August 27, 2015

Final Summary Report for Bridgeton Landfill Downwind Odor Assessment and Odorant Prioritization for the Missouri Attorney General's Office

Case No. 13SL-CC01088

from

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August 27, 2015

Don Wright & Associates, LLC is pleased to provide the following **Final** Summary Report, in confidence, for Consulting Services to **Peggy Whipple, Missouri Attorney General's Office.**

This report summarizes the results of the **Phase I** through **Phase III** odor-character and odorant prioritization investigation relative to the **Bridgeton Landfill,** located in Bridgeton, Missouri. The results and opinions expressed herein are derived from: **(1)** a beyond fence line odor survey assessment of the area between March 29 and March 31, 2015; **(2)** a combined on-site and beyond-fence line odor assessment carried out between July 20 and July 22, 2015 and **(3)** material samples from the **Bridgeton Landfill** which were collected and submitted by the Missouri Department of Natural Resources. This effort reflects an attempt by this investigator to correlate specific, high-impact VOC (i.e. volatile organic chemical) emissions from the **Bridgeton Landfill** with a characteristic environmental odor which was observed by this investigator at the time of the March site visit and which has been the focus of citizen odor complaints.

If, after reviewing this report, you have any questions or comments please feel free to contact Don Wright at 512-750-1047.

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BRIDGETON LANDFILL DOWNWIND ODOR ASSESSMENT AND ODORANT PRIORITIZATION SUMMARY REPORT

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Executive Summary

A unique and characteristic odor was noted by this investigator at-distance and downwind of the **Bridgeton Landfill** during a beyond-fence line assessment visit which was carried out during the March 29 to March 31, 2015 timeframe. It is the opinion of this investigator, that the observed odor was emitted by and carried a considerable distance downwind from the **Bridgeton Landfill** source. It is also the opinion of this investigator that this characteristic odor is primarily traceable to a very small fraction of the total VOC emission field from the landfill source; an 8.4 second isolate from a complex gas chromatographic VOC profile which spans, at least, 1260 seconds (i.e. less than 0.7% of the total VOC elution span). These opinions are based upon several factors, prioritized approximately as follows: (**1**) observation of a single, dominant odor response at the olfactory detector from direct environmental air samples which were collected by SPME (i.e. solid phase microextraction) during the **Bridgeton Landfill** area assessment visit of late March; (**2**) the odor character for this on-instrument sensory response was perceived, by this investigator, as virtually identical to that sensed directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary; (**3**) the suspect gas chromatographic fraction isolate, identified herein as **Unk 12.86** (i.e. unknown @ 12.86 min retention on this investigator's instrument), was found to be common to: (**a**) the air environment within and beyond the fence line of the **Bridgeton Landfill** site; (**b**) the equilibrated headspace VOCs surrounding flexible geomembrane barrier sheeting material which had undergone extended barrier-service exposure to the **Bridgeton Landfill** site and (**c**) the equilibrated headspace VOCs above a leachate sample which had been extracted from the **Bridgeton Landfill** site on April 09, 2015. In contrast; (**4**) the **Unk 12.86** chromatographic isolate fraction was found to be relatively absent from a control geomembrane sample which was taken from a roll stored on the Bridgeton Landfill site on July 22, 2015; a 'pristine' roll which had not seen barrier service on the site. In addition; (**5**) the combined odor character emitting from the site-exposed geomembrane sample of July 22, 2015 was perceived, by this investigator, as reflecting a substantial odor-match fidelity (i.e. estimated at >60%) to that which was sensed directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary during the area visit in late March; (**6**) the **Unk 12.86** chromatographic isolate fraction, when collected in whole-air form from **Bridgeton Landfill** site-exposed geomembrane headspace, yielded an odor character which this investigator perceived as reflecting a relatively high-fidelity odor-match (i.e. estimated at >70%) to the combined odor which was sensed in late March directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary and (**7**) the **Unk 12.86** chromatographic isolate fraction, when collected in whole-air form from site-exposed **Bridgeton Landfill** geomembrane headspace, and combined into an expanded, 3 component, odor-match formulation yielded an odor character which this investigator perceived as reflecting a relatively high-fidelity odor-match (i.e. estimated at ~80%) to the combined odor which was sensed in late March directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary.

Independent sensory panel odor-match fidelity grading of the proposed formulation has not been possible as of the time of this writing. This results from a combination of: (**1**) the unknown chemical ID status of **Unk 12.86** and (**2**) the potential constraints imposed by the NIH OHRP (i.e. Office of Human Research Protections) human subject testing guidelines in relation to that

uncertainty. Efforts to address these constraints are on-going; both through the resolution of the chemical ID barrier and through pursuit of a protocol review / approval of an independent IRB (i.e. Institutional Review Board).

I. Objective:

The objective of this investigation was execution of a direct, at-site odor assessment and odorant prioritization by this investigator, under contract to the Missouri Attorney General's Office, for the air environment downwind of the **Bridgeton Landfill** operation. The environmental odor character and odorant prioritization results which are summarized in the sections which follow were developed relative to the following physical samples and at-site air sampling efforts.

Environmental Sampling Sessions

- **Environmental Odor Assessment; Session #1**; beyond fence line downwind odor assessment carried out Sunday, March 29, 2015 between @1200 hrs. and @1700 hrs.
- **Environmental Odor Assessment; Session #2**; beyond fence line downwind odor assessment carried out Monday, March 30, 2015 between @0630 hrs. and @1600 hrs.

- **Environmental Odor Assessment and Air Sampling; Session #1**; beyond fence line downwind odor assessment and direct SPME air sampling carried out Monday, March 30, 2015 between @1730 hrs. and @2030 hrs.
- **Environmental Odor Assessment and Air Sampling; Session #2**; beyond fence line downwind odor assessment and direct SPME air sampling carried out Tuesday, March 31, 2015 between @0730 hrs. and @0930 hrs.

- **Environmental Odor Assessment and Air Sampling; Session #3**; on-site composite odor assessment and direct SPME air sampling carried out Tuesday, July 21, 2015 between @1415 hrs. and @1530 hrs.
- **Environmental Odor Assessment and Air Sampling; Session #4**; on-site composite odor assessment and direct SPME air sampling carried out Wednesday, July 22, 2015 between @0915 hrs. and @1030 hrs.

Physical Bridgeton Landfill Samples

- **Bridgeton Landfill Leachate;** Collected on April 09, 2015; Received on April 10, 2015.
- **Bridgeton Landfill Geomembrane – Site-Exposed;** Collected on May 29, 2015; Received on May 30, 2015 @ 1020 hrs.

- **Bridgeton Landfill Geomembrane – Pristine;** Collected and Received on-site on July 22, 2015.
- **Bridgeton Landfill Geomembrane – Site-Exposed;** Collected and Received on-site on July 22, 2015.

II. Experimental Procedure Summaries:

The following Parameters List presents a summary of the initial chromatographic parameters utilized for this MDGC-MS-Olfactometry survey work-up.

Parameters List

Instrument: Agilent 6890 Gas Chromatograph / 5975 B MSD modified for multidimensional gas chromatography-mass spectrometry-olfactometry (MDGC-MS-O) utilizing an AromaTrax™ control system from **MOCON Inc**.

