MEMORANDUM

Missouri Department of Transportation
Construction - Materials
Central Laboratory

TO: Philip Hamilton-cd/gs

CC/ATT: Randall Aulbur-cd/mt
Patty Lemongelli-cd/cm
Natalie Roark-cd/de
George Davis-ma

FROM: Ricardo N. Todd
Sr. Geotechnical Specialist

DATE: August 3, 2016

SUBJECT: Materials
Geotechnical Section
Foundation Investigation for
Structure No. FI2427
Linn Maintenance Facility
Route 50, Osage County

As requested in a letter dated June 7, 2016, from Central Office & Central District Geologist George H. Davis, a foundation investigation has been conducted for two (2) new maintenance buildings; salt storage and a truck wash, about 2 miles west of Linn on US 50 near Linn State Technical College in Osage County. The layout of the bore holes for the proposed structures is shown in Figure 1.

Existing Conditions

The soil encountered at the sixteen (16) borings primarily included base material that extended to a depth of approximately 0.5 feet. The soil beneath the base material consists of about 5.1 feet of gray fat clay, which classifies as CH by ASTM classification methods and beneath this material it consists 5.0 feet of whitish gray fat clay which classifies as CH by ASTM classification methods. The soils sampled would indicate that this site was at one time a fire clay prospect or mine site. The whitish-gray lean to fat clay is probably fire clay and should be wasted where encountered. The pocket penetrometer readings of the soil generally indicate a stiff to very stiff soil.

Free ground water was not observed in the borings upon completion. Further information on the subsurface materials encountered and their properties is presented on the attached boring logs.

Recommendations

The following recommendations are made based upon information provided regarding the proposed building and conditions observed during the foundation investigation:

- Remove any asphalt pavement, concrete pavement, foundations and any other existing surface or subsurface features from the proposed construction area. After making any grading excavation and before any fill placement, proof roll all cut and fill areas with a fully loaded tandem axle dump truck. Any areas exhibiting pumping or rutting should be undercut and backfilled with compacted granular fill. Prior to placement of any new fill, scarify the surface of any areas to be filled.

- It is recommended that any new fill material be lean clay or better. However, use of granular fill material is preferred if feasible. Fill should be compacted to 95% of standard Proctor maximum dry density. Non-granular fill material should be compacted at or within 3% of optimum moisture content. All fill and cut areas should be constructed to slope and drain away from the proposed building.

- An allowable bearing pressure of 2500 psf or less may be used for the design of shallow foundations constructed on or in properly compacted fill or natural soils at this site. Shallow foundations shall be embedded a minimum of 20 inches below finished grade for frost protection. Individual spread footings shall have a minimum width of 2.5 feet while strip footings shall have a minimum width of 1.5 feet.

