

# **ODOR MANAGEMENT PLAN**

**Bridgeton Landfill  
13570 St. Charles Rock Road  
Bridgeton, Missouri**

**Date: 6-20-2014**

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Figure 1: Facility Site Plan

Figure 2: Daily Odor Self-Inspection Designated Route

## **1.0 INTRODUCTION**

### **1.1 BACKGROUND**

The Bridgeton Landfill (the landfill or the Site) is located on a 214-acre parcel, of which approximately 52 acres has been permitted for municipal solid waste disposal under the conditions of Permit #118912 held by Bridgeton Landfill, LLC (“Bridgeton Landfill”). In accordance with the permit, waste was placed in former limestone quarries which were reportedly about 240 feet deep. The landfill ceased accepting waste at the end of 2004.

### **1.2 PURPOSE OF THE ODOR MANAGEMENT PLAN**

This Odor Management Plan is intended to become an integrated part of daily operations at the Bridgeton Landfill so as to effect diligent identification and remediation of odors generated by the Bridgeton Landfill.

## **2.0 ODOR MONITORING**

This odor monitoring program has been designed to provide guidance in the identification and documentation of odors through the utilization of self-inspections and odor complaint investigations. In addition, this program outlines the general methods by which odor sources can be identified and resolved.

### **2.1 IDENTIFYING THE PRESENCE OF ODOR**

The first step in the process of controlling odors is to determine if odors are present. These two methods of identifying odors and how they are implemented as part of this Odor Management Plan are discussed in the following sections.

#### **Routine Employee Observations**

When any on-site facility employee detects an odor that has sufficient intensity or volume that it could lead to detection off-site, it will be reported to an Environmental Specialist or the Environmental Manager who will investigate to determine the source. The investigator will then assign the proper staff to restore the source area to normal operation to eliminate the odor source. Such on-site investigation, reporting, and remediation are inherent components of the site's standard operating procedures.

### **Self-Inspection**

The primary objective of this method is to identify and mitigate odors from the facility before the odors can result in off-site migration. This is accomplished through the use of regular self-inspections. The self-inspection will be performed at random times with daily and weekly variability until meaningful trend data is collected in order to ensure that trending data is not biased by a pattern in self-inspection. This schedule will then be modified over time in order to include periods of highest historic off-site odor complaints when trending analysis of complaint data allows for the identification of patterns for off-site odor migration potential.

Self-inspection at the facility will be performed on a twice daily basis at minimum. The inspection will be performed by the Site environmental management staff or their designees. The inspection will consist of one or more of these individuals touring the facility perimeter along a pre-planned and consistent route (Figure 2). The focus of this inspection is limited specifically to the tasks detailed in this plan.

Detected odors will be classified with the scale defined by the Nasal Ranger® Field Olfactometer Operations Manual (Attachment 1). This method with accompanying instrument utilizes a "Dilution-to-Threshold" approach where a combination of carbon filtration and unfiltered air pass through the instrument based upon the test value selected on the instrument. These values are separated by 100% carbon filtered air from one another on the device, ensuring a "blank" sample in the progression through the scale. The exact methodology that will be applied is outlined in the previously mentioned Operations Manual (Attachment 1).

In addition to the Nasal Ranger® odors will be classified using the standardized terminology outlined in the St. Croix Odor Parameters Overview (Attachment 2).

The results of the daily odor inspection will be documented in an electronic database via tablet computer. This data shall be completed and maintained as part of the Site Operating Record (SOR). Any odors identified through self-inspection will be mitigated in accordance with the guidance for mitigation provided in the Operations, Maintenance, and Monitoring Plan. The process of self inspection will be as follows:

- Originating from The Bridgeton Landfill, LLC office at 13570 St. Charles Rock Road the inspecting party will drive the designated route from Figure 2 in a clockwise direction.
- This drive shall be performed with windows down (weather dependent) at a slow rate of speed.
- At each of the thirteen (13) designated locations the inspecting party will stop (where safe and in compliance with all traffic laws), turn off the vehicle engine, exit the vehicle, and record any odor observations on the Daily Odor Self-Inspection Form.
- If an odor is documented the investigator will be responsible for tracking back to the source of the odor. If the odor source is determined to be the Bridgeton Landfill the investigator will then request the necessary repair or mitigation. All significant off-site odors (odors evaluated to be >7 on the Nasal Ranger® scale) originating from the Bridgeton Landfill are to have the source and corrective action applied documented.

