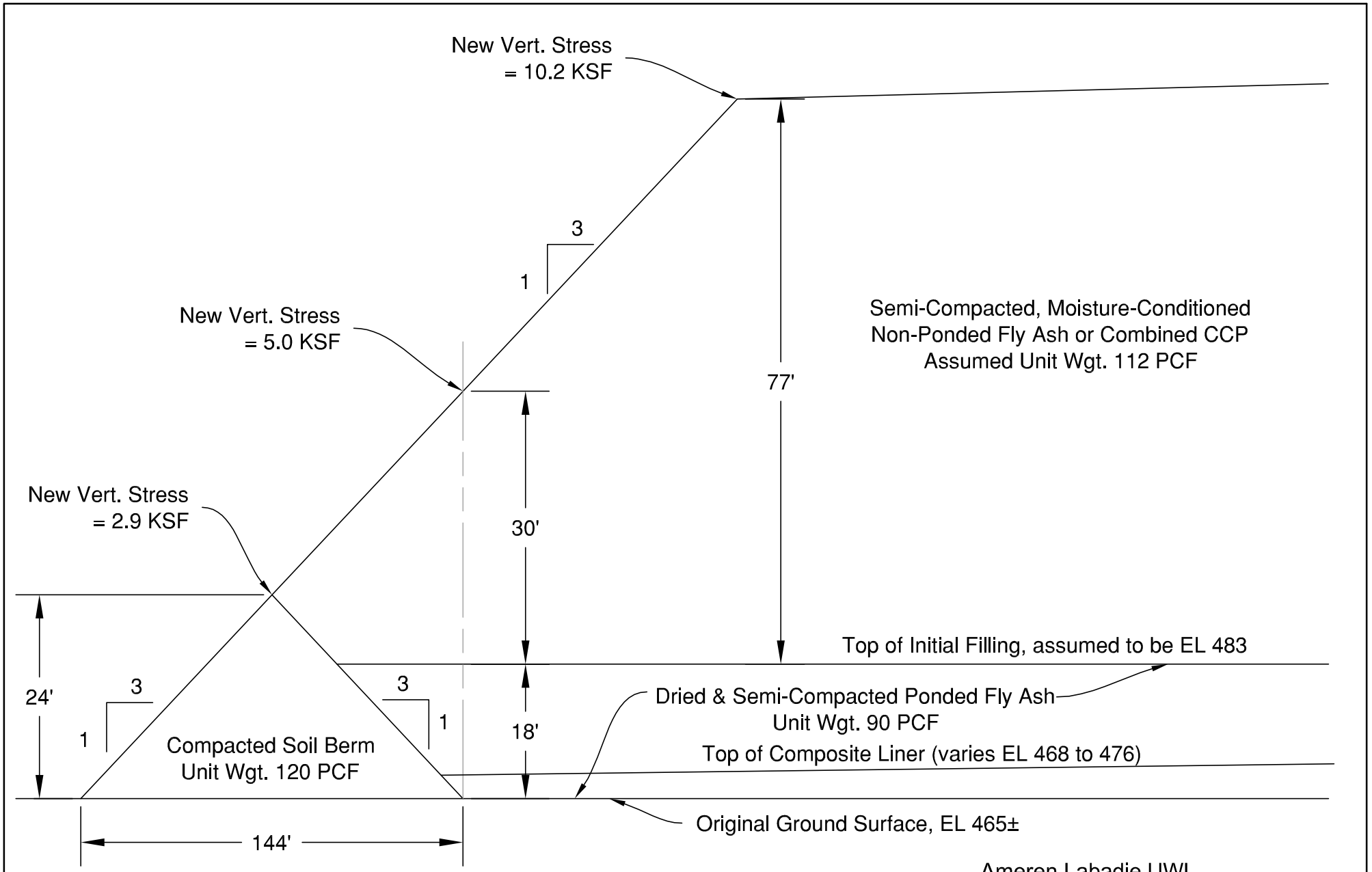
Ameren Labadie UWL
GRAPHIC DEPICTION OF MATERIALS FOR
STABILITY ANALYSES

Figure 6



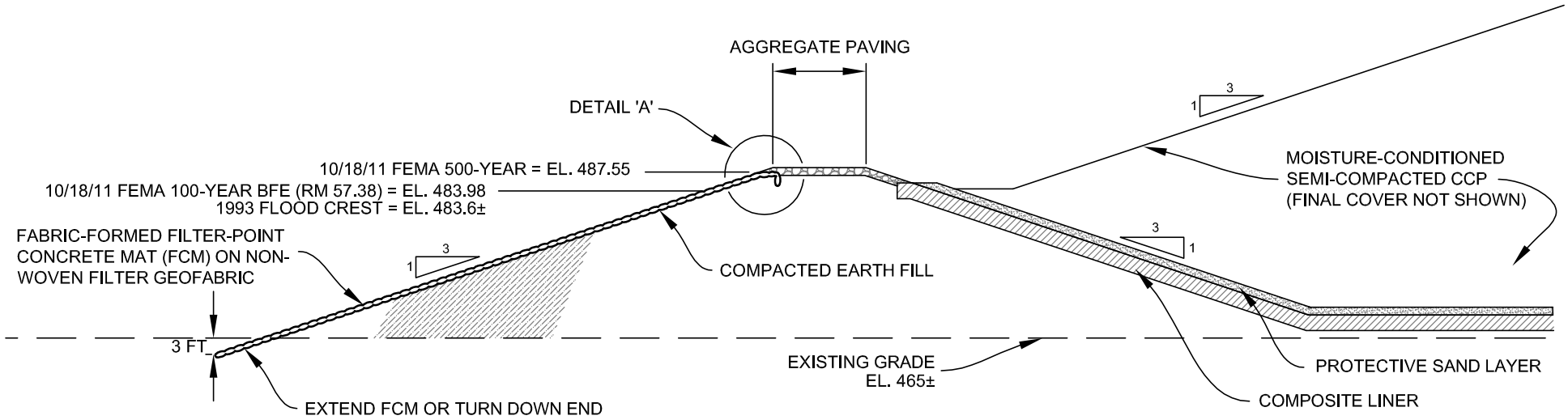
Ameren Labadie UWL
GRAPHIC DEPICTION OF MATERIALS
FOR SEISMIC ANALYSES

Figure 7

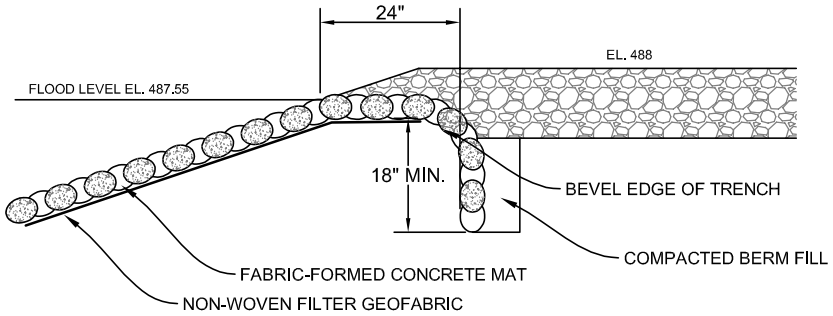


Ameren Labadie UWL
MODEL FOR CALCULATION OF VERT. STRESSES
FOR SETTLEMENT ANALYSES

Figure 8



GENERAL CROSS-SECTION OF PERMANENT EXTERIOR BERM

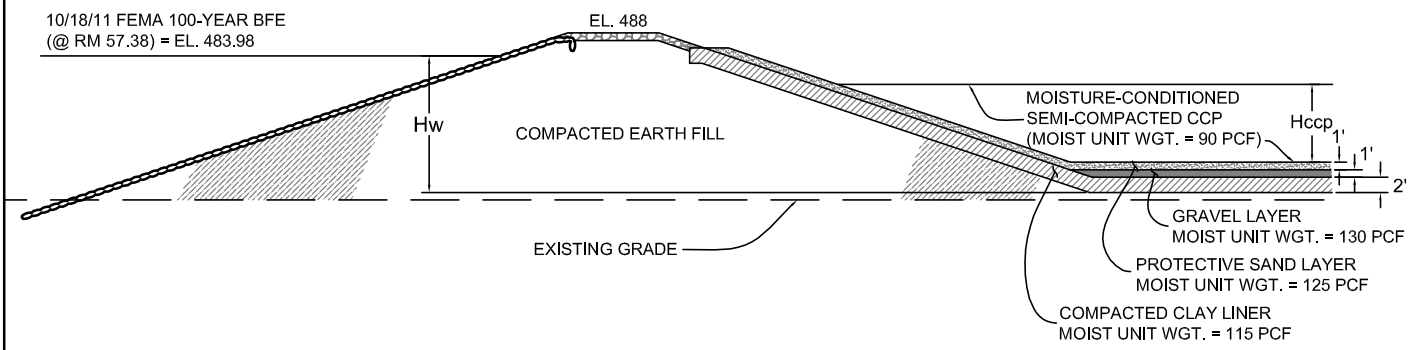


DETAIL 'A' - FCM ANCHOR TRENCH

Ameren Missouri Labadie UWL
PROPOSED CONCRETE EROSION
PROTECTION FOR EXTERIOR BERMS

Reitz & Jens, Inc.

Figure 9



Factor of Safety Against Hydrostatic Uplift of Bottom Clay Liner (FS_{uplift}):

FS_{uplift} = (Hccp x 90 PCF + 1' x 125 PCF + 1' x 130 PCF + 2' x 115 PCF) / (Hw x 62.4 PCF)

with a 12" thick protective sand layer, 12" thick gravel leachate collection layer, and a 24" thick compacted clay liner, where:

Hw = difference in height from flood level to bottom of clay liner (based upon the assumption that the subgrade of the clay liner is permeable)

Hccp = height of CCP above sand layer (with CCP moist unit weight = 93 PCF)

The required height of the CCP for a FS_{uplift} of 1.1 and with a gravel collection layer:

Required Hccp = [(Hw x 62.4 PCF x 1.1) - 485 PSF] / 90 PCF

Example: for 100-year flood at el. 484 and bottom of clay liner at el. 466,
Hw = 484 - 466 = 18 feet, and required Hccp = 8.3 feet for FS_{uplift} = 1.1,
or a vertical difference of 5.7 feet between the 100-year flood level and the top of the CCP fill.

If a geonet is substituted for the 12" thick gravel collection layer, and the geonet is considered to be weightless, then:

FS_{uplift} = (Hccp x 93 PCF + 1' x 125 PCF + 2' x 115 PCF) / (Hw x 62.4 PCF)

and the required height of the CCP is:

Required Hccp = [(Hw x 62.4 PCF x 1.1) - 355 PSF] / 90 PCF

where Hccp is the height of CCP above the protective sand layer. This equation applies to any point on the side slope of the berm where the geonet will be used, but only if the berm is constructed with permeable fill (sands and silts).

Ameren Missouri Labadie UWL
CALCULATION OF RESISTANCE
TO HYDROSTATIC UPLIFT ON CLAY LINER

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Appendix A

INVESTIGATION OF POTENTIAL CLAY LINER BORROW SITE AT AMEREN CALLAWAY PLANT
Revised August 2013

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REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, missouri 63132
phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

May 25, 2011

Mr. Kevin Gerhardt, P.E.
Ameren Missouri
3700 S Lindbergh Blvd., Mail Code F-604
St. Louis, Missouri 63127

RE: Report of Callaway Clay Borrow Site for
Labadie Plant Utility Waste Landfill
Franklin County, Missouri

Dear Mr. Gerhardt:

This report presents our findings and estimated quantity of available clay borrow based on the twelve (12) boring made at the Callaway borrow site. This borrow site is located in Callaway County approximately one mile east of the Callaway Power Plant on County Road 448 (see Figure 1). The purpose of these borings is to provide data on the subsurface conditions, which was used to quantify the clay borrow that could be used for the installation of clay liner and cover at the Labadie Plant Utility Waste Landfill.

Field Investigation

The borings were made at the approximate locations shown in Figure 1. The borings were located along existing gravel roads or existing farm roads so damage would be limited. The borings were located in the field using a hand-held GPS unit. The elevations at the borings were taken from GoogleEarth™ at the locations of the borings.

The borings were made on March 17 and 18, 2011, by Midwest Drilling, Inc. of Florissant, Missouri, under subcontract to Reitz & Jens. The borings were advanced using 4.25-in. outside diameter solid-stem continuous flight augers (CFA). The borings were drilled to termination depths ranging from 14 feet to 31 feet, with some borings terminating on intact bedrock. The borings were backfilled with cuttings, gravel, and Bentonite chips. The top 5 feet of each boring was backfilled with Bentonite chips to limit direct infiltration from the surface. Any remaining cuttings were mounded on the boring in anticipation of some subsequent settling.

Samples of subsurface soils were obtained at about 2.5-foot intervals in the top 10 feet, and at 5-foot intervals below 10 feet. Samples were taken using either: 1) a hydraulically pushed, 3-inch O.D., thin-wall Shelby tube sampler in general accordance with ASTM D1587 “Thin-Walled Tube Sampling for Geotechnical Purposes”; or 2) a 2-inch O.D., split-spoon sampler driven by an automatic SPT hammer in conjunction with a Standard Penetration Test, in general accordance with

ASTM D1586 “Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils”. The Shelby tube samples were trimmed and then sealed with a tight-fitting plastic cap and duct tape. Loose materials were removed from the upper end of the tube and the length of the recovered sample was measured. The top end of the tube was then sealed with a tight-fitting plastic cap and duct tape. The disturbed split-spoon samples obtained were visually classified in the field and sealed in glass jars to prevent loss of moisture, for later testing in the laboratory. The Shelby tubes were extruded in our lab immediately prior to testing.

The field investigation was completed under the direction of a Reitz & Jens geologist, with instructions from a geotechnical engineer, who determined the sampling intervals, termination depth, and logged the borings. The borings were logged in the field based upon cuttings, drilling characteristics and recovered samples. The boring logs were subsequently modified as appropriate based on laboratory test results. The boring logs are attached in Figure 2-1 through 2-12. The key and notes for the boring log are shown in Figure 2-0.

Ground water measurements were made during drilling, and some borings were left open to obtain a water measurement the following day. The ground water levels observed during drilling are only representative of the time during sampling. The ground water level will fluctuate with precipitation and seasonally. Water levels were as shallow as 8.5 feet in Boring B-5; but many of the borings were completely dry after drilling. This may be an indication of pockets of perched water.

Laboratory Testing

All recovered samples were visually described in general accordance with the ASTM procedures. Geotechnical soil tests performed included water content and density (ASTM D2216), Atterberg Limits (ASTM D4318), soil finer than the #200 sieve (ASTM D1140), and sieve size analysis of soil (ASTM D422). The results of these tests appear on the individual boring logs, and a summary of the data is shown in Figure 3. The sieve size analyses were performed on samples where more than 10% by weight was retained on the #200 sieve. The results of the sieve analyses are reported in Figures 4-1 through 4-21.

We collected the left-over materials from the Shelby tubes and produced two composite samples for further laboratory testing. The first composite contains silt and low plastic silty clay, and the second contained high plastic clay. Compaction tests were performed on both composites using the Standard Proctor procedure according to ASTM D698. The results are presented in Figures 5-1 and 5-2. Atterberg Limits were also performed and reported on Figures 5-1 and 5-2. A hydraulic conductivity test according to ASTM 5084 was completed using the silty clay Proctor point compacted nearest to 95% of the maximum dry unit weight and on the wet side of the optimum moisture content. This sample had a hydraulic conductivity of 1.1×10^{-8} cm/sec. This result is presented in Figure 6. The measured hydraulic conductivity is below the required 1×10^{-7} cm/sec, thus qualifying this material as liner quality clay. We expect clays with liquid limits greater than that tested (37%) and compacted to a similar degree would have hydraulic conductivities equal to or less than composite sample that was tested. This would qualify nearly all materials described in the boring logs as low plastic silty clay, low plastic clay, medium to high plastic clay, and high plastic clay without significant amounts of sand and gravel, as suitable for liner material.

Estimate of Available Clay Borrow

The potential borrow area was broken down into five smaller borrow areas denoted as "BA #" in Figure 1. Two of the borrow areas, BA-1 and BA-4, were split due to shallow rock and thin deposits of clay. These areas which have little to no available clay are denoted as BA-1A and BA-4A and were not included in our calculations.

The linear footage of liner quality clay in each boring was estimated using only clay with a liquid limit greater than 40 and which did not have a significant amount of sand and gravel. We judge that clays with these parameters will result in hydraulic conductivities of less than $1x10^{-7}$ cm/sec when compacted. The linear footage of liner quality clay is shown parentheses on Figure 1 next to the individual boring number. The calculation for the individual borrow areas is presented in Figure 7 (top). The total estimated amount of liner quality clay in all five borrow areas is roughly 4.4 million cubic yards. This calculation is based on the assumption that the borrow area is flat and that the clay extends horizontally throughout each borrow area. These assumptions were used because of the lack of topographic survey data and the limited number of borings.

A second calculation was made in the same manner as the first, but using all fine-grain soils (silts and low plastic clays) that did not have significant amounts of sand and gravel. The calculation for the individual borrow areas is presented in Figure 7 (bottom). The total estimated amount of fine-grain soil in all five borrow areas is roughly 5.6 million cubic yards. We believe that almost all of the fine-grain soil would be suitable for compacted clay liner, or the additional 1.2 million cubic yards would definitely be suitable for top cover.

Please let us know if you have any questions regarding this report. We appreciate this opportunity to continue our working relationship you and Ameren Missouri.

Sincerely,
REITZ & JENS, Inc.

Kyle E Kocher, P.E.
Project Engineer

Jeff L. Fouse, P.E.
Project Manager

The following figures are attached and complete this report:

Figure 1	Callaway Borrow Area
Figure 2-0	Key to Boring Logs
Figures 2-1 to 2-12	Log of Borings B-1 to B-12
Figure 3	Laboratory Test Summary
Figures 4-1 to 4-21	Sieve Analyses
Figures 5-1 and 5-2	Standard Proctors
Figure 6	Hydraulic Conductivity
Figure 7	Clay Volume Calculation

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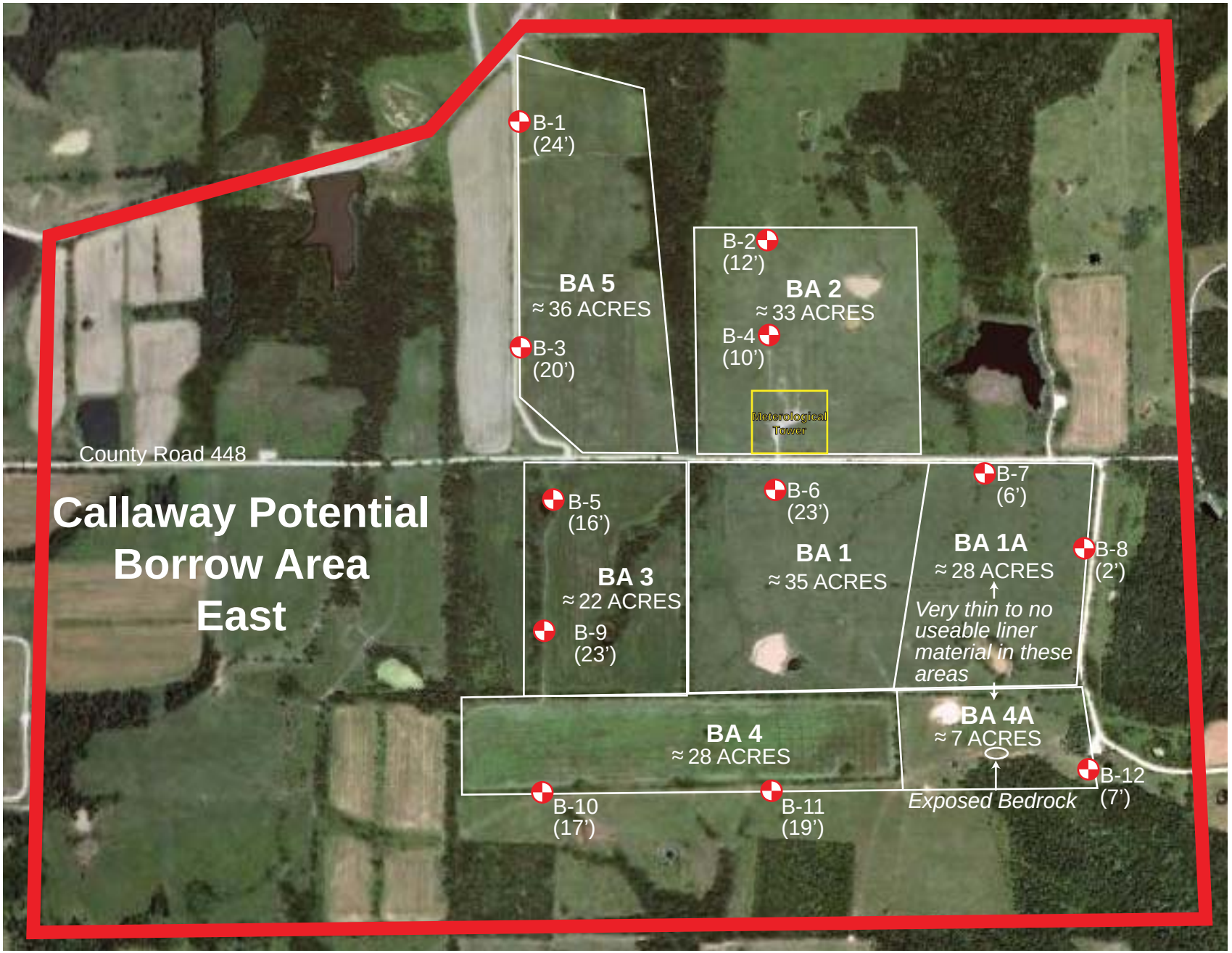


Callaway Borrow Area
Boring Number
(L.F. of liner quality clay)

KEY TO BORING LOGS

Symbol	Description
Strata symbols	
	Gravel frac
	Low-high plasticity clays
	Description not given for: "OZ"
	High plasticity clay
	Description not given for: "O:"
	Topsoil
	Description not given for: "O="
	Description not given for: "NR"
	Low plasticity clay
	Description not given for: "C-3"
	Silty sand
	Shale

Symbol	Description
	Description not given for: "OY"
	Description not given for: "LWU"
Misc. Symbols	
▲	Description not given for: "FTRANGLE"
■	Description not given for: "FSQUARE"
	Water table during drilling
	Water table at boring completion
Soil Samplers	
	Standard penetration test
	Undisturbed thin wall Shelby tube

Notes:

1. Exploratory borings were drilled on 03-17-11 using a 4-inch diameter continuous flight power auger.

2. No free water was encountered at the time of drilling or when re-checked the following day.

3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs.

