Stantec Consulting Services Inc.
3052 Beaumont Centre Circle, Lexington KY 40513

October 9, 2018
File: rpt_006_let_175567301
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Fault Areas
Ash Pond 2
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Shawnee Fossil Plant
West Paducah, Kentucky

1.0 PURPOSE

As described in 40 CFR § 257.62(a), an owner or operator of an existing CCR surface impoundment is required to demonstrate that the unit is not located in fault areas unless the unit meets certain requirements. This letter documents Stantec's certification that Ash Pond 2 at the TVA Shawnee Fossil Plant (SHF) complies with the location restrictions for fault areas in the EPA Final CCR Rule at 40 CFR § 257.62(a).

2.0 SUMMARY OF FINDINGS

The attached demonstration documents that Ash Pond 2 meets the requirements set forth in 40 CFR § 257.62(a).

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Don W. Fuller II, being a Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;

2. that the information contained herein is accurate as of the date of my signature below; and

3. that the TVA Shawnee Ash Pond 2 meets the requirements specified in 40 CFR § 257.62(a).

RE: **Fault Areas**
Ash Pond 2
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Shawnee Fossil Plant
West Paducah, Kentucky

SIGNATURE

DATE 10/9/2018

ADDRESS: Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703

TELEPHONE: (859) 422-3000

ATTACHMENTS: Fault Areas Demonstration

Fault Areas Demonstration

Ash Pond 2
Shawnee Fossil Plant
Paducah, McCracken County,
Kentucky

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 9, 2018
Revision 0

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LIST OF APPENDIX

1.0 BACKGROUND

On April 17, 2015, EPA published the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" final rule in the Federal Register. The Tennessee Valley Authority (TVA) contracted Stantec Consulting Services Inc. (Stantec) to evaluate the Ash Pond 2 at the Shawnee Fossil Plant (SHF) regarding the requirements for the Fault Areas Location Restriction as required by the EPA Final CCR Rule, 40 C.F.R. §257.62.

As required by §257.62 of the EPA Final CCR Rule, an owner or operator of a new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit is required by October 17, 2018 to demonstrate that the unit is not located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in the Holocene time period unless the owner or operator demonstrates that measures are in place to prevent damage to the structural integrity of the CCR unit under an alternative setback distance of less than 60 meters (200 feet).

SHF is a coal-fired, electric-generating plant. The plant is located in McCracken County, Kentucky along the south shore of the Ohio River near river mile 946 and just east of the confluence of Little Bayou Creek with the Ohio River. Ash Pond 2 is located in the northeastern part of the Mississippi embayment of the Gulf Coastal Plain Physiographic Province. The geologic setting may be described as a trough of Paleozoic rocks filled with unconsolidated sand and clay of Cretaceous and Eocene age, gravel of both Pliocene age, loess of Pleistocene age, and alluvium of Pleistocene and Recent age (MACTEC Engineering and Consulting, Inc., 2005). In summary, the site is in a region known as the Jackson Purchase region. This area was theorized to have been considered a shallow sea in which the Warsaw Limestone was deposited.

2.0 ASSESSMENT

This compliance demonstration was executed with two primary focus areas.

The first study was a review of available literature and published data related to the potential for faulting in the project vicinity. The result of that study which is titled "Literature Survey and Discussion of the Geology and Seismicity of the Tennessee Valley Authority Shawnee Fossil Plant, Western Kentucky," does not identify faults within the established minimum horizontal buffer and is presented in Appendix A.

The second study was a site specific neotectonics analysis. This study evaluates existing landforms for indications of past fault activity through a compilation of lineaments and surface drainage analysis within the project vicinity. The results of this study do not identify the presence of lineaments or drainage characteristics indicative of faults within the established minimum horizontal buffer distance. The results of the study are presented in a report titled "Shawnee Fossil Plant, Western Kentucky, Neotectonics Analysis," and are presented in Appendix B.

3.0 CONCLUSIONS

Based on the assessment outlined herein, Ash Pond 2 located at SHF meets the requirements of §257.62 of the EPA Final CCR Rule for the 60-meter (200 foot) buffer from fault areas.

4.0 REFERENCES

MACTEC Engineering and Consulting, Inc. (2005). *Report of Geotechnical Exploration, TVA Shawnee Fossil Plant, Proposed Dry Fly Ash Lateral Expansion Project, Paducah, Kentucky.* Prepared for Tennessee Valley Authority (TVA), November 2.

Stantec Consulting Services Inc. (2010a). *Report of Geotechnical Exploration and Slope Stability Evaluation, TVA Shawnee Fossil Plant, Ash Pond 1 & 2 and Consolidated Waste Dry Stack, Paducah, Kentucky.* Prepared for Tennessee Valley Authority (TVA), July 14.

Stantec Consulting Services Inc. (2016a). *Closure and Post-Closure Plan, TVA Shawnee Fossil Plant, Consolidated Waste Dry Stack, EPA Final Coal Combustion Residuals (CCR) Rule.* Prepared for Tennessee Valley Authority (TVA), October.

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APPENDIX A
LITERATURE SURVEY AND DISCUSSION OF GEOLOGY AND SEISMICITY OF THE TENNESSEE VALLEY AUTHORITY SHAWNEE FOSSIL PLANT, WESTERN KENTUCKY

Literature Survey and Discussion of the Geology and Seismicity of the Tennessee Valley Authority Shawnee Fossil Plant, Western Kentucky

Robert D. Hatcher, Jr., Ph.D., P.G.
Department of Earth and Planetary Sciences
and Science Alliance Center of Excellence
University of Tennessee–Knoxville

August 10, 2016

Introduction

The purpose of this report is to provide a literature survey and discussion of known active or potentially active faults in the vicinity of the Tennessee Valley Authority Shawnee Fossil Plant in western Kentucky. The plant is located in the Jackson Purchase (part of Kentucky west of the Tennessee River) 11 mi northwest of Paducah, across the Ohio River almost due west of Metropolis, Illinois (Fig. 1). The plant has a maximum production capacity of 1,750 Mw of electric power.

The references cited in this report are those considered critical for understanding the geology, paleoseismology, and seismicity of the region and near the Shawnee Fossil Plant in western Kentucky. Many of these papers, maps, and reports cited herein contain a plethora of additional citations that would provide much greater detail about the surface and subsurface geology and seismicity in the region. Several of these reports and publications include Kellberg (1951), Finch (1976), Pinckney (1976), Johnston and Schweig (1996), Obermeier (1998), McBride et al., (2002), Martin et al. (2007), Tavakoli, et al., 2010, Pratt (2012), Seid et al. (2013), and Van Arsdale et al. (2013).

