Appendix H

STORM WATER MANAGEMENT PLAN

FOR

AQUILA, INC.
d/b/a
KCP&L GREATER MISSOURI OPERATIONS COMPANY

PECULIAR 345 KV SUBSTATION

CITY OF PECULIAR, MISSOURI

SEPTEMBER 24, 2008

PREPARED BY:

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Stilwell, Kansas 66085-1000
(913) 681-2881

Sega Project No. 08-0176

Table of Contents

Introduction

The Peculiar 345-kV Substation, owned by the City of Peculiar but operated by Aquila, Inc., d/b/a KCP&L Greater Missouri Operations Company (KCP&L GMO), is located in the southeast quadrant of the intersection of South Knight Road and East 203rd Street. It was recently annexed and is now located inside the City of Peculiar. The substation was constructed by Aquila in 2005 in unincorporated Cass County, and as a result of the annexation is now subject to City of Peculiar storm water management plan requirements in accordance with the Municipal Code of the City of Peculiar (specifically Chapter 250: Storm Water Management Regulations). The property is a total of 55 acres and approximately 15 acres were cleared and graded for development of a substation and access drive. The purpose of this SWMP is to show that the existing substation will meet the requirements of the City of Peculiar.

Project Description

Historically, about 45 acres of the property was utilized for agricultural purposes. The other 10 acres were natural, wooded, drainage channels, including a USGS Blueline. After the substation development the drainage channels were undisturbed, with the exception of constructing an access drive and culvert pipes through each drainage channel. The post-development site utilizes approximately 15 acres for the substation and access drive, 10 acres are natural wooded areas, 10 acres are grassland, and 20 acres are still utilized for agriculture purposes. All areas are outside the 100-year flood (See FEMA FIRM maps).

The existing substation is surrounded by a chain link fence and the surface is constructed with approximately 6" of loose rock. The loose rock is installed for reasons concerning electrical safety but it also improves the drainage characteristics of the property by slowing the stormwater runoff flow velocity. Also, approximately one foot inside the substation fence is a rock berm (9" high) which provides additional filtration before stormwater runoff is routed outside the substation. The substation structures including the future expansion, is a net impervious area of approximately 13,000 square feet (0.3 acres, 0.5% of the property).

Site Drainage

The site was designed for a balanced cut and fill, approximately 14 feet. The substation development involved leveling and replacing agricultural land in the drainage area with loose, crushed rock surfacing. Drainage from in and around the substation is routed outside the substation to existing small drainage channels, thus preserving the existing drainage pattern from southeast to northwest near the substation.

It was determined that any increase in stormwater volume and peak runoff would be negligible because the time of concentration was lengthened by leveling the substation site and surfacing with crushed rock. Localized drainage in the level portion inside the substation serves to lengthen the flow paths, thus increasing the time of concentration. Stormwater runoff from inside the substation perimeter fence has a natural drainage route to the USGS Blueline drainage course. The substation development has created no net increase in stormwater discharge to the drainage area on or after construction of the substation property. In fact, as detailed in the attached "Pre-development vs. Post-development Discharge Calculations", stormwater flows slightly decrease (range 0.7-3.9 cfs) as a result of the development.

Maintenance Plan and BMPs

The Peculiar 345-kV Substation will have routine equipment maintenance to maintain a sufficient operating facility. The KCP&L GMO Design Department will be notified if any problems arise, such as standing water in the substation area and will make a field check and then determine the best course of action to correct the problem. The site structural Best Management Practices (BMPs) will be routinely inspected, cleaned, and maintained on an annual basis according to the City of Peculiar and KCP&L GMO standards.

As a result of the August inspection KCPL GMO has decided to install:

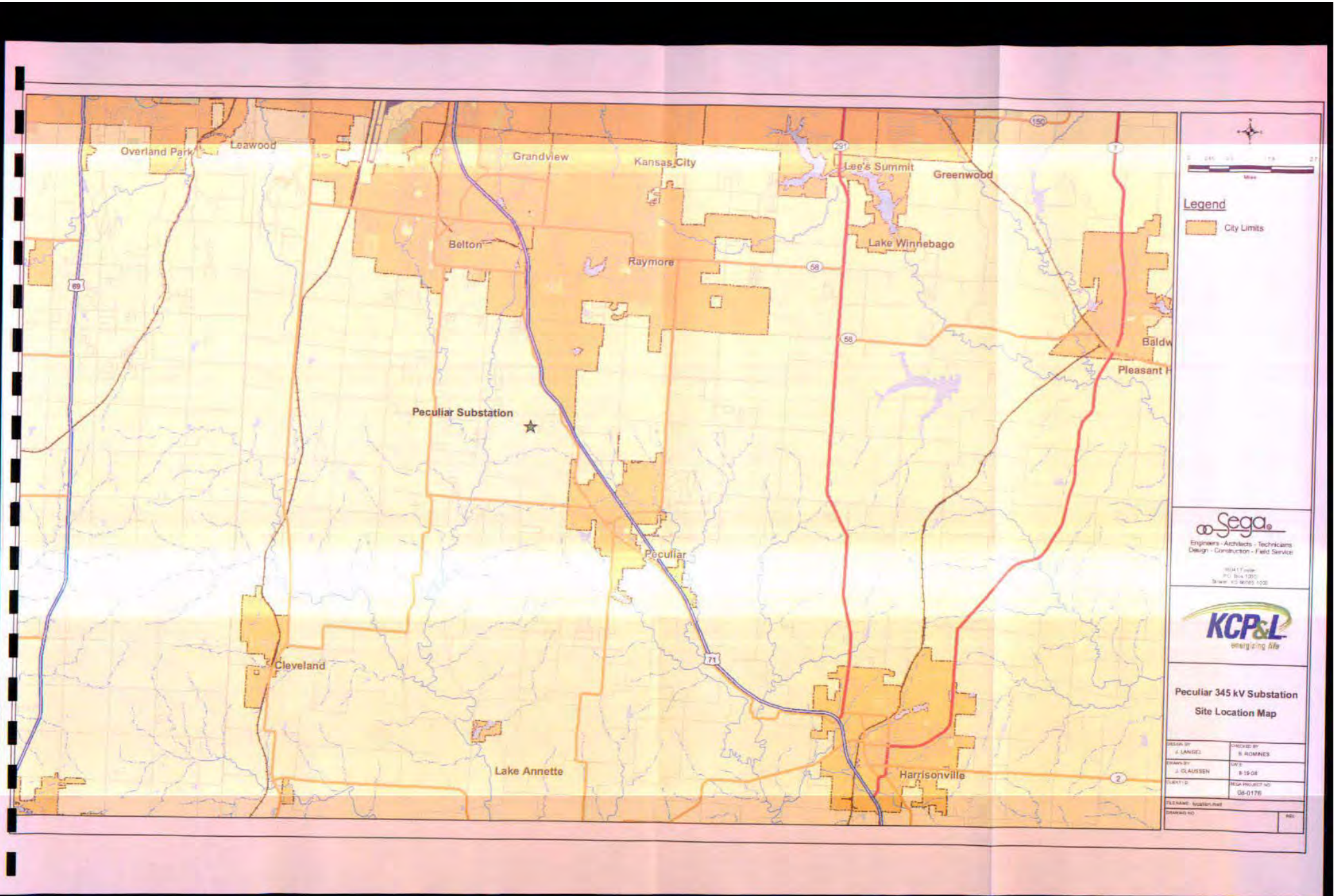
- Additional stormwater culvert pipes in multiple locations to route stormwater runoff:
  - Two (2) Arched reinforced concrete pipes under South Knight Road
  - One additional corrugated metal pipe for the existing substation access drive.
- Twelve flared end sections for all existing and proposed stormwater culvert pipes.
- Riprap located at each stormwater culvert inlet and outlet pipe, a total of 275 cubic yards.
- Six (6) check dams located at each existing agricultural terrace along the existing access drive.
- Silt fence extension near the existing USGS Blueline and near property line east of the existing substation access drive, a total of 2,500 linear feet.
- Riprap all existing small drainage channels located adjacent to the substation fence, a total of approximately 100 cubic yards.
- Plant Missouri natural grass vegetation on both sides of the existing substation access drive as approved by the Missouri Department of Conservation, approximately 50,000 square feet.
- Regrade both sides of the substation access drive ditches, approximately 15 feet on both sides of the road edge.
- Create field edge border, adjacent to the property line, and between the agricultural area and the access drive on the northeast side of the property.

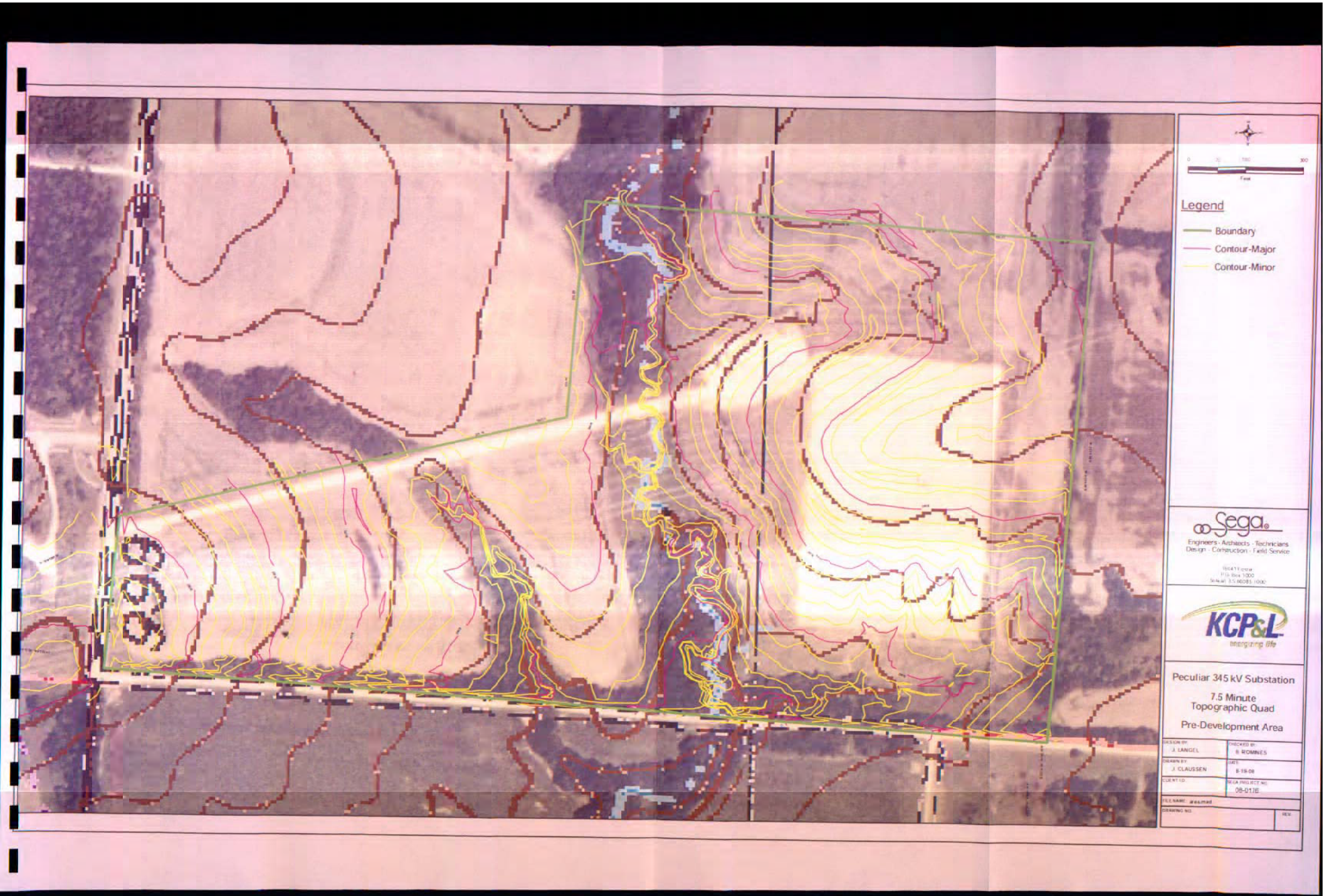
The existing BMPs onsite are erosion and sediment control which were implemented by utilizing silt fence on the northwest corner of the substation, green mesh on the substation side slopes, and channel mesh in small drainage courses. Existing permanent BMPs were utilized such as culvert pipes for the access drive, crushed rock surfaces, and riprap which lines small drainage courses throughout the property.