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Attachments

Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-17 (201)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+25.0 **Northing:** 958905 **Date of Work:** 07/06/16-07/06/16
Offset: 40.0 R **Easting:** 1835915.8 **Depth to Water:**
Elevation: 952.4 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled tannish gray, FAT CLAY, stiff to very stiff, moist	950						
				X	67	1-3-6 (12)		PP = 1.50 tsf	MC = 30.9% γ_{sat} = 120 pcf(1)
5									
		5.1-10.1' Whitish gray mottled, FAT CLAY trace gravel, very stiff, moist		X	67	4-7-8 (20)		PP = 3.50 tsf	MC = 13.8% γ_{sat} = 139 pcf(1)
			945						
				X	73	3-3-6 (12)		PP = 3.75 tsf	MC = 31.6% γ_{sat} = 119 pcf(1) LL = 52 PL = 19
10									
		10.1-12.6' Mottled grayish tan, FAT CLAY trace gravel, very stiff, moist		X	67	3-5-7 (16)		PP = 2.25 tsf	MC = 29.6% γ_{sat} = 121 pcf(1)
			940						
		12.6-14.2' Mottled grayish red, FAT CLAY scattered gravel, very stiff, moist		X	73	3-9-8 (22)		PP = 3.25 tsf	MC = 29.6% γ_{sat} = 121 pcf(1) LL = 100 PL = 34
15		14.2-17.5' Grayish red, GRAVELLY FAT CLAY trace cobbles, hard, moist							
				X	33	11-16-13 (38)			
			935						
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-18 (202)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+85.0 **Northing:** 958847 **Date of Work:** 07/06/16-07/06/16
Offset: 40.0 R **Easting:** 18359311.2 **Depth to Water:**
Elevation: 951.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled tannish gray, FAT CLAY, stiff to very stiff, moist	950						
				X	73	2-4-7 (14)		PP = 2.00 tsf	MC = 22.1% γ_{sat} = 128 pcf(1)
5									
		5.1-10.1' Whitish gray mottled, FAT CLAY trace gravel, very stiff, moist	945	X	67	6-8-8 (21)		PP = 3.75 tsf	MC = 23.5% γ_{sat} = 127 pcf(1)
				X	67	3-4-5 (12)		PP = 2.28 tsf	
10									
		10.1-12.5' Mottled grayish tan, FAT CLAY, very stiff, moist	940	X	67	3-4-5 (12)		PP = 2.25 tsf	MC = 24.4% γ_{sat} = 126 pcf(1)
		12.5-15.1' Mottled grayish red, FAT CLAY trace gravel, very stiff, moist		X	73	3-5-8 (17)		PP = 3.25 tsf	MC = 24.8% γ_{sat} = 125 pcf(1)
15									
		15.1-17.5' Grayish red, GRAVELLY FAT CLAY trace cobbles, hard, moist	935	X	33	10-17-16 (43)			
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
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BORING NO. T-16-15 (203)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+85.0 **Northing:** 958806.1 **Date of Work:** 07/06/16-07/06/16
Offset: 200.0 R **Easting:** 1835776.5 **Depth to Water:**
Elevation: 955.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0			955						
		0.0-5.1' Mottled gray, FAT CLAY, very stiff, moist		X	67	1-4-8 (16)		PP = 2.75 tsf	MC = 32.4% γ_{sat} = 118 pcf(1) LL = 60 PL = 25
5			950						
		5.1-10.1' Whitish gray, FAT CLAY scattered gravel, hard, moist		X	67	8-9-9 (24)		PP = 4.00 tsf	MC = 11.5% γ_{sat} = 142 pcf(1)
				X	67	4-4-6 (13)		PP = 3.00 tsf	MC = 21.8% γ_{sat} = 128 pcf(1) LL = 54 PL = 19
10			945						
		10.1-15.1' Mottled brownish tan, FAT CLAY, very stiff, moist		X	67	3-6-6 (16)		PP = 3.25 tsf	MC = 23.4% γ_{sat} = 127 pcf(1) LL = 63 PL = 19
		12.5' lost sample		X		3-4-7 (14)			
15			940						
		15.1-17.5' Mottled grayish red, FAT CLAY trace gravel, very stiff, moist		X	67	3-6-10 (21)		PP = 3.75 tsf	MC = 23.3% γ_{sat} = 127 pcf(1) LL = 69 PL = 20
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-16 (204)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+25.0 **Northing:** 958864.1 **Date of Work:** 07/06/16-07/06/16
Offset: 200.0 R **Easting:** 1835761.2 **Depth to Water:**
Elevation: 954.4 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled tannish gray, FAT CLAY, stiff, moist							
