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April 18, 2008

Mr. Herbert M. Meade, Administrator
Maryland Department of the Environment
Oil Control Program, Suite 620
1800 Washington Boulevard
Baltimore, Maryland 21230

RE: Lineament Trace Analysis Report
Exxon Service Station #2-8077
14258 Jarrettsville Pike
Phoenix, Baltimore County, Maryland
Facility I.D. No. 12342
Case No. 2006-0303-BA2

Dear Mr. Meade:

This letter report is submitted by Kleinfelder East, Inc. (Kleinfelder) on behalf of ExxonMobil Environmental Services Company (ExxonMobil) to summarize the findings of a lineament trace analysis completed at the request of the Maryland Department of the Environment (MDE), as described in MDE Monitoring Well Network[1] letter. A lineament trace analysis was requested by the MDE in order to identify linear surface features, to show possible relationships between the lineaments and known geologic structure, and to help identify potential structural features that may correlate to known regional hydrogeologic conditions.

This lineament trace analysis should not be used to conclude that an observed lineament is, in fact, a fracture; nor should it be used to conclude that there is water movement or dissolved-phase migration along the observed lineament. As discussed below, this lineament trace analysis is properly interpreted in conjunction with all existing data such as potentiometric surface contours, geophysical data and the proposed discrete interval sampling results.

Methods

High resolution aerial photographs were acquired in April 2006 by a low-altitude aircraft-mounted camera in a single run from northeast to southwest over the site. The photographs overlap by approximately 60 percent, making them suitable for stereoscopic analysis. Since the high resolution aerial photographs do not cover a 2-mile radius, additional data sources, as described below, were used to supplement the lineament trace analysis.

The stereo-pair photographs were reviewed for surface expressions of lineaments. The vertical exaggeration provided by the stereoscope aided in the identification of linearly trending topographic offsets. Lineaments may be caused by zones of more or less competent rock, structural features, fractures, or other factors resulting in variable weathering and erosion. Therefore, the lineaments often follow topographic highs or lows, or cross-cut the slope along topographic knick points (deflections in topographic grade).

Light Detection and Ranging (LiDAR) last-point (bare earth) data from 2004 were acquired from Baltimore County for analysis and lineament identification. These data supplemented the aerial photographs to provide 2-mile radial coverage. Preliminary analysis was performed by identifying lineaments along structural highs, lows, and cross-cutting features. High resolution aerial photography was draped onto a triangulated irregular network (TIN) base elevation layer for additional analysis of structural features in combination with soil surface features, hydrologic features, and vegetation features.

[1] MDE, December 15, 2006, Monitoring Well Network, Case No. 2006-0303-BA2, Jacksonville Exxon R/S No. 2-8077, 14258 Jarrettsville Pike, Phoenix, Baltimore County, Maryland, Facility I.D. No. 12342.

Results

Lineaments that were identified prominently, or through features from multiple data sources are displayed on **Figure 1**. Lineaments consistent with the regional structural trend (northeast-southwest) and longer than 7,000 feet are shown as “primary” lineaments on **Figure 1**, and are indicated with a thick line. Other lineaments are shown as “secondary” lineaments on **Figure 1**, and indicated with a thin line.

Discussion

The lineament pattern predominantly corresponds to the regional drainage pattern comprised of primary drainage channels/streams and secondary tributaries/headwaters. The primary drainage channels are aligned with the regional structural and metamorphic fabric that is oriented northeast-southwest. These drainages represent hydrologic boundary conditions. Surrounding the site, the secondary lineaments/drainage tributaries converge on and drain to the main lineament that has been identified to extend to the northeast and southwest of the service station property (i.e., the “strike line” along which the original monitoring well and recovery well network was installed). Other primary lineaments are oriented sub-parallel to the main strike line and occur in different drainage basins.

The “strike line” lineament, a known fracture which is extensively monitored, represents the origin of potential dissolved-phase migration to other potential cross-cutting fractures, along which dissolved-phase hydrocarbons would have to migrate before reaching a more regional lineament network via fracture flow. The potentiometric surface configuration (i.e., hydraulic gradient) would be the advective driving mechanism for such migration to occur. The current monitoring well network, potentiometric surface contours generated from the most recent groundwater elevation data (March 2008), and the lineaments identified proximal to the site are superimposed on Figure 2.

