Preliminary Report for Airborne Data Collected
In Support of US EPA Region VII
Barton Solvents
Valley Center, Kansas

Background

At approximately 1600 GMT (1100 local) on 17 July 2007 information was relayed to the ASPECT team concerning an explosion and fire that occurred at the Barton Solvent facility located in Valley Center, Kansas. The Region VII EOC indicated that this fire had started at approximately 0915 from an unknown cause. The fire and resulting plume prompted an evacuation of the surrounding area.

The Barton Solvent facility (Barsol) is located at 201 South Cedar, Valley Center, Kansas. This location is near the downtown area of the town with an approximate geographical location of N37.8306, W97.37731. Valley Center is located approximately 15 minutes northwest of Wichita, Kansas.

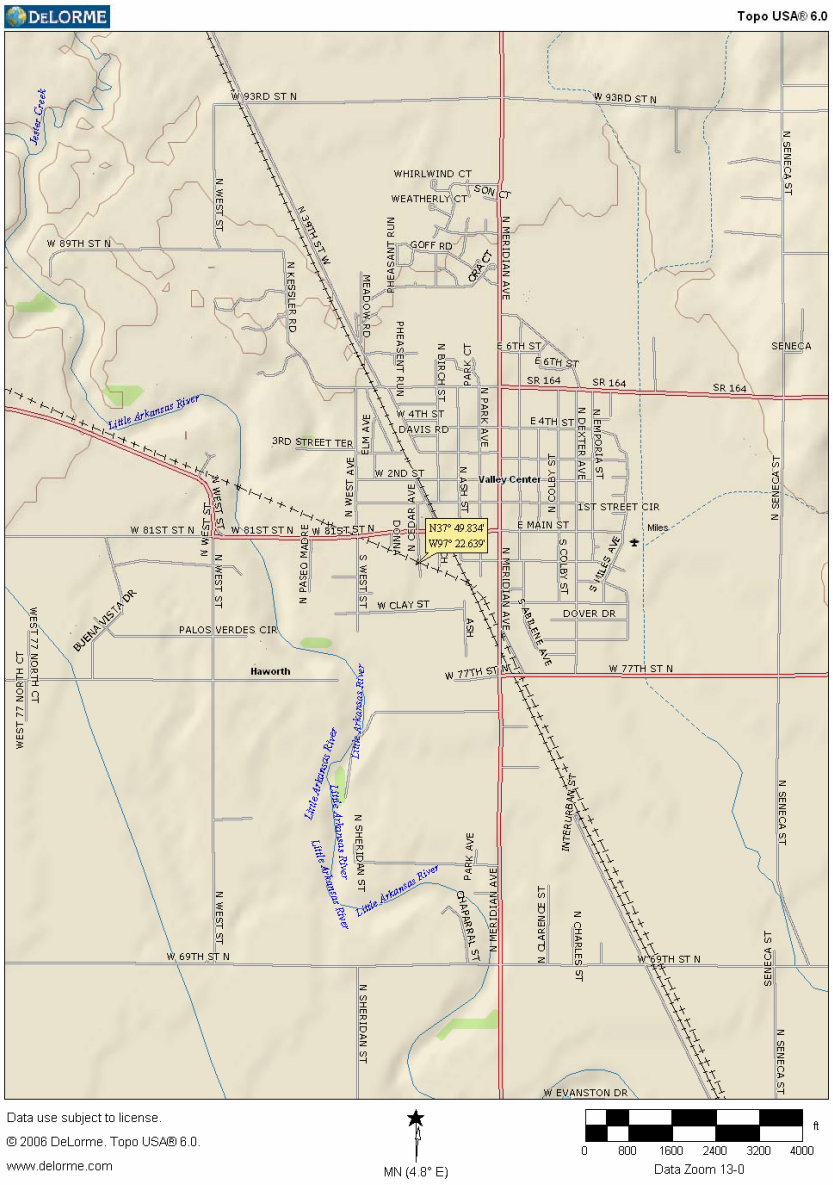

Figure 1. Site Map of the Barton Solvents, Valley Center, Kansas

Figure 2 – Location MAP of Barton Solvents, Valley Center, Kansas

At 1630 GMT (1130) the aircraft was airborne from Midway Region Airport (KJWY) Waxahachie, Texas and reported a flight time of approximately 2 hours 11 minutes. At 1820 GMT (1320 Local) the aircraft called in and reported that they were beginning the descent to collect data and approximately 5 minutes from the target. The crew reported that smoke was rising at a 45 degree angle toward the northeast. The plume was reported to level out at about 6000 feet (AGL). An aerial image of the scene is given in Figure 3.