				X	67	1-3-6 (12)		PP = 1.50 tsf	MC = 36.0% γ_{sat} = 116 pcf(1)
5			950						
		5.1-7.6' Whitish gray mottled, FAT CLAY trace gravel, very stiff, moist		X	67	6-5-7 (16)		PP = 3.75 tsf	MC = 10.7% γ_{sat} = 144 pcf(1)
		7.6-15.1' Mottled tannish gray, FAT CLAY trace gravel, very stiff to hard, moist		X	67	3-4-7 (14)		PP = 3.00 tsf	MC = 32.8% γ_{sat} = 118 pcf(1)
10			945						
				X	67	3-5-7 (16)		PP = 3.00 tsf	MC = 30.6% γ_{sat} = 120 pcf(1)
				X	67	3-7-11 (24)		PP = 4.00 tsf	MC = 22.5% γ_{sat} = 128 pcf(1)
15			940						
		15.1-17.5' Grayish red, FAT CLAY trace gravel, hard, moist		X	67	4-7-12 (25)		PP = 4.50 tsf	MC = 29.2% γ_{sat} = 121 pcf(1)
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-19 (205)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+25.0 **Northing:** 958851.3 **Date of Work:** 07/06/16-07/06/16
Offset: 250.0 R **Easting:** 1835712.8 **Depth to Water:**
Elevation: 955.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled tannish gray, FAT CLAY, stiff, moist	955						
				X	73	1-5-7 (16)		PP = 2.00 tsf	MC = 23.2% γ_{sat} = 127 pcf(1) LL = 52 PL = 21
5			950						
		5.1-10.1' Whitish gray mottled, FAT CLAY trace gravel, very stiff, moist		X	67	7-9-7 (21)		PP = 3.25 tsf	MC = 24.7% γ_{sat} = 125 pcf(1) LL = 39 PL = 16
				X	67	3-4-5 (12)		PP = 2.75 tsf	MC = 29.2% γ_{sat} = 121 pcf(1)
10			945						
		10.1-12.1' Mottled gray, FAT CLAY, very stiff to hard, moist		X	67	3-5-8 (17)		PP = 4.00 tsf	MC = 22.1% γ_{sat} = 128 pcf(1) LL = 72 PL = 23
		12.1-15.1' Mottled grayish tan, FAT CLAY trace gravel, very stiff, moist		X	73	4-7-10 (22)		PP = 4.25 tsf	MC = 21.7% γ_{sat} = 128 pcf(1) LL = 71 PL = 19
15			940						
		15.1-17.5' Brownish red, GRAVELLY FAT CLAY, hard, moist		X	33	7-15-11 (34)			
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-21 (206)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+25.0 **Northing:** 958820.6 **Date of Work:** 07/06/16-07/06/16
Offset: 370.0 R **Easting:** 1835596.8 **Depth to Water:**
Elevation: 955.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0			955						
		0.0-5.1' Mottled gray, FAT CLAY trace gravel, stiff, moist		X	73	2-4-6 (13)		PP = 2.25 tsf	MC = 24.9% γ_{sat} = 125 pcf(1)
5			950						
		5.1-7.6' Whitish gray mottled, FAT CLAY trace gravel, very stiff, moist		X	67	3-7-5 (16)		PP = 2.50 tsf	MC = 13.6% γ_{sat} = 139 pcf(1)
		7.6-15.1' Mottled gray, FAT CLAY trace gravel, very stiff to hard, moist		X	73	2-4-6 (13)		PP = 2.75 tsf	MC = 28.0% γ_{sat} = 122 pcf(1)
10			945						
				X	67	3-6-10 (21)		PP = 4.25 tsf	MC = 21.5% γ_{sat} = 129 pcf(1)
				X	73	5-8-9 (22)		PP = 4.50 tsf	MC = 22.8% γ_{sat} = 127 pcf(1)
15			940						
		15.1-17.5' Mottled tan, FAT CLAY trace gravel, hard, moist		X	67	4-10-14 (32)		PP = 6.00 tsf	MC = 19.5% γ_{sat} = 131 pcf(1)
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
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BORING NO. T-16-22 (207)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+85.0 **Northing:** 958762.6 **Date of Work:** 07/06/16-07/06/16
Offset: 370.0 R **Easting:** 1835612.1 **Depth to Water:**
Elevation: 955.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled gray, FAT CLAY trace gravel, stiff, moist	955						
				X	73	2-5-7 (16)		PP = 3.00 tsf	MC = 21.5% γ_{sat} = 129 pcf(1) LL = 53 PL = 20
5		5.1-7.6' Whitish gray mottled, FAT CLAY trace gravel, hard, moist	950	X	73	8-13-11 (32)		PP = 6.00 tsf	MC = 10.5% γ_{sat} = 144 pcf(1)
		7.6-12.5' Mottled gray, FAT CLAY trace gravel, very stiff to hard, moist		X	67	3-5-7 (16)		PP = 3.50 tsf	MC = 25.5% γ_{sat} = 124 pcf(1) LL = 55 PL = 20
10			945	X	67	3-5-7 (16)		PP = 3.50 tsf	MC = 23.1% γ_{sat} = 127 pcf(1)