An active fault (or earthquake fault) is one that has been demonstrated to have moved during the Holocene (last 11,700 years). This would include the zone of deformation (damage zone) on either side of the fault, which would include geologic structures (folds, subsidiary faults, joints and shear fractures, etc.) that would have been produced as coseismic features during movement on the fault that produced seismicity (California Geological Survey, 2007).

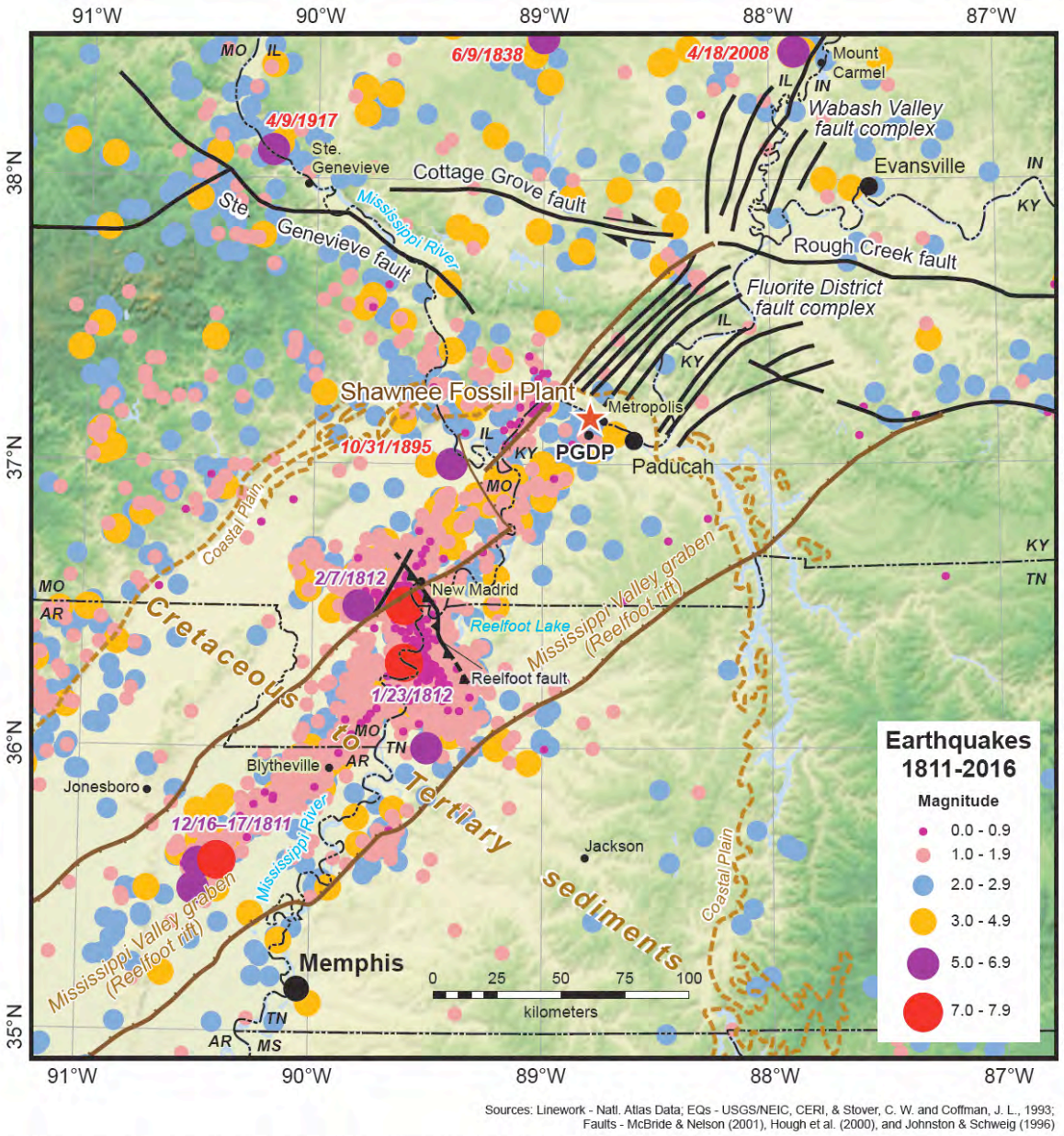
Regional Geology and Seismicity

The Shawnee Fossil Plant is located in the Gulf Coastal Plain in the northern part of the Mississippi Embayment. Surface geology in this region consists of late Paleozoic carbonate and clastic sedimentary rocks of the western Highland Rim and southernmost Illinois basin exposed east of the Tennessee River, unconformably overlain by largely unconsolidated Cretaceous and Tertiary sediments, and then by Plio-Pleistocene sediments, including loess deposits, and then Quaternary terrace and other river deposits (Fig. 1). The sedimentary sequence was intruded by numerous small lamprophyre and related igneous rocks during

the late Paleozoic (Pinckney, 1976; Olive, 1980; Seid et al., 2013). A complex northeast-trending normal-fault system of late Paleozoic horsts and grabens, the Kentucky-Illinois Fluorite District fault system, cuts the Paleozoic rocks in this area (Pinckney, 1976; McBride et al., 2002; Martin et al., 2007; Seid et al., 2013). Several of these faults strike toward the Shawnee Fossil Plant from their surface outcrop traces in southern Illinois, but disappear beneath the Coastal Plain sediments and do not appear to related to the modern patterns of seismicity (Sparks, 2009). McBride and Nelson (2001) and McBride et al. (2002, their Figure 2) reported that several of the young fault suite in southern Illinois, in both seismic reflection profiles and surface exposures, actually displace Cretaceous and Tertiary deposits and early Pleistocene sediments, but not the late Pleistocene sediments, and overlying Pleistocene loess and Quaternary stream deposits. These young faults (inactive for at least 55 ka) may or may not be related to the complex of Paleozoic faults in this area (McBride et al., 2002, their Fig. 2). The Paleozoic Fluorite District fault zone appears to separate the New Madrid seismic zone from the Wabash Valley fault system and seismic zone (Obermeier, 1998) (Fig. 1). A similar group of faults was imaged in seismic-reflection data by Luzietta et al. (2006) in the Crittenden fault zone in eastern Arkansas. This fault system similarly displaces Paleozoic, Cretaceous, and Tertiary sediments, but could not be demonstrated to have displaced the younger Pleistocene sediments, although they may have been folded (very broad interpretation

To the northwest and southwest of the Shawnee Plant is the northeastern extent of the large early Paleozoic Mississippi Valley graben, identified by aeromagnetic data (frequently referred to as the Reelfoot rift, e.g., Hildenbrand and Hendricks, 1995; Johnston and Schweig, 1996; Van Arsdale et al., 2013). Most of the seismicity of the New Madrid seismic zone is contained within the graben (Fig. 1), and some have suggested that the seismic activity in this and other eastern U.S. intraplate seismic zones is related to early Paleozoic faults (e.g., Johnston and Schweig, 1996; Wheeler, 1996).