Due to the vertical nature of the plume and the low ceiling, the ASPECT crew was forced to collect some data passes at an oblique angle to keep from flying through the plume. A georectified version of the image is given in Figure 4. The shape of the image is due to attitude of the aircraft while the image was collected.

Figure 3. Aerial Image, Barton Solvents, Valley Center, Kansas

Weather conditions during the data collection consisted of a reported scattered clouds at 5500 feet (AGL) with 10 miles of visibility. Winds were moderate (10 kts) from the SSW (210^{o}). The surface temperature was 32 ^{o}C (89^{o}F) with a dew point of 19^{o}C. Surface pressure was reported at 1014 mb.

ASPECT System

The US EPA ASPECT system was used to collect airborne infrared (IR) images and data over the site. The ASPECT system is an emergency response aircraft permitting remote chemical detection in support of the first responder. The system consists of an airborne high speed Fourier transform infrared spectrometer (FTIR) coupled with a wide-area IR line scanner. The ASPECT IR systems have the ability to detect compounds in both the 8 to 12 micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this

region is used to detect carbon—non- carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The Carbon – Hydrogen stretch is very common in this region.

Flight Status

The order to launch the aircraft was given at 1600 GMT (1100 local). The aircraft was observed on radar at 1645 (1145 local) with an estimated flight time of 2 hours 11 minutes. The aircraft arrived on-scene at 1825 GMT (13:25 local) and collected 5 data passes over the site. Flight information is summarized in Table 1 and the flight track is given in Figure 4.

Table 1. Flight Status Sortie I – 17 July 2007

Run (log sheet run #)	Time (GMT)	Altitude (MSL Ft)	Heading (Deg)	L/S File (2007_07_18….	FTIR File	Comments
1	18:07	------	---	---	---	System Test All OK
2 (R02)	18:25	3300	350	18_25_30_R02	S25	3 photos 16 cm-1
3 (R03)	18:29	3000	318	18_29_07_R03	S29	2 photos 16 cm-1
4 (R04)	18:31	3000	022	18_31_57_R04	S31	3 photos 16 cm-1
5 (R05)	18:35	3000	032	18_35_38_R05	S35	4 photos 16 cm-1
6 (R06)	18:37	3100	117	18_37_14_R06	S37	4 photos 16 cm-1