### **Odor Complaint Investigation**

One of our goals as a company is to be a good neighbor and a contributor to the local community. All real-time odor complaints received will be investigated as soon as is practical within the confines of proper safety protocols and site logistics. A real-time odor complaint is defined as a complaint filed within two hours of the observation time and prior to any significant change in meteorological conditions. The goal of the investigation will be to determine if an odor originates from the landfill site and, if so, to determine the specific source and cause of the odor, and then to remediate the odor. Upon receipt of an odor complaint, the following actions will be taken:

- The complaint will be investigated by the Site environmental management staff.
- The investigation will be documented in a customized electronic database via tablet and will apply the same odor ranking scale as the self-inspection.

- If a complaint is verified (the Bridgeton Landfill investigator confirms that an odor is present and that the landfill cannot be ruled out as a source), the investigator will be responsible for tracking back to the source of the odor, requesting the necessary repair or mitigation, and documenting that the mitigation has occurred.

All off-site odor complaints will be logged in order to provide data for trending analysis of odor complaints in order to better schedule self-inspections and understand potential site problems.

Complaints that are received greater than one hour after the specified time, prior to a significant change in meteorological conditions, or on a different date will be investigated as non-real-time complaints. Non-real-time complaints and real-time complaints received during periods when real-time investigation can not be conducted for safety or site logistics restrictions should still be investigated through a combination of most recent inspection data, weather data, and site work schedules in order to determine if the odor could possibly have originated from the Bridgeton Landfill.

### **Equipment for Odor Inspection and Investigation**

The transmission of odor depends on a number of variables including atmospheric conditions. As a result, an on-site weather station compliant with the EPA Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD) (EPA-450/4-87-007) will be employed to track wind direction, windspeed, humidity, precipitation, and other factors that can impact odor transmission. Data from both inspections and investigations will be recorded via tablet computers equipped with custom built software. This software will automatically log latitude and longitude from the tablet computer's built in GPS device and weather data from the nearest public meteorological station, most likely to be Lambert International Airport. The combination of two different weather station data sets and accurate latitude and longitude data will greatly enhance the mapping and analysis of odor sources.

## **2.2 IDENTIFYING THE SOURCE OF ODOR**

Once the presence of odor is identified through either self-inspection or through investigation of an odor complaint, the source of the odor needs to be identified and coded based on the odor

descriptors selected during the self-inspection. The source of an odor may not be readily identifiable. If the source of the odor is not obvious and cannot be traced immediately to an issue or activity at the facility, the following steps may be used to identify the source of the odor:

- Use data from the on-site weather station. Determine the wind direction, speed, and barometer reading at the time the odor was identified.
- Collect daily facility inspection data from the Site's environmental technician staff.
- Using an aerial photograph or plan of the facility, draw a vector in the same direction as the wind, and intersect the location where the odor was identified. If the vector crosses the facility and the facility is in an upwind position compared to the location where the odor was identified, then determine the facility features and activities that lie along the vector. Compare the identified odor to any potential odor sources along the vector path and then inspect these potential odor sources in the field to identify the source.
- Collaborate with Site environmental technician staff to prioritize repair and remediation efforts on potential sources of off-site odor.
- Perform a follow up self-inspection of the previously impacted areas to verify successful elimination of off-site odors. If not eliminated, repeat this process at varying times of the day, under varying operational conditions, and with varying wind directions until the source of the odor is identified and repaired or remediated.

## **2.3 ODOR MANAGEMENT**

Odor management and landfill gas management are inter-related. Odor management, for purposes of this Plan, will be the temporary measures employed during any work activity at the site that might generate odors such as excavation, significant well maintenance, etc.

### **Odor Management During Excavation**

Any or all of the following may be used to manage odors during excavations into waste material:

- Minimize aerial extent of excavation to the extent required to maintain safe working conditions.
- If necessary, install a portable odor control unit near the excavation site, and install a 1,500 gallon water tank on a suitable pad.

- Use odor control neutralizers at a suitable concentration during the excavation and backfilling process. The concentration can be adjusted as necessary to achieve acceptable neutralization and to more fully neutralize aggressive odors.
- Adjust concentrations and nozzle spacing as necessary during the activities to neutralize the odors.
- During the backfill process, the neutralization process can be discontinued once more permanent landfill gas extraction methods are employed in this area; otherwise maintain neutralization until backfill is completed.