The active seismicity, however, only roughly parallels the graben boundaries, and is located in a northeast-trending zone of earthquakes that is truncated (or displaced by) in northwestern Tennessee and southeastern Missouri by a northwest-trending zone of seismicity, a thrust now called the Reelfoot fault (Chiu et al., 1992; Johnston and Schweig, 1996; Cox et al., 2006). A major zone of seismicity continues to the northeast from near the northwest end of the Reelfoot fault that diminished in frequency and magnitude of earthquakes northeastward to the region in Kentucky near Paducah and the Shawnee Fossil Plant (Fig. 1). The northeast-trending faults that are defined by the seismicity in the New



Sources: Linework - Natl. Atlas Data; EQs - USGS/NEIC, CERI, & Stover, C. W. and Coffman, J. L., 1993; Faults - McBride & Nelson (2001), Hough et al. (2000), and Johnston & Schweig (1996)

Figure 1. Location map for the Tennessee Valley Authority Shawnee Fossil Plant (red star), regional seismicity, major tectonic features and faults, and the locations of major population centers. Dates of earthquakes of $M_w > 5$ are shown in redand purple letters. PGDP– U. S. Department of Energy Paducah Gaseous Diffusion Plant.

Madrid seismic zone have been interpreted as dextral strike-slip faults that are truncated by the Reelfoot fault (Cox et al., 2006; Tavakoli et al., 2010). The zone of greatest frequency and magnitude of historic earthquakes continues northwestward across southernmost Illinois into southeastern Missouri in a zone that parallels the strike of the Paleozoic Ste. Genevieve fault (Fig. 1). The northeastern limit of historical New Madrid earthquakes, which ends immediately southwest of Paducah and the Shawnee Fossil Plant, bounds a region of very low to no historic seismicity in southern Illinois and adjacent Kentucky to an area near the N70°W-trending Paleozoic Cottage Grove dextral fault in southern Illinois where a group of

historical earthquakes mostly of M_w < 4.0 occurs on both sides of the Cottage Grove fault (Fig. 1). The current interpretation of the New Madrid seismic zone if that it is related to a crustal-scale dextral strike-slip fault system and flower structure (Tavakoli, et al., 2010; Pratt, 2012). This interpretation is based on earthquake, seismic reflection, and surface geologic data (Tavakoli et al., 2010), as well as computer modeling of the structure (Pratt, 2012). This interpretation fits the available data better than any previous interpretation. The history of the New Madrid seismic zone and the 1811-1812 earthquakes is chronicled by Johnson and Schweig (1996) and Hough et al. (2000).

There is, however, a zone of historic and prehistoric earthquakes along the Wabash River Valley associated with a series of Paleozoic faults, the Wabash Valley fault complex (Obermeier, 1998). This is a currently active seismic zone that has been active for several thousand years (Obermeier, 1988); a M_w = 5.2 earthquake followed by a M_w = 4.7 seismic event occurred very close to each other <10 miles west of Mt. Carmel, Illinois, on April 18, 2008 (see Stover and Coffman, 1993, and other sources of earthquake data for Fig. 1).

Shawnee Site Geology and Potentially Active Faults Within Two Miles of the Site

The geology at the Shawnee Plant site consists of unconsolidated Tertiary clastic sediments; Pleistocene sand, river deposits, and loess; and Quaternary clastic stream deposits (Kellberg, 1951; Finch, 1967; Martin et al., 2007). There is no consolidated bedrock within several hundred feet of the surface; some of the exploratory boreholes encountered Mississippian Warsaw Limestone at a depth of ~350 ft (Kellberg, 1951).

Finch (1967) made a geologic map of the area in western Kentucky in part of the Joppa quadrangle, which includes the Shawnee Fossil Plant site. There were no faults recognized during his mapping, and he noted that none of the faults mapped in southern Illinois are traceable across the Ohio River into western Kentucky. There are no faults indicated on the site geologic map for the Shawnee Fossil Plant (Lindquist and Bohac, 1993), but this map is derived from Finch's map.

The U. S. Department of Energy Paducah Gaseous Diffusion Plant (PGDP) is located a short distance south of the TVA Shawnee Fossil Plant (Fig. 1). A detailed surface and subsurface investigation of part of the PGDP was investigated for Holocene faulting prior to a proposed expansion of a landfill near the plant (Baldwin et al., 2007). This investigation included data collected from 86 30-ft cores and two seismic-reflection profiles across the landfill site. While several faults were recognized in the seismic-reflection data, none of

these faults displace the youngest stratigraphic units and they concluded that there was no evidence for Holocene faulting at the proposed landfill site (Baldwin et al., 2007).

The U.S Army Corps of Engineers (1993) performed a site-specific seismic response analysis of the PGDP area based on model earthquakes that would produce accelerations of 0.19, 0.27, and 0.63 g for 500-, 1000-, and 5,000-year recurrence events, respectively, affecting the site. This analysis was not based on a particular source, such as the New Madrid seismic zone located a short distance to the southwest, or on knowledge of any active or potentially active faults in the area.

Conclusions

1. The Shawnee Fossil Plant is located immediately northeast of the northeast end of the New Madrid seismic zone, and > 60 miles southwest of the Wabash Valley seismic zone.

2. None of the literature reviewed, including published papers and TVA reports and reports from other agencies, have indicated the existence of any active faults within two miles of the Shawnee Fossil Plant.