Injection Temperature: 250°
Detector #1: Flame Ionization; Temperature 280°C
Detector #2 (a): Agilent 5975 MSD in ms-Scan or ms-SIM mode.
Column # 1: 12 meter x .53mmID BPX 5 - 1.0um film (pre-column from SGE)
Column # 2: 25 meter x .53mmID BPX 20 - 1.0um film (analytical column from SGE)
Column Temperature Program (overview survey and MDGC-MS-O): 40°C initial, 3 min hold, 7°C/min., 220°C final, 20 minutes hold

Injection Mode: Split-less Solid Phase Microextraction (i.e. SPME)

Sample preparation for composite odor and odor profile survey series; leachate samples: Odor samples were collected from the equilibrated headspace formed within 1 quart glass headspace vessels containing 1.1 gm. of undiluted liquid leachate sample, injected onto an inverted filter paper cone substrate. The inverted filter paper cone substrate was formed from a 150 mm diameter Whatman #1 filter paper disc which was folded in half twice before opening into the final cone form. The samples were equilibrated, stored and sampled in an open air laboratory environment which was maintained @ 24 degC. Direct comparison samples were collected utilizing a single, designated, 1 cm / 75 um Carboxen modified polydimethyl siloxane SPME (solid phase micro-extraction) fiber from Supelco (i.e. SPME fiber **#24**). Headspace volatiles were collected by way of SPME fiber insertion through a pinhole placed in the vessels' PTFE disc closures. Volatiles loadings on the SPME fiber were varied by altering the length of time the fiber was exposed to the equilibrated headspace formed within the vessel.

Sample preparation for odor profile survey series; direct environmental air samples: A series of direct environmental air samples were collected and analyzed in conjunction with this current effort, utilizing a direct SPME fiber exposure approach. The SPME fibers which were prepared for this segment of the project were: **(a)** preconditioned @260 degC by this investigator utilizing the instrumentation resources of **MOCON Inc., Texas Laboratory**; **(b)** transported by this investigator, under dry-ice storage conditions, to the **Bridgeton Landfill** site on March 29, 2015 for execution of on-site upwind and downwind VOC collection by direct SPME fiber exposure and **(c)** return transported by the this investigator, under dry-ice conditions back to the **MOCON Inc., Texas Laboratory** for execution of the analytical, odorant prioritization segment of the investigation. **Figure #1** below presents a general image of the environmental sampling process by direct SPME fiber exposure. In this case, the preconditioned SPME sampler is shown secured within a field-support fixture; the adsorbent coated fiber tip shown retracted back into the protective needle sheath (i.e. in preparation for exposure to the environment to initiate sample collection). Environmental VOCs were collected by way of direct SPME fiber exposure to the on-site and downwind environments. Volatiles loadings on the SPME fibers were varied by

altering the length of time the SPME fibers were exposed to the air environments. As shown in the **Table IV** listing below, a fiber exposure interval of 15 minutes was applied to the **upwind reference** air sample collection while 15 to 98 minute exposure intervals were applied to the **downwind** SPME fiber collection series.

Figure 1: SPME sampler stand with 1 field SPME fiber in place.

Sample preparation for odor profile survey series; grab environmental air samples: In an effort to off-set the challenges brought about by transient odor events (i.e. the momentary, fleeting nature of environmental odor events often brought about by shifting wind conditions and associated shifting of targeted odor plumes) a sampling variation was applied during the sampling sessions of March 30 and March 31. In addition to the direct SPME fiber exposure air sample collections summarized above, three alternate collections were taken in which the SPME fiber exposures were applied to momentary grab 'capture' air samples. These grab samples were collected by this investigator over a 2-3 second interval (i.e. **Figure 2** and **Figure 3** below); attempting to coincide that collection with perceived momentary peak odor events. The odor queued air sample collections were captured within 1 liter metalized FEP (i.e. metalized fluorinated ethylene polymer) gas sampling bags before immediately transferring onto SPME fibers; exposing the SPME fiber to the captured odorous air contents within the bag. All other SPME fiber preconditioning and logistics handling parameters were as described above for direct environmental air sampling.

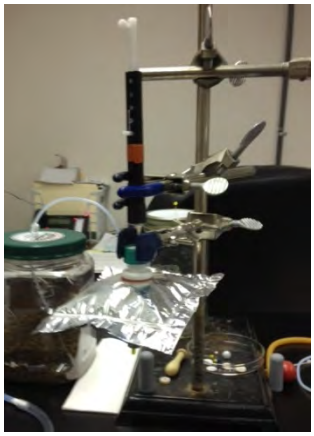


Figure 2: Awaiting odor queued grab collection event. **Figure 3:** SPME fiber sampling of bag capture air sample.

MDGC separations were carried out with heart-cuts of the selected regions of the non-polar pre-column effluent taken to the polar second column for additional chromatographic separation followed by detection utilizing either ms-SIM or ms-SCAN mode mass spectrometric detection. Operating in parallel with the mass spectrometric electronic detection, odor detection was also carried out at the olfactory detector (i.e. 'sniff port') by this investigator.

Environmental Odor Assessments of the Bridgeton Landfill Area: Phase I odor assessment and sampling efforts were performed by this investigator during two separate visits to the area. The first was a beyond fence line, visit between Sunday, March 29, 2015 @ 1200 hrs. and Tuesday, March 31, 2015 @ 1030 hrs. The next were 2 scheduled, on-site visits; Tuesday, July 21, 2015 @ 1415 hrs. to @ 1530 hrs. and Wednesday, July 22, 2015 @ 0915 hrs. to @ 1030 hrs. Downwind assessments during the March visit were carried out utilizing a combination of approaches, including: (**1**) overview odor survey utilizing vehicle patrolling of a public road network circling the Bridgeton Landfill operation; (**2**) local area foot patrols were used for refined odor assessments subsequent to significant event encounters during gross vehicle survey and (**3**) stationary, point surveys carried out at fixed downwind locations during periods of generally stable wind conditions. The overview vehicle surveys generally utilized a route ~ 4.9 miles in length which encompassed a total area of approximately 1.0 square mile (i.e. beginning St. Charles Rock Rd. at Boenker Ln.; NW to Corporate Exchange Dr; SW to Rider Trail S; NW to Rte. 141; NW to St. Charles Rock Rd. and SE back to Boenker Ln). In addition to this 'screening' circuit, additional spur survey assessments were taken down Taussig Rd and Foerster Rd. These primary routes resulted in source-to-receptor separation distances ranging from approximately 25 yards to 1.0 mile (i.e. referenced to the approximate nearest fence line of the **Bridgeton Landfill**).

III. Results:

Based upon the initial beyond fence line odor assessment visit of March 29th to March 31st, 2015 the following odorous compound(s) represent, from this investigator's perspective, the most significant downwind odor impact relative to the **Bridgeton Landfill**.

Table I
Primary – Downwind Odor Impact

Odor Ranking	Retention Time (min)	Descriptor	Tentative Identification
1	**12.86**	**'characteristic', 'solventy', 'ketone', 'resiny'**	**unknown**

Secondary – Potential Downwind Odor Modifiers

Odor Ranking	Retention Time (min)	Odor Descriptor	Tentative Identification

In addition;

Based upon the follow-up, scheduled, on-site odor assessment visits of July 21st and July 22nd, 2015 and odor assessment of submitted physical samples, the following expanded odorous compound listing represents, from this investigator's perspective, the most significant potential impact-priority odorant subset relative to the **Bridgeton Landfill**. An attempt has been made to list the prioritized odorants in an approximate descending order with respect to perceived relative significance (i.e. perceived odor impact-priority from the perspective of this investigator).