### **Odor Control During Transportation of Excavated Wastes**

Any or all of the following may be used to manage odors during transportation of excavated waste material:

- In most cases, excavated wastes will be placed in a roll-off container or dump truck to transport to the Bridgeton transfer station. The container or dump truck will be tarped following placement of waste.
- The waste may be covered with an odor control product in the container used for transport, when applicable. If wastes require mixing, then a product can be applied following mixing if odors persist from these waste materials. The product must be applied to completely cover the wastes with a thin coating.

### **Odor Management During Gas Emission Activities**

Any or all of the following may be used to manage odors during activities that cause gas emissions:

- The wind location will be monitored during the course of the work to determine if odor modification (neutralizers) should be utilized.
- Install a portable odor control system downwind of the work area.
- Use an odor control neutralizer at a suitable concentration during the excavation and backfilling process. The concentration can be adjusted as necessary to achieve acceptable neutralization and to more fully modify aggressive odors.



## **2.4 REQUIRED DOCUMENTATION**

In order to successfully measure the effectiveness of odor remediation, trend the causes of odors, document complaint follow-up, and focus our efforts on the best possible solutions for odor management, it is necessary to create and maintain proper documentation. This documentation should consist of an electronic database for odor self-inspections and odor complaint investigations, odor mitigation efforts, and the transference of this data into the Site Operating Record.

### **Electronic Database**

In order to optimally track and analyze odor self-inspection and complaint investigation data these tasks will be performed through use of a tablet computer. Data will be logged in the field through a forced choice procedure to ensure uniformity in documentation. This data set will be designed with a compatible format to allow for export of the data into Microsoft Excel® or similar data management software.

### **Odor Mitigation Efforts**

When off-site odors necessitate the implementation of the odor mitigation and control practices outlined in section 2.3 of this plan the effectiveness of these methods will be evaluated and documented for use by the management staff in determining the effectiveness of each method.

In the event that a mitigation method is attempted and found to be ineffective, another mitigation method must be attempted and/or outside experts must be contacted until the facility is successful in controlling odor. The decision-making process in choosing a method to control odor should also be documented. In documenting mitigation efforts, the following information must be recorded:

- The reasoning used in selecting the mitigation process.
- The manner and extent to which the mitigation efforts are made.
- The results of the mitigation effort.

Recording these details may be done through memorandum to the Site Operating Record (SOR).

### **Site Operating Record**

Whenever the daily odor self-inspection or odor complaint investigation is performed, the appropriate document should be completed and maintained on site as part of the SOR. In addition to maintaining these documents in the SOR, all efforts to mitigate odors must be documented in detail. It is important to document all efforts taken to mitigate odors whether or not there have been complaints from the public. The SOR is available for MDNR review per request.

## **2.5 TERM OF MONITORING**

Bridgeton Landfill will perform the odor monitoring program for a period of six months upon acceptance of this Plan. Every 90 days thereafter the Environmental Manager and MDNR will review the results of monitoring and consider modification or discontinuation of the program if actionable results are no longer obtained.

## **ATTACHMENT 1**

**THE  
NASAL RANGER®  
FIELD OLFACTOMETER**



**OPERATION MANUAL**

Version 6.2

*U.S. Patent No.: 6,595,037*



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# NASAL RANGER® FIELD OLFACTOMETER

## INTRODUCTION TO FIELD OLFACTOMETRY

The Nasal Ranger® Field Olfactometer is the “state-of-the-art” in field olfactometry for confidently measuring and quantifying odor strength in the ambient air. The Nasal Ranger® Field Olfactometer, a portable odor detecting and measuring device, determines ambient odor “Dilution-to-Threshold” (D/T) values objectively.

Field olfactometry can be used as a proactive monitoring or enforcement tool for confident odor measurement at property lines and in the neighboring community. Quantifying ambient odor is often needed for the following purposes:

1. Monitoring daily operations (i.e. management performance evaluations),
2. Comparison of operating practices (i.e. evaluating alternatives),
3. Documenting specific events or episodes (i.e. defensible, credible evidence),
4. Monitoring compliance (i.e. compliance assurance for permits),
5. Determination of compliance (i.e. permit renewal),
6. Determination of status (i.e. baseline data for expansion planning),
7. Investigation of odor control effectiveness (i.e. scientific testing),
8. Verification of odor dispersion modeling (i.e. model calibration),
9. Determination of specific odor sources (i.e. investigation of complaints),
10. Verification of complaints (i.e. notice of violation).

The Nasal Ranger® Field Olfactometer, as a nasal organoleptic instrument, provides field olfactometry with a scientific method for dependable ambient odor quantification.