REITZ & JENS, INC.
CONSULTING ENGINEERS

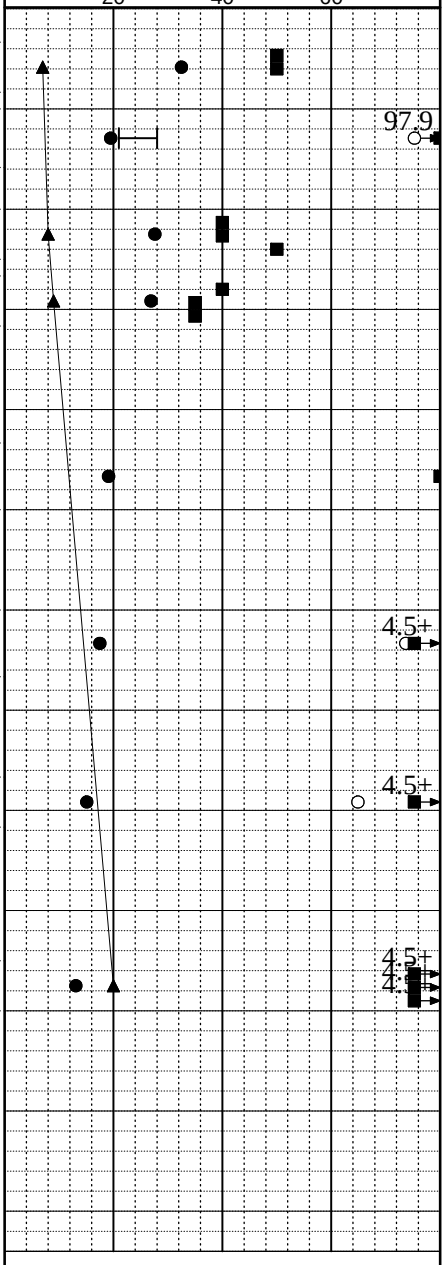
BORING LOG B-1

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1070025 E 1850593
ELEVATION: 821 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						8-inches of crushed limestone		
					78	CLAY (CL-CH), brown and gray, moderately plastic, slightly silty, stiff, moist	3-3-4	32.5
					95	Silty CLAY (CL-ML), brown and tan, with lignite and limonite, dry	110.5	19.5
	816							
6					100	CLAY (CH), light brown and gray, high plastic, moist, dry	3-3-5	27.6
					94	With trace fine sand and fine gravel	3-4-5	26.9
	810							
12					100	Becoming gray	110.3	19.1
	804							
18					100	With fine sand	113.2	17.5
	798				100	Becoming gray and orange brown, with medium to fine sand	117.7	15.1
24								
	792				100	Sandy CLAY (CH), golden brown, high plastic, fine grain sand, with silt lenses, very stiff	4-9-11	13.1
30						Boring terminated in sandy clay at 30'- 0" NOTE: Bulk sample taken at 13'-20'		
	786							
36								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-1 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

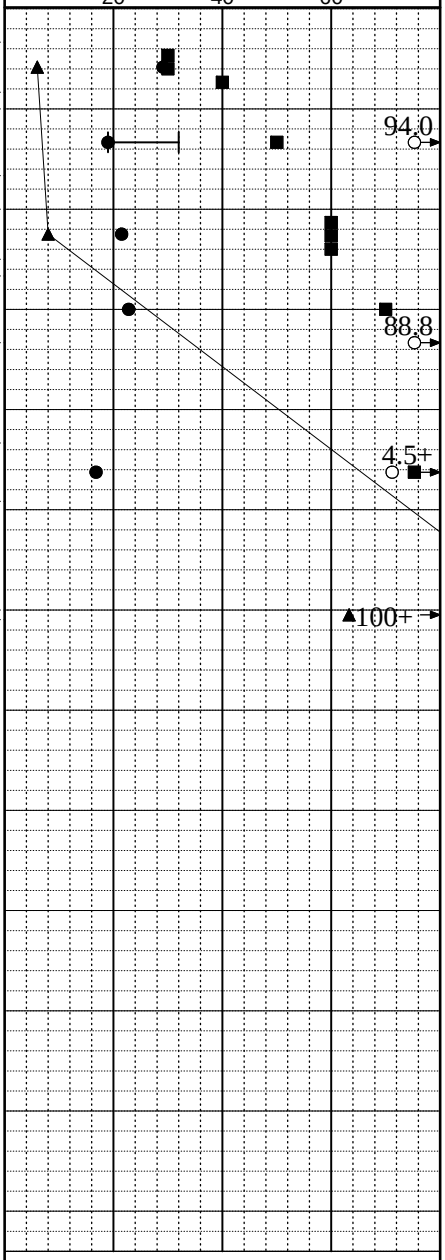
BORING LOG B-2

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1069272 E 1852010
ELEVATION: 813 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						5-inches of topsoil		
	810				83	Silty CLAY (CL), brown and gray, trace lignite and limonite, firm, moist	2-2-4	29.1
					92	Becoming dry	106.7	19.0
6					100	CLAY (CH), red-brown, high plastic, with lignite and limonite, stiff	3-3-5	21.5
	804				71	Becoming gray brown	102.9	22.8
12					100	With fine sand, trace medium sand	110.5	16.8
	798							
18					100	Highly weathered sandstone with chert gravel	50/3.5"	
	792					Boring terminated in weathered sandstone at 18'-9.5" NOTE: Bulk sample taken 10'-13'		
24								
	786							
30								
	780							
36								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-2 Sheet 1 of 1

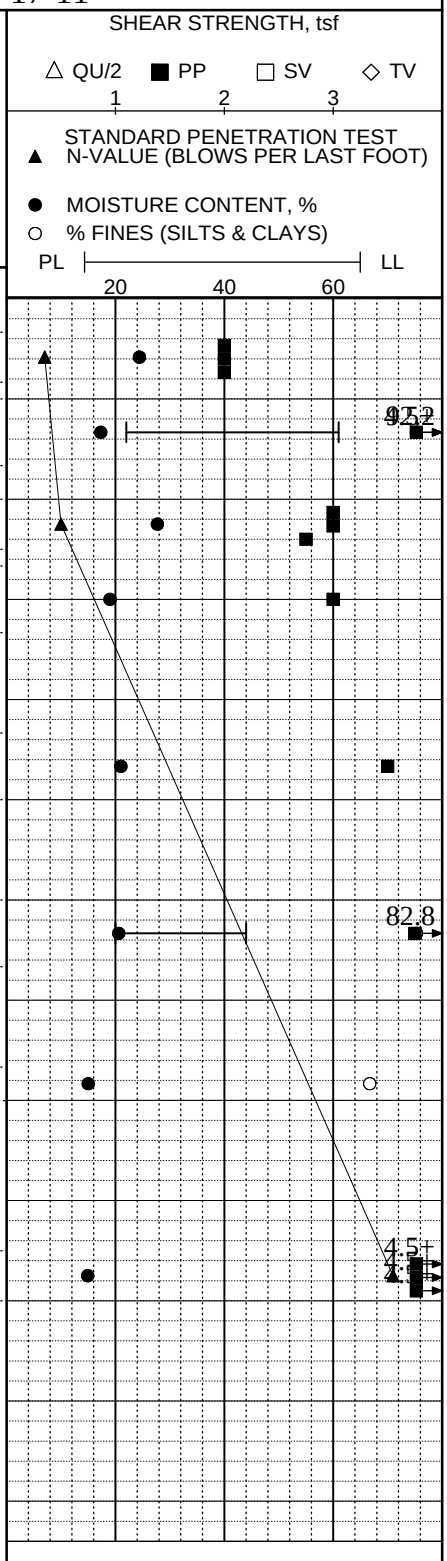
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1068835 E 1850564
ELEVATION: 822 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	822					8-inches of gravel and topsoil		
					100	Silty CLAY (CL), brown and gray, trace lignite and limonite, stiff, moist	2-3-4	24.4
					100	CLAY (CH), brown and gray, high plastic, slightly silty, dry	107.3	17.3
6	816				100		3-4-6	27.7
					38	Becoming tannish gray	107.8	19.0
12	810				100		107.2	21.0
18	804				100	CLAY (CL), gray, with fine sand, trace fine gravel	107.4	20.6
					100	Becoming very sandy and gravelly	115.0	15.0
24	798					Shaley CLAY, golden, with chert gravel and rock residuum		
					100		17-32-39	14.9
30	792					Boring terminated in shaley clay at 30'- 0" NOTE: Bulk sample taken 1'-10'		
36	786							



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-3 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

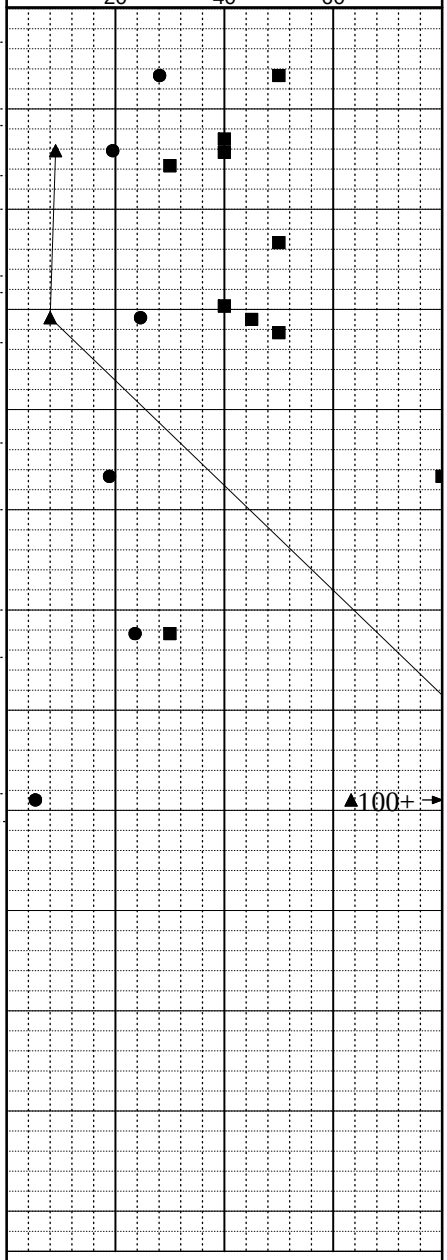
BORING LOG B-4

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1068562 E 1852007
ELEVATION: 821 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						5-inches of topsoil		
					92	Silty CLAY (CL), gray-brown, with lignite and limonite, stiff, moist	95.6	28.1
					100	Becoming dry	4-4-5	19.5
	816							
6					21	No recovery		
					100	CLAY (CH), gray and golden, high plastic	2-3-5	24.6
	810							
12					100	With sand and trace fine gravel	111.4	18.9
	804							
18					100	Silty SAND (SM), golden and gray, trace clay, with layers of clayey silt, dry, hard	100.2	23.6
						Shale, maroon		
	798							
24					100	Boring terminated in shale at 24'-0"	50/4.5"	5.3
						NOTE: Bulk sample taken 15'-24'		
	792							
30								
	786							
36								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-4 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

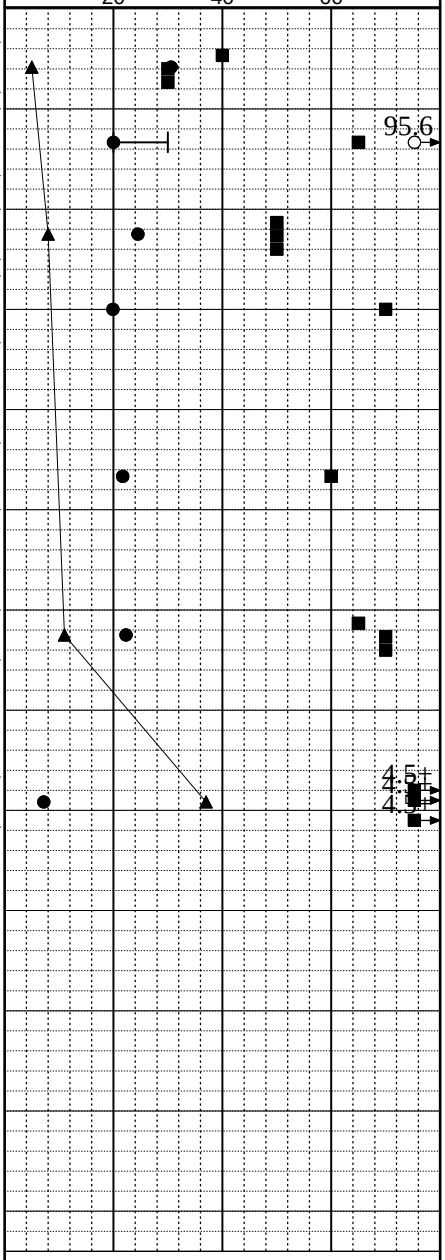
BORING LOG B-5

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1068017 E 1850704
ELEVATION: 823 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	822					2-inches of topsoil		
					94	Silty CLAY (CL), gray-brown, firm, moist	2-2-3	30.6
					100	With lignite and limonite	108.2	20.0
6	816				100	CLAY (CH), gray and golden, high plastic, stiff, dry	3-3-5	24.5
					100		108.6	19.9
12	810				92		106.0	21.7
18	804				100	With fine sand	3-4-7	22.3
					89	Weathered shale with sandstone and siltstone gravel, hard, dry	4-13-24	7.2
24	798					Boring terminated in weathered shale at 24'-6" NOTE: Bulk sample taken 15'-18.5'		
30	792							
36	786							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 22 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.5 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-5 Sheet 1 of 1

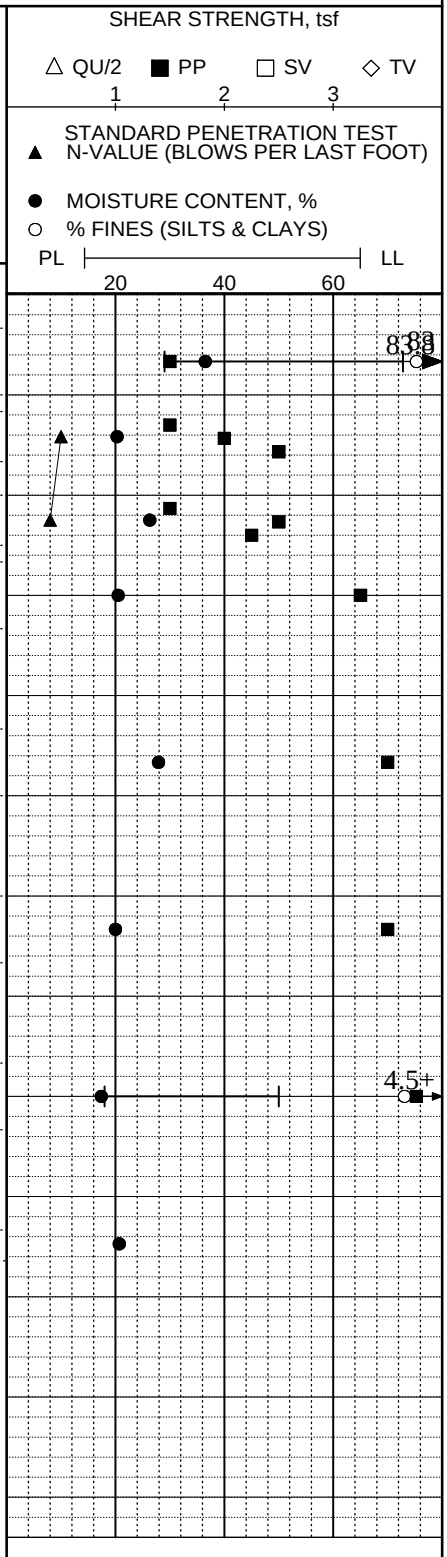
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1067907 E 1852069
ELEVATION: 822 DATUM:
DATE DRILLED: 03-18-11

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	822			4-inches of topsoil		
			46	CLAY (CH), golden and red-brown, high plastic, with fine sand, stiff, moist	85.1	36.5
			100	Silty CLAY (CL), gray-brown, with lignite	2-5-5	20.3
6	816		100	CLAY (CH), gray-brown, high plastic, dry	2-4-4	26.3
			100		108.8	20.5
12	810		100		95.5	27.9
18	804		100		110.9	20.0
24	798		100	With fine sand, dry	114.8	17.4
			100	With fine gravel	103.7	20.7
30	792			Boring terminated at tube refusal on rock at 28'-10" NOTE: Bulk sample taken 10'-13.5'		
36	786					



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 28.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-6 Sheet 1 of 1

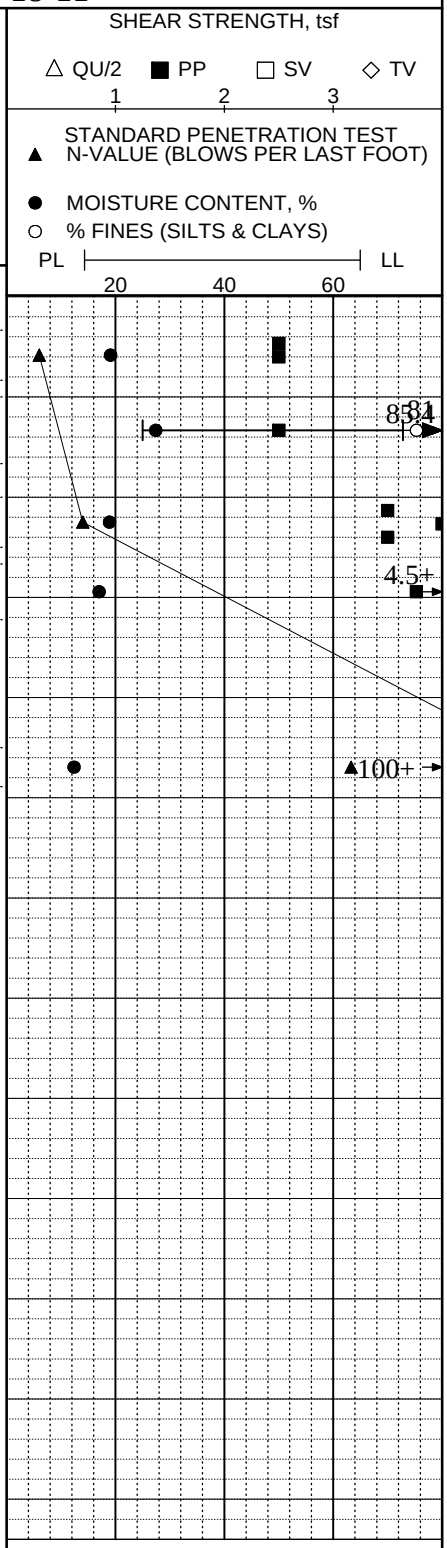
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-7

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1068084 E 1852942
ELEVATION: 809 DATUM:
DATE DRILLED: 03-18-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						7.5-inches of crushed limestone		
					83	Silty CLAY (CL), gray-brown, firm, dry	3-3-3	19.1
					67	CLAY (CH), gray and tan, trace fine sand	95.6	27.4
	804							
6					100	Becoming golden, trace fine gravel, dry, very stiff	3-6-8	18.9
					80	Shaley CLAY (CH), golden and maroon, with chert gravel	121.0	17.0
	798							
12					100		17-50/5.5"	12.4
						Boring terminated at auger refusal on limestone at 15'-0"		
						NOTE: Bulk sample taken 10'-13.5'		
	792							
18								
	786							
24								
	780							
30								
	774							
36								



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-7 Sheet 1 of 1

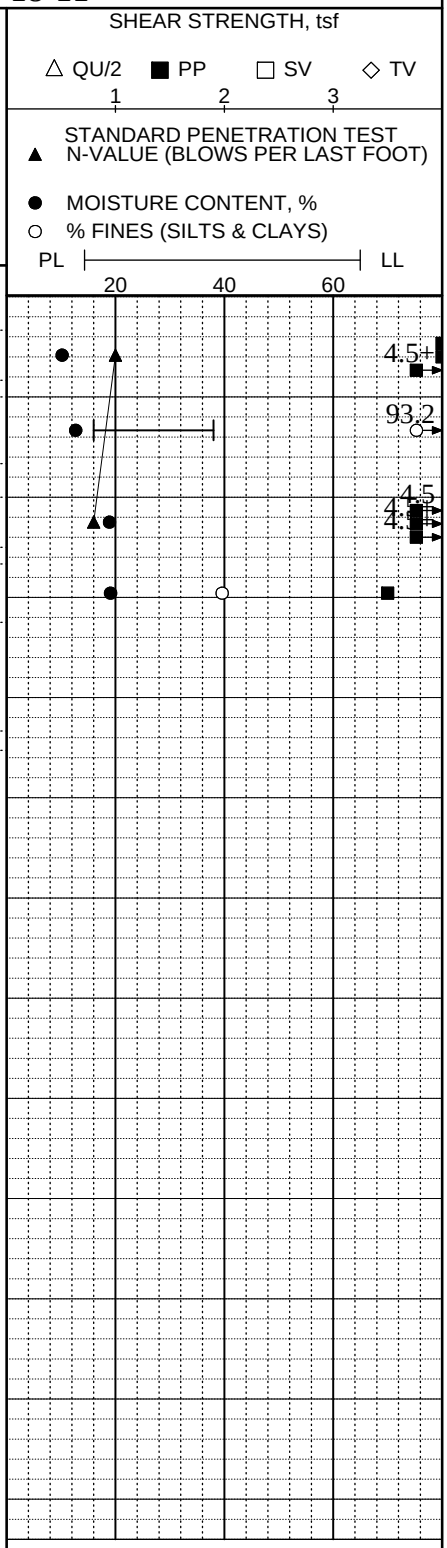
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-8

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1067429 E 1853784
ELEVATION: 816 DATUM:
DATE DRILLED: 03-18-11

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	816			5-inches of crushed limestone		
			83	Silty CLAY (CL), gray-brown, very stiff, dry	3-6-14	10.2
			54		106.8	12.7
6	810		89	CLAY (CH), golden and gray, high plastic, with fine gravel	4-6-10	18.9
			86	Gravelly CLAY (GC), brown and tan, high plastic, coarse to fine gravel, with fine sand	100.4	19.1
12	804		100	No recovery From 14.5' to 15.5' heavy rocky drilling		
18	798			Boring terminated at auger refusal on limestone at 17'-0" NOTE: Bulk sample taken 1'-15'		
24	792					
30	786					
36	780					



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-8 Sheet 1 of 1

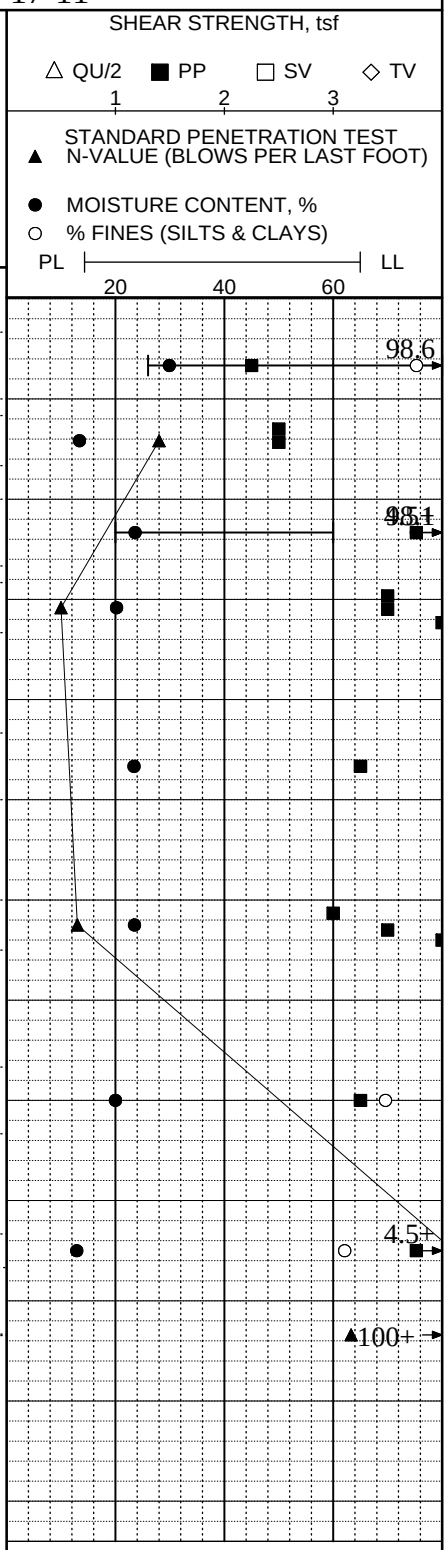
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-9

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1067143 E 1850654
ELEVATION: 834 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	834			CLAY (CH), reddish brown and gray, high plastic, with lignite and limonite, moist		
			58		91.0	29.9
			100	Silty CLAY (CL), gray brown, dry, hard	5-12-16	13.4
6	828		100		100.0	23.6
				CLAY (CH), brown and gray, high plastic, slightly silty, stiff		
			100		4-4-6	20.2
12	822		100		104.3	23.4
18	816		100	Becoming golden	3-5-8	23.5
24	810		100	With fine to medium sand	109.3	20.0
			100	Shaley CLAY (CH), brown gray and purple, with weathered limestone, with fine to medium sand	125.9	12.9
30	804		100	Boring terminated at auger refusal on limestone at 31'-1" NOTE: Bulk sample taken 10'-13'	50/.5"	
36	798					



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 31 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 11.1 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-9 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

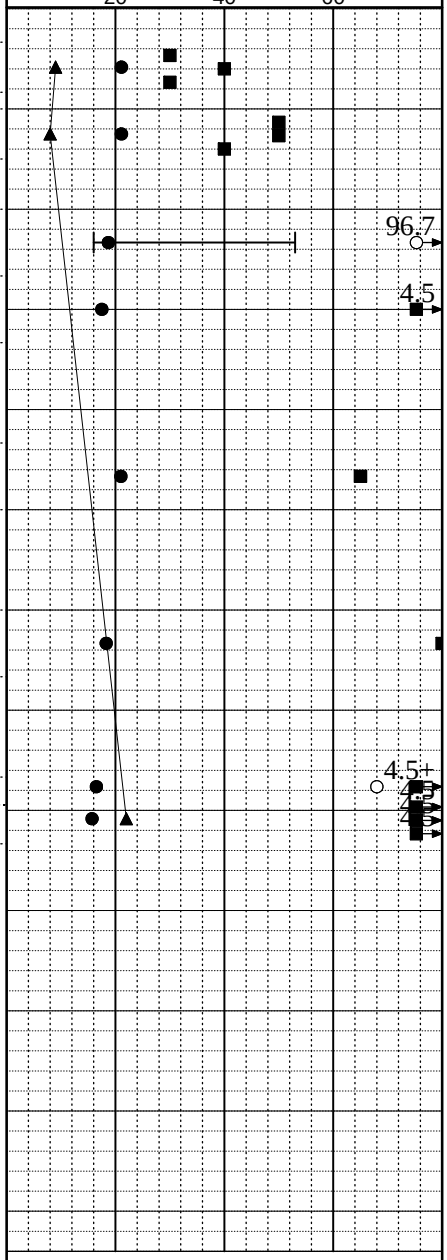
BORING LOG B-10

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1066225 E 1850478
ELEVATION: 833 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						4-inches of topsoil		
					100	Silty CLAY (CL), brown and tan, with lignite and limonite, moist, stiff	2-4-5	21.1
					100		3-3-5	21.1
	828					CLAY (CH), gray and tan, high plastic, dry		
6					100		107.5	18.7
					100	Becoming golden	113.0	17.5
	822							
12					100	Becoming gray	105.7	21.0
	816	▽						
18					100	Becoming orangish brown, trace fine sand	112.9	18.3
	810	▽			100	Gravelly drilling at 22.5'		
24					100	With fine to medium sand	116.0	16.5
						With fine gravel, very stiff	7-9-13	15.7
						Boring terminated in high plastic clay at 25'-0"		
						NOTE: Bulk sample taken 15'-18.5'		
	804							
30								
	798							
36								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 23.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 16.5 FEET AFTER 18 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-10 Sheet 1 of 1