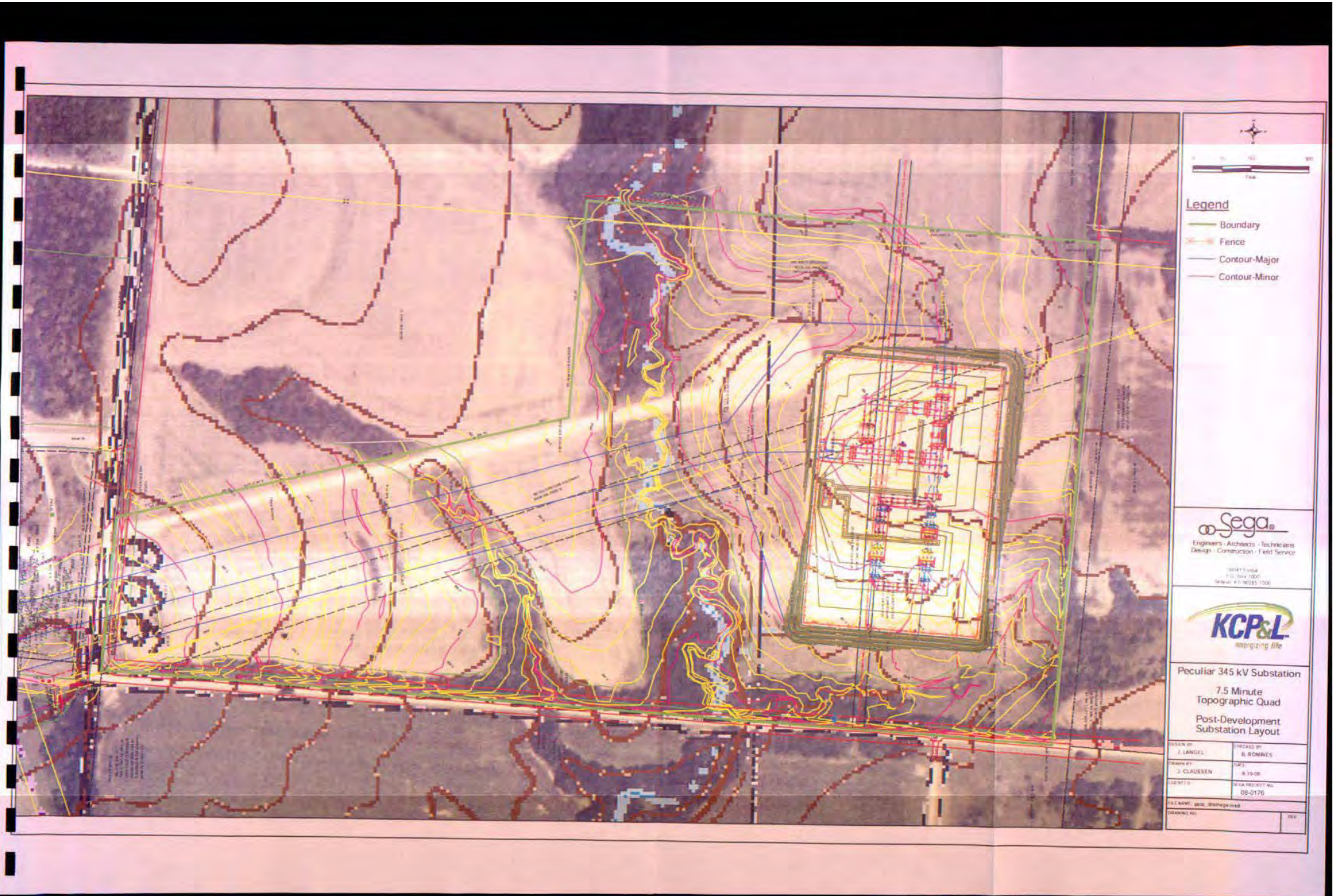
Conclusion

The Peculiar 345-kV Substation incorporates stormwater management measures that control runoff from the site in accordance with the Municipal Code of the City of Peculiar. Permanent BMPs will be utilized during the life of the project. With implementation of the Maintenance Plan and BMP's described above, we believe the Peculiar 345-kV Substation will meet all stormwater management requirements for the City of Peculiar.

REFERENCES


Overland Park
Leawood
Grandview
Kansas City
Lee's Summit
Greenwood
Belton
Raymore
Lake Winnebago
Peculiar Substation
Peculiar
Cleveland
Lake Annette
Harrisonville
Pleasant H
Legend
City Limits
Sega
Engineers - Architects - Technicians
Design - Construction - Field Service
KCP&L
energizing life
Peculiar 345 kV Substation
Site Location Map
J. LANGE
B. ROMINES
J. GLAUSSEN
8-19-08
08-0178


Legend
Boundary
Contour-Major
Contour-Minor
Sega
Engineers - Architects - Technicians
Design - Construction - Field Service
KCP&L
energizing life
Peculiar 345 kV Substation
7.5 Minute
Topographic Quad
Pre-Development Area
J. LANGEL
R. ROMINES
J. CLAUSSEN
08-0138


Legend
Boundary
Fence
Contour-Major
Contour-Minor
Sega
Engineers - Architects - Technicians
Design - Construction - Field Service
KCP&L
Energizing life
Peculiar 345 kV Substation
7.5 Minute
Topographic Quad
Post-Development
Substation Layout
J. LANGEL
B. ROMINES
J. CLAUSSEN
8-19-08
08-0176

Hydrologic Soil Group–Cass County, Missouri
(Peculiar Substation)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 15N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cass County, Missouri
Survey Area Data: Version 9, Jun 18, 2008

Date(s) aerial images were photographed: 1991; 1996; 1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Cass County, Missouri				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	8.1	14.8%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	D	17.5	31.9%
30080	Greenton silty clay loam, 5 to 9 percent slopes	C	29.2	53.3%
Totals for Area of Interest (AOI)			54.9	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Depth to Water Table–Cass County, Missouri
(Peculiar 345 kV Substation)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 15N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cass County, Missouri
Survey Area Data: Version 9, Jun 18, 2008

Date(s) aerial images were photographed: 1991; 1996; 1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — Cass County, Missouri				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	61	8.4	15.1%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	23	17.6	31.7%
30080	Greenton silty clay loam, 5 to 9 percent slopes	53	29.4	53.1%
Totals for Area of Interest (AOI)			55.4	100.0%

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

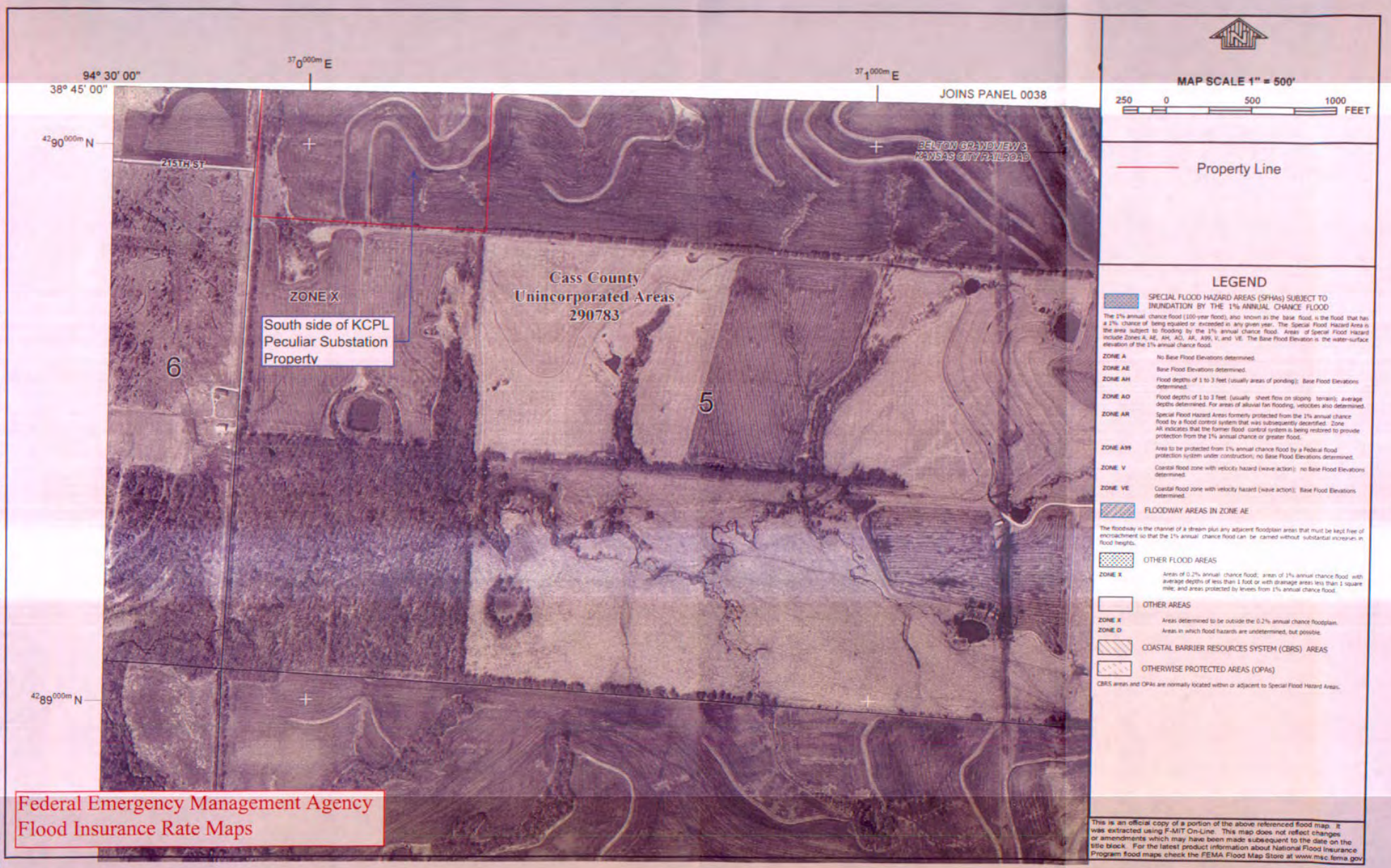
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

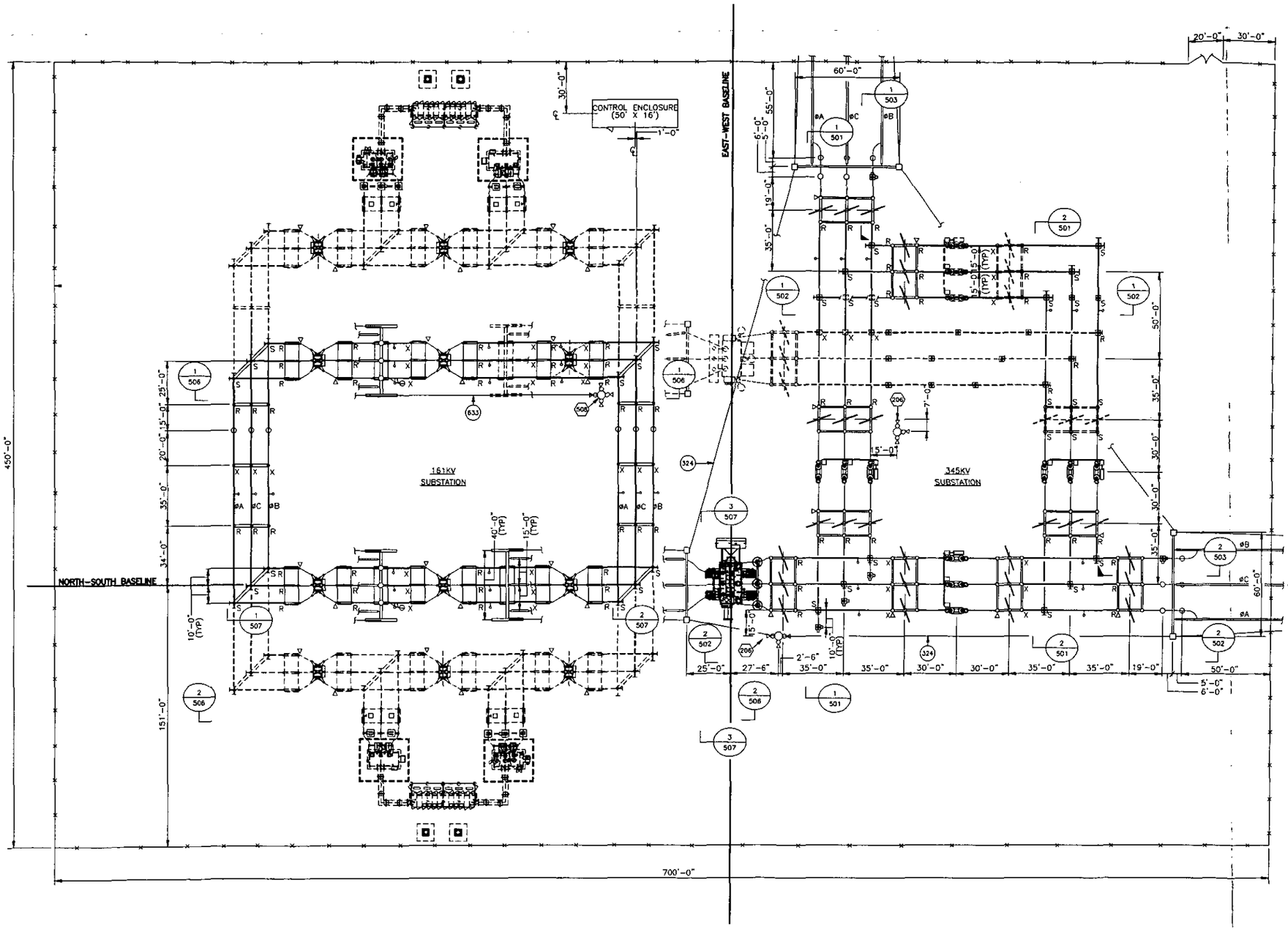
Ending Month: December

Federal Emergency Management Agency
Flood Insurance Rate Maps



Federal Emergency Management Agency
Flood Insurance Rate Maps


1
5.4 acres
2
12.5 acres
3
3.4 acres
4
14.9 acres
5
120.4 acres
6
17.5 acres
7
5.7 acres
8
5.1 acres
9
34.1 acres
999
950
1000
1011
990
East 203rd Street
South Knight Road
Legend
Drainage Areas
Property Line
Fence
City Limits
0
200
400
800
Feet
Sega
Engineers - Architects - Technicians
Design - Construction - Field Service
KCP&L
Peculiar 345 kV Substation
Drainage Areas
DESIGN BY
J. LANGEL
CHECKED BY
B. ROMINES
DRAWN BY
J. CLAUSSEN
DATE
8-13-08
SEGA PROJECT NO.
08-0176
FILE NAME: drainage.mxd
DRAWING NO.
Drainage-1
REV
B



GENERAL NOTES

G1. 345KV PHASE TO PHASE SPACING SHALL BE 15'-0' UNLESS OTHERWISE NOTED ON THIS DRAWING.