Table II
Primary – Downwind Odor Impact

Odor Ranking	Retention Time (min)	Descriptor	Tentative Identification
1	**12.86**	**'characteristic', 'solventy', 'ketone', 'resiny'**	**unknown**

Secondary – Odor Modifiers

Odor Ranking	Retention Time (min)	Descriptor	Tentative Identification
2	15.8	'musty', 'nutty', 'stale coffee grounds'	2-dimethyl-3(5 or 6)-ethyl pyrazine
3	21.2	'smoky', 'medicinal'	guaiacol
4	13.8	'sulphurous', 'fecal'	dimethyltrisulfide

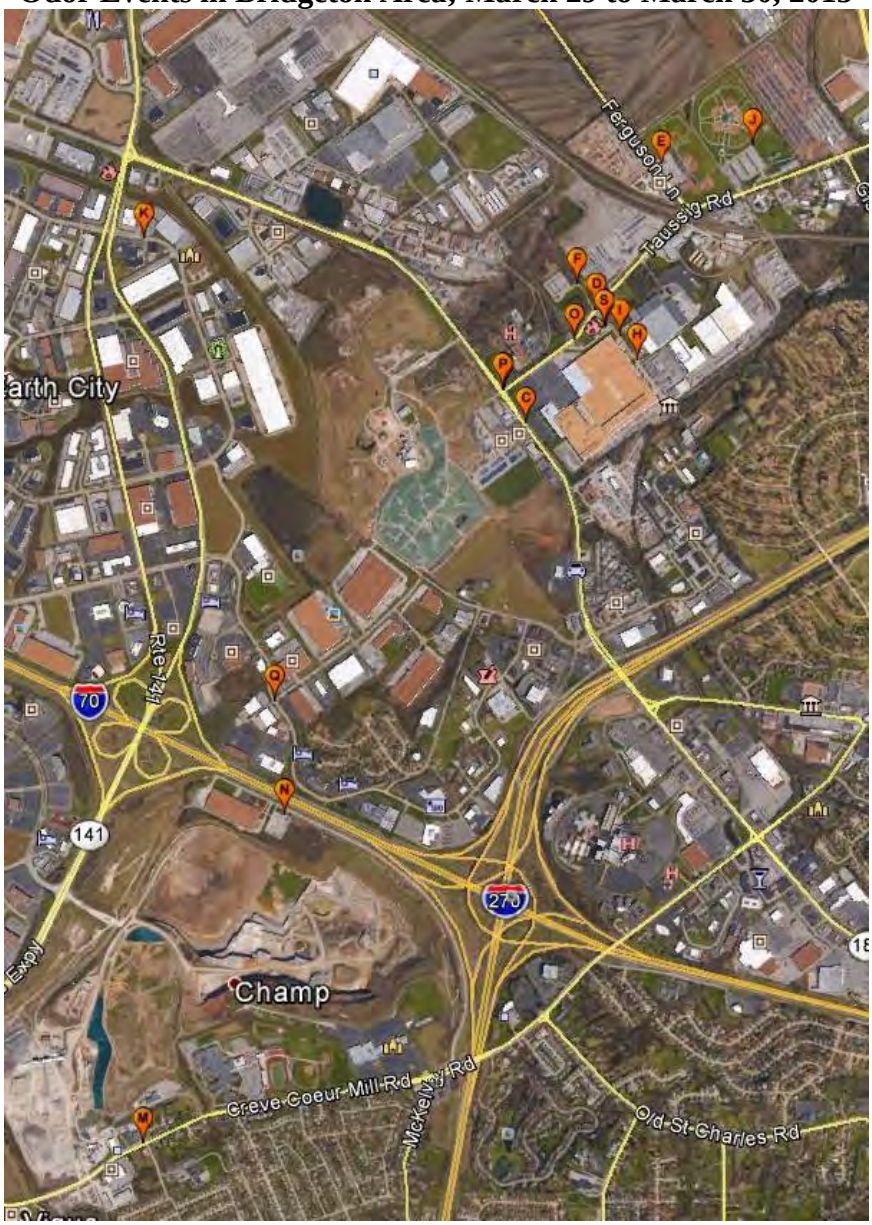
The odorant prioritizations listed above were derived from this investigator's attempt to correlate the following chronological listing of personally encountered environmental odor events (i.e. **Table III** and Google Earth **Photo I**) with the subsequent analytical prioritizations of individual chemical odorants present.

Table III
Bridgeton Landfill Area Visit of March 29, 2015 through March 31, 2015; Chronological Odor Events Log and Downwind Composite Odor Characterizations

Location (Google image code)	**Date & Time**	**Location Coordinates**	**Wind** dir / ws	**Composite Odor Descriptors**
Taussig rd. x Enterprise rd. **(A)**	Sun, 03-29-15 1205 hrs.	38.77279 N -90.43483W	173 - S 9.0	'chemical', 'solventy', 'not sulfury'
Taussig rd. x Enterprise rd. x St. Charles Rock rd. **(B)**	Sun, 03-29-15 1530 hrs.	38.77279 N -90.43483W	231 - SW 9.2	'chemical', 'solventy', 'not sulfury'
St. Charles Rock rd. Hussmann vicinity **(C)**	Sun, 03-29-15 1700 hrs.	38.76811 N -90.43847W	232 - SW 5.4	'chemical', 'solventy', 'not sulfury'
Taussig rd. **(D)**	Mon, 03-30-15 0635 hrs.	38.77279 N -90.43483W	203 - SSW 0.9	'chemical', 'solventy', e.g. MIBK, e.g. acrylate
Community park on Taussig rd. **(E)**	Mon, 03-30-15 0710 hrs.	38.77863 N -90.43134W	210 - SSW 1.1	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (1/5)

MSD drive on Taussig rd. **(F)**	Mon, 03-30-15 0745 hrs.	38.77380 N -90.43577W	213 - SSW 2.0	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (2/5)
Fire station on Taussig rd. **(G)**	Mon, 03-30-15 0755 hrs.	38.77205 N -90.43426W	200 - SSW 1.6	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (2/5)
Schuck's on Enterprise rd. **(H)**	Mon, 03-30-15 0758 hrs.	38.77070 N -90.43259W	210 - SSW 3.6	'garbage', 'slight sulfury' (1/5)
Store Supply on Enterprise rd. **(I)**	Mon, 03-30-15 0800 hrs.	38.77172 N -90.43350W	216 - SW 3.8	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (2/5)
Community park on Taussig rd. **(J)**	Mon, 03-30-15 1020 hrs.	38.77953 N -90.42652W	233 - SW 6.3	'chemical', 'solventy', e.g. MIBK, 'not sulfury'
Downwind near Hummert Facility **(K)**	Mon, 03-30-15 1040 hrs.	38.77568 N -90.45857W	211 - SSW 4.5	'cereal', 'hay', 'mulchy', 'fermentation'
Downwind near Scott Facility **(L)**	Mon, 03-30-15 1040 hrs.		211 - SSW 4.5	odor faint, if at all
Downwind near asphalt plant; Creve Coeur rd. **(M)**	Mon, 03-30-15 1055 hrs.	38.73859 N -90.45852W	224 - SW 5.2	'asphalt'
Downwind near Champ Landfill **(N)**	Mon, 03-30-15 1120 hrs.	38.75204 N -90.45112W	251 - WSW 4.7	'swinebog', 'pig sty', 'manure' (2/5)
Fire station on Taussig rd. **(O)**	Mon, 03-30-15 1320 hrs.	38.77153 N -90.43588W	260 - W 4.3	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (1/5)
Taussig rd. x St. Charles Rock rd. **(P)**	Mon, 03-30-15 1500 hrs.	38.76947 N -90.43960W	180 - S 3.8	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (2/5)
Corporate Exchange rd. x Rider's Trail S rd. **(Q)**	Mon, 03-30-15 1505 hrs.	38.75671 N -90.45166W	178 - S 4.0	'swinebog', 'pig sty', 'manure' (1/5)
Taussig rd. x St. Charles Rock rd. **(R)**	Mon, 03-30-15 1545 hrs.	38.76947 N -90.43960W	203 - SSW 15.2	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (1/5)
Fire station on Taussig rd. **(S)**	Mon, 03-30-15 1600 hrs.	38.77207 N -90.43432W	232 - SSW 9.2	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (1/5)
near NW Industrial Ct x St. Charles Rock rd. **(T)**	Mon, 03-30-15 ~2045 hrs.	38.77237 N -90.44258W	143 - SE 2.5	'chemical', 'solventy', e.g. MIBK, 'not sulfury' (2/5) ~eastern plume boundary