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APPENDIX B
NEOTECTONIC ANALYSIS

Tennessee Valley Authority
Shawnee Fossil Plant, Western Kentucky

Neotectonics Analysis

September 24, 2018

Prepared for:

Tennessee Valley Authority

Prepared by:

Stantec Consulting Service Inc.
500 – 4730 Kingsway
Burnaby, British Columbia
V5H 0C6

Project Number:
175555010.222A.3

FINAL REPORT

Revision	Description	Author		Quality Check		Independent Review	
0	IFR	Sid Tsang	2017-09-18	Sid Tsang	2017-09-18	Rick Guthrie	2017-09-18
1	IFU	Sid Tsang	2018-09-24	Sid Tsang	2018-09-24	Rick Guthrie	2018-09-24

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LIST OF FIGURES

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) was retained by the Tennessee Valley Authority (TVA) to complete Location Restriction Demonstration Phase 1 Assessments for the Shawnee Fossil Plant in Western Kentucky (Figure 1). The demonstration is required by the US Environmental Protection Agency's (EPA) disposal of Coal Combustion Residuals (CCR) Rule (US EPA 2015). This report addresses the Location Restriction Demonstration for Fault Areas. The first phase was to complete a literature review of available data of known active faults[1] near the Shawnee Fossil Plant (Hatcher 2016). Hatcher (2016) did not indicate the existence of any active faults within two miles of the Shawnee Fossil Plant. The second phase of the Demonstration for Fault Areas comprises a neotectonics analysis near the site—the subject of this report.

1.1 SCOPE OF WORK

The scope of this work is comprised of the following three tasks:

1. The first task builds on the literature review findings by utilizing the online USGS archival earthquake map, the online USGS interactive fault map, and Kentucky Geological Survey website. Publically available maps, reports and scientific literature relevant to the terrain conditions of the site are reviewed.

2. The second task involves a lineament analysis where lineaments mapped from air photographs, Light Detection and Ranging (LiDAR) hillshade or satellite images within at least a two-mile radius of the Shawnee Fossil Plant (study area), centered on Ash Pond 2, will be identified. A two-mile radius was selected for the Fault Area demonstration to assess faults not only within but nearby the Shawnee Fossil Plant which could affect the site. The mapping will be carried out in ArcGIS to facilitate the plotting of maps and viewing of spatial data. Where lineaments are identified, the main directions are plotted. Lineament age indicators will be characterized where possible.

3. The third task involves a drainage analysis of well-defined patterns (dendritic, parallel, trellis, rectangular, radial, annular and contorted) which are not redirected by anthropogenic activity. Deviations from an expected pattern such as flow in a direction that is oblique to the regional topographical gradient could be related to structural or lithological discontinuities.

[1] For the purposes of this report, an active fault is one that has demonstrated movement during the Holocene (last 11,700 years).

2.0 BACKGROUND INFORMATION

2.1 DATA SOURCES

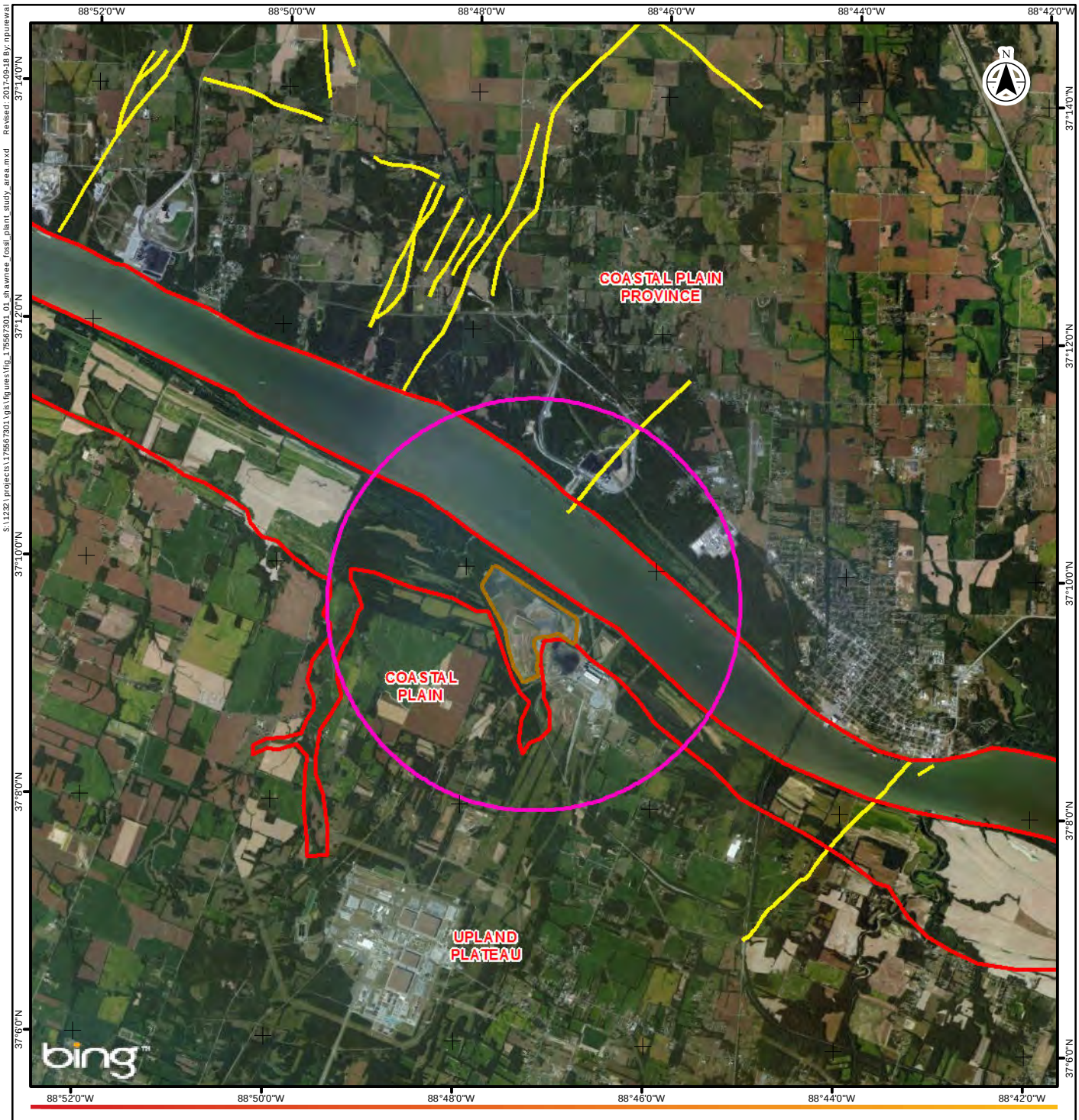
Readily available background information of relevance to the neotectonics analysis and geological conditions of the site was gathered and reviewed. This information included:

- Literature Survey and Discussion of the Geology and Seismicity of the Tennessee Valley Authority Shawnee Fossil Plane, Western Kentucky (Hatcher 2016).
- Geologic map of part of the Joppa quadrangle, McCracken County, Kentucky: U. S. Geological Survey Map GQ-652 (Finch 1967).
- Geologic maps of the Jackson Purchase region, Kentucky: U.S. Geological Survey, Miscellaneous Investigations Series Map I–1217 (Olive 1980).
- Geology of Joppa Quadrangle – Massac County, Illinois. Illinois Geologic Quadrangle Map IGQ Joppa-G (Nelson and Masters 2008).
- Soil Survey of Ballard and McCracken Counties, Kentucky (USDA 1976).
- Soil Survey of Massac County, Illinois (USDA 2009)
- USGS Mineral Resources On-Line Spatial Data: Digital Faults for Illinois and Kentucky
  http://mrdata.usgs.gov/geology/state/
  Accessed September 25, 2016
- Kentucky Geological Map Information Service: 24K Geological Faults and Geologic Formations
  http://kgs.uky.edu/kgsmap/kgsgeoserver/viewer.asp
  Accessed September 25, 2016
- Kentucky Geological Survey Hi-Res National Hydrography Dataset
  http://www.uky.edu/KGS/gis/kyhuc8pic.htm
  Accessed September 20, 2016
- Kentucky Geological Survey Web Map Services
  http://kgs.uky.edu/kgsweb/mapdata.asp
  Accessed September 25, 2016

2.2 PROJECT SETTING

The study area is located within the Gulf Coastal Plain of the Mississippi Embayment Region; a region of flat, low plains dissected by a dendritic network of low gradient creeks and small rivers. The study area can be subdivided into two regions: Coastal Plain and Upland Plateau (Figure 1). The Coastal Plain comprises the lowlands adjacent to the Ohio River and its tributaries, generally at an elevation below 330 feet. Bordering the southwest edge of the Coastal Plain is the Upland Plateau—a dissected plateau surface that ranges in elevation from 360 to 375 feet within the study area. The underlying bedrock geology comprises Paleozoic carbonate and clastic sedimentary rocks which are unconformably overlain by thick, unconsolidated Cretaceous and Tertiary sediments, then by loess and continental deposits, and then by Quaternary lacustrine and fluvial deposits. The Ohio River flows southeast to northwest within the study area and is joined by its north-flowing tributaries: Bayou Creek and Little Bayou Creek immediately west of the Shawnee Fossil Plant.

The published geological fault mapping shows northeast-trending faults in southern Illinois that disappear beneath the Coastal Plain sediments (Nelson and Masters 2008 and Figure 1).



Fault Line
Shawnee Fossil Plant
Study Area - 2 Mile Radius
Physiographic Region

0 0.5 1 1.5 2 Miles

1:90,000 (at original document size of 8.5x11)

Stantec

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Orthoimagery © Microsoft BING

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Project Location
Kentucky, U.S.A.

175555010
Prepared by NPUREWAL on 2017-09-18
Technical Review by STSANG on 2017-09-18
Independent Review by RCOATTA on 2017-09-18

Client/Project
Shawnee Fossil Plant Study
Neotectonics Analysis
Kentucky, USA

Figure No.
1

Title
Shawnee Fossil Plant Study Area

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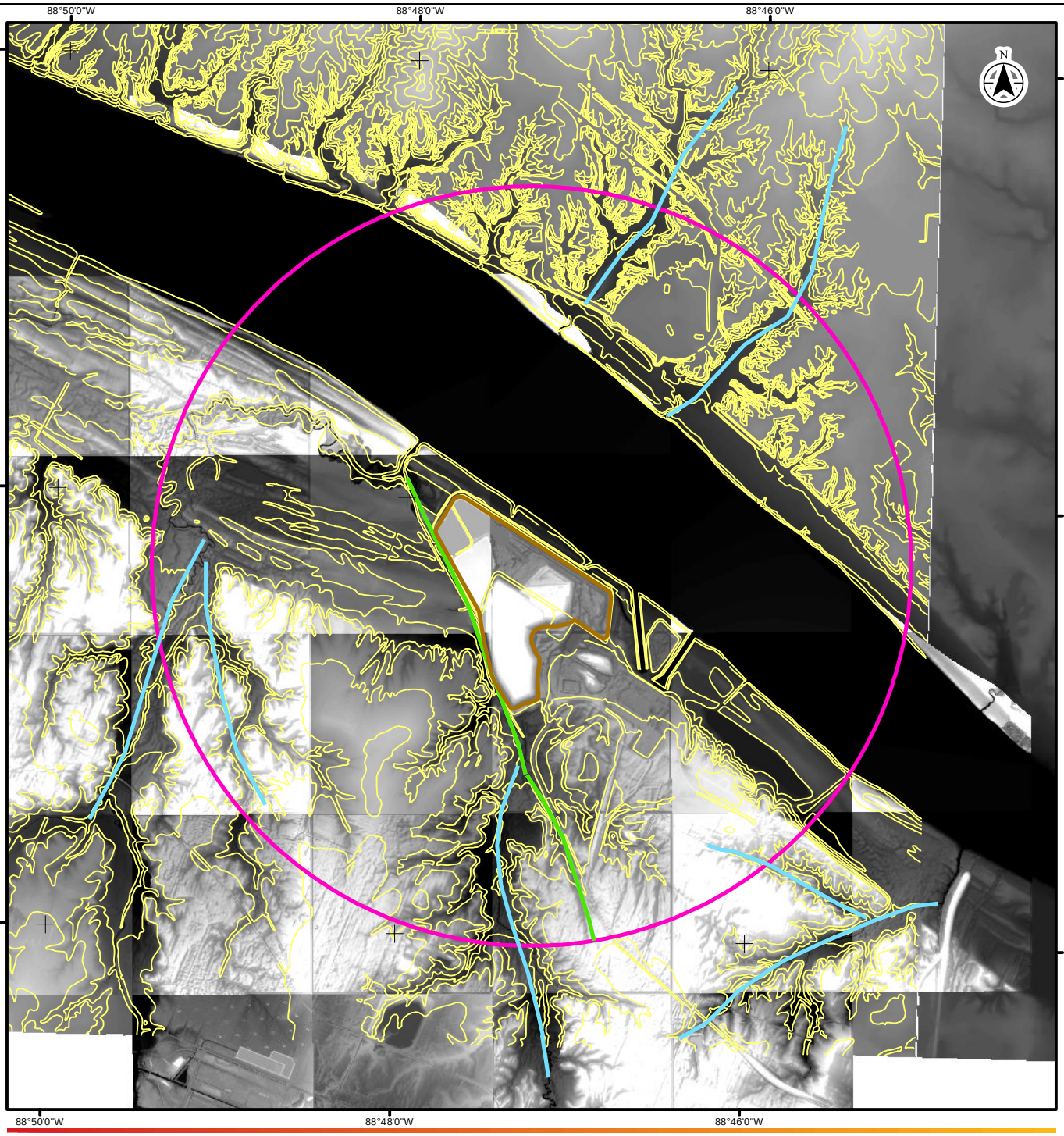
3.0 LINEAMENT ANALYSIS