G2. 161KV PHASE TO PHASE SPACING SHALL BE 10'-0' UNLESS OTHERWISE NOTED ON THIS DRAWING.

LEGEND

X	EXPANSION FITTING
R	FIXED FITTING
S	SLIP FITTING
◁	SWITCH OPERATOR LOCATION
⏚	GROUND STUD LOCATION
⊠	LIGHT
- - - - - - -	FUTURE BUS AND EQUIPMENT

REFERENCE DRAWINGS

FOUNDATION PLAN	637-200, 201
RACEWAY PLAN	637-300, 301
GROUNDING PLAN	637-400, 401
HARDWARE DETAILS	637-504, 508
BILL OF MATERIALS	637-505, 509
STEEL STRUCTURES	637-700 SERIES

PLAN NORTH

30' 20' 10' 0 30' 60'

1"=30'

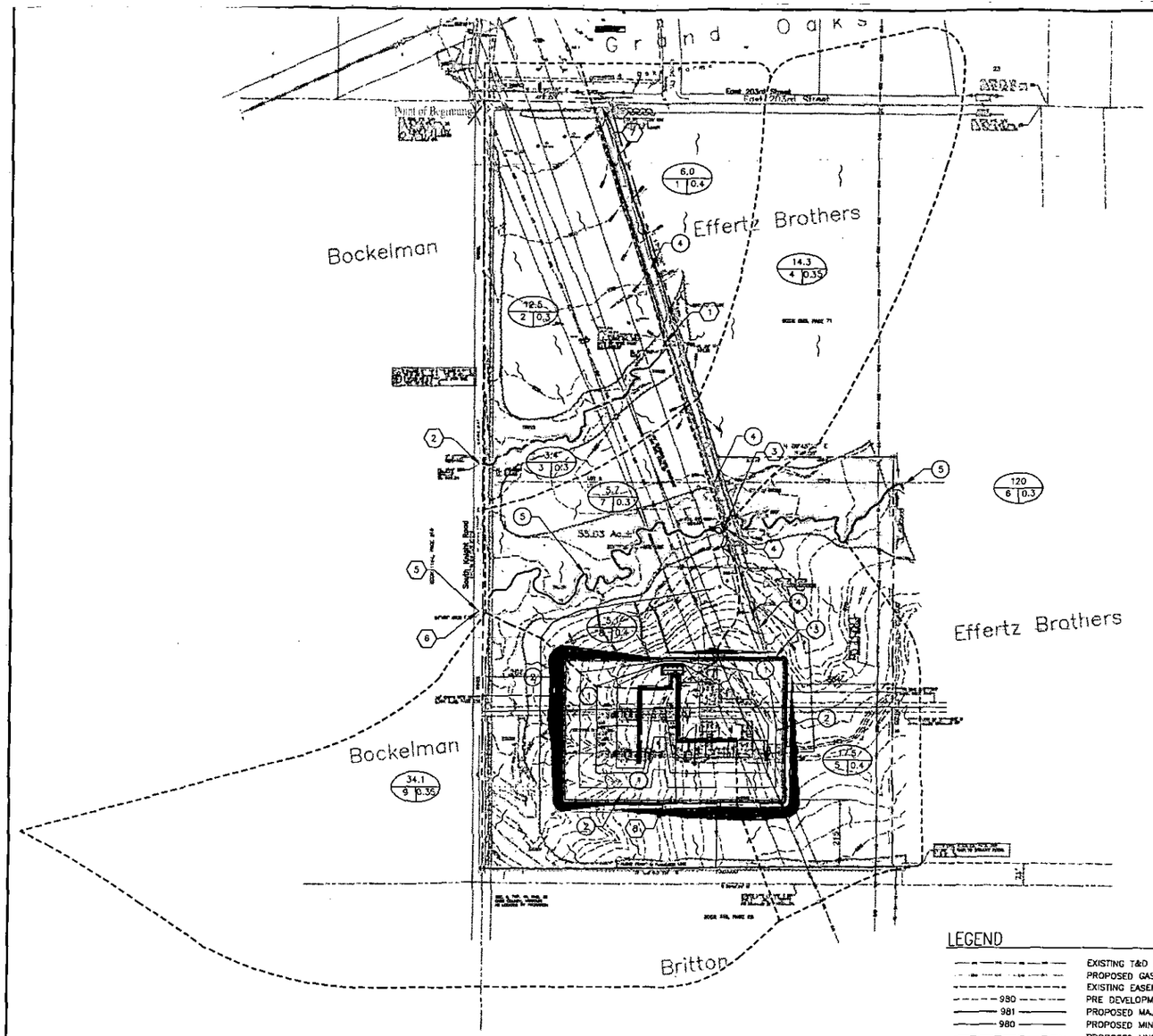
REV. NO.	BY	CHK.	DATE	DESCRIPTION
2	JDN	JDN	2/7/05	GENERAL REVISIONS
1	JDN	JDN	2/1/05	ADDED BASELINES

REVISIONS

AQUILA, INC.
KANSAS CITY, MISSOURI 64138

PECULIAR 345/161KV SUBSTATION
BUS AND EQUIPMENT
ULTIMATE ARRANGEMENT PLAN

DWG. NO. 637-500
DRAWN JDN
CHK. BY
DATE 8/30/04
CAD REF.
W.O. NO.
SCALE 1"=30'
SHEET 1 OF 1
REVISION 2



GRADING AND DRAINAGE PLAN

N

200 0 200 400

SCALE IN FEET

CIVIL KEYNOTES:

1. EXISTING SUBSTATION CRUSHED ROCK SURFACE APPROX. 6" THICK LAYER.
2. EXISTING 9" HIGH CRUSHED ROCK BERM APPROX. 3' DIA. ROCK (SPEC. AB-3).
3. EXISTING PRIMARY SUBSTATION ACCESS GATE.
4. EXISTING 16' WIDE CRUSHED ROCK ACCESS DRIVE.
5. EXISTING USGS BLUELINE DRAINAGE CHANNEL.

STORM DRAINAGE KEYNOTES

1. EXISTING 36" DIA. CMP
   40 L.F. @ 1.1% SL.
   INSTALL 36" DIA CMP FLARED END SECTION BOTH ENDS.
2. EXISTING 48" DIA. CMP
   25 L.F. @ 2.35% SL.
   INSTALL 48" DIA CMP FLARED END SECTION BOTH ENDS.
3. EXISTING 60" DIA. CMP
   40 L.F. @ 2.37% SL.
   INSTALL 60" DIA. CMP FLARED END SECTION BOTH ENDS.
4. INSTALL 60" DIA. RCP FLARED END SECTION
   INSTALL 40 L.F. 60" DIA. RCP @ 2.5% SL.
   INSTALL 60" DIA. RCP FLARED END SECTION.
5. EXISTING 54"x38" ARC CMP REMOVE AND REPLACE PIPE SEE KEYNOTES 6 AND 7.
6. INSTALL TWO 48"x76" ARC RCP FLARED END SECTIONS
   INSTALL TWO 22.5 L.F. 48"x76" ARC RCP @ MIN. 1.6% SL.
   INSTALL TWO 48"x76" ARC RCP FLARED END SECTION.
7. EXISTING 12" DIA. STEEL PIPE APPROX. 30 L.F.
8. EXISTING 24" DIA. CMP APPROX. 25 L.F.

GENERAL NOTES:

NOTES:

1. SUBSTATION SITE WAS ORIGINALLY DESIGNED AND CONSTRUCTED BY AQUILA, INC. IN 2005, RECENTLY ACQUIRED BY KCP&L GREATER MISSOURI OPERATIONS COMPANY.
2. FOR TOTAL DRAINAGE AREAS, SEE DRAINAGE AREA MAP IN REFERENCE SECTION OF STORMWATER MANAGEMENT PLAN.

LEGEND:

A = AREA IN ACRES
B = BASIN DESIGNATION
C = COMPOSITE RUNOFF COEFFICIENT
D = BASIN DESIGNATION
DRAINAGE AREA LIMITS

KEY:

(EX)	–	EXISTING STRUCTURES
CI	–	CURB INLET
SI	–	CURB INLET IN SUMP
DI	–	SINGLE DROP INLET
DI-2	–	DOUBLE DROP INLET
ES	–	PREFABRICATED END SECTION
JB	–	JUNCTION BOX
YI	–	YARD INLET
AI	–	AREA INLET
MH	–	MANHOLE
R	–	REDUCER
FI	–	FIELD INLET
BEND	–	PREFABRICATED VERTICAL BEND
T.D.	–	TRENCH DRAIN
G.I.	–	GRATE INLET
D.C.	–	DETENTION OUTLET CONTROL STRUCTURE
RCP	–	REINFORCED CONCRETE PIPE
CMP	–	CORREGATED METAL PIPE

DESIGN NOTES:

(a) TIME OF CONCENTRATION
15 MINUTES MAX.
5 MINUTES MIN.

(b) PIPE LENGTHS EXCLUDE END SECTIONS AND ARE MEASURED ALONG CENTERLINE OF PIPE FROM CENTER OF INSIDE FACE TO CENTER OF INSIDE FACE OF STRUCTURES.

(c) MANNING'S ROUGHNESS COEFFICIENT = 0.013 (CONCRETE)
= 0.024 (CMP)

100 YR. STORM ANALYSIS

STRUCTURE		DIRECT RUNOFF						TOTAL RUNOFF	PIPE#						
STRUCT. NO. (AREA NO.)	TYPE	AREA (acres) A	RUNOFF COEF. C	CxA	K	I (in/hr) (a)	Q (CFS)	TOTAL Q (CFS)	PIPE NO.	PIPE SIZE DIA.	PIPE SLOPE %	PIPE LENGTH (LF)	PIPE CAP. (CFS)	VELOCITY (ft/sec)	DEPTH OF FLOW (INCHES)
1	CMP	6.0	0.40	2.40	1.25	8.2	24.6	24.6	1	36	1.1	40	40.8	5.7	21.1
2	CMP	12.5	0.30	3.75	1.25	7.7	36.0	64.7	2	48	2.35	25	128.3	9.7	25.2
3	CMP	3.4	0.30	1.02	1.25	7.3	9.3								
4	CMP	14.3	0.35	5.00	1.25	7.5	45.9	483.9	3	60	2.37	40	233.0	11.1	FULL
									4*	50	3.00	40	262	12.0	FULL
5	CMP	17.5	0.40	7.00	1.25	8.8	77.0						495		
6	CMP	120	0.30	36.00	1.25	8.0	360.0								
7	CMP	5.7	0.30	1.71	1.25	7.8	16.7								
8	CMP	5.1	0.40	2.04	1.25	8.8	22.4								
9	CMP	34.1	0.35	11.9	1.25	8.4	125.0	648.0	5**	54"x38" ELLIPTICAL	ASSUMED 2.0 REPLACE	22.2	92.9	8.3	FULL FLOW
								RCP	6*	48"x76"	1.5	22.5	345.0	18.7	39.0
								RCP	7*	48"x76"	1.5	22.5	345.0	18.7	39.0
													690		

* PROPOSED PIPE
** REMOVE EXISTING PIPE

LEGEND

- EXISTING T&D LINE
- PROPOSED GAS LINE
- EXISTING EASEMENT
- 980 PRE DEVELOPMENT MAJOR CONTOUR
- 981 PROPOSED MAJOR CONTOUR
- 980 PROPOSED MINOR CONTOUR
- PROPOSED UNDERGROUND ELECTRICAL
- EXISTING ELECTRIC LINE
- EXISTING TELEPHONE (COMMUNICATIONS) LINE
- PROPOSED RCP STORMWATER PIPE
- PROPERTY LINE
- SUBSTATION FENCE
- S EXISTING SILT FENCE
- PARCEL LINE
- DRAINAGE PATH (FLOWLINE)
- TREE LINE
- EXISTING STORMWATER PIPE
- DIRECTION OF FLOW
- EXISTING BRUSH
- EXISTING CRUSHED ROCK
- STORMWATER PIPE RIPRAP
- NATIVE VEGETATION
- DRAINAGE CHANNEL RIPRAP
- AGRICULTURAL SOIL TERRACE
- DRAINAGE AREA