In 1958 the U.S. Public Health Service sponsored the development of an instrument and procedure for **field olfactometry** (ambient odor strength measurement) through Project Grants A-58-541, A-59-541, and A-60-541. The Barnebey-Cheney Company originally manufactured a field olfactometer instrument based on these grants, known as a “scentometer”.

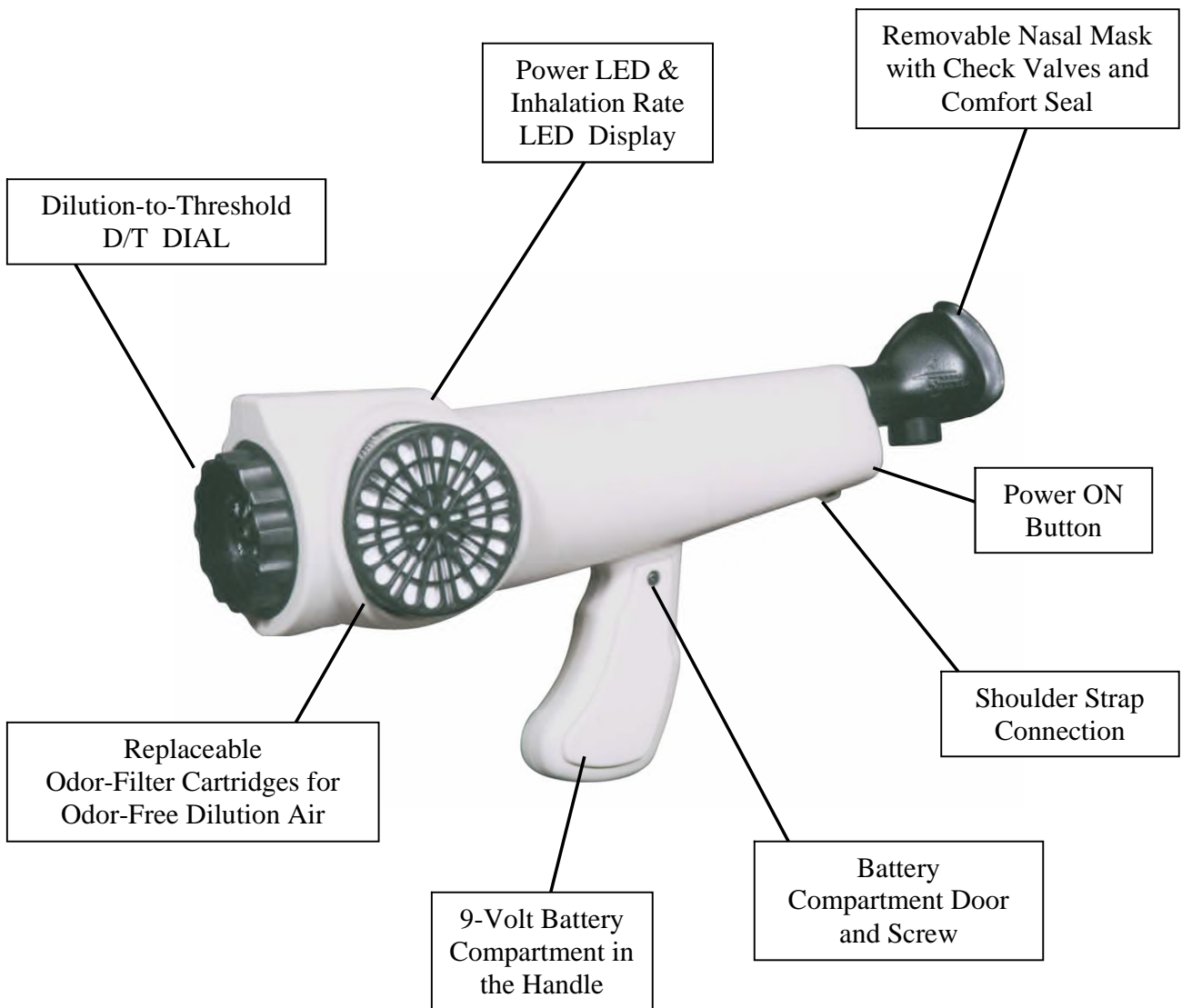
A Nasal Ranger® Field Olfactometer creates a calibrated series of discrete dilutions by mixing the odorous ambient air with odor-free (carbon) filtered air. Field olfactometry defines each discrete dilution level as a “Dilution-to-Threshold,” **D/T**, ratio. The “Dilution-to-Threshold” ratio is a measure of the number of dilutions needed to make the odorous ambient air “non-detectable”.