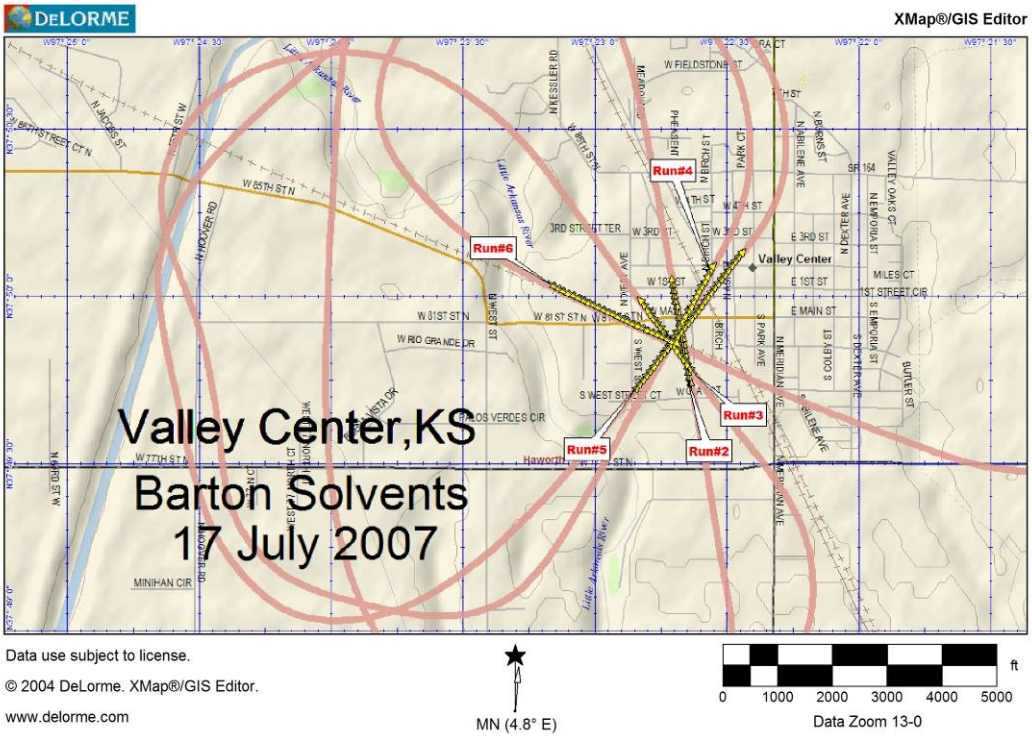

Figure 4. Flight Tracks

Data Results

Line Scanner Data Results

A total of five data passes were made and an infrared line scanner images was generated for each pass. Figure 5 shows an IR image generated from Run 5 using three spectral bands pass channels consisting of a wideband long wave channel, a methanol band and a sulfur dioxide band. The hot signature of the fire is clearly evident to the point that the detector channels are fully saturated. A modest plume is evident moving toward the northeast.

IR imagery for Run 5 was subsequently enhanced by combining the methanol, sulfur dioxide and an emissivity channel and is given in Figure 6. This image tends to show a strong spectral feature near the hot portion of the fire.