Google Earth Photo I
Odor Events in Bridgeton Area; March 29 to March 30, 2015



The odorant prioritization listed in **Table I** above was derived from this investigator's attempt to correlate the chronological listing of the personally encountered environmental odor events (i.e. **Table III** and Google Earth **Photo I** above) with the analytical prioritizations of individual chemical odorants based upon the air sample collections and sampling locations listed / shown in **Tables IV** and **V** which follow:

Table IV
SPME Sampler Distribution – Monday, March 30 ~1730 hrs. to ~2030 hrs.

Sample Point & Fiber	coordinates	start time	span	type	data file
			min		

Location #1 **Ceiling Center Inc.** **SW Fence line**	38.76666 N -90.43813 W				
Sample #1 (#5C)		1748	15	direct	mago012
Sample #2 (#07)		1748	26	direct	mago013
Sample #3 (#B)		1748	26	direct	mago008
Sample #4 (#8)		1838	30	grab	mago009
Location #2 **Northwest Auto Corner**	38.76906 N -90.43991 W				
Sample #5 (#1)		1928	15	direct	mago015
Sample #6 (#3)		1928	30	direct	retained
Sample #7 (#4)		1928	30	direct	mago017
Sample # ()					
Location #3 (upwind ref) **Foreshaw Parking Lot**	38.76068 N -90.44469 W				
Sample #8 (#02)		2021	15	direct	mago014
Sample # ()					
Other					
Sample # ()					
Sample # ()					

Table V

SPME Sampler Distribution – Tuesday, March 31 ~0730 hrs. to ~0930 hrs.

Sample Point & Fiber	coordinates	start time	span	type	data file
			min		
Location #4 **DNR Trailer**	38.76605 N -90.43605 W				
Sample #1 (#50)		0737	58	direct	mago016
Sample #2 (#09)		0737	55	direct	mago010*
Sample # ()					
Sample # ()					
Location #5 **DNR Trailer off-set NW**					
Sample #3 (#sbir)	38.76630 N -90.43623 W	0752	30	grab	mago011
Sample #4 (#09)	38.76658 N -90.43651 W	0810	30	grab	mago010*
Sample # ()					
Sample # ()					

Location #					
Sample # ()					
Sample # ()					
Other					
Sample # ()					
Sample # ()					

Comments * As a result of perceived transient nature of odor events encountered, I opted to redirect / combine the SPME fiber #09 from direct to peak-event grab sampling service; the results reflecting a composite of the two sampling processes. It is noteworthy that the odor character perceived for the expelled bag 'capture' contents, after SPME fiber transfer, was strong and characteristic of the targeted 'chemical', 'solventy', 'ketone' descriptions previously applied to the encountered downwind composite odor events.

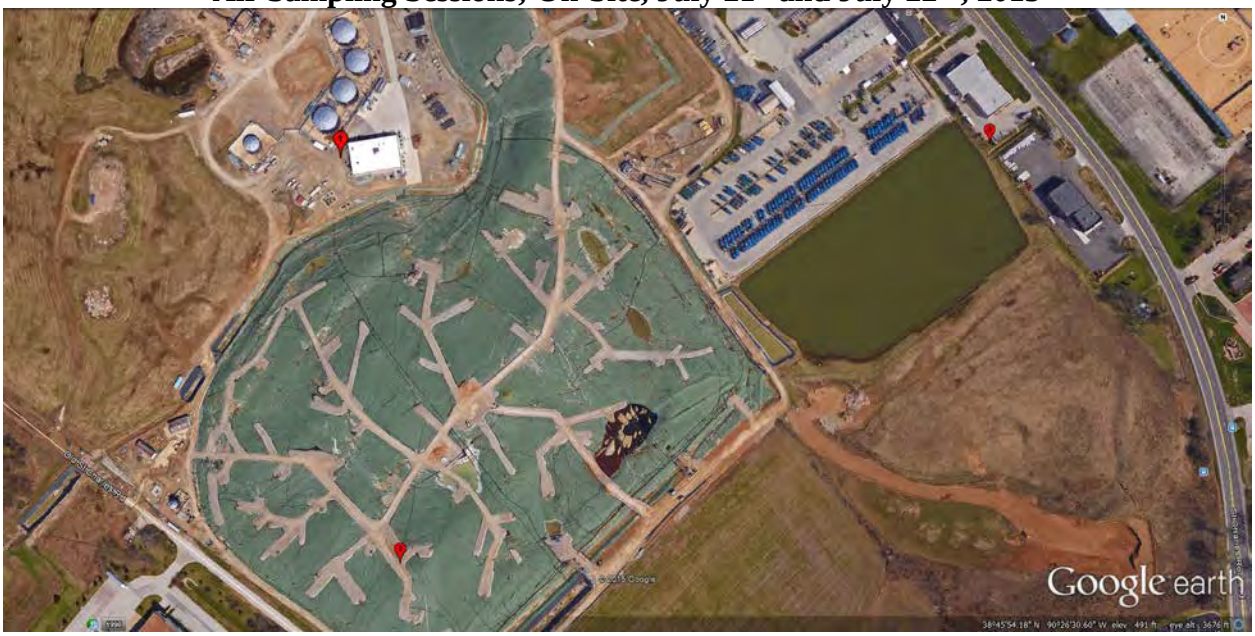
Google Earth Photo II
Air Sampling Sessions, Beyond Fence line, March 30th and March 31st, 2015

Table VI
SPME Sampler Distribution; On-Site – Tuesday, July 21 ~1350 hrs. to ~1530 hrs. and Wednesday, July 22 0850 hrs. to ~1030 hrs.