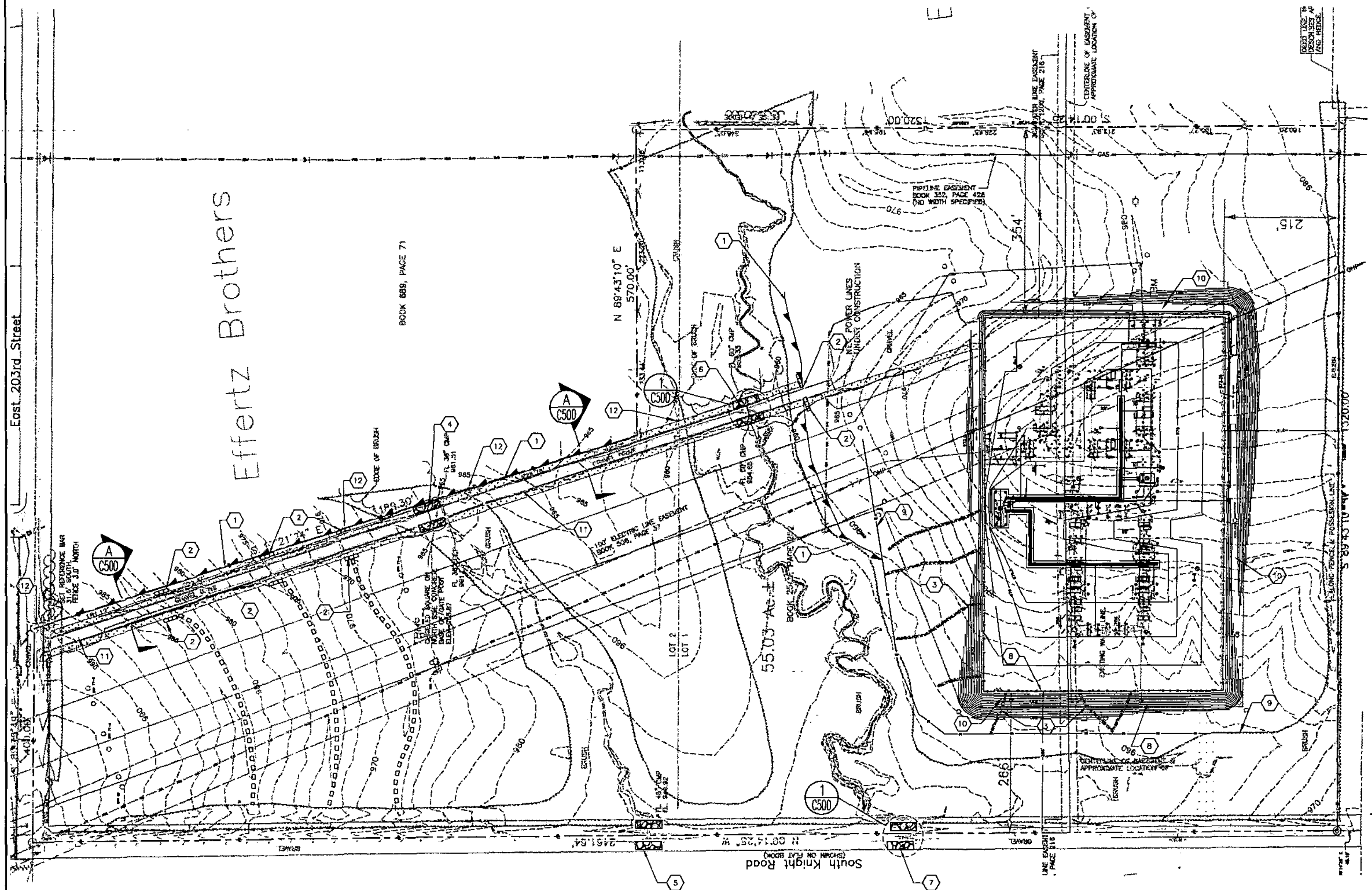
REV.	REV. DATE	REVISIONS & JOB NO.	BY	CK.	APP.
B	9-24-08	ISSUED FOR APPROVAL	MCB	JPL	WHR
A	9-3-08	ISSUED FOR REVIEW	BCG	JPL	WHR

DWG. NO. C300

DESIGN B. GASPERS	DATE	APPROVED J. LANGEL	DATE
DRAFT. CK. B. GASPERS	DATE	SCALE 1:200	
ENGR. CK. B. ROMINES	DATE	JOB NO. 08-0176	

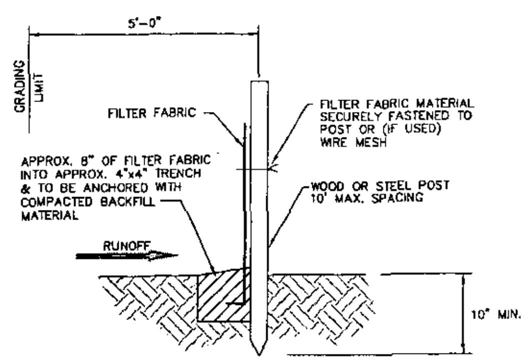
PECULIAR 345 kv SUBSTATION
CIVIL
GRADING AND DRAINAGE PLAN

Sega ®
08-0176
KANSAS CITY
POWER & LIGHT COMPANY
DWG. NO. C300

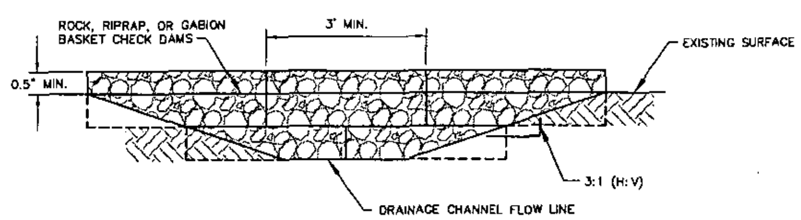


EROSION CONTROL PLAN

100 0 100 200
SCALE IN FEET



1 TYPICAL SILT FENCE
NOT TO SCALE



2 TYPICAL CHECK DAM
NOT TO SCALE

EROSION CONTROL LEGEND:

- EXISTING SILT FENCE
- PROPOSED SILT FENCE EROSION CONTROL
- CHECK DAM

EROSION CONTROL KEYNOTES:

1. INSTALL PERMANENT SILT FENCE. SEE DETAIL THIS DRAWING.
2. INSTALL PERMANENT CHECK DAMS. SEE DETAIL THIS DRAWING.
3. INSTALL RIPRAP IN DRAINAGE CHANNELS, LOCATIONS VARY. INSTALL AS SHOWN ON PLAN AND APPROVED BY OWNER.
4. INSTALL MIN. 8 CUBIC YARDS (C.Y.) OF 18" DEEP RIPRAP, BOTH ENDS.
5. INSTALL MIN. 18 C.Y. OF 24" DEEP RIPRAP. BOTH ENDS.
6. INSTALL MIN. 56 C.Y. OF 24" DEEP RIPRAP, BOTH ENDS.
7. INSTALL MIN. 56 C.Y. OF 24" DEEP RIPRAP. BOTH ENDS.
8. REMOVE AND REPLACE EXISTING SITE CRUSHED ROCK SURFACE OUTSIDE SUBSTATION. INSTALL SLOPE MESH MIN. 25' BEFORE REPLACING CRUSHED ROCK SURFACE. ROCK SHOULD EXTEND A MIN. OF 5' OUTSIDE SUBSTATION FENCE AND BE COMPACTED.
9. EXISTING SILT FENCE, IF UNSTABLE OR DAMAGED REINSTALL TO EXISTING CONDITION. REPLACE IF DEEMED NOT REPAIRABLE.
10. EXISTING MESH.
11. RECOMPACT AND REDRESS EXISTING CRUSHED ROCK ROAD.
12. FIELD EDGE BORDER.

EROSION CONTROL NOTES:

1. SILT FENCE SHALL BE CLEANED AND REPAIRED WHEN SILT BUILD-UP REACHES 1/3 SILT FENCE HEIGHT.
2. CLEARING AND GRUBBING WORK SHALL COMPLY WITH THE CITY OF PECULIAR, MISSOURI STANDARDS AND SPECIFICATIONS LATEST EDITION.
3. NO VEGETATION OR CONSTRUCTION DEBRIS SHALL BE BURIED ON SITE. NO BURNING PITS SHALL BE ALLOWED.
4. ALL DISTURBED AREAS THAT REMAIN ACTIVE FOR MORE THAN 21 DAYS SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, COVERING OR BY OTHER EQUIVALENT EROSION CONTROL MEASURES AS SOON AS PRACTICAL, BUT IN NO CASE MORE THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED.
5. PRIOR TO ANY GRADING, STRIPPING, EXCAVATING, FILLING OR ANY OTHER DISTURBANCE OF THE NATURAL GROUND COVER, THE CONTRACTOR SHALL INSTALL ALL EROSION AND SEDIMENT CONTROL MEASURES. THE CONTRACTOR SHALL MAINTAIN THESE DEVICES THROUGHOUT THE DURATION OF THE PROJECT AND UNTIL PERMANENT VEGETATION IS PROPERLY ESTABLISHED.
6. STOCKPILES SHALL BE LOCATED AWAY FROM SLOPES AND TRAFFIC ROUTES AND BE TEMPORARILY SEEDED AS SOON AS POSSIBLE, NO MORE THAN 30 WORKING DAYS OR 120 CALENDAR DAYS AFTER FORMATION OF THE STOCKPILE. SILT FENCE SHALL BE PLACED APPROPRIATELY AROUND THE STOCKPILE TO CONTROL EROSION.
7. THE SITE SHALL HAVE GRADED ROADS AND ACCESS DRIVES TO PARKING AREAS OF SUFFICIENT WIDTH AND LENGTH TO PREVENT SEDIMENT FROM BEING TRACKED ON TO PUBLIC ROADWAYS. ANY SEDIMENT REACHING A PUBLIC OR PRIVATE ROAD SHALL BE REMOVED. BULK CLEARING OF ACCUMULATED SEDIMENT SHALL BE RETURNED TO THE POINT OF LIKELY ORIGIN OR OTHER SUITABLE LOCATION BEFORE THE END OF EACH WORK DAY. CONSTRUCTION ENTRANCES SHALL BE ROCKED PRIOR TO ANY OTHER SITE WORK.
8. EROSION AND SEDIMENTATION CONTROLS AND SEEDING SHALL MEET THE STANDARDS AND SPECIFICATIONS OF CITY OF PECULIAR, MISSOURI.
9. PROPOSED MINOR GRADES ARE NOT SHOWN FOR CLARITY. PLEASE REFERENCE THE GRADING AND DRAINAGE PLAN FOR DETAILS.
10. PROVIDE VELOCITY CHECK DAMS IN ALL UNPAVED GRADED CHANNELS AT THE INTERVALS INDICATED BELOW:

GRADE OF CHANNEL	INTERVALS BETWEEN CHECK DAMS
LESS THAN 3%	100 FEET
3% TO 6%	50 FEET
OVER 6%	25 FEET

11. PROVIDE VELOCITY CHECK DAMS AT TERRACE LOCATIONS. VELOCITY CHECK DAMS MAY BE CONSTRUCTED OF SANDBAGS, TIMBAR, OR OTHER EROSION RESISTANT MATERIALS APPROVED BY THE CITY ENGINEER, AND SHALL EXTEND COMPLETELY ACROSS THE CHANNEL AT RIGHT ANGLES TO THE CENTERLINE. VELOCITY CHECK DAMS MAY ALSO SERVE AS SEDIMENT TRAPS.

LEGEND

- EXISTING T&D LINE
- PROPOSED GAS LINE
- EXISTING EASEMENT
- PRE DEVELOPMENT MAJOR CONTOUR (980)
- PROPOSED MAJOR CONTOUR (981)
- PROPOSED MINOR CONTOUR (980)
- PROPOSED UNDERGROUND ELECTRICAL
- EXISTING ELECTRIC LINE
- EXISTING TELEPHONE (COMMUNICATIONS) LINE
- PROPOSED RCP STORMWATER PIPE
- PROPERTY LINE
- SUBSTATION FENCE
- EXISTING SILT FENCE
- PARCEL LINE
- DRAINAGE PATH (FLOWLINE)
- TREE LINE
- EXISTING STORMWATER PIPE
- DIRECTION OF FLOW
- EXISTING BRUSH
- EXISTING CRUSHED ROCK
- STORMWATER PIPE RIPRAP
- NATIVE VEGETATION
- DRAINAGE CHANNEL RIPRAP
- AGRICULTURAL SOIL TERRACE

REV.	REV. DATE	REVISION & JOB NO.	BY	CK.	APP.
B	9-24-08	ISSUED FOR APPROVAL	MCB	JPL	WHR
A	9-3-08	ISSUED FOR REVIEW	BCC	JPL	WHR

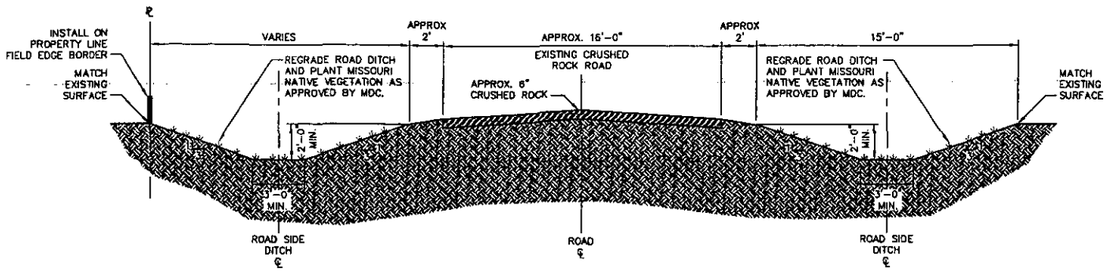
DRAWN: B. CASPERS	APPROVED: J. LANGEL
DRAFT. CK.: B. CASPERS	SCALE: 1:100
ENGR. CK.: B. ROMINES	JOB NO.: 08-0176

PECULIAR 345 kv SUBSTATION
CIVIL
EROSION CONTROL PLAN

Sega ®
08-0176

KANSAS CITY
POWER & LIGHT COMPANY

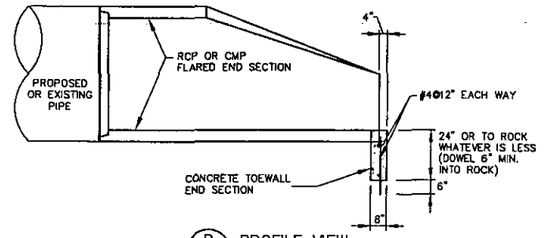
DWG. NO. C400



A C400 EXISTING SUBSTATION ACCESS DRIVE

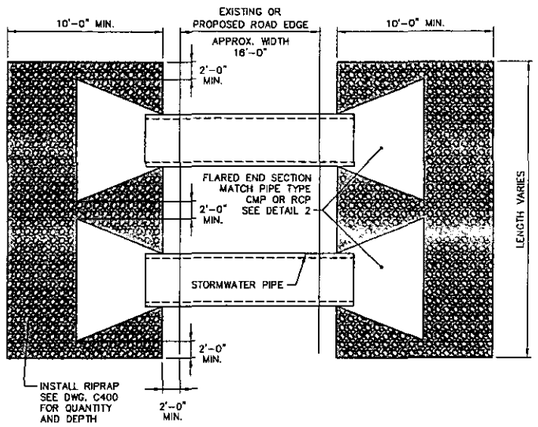
1 0 1 2

SCALE IN FEET



B PROFILE VIEW

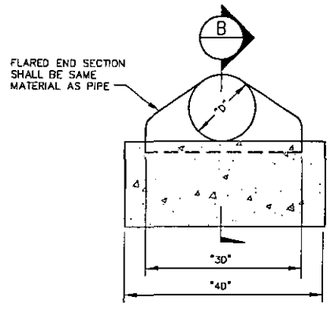
NOT TO SCALE



1 C400 STORMWATER PIPE AND RIPRAP DETAIL

1 0 1 2

SCALE IN FEET



2 FLARED END SECTION

NOT TO SCALE

GENERAL NOTES:

1. THE LOCATION OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTH OF ALL UTILITIES PRIOR TO BEGINNING CONSTRUCTION IN ORDER TO PROVIDE FOR NON-INTERRUPTION OF SERVICE AND TO ENSURE PROPER CLEARANCES.
2. WHERE THE NEW IMPROVEMENTS ABUT EXISTING IMPROVEMENTS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR MATCHING THE ELEVATION OF THE EXISTING IMPROVEMENTS.
3. ALL CONSTRUCTION PERFORMED ON THIS PROJECT SHALL CONFORM TO THE STANDARDS AND SPECIFICATIONS OF THE CITY OF PECULIAR, MISSOURI. WHERE DISCREPANCIES EXIST BETWEEN THE PROJECT SPECIFICATIONS AND CITY STANDARDS, THE CONTRACTOR SHALL ABIDE BY THE GREATER OR MORE RESTRICTIVE REQUIREMENTS.
4. CONTRACTOR SHALL PROVIDE FOR CONTROL OF SURFACE EROSION DURING CONSTRUCTION AND UNTIL THE OWNER ACCEPTS THE WORK AS COMPLETE. THE CONTRACTOR SHALL PROVIDE BERMS, SILT FENCE, STRAW BALES, SILT BASINS, OR OTHER MEANS TO PREVENT EROSION FROM REACHING THE PUBLIC RIGHT-OF-WAY OR ADJACENT PROPERTY. IN THE EVENT THE PREVENTION MEASURES ARE NOT EFFECTIVE, THE CONTRACTOR SHALL REMOVE ANY DEBRIS AND EROSION AND RESTORE THE RIGHT-OF-WAY AND ADJACENT PROPERTY TO ORIGINAL OR BETTER CONDITION.
5. CONTRACTOR SHALL, BY HIS OWN INVESTIGATION AND PRIOR TO COMMENCING WORK, SATISFY HIMSELF AS TO THE SURFACE AND SUBSURFACE CONDITIONS TO BE ENCOUNTERED.
6. A TOPOGRAPHIC SURVEY WAS PREPARED BY BOWERS SURVEY COMPANY DATED SEPTEMBER 2004. THE ENGINEER WILL NOT BE RESPONSIBLE FOR THE COMPLETENESS OR ACCURACY OF THE DATA AND NO EXPRESSED OR IMPLIED GUARANTEE IS GIVEN OF THE INTERPRETATION THEREOF.
7. THE OWNER SHALL EMPLOY AN INDEPENDENT ENGINEERING TESTING AGENCY TO VERIFY SOIL COMPACTION AND PAVEMENT MATERIAL PROPERTIES. THE CONTRACTOR SHALL ALLOW THE TESTING AGENCY TO PERFORM TESTING AND RETESTING AS NECESSARY TO VERIFY COMPLIANCE WITH THE PROJECT SPECIFICATIONS.
8. REFERENCE IS MADE TO THE REVISED GEOTECHNICAL EXPLORATION REPORT BY TERRACON CONSULTANTS AND DATED NOVEMBER 12, 2004. NEITHER THE OWNER NOR THE ENGINEER WILL BE RESPONSIBLE FOR THE COMPLETENESS OR ACCURACY, NOR THE INTERPRETATION THEREOF. ALL SITE PREPARATION AND EARTHWORK CONSTRUCTION SHALL BE IN CONFORMANCE WITH THE GEOTECHNICAL RECOMMENDATIONS AND THEIR "STANDARD GUIDELINES FOR GRADING PROJECTS."
9. TOPSOIL AND ALL ORGANIC MATTER SHALL BE REMOVED FROM THE LOCATION OF PROPOSED IMPROVEMENTS. UNSTABLE OR SPONGY AREAS SHALL BE OVEREXCAVATED AND REPLACED WITH COMPACTED FILL IN ACCORDANCE WITH THE TERRACON CONSULTANTS GEOTECHNICAL REPORT.
10. SUBGRADE SHALL BE SCARIFIED A MINIMUM OF 12", MOISTURE CONDITIONED TO WITHIN ±2% OF OPTIMUM MOISTURE CONTENT (BASED ON ASTM D1557 TEST) AND ROLLED WITH A HEAVY ROLLER TO ACHIEVE A MINIMUM OF 95% RELATIVE COMPACTION PRIOR TO BACKFILLING.
11. COMPACTED FILL SHALL NOT CONTAIN ROCK LARGER THAN 3 INCHES. FILL SLOPES SHALL BE BENCHED INTO NATIVE MATERIAL OR AS REQUIRED BY THE TERRACON CONSULTANTS GEOTECHNICAL REPORT.
12. COMPACTED ROAD FILL SHALL BE PLACED IN NO GREATER THAN 4 INCH LOOSE LIFTS AND COMPACTED TO AT LEAST 95% OF MAXIMUM DRY DENSITY AT ± 2% OPTIMUM MOISTURE CONTENT (BASED ON ASTM D1557 TEST). FIELD DENSITY TESTS SHALL BE TAKEN AT A FREQUENCY OF AT LEAST ONE TEST FOR EACH 2500 SQUARE FEET OF FILL LIFT. IN PAVEMENT AREAS, THE TESTING FREQUENCY MAY BE ONE FIELD DENSITY TEST FOR EACH 5000 SQUARE FEET OF FILL LIFT, BUT NO LESS THAN 3 TESTS PER LIFT.
13. CRUSHED ROCK PAVEMENT (ALSO CALLED CRUSHED ROCK BASE OR CRUSHED ROCK SURFACE) SHALL BE COMPACTED WELL GRADED, CLASS II AGGREGATE ROAD BASE AND MEET THE REQUIREMENTS FOR THE CITY OF PECULIAR, MISSOURI. IT SHALL BE PLACED IN LIFTS NO GREATER THAN 4" AND COMPACTED TO A MINIMUM 95% RELATIVE COMPACTION (BASED ON ASTM TEST METHOD D1557).

REV.	REV. DATE	REVISIONS & JOB NO.	BY	CK.	APP.
B	9-24-08	ISSUED FOR APPROVAL	MCB	JPL	WHR
A	9-3-08	ISSUED FOR REVIEW	BCG	JPL	WHR

DWG. C500

DRAWN B. GASPERS	DATE	APPROVED J. LANGEL	DATE
PROJ. ENG. B. GASPERS	DATE	SCALE N.T.S.	
CHKD. ENG. B. ROMINES	DATE	JOB NO. 08-176	

PECULAIAR 345 kv SUBSTATION

CIVIL

SITE DETAILS

Sega ®

08-176

KANSAS CITY POWER & LIGHT COMPANY

DWG. NO. C500

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Customer KCP&L GREATER MISSOURI OPERATIONS CO. Page 1 Of

Job No. 08-0176 Date 9/4/08 Made By JPL

PRE-DEVELOPMENT VS. POST-DEVELOPMENT DISCHARGES

DRAINAGE AREA #5 (5)

PRE-DEVELOPMENT : $Q = kCIA$

$C = 0.3$ $S = 4/100$ T_c = TIME OF CONCENTRATION I = INTENSITY

$T_c = T_I + T_T$

$T_I = \frac{1.8\,(1.1 - C)\,D^{1/2}}{S^{1/3}} = \frac{1.8\,(1.1 - 0.3)\,100^{1/2}}{4^{1/3}} = 9.07$ MINUTES

$A = 14.0$ ACRES

FIGURE 5602-7 CHANNEL FLOW

$T_T = 2.5$ MINUTES

$T_c = 9.07 + 2.5 = 11.57$ MINUTES

FIGURE 5602.5 $T_c = 11.57$ MINUTES = 8.5 INCHES/HOUR = I

$Q = kCIA$

$= (1.25)(0.3)(8.5)(14) = \boxed{44.6 \text{ cfs} = Q_{PRE}}$

POST-DEVELOPMENT

$A = 14.0$ ACRES

$C = \frac{1.0(0.13) + 0.3(11.87) + 0.35(2)}{14.0} = 0.31$

$T_I = \frac{1.8\,(1.1 - C)\,D^{1/2}}{S^{1/3}} = \frac{1.8\,(1.1 - 0.31)\,100^{1/2}}{1.5^{1/3}} = 12.4$ MINUTES

FIGURE 5602-7 = 2.5 MINUTES $T_c = 14.9$ MINUTES

$I = 7.5$ INCHES/HOUR FIGURE 5602.5

$Q = kCIA$

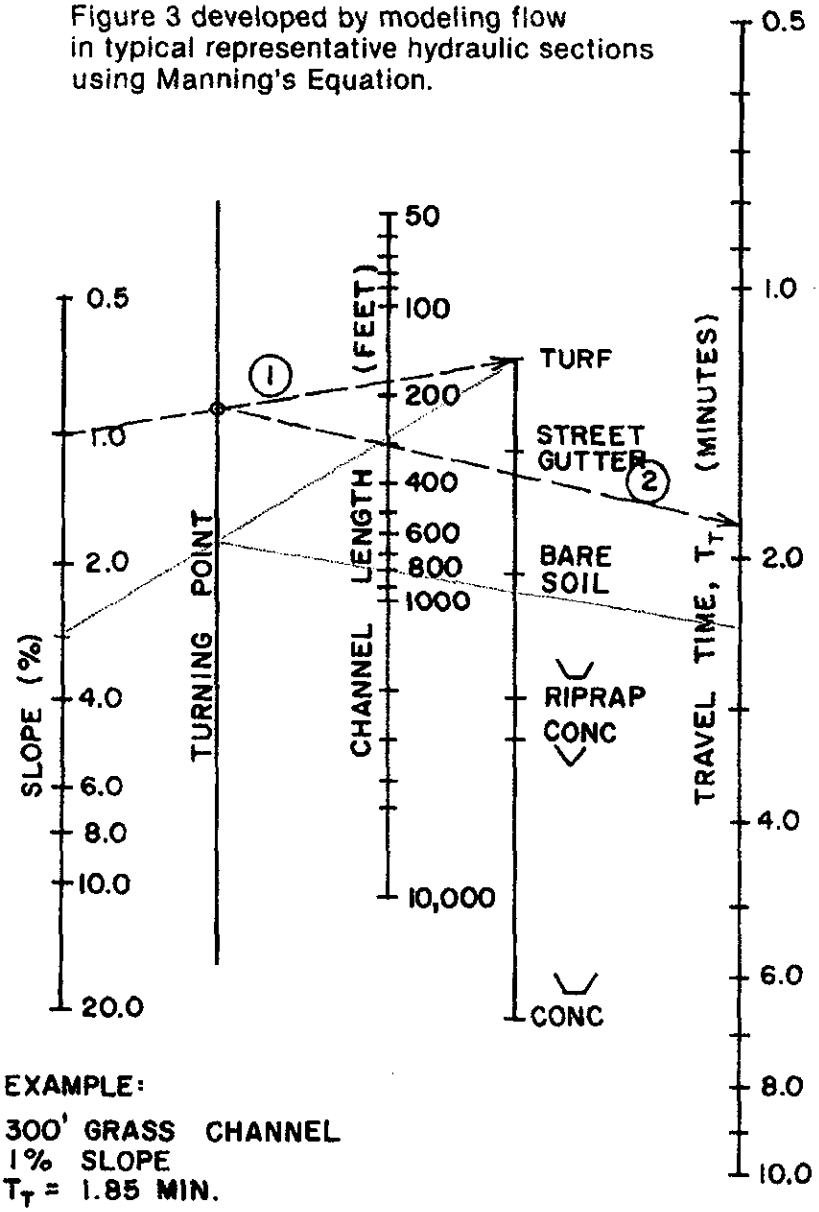
$= (1.25)(0.31)(7.5)(14.0) = \boxed{40.7 \text{ cfs} = Q_{POST}}$ ✓

(5) PRE & POST

Figure 5602-7

CHANNEL FLOW TIME NOMOGRAM

Figure 3 developed by modeling flow in typical representative hydraulic sections using Manning's Equation.



EXAMPLE:

300' GRASS CHANNEL
1% SLOPE
T_T = 1.85 MIN.