Inspection of Figure 2 reveals two primary lineaments oriented parallel to the strike of the regional foliation, one of these being the “strike line” lineament. Three cross-cutting lineaments intercept the “strike line” lineament in proximity to the monitoring well network. Two of these cross-cutting lineaments are located at the extremities of dissolved-phase migration along the strike line, one to the northeast extent (Lineament “A” on Figure 2) and one to the southwest extent (Lineament “B” on Figure 2). A third cross-cutting lineament intersects the transverse line of groundwater recovery wells located across the “strike line” to the southwest of the service station property (Lineament “C” on Figure 2).

Based on an evaluation of the lineament study results as illustrated in Figure 2, the degree to which monitoring and recovery well coverage overlaps the identified lineaments is summarized below.

1) The segment of cross-cutting Lineament “A” to the northeast that is located downgradient of the intersection with the “strike line” is monitored by one monitoring well located directly on the lineament (MW-150A) and two monitoring wells in close proximity to the lineament (MW-150B and MW-136).

2) The “strike line” lineament is monitored by several monitoring wells directly southwest and upgradient of Lineament “A”.

3) Cross cutting Lineament “B” intersects the “strike line” beyond the extent of the monitoring well network at the southwest extent of the site. The “strike line” lineament is monitored by several monitoring wells upgradient of this intersection.

4) The transverse line of groundwater recovery wells (MW-119, MW-102, MW-112, MW-111, MW-72, and MW-118) located along the cross-cutting lineament southwest of the service station property (Lineament “C”) provides several monitoring points at the potentiometric low point of this intersection while exerting hydraulic control and extraction of dissolved-phase hydrocarbons at this intersection.

Conclusions

The lineaments identified in this analysis are two-dimensional surface expressions of features that may or may not represent fractures in the subsurface. Inspection of the superimposed groundwater monitoring/recovery well network, the groundwater potentiometric surface, and the identified lineament network indicates that the current monitoring well network overlays the identified lineament network near several potentially important intersections. The hydraulic gradient is the advective driving force for dissolved-phase migration via fracture flow. The potential for dissolved-phase migration to the regional lineament network is limited by the natural convergence of the potentiometric surface toward the "strike line" lineament, the hydraulic control maintained along the "strike line" and the paucity of cross-cutting lineaments that intersect the "strike line" in the vicinity of the site.

Discrete interval groundwater sampling is proposed in a separate submission to MDE to target fractures in deep bedrock wells installed as part of the expanded monitoring well network. These data in conjunction with borehole geophysical data will collectively better correlate the 3-dimensional configuration of identified lineaments, borehole fractures, and dissolved-phase hydrocarbon distribution. As such, the lineament trace results and discrete interval sampling results are considered complementary. Consequently, the lineament trace results should be reassessed in conjunction with the results from the proposed discrete interval groundwater sampling from the expanded monitoring well network installed to date prior to determining if the site monitoring well network is complete. The discrete sampling intervals have been proposed to MDE within the Expanded Monitoring Well Installation Report - Phases I/II, submitted under separate cover.

Closing

Please contact us with any questions pertaining to the information provided. It is anticipated that the findings of the Phase I/II Expanded Monitoring Well Network activities and this lineament analysis will be discussed during the May 7, 2008 meeting.

Sincerely,
Kleinfelder East, Inc.