The desktop lineament analysis utilizes digital stereo air photos, 2011 satellite imagery and Light Detection and Ranging (LiDAR) hillshade (5 feet)[2]. The satellite imagery and LiDAR hillshade were viewed in an ArcGIS platform to enable the mapper to view imagery, LiDAR data and other GIS layers readily.

The lineament analysis is based on the visible interpretation of mappable linear, rectilinear, or curvilinear surface features that are expected to reflect subsurface phenomena. Without accompanying geophysical data, the mapping of these surface features is somewhat subjective. Only a few lineaments were mapped, which appear to be reflective of the relatively young Coastal Plain deposits and not the underlying bedrock in the study area (Figure 2).
The lineament highlighted in light green follows the valley axis of Little Bayou Creek. The lower reaches of Little Bayou Creek originally drained north into the Ohio River in 1952 (TVA 1952) and was diverted to make room for the original ash disposal area.

It is inconclusive whether the alignment of Little Bayou Creek was formed by or affected by an active fault because the development of the original ash disposal area obscures the lower reaches of the Little Bayou Creek. Geophysical survey data may help to indicate the absence or presence of a fault for this particular lineament.

[2] Publically available 2003 digital stereo air photos and 2013 LiDAR DEM 5FT data was downloaded from the Kentucky Geological Survey website.



- Lineaments
- Little Bayou Creek Lineament
- Contour (10 foot interval)
- Shawnee Fossil Plant
- Study Area - 2 Mile Radius

0 0.25 0.5 0.75 1 1.25 Miles

1:50,000 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Orthoimagery © Microsoft BING

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Project Location
Kentucky, U.S.A.

175555010
Prepared by NPUREWAL on 2017-09-18
Technical Review by STSANG on 2017-09-18
Independent Review by RCOATTA on 2017-09-18

Client/Project
Shawnee Fossil Plant Study
Neotectonics Analysis
Kentucky, USA

Figure No.
2

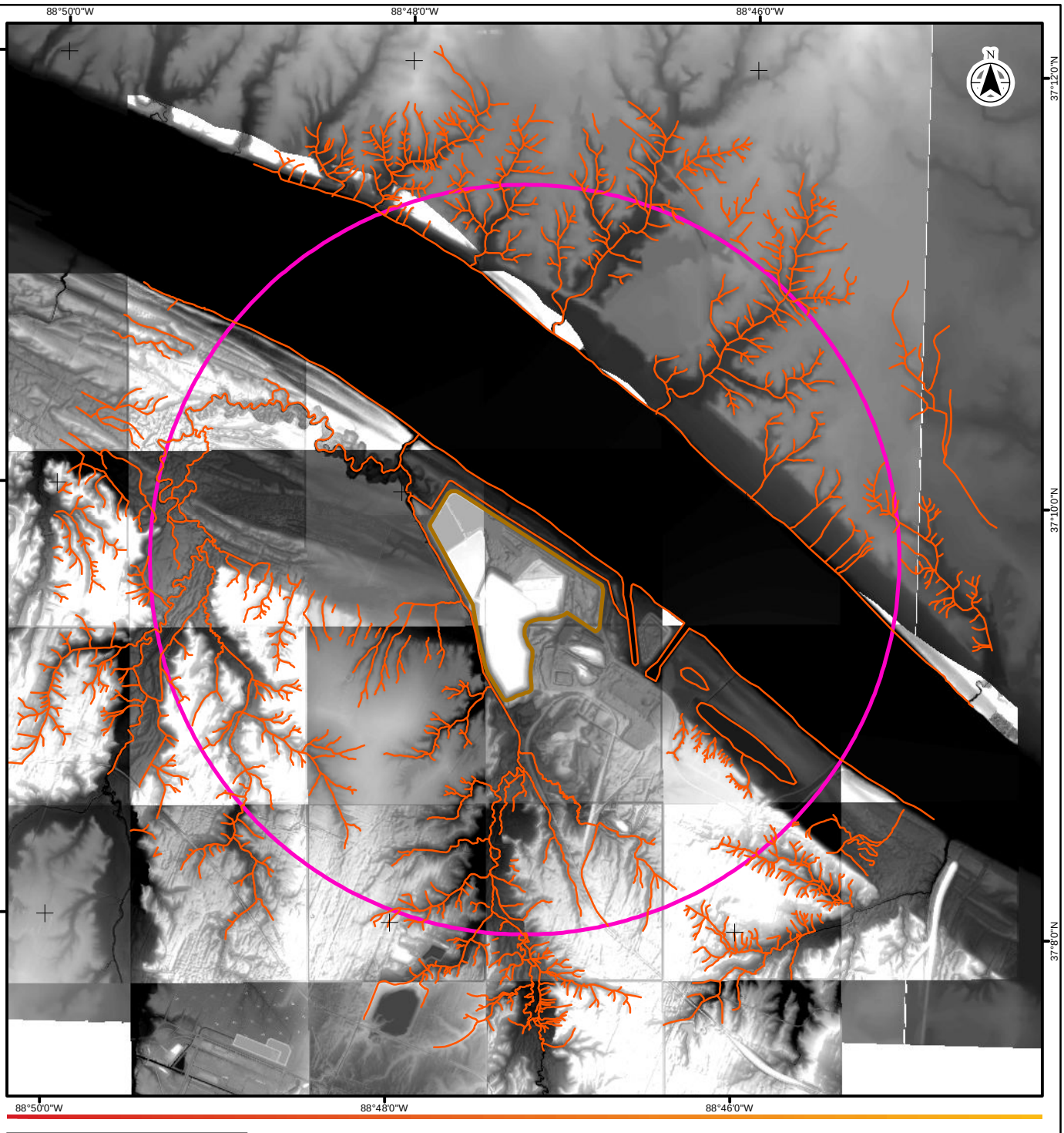
Title
Mapped Lineaments Overlain on LiDAR Hillshade and 10 foot Contours