		12.5-17.5' Mottled grayish tan, FAT CLAY trace gravel, hard, moist		X	67	3-7-9 (21)		PP = 4.25 tsf	MC = 23.4% γ_{sat} = 127 pcf(1) LL = 74 PL = 21
15			940	X	67	4-9-11 (26)		PP = 4.50 tsf	MC = 23.2% γ_{sat} = 127 pcf(1) LL = 68 PL = 21
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-20 (208)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 1+85.0 **Northing:** 958793.3 **Date of Work:** 07/06/16-07/06/16
Offset: 255.0 R **Easting:** 1835728.2 **Depth to Water:**
Elevation: 955.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled gray, FAT CLAY trace gravel, stiff, moist	955						
				X	67	1-2-6 (11)		PP = 1.25 tsf	MC = 24.3% γ_{sat} = 126 pcf(1)
5		5.1-7.6' Mottled whitish gray, FAT CLAY scattered gravel, very stiff to hard, moist	950	X	73	7-6-6 (16)		PP = 3.75 tsf	MC = 16.3% γ_{sat} = 135 pcf(1)
		7.6-17.5' Mottled gray, FAT CLAY, very stiff to hard, moist		X	67	3-4-5 (12)		PP = 2.25 tsf	MC = 32.5% γ_{sat} = 118 pcf(1)
10			945	X	67	2-5-6 (14)		PP = 2.50 tsf	MC = 21.1% γ_{sat} = 129 pcf(1)
				X	73	3-4-8 (16)		PP = 3.00 tsf	MC = 23.4% γ_{sat} = 127 pcf(1)
15			940	X	33	3-7-9 (21)		PP = 3.75 tsf	
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. B-16-40 (WASH 1)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 3+90 **Northing:** 958648.8 **Date of Work:** 07/11/16-07/11/16
Offset: 40.0 R **Easting:** 1835983.6 **Depth to Water:**
Elevation: 952.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-7.6' Brown, LEAN CLAY, medium stiff to stiff, moist	950						
				X	53	1-2-2 (5)		PP = 1.25 tsf	
5				X	87	1-2-3 (6)		PP = 2.50 tsf	
			945						
		7.6-16.5' Light gray mottled light brown, LEAN CLAY, stiff to very stiff, moist		X	79	1-3-5 (9)		PP = 1.75 tsf	
10				X	93	2-4-5 (11)		PP = 2.25 tsf	
			940	X	93	4-5-7 (14)		PP = 3.25 tsf	
15				X	93	4-7-10 (20)		PP = 4.00 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. B-16-39 (WASH 2)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 3+90 **Northing:** 958641.1 **Date of Work:** 07/11/16-07/11/16
Offset: 70.0 R **Easting:** 1835954.6 **Depth to Water:**
Elevation: 952.7 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-7.6' Dark red mottled dark brown, LEAN CLAY, stiff, moist	950						
				X	67	1-3-6 (11)		PP = 1.25 tsf	
5				X	93	5-4-7 (13)		PP = 2.25 tsf	
			945						
		7.6-16.5' Gray mottled light brown, LEAN CLAY, stiff to very stiff, moist		X	73	3-5-8 (15)		PP = 2.75 tsf	
10				X	93	3-5-7 (14)		PP = 3.25 tsf	
			940	X	93	3-4-8 (14)		PP = 3.75 tsf	
15				X	93	4-4-10 (17)		PP = 3.25 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. B-16-37 (WASH 3)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 4+40 **Northing:** 958592.8 **Date of Work:** 07/11/16-07/11/16
Offset: 70.0 R **Easting:** 1835967.4 **Depth to Water:**
Elevation: 953.2 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.6' Light brown, LEAN CLAY, medium stiff to very stiff, moist		X	53	1-2-2 (5)		PP = 0.75 tsf	
			950	X	93	1-5-11 (19)		PP = 4.00 tsf	
5		2.6-16.5' Light gray mottled light brown, LEAN CLAY, stiff to very stiff, moist		X	93	3-4-5 (11)		PP = 3.75 tsf	
			945	X	73	2-4-5 (11)		PP = 3.75 tsf	
10				X	87	3-4-7 (13)		PP = 2.75 tsf	
			940	X	80	3-5-8 (15)		PP = 3.25 tsf	
15				X	87	4-7-8 (18)		PP = 3.00 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. B-16-38 (WASH 4)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 4+40 **Northing:** 958600.5 **Date of Work:** 07/11/16-07/11/16
Offset: 40.0 R **Easting:** 1835996.4 **Depth to Water:**
Elevation: 952.6 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-7.5' Light brown, LEAN CLAY, medium stiff to stiff, moist	950						
				X	53	3-3-5 (9)		PP = 2.50 tsf	
5									