Jeffrey R. Hale

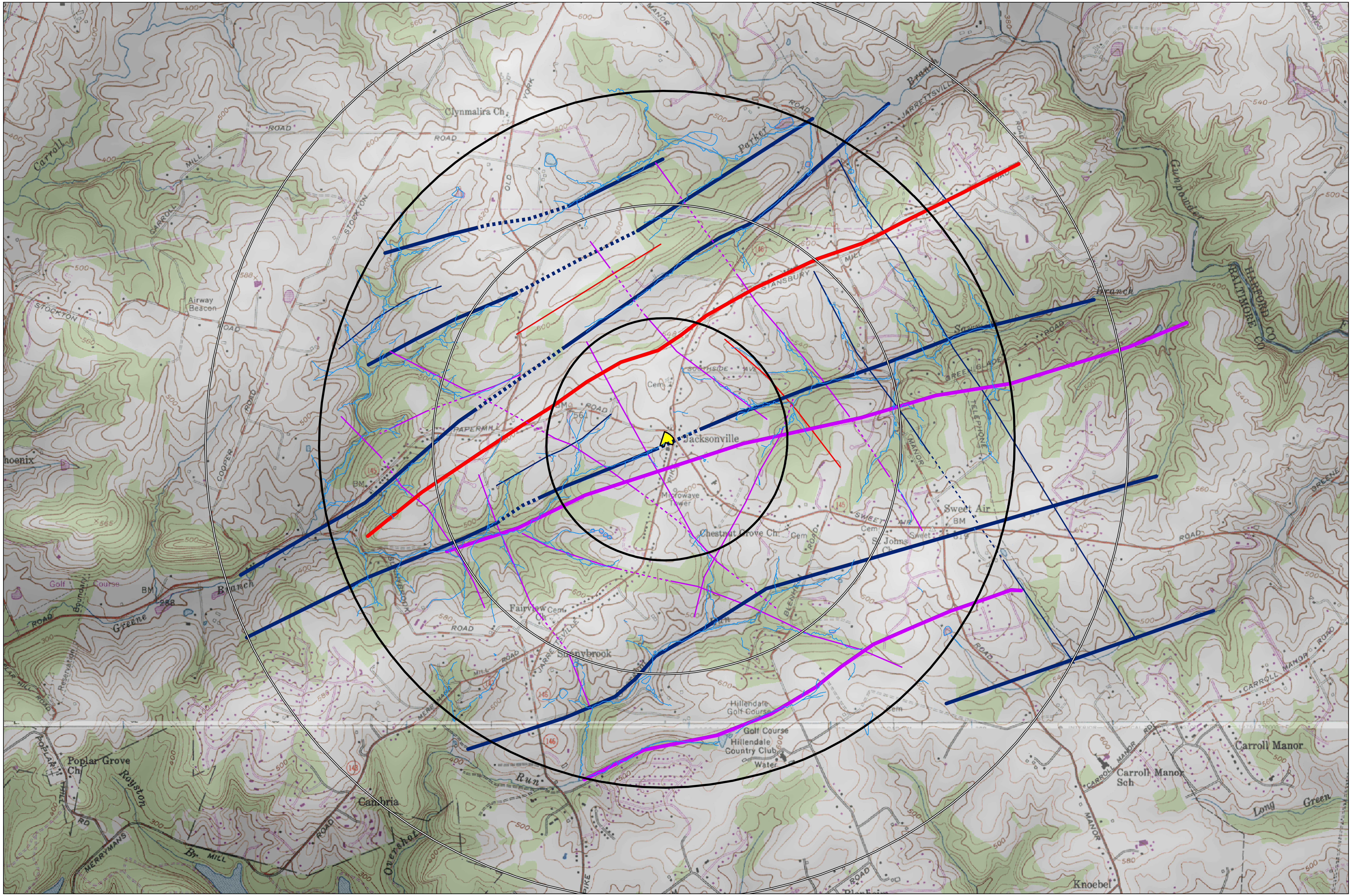
Jeffrey R. Hale, P.G.
Principal Hydrogeologist

Mark J. Schaaf, CPG
Project Director

Attachments

Figure 1 - Lineament Trace Analysis
Figure 2 - Lineament Trace, Potentiometric, and Monitoring Well Map

cc: Yolande Norman – MDE
Ellen Jackson - MDE
James F. Medlin – ExxonMobil (Kleinfelder file)



Legend

Service Station Property Boundary

Observed Lineaments (Line Thickness)

- Primary
- Secondary
- Inferred Location
- Topographic High
- Topographic Low
- Combination
- Streams