\\cd1183-f03\workgroup\1232\projects\175567301\gis\figures\fig_175567301_02_mapped_lineaments_overlain_on_lidar_hillshade_and_10_foot_contours.mxd Revised: 2017-09-18 By: npurewal

4.0 DRAINAGE ANALYSIS

Similar to the lineament analysis, ArcGIS was used for drainage analysis to view the satellite imagery, LiDAR hillshade, and the 1:24,000-scale National Hydrology Dataset for Kentucky. The LiDAR hillshade was effectively used to delineate the drainage network of streams at viewing scales ranging from 1:2,000 to 1:5,000 (Figure 3). A comparison of the Kentucky National Hydrology Dataset flowlines and mapping from the drainage analysis are shown in Figure 4. In the study area, the drainage network has a dendritic drainage pattern which is consistent with the underlying horizontal strata of deep, unconsolidated sedimentary deposits. Deviations from an expected pattern could be related to structural or lithological discontinuities and were checked against the satellite imagery. Observed deviations were judged to be the result of anthropogenic activity (e.g., drainage ditches, straightening of streams for agricultural purposes).

No fault scarps or other tectonic features (e.g., spreading ridges, convergent boundaries) associated with active faults were observed within the study area.



Drainage Network
Shawnee Fossil Plant
Study Area - 2 Mile Radius

0 0.25 0.5 0.75 1 1.25 Miles

1:50,000 (at original document size of 8.5x11)

Stantec

Notes
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Client/Project
Shawnee Fossil Plant Study
Neotectonics Analysis
Kentucky, USA

Figure No.
3a

Title
Drainage Network Mapping Using 2013 LiDAR Hillshade

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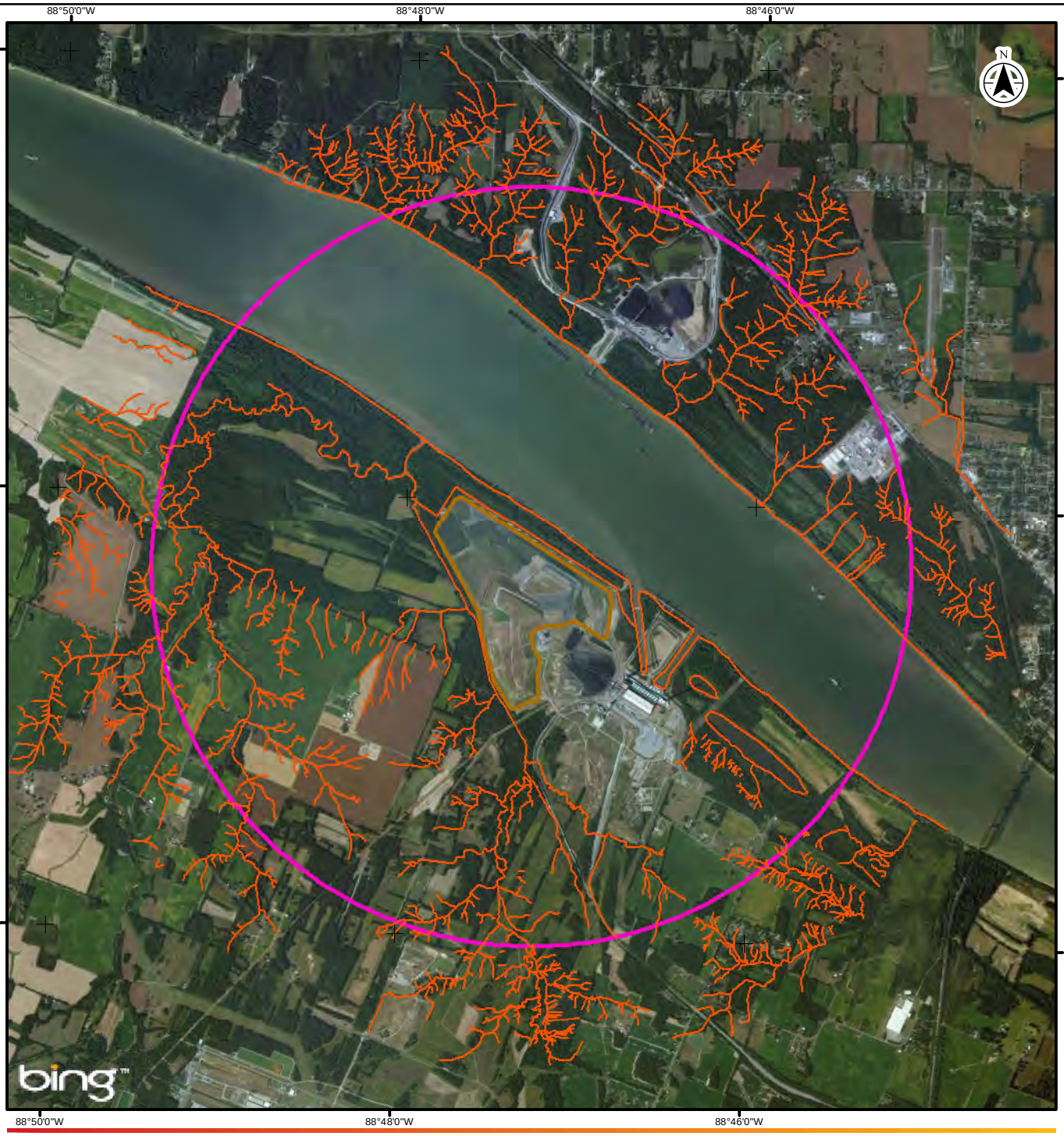

Drainage Network
Shawnee Fossil Plant
Study Area - 2 Mile Radius

0 0.25 0.5 0.75 1 1.25 Miles

1:50,000 (at original document size of 8.5x11)