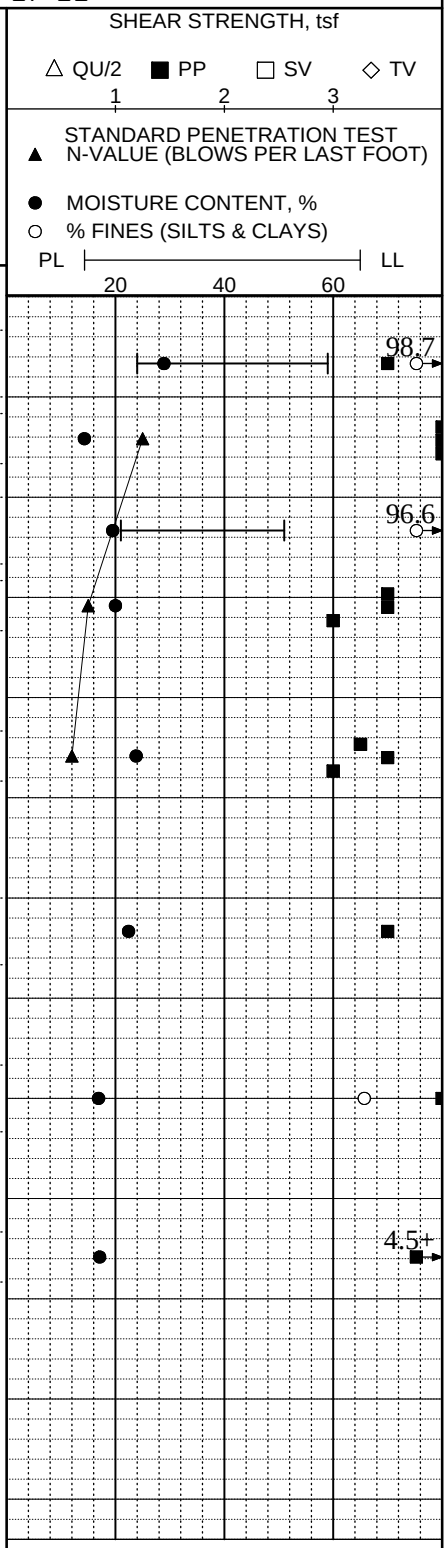
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-11

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1066268 E 1852244
ELEVATION: 836 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						6-inches of topsoil		
	834				100	CLAY (CH), gray and reddish brown, high plastic, silty, moist	95.2	28.9
					100	Silty CLAY (CL), gray-brown, dry, hard	5-10-15	14.3
6					50	CLAY (CH), tan and gray, high plastic, very stiff	101.0	19.5
	828							
					100	Becoming gray	3-6-9	20.0
12								
	822				100	Becoming gray red-brown and golden, trace fine gravel	3-5-7	23.8
18								
					100	Becoming gray-tan	105.1	22.4
	816							
24					100	Sandy CLAY (CH), tan gray and orangish brown, fine to medium grain sand	117.4	16.9
	810							
					100		116.4	17.1
30						Boring terminated in sandy clay at 29'- 6" NOTE: Bulk sample taken 10'-13.5'		
	804							
36								



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-11 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

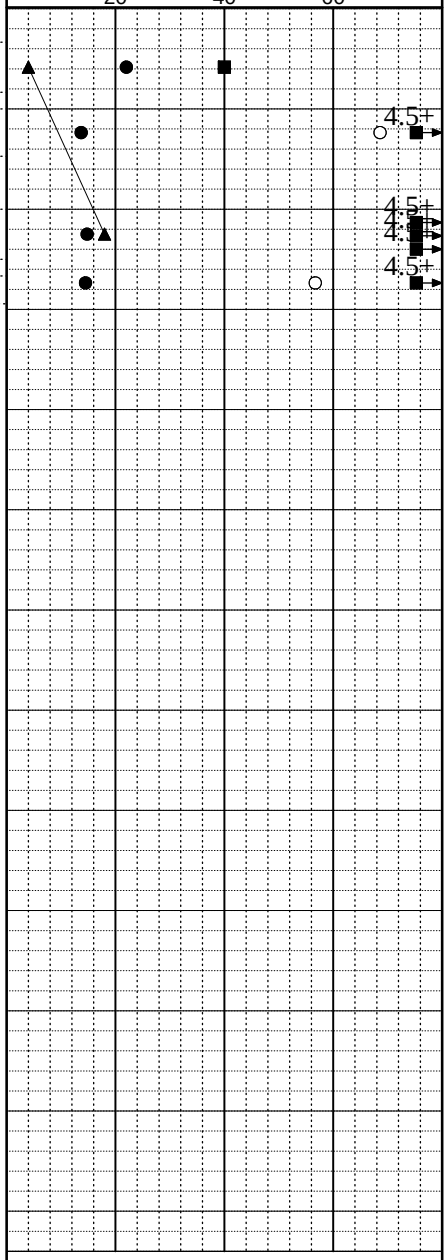
BORING LOG B-12

Labadie Plant Utility Waste Landfill
Potential Clay Borrow at Callaway Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1066354 E 1853688
ELEVATION: 812 DATUM:
DATE DRILLED: 03-17-11

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						1-inch of topsoil		
	810				33	CLAY (CH), brown and gray, high plastic, slightly silty, firm, moist	1-2-2	22.0
					100	With fine to medium sand, dry	116.2	13.7
6					89	Trace weathered limestone, very stiff	5-8-10	14.8
	804				100	Sandy CLAY (CH), brown tan gray and orange-brown, high plastic, fine to medium grain sand, with fine to coarse gravel	115.0	14.5
12						Becoming very rocky drilling below 11.5'		
	798					Weathered limestone		
						Boring terminated at auger refusal on limestone at 14'-0" NOTE: Bulk sample taken 6'-14'		
18								
	792							
24								
	786							
30								
	780							
36								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Midwest Drilling
METHOD: 4.25" CFA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. David

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING ___ FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ___ FEET AFTER ___ HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2008012455

Figure 2-12 Sheet 1 of 1

LABORATORY TEST SUMMARY

Client: Ameren Missouri
Project: Labadie UWL
Location: Callaway Borrow Site

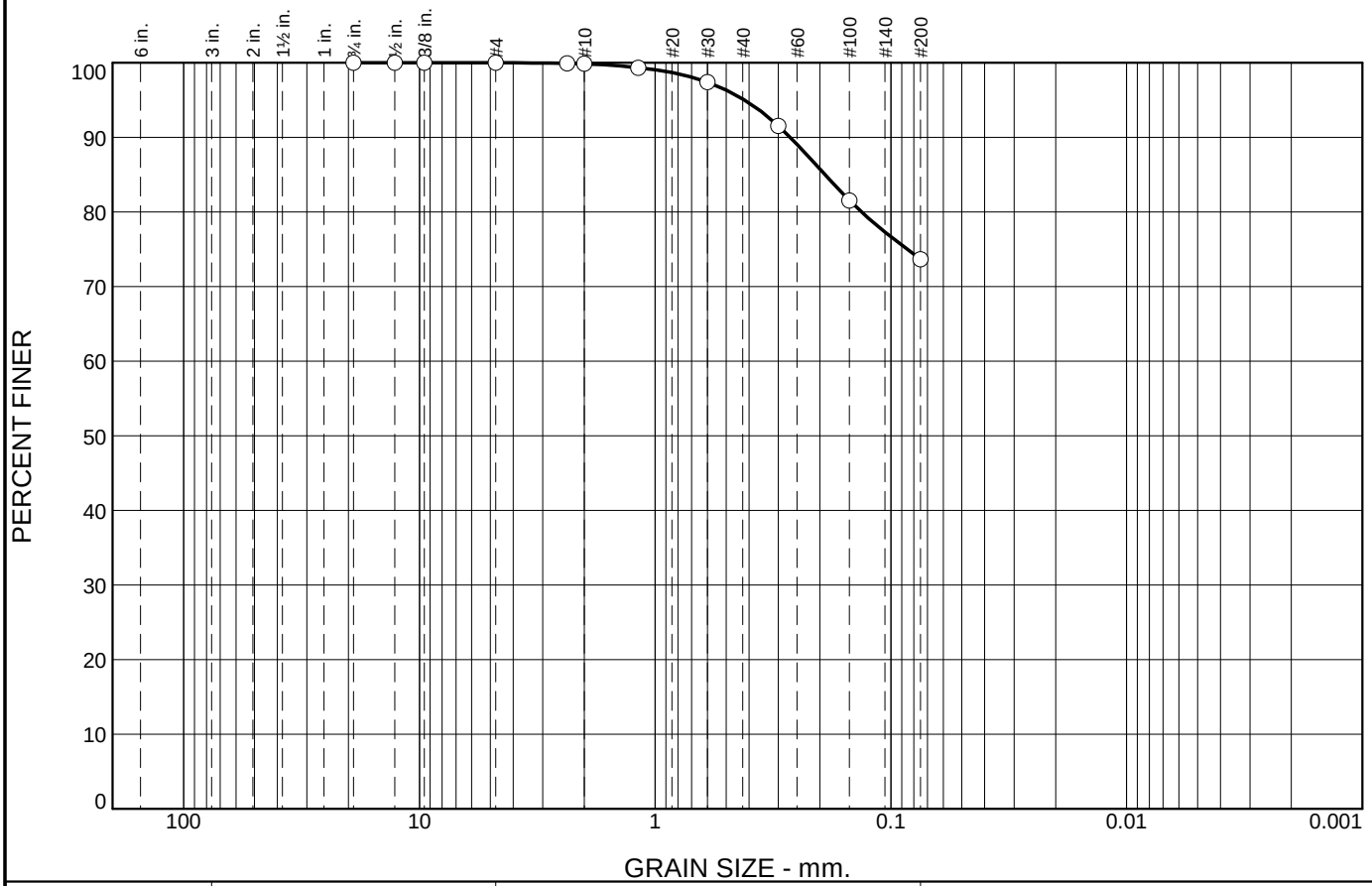
Sample Identification				Index Properties							
Boring Number	Sample Number	Depth (ft)	Sample Recovery (inches)	Visual Classification ASTM D2488	Water Content (%) ASTM D2216	Dry Density (pcf)	Liquid Limit ASTM D4318	Plastic Limit ASTM D4318	#200 Wash (Fines Content %) ASTM D2488 If greater than 10% remains on #200 sieve, dry shake with full nest of sieves	Penetrometer (tsf)	Remarks
B-1	SPT-1	1-2.5	14	CL-CH	32.5					2.5	
B-1	ST-2	3-5	20	CL-ML	19.5	110.5	28	21	97.9	4.0	
B-1	SPT-3	6-7.5	18	CH	27.7					2.2	
B-1	SPT-4	8-10	17	CH	26.9					1.8	
B-1	BULK	13-20		CH			69	22	95.7		
B-1	ST-5	13-15	24	CH	19.1	110.3				4.0	
B-1	ST-6	18-20	24	CH, sandy	17.5	113.2			Figure 4-1	4.5+	
B-1	ST-7	23-25	24	CH, sandy	15.1	117.7			Figure 4-2	4.5+	
B-1	SPT-8	28.5-30	18	CH, sandy	13.1					4.5+	
B-2	SPT-1	1-2.5	15	CL, silty	29.1					1.7	
B-2	ST-2	3-5	22	CL, silty	19.0	106.7	32	19	94.0	2.5	
B-2	SPT-3	6-7.5	18	CH	31.5					3.0	
B-2	ST-4	8-10	17	CH	50.6	83.9				3.5	
B-2	BULK	10-13		CH, trace sand			78	22	Figure 4-3		
B-2	ST-5	13-15	24	CH, sandy	16.8	110.5			Figure 4-4	4.5+	Bent Tube
B-2	SPT-6	18.5-20	1.5	Weathered rock							
B-3	SPT-1	1-2.5	18	CL, silty	24.4					2.0	
B-3	ST-2	3-5	24	CH	17.3	107.3	61	22	92.2	4.5+	
B-3	SPT-3	6-7.5	18	CH	27.7					2.9	
B-3	ST-4	8-10	9	CH	19.0	107.8				3.0	
B-3	BULK	1-10		CH			101	33	97.8		
B-3	ST-5	13-15	24	CH	21.0	107.2				3.5	
B-3	ST-6	18-20	24	CL, sandy, trace gravel	20.6	107.4	44	20	Figure 4-5	3.8	
B-3	ST-7	23-25	18	CL, sandy, gravelly	15.0	115.0			Figure 4-6		
B-3	SPT-8	28.5-30	18	Shaley clay	14.9					4.5+	
B-4	ST-1	1-3	22	CL, silty	28.1	95.6				2.5	
B-4	SPT-2	3.5-5	18	CL, silty	19.5					1.8	
B-4	ST-3	6-8	5	CL, silty						2.5	Sample was all fall in, no virgin material
B-4	SPT-4	8.5-10	18	CH	24.7					2.3	
B-4	ST-5	13-15	24	CH, sandy, trace gravel	18.9	111.4				4.0	
B-4	BULK	15-24		CH, sandy			56	21	Figure 4-7		
B-4	ST-6	18-20	21	SM	23.6	100.2				1.5	Not acceptable liner material
B-4	SPT-7	23.5-24	4.5	SHALE	5.3						
B-5	SPT-1	1-2.5	17	CL, silty	30.6					1.7	
B-5	ST-2	3-5	24	CL, silty	20.0	108.2	30	20	95.6	3.3	
B-5	SPT-3	6-7.5	18	CH	24.5					2.5	
B-5	ST-4	8-10	24	CH	19.9	108.6				3.5	
B-5	ST-5	13-15	22	CH	21.7	106.0				3.0	
B-5	BULK	15-18		CH			67	21	93.3		
B-5	SPT-6	18-19.5	18	CH, sandy	22.3					3.4	
B-5	SPT-7	23-24.5	16	Weathered rock	7.2					4.5+	
B-6	ST-1	1-3	11	CH, sandy	36.5	85.1	83	29	Figure 4-8	1.5	
B-6	SPT-2	3.5-5	18	CL	20.3					2.0	
B-6	SPT-3	6-7.5	18	CH	26.3					2.1	
B-6	ST-4	8-10	24	CH	20.5	108.8				3.3	
B-6	BULK	10-13		CH			86	22	96.5		
B-6	ST-5	13-15	24	CH	27.9	95.5				3.5	
B-6	ST-6	18-20	24	CH	20.0	110.9				3.5	
B-6	ST-7	23-25	24	CH, sandy	17.5	114.8	50	18	Figure 4-9	4.5+	
B-6	ST-8	28-30	10	CH, sandy, gravelly	20.7	103.7					Bent Tube

LABORATORY TEST SUMMARY

Client: Ameren Missouri
Project: Labadie UWL
Location: Callaway Borrow Site

Sample Identification				Index Properties							
Boring Number	Sample Number	Depth (ft)	Sample Recovery (inches)	Visual Classification ASTM D2488	Water Content (%) ASTM D2216	Dry Density (pcf)	Liquid Limit ASTM D4318	Plastic Limit ASTM D4318	#200 Wash (Fines Content %) ASTM D2488 If greater than 10% remains on #200 sieve, dry shake with full nest of sieves	Penetrometer (tsf)	Remarks
B-7	SPT-1	1-2.5	15	CL, silty	19.2					2.5	
B-7	ST-2	3-5	16	CH, trace sand	27.4	95.6	81	25	Figure 4-10	2.5	
B-7	SPT3	6-7.5	18	CH, trace sand & gravel	19.0					3.7	
B-7	ST-4	8-10	16	Shaley clay	17.0	121.0				4.5+	
B-7	BULK	8-15		CH, sandy, trace gravel			54	20	Figure 4-11		
B-7	SPT-5	13.5-15	14	Shaley clay	12.4						
B-8	SPT-1	1-2.5	15	CL, silty	10.2					4.2	
B-8	ST-2	3-5	13	CL, silty	12.7	106.8	38	16	93.2		
B-8	SPT-3	6-7.5	16	CH, sandy, gravelly	18.9					4.5+	
B-8	ST-4	8-10	18	GC, sandy	19.1	100.4			Figure 4-12	3.5	
B-8	BULK	1-15		CH, sandy			52	17	Figure 4-13		
B-8	ST-5	13-15	9	GC, sandy							Bent Tube, All Fall-in
B-9	ST-1	1-3	14	CH	29.9	91.0	80	26	99.9	2.3	
B-9	SPT-2	3.5-5	18	CL, silty	13.4					2.5	
B-9	ST-3	6-8	24	CL, silty	19.7	100.0	60	20	98.1	4.5+	
B-9	SPT-4	8.5-10	18	CH	20.2					3.7	
B-9	BULK	10-13		CH			52	18	95.7		
B-9	ST-5	13-15	24	CH	23.4	104.3				3.3	
B-9	SPT-6	18-19.5	18	CH	23.5					3.5	
B-9	ST-7	23-25	24	CH, sandy	20.0	109.3			Figure 4-14	3.3	
B-9	ST-8	28-30	15	Shaley clay, sandy	12.9	125.9			Figure 4-15	4.5+	Bent Tube
B-9	SPT-9	31-32.5	0.5	Limestone							
B-10	SPT-1	1-2.5	18	CL, silty	21.1					1.7	
B-10	SPT-2	3-4.5	18	CL, silty	21.1					2.3	
B-10	ST-3	6-8	24	CH	18.7	107.5	53	16	96.7		
B-10	ST-4	8-10	24	CH	17.5	113.0				4.5	
B-10	ST-5	13-15	24	CH	21.0	105.7				3.3	
B-10	BULK	15-18		CH, sandy			65	18	Figure 4-16		
B-10	ST-6	18-20	24	CH, trace sand	18.3	112.9				4.0	
B-10	ST-7	23-23.6	7	CH, sandy	16.5	116.0			Figure 4-17	4.5+	Bent Tube
B-10	SPT-8	23.6-25.1	18	CH, sandy, gravelly	15.7					4.5	
B-11	ST-1	1-3	24	CH	28.9	95.2	59	24	98.7	3.5	
B-11	SPT-2	3.5-5	18	CL, silty	14.3					4.0	
B-11	ST-3	6-8	12	CH	19.5	101.0	51	21	96.5		
B-11	SPT-4	8.5-10	18	CH	20.0					3.3	
B-11	BULK	10-13		CH			63	16	98.5		
B-11	SPT-5	13-15	18	CH, trace gravel	23.8					3.3	
B-11	ST-6	18-20	24	CH	22.4	105.1				3.5	
B-11	ST-7	23-25	24	CH, sandy	16.9	117.4			Figure 4-18	4.0	
B-11	ST-8	28-29.5	18	CH, sandy	17.1	116.4				4.5+	
B-12	SPT-1	1-2.5	6	CH	22.0					2.0	
B-12	BULK	2.5-10		CH, sandy			74	22	Figure 4-19		
B-12	ST-2	3-5	18	CH, sandy	13.7	116.2			Figure 4-20	4.5+	
B-12	SPT-3	6-7.5	16	CH, sandy, trace gravel	14.8					4.5+	
B-12	ST-4	8-10	10	CH, sandy, gravelly	14.5	115.0			Figure 4-21	4.5+	

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	4.8	21.4	73.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	99.9		
#10	99.9		
#16	99.3		
#30	97.4		
#50	91.5		
#100	81.6		
#200	73.7		

* (no specification provided)

Material Description

CLAY (CH), gray and orangish brown, high plastic, with fine sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.1902 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

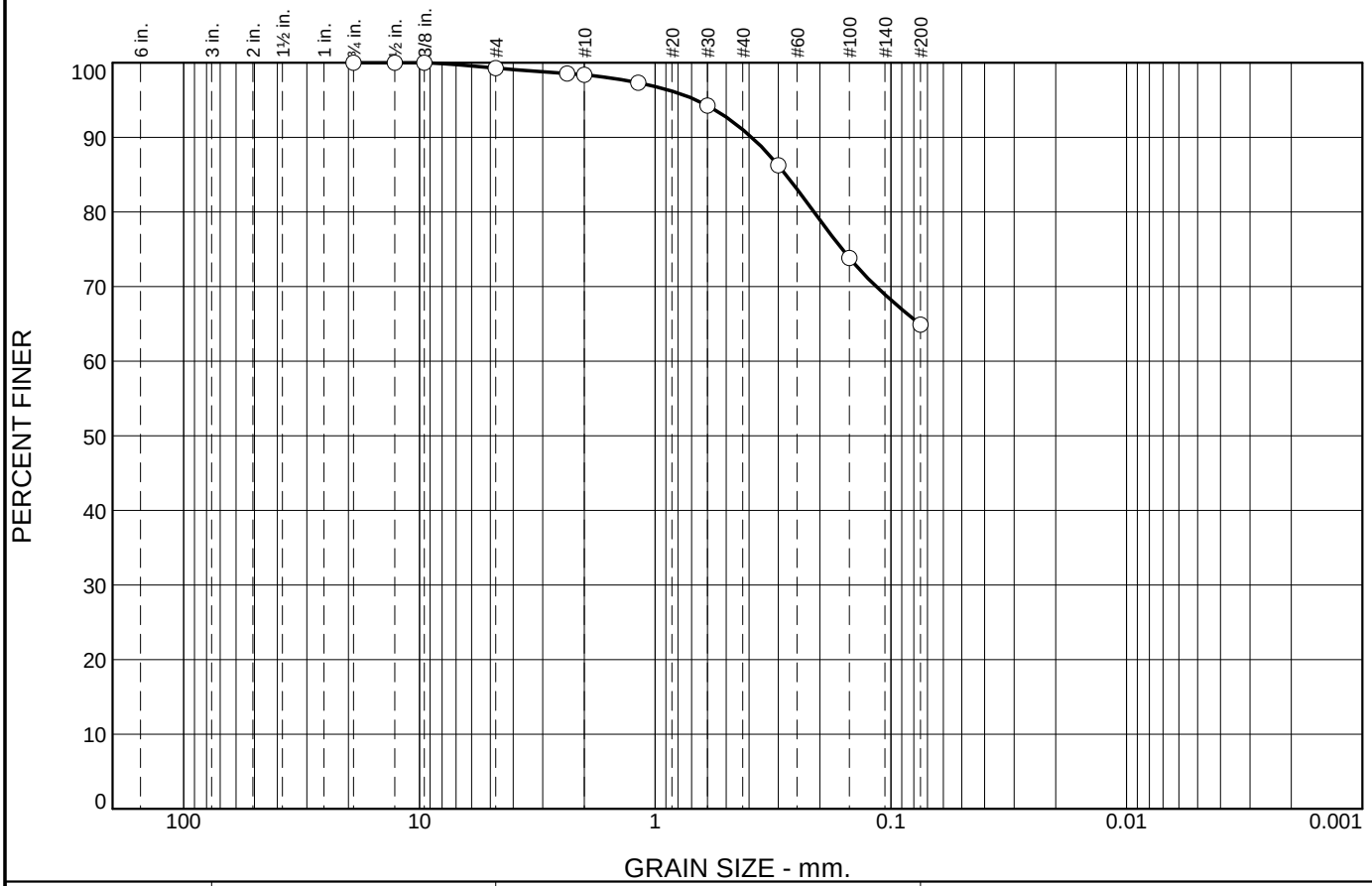
Sample No.: ST-6 **Source of Sample:** B-1 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-1

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.9	7.4	26.1	64.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	99.3		
#8	98.6		
#10	98.4		
#16	97.3		
#30	94.3		
#50	86.2		
#100	73.8		
#200	64.9		

* (no specification provided)

Material Description

CLAY (CH), gray and orangish brown, high plastic, with medium to fine grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2785 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

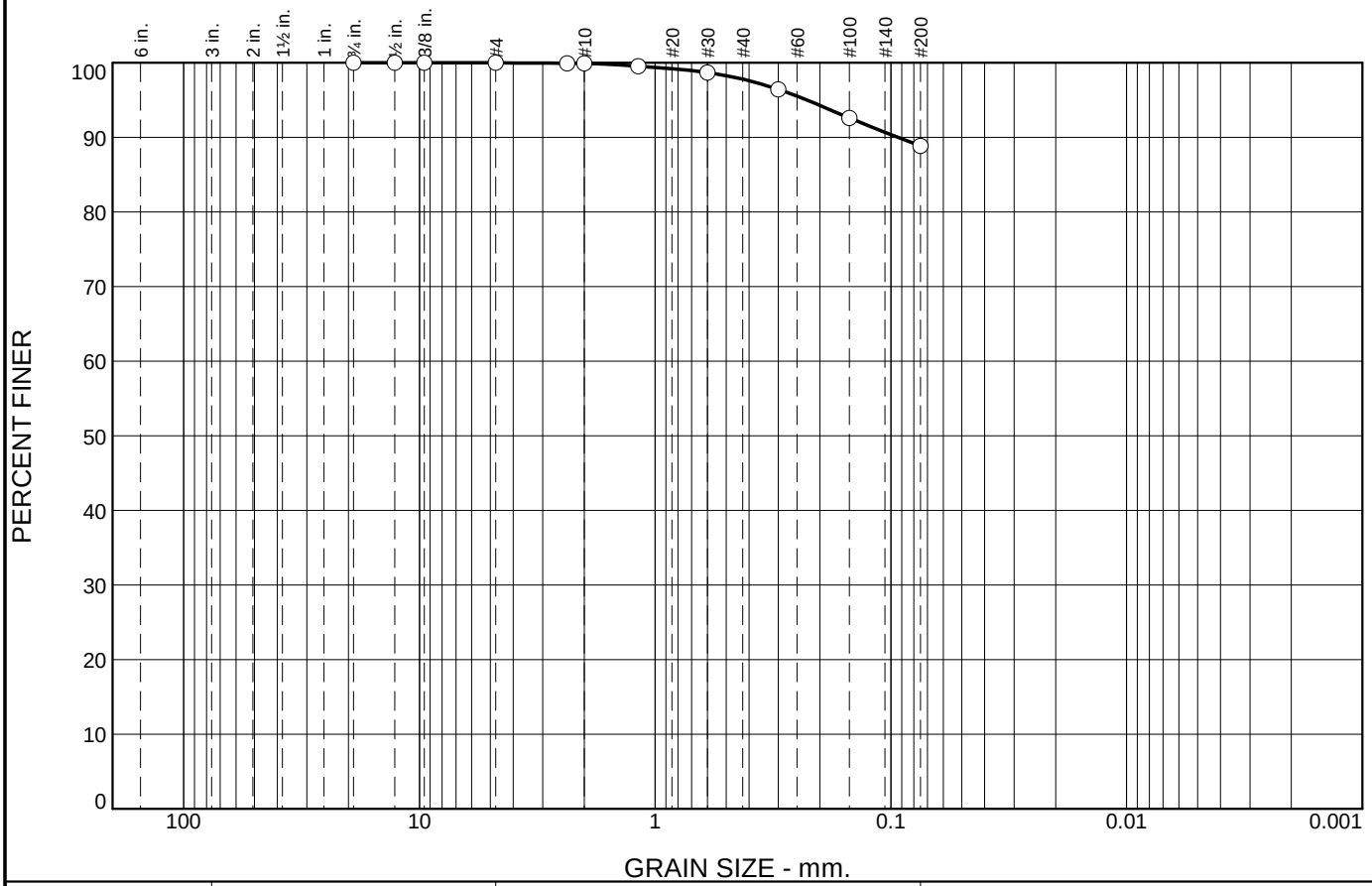
Sample No.: ST-7 **Source of Sample:** B-1 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-2