0.5 Mile Radii

- 0.00 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00

0 1,000 2,000 Feet

0 300 600 Meters

FIGURE 1
LINEAMENT TRACE ANALYSIS

EXXON RAS# 2-8077
14258 JARRETTSVILLE PIKE
PHOENIX, MARYLAND

DRAWN BY:	BNM	SCALE:	1:12,000
REVISED BY:	BNM	PROJECT NO:	88407
DATE:	03/25/08	SOURCE: CONTACT KLEINFELDER FOR METADATA	
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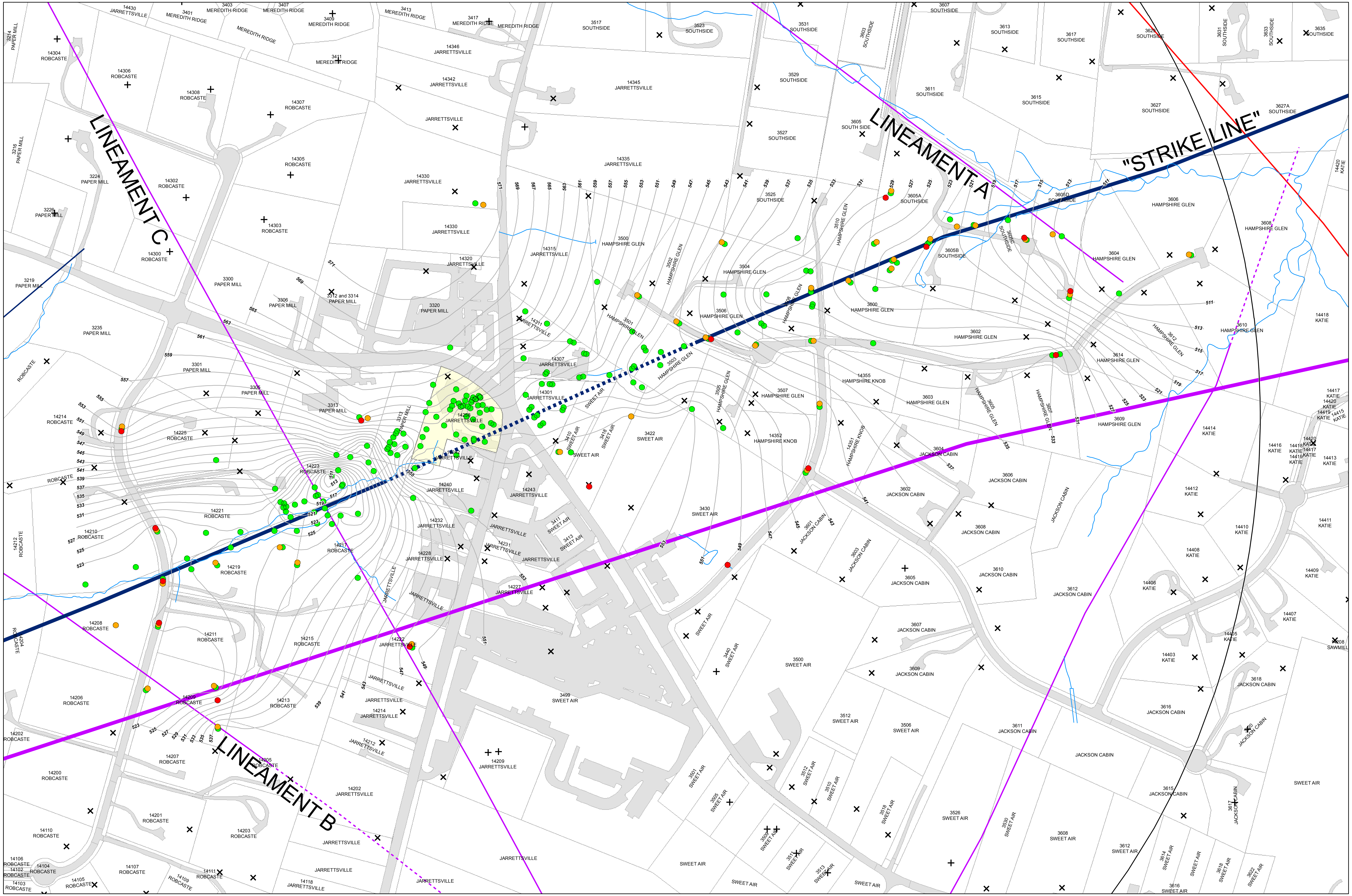

DRAFT
WORK IN PROGRESS

Legend

Monitoring Well Depth Group

- A - Shallow
- B - Intermediate
- C - Deep
- Private Supply Well
- Non-GPS Private Supply Well

Observed Lineaments (Line Thickness)

- Primary
- Secondary
- Inferred Location
- Topographic High
- Topographic Low
- Combination
- GW Contours March 11, 08
- Service Station Property Boundary
- Streams
- 0.5 Mile Radius

0 150 300 Feet

0 45 90 Meters

FIGURE 2
LINEAMENT TRACE, POTENTIOMETRIC,
AND MONITORING WELL MAP

EXXON RAS# 2-8077
14258 JARRETTSVILLE PIKE
PHOENIX, MARYLAND

DRAWN BY:	BNM	SCALE:	1:1,800
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