				X	93	2-3-4 (8)		PP = 1.00 tsf	
			945						
		7.5-13.2' Light gray mottled light brown, LEAN CLAY, stiff to very stiff, moist		X	87	1-4-5 (11)		PP = 2.50 tsf	
10									
				X	93	3-4-7 (13)		PP = 2.25 tsf	
			940						
		13.2-16.5' Reddish brown, LEAN CLAY with fine gravel, very stiff, moist		X	80	4-5-10 (18)		PP = 2.00 tsf	
15									
				X	933	4-7-8 (18)		PP = 3.00 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
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BORING NO. T-16-24 (SALT 1)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 5+40.0 **Northing:** 958503.8 **Date of Work:** 07/07/16-07/07/16
Offset: 40.0 R **Easting:** 1836022 **Depth to Water:**
Elevation: 952.1 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.3' Mottled gray, LEAN CLAY trace gravel, stiff, moist	950						
				X	67	2-4-8 (16)		PP = 2.25 tsf	MC = 25.7% γ_{sat} = 124 pcf(1) LL = 49 PL = 20
5		5.3-7.7' Whitish gray mottled, LEAN CLAY scattered gravel, very stiff, moist	945	X	73	6-6-7 (17)		PP = 3.25 tsf	MC = 24.2% γ_{sat} = 126 pcf(1) LL = 46 PL = 19
		7.7-17.5' Mottled tannish gray, FAT CLAY trace gravel, very stiff to hard, moist		X	67	4-5-6 (14)		PP = 3.25 tsf	MC = 29.6% γ_{sat} = 121 pcf(1) LL = 63 PL = 20
10				X	73	4-7-8 (20)		PP = 4.00 tsf	MC = 14.3% γ_{sat} = 138 pcf(1)
			940						
				X	67	3-6-9 (20)		PP = 3.50 tsf	LL = 68 PL = 21
15									
				X		3-7-9 (21)			
			935						
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. B-16-35 (SALT 2)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 5+40 **Northing:** 958485.9 **Date of Work:** 07/11/16-07/11/16
Offset: 110.0 R **Easting:** 1835954.3 **Depth to Water:**
Elevation: 953.3 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.5' Light brown, LEAN CLAY, medium stiff to very stiff, moist		X	53	2-3-3 (7)		PP = 1.50 tsf	
		2.5-15.0' Light gray mottled light brown, LEAN CLAY, medium stiff to very stiff, dry to moist	950	X	93	6-11-14 (30)		PP = 3.75 tsf	
5				X	60	4-5-5 (12)		PP = 4.00 tsf	
			945	X	80	2-3-4 (8)		PP = 2.75 tsf	
10				X	73	4-4-6 (12)		PP = 3.75 tsf	
			940	X	80	3-4-10 (17)		PP = 3.75 tsf	
15									
		15.0-16.5' Red and brown, LEAN CLAY, very stiff, moist		X	87	3-6-9 (18)		PP = 3.75 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
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Missouri Department of Transportation
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BORING NO. B-16-36 (SALT 3)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: Fi2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Matthew Kraus **Operator:** Rick Fredrick
Station: 6+12 **Northing:** 958416.3 **Date of Work:** 07/11/16-07/11/16
Offset: 110 R **Easting:** 1835972.7 **Depth to Water:**
Elevation: 951.9 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** Simco 4000 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-8690 **Hammer Efficiency:** 71% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-2.7' Light brown, LEAN CLAY, very stiff, moist	950	X	47	3-3-4 (8)		PP = 2.25 tsf	
		2.7-5.3' Light gray mottled light brown, LEAN CLAY, stiff to very stiff, dry to moist		X	87	2-10-12 (26)		PP = 4.00 tsf	
5		5.3-10.1' Light brown, LEAN CLAY, very stiff, moist	945	X	87	4-4-4 (9)		PP = 3.50 tsf	
				X	47	3-4-4 (9)		PP = 3.25 tsf	
10		10.1-16.5' Light gray mottled light brown, LEAN CLAY, stiff to very stiff, moist	940	X	93	2-4-7 (13)		PP = 2.50 tsf	
				X	60	5-5-7 (14)		PP = 2.75 tsf	
15				X	73	5-6-4 (12)		PP = 3.00 tsf	
		Bottom of borehole at 16.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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Missouri Department of Transportation
Construction and Materials