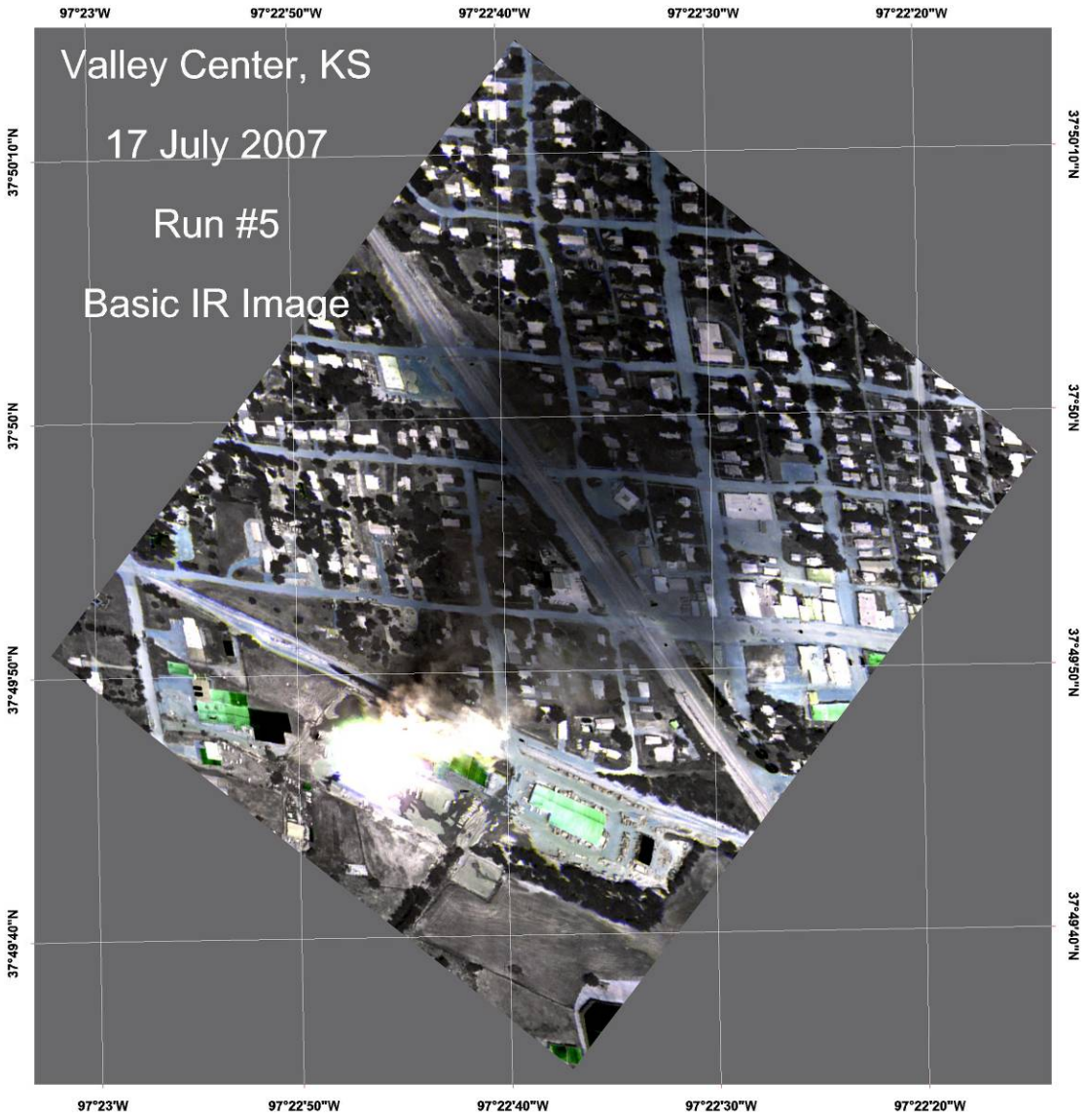

Figure 5. IR Image for Run 5, Barton Solvents, Valley Center, Kansas

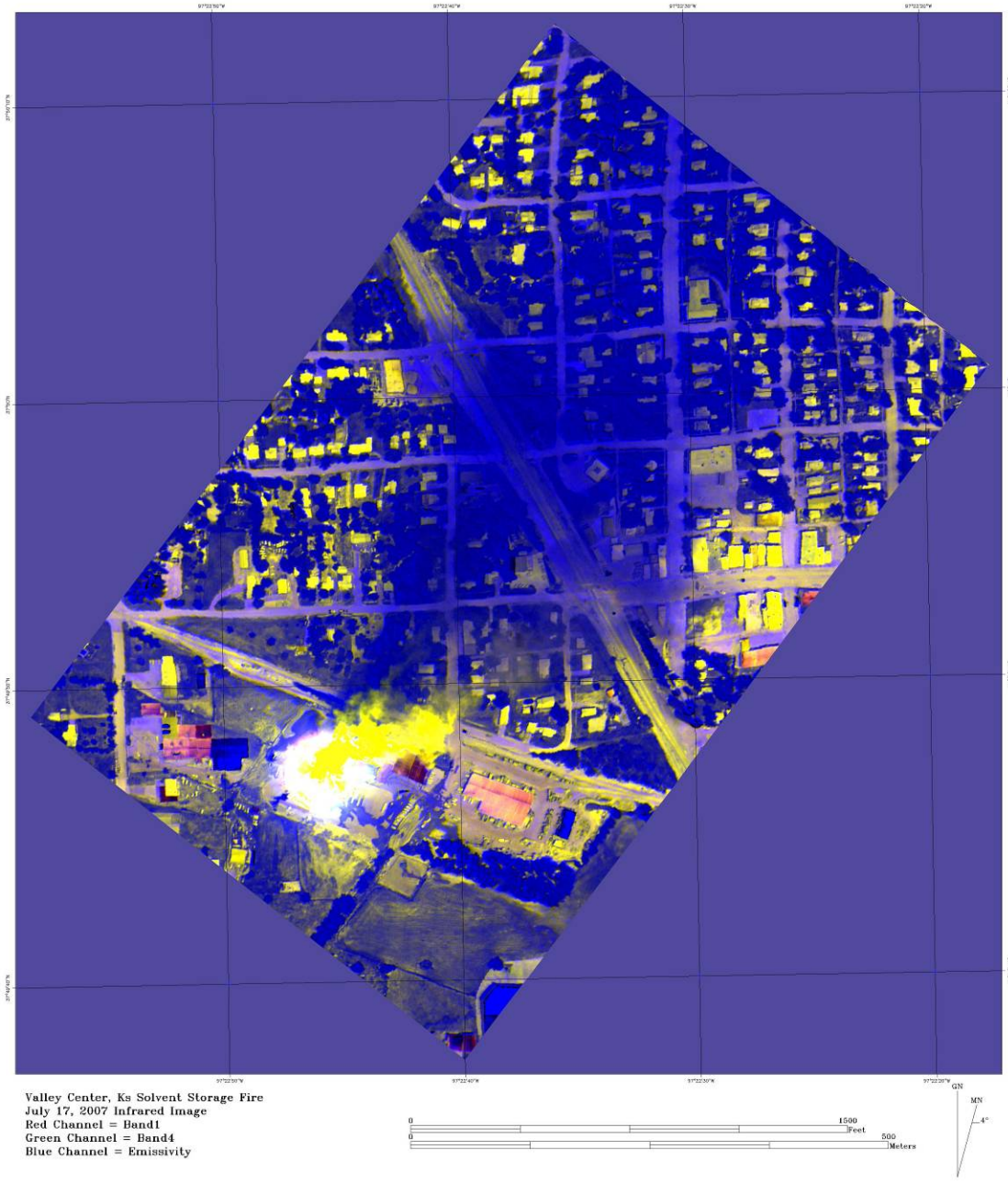

Figure 6 Enhanced IR image using Emissivity

FTIR Data Results

Spectral data was collected using the FTIR for each pass. A spectral resolution of 16 wavenumbers was used for the first three passes followed by data collections at 4 wavenumbers. The following is a table summarizing the data sets generated during the flight.

Run	Compound
1	System Test
2	Trace < 1 ppm Glycol
3	Ozone < 1 ppm
4	No Detections
5	Trace < 1 ppm Glycol
6	Benzyl Alcohol 5 ppm Ozone , 1 ppm

Table 2 – FTIR data set and detection notations.

Analysis of the data tended to show weak detections of ozone and glycol in most of the data passes (with exception of Run 4). A representative spectra for ozone is given in Figure 7. The source of the ozone may be from the fire or may be a result of the high atmospheric temperature and strong solar radiation for this day. Figure 8 shows a representative spectra for glycol. The exact glycol is difficult to determine due to the weak nature of the spectra.

Figure 9 shows a representative spectra for a complex alcohol that is most likely benzyl alcohol due to the strong absorption feature located near 1025 wavenumber. A concentration estimate of 5 ppm was developed based on the absorbance and the plume thickness.

An automatic pattern recognition algorithm was used to scan the ftir data with the results shown in figure 10. This algorithm uses a unique digital filter that has been optimized for common ethyl alcohol. While benzyl alcohol is chemically different than ethyl alcohol, they both have similar spectral signatures with the benzyl alcohol shifted about 40 wavenumbers lower than ethyl alcohol. The positive alarm of the ethanol filter (data above the 0.00 threshold) shows a trigger along the shoulder of the benzyl alcohol feature.