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.1	9.0	88.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	99.9		
#10	99.9		
#16	99.5		
#30	98.7		
#50	96.4		
#100	92.6		
#200	88.8		

* (no specification provided)

Material Description

CLAY (CH), golden and grayish tan, high plastic, trace fine sand

Atterberg Limits (ASTM D 4318)

PL= 22 LL= 78 PI= 56

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

Bag Sample
10'-13'

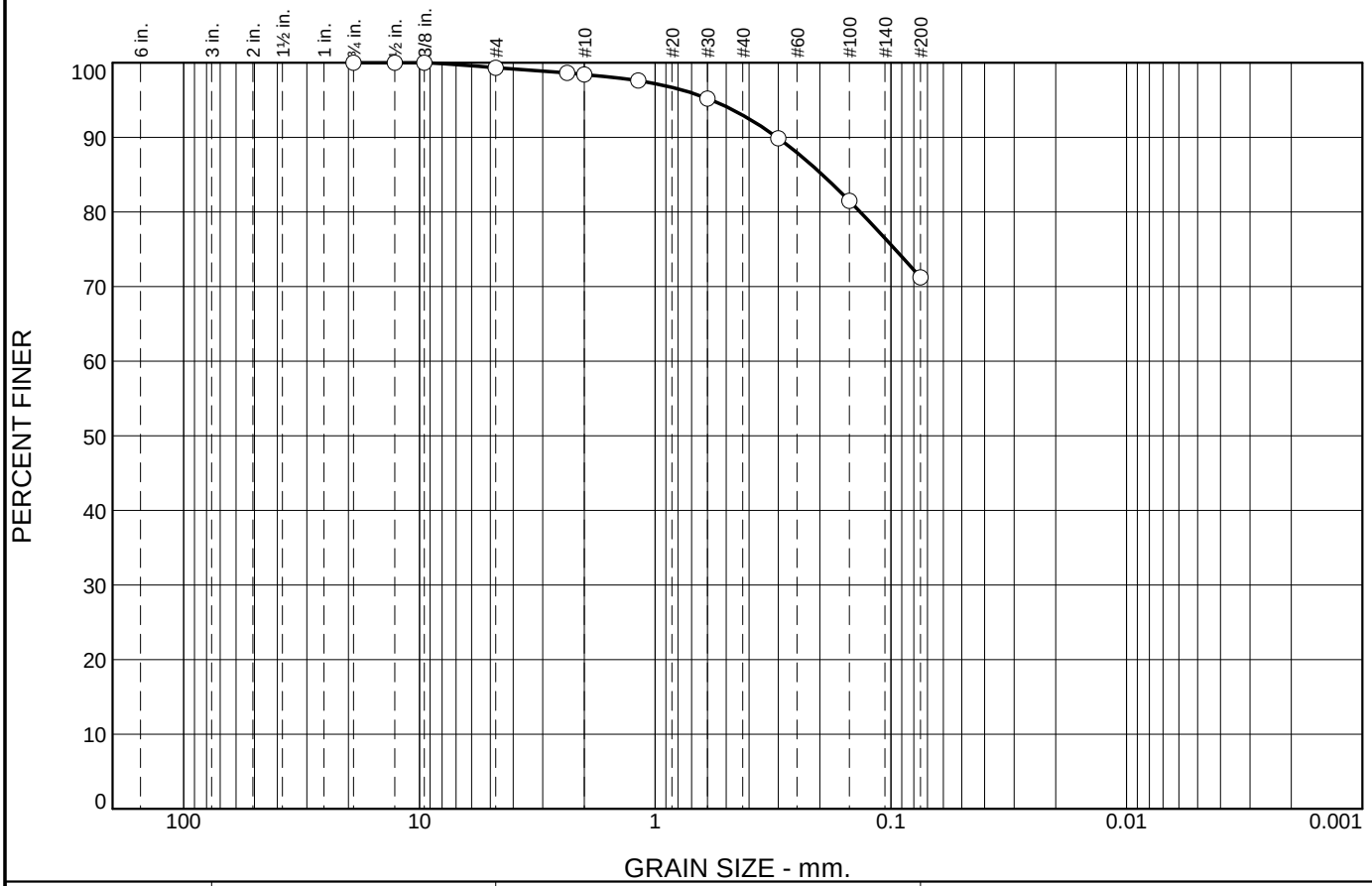
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-2 **Elev./Depth:** 10-13
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-3

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.9	5.4	21.8	71.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	99.3		
#8	98.6		
#10	98.4		
#16	97.6		
#30	95.2		
#50	89.9		
#100	81.5		
#200	71.2		

* (no specification provided)

Material Description

CLAY (CH), brown and tan, high plastic, with fine sand, trace medium sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.1953 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

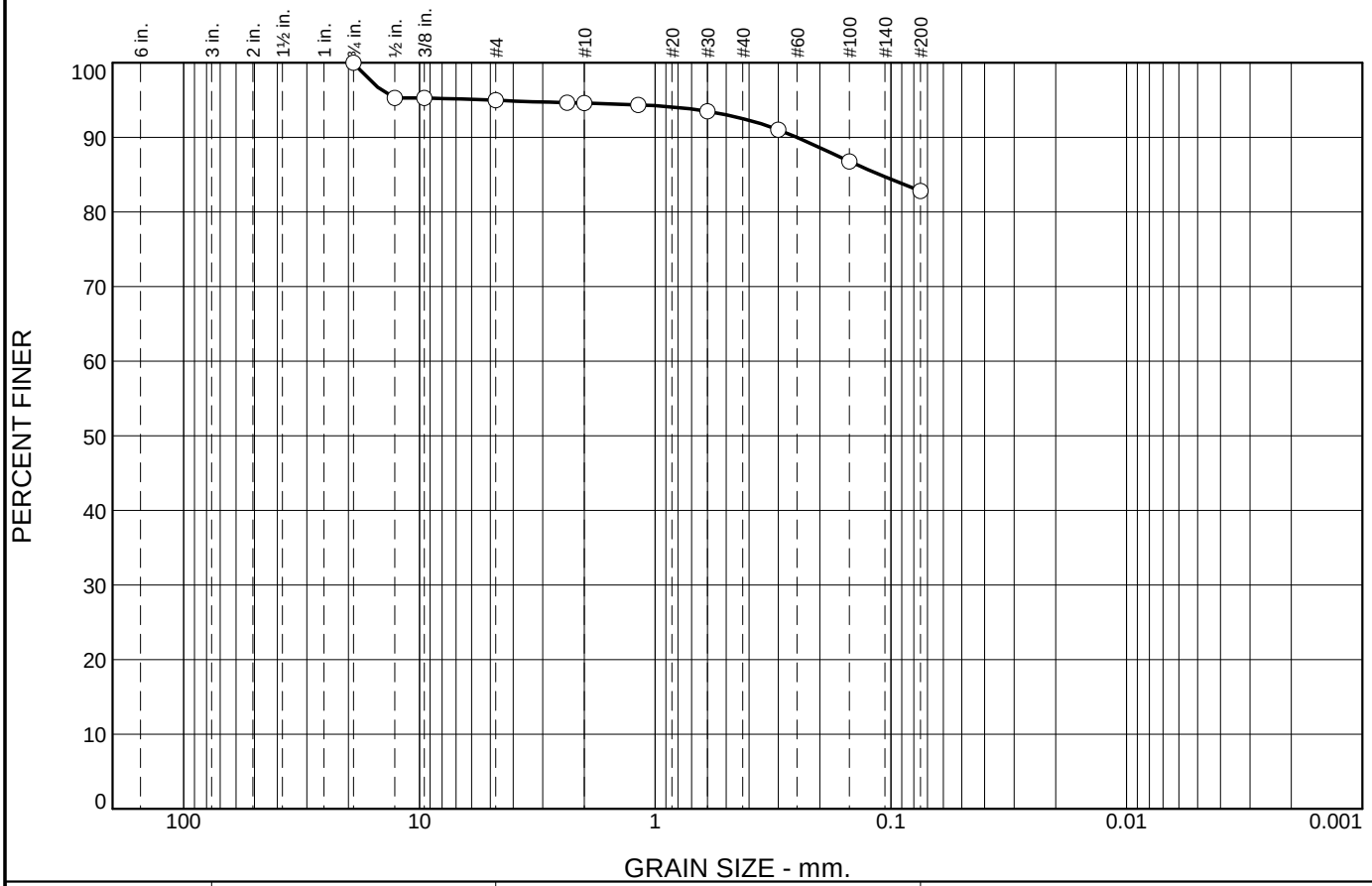
Sample No.: ST-5 **Source of Sample:** B-2 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-4

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.0	0.4	2.1	9.7	82.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	95.3		
3/8	95.3		
#4	95.0		
#8	94.7		
#10	94.6		
#16	94.4		
#30	93.5		
#50	91.0		
#100	86.8		
#200	82.8		

* (no specification provided)

Material Description

CLAY (CL), gray, with fine sand, trace fine gravel

Atterberg Limits (ASTM D 4318)

PL= 20 LL= 44 PI= 24

Classification

USCS= CL AASHTO=

Coefficients

D_{85}= 0.1111 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

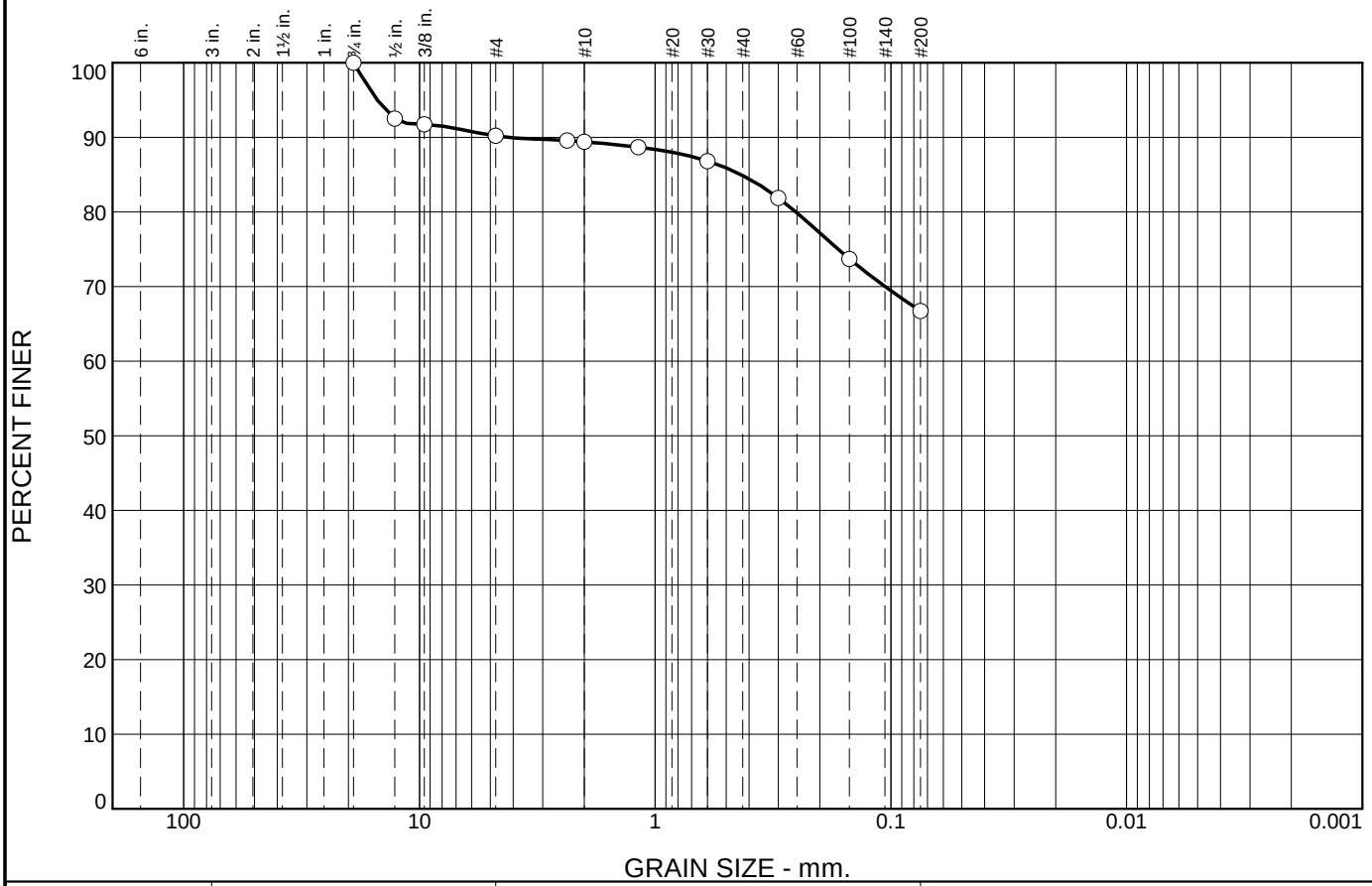
Sample No.: ST-6 **Source of Sample:** B-3 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-5

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.8	0.8	4.5	18.2	66.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	92.5		
3/8	91.7		
#4	90.2		
#8	89.6		
#10	89.4		
#16	88.7		
#30	86.8		
#50	81.9		
#100	73.7		
#200	66.7		

* (no specification provided)

Material Description

CLAY (CL), golden tan and pinkish gray, with fine sand, trace fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.4333 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

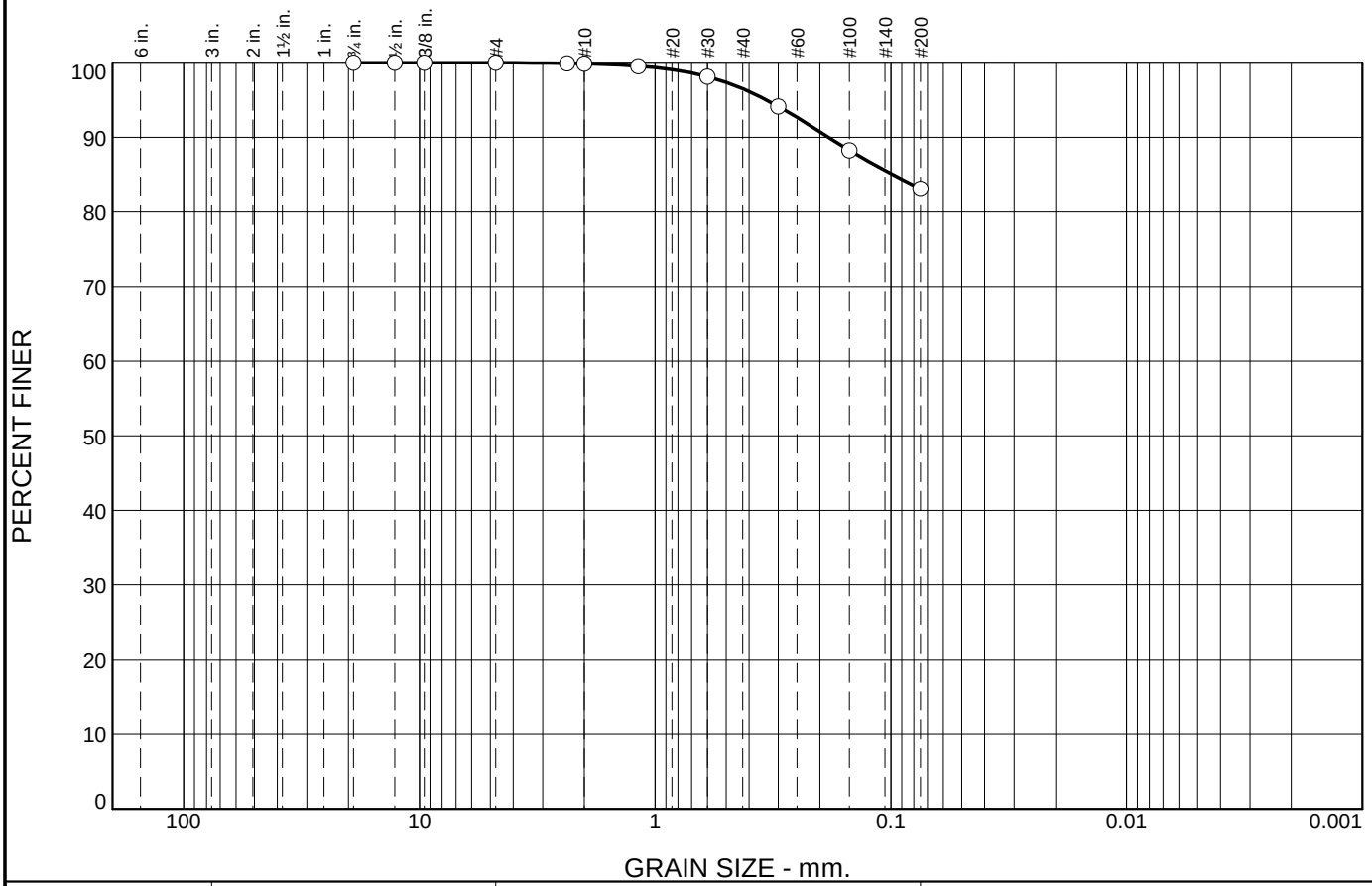
Sample No.: ST-7 **Source of Sample:** B-3 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-6

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.4	13.4	83.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	99.9		
#10	99.9		
#16	99.6		
#30	98.1		
#50	94.2		
#100	88.3		
#200	83.1		

* (no specification provided)

Material Description

CLAY (CH), golden and tan, high plastic, with fine sand

Atterberg Limits (ASTM D 4318)

PL= 21 LL= 56 PI= 35

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.0979 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

Bag Sample
15' - 25'

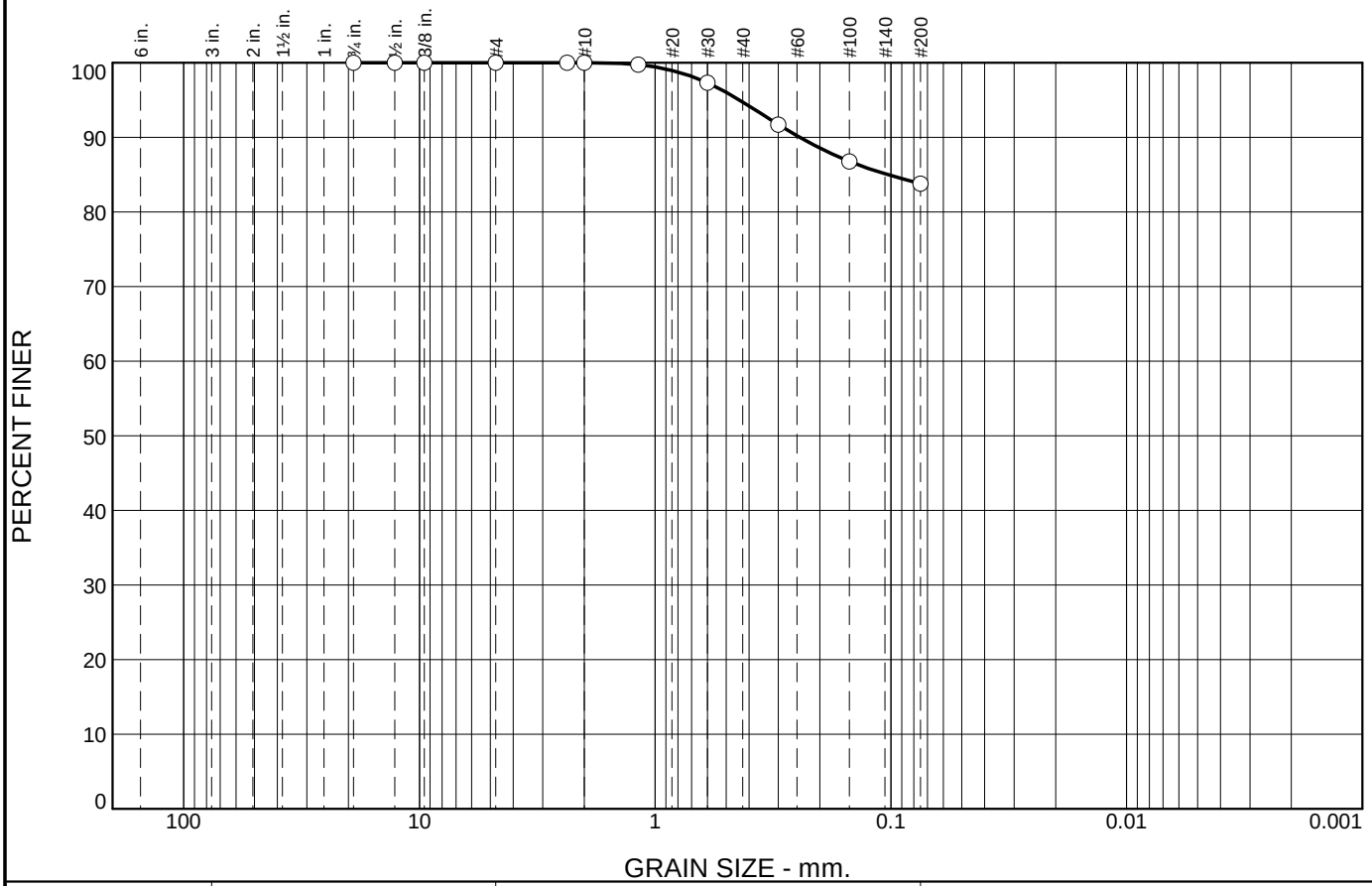
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-4 **Elev./Depth:** 15-25
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-7

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	5.3	10.9	83.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	99.7		
#30	97.3		
#50	91.7		
#100	86.8		
#200	83.8		

* (no specification provided)

Material Description

CLAY (CH), golden tan and reddish brown, high plastic, with fine sand

Atterberg Limits (ASTM D 4318)

PL= 29 LL= 83 PI= 58

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.1029 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Crose/C. Cook

Remarks

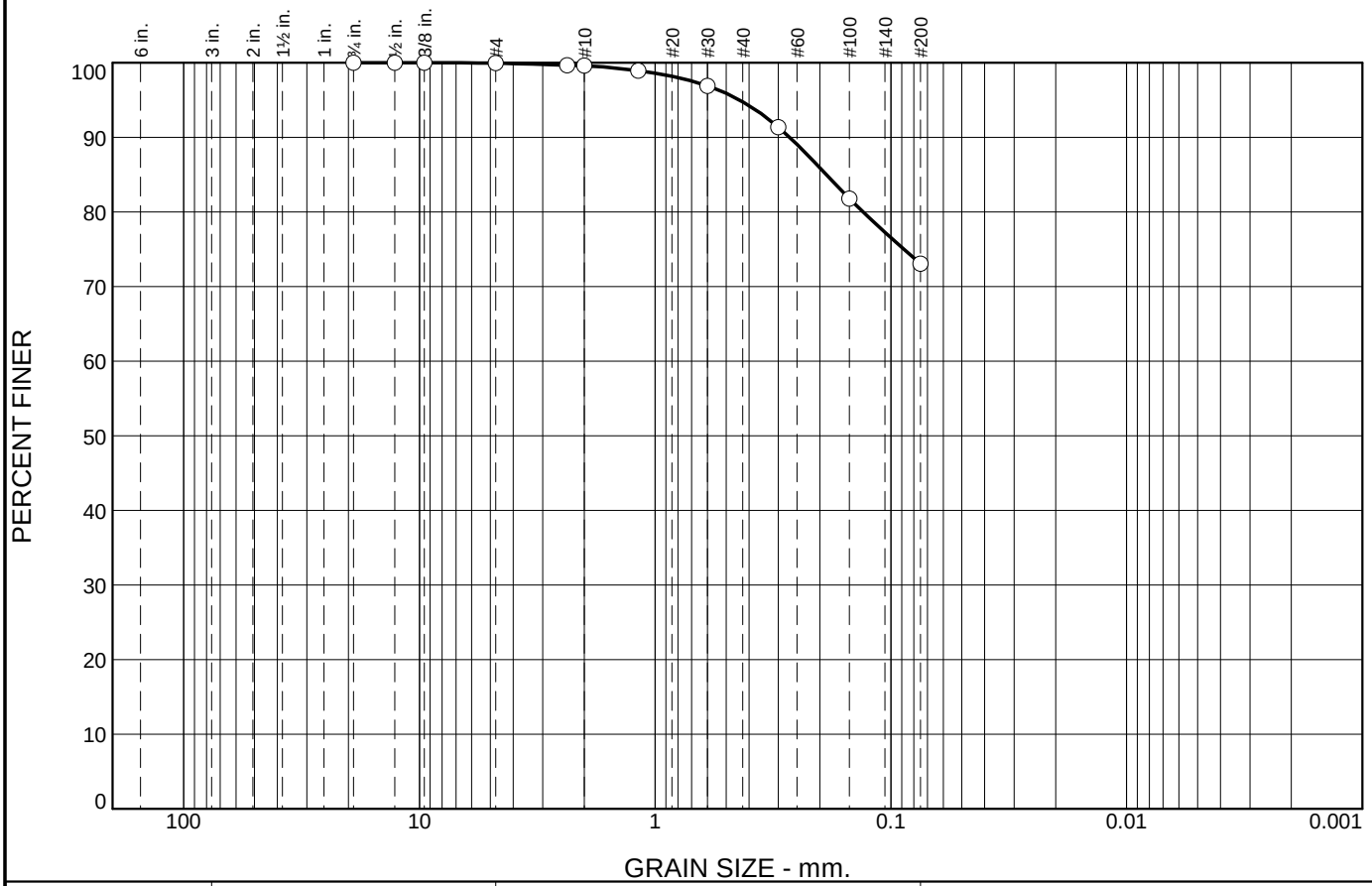
Sample No.: ST-1 **Source of Sample:** B-6 **Date Sampled:**
Location: **Elev./Depth:** 1
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-8