BORING NO. T-16-23 (SALT 4)

Job No.: R35G_FI2427 **County:** Osage **Route:** 50
Design: FI2427 **Skew:** **Location:** Linn
Bent: **Logged By:** Ricardo Todd **Operator:** Michael Donahoe
Station: 6+12.0 **Northing:** 958434.2 **Date of Work:** 07/07/16-07/07/16
Offset: 40.0 R **Easting:** 1836040.4 **Depth to Water:**
Elevation: 950.8 **Requested Northing:** **Depth Hole Open:**
Requested Station: **Requested Easting:** **Time Change:**
Requested Offset: **Equipment:** CME 45 ,Split-Spoon Sampler
Requested Elevation: **Location Note:** About 2 Miles West of Linn
Drill No.: G-9577 **Hammer Efficiency:** 79% **Drilling Method:** Hollow Stem Auger

Depth (ft)	Graphic	Description	Elevation (ft)	Sample Type	REC % (RQD %)	Blow Counts (N_{60})	Shear Data	Field Tests	Index Tests
0		0.0-5.1' Mottled gray, LEAN CLAY trace gravel, stiff, moist	950						
				X	73	2-4-6 (13)		PP = 1.50 tsf	MC = 25.2% γ_{sat} = 125 pcf(1)
5		5.1-7.6' Whitish gray mottled, LEAN CLAY scattered gravel, very stiff, moist	945	X	73	6-6-7 (17)		PP = 3.25 tsf	MC = 24.3% γ_{sat} = 126 pcf(1)
		7.6-12.9' Mottled tannish gray, LEAN CLAY trace gravel, very stiff to hard, moist		X	67	4-5-9 (18)		PP = 3.75 tsf	MC = 24.9% γ_{sat} = 125 pcf(1)
10			940	X	67	5-6-8 (18)		PP = 3.50 tsf	MC = 27.1% γ_{sat} = 123 pcf(1)
		12.9-17.5' Tan, GRAVELLY LEAN CLAY trace gravel, hard, moist		X	67	13-21-18 (51)		PP = 6.50 tsf	MC = 23.6% γ_{sat} = 126 pcf(1)
15			935	X	33	15-15-11 (34)			
		Bottom of borehole at 17.5 feet.							

N_{60} = (Em/60)Nm N_{60} - Corrected N value for standard 60% SPT efficiency; Em - Measured hammer efficiency in percent; Nm - Observed N-value
(1) = Assumed, (2) = Actual

Coordinate System: Modified U.S. State Plane 1983 **Coordinate Zone:** Missouri Central **Coordinate Proj. Factor:** 1.0000574
Coordinate Datum: NAD 83 (CONUS) **Coordinate Units:** U.S. Survey Feet

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KEY TO SYMBOLS

Missouri Department of Transportation
1617 Mo. Blvd.
Jefferson City, Mo. 65109

CLIENT _____ **PROJECT NAME** Linn Maintenance Building

PROJECT NUMBER R35G_FI2427 **PROJECT LOCATION** Linn

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)


CH: USCS High Plasticity Clay


CHG: USCS High Plasticity Gravelly Clay


CL: USCS Low Plasticity Clay


CLG: USCS Low Plasticity Gravelly Clay

SAMPLER SYMBOLS


Split-Spoon Sampler

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
Qu - UNCONFINED COMPRESSIVE STRENGTH (PSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level after Drilling