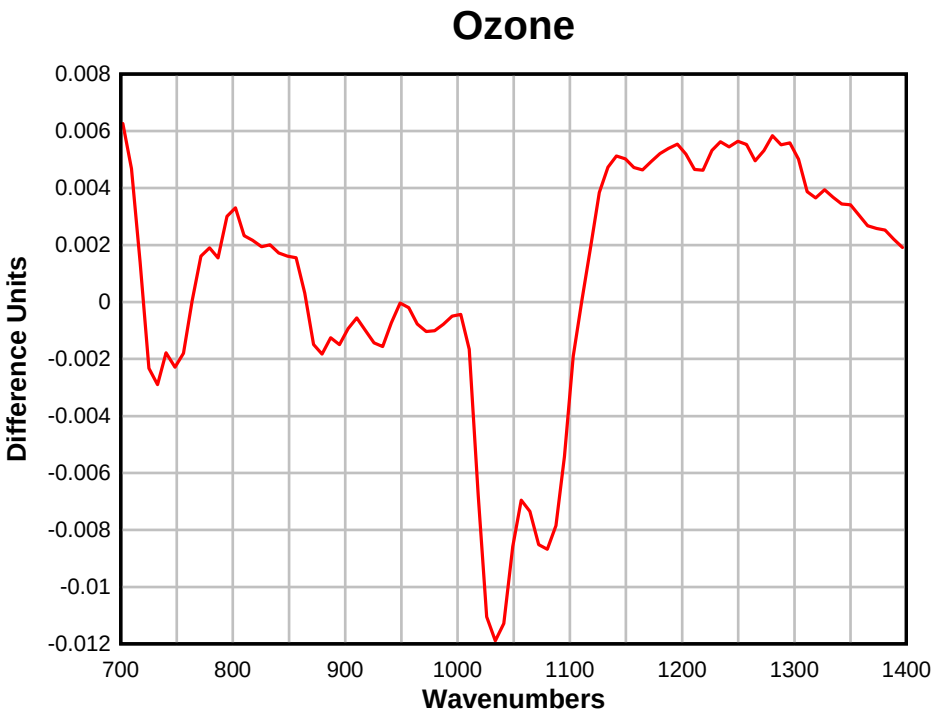

Figure 7. Ozone Spectra, Barton Solvents, Valley Center, Kansas

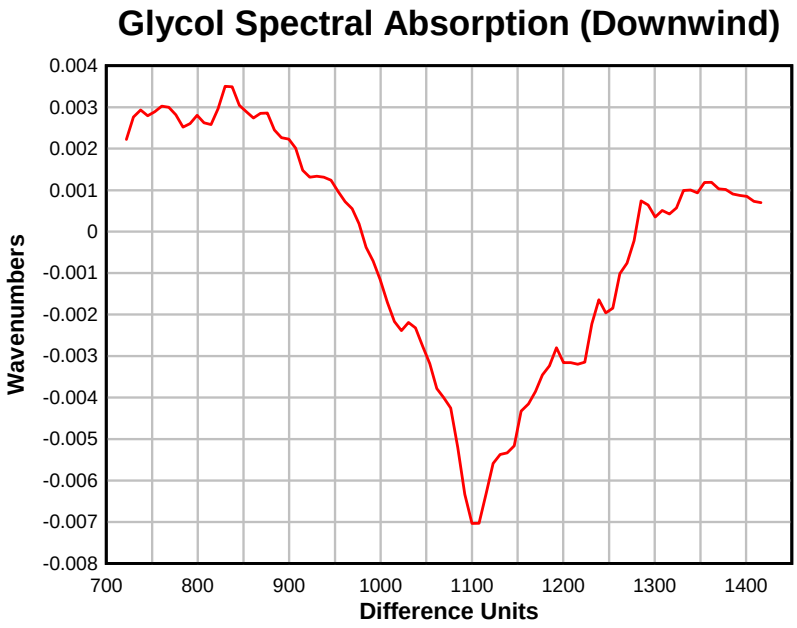

Figure 8. Glycol Spectra, Barton Solvents, Valley Center, Kansas

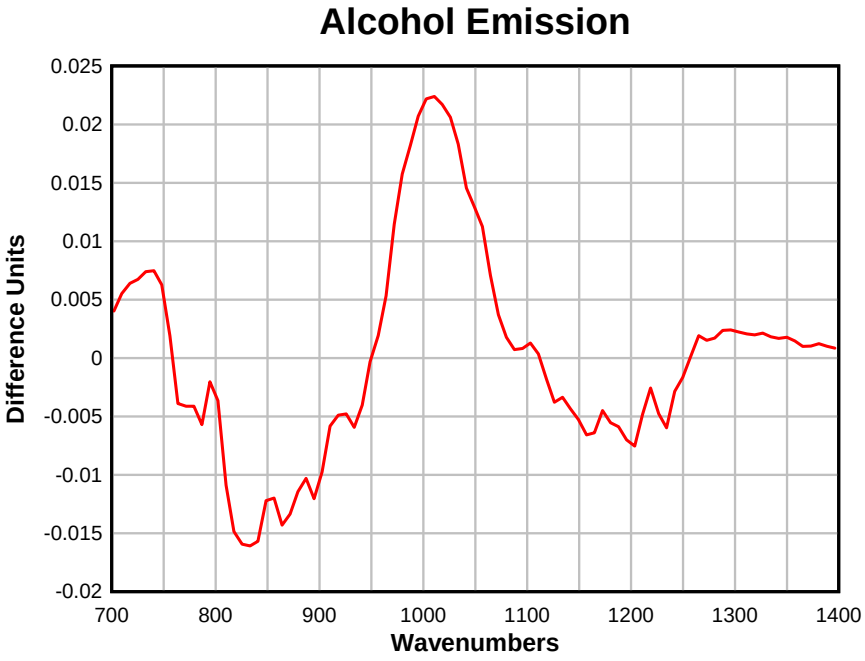