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	4.8	21.7	73.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	99.7		
#10	99.6		
#16	98.9		
#30	96.9		
#50	91.4		
#100	81.8		
#200	73.1		

* (no specification provided)

Material Description

CLAY (CH), gray, high plastic, with fine sand

Atterberg Limits (ASTM D 4318)

PL= 18 LL= 50 PI= 34

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.1875 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Crose/C. Cook

Remarks

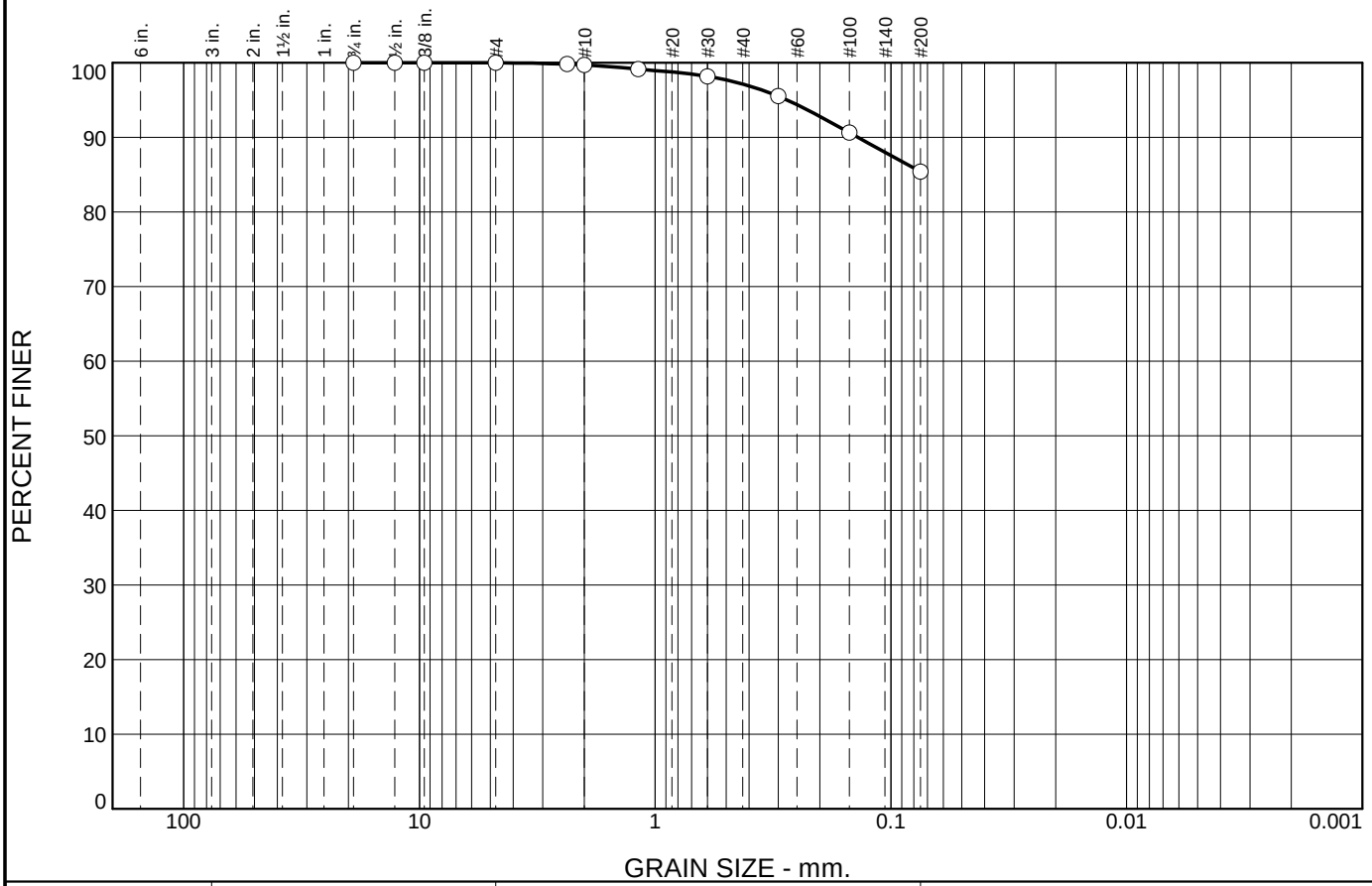
Sample No.: ST-7 **Source of Sample:** B-6 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-9

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	2.5	11.8	85.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	99.8		
#10	99.7		
#16	99.1		
#30	98.2		
#50	95.5		
#100	90.6		
#200	85.4		

* (no specification provided)

Material Description

CLAY (CH), gray and tan, high plastic, trace fine sand

Atterberg Limits (ASTM D 4318)

PL= 25 LL= 81 PI= 52

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-15-11 **Tested By:** C. Cook

Remarks

Sample No.: ST-2 **Source of Sample:** B-7 **Date Sampled:**
Location: **Elev./Depth:** 3
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-10

Particle Size Distribution Report - ASTM D422

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.6	2.1	5.5	13.6	73.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	96.9		
3/8	95.9		
#4	94.4		
#8	92.7		
#10	92.3		
#16	90.8		
#30	88.6		
#50	84.5		
#100	78.5		
#200	73.2		

* (no specification provided)

Material Description

CLAY (CH), golden, high plastic, with maroon shaley clay, with fine sand, trace medium sand and fine gravel

Atterberg Limits (ASTM D 4318)

PL= 20 LL= 54 PI= 26

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.3215 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

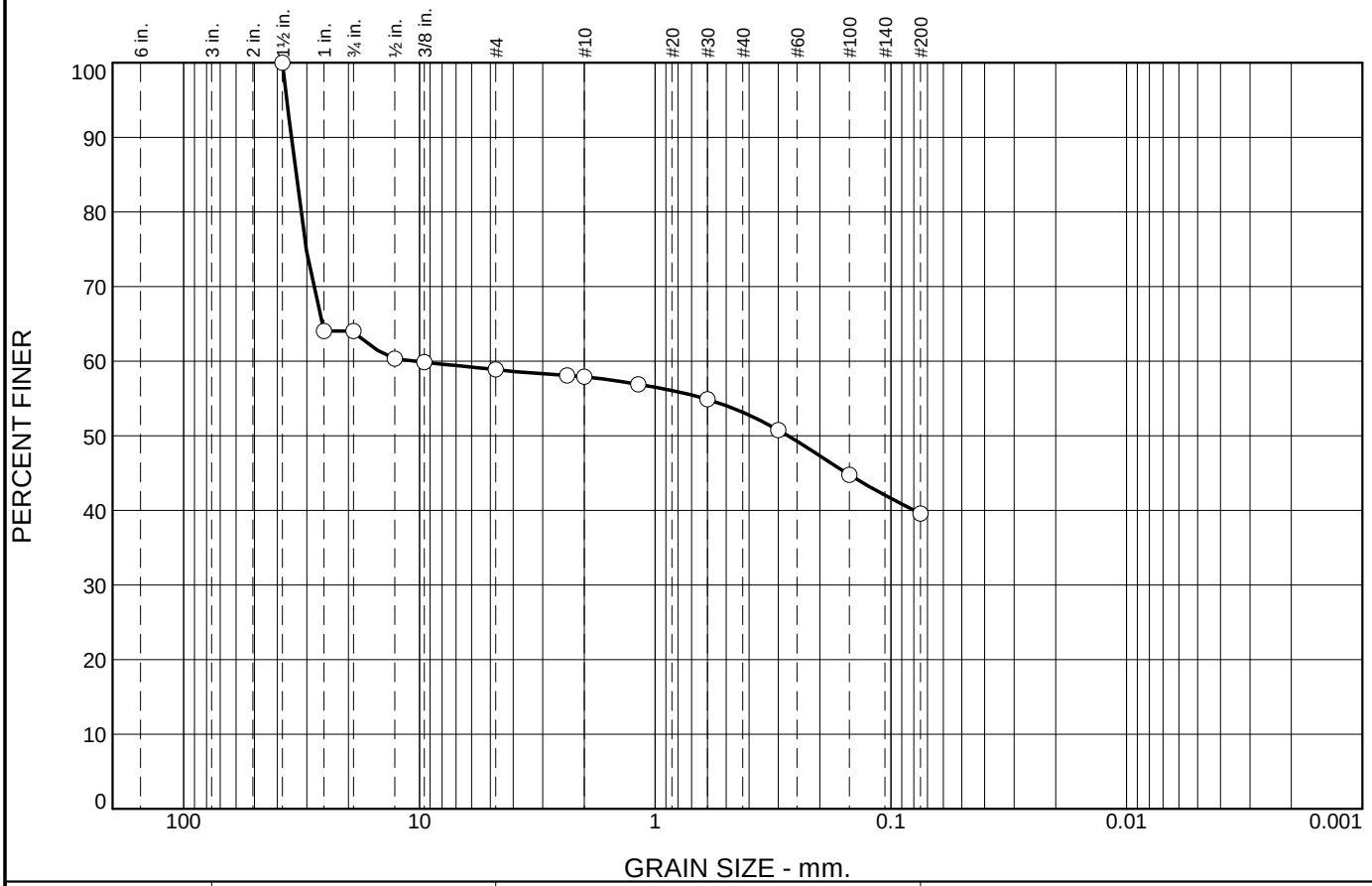
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-7 **Elev./Depth:** 8-15
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-11

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	36.0	5.1	1.0	4.7	13.6	39.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	64.0		
3/4	64.0		
1/2	60.3		
3/8	59.9		
#4	58.9		
#8	58.1		
#10	57.9		
#16	56.9		
#30	54.9		
#50	50.8		
#100	44.8		
#200	39.6		

* (no specification provided)

Material Description

Clayey GRAVEL (GC), brown gray and tan, high plastic, coarse grain gravel, with fine grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 33.3923 D_{60}= 10.3573 D_{50}= 0.2723
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Crose/C. Cook

Remarks

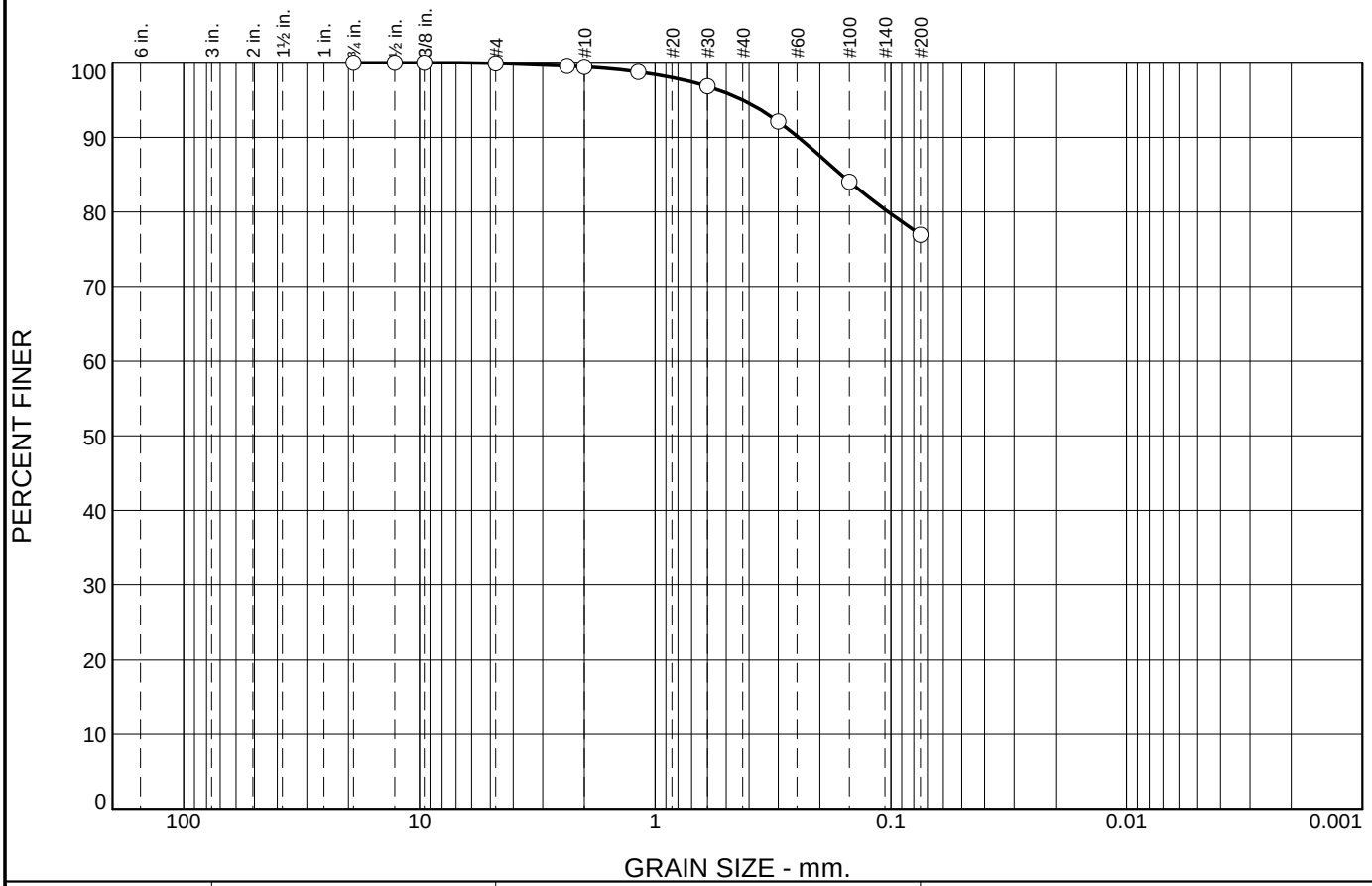
Sample No.: ST-4 **Source of Sample:** B-8 **Date Sampled:**
Location: **Elev./Depth:** 8
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-12

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.4	4.5	18.1	76.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	99.9		
#8	99.6		
#10	99.5		
#16	98.8		
#30	96.8		
#50	92.1		
#100	84.1		
#200	76.9		

* (no specification provided)

Material Description

CLAY (CH), golden and tan, high plastic, with fine sand

Atterberg Limits (ASTM D 4318)

PL= 17 LL= 52 PI= 35

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.1625 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

Bag Sample
1' - 15'

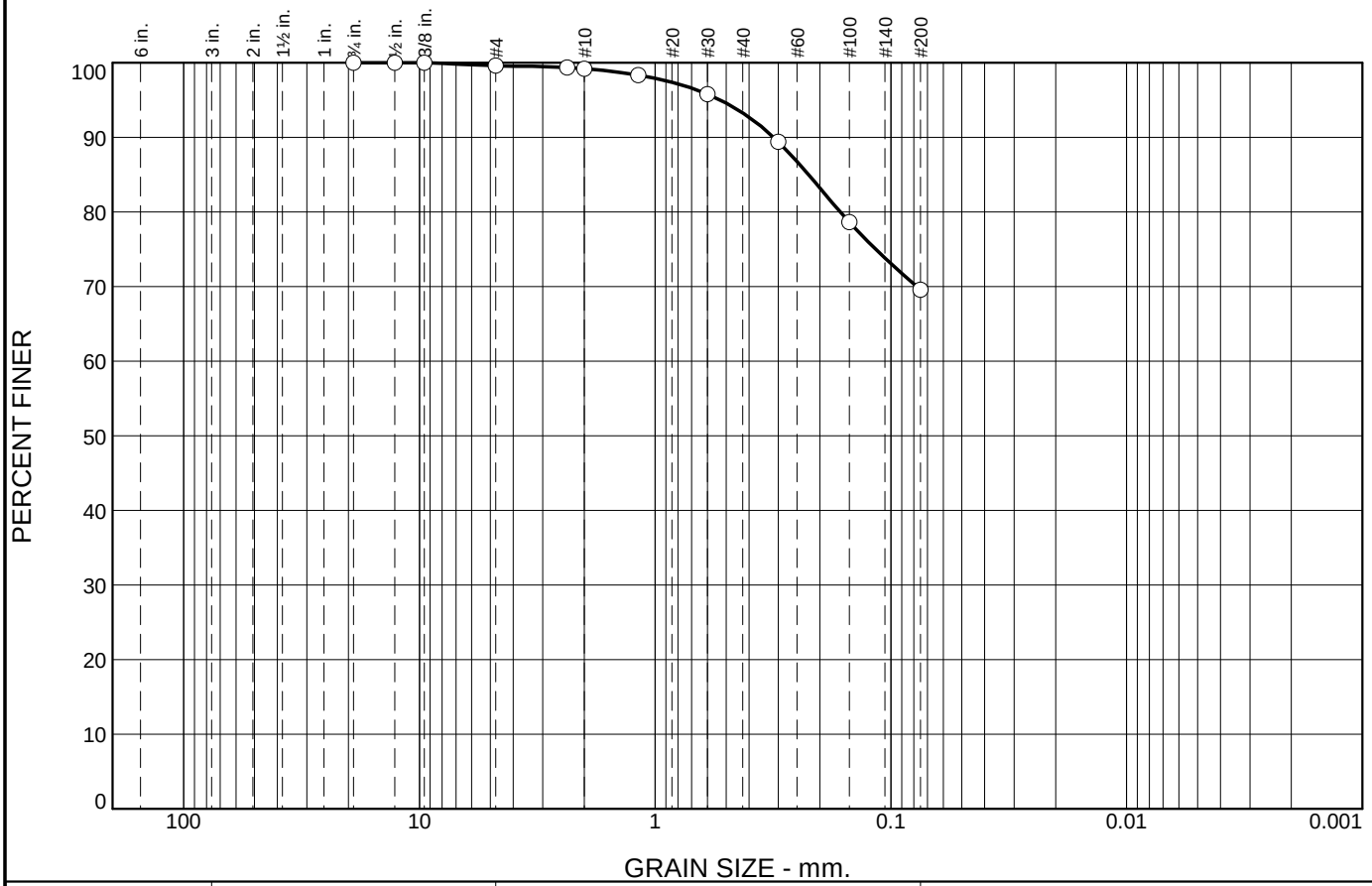
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-8 **Elev./Depth:** 1-15
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-13

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	0.4	5.9	23.7	69.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	99.6		
#8	99.4		
#10	99.2		
#16	98.3		
#30	95.8		
#50	89.4		
#100	78.6		
#200	69.6		

* (no specification provided)

Material Description

CLAY (CH), gray and orangish brown, with fine to medium grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2233 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

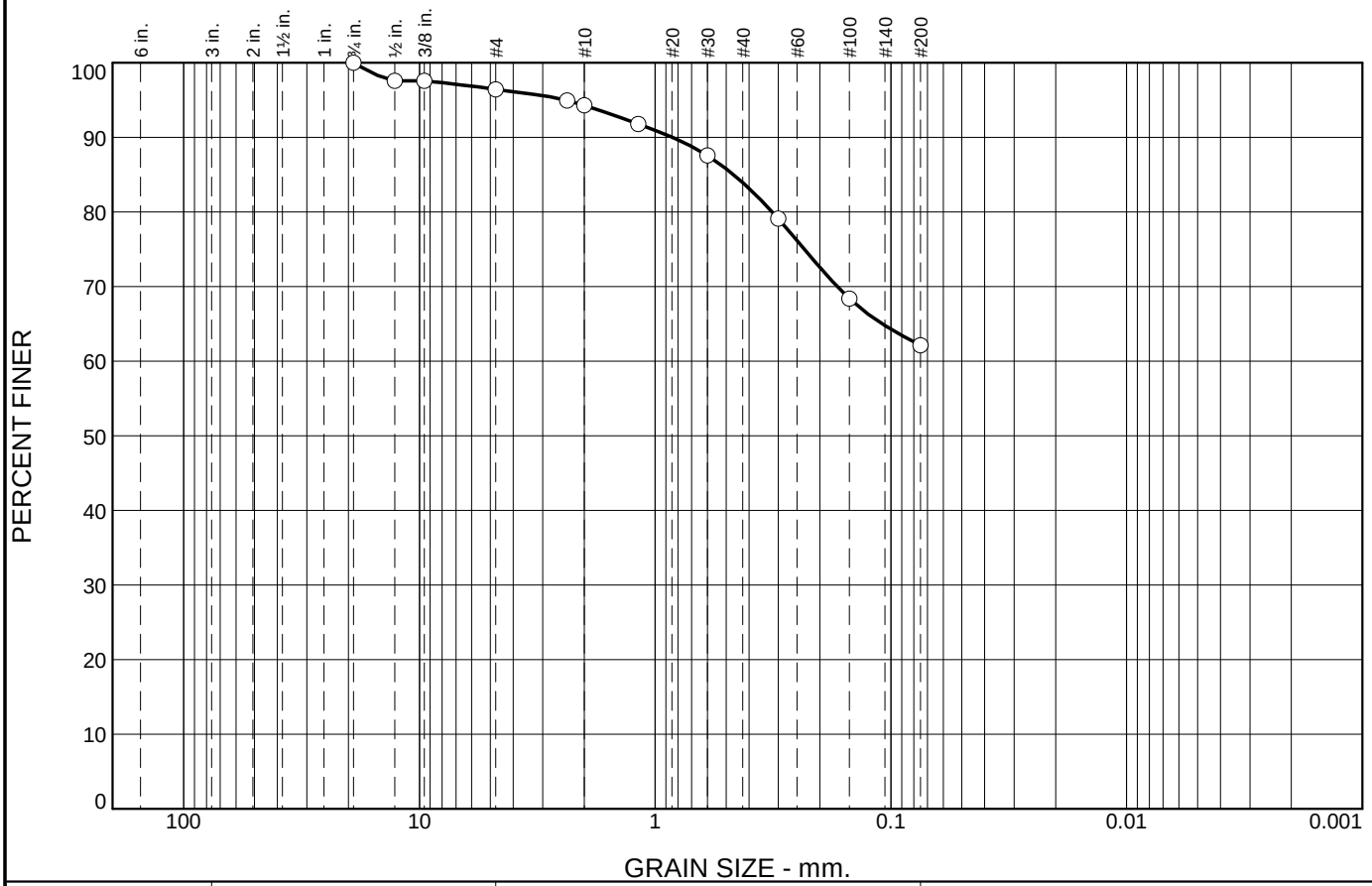
Sample No.: ST-7 **Source of Sample:** B-9 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-14

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	2.1	10.4	21.8	62.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	97.6		
3/8	97.6		
#4	96.4		
#8	94.9		
#10	94.3		
#16	91.8		
#30	87.6		
#50	79.1		
#100	68.4		
#200	62.1		

* (no specification provided)

Material Description

Shaley CLAY (CH), brown gray and purple, with weathered limestone, with fine to medium sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.4651 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