Sample Point & Fiber	coordinates	start time	span	type	data file
		day / time	min		
Location #1 Leachate Pre-treat Area	38.76642 N -90.44489 W				
Sample #1 (#21)		Tue /1425	5	direct	mago152
Sample #2 (#31)		Tue /1425	5	direct	NA

Sample #3 (#22)		Tue /1425	15	direct	mago157
Sample #4 (#32)		Tue /1425	15	direct	NA
Sample #5 (#23)		Tue /1425	45	direct	mago153
Sample #6 (#33)		Tue /1425	45	direct	NA
Location #2 GEW-26R Vicinity	38.763058 N -90.444151 W				
Sample #7 (#24)		Wed / 0935	30	direct	mago154
Sample #8 (#34)		Wed / 0935	30	direct	NA
Sample #9 (#25)		Wed / 0935	30	direct	mago158
Sample #10 (#35)		Wed / 0935	30	direct	NA
Location #3 Ceiling Company S corner (Upwind Reference)	38.76653 N -90.43795 W				
Sample #11 (#26)		Wed / 1444	30	direct	mago155
Sample #12 (#36)		Wed / 1444	30	direct	NA
Blank Fiber Transported / Not Sampled					
Sample #13 (#50)	NA	NA	NA	NA	mago159
Sample #14 (#cteh01)	NA	NA	NA	NA	mago156

Google Earth Photo III
Air Sampling Sessions; On-Site, July 21st and July 22nd, 2015



IV. Narrative Summary:

The following is a narrative summary of this investigator's efforts to prioritize the odorous emissions carried downwind of the **Bridgeton Landfill** operation at the time of the at-site, beyond fence line odor assessment of March 29th through March 31st, 2015.

First Bridgeton Landfill At-Site, Beyond Fence line Odor Assessment and Air Sampling Visit; March 29th to March 31st, 2015

Prioritized Downwind Odor from March 29 to March 31, 2015: Although limited to a single, 2-day, beyond-fence line odor assessment of the **Bridgeton Landfill** area in late March, a significant conclusion could still be drawn, by this investigator, from the observations made during that period. Specifically, there was observed a persistent, characteristic odor which, in this investigator's opinion, justified assignment of an odor impact-priority ranking at the time of that visit. This priority ranking assignment is for an environmental odor which, at its outer boundary, was consistently perceived by this investigator as 'characteristic', 'ketone', 'solventy' and 'chemical'. This investigator's opinion that impact-priority status is warranted for this environmental odor derives from: (**1**) its observed consistency of perceived odor character; (**2**) its greater frequency of encounter at-distance, downwind of the **Bridgeton Landfill** source; (**3**) its greater downwind reach relative to the **Bridgeton Landfill** source (i.e. a distance up to 1 mile) and (**4**) confirmation from accompanying DNR representatives that the observed odor was consistent with the odor character which, historically, has been the focus of downwind citizen complaint.

Competing Composite Odors from March 29 to March 31, 2015: It is this investigator's opinion that impact-priority ranking is warranted for the above described odor in spite of the fact that other, distinctly different odor emissions were sporadically detected in traversing the area surrounding the **Bridgeton Landfill** operation. This included, most notably, a 'swinebog', 'pig sty', 'manure' odor which was detected at two locations: (**1**) adjacent to the Champ Landfill NE fence line @1120 hrs. on March 30 and (**2**) near the intersection of Corporate Exchange Dr. and Rider Trail S @1505 (i.e. a distance @.33 mile north from the earlier Champ Landfill sighting). Additionally observed, limited reach, transient odor events of Monday, March 30th included: (**3**) a 'stale garbage', 'slight sulfury' odor event on Enterprise Rd. @0758 hrs.; (**4**) a 'cereal', 'hay', 'mulchy', 'fermentation' transient odor event adjacent to Hummert International @1040 hrs. and (**5**) a characteristic 'asphalt' transient odor event on Creve Coeur Rd @1055 hrs. From the perspective of this investigator, the odor character of these competing, transient odors should not be confused with the priority 'characteristic', 'ketone', 'solventy' and 'chemical' odor described in the paragraph above. Likewise, none of these competing odors were believed to warrant priority status; all lacking the downwind reach, frequency of encounter and indicated DNR link to citizen complaint.

Air Sampling Session #1; Ceiling Center Inc. SW fence line; March 30th 1730 hrs. to 1915 hrs.: Based upon a relative constant SW wind direction observed during Monday's odor assessment efforts, a first sampling session was initiated @1730 hrs. at the DNR Summa canister test station located at the Ceiling Center Inc. SW fence line. Unfortunately, accurately predicting upcoming wind direction for planned sampling sessions at a fixed-point location can be challenging, at best.

Such proved to be the case for this session; initial sustained encounters with the targeted odor plume giving way to encounters reflecting reduced odor intensities, reduced frequency of encounter and a more fleeting, transient nature. This observed weakening of the targeted impact-priority odor appeared, at the time, to correspond to a general shifting of the wind direction from a more southerly direction. As summarized in **Table IV** above, against this transient characteristic of the odor events encountered, a series of 3 direct SPME fiber exposures was executed during this first air sampling session. In addition, in an attempt to off-set the challenges of the transient odor characteristic of these events, an additional odor grab sample was collected onto a fourth SPME fiber; completing the first sampling session.

Air Sampling Session #2; Northwest Auto Inc. N corner grass area; March 30th @1915 hrs. to 2000 hrs.: Based upon the observed odor impact reduction brought about by shifting wind conditions during preceding air sampling session at the DNR Summa canister test station, a second session was shifted northward to the Northwest Auto Inc. property. Unfortunately, the situation encountered at the first location was repeated, if not magnified, at this second location. Initial weak and transient encounters with the targeted odor plume gave way to encounters reflecting reduced odor intensities, reduced frequency of encounter and, from this investigator's perspective, even more fleeting nature. This observed further weakening of the targeted odor appeared, at the time, to correspond to a further shifting of the wind direction to a more southerly direction. As summarized in **Table IV** above, against the transient nature of the odor events encountered, a series of 3 additional direct SPME fiber exposures was carried out during this second air sampling session of the evening.

Air Sampling Session #3; Foreshaw Inc. parking lot; March 30th @2000 hrs. to 2030 hrs.: As an upwind reference to Monday's first two **Bridgeton Landfill** downwind air sampling sessions a third session was set up and executed near the SW edge of the Foreshaw Inc. parking lot on Corporate Exchange Dr. As expected, with winds generally out of the south, the perceived 'ketone', 'solventy' impact-priority odor was not detectable, by this investigator, during the time spent sampling this upwind reference location. Neither were there significant competing odors detected during this upwind reference session. As summarized in **Table IV** above, a single direct SPME fiber exposure was carried out during this third, and final, air sampling session of Monday, March 30, 2015.

Air Sampling Session #4; Hussmann parking lot S corner near the DNR emergency response trailer; March 31st @0730 hrs. to 0930 hrs.: Based upon the challenges brought about by shifting wind directions and transient odor events during Monday's first two downwind air sampling sessions, a third and final downwind session was executed on Tuesday morning near the DNR trailer at the S corner of the Hussmann parking lot. Fortunately, the wind conditions were considerably improved relative to those encountered the previous evening; although still transient in nature at this location, the odor events encountered appeared to be more sustained and with a targeted odor plume reflecting increased odor intensities, frequency of encounter and a less fleeting nature than those encountered the previous evening. As summarized in **Table V** above, 2 direct SPME fiber exposures were executed at the time of this final session. In addition, in an attempt to maximize the yield of potentially impact-priority individual odorants, two additional grab samples were collected onto 2 SPME fibers to complete this final sampling session. It is believed noteworthy that the composite odor character perceived for the expelled

bag contents upon completion of the last of the grab collections was noted, by this investigator, as particularly strong and characteristic of the targeted 'chemical', 'solventy', 'ketone' odor. It is also believed noteworthy that SPME fiber #09 was redirected from direct environment collection to peak-event grab sampling service; the results for that fiber reflecting a composite of the two sampling processes. This collection completed the odor assessment and sampling tasks for the first visit to the **Bridgeton Landfill** area; marking close-out of the at-site, beyond fence line phase and initiating a return to the Round Rock, Texas laboratory for the in-laboratory, analytical phase of the investigation.