KEY TO SYMBOLS - MODOT 20150728.GDT - 8/3/16 09:12 - J:\SG\GINT\PROJECT FILES\R35G-FI2427.GPJ

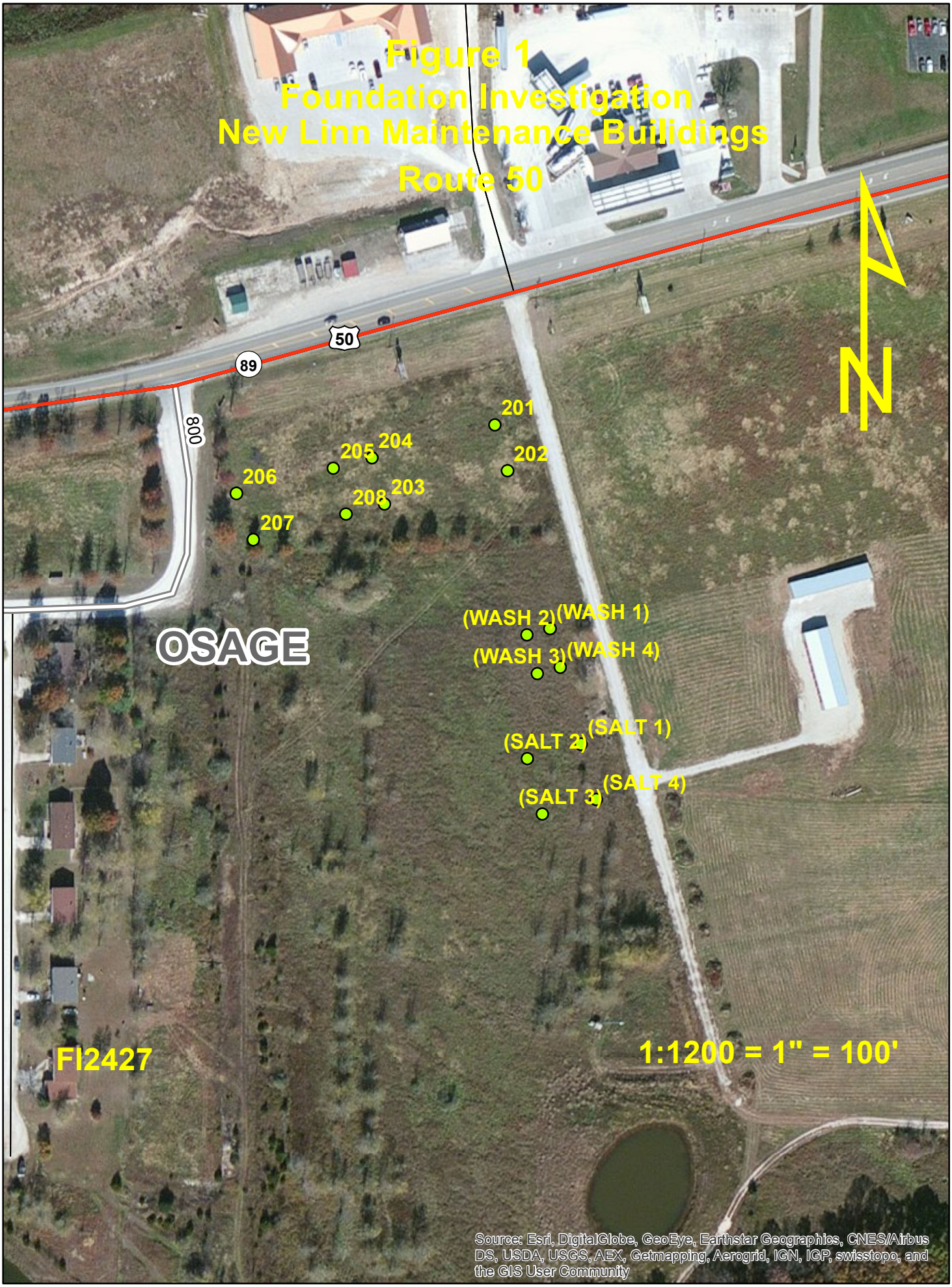
Figure 1
Foundation Investigation
New Linn Maintenance Buildings
Route 50
50
89
800
201
202
205
204
206
208
203
207
(WASH 2)
(WASH 1)
(WASH 3)
(WASH 4)
OSAGE
(SALT 1)
(SALT 2)
(SALT 4)
(SALT 3)
FI2427
1:1200 = 1" = 100'
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community