(1) Connect Slope & Channel Condition to locate point on Turning Line

(2) Extend line from Turning Line through Channel Length, Read T_T

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Customer KCP&L GREATER MISSOURI OPERATIONS CO. Page 1 Of

Job No. 08-0176 Date 9/4/08 Made By JPL

PRE-DEVELOPMENT Vs. POST-DEVELOPMENT DISCHARGES

DRAINAGE AREA (B)

PRE-DEVELOPMENT Q = kCIA AREA (A) = 6.4 ACRES

C = 0.3 S = 7/100 $T_c = T_I + T_T$ k = 1.25 (100 YEAR STORM)

$T_I = \frac{1.8\,(1.1 - 0.3)\sqrt{100}}{7^{1/3}} = 7.5$ MINUTES

FIGURE 5602-7 = 1.8 MINUTES

T_T = 9.3 MINUTES FIGURE 5602-5 = 9.0 INCHES/HOUR = I

Q = kCIA

= (1.25)(0.3)(9.0)(6.4) = **21.6 cfs = Q_{PRE}**

POST-DEVELOPMENT

A = 6.4 ACRES S = 2.0%

$C = \frac{1.0\,(0.13) + 0.2\,(6.0) + 0.35\,(0.27)}{6.4} = 0.32$

$T_I = \frac{1.8\,(1.1 - 0.32)\sqrt{100}}{2.0^{1/3}} = 11.1$ MINUTES

FIGURE 5602-7 = 1.8 MINUTES

T_c = 12.9 MINUTES FIGURE 5602-5 = 7.8 INCHES/HOUR = I

Q = kCIA

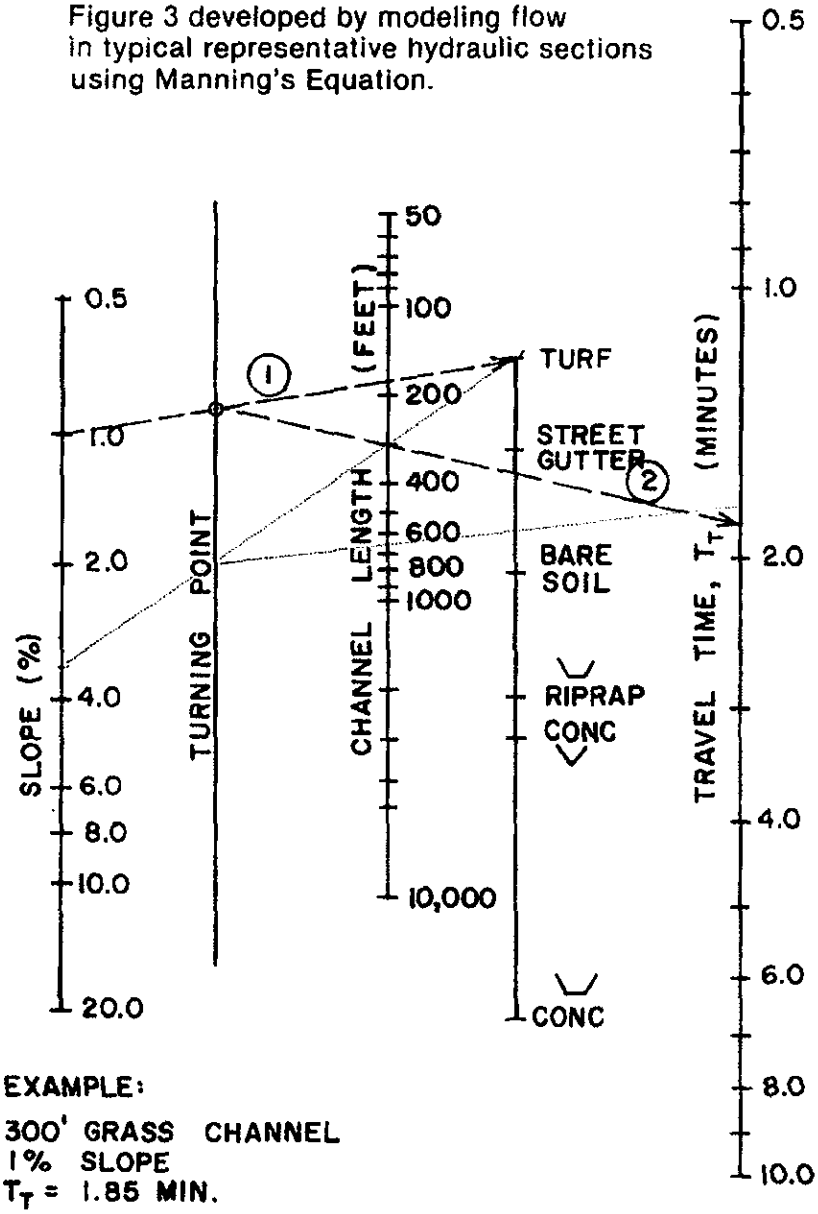
= (1.25)(0.32)(7.8)(6.4) = **19.96 cfs = Q_{post}** ✓

(8) PRE + POST

Figure 5602-7

CHANNEL FLOW TIME NOMOGRAM

Figure 3 developed by modeling flow in typical representative hydraulic sections using Manning's Equation.



EXAMPLE:

300' GRASS CHANNEL
1% SLOPE
T_T = 1.85 MIN.

(1) Connect Slope & Channel Condition to locate point on Turning Line

(2) Extend line from Turning Line through Channel Length, Read T_T

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Customer KCP&L GREATER MISSOURI OPERATIONS CO. Page 1 Of

Job No. 08-0176 Date 9/4/08 Made By JPL

PRE-DEVELOPMENT VS. POST-DEVELOPMENT DISCHARGE

DRAINAGE AREA #(9)

▷ PRE-DEVELOPMENT = $Q = kCIA$

$C = 0.3$ $A = 13.3$ ACRES $k = 1.25$ $T_c = T_I + T_T$ $S = 3/100$

$$T_I = \frac{1.8\,(1.1 - 0.3)\,100^{1/2}}{3.0^{1/3}} = 10.0 \text{ MINUTES}$$

FIGURE 5602-7 $T_T = 4$ MINUTES $T_c = 14.0$ MINUTES

FIGURE 5602-5

$I = 7.6$ INCHES/HOUR

$Q = kCIA$

$= (1.25)(0.3)(7.6)(13.3) =$ **37.9 cfs = Q_{PRE}**

▷ POST-DEVELOPMENT

$A = 13.3$ ACRES

$$C = \frac{1.0\,(0.13) + 0.35\,(4.0) + 0.7\,(9.17)}{13.3} = 0.32$$

$$T_I = \frac{1.8\,(1.1 - 0.32)\,100^{1/2}}{1.1^{1/3}} = 14.0 \text{ MINUTES}$$

FIGURE 5602-7 = 3.0 MINUTES $T_c = 17.0$ MINUTES

FIGURE 5602-5

$I = 7$ INCHES/HOUR

$Q = kCIA$

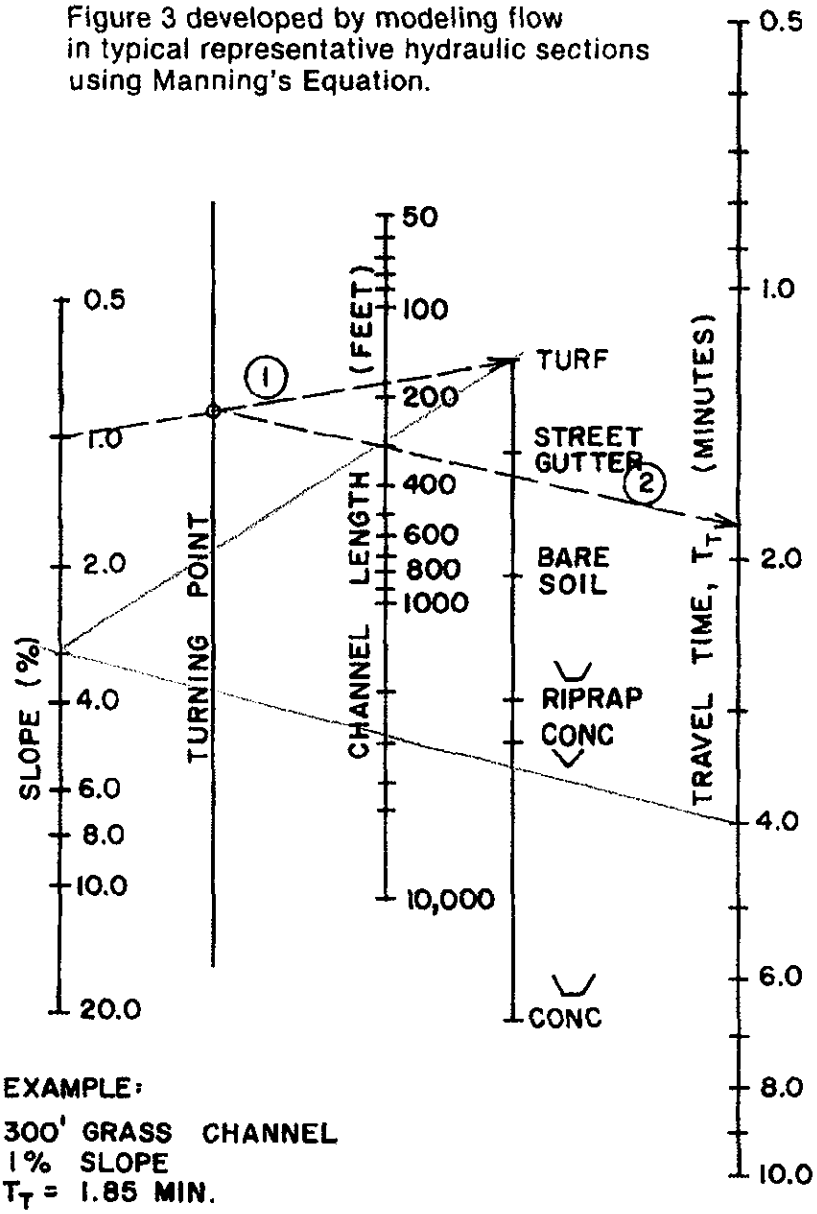
$= (1.25)(0.32)(7.0)(13.3) =$ **37.2 cfs = Q_{POST}** ✓

(9) Pre & Post

Figure 5602-7

CHANNEL FLOW TIME NOMOGRAM

Figure 3 developed by modeling flow in typical representative hydraulic sections using Manning's Equation.



EXAMPLE:

300' GRASS CHANNEL
1% SLOPE
T_T = 1.85 MIN.

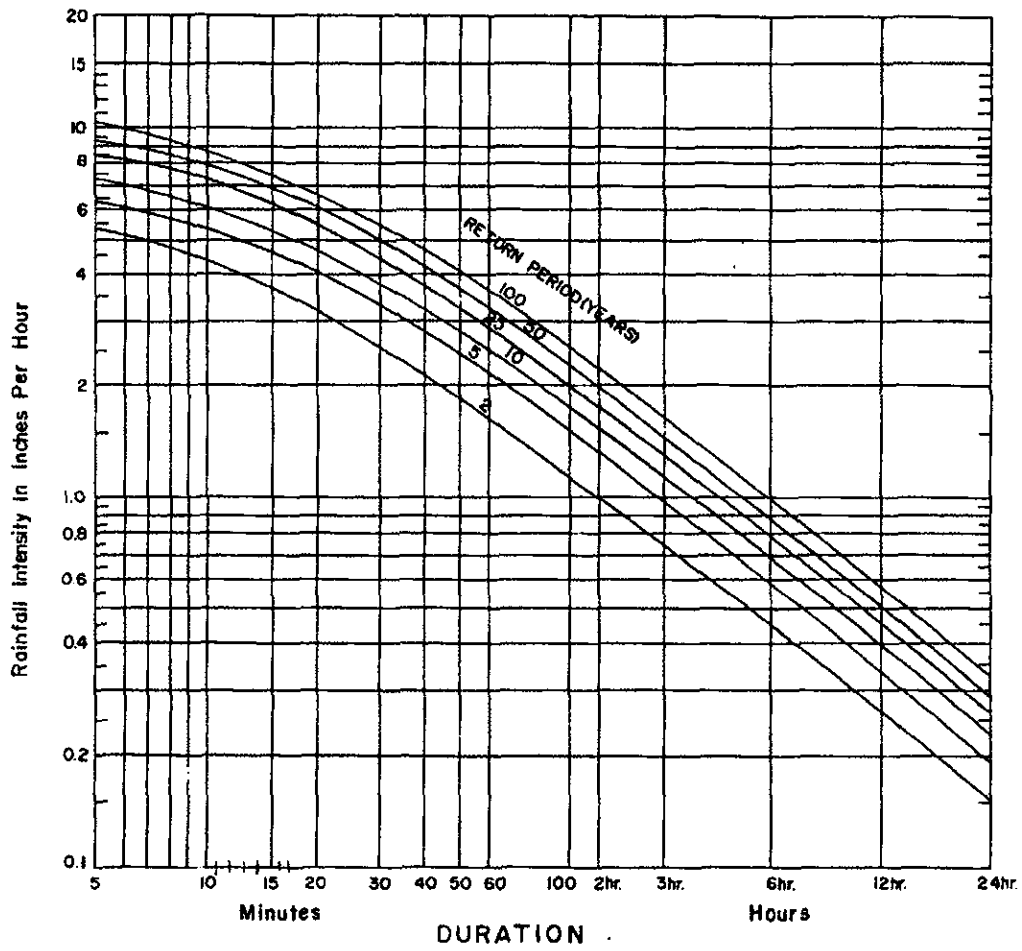
(1) Connect Slope & Channel Condition to locate point on Turning Line