Analytical Odorant Prioritization by MDGC-MS-O; for Beyond Fence-Line; March 29th to March 31st, 2015

Odorant Prioritization Analytical Session #1; Working from a prioritized SPME fiber ranking, the first, exploratory, series of 3 MDGC-MS-O based odor profile and odorant prioritization analyses were performed on Thursday, April 02, 2015. The fiber prioritization assignments are believed noteworthy given the odorant prioritization results which would emerge from this first analytical series. In advance of the analytical session, the order of analysis was scheduled as (**1**) **SPME fiber #B**; a 66 min direct environmental exposure collected during the first air sampling session (i.e. at the Ceiling Center fence line); (**2**) **SPME fiber #8**; a 30 min indirect, grab sample exposure also collected during that first air sampling session and (**3**) **SPME fiber #9**; a combined 55 min direct environmental exposure + 30 min grab sample exposure during the final air sampling session of Tuesday morning, May 31st (i.e. near the DNR emergency response trailer at the S corner of the Hussmann parking lot). These fiber prioritizations were assigned, intentionally, as a result of the 'single-shot' nature of SPME fiber based air sampling analysis, to achieve, in turn; **Run #**(**1**) testing / conditioning the instrument and this investigator with a sample which was predicted least likely to produce a significant VOC / odorant yield (i.e. as a result of the shifting wind direction and transient odor events noted at the time of collection); **Run #**(**2**) further testing / conditioning the instrument and this investigator with a sample which was predicted to carry a greater likelihood of producing a significant VOC / odorant yield (i.e. as a result of the grab odor capture technique which was applied during that same session in an effort to off-set the noted shifting wind direction and associated transient odor events) and, finally, **Run #**(**3**) the sample predicted to carry the greatest likelihood of producing a significant VOC / odorant yield. The latter prediction / assignment of priority for **SPME fiber #9** was based upon three considerations: **(a)** its collection from a sample reflecting an odor queued momentary grab capture of a peak odor-event; **(b)** its collection during a sampling session reflecting a perceived greater frequency and intensity of targeted impact-priority odor events; **(c)** from indicated success of the momentary peak odor event grab capture attempt (i.e. evidenced by a strong, characteristic odor which was noted upon assessment of the discharged contents from the air sampling bag after completion of the transfer collection onto **SPME fiber #9)** and **(d)** from the perspective of this investigator, a very close match of the targeted 'ketone', 'solventy' odor character with that of the discharged contents of the grab sample bag at the time of that assessment. This initial survey odorant prioritization session was completed with this third analysis. From the perspective of this investigator, a significant conclusion could be drawn from this initial effort regarding the priority odorous chemical composition believed to be primarily responsible for the characteristic 'ketone', 'solventy' odor which had consistently been observed at-distance downwind of the **Bridgeton Landfill** during this investigator's area assessment of

March 29th through March 31st, 2015. The targeted odor appeared to be primarily carried by an, as-yet unidentified, chemical odorant or odorants, eluting at approximately the 12.86 min retention time on this investigator's integrated AromaTrax™ MDGC-MS-O system; a compound, or compounds, denoted herein as **Unk 12.86.** Although this conclusion could be drawn relatively early in the investigative process, scores of additional MDGC-MS-O runs were subsequently carried out by this investigator in an attempt to answer several related questions regarding this single, high-impact odor response and its relationship to the characteristic **Bridgeton Landfill** at-distance odor which was observed by this investigator during the area assessment of late March, 2015. The follow-on analytical efforts undertaken to address these questions included: (**1**) development of an MDGC-MS-O based isolation clean-up method targeting **Unk 12.86;** (**2**) application of the MDGC-MS-O based isolation clean-up method to the attempted determination of the chemical identity of **Unk 12.86**; (**3**) application of the MDGC-MS-O based isolation clean-up method to determination of the connection between **Unk 12.86** and the **Bridgeton Landfill** air emission; (**4**) application of the MDGC-MS-O based isolation clean-up method to determine the connection between **Unk 12.86** and material samples from the **Bridgeton Landfill**; (**5**) attempts to odor profile and prioritize odorants based upon the headspace VOC composition formed above a leachate sample obtained from **Bridgeton Landfill;** (**6**) attempts to odor profile and prioritize odorants based upon the headspace VOC composition formed above site-exposed geomembrane samples obtained from **Bridgeton Landfill** and (**7**) application of the MDGC-MS-O based isolation clean-up method to the physical isolation of the **Unk 12.86** fraction for preliminary odor-match fidelity grading by independent odor investigators or sensory panels.

Odorant Prioritization Analytical Sessions #2 and #3; Continuing with the prioritized SPME fiber listing, a second and third, exploratory, series of 7 MDGC-MS-O based odor profile and odorant prioritization analyses were performed between Friday, April 03 and Saturday, April 04, 2015. Of the remaining 7 fiber collections, only 3 presented with detectable odor responses for **Unk 12.86**; (**1**) a 58 minute direct SPME fiber exposure on Tuesday morning at the DNR trailer; presenting with a relatively strong response for **Unk 12.86**; (**2**) a 15 minute direct SPME fiber exposure on Monday evening at the Ceiling Center fence line; presenting with a distinct but relatively weak response for **Unk 12.86** and (**3**) the second grab capture sample of Tuesday morning at the DNR trailer with indirect SPME fiber exposure of 30 min duration; presenting with a relatively weak response for **Unk 12.86**. Beyond these positive responses for **Unk 12.86** the balance of the fiber collections presented as below the limit of detection of this investigator; including the direct upwind reference sample collected on Monday evening in the Foreshaw parking lot, 2 direct collections at the Northwest Auto location on Monday evening and 1 direct collection from the Ceiling Center on Monday evening.

MDGC-MS-O Based Clean-Up / Isolation of Unk 12.86; Utilizing **Bridgeton Landfill** site-exposed geomembrane headspace samples as the surrogate odor source, an MDGC based heart-cut isolation method was developed which targeted **Unk 12.86**. It was experimentally determined that a timed heart-cut event; transferring the pre-column effluent eluting between retention times 10.55 min and 10.90 min to the analytical column, effectively isolated the targeted **Unk 12.86** odorant from the bulk of potential VOC interference peaks and odorants. This 21 sec. transfer window represented less than 2% of the total precolumn VOC separation profile of 21 min. It was further determined experimentally, that an 8.4 second whole-air fraction collection, when

taken at the olfactory detector from this initial 21 sec heart-cut separation band; further refined the targeted **Unk 12.86** fraction (i.e. essentially constituting a heart-cut of a heart-cut). Mechanically, an inert polyolefin gas-tight syringe was used to 'vacuum' aspirate this 8.4 sec fraction (i.e. between 12.79 min and 12.93 min) capturing the targeted **Unk 12.86** peak as it eluted to the olfactory detector. This 2-stage clean-up fraction represented less than 0.7% of the extremely complex 21 minute total injected precolumn VOC profile; collected from the headspace of the **Bridgeton Landfill** geomembrane sample.