Figure 9. Benzyl Alcohol, Barton Solvents, Valley Center, Kansas

Figure 11 shows a result of mapping the alcohol alarm hits on top of an aerial image. Agreement between the hits and the aerial image is excellent.

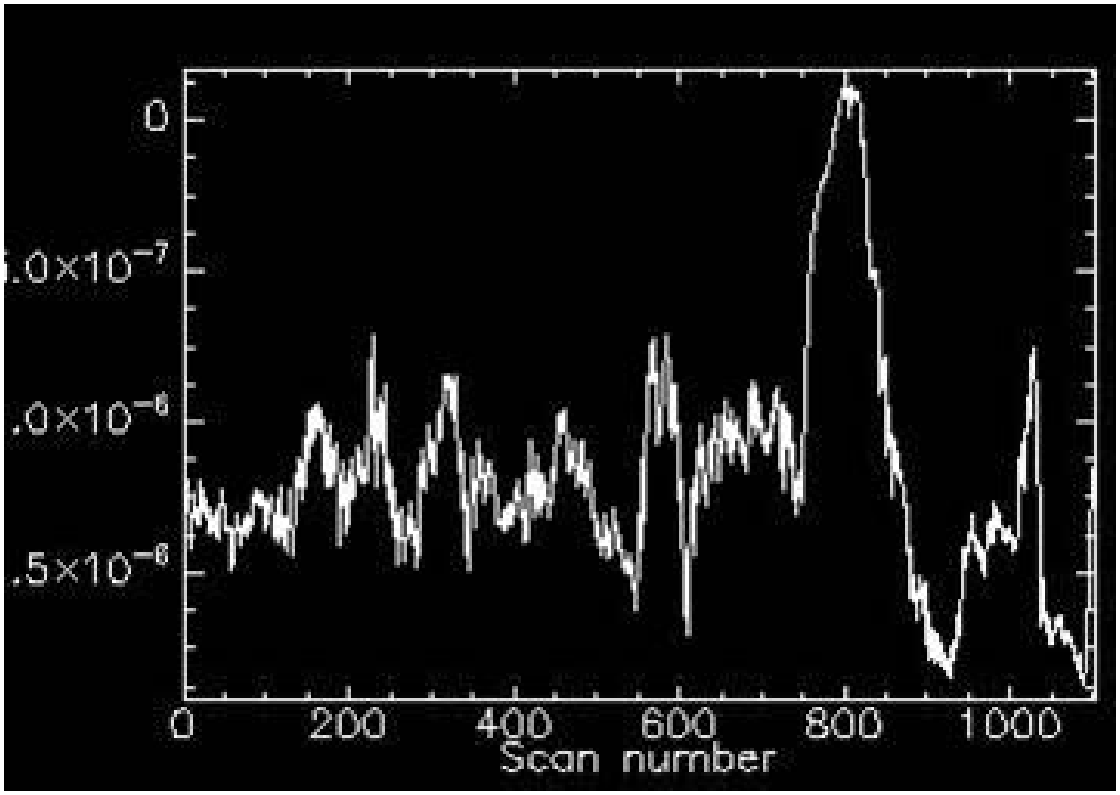

Figure 10. Pattern Recognition Results, Run 5.