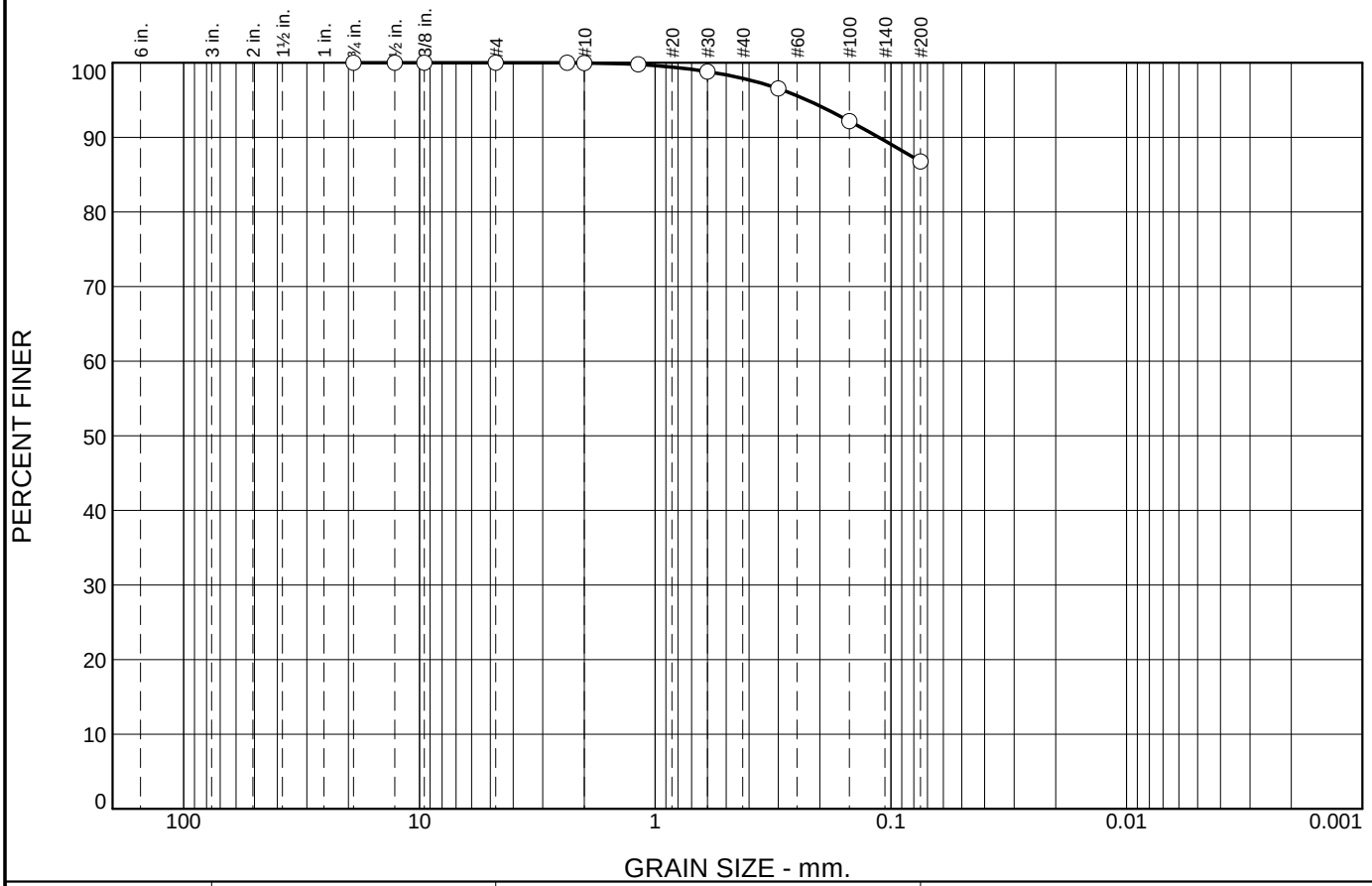
Sample No.: ST-8 **Source of Sample:** B-9 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-15

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.0	11.1	86.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	100.0		
#10	99.9		
#16	99.8		
#30	98.8		
#50	96.6		
#100	92.2		
#200	86.8		

* (no specification provided)

Material Description

CLAY (CH), golden and gray brown, high plastic, trace fine sand

Atterberg Limits (ASTM D 4318)

PL= 18 LL= 65 PI= 46

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

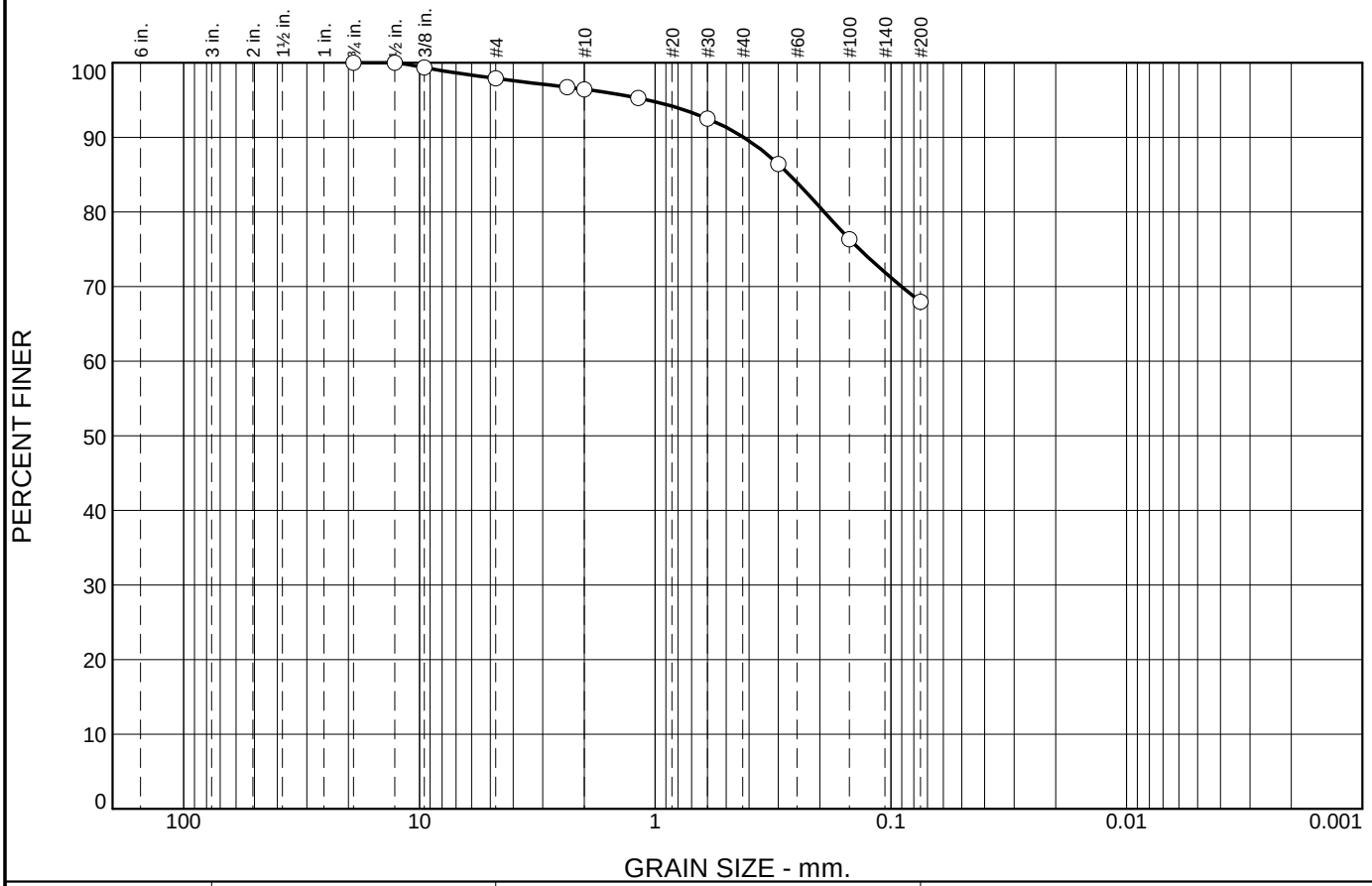
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-10 **Elev./Depth:** 15-18
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-16

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	1.4	6.4	22.1	68.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	99.4		
#4	97.9		
#8	96.7		
#10	96.5		
#16	95.3		
#30	92.5		
#50	86.4		
#100	76.3		
#200	68.0		

* (no specification provided)

Material Description

CLAY (CH), golden and gray, with fine to medium sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2690 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

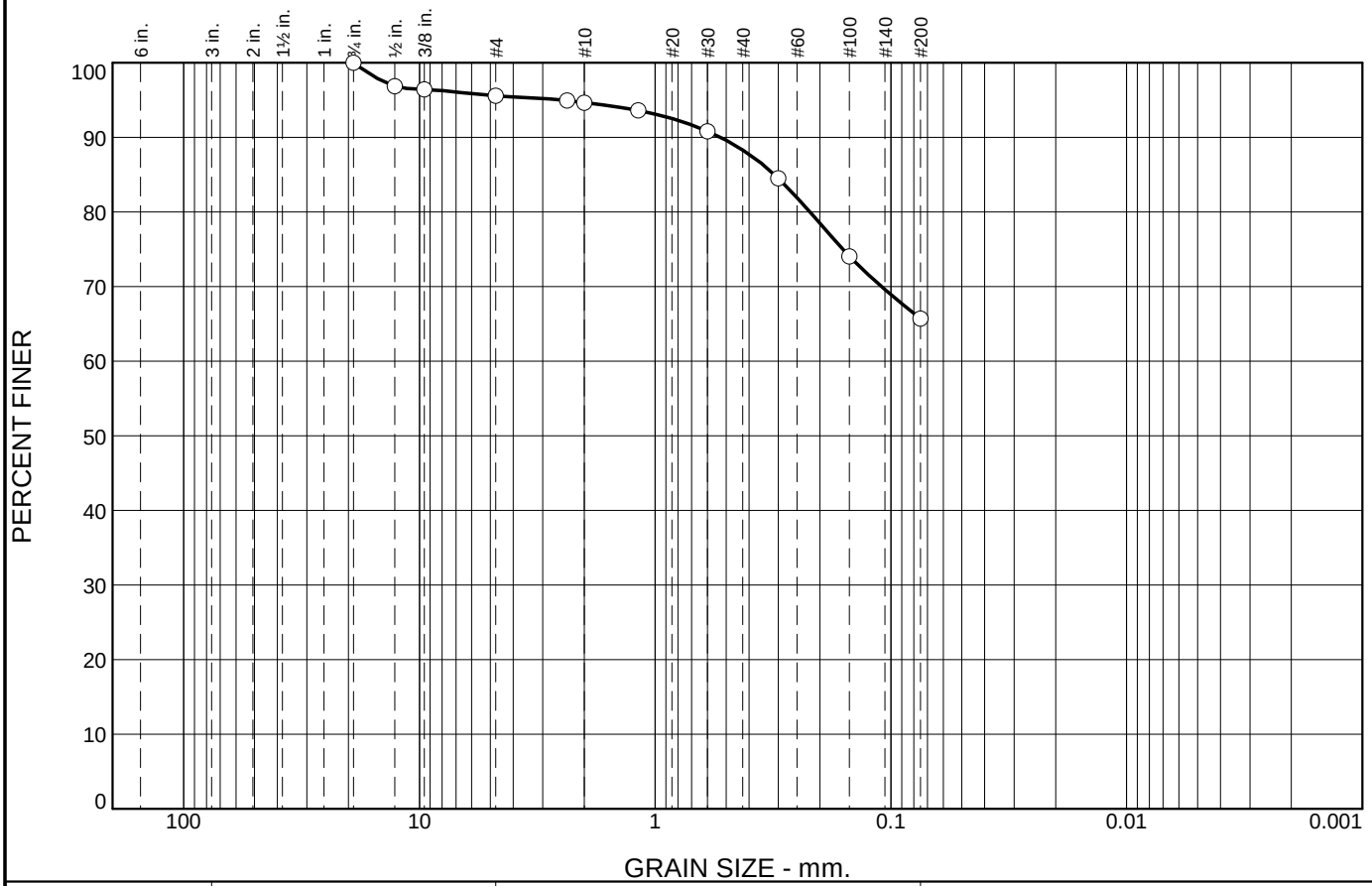
Sample No.: ST-7 **Source of Sample:** B-10 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-17

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.4	0.9	6.4	22.6	65.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	96.9		
3/8	96.4		
#4	95.6		
#8	94.9		
#10	94.7		
#16	93.6		
#30	90.8		
#50	84.5		
#100	74.1		
#200	65.7		

* (no specification provided)

Material Description

Sandy CLAY (CH), brown tan gray and orangish brown, high plastic, fine to medium grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.3117 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

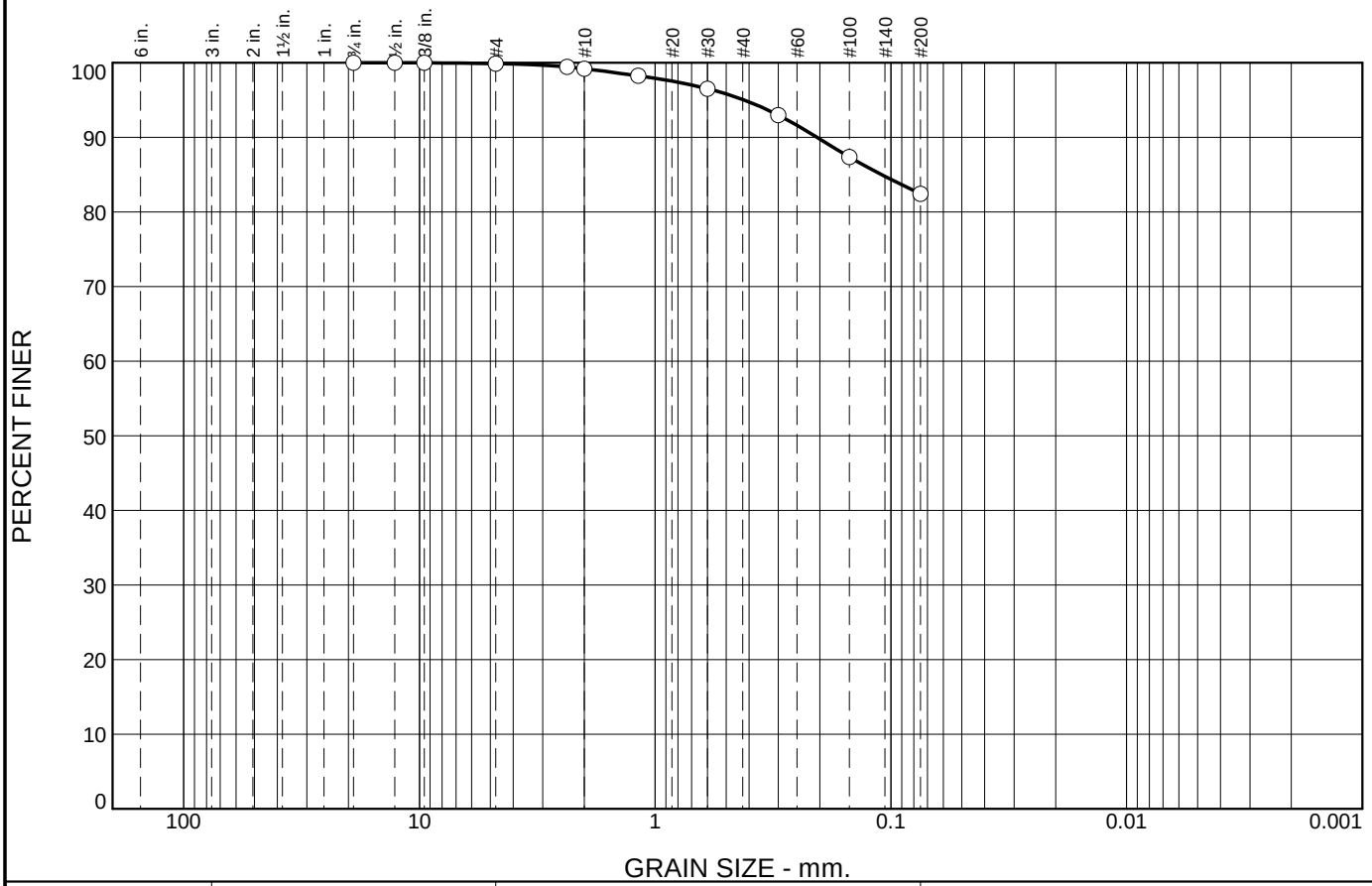
Sample No.: ST-7 **Source of Sample:** B-11 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-18

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.7	4.1	12.7	82.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	99.9		
#8	99.4		
#10	99.2		
#16	98.2		
#30	96.5		
#50	93.0		
#100	87.4		
#200	82.4		

* (no specification provided)

Material Description

CLAY (CH), golden, high plastic, trace fine sand

Atterberg Limits (ASTM D 4318)

PL= 22 LL= 74 PI= 52

Classification

USCS= CH AASHTO=

Coefficients

D_{85}= 0.1095 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-07-11 **Tested By:** J. Pruett/C. Cook

Remarks

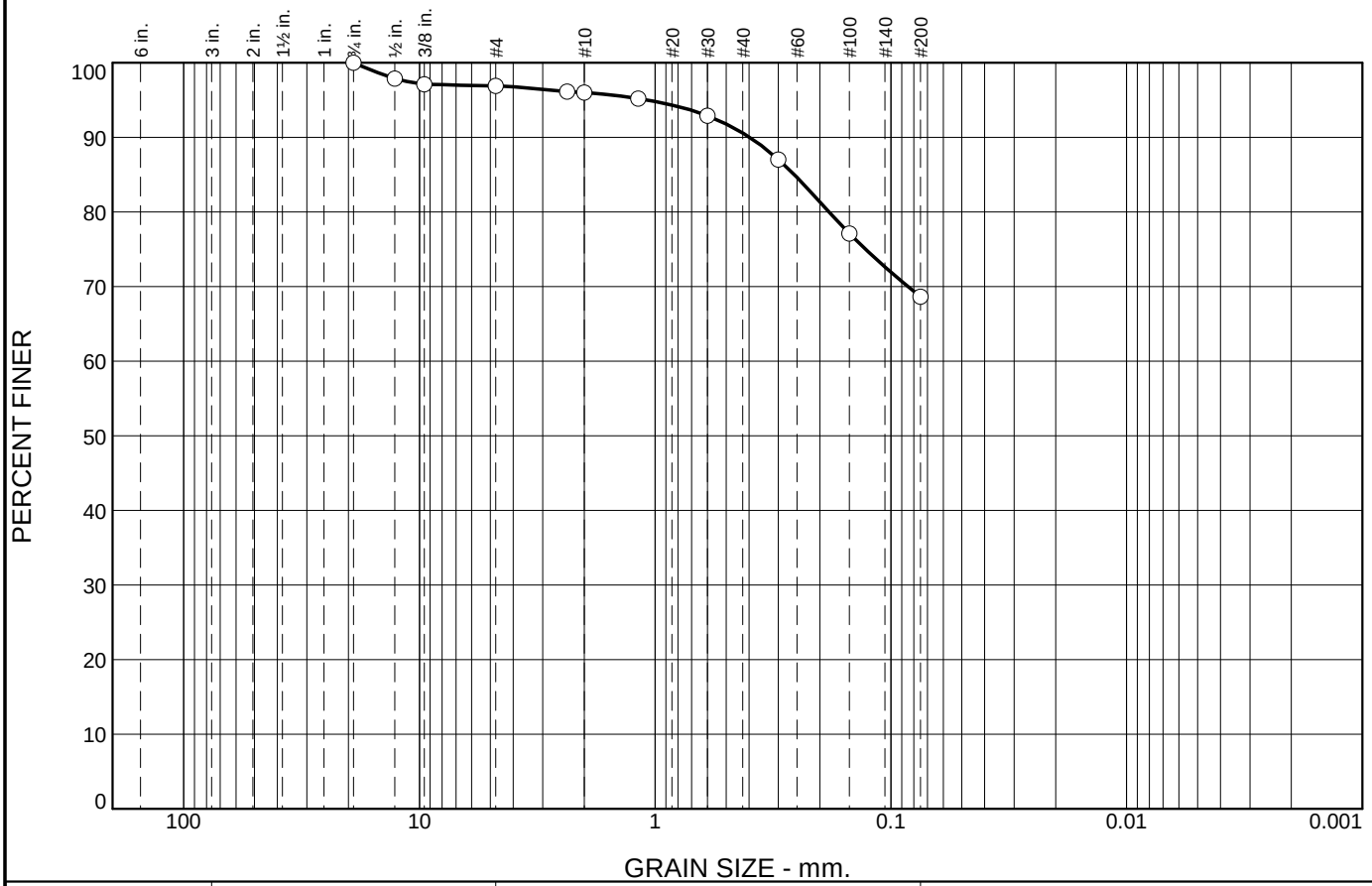
Sample No.: Bulk **Source of Sample:** **Date Sampled:**
Location: B-12 **Elev./Depth:** 2.5-10
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-19

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	0.9	5.4	22.0	68.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	97.9		
3/8	97.1		
#4	96.9		
#8	96.2		
#10	96.0		
#16	95.2		
#30	92.9		
#50	87.0		
#100	77.1		
#200	68.6		

* (no specification provided)

Material Description

CLAY (CH), brownish gray and orange-brown, high plastic, with fine to medium grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2567 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

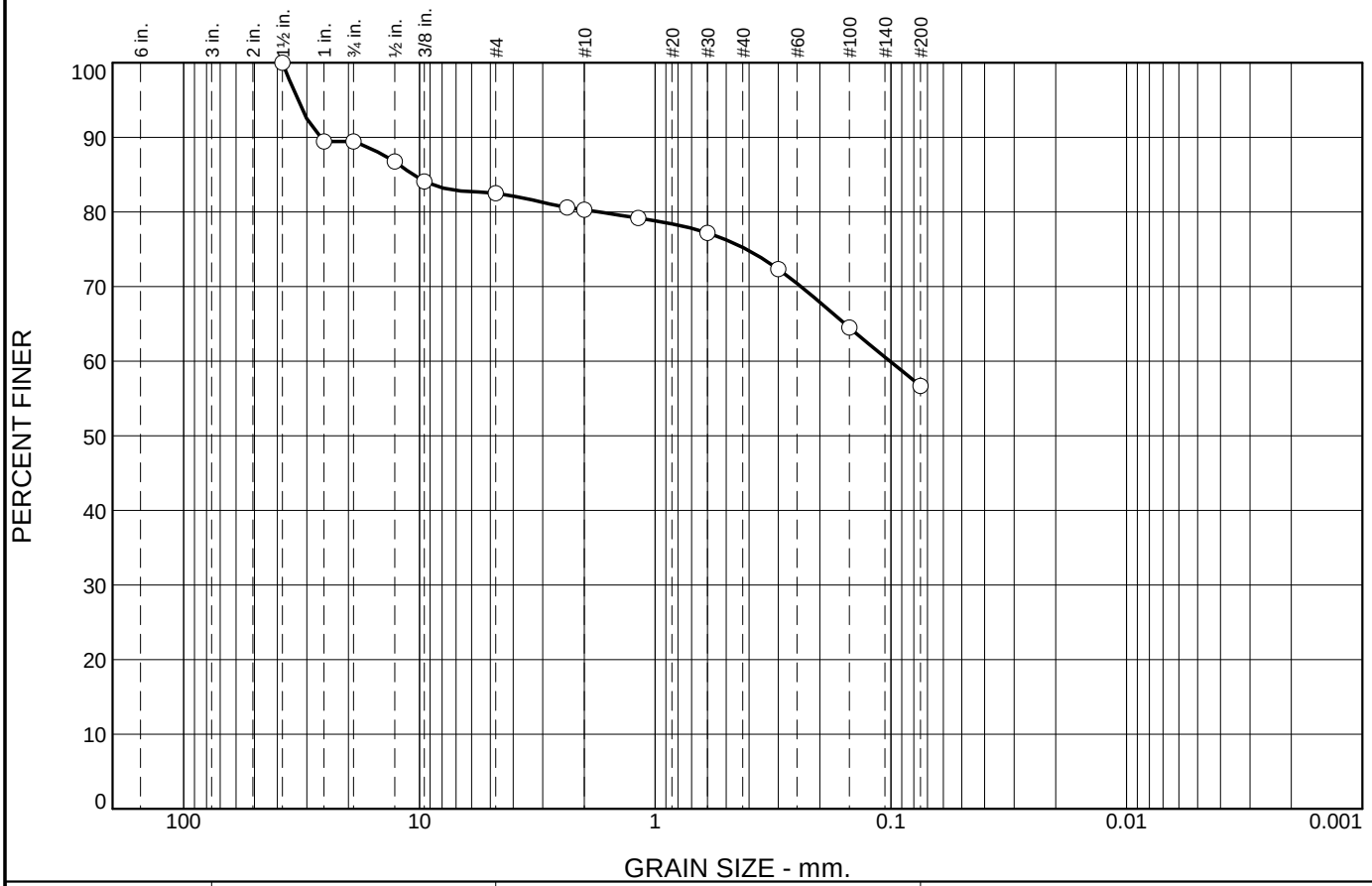
Sample No.: ST-2 **Source of Sample:** B-12 **Date Sampled:**
Location: **Elev./Depth:** 3
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-20

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.5	7.0	2.2	5.1	18.5	56.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	89.5		
3/4	89.5		
1/2	86.8		
3/8	84.1		
#4	82.5		
#8	80.6		
#10	80.3		
#16	79.2		
#30	77.2		
#50	72.3		
#100	64.5		
#200	56.7		

* (no specification provided)

Material Description

Sandy CLAY (CH), brown tan gray and orange-brown, high plastic, fine to medium grain sand, with fine to coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SC AASHTO=

Coefficients

D_{85}= 10.6353 D_{60}= 0.1011 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 04-11-11 **Tested By:** J. Crose

Remarks

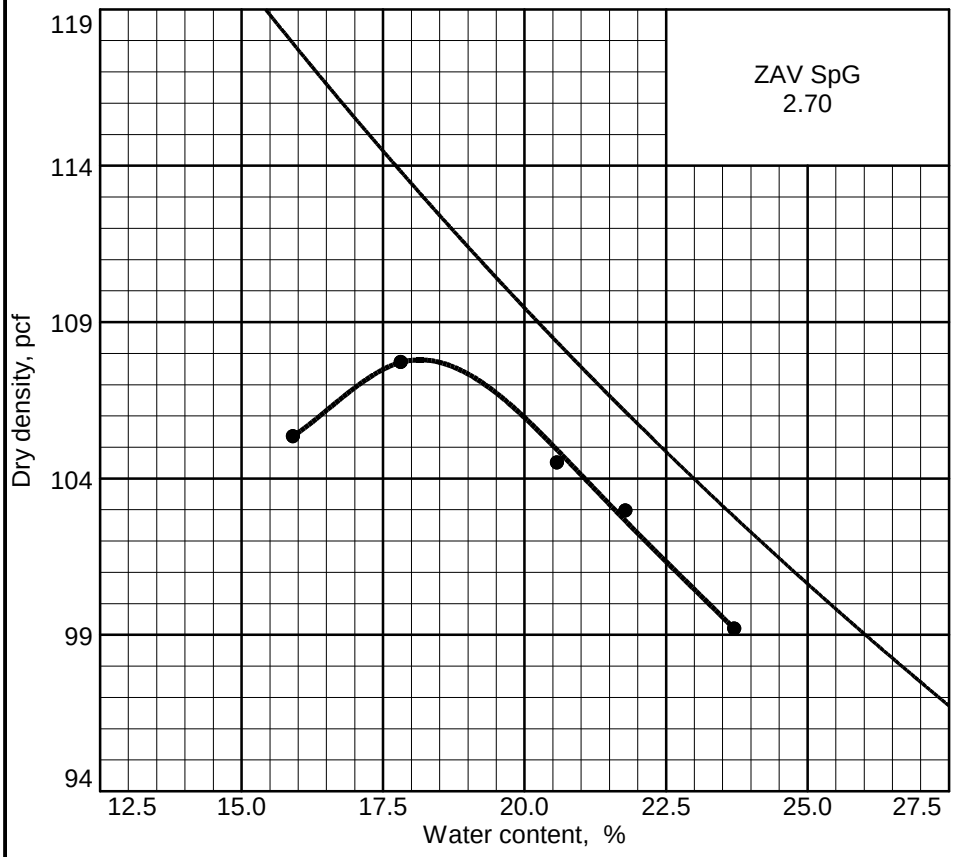
Sample No.: ST-4 **Source of Sample:** B-12 **Date Sampled:**
Location: **Elev./Depth:** 8
Checked By: K. Kocher **Title:** Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill

Project No: 2008012455 **Figure** 4-21

MOISTURE-DENSITY TEST REPORT



Curve No.