MDGC-MS-O Based Clean-Up / Isolation Applied to Attempted Chemical Identification of Unk 12.86; Utilizing **Bridgeton Landfill** site-exposed geomembrane headspace samples as the surrogate odor source, in conjunction with the optimized MDGC-MS-O isolation clean-up method, considerable efforts were applied to the chemical identification of **Unk 12.86**. Unfortunately, these efforts, to date, have been unsuccessful in yielding a conclusive chemical identification match for the **Unk 12.86** target. This is in spite of isolation of, what appears to be, a high purity mass spectral ion profile and the engagement of multiple subcontracted GCMS experts for independent interpretation of this refined mass spectral profile. Independent experts have included: (**1**) Anna Iwasinska of MOCON Inc. and (**2**) Dr. Steven Shrader of Shrader Software Solutions. Efforts continue aimed at developing conclusive chemical identification of **Unk 12.86** but, as of the time of this writing, these efforts have been unsuccessful.

MDGC-MS-O Based Clean-Up / Isolation Method Applied to Explore Link Between Bridgeton Landfill Materials and Unk 12.86; Applying the MDGC-MS-O based heart-cut isolation method to physical materials taken from the Bridgeton Landfill, the **Unk 12.86** gas chromatographic fraction isolate was found to be common to: (**a**) the equilibrated headspace VOCs surrounding flexible geomembrane barrier sheeting material which had undergone extended barrier-service exposure to the **Bridgeton Landfill** site and (**b**) the equilibrated headspace VOCs formed above a leachate sample which had been collected from the **Bridgeton Landfill** site on April 09, 2015. In contrast, the **Unk 12.86** chromatographic isolate fraction was found to be relatively absent from a control geomembrane sample which had not seen barrier service on the site; taken on July 22, 2015 from an unused roll being stored on the **Bridgeton Landfill** site.

Second Bridgeton Landfill Area Odor Assessment, On-Site Odor Assessment and Air Sampling Visit; July 21st to July 22nd, 2015

Follow-Up Composite Odor Assessment From July 21st and July 22nd, 2015 On-Site Visits: Two scheduled, on-site visits to the **Bridgeton Landfill** site were carried out on July 21st and July 22nd, 2015. A brief beyond fence line odor assessment was carried out before initiating the on-site composite odor assessments and associated SPME fiber collections. This investigator's impressions from this brief downwind revisit can be summarized as follows: (**1**) the perceived odor character downwind at-distance was consistent with the 'ketone', 'solventy' description as described during the first visit in late March; (**2**) the faint, characteristic odor may have been detected as far south as Harmony Ln and St. Charles Rock Rd upon initial approach to the area @0645 hrs. on July 21st and (**3**) distinct, characteristic odors were detected in the vicinity of the intersection of Boenker Ln and St. Charles Rock Rd @0700 hrs. of July 21st. The on-site odor assessment was initiated @1015 hrs. with an east to west survey walk around the southern

perimeter road, beginning near the reservoir and terminating near the lift station at the western corner fence line at Old St. Charles Rock Rd. Winds were generally out of the north and the 'characteristic'. 'ketone', 'solventy' odor was distinctly to strongly detected in 'packets' of increased intensity; overlaying a relatively constant background 'characteristic' odor. Interspersed within that characteristic 'ketone', 'solventy' odor background were brief encounters with distinctly different odors; to this investigator, warranting descriptors such as 'garbage', 'pine', 'citrus' and 'musty'. From the perspective of this investigator, the composite odor character, perceived as dominant and carrying at-distance downwind from the Bridgeton Landfill operation, was consistent with the 'solventy', 'ketone', 'MIBK-like' odor characterized and prioritized during the first visit in late March, 2015.

On-Site Air Sampling Session #1; Leachate Pre-treat area; Tuesday, July 21st @1350 hrs. to @1530 hrs.: Based upon a late-morning encounter with a perceived high-intensity characteristic odor event during a survey drive-through of the **Bridgeton Landfill** facility, the first sampling session was set up and carried out in the leachate pre-treat area (i.e. approx. 38.76642N; -90.44489W) beginning @1350 hrs. on Tuesday afternoon, July 21st. Unfortunately, the composite odors detected during the session were, at best, transient in nature. The targeted characteristic 'ketone', 'solventy' odor appeared to be the most frequent but, as described above, occasional brief encounters with very different odors were noted; including 'stale coffee ground', 'smoky' and 'pig sty', among others. As summarized in **Table VI** above, against this transient characteristic of the odor events encountered, a series of 6 direct SPME fiber exposures was executed during this first on-site air sampling session; (**1**) fiber #21 and fiber #31 reflecting a 5 minute exposure interval; (**2**) fiber #22 and fiber #32 reflecting a 15 minute exposure interval and (**3**) fiber #23 and fiber #33 reflecting a 45 minute exposure interval. From this 6 sampler series the 20 series fibers were retained by this investigator and returned to dry-ice storage for transport back to the laboratory for analysis. The 30 series fibers were handed over to the **Bridgeton Landfill** representatives for their own reference purposes.

On-Site Air Sampling Session #2; GEW-26R Vicinity; Wednesday, July 22nd @0850 hrs. to @1030 hrs.; Based upon reports from associates of a relatively sustained, high-intensity characteristic odor presence during on-site inspection activities the previous day, the second sampling session was set up and carried out in the GEW-26R vicinity (i.e. approx. 38.763058N; -90.444151W) beginning @0850 hrs. on Wednesday morning, July 22nd. Although, the composite odors detected during the session did reflect, as reported, a more sustained presence and reflected greater general odor intensity they also presented, from the perspective of this investigator, with a discernable transient character. In this case, however, there appeared to be a cyclic shift between the targeted characteristic 'ketone', 'solventy' odor and a distinctly different odor, perceived by this investigator, as reminiscent of 'over-heated petroleum grease' or 'refinery distillation residues'. As summarized in **Table VI** above, against this cyclic shifting of the odor events presenting to the location, a series of 4 direct SPME fiber exposures was executed during this second on-site air sampling session; (**1**) fiber #24 and fiber #34 reflecting a 30 minute exposure interval and (**2**) fiber #25 and fiber #35 reflecting duplicate 30 minute exposure intervals. As done for the previous session, from this 4 sampler, duplicate series the 20 series fibers were retained by this investigator and returned to dry-ice storage for transport back to the laboratory for analysis. The 30 series fibers were handed over to the **Bridgeton Landfill** representatives for their own reference purposes.

Upwind Reference Air Sampling Session #3; Ceiling Center Inc. property, south corner; July 22nd @1430 hrs. to 1515 hrs.: With winds generally from the SE, as follow-up to Wednesday's second **Bridgeton Landfill** on-site air sampling session, a final, upwind reference sampling session was set up and executed near the south corner of the Ceiling Center property (i.e. 38.76653N; -90.43795W), beginning @1430 hrs. on Wednesday, July 22nd. As expected, with winds generally out of the south to southeast, the perceived 'ketone', 'solventy' impact-priority odor were not significantly detectable, by this investigator, during the time interval spent sampling this upwind reference location. However, it is believed noteworthy that occasional, momentary hints of the characteristic odor were detectable during the session. The wind strip indicator at the sampler stand indicated that there were intermittent shifts from a more southerly direction; possibly cutting across the southeastern corner of the **Bridgeton Landfill** property. Beyond this, however, no significant competing odors were detected during this upwind reference session. As summarized in **Table VI** above, duplicate direct SPME fiber exposures were collected during this third, and final, air sampling session of Wednesday, July 22nd, 2015; (**1**) fiber #26 retained by this investigator and returned to dry-ice storage for transport back to the laboratory for analysis and (**2**) fiber #36 handed over to the **Bridgeton Landfill** representatives for their own reference purposes.