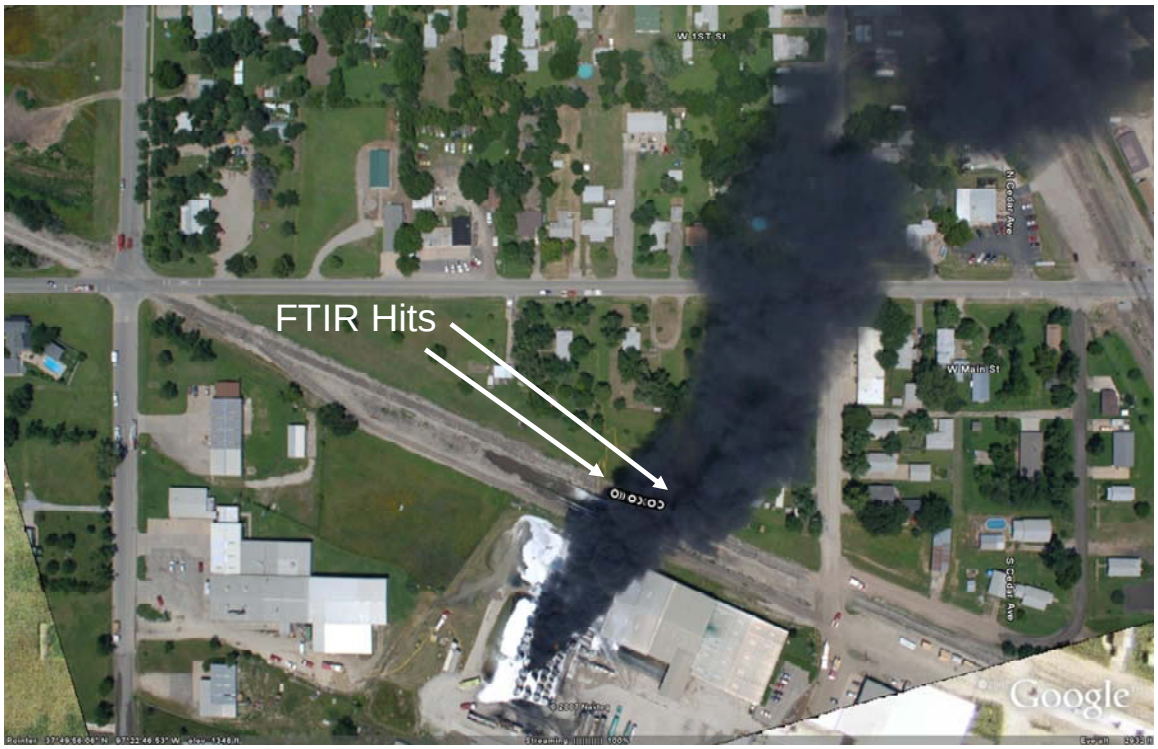

Figure 11. Pattern Recognition Alarm Locations

Conclusions

Data was collected over the Barton Solvents facility at an altitude of 2200 ft AGL. The data consisted of Fourier Transform Infrared (FT-IR) spectra, IR line scanner images, and high-resolution digital photos. The data indicated the presence of several vapor species in both the FT-IR spectrum and the IR line scanner images. The spectra were reviewed and analyzed through an automated processing software system. The automated analysis was followed up with an independent review and assessment of all of the collected spectra. All results from the sensors correlated with the chemical detections being detected in the immediate areas inside or around the smoke plume.

The aircraft continues to be on-station at the site in Valley Center, KS. A second flight will be conducted on17 July.