(2) Extend line from Turning Line through Channel Length, Read T_T

Figure 5602-5

INTENSITY-DURATION-FREQUENCY

KANSAS CITY, MISSOURI
1896-1972

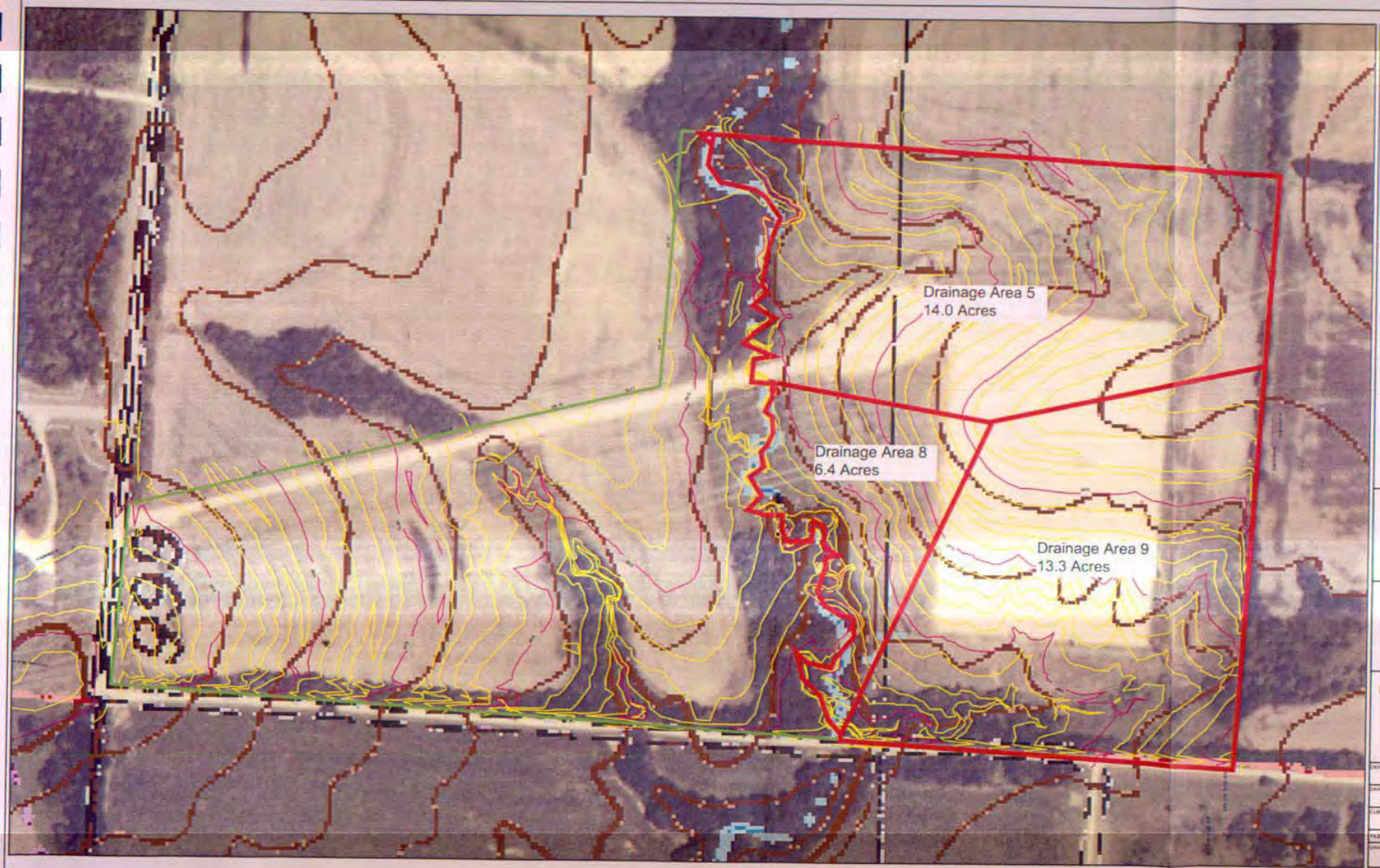


REFERENCES

1. NOAA Technical Memorandum NWS HYDRO-35 National Oceanic and Atmospheric Administration Of The National Weather Service, Department Of Commerce Silver Spring, Md., June 1977.

2. Technical Paper No. 40, Rainfall Frequency Atlas For Durations From 30 Minutes To 24 Hours And Return Periods From 1yr To 100 Yrs. U.S. Weather Bureau, Department Of Commerce, Washington, D.C., January 1963.

3. Design Of Urban Highway Drainage-State Of The Art FHWA-TS-79-225 U.S. Department Of Transportation Federal Highway Administration, Washington, D.C., August 1979.



Legend

- Boundary
- Contour-Major
- Contour-Minor
- Drainage Areas

Sega

Engineers - Architects - Technicians
Design - Construction - Field Service

KCP&L
energizing life

Peculiar 345 kV Substation

Drainage Areas
for Substation

Pre-Development Area

DESIGN BY: J. LANGEL	CHECKED BY: B. ROMINES
DRAWN BY: J. CLAUSSEN	DATE: 6-19-08
CLIENT ID:	SEGA PROJECT NO: 08-0176
FILE NAME: area.mxd	
DRAWING NO:	REV:

November 12, 2004

Terracon
Consulting Engineers & Scientists

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Aquila Networks
10700 East 350 Highway
P.O. Box 11739
Kansas City, Missouri 64138

Attention: Mr. Jeff Newman

Re: Contract Drilling and Laboratory Testing
Peculiar 345/161 kV Substation
Peculiar, Missouri
Terracon Project No. 02045408

Dear Mr. Newman:

Terracon has completed the drilling and requested laboratory testing for the above referenced project in general accordance with the Field Service Agreement dated October 22, 2004. Due to the existing, wet ground conditions the requested field resistivity tests were not completed at this time. Results of these tests will be sent in a separate letter upon completion. Aquila Networks selected the boring locations. Terracon located the borings in the field at the substation site by pacing distances from existing site features and estimating right angles. The borings at the three transmission line locations were located by Aquila.

The borings were drilled with truck-mounted and track-mounted rotary drilling rigs using continuous flight augers to advance the boreholes. Representative samples were obtained by thin-walled tube and split-barrel sampling procedures. The sampling depths and SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The soil samples were sealed and returned to the laboratory for testing and classification.

Upon practical auger refusal was encountered in Borings B-1, B-6, and B-9, these borings were advanced into bedrock using rock coring techniques. The core samples recovered were approximately 2 inches in diameter. Percent recovery and rock quality designation (RQD) were calculated for the rock core samples and are noted at their depths of occurrence on the attached boring logs. RQD is the percent of total length cored consisting only of sound pieces at least 4 inches or more in length.

The drill crew estimated subsurface conditions shown on the attached boring logs based on visual classification of cuttings returned to the surface in the auger flights. Classification and descriptions of rock core samples are in accordance with the attached General Notes, and are based on visual and tactile observations. Petrographic analysis of thin sections may indicate other rock types.

Subsurface conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries shown on the boring logs represent the *approximate location* of changes in soil and rock types; in-situ, the transition between materials usually occurs more gradually. The boring logs do not reflect variations that

may occur between borings or across the alignment. The nature and extent of such variations may not become evident until construction.

The laboratory testing, as requested by Aquila included water content, dry density, calibrated penetrometer, unconfined compression and Atterberg limits tests performed on selected samples. The laboratory test results are provided on the attached boring logs.

As part of the testing program, the samples were examined in the laboratory and classified in accordance with the attached General Notes and the Unified Soil Classification System based on the texture and plasticity of the soil. The estimated group symbols for this system are shown on the boring logs. A brief description of the Unified System is included with this letter.

No engineering analyses of the subsurface conditions were performed, in accordance with the Field Service Agreement. This letter has been prepared for the exclusive use of our client for specific application to the project discussed. No warranties, either express or implied, are intended or made. If you have any questions, please contact us.

We appreciate the opportunity to work with you on this project. If you have any questions regarding this report, please contact us.

Sincerely,

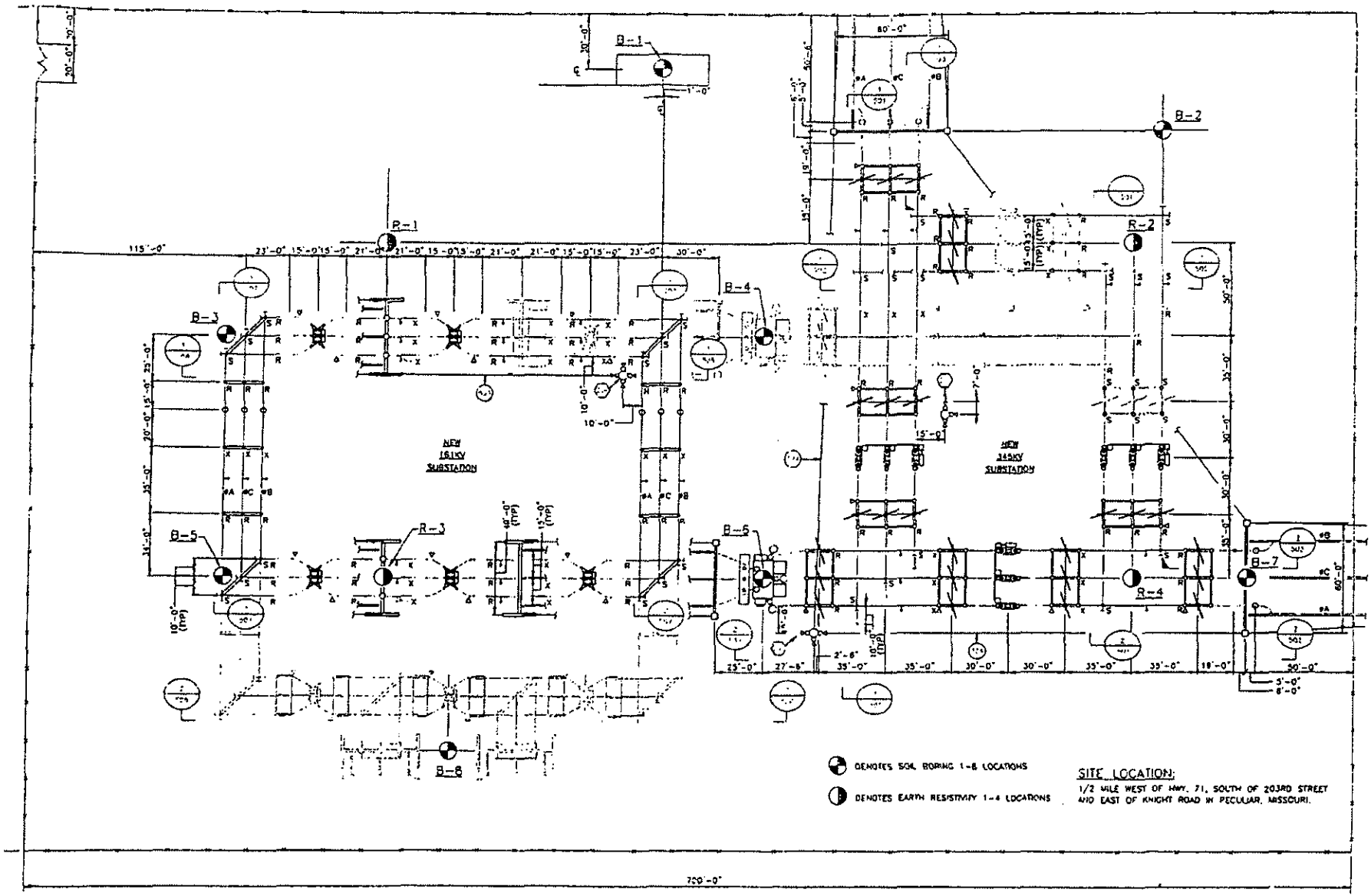
Terracon

Todd D. Dwyer, E.I.
Project Engineer

James M. Landrum, P.E.
Missouri: 028954

Attachments: Boring Location Diagrams, Boring Logs, Unified Soil Classification System, General Notes

Copies to: Addressee (5)



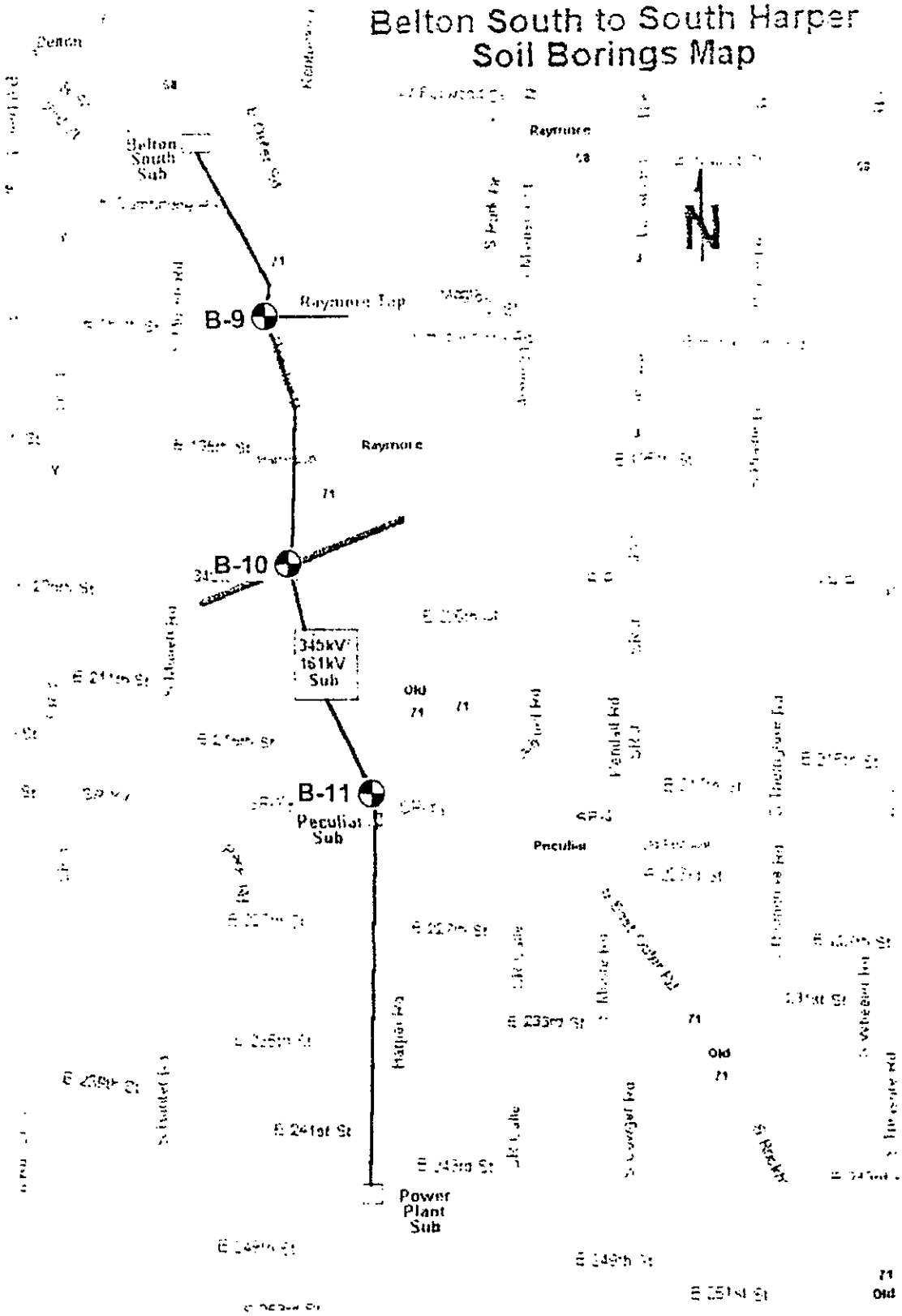
N

Boring Location Diagram
Peculiar 345/161 kV Substation
203rd Street & Knight Road
Peculiar, Missouri