Analytical Odorant Prioritization by MDGC-MS-O; for On-Site; July 21st and July 22nd, 2015

Odorant Prioritization Analytical Session #1; **On-Site Collections**; Working from a prioritized SPME fiber ranking from the **Bridgeton Landfill** on-site collections, the first series of 5 MDGC-MS-O based odor profile and odorant prioritization analyses were carried out on Saturday, July 25th, 2015. In advance of the analytical session, the order of analysis was scheduled as: (**1**) **SPME fiber #21**; a 5 min direct environmental exposure collected during the first air sampling session (i.e. in the leachate pretreat area); (**2**) **SPME fiber #23**; a 45 min direct environmental exposure also collected during that first air sampling session; (**3**) **SPME fiber #24**; a 30 min direct environmental exposure collected during the second air sampling session of Wednesday morning, July 22nd (i.e. in the vicinity of GEW-26R); (**4**) **SPME fiber #26**; a 30 min direct upwind reference exposure collected during the third air sampling session (i.e. Wednesday afternoon, July 22nd @1430 hrs. to 1515 hrs.; south corner Ceiling Center) and (**5**) **SPME fiber #CTEH01**; a control blank (i.e. preconditioned, processed for shipment and transported under dry-ice but not exposed).

Odorant Prioritization Analytical Session #2; **On-Site Collections**; A second series of 3 MDGC-MS-O based odor profile and odorant prioritization analyses were performed on Sunday, July 26th, 2015. In advance of the analytical session, the order of analysis was scheduled as: (**1**) **SPME fiber #22**; a 15 min direct environmental exposure collected during the first air sampling session (i.e. in the leachate pretreat area); (**2**) **SPME fiber #25**; a 30 min direct environmental exposure collected during the second air sampling session of Wednesday morning, July 22nd (i.e. in the vicinity of GEW-26R) and (**3**) **SPME fiber #50**; a control blank (i.e. preconditioned, processed for shipment and transported under dry-ice but not exposed). It is this investigator's opinion that several conclusions can be drawn from the combined results of the **Bridgeton Landfill** on-site assessments of July 21st and July 22nd, 2015, including: **(a)** the impact-priority

Unk 12.86 fraction is common to the air emissions from the **Bridgeton Landfill**; **(b)** based upon odorant prioritization results from the vicinity of GEW-26R, additional, potentially high-impact secondary odorants are also common to the **Bridgeton Landfill** emission include: (**1**) 2-ethyl-3-(5 or 6)-dimethyl pyrazine (e.g. 'stale coffee ground', 'musty', 'nutty); (**2**) guaiacol (e.g. 'smoky', 'medicinal') and (**3**) dimethyltrisulfide (e.g. 'fecal', 'burnt', 'sulfurous'). It is believed significant that this same 4-component odorant subset had previously emerged as priority from odorant prioritizations carried out relative to the equilibrated headspace surrounding **Bridgeton Landfill** site-exposed geomembrane samples. However, one conflicting difference emerged with respect to odorant prioritizations; whether derived from the indirect geomembrane surrogate headspace or direct GEW-26R vicinity environment of July 22, 2015. This point of deviation was the reversal of apparent impact dominance of the C4-pyrazine + guaiacol odorant pair relative to that of **Unk 12.86;** the former presenting as dominant in the GEW-26R vicinity direct environmental collections**.** The reason for this priority reversal is unknown at this juncture but is believed to be tied to the cyclic non-uniformity which has been previously noted for the odor plume at that sampling location (i.e. cycling between the targeted characteristic 'ketone', 'solventy' odor and the contrasting 'over-heated petroleum grease' or 'refinery distillation residues').

MDGC-MS-O Based Clean-Up / Isolation Applied to Odor-Match Fidelity Rating Assessments Relative to Unk 12.86; Utilizing **Bridgeton Landfill** site-exposed geomembrane headspace samples as the surrogate odor source, in conjunction with the optimized MDGC-MS-O isolation clean-up and whole-air fraction collection method, additional efforts were applied to develop a method enabling independent verification of this investigator's assignment of odor impact-priority status to **Unk 12.86**. Immediate transfer of the 10 cc **Unk 12.86** fraction to a clean 40 cc headspace vial provides a simple vehicle to present the isolated fraction to independent odor investigators or sensory panels for odor-match fidelity rating of: (**1**) the odor-match quality of the **Unk 12.86** fraction alone relative to that of surrogate odor source materials obtained from the **Bridgeton Landfill** site; (**2**) the odor-match quality of the **Unk 12.86** fraction alone with the odor at-distance downwind of the Bridgeton Landfill operation and (**3**) the odor-match quality of the **Unk 12.86** fraction when combined with additional high-impact secondary odorants from the odorant prioritization process with the odor downwind of the Bridgeton Landfill operation. Independent sensory panel odor-match grading of the proposed formulation has not been possible as of the time of this writing. This results from a combination of: (**1**) the unknown chemical ID status of **Unk 12.86** and (**2**) the potential constraints imposed by the NIH OHRP (i.e. Office of Human Research Protections) human subject testing as a result of that uncertainty. Efforts to address these constraints are on-going; both through the resolution of the chemical ID barrier and through pursuit of a protocol review / approval of an independent IRB (i.e. Institutional Review Board).

The limited odor-match efforts, to date, however, have been successful in supporting the proposed impact-priority status for **Unk 12.86**. Specifically: (**1**) the **Unk 12.86** chromatographic isolate fraction, when collected in whole-air form from **Bridgeton Landfill** site-exposed geomembrane headspace, yielded an odor character which this investigator perceived as reflecting a relatively high-fidelity odor-match (i.e. estimated at >70%) to the combined odor which was sensed in late March directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary and (**2**) the **Unk 12.86** chromatographic isolate fraction, when collected in

whole-air form from site-exposed **Bridgeton Landfill** geomembrane headspace, and combined into an expanded, 3 component, odor-match formulation yielded an odor character which this investigator perceived as reflecting a high-fidelity odor-match (i.e. estimated at ~80%) to the combined odor which was sensed in late March directly within the **Bridgeton Landfill** downwind odor plume, at its outer boundary.

V. Attachments:

A	**Graphics I:** Bridgeton Landfill odorant prioritization; survey VOC and odorous VOC chromatographic profiles
B	**Graphics II:** Geomembrane sample 07222015 EX; Bridgeton Landfill site-exposed; serial dilution ms-SIM and odor profiles
C	**Graphics III Photos:** Bridgeton Landfill; at-site and on-site
D	**Graphics IV Photos:** Bridgeton Landfill Project; in-laboratory
E	**Subcontractor Report #1:** Dr. Stephen Shrader / Shrader Software Solutions, Inc.
F	**Subcontractor Report #2:** Anna Iwasinska / MOCON, Inc.
G	**Biography:** Don Wright