Notes
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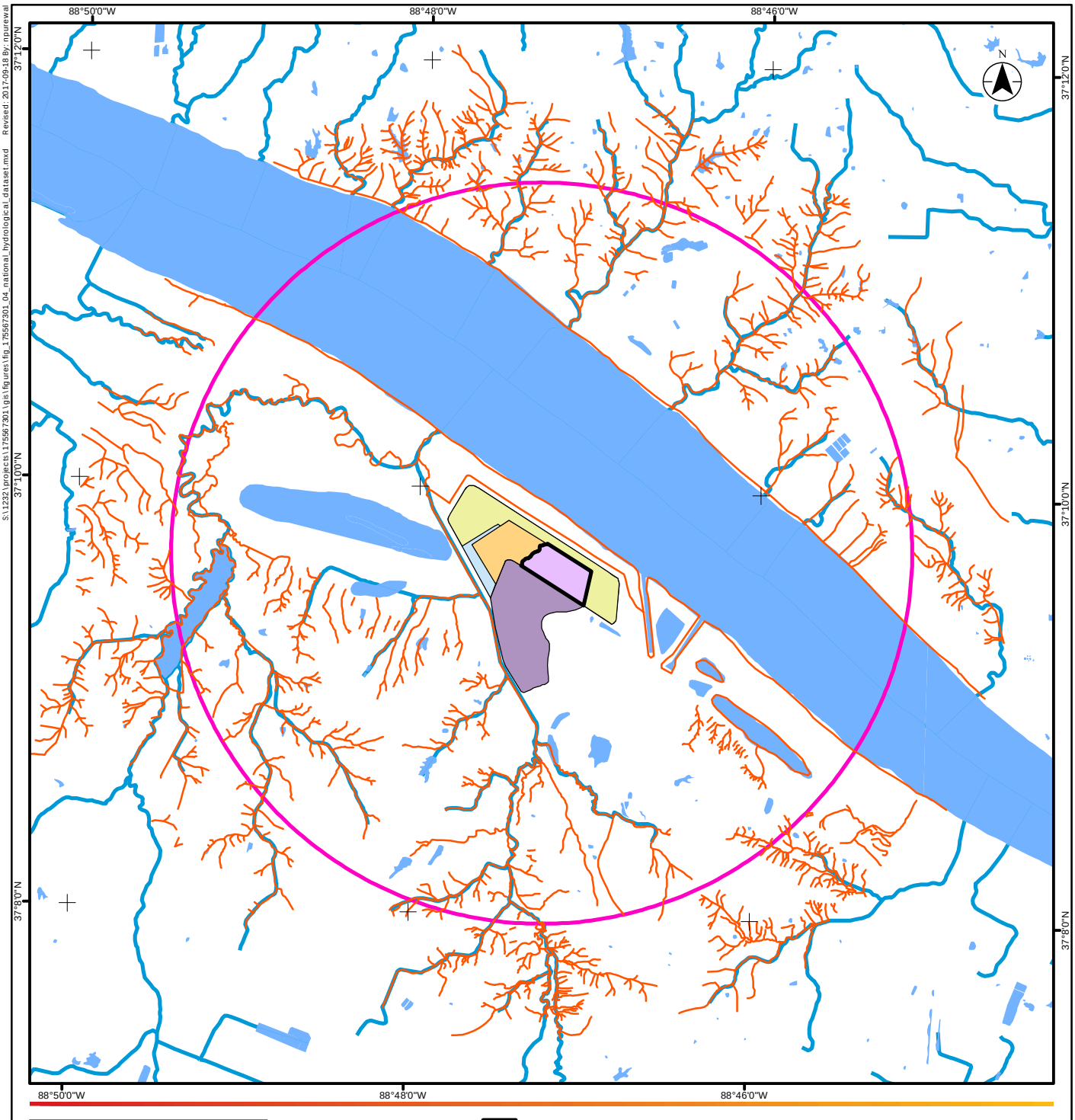
Client/Project
Shawnee Fossil Plant Study
Neotectonics Analysis
Kentucky, USA

Figure No.
3b

Title
Drainage Network Mapping Using 2011 Satellite Imagery

S:\1232\projects\175567301\gis\figures\fig_175567301_03b_drainage_network_mapping_using_2011_satellite_imagery.mxd Revised: 2017-09-18 By: npurewal



- Drainage Network
- Watercourse
- Waterbody
- Study Area - 2 Mile Radius
- Current Operations
- Original Ash Pond
- Special Waste Landfill
- Future Ash Pond
- Future Expansion

0 0.25 0.5 0.75 1 1.25 Miles

1:50,000 (at original document size of 8.5x11)

Notes
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Client/Project
Shawnee Fossil Plant Study
Neotectonics Analysis
Kentucky, USA

Figure No.
4

Title
National Hydrological Dataset

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5.0 CONCLUSIONS

In conclusion, the neotectonics analysis (second phase) of the Location Restriction Demonstration for Fault Areas for the Tennessee Valley Authority Shawnee Fossil Plant in Western Kentucky was completed within a 2 mile-radius centered on Ash Pond 2. The neotectonics analysis involved a review of published geology, hydrology, soils, fault, and earthquake information, a lineament analysis, and a drainage analysis. The conclusion from the second phase is consistent with the first phase by Hatcher (2016) and does not indicate the existence of any active faults within two miles of the Shawnee Fossil Plant.

The lineament analysis identified a few linear features that follow major valleys; however, these have been interpreted to be related to surface structures or anthropogenic activity. It is inconclusive whether the mapped lineament adjacent to the Shawnee Fossil Plant (Figure 2) was formed by or affected by an active fault because the development of the original ash disposal area obscures the lower reaches of Little Bayou Creek.

Drainage analysis in the study area shows a dendritic drainage pattern which is consistent with the underlying horizontal strata of sedimentary deposits with no obviously visible deviations from well-defined drainage patterns that are not redirected by anthropogenic activity. No active (Holocene-aged) faults that could displace drainage patterns were visibly observed within a 2 mile-radius of the Shawnee Fossil Plant.

No fault scarps or other tectonic features (e.g., spreading ridges, convergent boundaries) associated with active (Holocene-aged) faults were observed within a 2 mile-radius of the Shawnee Fossil Plant.

6.0 CLOSURE

This document entitled "Tennessee Valley Authority Shawnee Fossil Plant, Western Kentucky" (Report) was prepared by Stantec Consulting Services Inc. ("Stantec") for the Tennessee Valley Authority. This Report supports the fault area demonstration only for the TVA Shawnee Fossil Plant and the conclusions are not valid for other applications. This Report is based on a literature review of cited references, a desktop lineament and drainage mapping exercise based on interpretation of DEM hillshade and satellite imagery. The material in this Report reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the Report. The opinions in the Report are based on conditions and information existing at the time the Report was published and do not take into account any subsequent changes.

Yours truly,

STANTEC CONSULTING LTD.

Prepared by _____

(signature)

Sid Tsang, P.Geo. (AB, BC, MB)

Reviewed and Approved by _____

(signature)

Richard Guthrie, M.Sc., Ph.D., P.Geo. (AB, BC)

7.0 REFERENCES

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