Test Specification:
ASTM D 698-00a Method A Standard

Preparation Method	ASTM
Hammer Wt.	5.5 lb.
Hammer Drop	12 in.
Number of Layers	three
Blows per Layer	25
Mold Size	.03333 cu.ft.

Test Performed on Material Passing No.4 **Sieve**

NM _____ **LL** 37 **PI** 17
Sp.G. (ASTM D 854) _____
%>No.4 0.0 **%<No.200** 93.3
USCS CL **AASHTO** _____
Date Sampled _____
Date Tested 4/28/11
Tested By J. Crose

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.63	8.79	8.76	8.74	8.65	
WM	4.56	4.56	4.56	4.56	4.56	
WW + T #1	247.88	261.81	338.07	328.92	317.90	
WD + T #1	218.69	228.26	286.71	276.49	263.53	
TARE #1	34.62	40.71	36.76	36.34	34.57	
WW + T #2	317.87	309.88	318.73	328.11	328.19	
WD + T #2	279.71	269.28	271.07	276.81	272.52	
TARE #2	40.63	40.50	39.77	40.84	37.25	
MOISTURE	15.9	17.8	20.6	21.8	23.7	
DRY DENSITY	105.4	107.7	104.5	103.0	99.2	

TEST RESULTS

Maximum dry density = 107.8 pcf

Optimum moisture = 18.1 %

Material Description

Silty CLAY (CL), brown to tan

Remarks:

Sample is a composite of material left over from the Shelby tubes. This material was visually classified as silty clay or clayey silt

Project No. 2008012455 **Client:** Ameren Missouri

Project: Labadie Plant Utility Waste Landfill

● **Location:** Composite: silty clay material

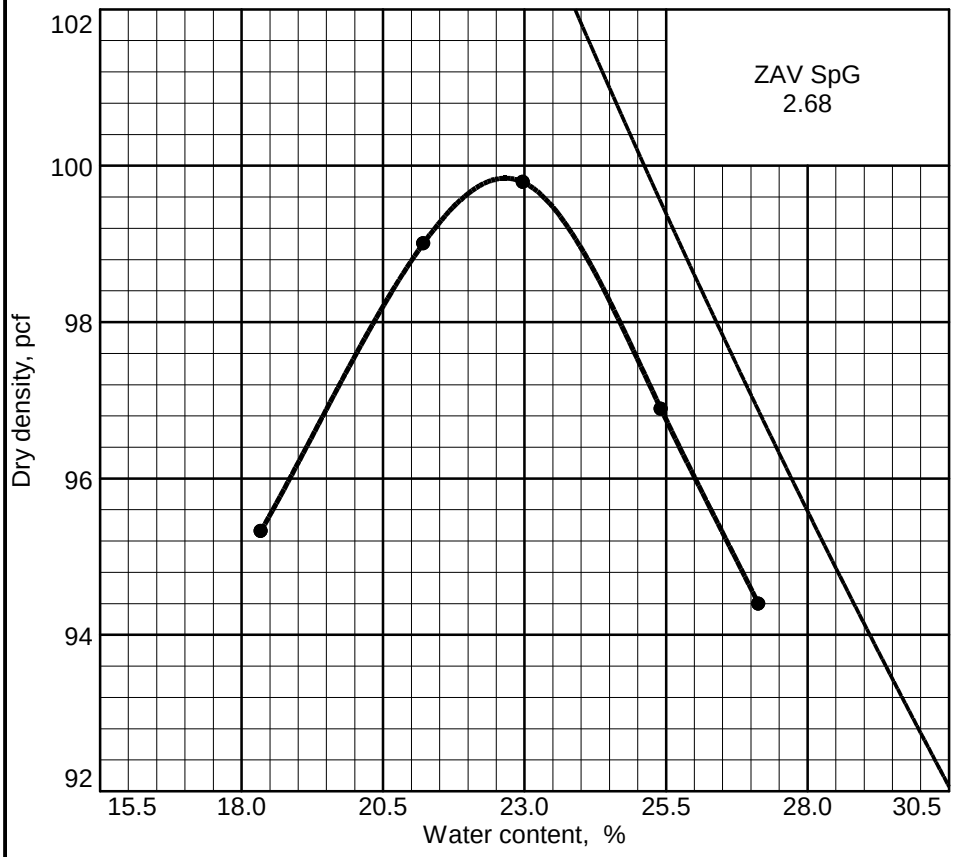
Checked by: K. Kocher

Title: P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 5-1

MOISTURE-DENSITY TEST REPORT



Curve No.

Test Specification:
ASTM D 698-00a Method A Standard

Preparation Method	ASTM
Hammer Wt.	5.5 lb.
Hammer Drop	12 in.
Number of Layers	three
Blows per Layer	25
Mold Size	.03333 cu.ft.

Test Performed on Material Passing No.4 **Sieve**

NM		**LL** 62	**PI** 43
Sp.G. (ASTM D 854)			
%>No.4		**%<No.200**	91.3
USCS	CH	**AASHTO**	
Date Sampled			
Date Tested	5/3/2011		
Tested By	J. Crose		

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.32	8.56	8.65	8.61	8.56	
WM	4.56	4.56	4.56	4.56	4.56	
WW + T #1	218.80	211.58	293.31	286.21	266.97	
WD + T #1	191.11	181.41	245.76	235.19	217.38	
TARE #1	40.69	40.50	37.73	33.99	32.74	
WW + T #2	254.74	229.19	280.98	300.29	282.30	
WD + T #2	221.77	195.94	235.74	246.67	229.18	
TARE #2	41.32	37.73	39.70	36.07	35.34	
MOISTURE	18.3	21.2	23.0	25.4	27.1	
DRY DENSITY	95.3	99.0	99.8	96.9	94.4	

TEST RESULTS

Maximum dry density = 99.8 pcf

Optimum moisture = 22.7 %

Material Description

CLAY (CH), grey-brown-tan-orangish brown, high platic, with trace fine chert fragments

Remarks:

Sample is a composite of material left over from the Shelby tubes. This material wwas visually classified as high plastic clay

Project No. 2008012455 **Client:** Ameren Missouri

Project: Labadie Plant Utility Waste Landfill

● **Location:** Composite: high plastic clay material

Checked by:

Title:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 5-2

Ameren Missouri; Labadie Power Plant UWL
Calaway Borrow Site
Silty CLAY Composite
Compacted Proctor point 103.0pcf at 21.8% moisture
Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 125.7 (lbs/ft^3)	Wet Density = 128.1 (lbs/ft^3)
% Moisture = 21.7%	% Moisture = 22.9%
Dry Density = 103.3 (lbs/ft^3)	Dry Density = 104.2 (lbs/ft^3)

Test Information	
a (cm^2)=	0.1969
L (cm)=	4.8061
A (cm^2)=	19.4194

Trial 1

Date and Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Base Burette Reading (ml)	Base Burette Distance from Datum (cm)	Top Burette Reading (ml)	Top Burette Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (℃)	Weighted Average Temp. (℃)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Cumulative Time (sec)	Corrected Hydraulic Conductivity (cm/sec)
5/4/11 7:55	0	8.5	10.00	27.200	0.00	78.000	85.979	18.1					
5/4/11 14:25	23400	8.4	9.92	27.606	0.13	77.340	84.912	21.5	19.80	1.30E-08	1.0051515	23400	1.31E-08
5/5/11 9:10	90900	8.7	9.67	28.876	0.44	75.765	82.067	19.8	20.43	1.25E-08	0.9897973	90900	1.24E-08
5/6/11 8:10	173700	8.7	9.38	30.350	0.80	73.936	78.765	19.5	20.06	1.23E-08	0.9988069	173700	1.23E-08
5/9/11 7:15	429600	8.9	8.61	34.261	1.83	68.704	69.621	22.9	20.74	1.20E-08	0.9824633	429600	1.18E-08

Trial 2

Date and Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Base Burette Reading (ml)	Base Burette Distance from Datum (cm)	Top Burette Reading (ml)	Top Burette Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (℃)	Weighted Average Temp. (℃)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Cumulative Time (sec)	Corrected Hydraulic Conductivity (cm/sec)
5/9/11 7:45	0	8.9	10.00	27.200	0.00	78.000	85.979	22.6					
5/10/11 7:30	85500	9.2	9.67	28.876	0.37	76.120	82.423	22.4	22.50	1.20E-08	0.9421229	85500	1.13E-08
5/11/11 8:30	175500	9.2	9.35	30.502	0.77	74.088	78.765	22.4	22.45	1.22E-08	0.9432589	175500	1.15E-08
5/12/11 8:05	260400	9.3	9.07	31.924	1.10	72.412	75.667	22	22.37	1.20E-08	0.9450598	260400	1.13E-08
5/13/11 8:15	347400	9.3	8.79	33.347	1.42	70.786	72.619	22.1	22.29	1.18E-08	0.9468317	347400	1.12E-08

Trial 3

Date and Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Base Burette Reading (ml)	Base Burette Distance from Datum (cm)	Top Burette Reading (ml)	Top Burette Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (℃)	Weighted Average Temp. (℃)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Cumulative Time (sec)	Corrected Hydraulic Conductivity (cm/sec)
5/16/11 7:55	0	10.1	10.00	27.200	0.00	78.000	85.979	19					
5/17/11 7:50	86100	9.9	9.71	28.673	0.32	76.374	82.880	19.2	19.10	1.04E-08	1.0226658	86100	1.06E-08
5/18/11 8:00	173100	9.9	9.43	30.096	0.66	74.647	79.731	20.5	19.48	1.06E-08	1.0131690	173100	1.08E-08
5/19/11 8:00	259500	9.9	9.16	31.467	0.98	73.022	76.733	21.7	20.02	1.07E-08	0.9998188	259500	1.07E-08
5/20/11 8:30	347700	10.0	8.91	32.737	1.28	71.498	73.939	21.8	20.46	1.06E-08	0.9891813	347700	1.05E-08
												H.C.=	**1.1E-08**

CLAY VOLUME CALCULATION

Client: Ameren Missouri
Project: Labadie UWL
Location: Callaway Borrow Site

USING ONLY MODERATE TO HIGH PLASTIC CLAY MATERIAL WITH LOW SAND/GRAVEL CONTENT				
Borrow Area No.	Surface Area (acres)	Thickness of Useable Liner Material (feet)	Volume (acre-ft)	Volume (cubic yards)
1	35	20	700	1130000
2	33	11	363	590000
3	22	19	418	670000
4	28	18	504	810000
5	36	22	792	1280000
		TOTAL	**2777**	**4480000**

USING ALL SILT, LOW PLASTIC CLAY, AND HIGH PLASTIC CLAY MATERIAL WITH LOW SAND/GRAVEL CONTENT				
Borrow Area No.	Surface Area (acres)	Thickness of Useable Liner Material (feet)	Volume (acre-ft)	Volume (cubic yards)
1	35	27	945	1520000
2	33	17	561	910000
3	22	24	528	850000
4	28	21	588	950000
5	36	25	900	1450000
		TOTAL	**3522**	**5680000**

Figure 7

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Appendix A-1

POTENTIAL HAUL ROUTE FOR CLAY BORROW AND SUPPLEMENTAL LABORATORY TESTING

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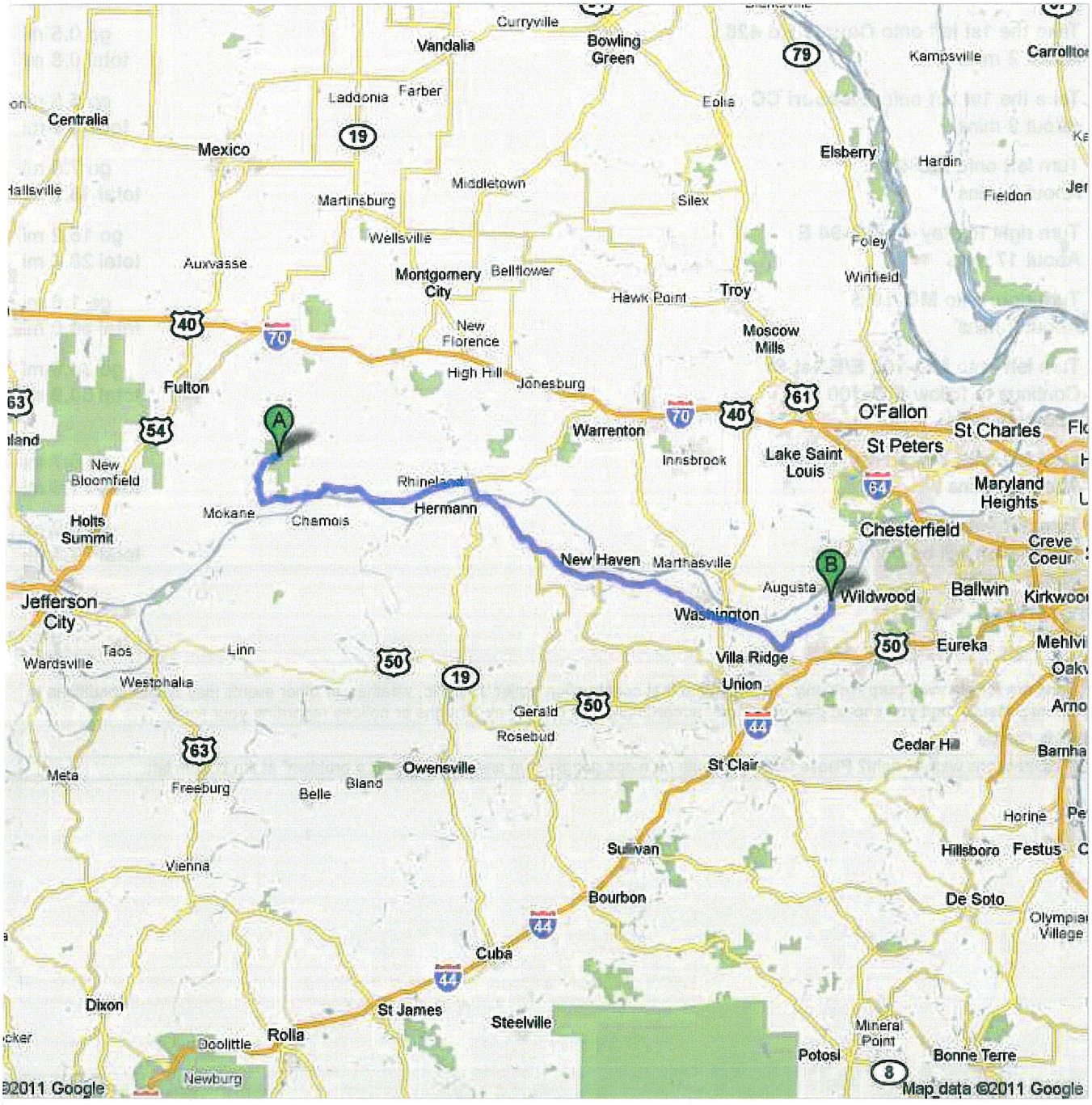
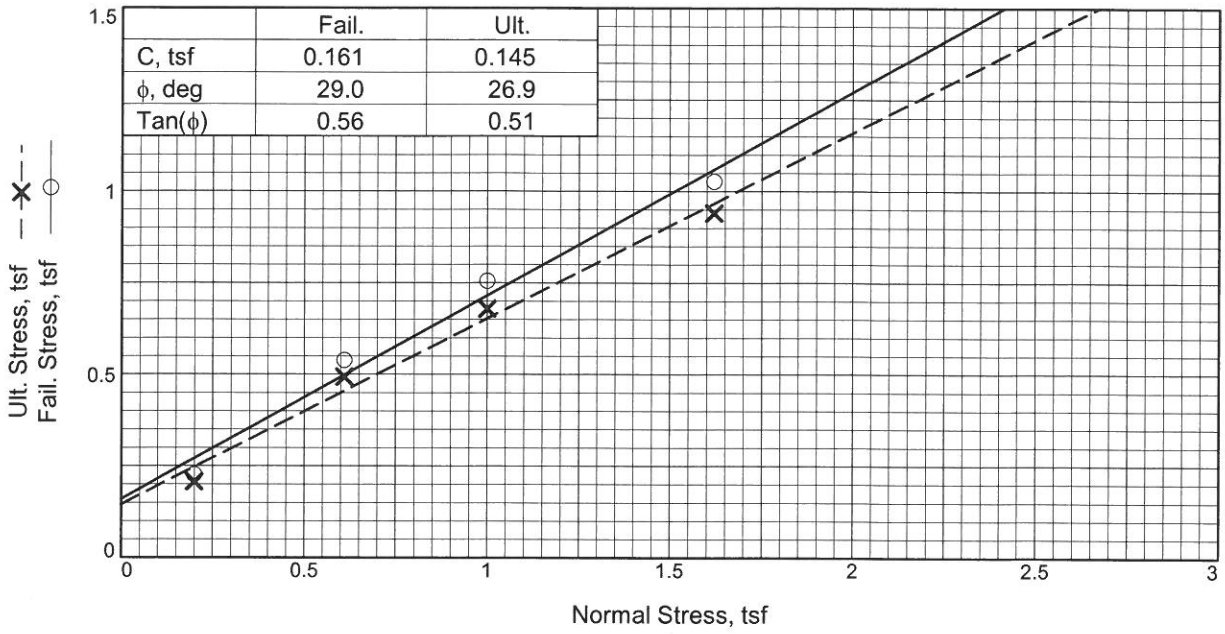
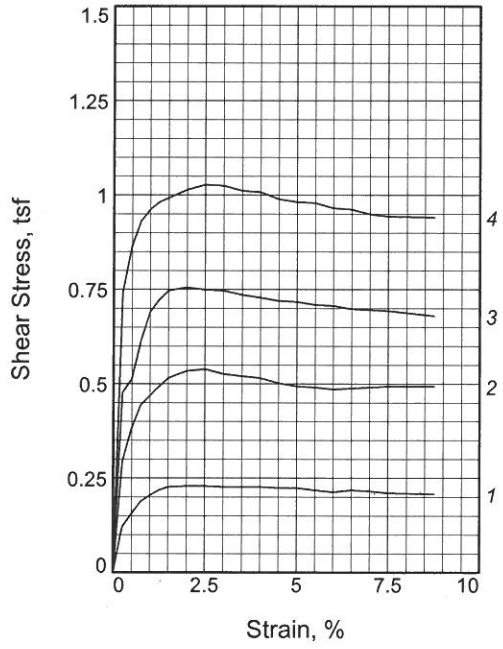
Google maps

Directions to Unknown road
72.5 mi – about 1 hour 40 mins
Callaway to UWL (Davis RD at Labadie Bottom Rd)



Ameren Missouri Labadie UWL
POSSIBLE ROUTE FROM CALLAWAY PLANT
CLAY BORROW SITE TO LABADIE UWL





Sample No.		1	2	3	4
Initial	Water Content, %	24.9	24.9	24.9	24.9
	Dry Density, pcf	98.8	98.8	98.8	98.8
	Saturation, %	96.2	96.2	96.2	96.2
	Void Ratio	0.6933	0.6933	0.6933	0.6933
	Diameter, in.	2.00	2.00	2.00	2.00
	Height, in.	1.28	1.28	1.28	1.28
At Test	Water Content, %	24.9	24.9	24.9	24.9
	Dry Density, pcf	98.8	98.8	98.8	98.8
	Saturation, %	96.2	96.2	96.2	96.2
	Void Ratio	0.6933	0.6933	0.6933	0.6933
	Diameter, in.	2.00	2.00	2.00	2.00
	Height, in.	1.28	1.28	1.28	1.28
Normal Stress, tsf		0.200	0.610	1.000	1.620
Fail. Stress, tsf		0.226	0.539	0.755	1.027
Strain, %		1.5	2.5	2.0	2.5
Ult. Stress, tsf		0.208	0.493	0.679	0.941
Strain, %		8.8	8.8	8.8	8.8
Strain rate, %/min.		0.80	0.80	0.80	0.80

Sample Type: Compacted
Description: CLAY (CH), grey-brown-tan-orangish brown, high platic, with trace fine
LL= 62 **PL=** 19 **PI=** 43
Assumed Specific Gravity= 2.68
Remarks: High plastic clay was sheared against the textured liner from Sioux UWL

Client: Ameren Missouri

Project: Labadie Plant Utility Waste Landfill

Location: Composite: high plastic clay material

Proj. No.: 2008012455 **Date Sampled:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure A1-2

Tested By: J. Crose **Checked By:** K. Kocher

DIRECT SHEAR TEST

11/20/2012

Date:
Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill
Project No.: 2008012455
Location: Composite: high plastic clay material
Description: CLAY (CH), grey-brown-tan-orangish brown, high platic, with trace fine chert fragments Sample is a composite of material left over from shelby tubes that was visually classified as high plastic clay.
Remarks: High plastic clay was sheared against the textured liner from Sioux UWL
Type of Sample: Compacted
Assumed Specific Gravity=2.68 **LL=**62 **PL=**19 **PI=**43

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	329.350		329.350
Moisture content: Dry soil+tare, gms.	271.510		271.510
Moisture content: Tare, gms.	39.160		39.160
Moisture, %	24.9	24.9	24.9
Moist specimen weight, gms.	129.8		
Diameter, in.	2.00	2.00	
Area, in.²	3.14	3.14	
Height, in.	1.28	1.28	
Net decrease in height, in.		0.00	
Wet density, pcf	123.4	123.4	
Dry density, pcf	98.8	98.8	
Void ratio	0.6933	0.6933	
Saturation, %	96.2	96.2	

Test Readings for Specimen No. 1

Primary load ring constant = .1176 lbs. per input unit
Normal stress = 0.2 tsf
Strain rate, %/min. = 0.80
Fail. Stress = 0.226 tsf **at reading no.** 6
Ult. Stress = 0.208 tsf **at reading no.** 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
0	0.0000	0.00	0.0	0.0	0.000
1	0.0050	45.00	5.3	0.3	0.121
2	0.0100	58.00	6.8	0.5	0.156
3	0.0150	70.00	8.2	0.8	0.189
4	0.0200	76.00	8.9	1.0	0.205
5	0.0250	81.00	9.5	1.3	0.218
6	0.0300	84.00	9.9	1.5	0.226
7	0.0400	85.00	10.0	2.0	0.229
8	0.0500	85.00	10.0	2.5	0.229
9	0.0600	84.00	9.9	3.0	0.226
10	0.0700	84.00	9.9	3.5	0.226
11	0.0800	84.00	9.9	4.0	0.226

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
12	0.0900	83.00	9.8	4.5	0.224
13	0.1000	83.00	9.8	5.0	0.224
14	0.1100	81.00	9.5	5.5	0.218
15	0.1200	79.00	9.3	6.0	0.213
16	0.1300	81.00	9.5	6.5	0.218
17	0.1400	80.00	9.4	7.0	0.216
18	0.1500	78.00	9.2	7.5	0.210
19	0.1750	77.00	9.1	8.8	0.208

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	329.350		329.350
Moisture content: Dry soil+tare, gms.	271.510		271.510
Moisture content: Tare, gms.	39.160		39.160
Moisture, %	24.9	24.9	24.9
Moist specimen weight, gms.	129.8		
Diameter, in.	2.00	2.00	
Area, in.²	3.14	3.14	
Height, in.	1.28	1.28	
Net decrease in height, in.		0.00	
Wet density, pcf	123.4	123.4	
Dry density, pcf	98.8	98.8	
Void ratio	0.6933	0.6933	
Saturation, %	96.2	96.2	

Test Readings for Specimen No. 2

Primary load ring constant = .1176 lbs. per input unit

Normal stress = 0.61 tsf

Strain rate, %/min. = 0.80

Fail. Stress = 0.539 tsf **at reading no.** 8

Ult. Stress = 0.493 tsf **at reading no.** 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
0	0.0000	0.00	0.0	0.0	0.000
1	0.0050	109.00	12.8	0.3	0.294
2	0.0100	142.00	16.7	0.5	0.383
3	0.0150	165.00	19.4	0.8	0.445
4	0.0200	174.00	20.5	1.0	0.469
5	0.0250	183.00	21.5	1.3	0.493
6	0.0300	191.00	22.5	1.5	0.515
7	0.0400	198.00	23.3	2.0	0.534
8	0.0500	200.00	23.5	2.5	0.539
9	0.0600	195.00	22.9	3.0	0.526
10	0.0700	193.00	22.7	3.5	0.520
11	0.0800	191.00	22.5	4.0	0.515
12	0.0900	186.00	21.9	4.5	0.501
13	0.1000	183.00	21.5	5.0	0.493
14	0.1100	182.00	21.4	5.5	0.491