Job # 02045408	Scale Not to Scale	Approved TDD

Terracon

Belton South to South Harper
Soil Borings Map



Boring Location Diagram
Peculiar 345/161 kV Substation
Belton South to South Harper
Belton, Missouri

Job # 02045408	Scale Not to Scale	Approved TDD

Terracon

Form 104 Rev (2-01)

LOG OF BORING NO. B-1

CLIENT: Aquila Networks

SITE: 203rd Street & Knight Road, Peculiar, Missouri

PROJECT: Peculiar 345/161 kV Substation

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS LL, PL, PI
	0.5 6"ROOT ZONE				HS						
	LEAN TO FAT CLAY, gray brown, yellow brown		CL CH	1	ST	24		25.6			49, 20, 29
	4				HS						
				2	ST						
	4.5 ***LIMESTONE, highly weathered, gray	5		R1	DB	88%	RQD 13%				
	6.1 LIMESTONE, slightly weathered, thin bedded, dark gray, fossiliferous, moderately hard, solid										
	- weathered yellow brown at 5.3' to 6.1'										
	8.3 SHALE, moderately weathered, clayey, yellow brown, soft	10									
	SHALE, moderately to slightly weathered, gray, soft to moderately hard										
	14.5 BOTTOM OF BORING										

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▽ NONE	AB
WL	▽		▽	
WL				

Terracon

BORING STARTED	10-25-04		
BORING COMPLETED	10-25-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-2

CLIENT **Aquila Networks**

SITE **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS LL, PL, PI
	1 12"ROOT ZONE				PA						
	FAT CLAY, gray, yellow brown		CH	1	ST	5		31.2			57, 21, 36
	3		CH	2	ST	6		30.4			67, 22, 45
	FAT CLAY, shaley, trace limestone fragments, gray, yellow brown (possible clay filled joint in limestone)	5			PA						
	8.5			3	SS	18	42				
	***SHALE, highly weathered, yellow brown, gray, soft	10			PA						
	13.5			4	SS PA	3	50/3"				
	***SHALE, highly to moderately weathered, gray, moderately hard	15									
		20		5	SS PA	4	50/4"				
		25		6	SS PA	2	50/2"				
	28.7										
	BOTTOM OF BORING			7	SS	3	50/3"				

All descriptions taken from driller's field logs.

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD	▽ NONE AB
WL	▽		▽
WL			

Terracon

BORING STARTED	11-2-04
BORING COMPLETED	11-2-04
RIG CME 850	FOREMAN KK
APPROVED CWV	JOB # 02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-3

CLIENT: Aquila Networks

SITE: 203rd Street & Knight Road, Peculiar, Missouri

PROJECT: Peculiar 345/161 kV Substation

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS LL, PL, PI
	0.5 6"ROOT ZONE				HS						
				1	ST						39, 23, 16
					HS						
	***SHALE, highly weathered, yellow brown, gray, soft			2	ST	9		14.0	118	+9000	45, 24, 21
		5			HS						
	8.5										
	***SHALE, highly to moderately weathered, olive gray, soft to moderately hard			3	SS HS	16	50/3"				
		10									
	14.5			4	SS HS	10	50/3"				
	***SHALE, moderately weathered, gray, moderately hard	15									
	18.5										
	***SANDSTONE, moderately weathered, gray			5	SS HS	1	50/1"				
		20									
	23.5										
	***SHALE, moderately weathered, with sandstone seams, gray, moderately hard			6	SS HS	1	50/1"				
		25									
	28.5										
	BOTTOM OF BORING			7	SS	0	50/0"				
	***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.										

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE WD	▼ NONE AB	
WL	▽	▼	
WL			

Terracon

BORING STARTED	10-25-04		
BORING COMPLETED	10-25-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-4

CLIENT: **Aquila Networks**

SITE: **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT: **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS LL, PL, PI
	12"ROOT ZONE	1			PA						
	FAT CLAY, shaley, red brown, gray	3	CH	1	ST	14					71, 25, 46
				2	ST	15		20.1	110	7930	
	***SHALE, highly weathered, gray, olive brown, soft	5			PA						
		9.5		3	SS	14	26				
	***LIMESTONE, highly weathered, gray	10			PA						
		11.5		4	SS	18	50/6"				
	***SHALE, highly to moderately weathered, gray, soft to moderately hard	15			PA						
		20		5	SS PA	6	50/6"				
		25		6	SS PA	5	50/5"				
		28.8		7	SS	4	50/4"				
	BOTTOM OF BORING										

All descriptions taken from driller's field logs.

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▽ NONE	AB
WL	▽		▽	
WL				

Terracon

BORING STARTED	11-3-04		
BORING COMPLETED	11-3-04		
RIG	CME 850	FOREMAN	KK
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-5

CLIENT **Aquila Networks**

SITE **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS LL, PL, PI
	0.5 6"ROOT ZONE				HS						
	FAT CLAY, gray, red brown		CH	1	SS	18	7	29.6			61, 22, 39
					HS						
	4.5			2	SS	18	18	23.0			56, 22, 34
	***SHALE, highly weathered, yellow brown, gray, soft	5			HS						
	9.5			3	SS	18	31				
	***SHALE, highly to moderately weathered, olive gray, soft to moderately hard	10			HS						
		15		4	SS HS	6	50/6"				
	18.5										
	***SANDSTONE, moderately weathered, gray	20		5	SS HS	2	50/2"				
		25		6	SS HS	1	50/1"				
	30			7	SS	1	50/1"				
	BOTTOM OF BORING										
	***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.										

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▼ NONE	AB
WL	▽		▼	
WL				

Terracon

BORING STARTED	10-25-04		
BORING COMPLETED	10-25-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-6

CLIENT **Aquila Networks**

SITE **203rd Street & Knight Road**
Peculiar, Missouri

PROJECT
Peculiar 345/161 kV Substation

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS LL, PL, PI
	1 12"ROOT ZONE				PA						
	3 FAT CLAY, gray brown, yellow brown, medium stiff		CH	1	ST	12		27.7	94	1730	56, 22, 34
	***SHALE, highly weathered, yellow brown, olive brown, soft			2	ST						
		5			PA						
	7.5 ***LIMESTONE, highly weathered, gray			3	SS	0	50/0"				
	9.5 9.8 LIMESTONE, slightly weathered, gray, moderately hard	10		R1	DB	60%	RQD				
	11.1 SHALE, slightly weathered, dark gray, moderately hard			R2	DB	100%	0% RQD 46%				
	SHALE, slightly weathered, gray, laminated, soft to moderately hard - with calcareous laminations below 16'	15									
				R3	DB	100%	RQD 70%				
	19.5 BOTTOM OF BORING										
	***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.										

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▽ NONE	AB
WL	▽		▽	
WL				

Terracon

BORING STARTED	11-2-04		
BORING COMPLETED	11-3-04		
RIG	CME 850	FOREMAN	KK
APPROVED	CWV	JOB #	02045408

LOG OF BORING NO. B-7

CLIENT **Aquila Networks**

SITE **203rd Street & Knight Road**
Peculiar, Missouri

PROJECT **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	12"ROOT ZONE	1			PA					
	LEAN TO FAT CLAY, dark brown	3		1	ST					
	FAT CLAY, shaley, gray			2	ST					
		5			PA					
		8.5		3	SS	18	32			
	***SHALE, highly weathered, yellow brown, olive brown, very dark gray, soft	10			PA					
		13.5		4	SS	12	50/6"			
	***SHALE, highly to moderately weathered, gray, soft to moderately hard	15			PA					
		18.6		5	SS	5	50/5"			
	BOTTOM OF BORING	20			PA					
	All descriptions taken from driller's field logs.			6	SS	4	50/4"			
	***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.	25			PA					
				7	SS	0	50/1"			

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▼ NONE	AB
WL	▽		▼	
WL				

Terracon

BORING STARTED	11-3-04
BORING COMPLETED	11-3-04
RIG CME 850	FOREMAN KK
APPROVED CWV	JOB # 02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/4/04

LOG OF BORING NO. B-8

CLIENT: Aquila Networks

SITE: 203rd Street & Knight Road, Peculiar, Missouri

PROJECT: Peculiar 345/161 kV Substation

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS LL, PL, PI
	1 12"ROOT ZONE				PA						
				1	ST	24		16.4	114	+9000*	
				2	ST						39, 25, 14
		5			PA						
	***SHALE, highly weathered, yellow brown, olive brown, gray, soft			3	SS	18	59				
		10			PA						
	13.5										
				4	SS	9	50/3"				
		15			PA						
				5	SS	2	50/2"				
	***SHALE, highly to moderately weathered, olive gray, gray, soft to moderately hard	20			PA						
				6	SS	4	50/4"				
		25			PA						
	28.7										
	BOTTOM OF BORING			7	SS	2	50/2'				

All descriptions taken from driller's field logs.

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▽ NONE	AB
WL	▽		▽	
WL				

Terracon

BORING STARTED	11-2-04		
BORING COMPLETED	11-2-04		
RIG	CME 850	FOREMAN	KK
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/12/04

LOG OF BORING NO. B-9

CLIENT: **Aquila Networks**

SITE: **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT: **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	GRAVEL	2			HS					
	FAT CLAY, olive gray	3								
			CH	1	SS	18	10	29.8		5000*
		5			HS					
	FAT CLAY, yellow brown, gray, stiff		CH	2	SS	18	11	31.9		6000*
		10			HS					
		13								
	***LIMESTONE, highly weathered, gray	13.5								
	LIMESTONE, slightly weathered, thin bedded, moderately hard, gray, weathered yellow brown on bedding planes	15		R1	DB	91%	RQD 56%			
		18.8								
	LIMESTONE, slightly weathered, thin bedded, moderately hard, trace fossils, gray, solid - gray shale seam at 20.3' to 20.6' - gray shale at 23.3' to 23.5'	20								
		23.5								
	BOTTOM OF BORING									

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▽ NONE	AB
WL	▽		▽	
WL				

Terracon

BORING STARTED	10-28-04		
BORING COMPLETED	10-28-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408 GPJ TERRACON GDT 11/9/04

LOG OF BORING NO. B-10

CLIENT: **Aquila Networks**

SITE: **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT: **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	12"ROOT ZONE	1			HS					
	LEAN TO FAT CLAY, trace fine roots, dark gray, very stiff		CL CH	1	ST	7		25.5	98	6000*
					HS					
			CL CH	2	ST	8		24.5	101	5000*
		5			HS					
	***SANDSTONE, highly weathered, brown	8.5								
				3	SS	17	84/11"	15.9		
		10			HS					
	***SHALE, highly weathered, olive gray, olive brown, soft	18		4	SS	18	53	16.0		
		15			HS					
	***LIMESTONE, highly weathered, with shale seams, broken at 21' to 22'	22		5	SS PA	1	50/1"			
		20		6	SS PA	4	50/4"	14.4		
	***SHALE, moderately weathered, dark gray, gray, moderately hard	28.8								
	BOTTOM OF BORING	25		7	SS	3	50/3"	27.7		
	***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.									

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	WD	▼ NONE	AB
WL	▼		▼	
WL				

Terracon

BORING STARTED	10-28-04		
BORING COMPLETED	10-28-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/9/04

LOG OF BORING NO. B-11

CLIENT: **Aquila Networks**

SITE: **203rd Street & Knight Road, Peculiar, Missouri**

PROJECT: **Peculiar 345/161 kV Substation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	12"ROOT ZONE	1			PA					
	LEAN CLAY, trace fine roots and silt, dark gray, soft	3.5	CL	1	ST	6		34.2	90	500*
					PA					
	LEAN TO FAT CLAY, dark gray, stiff		CL CH	2	ST	15		32.1	90	2000*
		8.5			PA					
	FAT CLAY, trace sand and limestone fragments, gray, yellow brown, very stiff	13	CH	3	ST	12		24.3	104	4000*
					PA					
	***LIMESTONE, highly weathered, broken, with clay filled joints, gray	20		4	SS PA	2	50/2"			
				5	SS	0	50/0"			
	***SHALE, highly to moderately weathered, gray, soft to moderately hard	28.8		6	SS PA	5	50/5"	11.9		
	BOTTOM OF BORING			7	SS	4	50/4"	13.8		

All descriptions taken from driller's field logs.

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

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

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 4.5	WD	▼ 14.5	AB
WL	▽		▼	
WL				

Terracon

BORING STARTED	10-28-04		
BORING COMPLETED	10-28-04		
RIG	CME 75	FOREMAN	AT
APPROVED	CWV	JOB #	02045408

BOREHOLE 02045408.GPJ TERRACON.GDT 11/9/04