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
15	0.1200	180.00	21.2	6.0	0.485
16	0.1300	181.00	21.3	6.5	0.488
17	0.1400	182.00	21.4	7.0	0.491
18	0.1500	183.00	21.5	7.5	0.493
19	0.1750	183.00	21.5	8.8	0.493

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	329.350		329.350
Moisture content: Dry soil+tare, gms.	271.510		271.510
Moisture content: Tare, gms.	39.160		39.160
Moisture, %	24.9	24.9	24.9
Moist specimen weight, gms.	129.8		
Diameter, in.	2.00	2.00	
Area, in.^{2}	3.14	3.14	
Height, in.	1.28	1.28	
Net decrease in height, in.		0.00	
Wet density, pcf	123.4	123.4	
Dry density, pcf	98.8	98.8	
Void ratio	0.6933	0.6933	
Saturation, %	96.2	96.2	

Test Readings for Specimen No. 3

Primary load ring constant = .1176 lbs. per input unit

Normal stress = 1 tsf

Strain rate, %/min. = 0.80

Fail. Stress = 0.755 tsf **at reading no.** 7

Ult. Stress = 0.679 tsf **at reading no.** 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
0	0.0000	0.00	0.0	0.0	0.000
1	0.0050	177.00	20.8	0.3	0.477
2	0.0100	190.00	22.3	0.5	0.512
3	0.0150	228.00	26.8	0.8	0.615
4	0.0200	256.00	30.1	1.0	0.690
5	0.0250	268.00	31.5	1.3	0.722
6	0.0300	277.00	32.6	1.5	0.747
7	0.0400	280.00	32.9	2.0	0.755
8	0.0500	278.00	32.7	2.5	0.749
9	0.0600	277.00	32.6	3.0	0.747
10	0.0700	273.00	32.1	3.5	0.736
11	0.0800	270.00	31.8	4.0	0.728
12	0.0900	267.00	31.4	4.5	0.720
13	0.1000	266.00	31.3	5.0	0.717
14	0.1100	263.00	30.9	5.5	0.709
15	0.1200	262.00	30.8	6.0	0.706
16	0.1300	259.00	30.5	6.5	0.698
17	0.1400	258.00	30.3	7.0	0.695

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
18	0.1500	257.00	30.2	7.5	0.693
19	0.1750	252.00	29.6	8.8	0.679

Parameters for Specimen No. 4

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	329.350		329.350
Moisture content: Dry soil+tare, gms.	271.510		271.510
Moisture content: Tare, gms.	39.160		39.160
Moisture, %	24.9	24.9	24.9
Moist specimen weight, gms.	129.8		
Diameter, in.	2.00	2.00	
Area, in.²	3.14	3.14	
Height, in.	1.28	1.28	
Net decrease in height, in.		0.00	
Wet density, pcf	123.4	123.4	
Dry density, pcf	98.8	98.8	
Void ratio	0.6933	0.6933	
Saturation, %	96.2	96.2	

Test Readings for Specimen No. 4

Primary load ring constant = .1176 lbs. per input unit

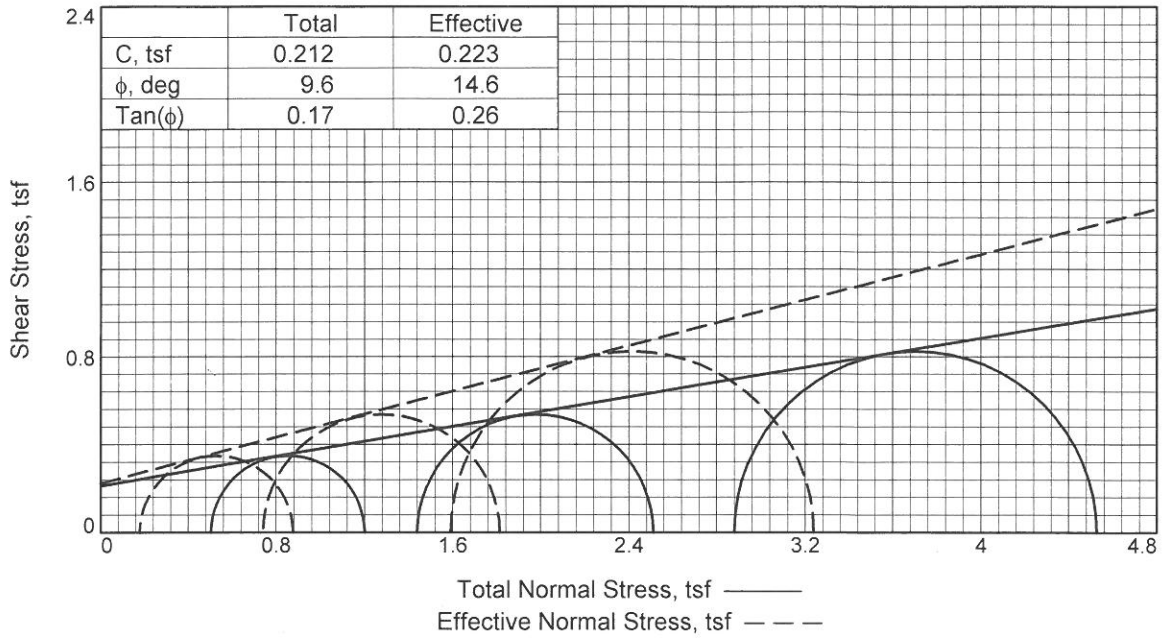
Normal stress = 1.62 tsf

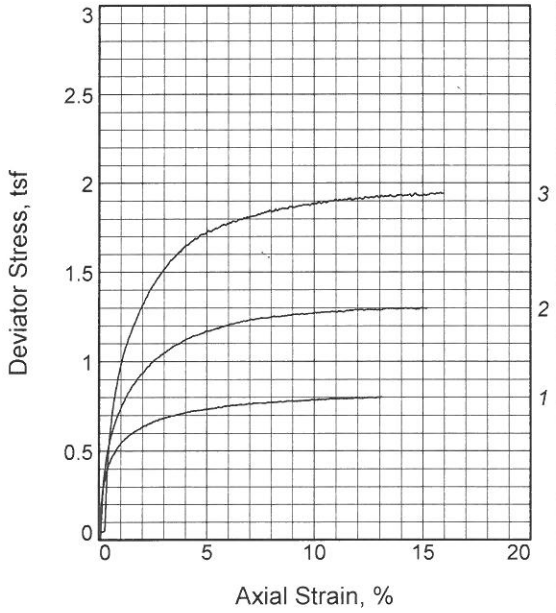
Strain rate, %/min. = 0.80

Fail. Stress = 1.027 tsf **at reading no.** 7

Ult. Stress = 0.941 tsf **at reading no.** 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf
0	0.0000	0.00	0.0	0.0	0.000
1	0.0050	275.00	32.3	0.3	0.741
2	0.0100	321.00	37.7	0.5	0.865
3	0.0150	346.00	40.7	0.8	0.933
4	0.0200	357.00	42.0	1.0	0.962
5	0.0250	364.00	42.8	1.3	0.981
6	0.0400	376.00	44.2	2.0	1.013
7	0.0500	381.00	44.8	2.5	1.027
8	0.0600	380.00	44.7	3.0	1.024
9	0.0700	375.00	44.1	3.5	1.011
10	0.0800	374.00	44.0	4.0	1.008
11	0.0900	367.00	43.2	4.5	0.989
12	0.1000	364.00	42.8	5.0	0.981
13	0.1100	363.00	42.7	5.5	0.978
14	0.1200	358.00	42.1	6.0	0.965
15	0.1300	357.00	42.0	6.5	0.962
16	0.1400	352.00	41.4	7.0	0.949
17	0.1500	350.00	41.2	7.5	0.943
18	0.1750	349.00	41.0	8.8	0.941





Sample No.		1	2	3
Initial	Water Content, %	26.5	26.6	26.7
	Dry Density, pcf	95.4	95.7	95.8
	Saturation, %	94.4	95.4	95.9
	Void Ratio	0.7535	0.7482	0.7466
	Diameter, in.	2.00	2.00	1.99
	Height, in.	4.08	4.33	4.04
At Test	Water Content, %	27.1	24.4	22.4
	Dry Density, pcf	97.0	101.2	104.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7252	0.6536	0.6003
	Diameter, in.	1.99	1.96	1.93
	Height, in.	4.06	4.25	3.92
Strain rate, %/min.		0.02	0.02	0.02
Back Pressure, tsf		3.96	3.96	3.96
Cell Pressure, tsf		4.46	5.40	6.84
Fail. Stress, tsf		0.70	1.07	1.65
Total Pore Pr., tsf		4.28	4.66	5.25
Ult. Stress, tsf		0.80	1.29	1.92
Total Pore Pr., tsf		4.15	4.60	5.26
$\bar{\sigma}_1$ Failure, tsf		0.88	1.81	3.24
$\bar{\sigma}_3$ Failure, tsf		0.18	0.74	1.59

Type of Test:
CU with Pore Pressures

Sample Type: Compacted (Standard Proctor)

Description: CLAY (CH), grey-brown-tan-orangish brown, high platic, with trace fine chert fragments

Assumed Specific Gravity= 2.68

Remarks: Samples were compacted using the standard proctor between the 25% and 27% moisture. Samples were then trimmed to 2" diameter by 4.0"+ length and tested

Figure A1-3

Client: Ameren Missouri

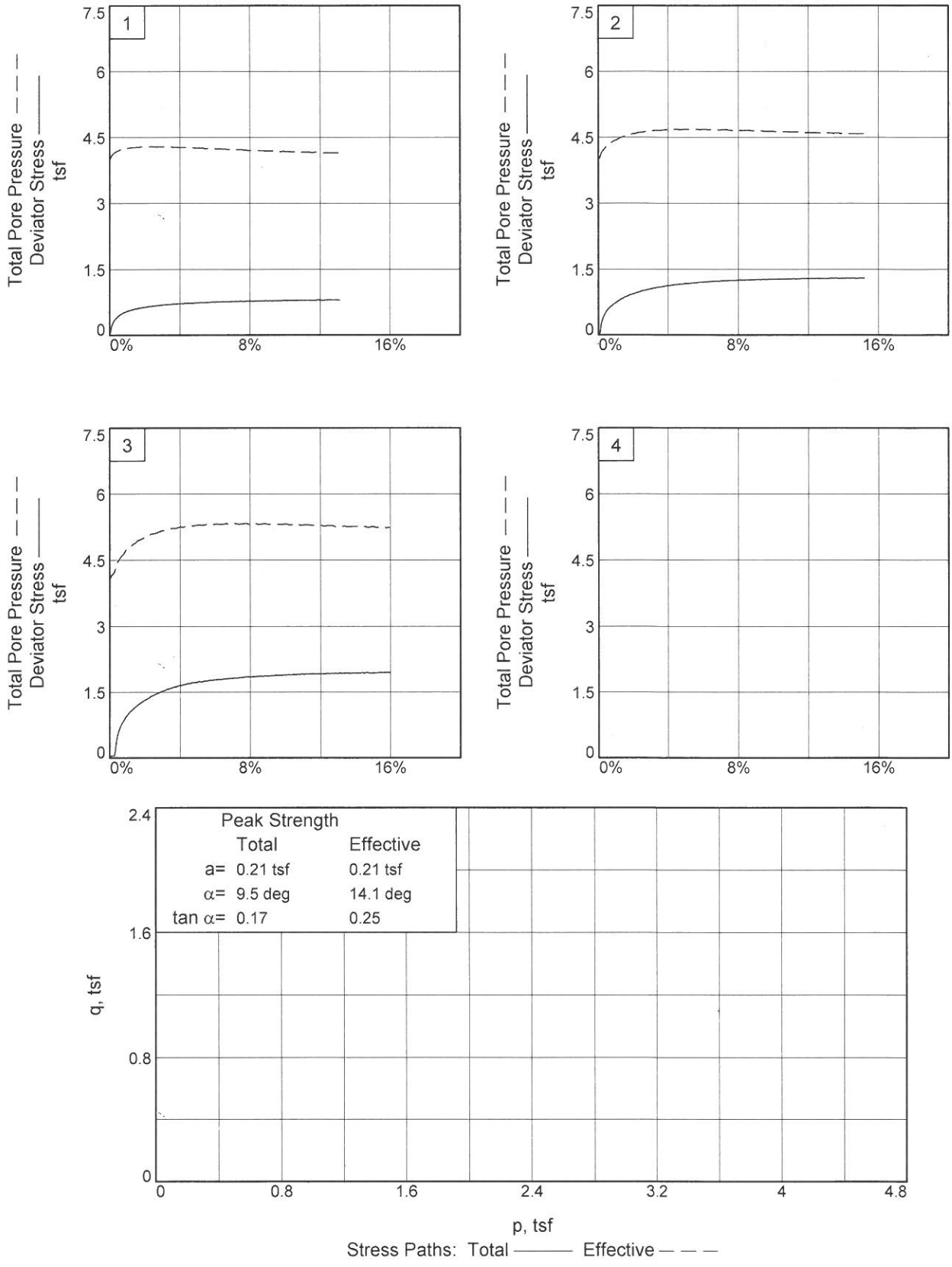
Project: Labadie Plant Utility Waste Landfill

Location: Composite: high plastic clay material (Standard Proctor)

Proj. No.: 2008012455 **Date Sampled:** 7/6/12

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse



Client: Ameren Missouri
Project: Labadie Plant Utility Waste Landfill
Location: Composite: high plastic clay material (Standard Proctor)
Project No.: 2008012455 **Figure** _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse

TRIAXIAL CELL SETUP & TAKEDOWN

Project Ameren UE - Callaway Clay Date 6/27/12

Sample ± 25-27% M Depth Compacted using Standard Proctor Method

Description tan + golden HP clay

Type of Test CU Confining Pressure Differential 7 psi

Cell Number 1 Saturate (before) after Consolidation

Number of Membranes 2 Filter Strips (Yes) No

MOISTURE CONTENT

	INITIAL		FINAL
Tare No.	56	22	Bowl 1
Wet Wt. + Tare	117.37	129.51	605.78
Dry Wt. + Tare	97.08	107.16	513.96
Wt. Water			
Tare Wt.	21.55	22.06	195.04
Dry Soil Wt.			
Moisture %	26.863	26.263	28.791
Avg. w %			

LENGTH CHANGE

STRAIN GAUGE at setup	500
at saturation start	500
at consolidation start	583 (488?)
at axial load start	522

MASS PROPERTIES

Wt. Tube + Soil		gm.
Wt. Tube		gm.
Wt. Soil	404.81	gm.
Tube Diameter		in.
Sample Length		in
tube length		in.
top trim		in.
bottom trim		in.
total trim		in.
sample length		in.
Density constant 4.85/(D^2 * L)		
Wet Density		pcf.
Dry Density		pcf.

SPECIMEN DIMENSIONS in. / mm.

	HEIGHT		DIAMETER	
	Initial	Final	Initial	Final
1	4.0795		T 1.9775	
2	4.0825		M 1.9920	
3	4.0815		B 2.0190	
Avg.	4.08117		1.99617	

Description After Test

Remarks

Failure Sketch

Trimmed By JR
Trimmed Date 6/27/12

Setup By JR
Setup Date 6/27/12

Taken Down By KCK
Take Down Date 6-5-12

TRIAXIAL CELL SATURATION & BETA FACTOR

PROJECT Ameren Callaway Clay borrow

SAMPLE ≈ 25-27½ M DEPTH

INITIAL CELL PRESSURE 51.0 START DATE 6/27/12

INITIAL PORE PRESSURE 50.0 CELL NUMBER 1

INITIAL TRANSDUCER READING 51.8 TRANSDUCER NUMBER 1

TRIAL DATE	TRIAL TIME	BASE BURETTE READING	CELL PRESSURE	TRANS-DUCER READING	CHANGE IN PRESSURE Transducer Constant			
					CELL DELTA (1)	TRANSDUCER READING CHANGE	TRANSDUCER PRESSURE CHANGE (2)	BETA FACTOR (2/1)
6/29/12	0	7.90	50.0	51.1				
	1	↓	56.0	56.1	5.0		5.0	1.00
	2			56.1	5.0		5.0	1.00
	4			56.1	5.0		5.0	1.00
	8			56.1	5.0		5.0	1.00

OK

TRIAXIAL CELL CONSOLIDATION TEST

PROJECT: Ameren Callaway Clay Borrow

SAMPLE: ≈ 25-2720M DEPTH: 7 psi

CONSOLIDATION CELL PRESSURE: 62.0 CELL NUMBER: 1

CONSOLIDATION PORE PRESSURE: 55.0

DATE	Δ TIME	BURETTE READING	DELTA VOLUME	SUM DELTA VOLUME	~~DELTA~~ TIME	TEMP	REMARKS
7/2/12	0	10.00			10:00		
	6sec	9.48					
	15sec	9.34					
	30sec	9.25					
	1min	9.13			10:01		
	2	9.01			10:02		
	4	8.87			10:04		
	8	8.70			10:08		
	15	8.52			10:15		
	30	8.25			10:30		
	60	7.90			11:00		
	90	7.63			11:30		
	120	7.41			12:00		
	150	7.23			12:30		
	185	7.03			13:05		
	240	6.77			14:00		
	300	6.54			15:00		
395	~~360~~	6.25			~~16:00~~	1635	
7/3/12	1280	5.28			7:20		
7/3/12	1725	5.18			13:05		
7/4/12	2786	4.99			8:26		
7/5/12	4160	4.92			7:20		

1440 − 160 = 1280

1440 + 285 = 1725

2880 − 94 = 2786

TRIAXIAL CELL AXIAL LOADING TEST

DATE 7-5-12

PROVING RING _____

PROJECT Amerigon

SAMPLE Callaway Clay Borrow DEPTH ≈25% to 27% Moisture Compacted to Standard Proctor

INITIAL CELL PRESSURE 62.0 CELL NUMBER 1

INITIAL PORE PRESSURE 55.0 START DATE 7-5-12

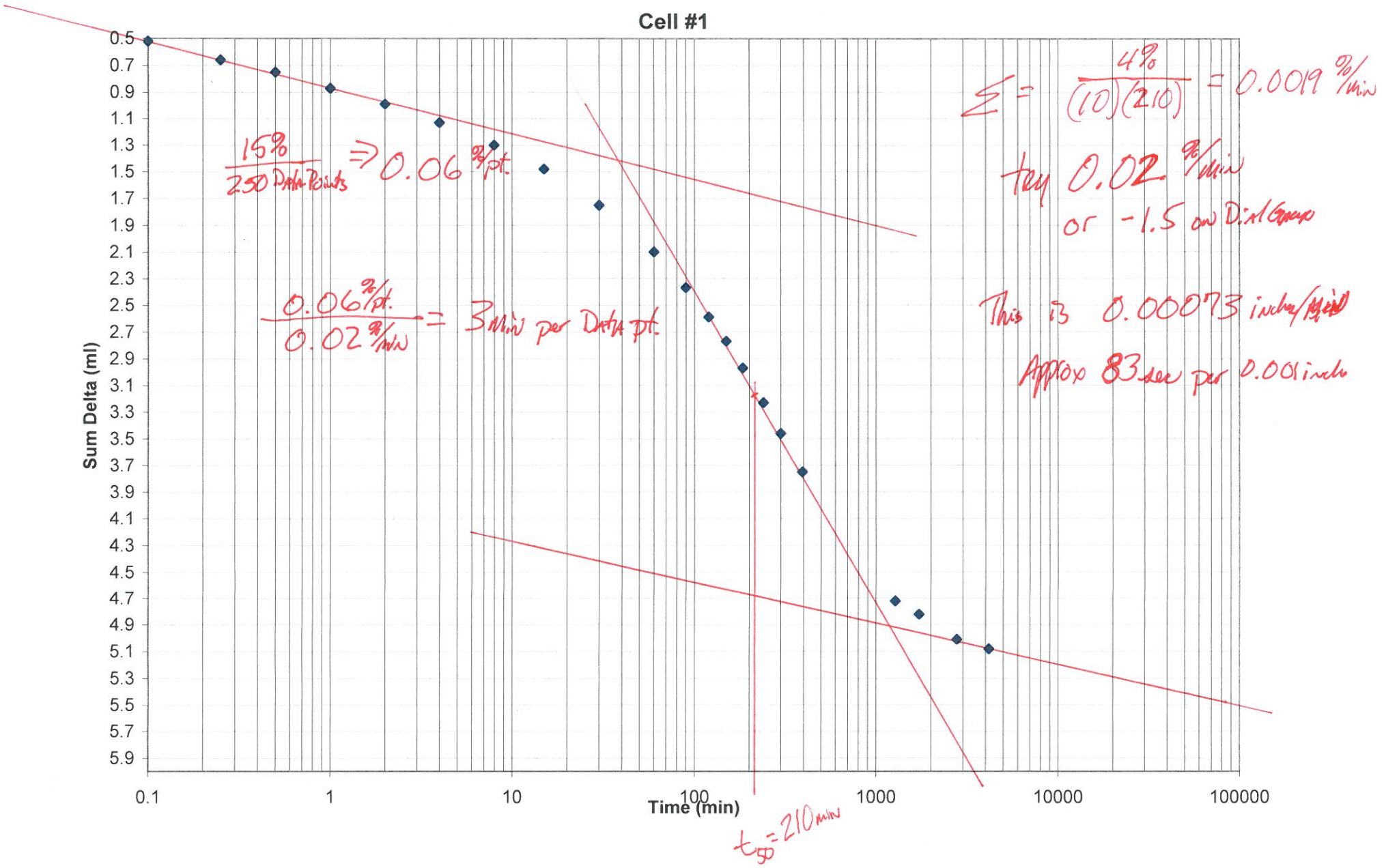
SAMPLE HEIGHT: AT SETUP ≈4.06 inches AT START OF LOADING _____

STRAIN RATE ≈ 0.02 %/min TYPE OF TEST CU

58

TIME	STRAIN DIAL (.001) IN	LOAD DIAL (.0001) IN	PORE PRESSURE READING	TIME	STRAIN DIAL (.001) IN	LOAD DIAL (.0001) IN	PORE PRESSURE READING
8:31 AM	10	19.0	55.7				

MASS OF TOP CAP & POROUS STONE: _____ g.


Cell #1
Sum Delta (ml)
0.5
0.7
0.9
1.1
1.3
1.5
1.7
1.9
2.1
2.3
2.5
2.7
2.9
3.1
3.3
3.5
3.7
3.9
4.1
4.3
4.5
4.7
4.9
5.1
5.3
5.5
5.7
5.9
0.1
1
10
100
1000
10000
100000
Time (min)
15% / 250 Data Points ⇒ 0.06 %/pt.
0.06 %/pt. / 0.02 %/min = 3 min per Data pt.
Σ = 4% / (10)(210) = 0.0019 %/min
try 0.02 %/min
or -1.5 on Dial Gauge
This is 0.00073 inches/day
Approx 83 sec per 0.001 inch
t50 = 210 min

TRIAXIAL CELL SETUP & TAKEDOWN

Project: Ameren Callaway Borrow
Date: 7-6-12

Sample: CLAY @ 25-27%
Depth: Compacted @ Standard Proctor

Description: HP CLAY Grey & golden tan, Trace Lignite & Limonites

Type of Test: CW
Confining Pressure Differential: 20 psi

Cell Number: 2
Saturate (before) after Consolidation

Number of Membranes: 2
Filter Strips (Yes) No

LENGTH CHANGE

STRAIN GAUGE at setup	500
at saturation start	500
at consolidation start	491
at axial load start	579

MOISTURE CONTENT

	INITIAL		FINAL
Tare No.	R-123	L-77	Bowl C
Wet Wt. + Tare	333.79	307.97	987.93
Dry Wt. + Tare	270.53	250.95	896.40
Wt. Water			
Tare Wt.	33.06	36.78	554.94
Dry Soil Wt.			
Moisture %	26.639	26.624	26.805
Avg. w %			

MASS PROPERTIES

Wt. Tube + Soil		gm.
Wt. Tube		gm.
Wt. Soil	432.73	gm.
Tube Diameter		in.
Sample Length		in
tube length		in.
top trim		in.
bottom trim		in.
total trim		in.
sample length		in.
Density constant 4.85/(D^2 * L)		
Wet Density		pcf.
Dry Density		pcf.

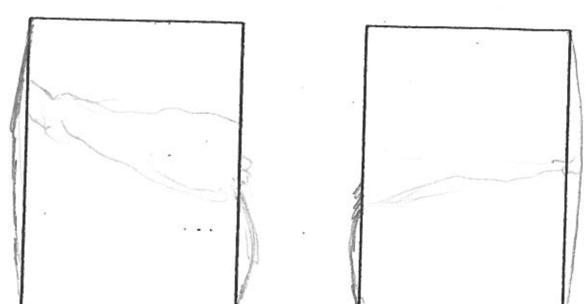
SPECIMEN DIMENSIONS in. / mm.

	HEIGHT		DIAMETER	
	Initial	Final	Initial	Final
1	4.3280		T 2.0025	
2	4.3240		M 1.9985	
3	4.3310		B 2.0005	
Avg.	4.32767		2.0005	

Description After Test

Remarks

Failure Sketch



Trimmed By: KEK
Trimmed Date: 7-6-12

Setup By: KEK
Setup Date: 7-6-12

Taken Down By: KEK
Take Down Date: 7-11-12