Field olfactometry calculates the “**Dilution-to-Threshold**” (D/T) ratio as:

$$D/T = \frac{\text{Volume of Carbon-Filtered Air}}{\text{Volume of Odorous Air}}$$

# NASAL RANGER® FIELD OLFACTOMETER

## COMPONENT DIAGRAM



# NASAL RANGER® FIELD OLFACTOMETER

## SAFETY AND MAINTENANCE

The Nasal Ranger® Field Olfactometer is a safe and effective means to quantify odor strength in terms of “Dilution-to-Threshold” (D/T) ratios. Facility operators, community inspectors, and neighborhood citizens can use this instrument to monitor ambient odor strength at specific locations within or around a facility’s property line and within the community.

Please refer to pages 4-7 of this manual for proper operating procedures.

### Safety precautions:

- Be familiar with your surroundings before using the Nasal Ranger® Field Olfactometer.
- Obtain proper permission to use the Nasal Ranger® Field Olfactometer at the desired locations.
- The Nasal Ranger® Field Olfactometer and its related products should not be used for purposes other than its intended purpose.
- The Nasal Ranger® Field Olfactometer is not to be used as a respirator for the reduction or elimination of hazardous chemicals in the air.
- You should not use the Nasal Ranger® Field Olfactometer in atmospheres where contaminant concentrations are unknown, immediately dangerous to life/health, or exceed applicable local standards.
- You should not use the Nasal Ranger® Field Olfactometer in atmospheres that contain less than 19.5% oxygen.
- The Nasal Ranger® Field Olfactometer should not be misused, altered, disassembled, neglected or handled carelessly.
- Use the Nasal Ranger® Field Olfactometer in a stationary position, do not walk or move around with the unit held up to your nose. Remove the unit from your nose before moving to the next measurement location.
- The Nasal Mask is fragile and can break if dropped onto a hard surface. If the Nasal Mask was to become cracked or broken, do not use. Usage of a broken mask could cause injury to face. Discard the broken mask and replace with a new mask.

If a defect with the Nasal Ranger® Field Olfactometer should appear during the warranty period, please refer to the *Warranty Service Procedure* section of the *Sales Terms and Conditions* (pg.13).

### Maintenance:

- Comfort Seals should be changed frequently.
- Cartridges (see pg.10).
- Mask should be cleaned with Isopropyl alcohol wipes (also see pg.10).
- Mask o-rings should be changed when necessary.
- Barrel should be cleaned with barrel brush when visible debris is present.
  - To clean barrel, follow these simple steps:
  - 1. Turn dial to blank position.
  - 2. Take mask off.
  - 3. Lightly insert brush through barrel at the mask end until it reaches the D/T dial.
  - 4. Pull brush out giving slight twist.

**Be sure to register your Nasal Ranger® Field Olfactometer on-line at [www.NasalRanger.com](http://www.NasalRanger.com) or by completing the Registration Form (pg.22) and faxing or mailing the form as instructed. Your registration will allow us to better serve you with product updates and important information regarding your Nasal Ranger® Field Olfactometer.**

If you have any questions about proper usage and safety regarding the Nasal Ranger® Field Olfactometer, please send an e-mail to [info@nasalranger.com](mailto:info@nasalranger.com) or call St. Croix Sensory, Inc. at 1-800-879-9231 (+651-439-0177).



# Nasal Ranger® Field Olfactometer

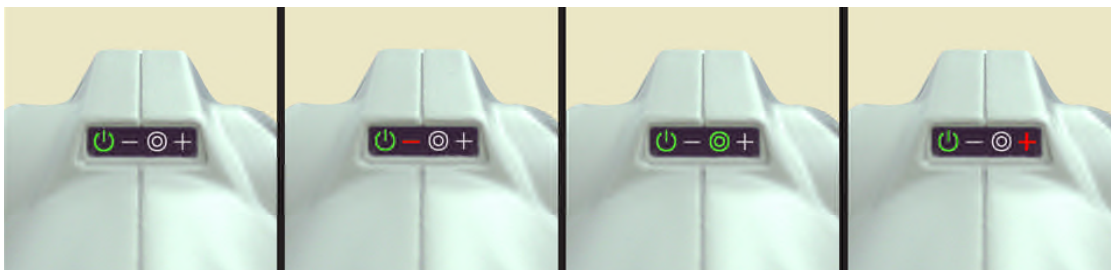
## QUICK START GUIDE

The Nasal Ranger® Field Olfactometer, a portable odor detecting and measuring device developed by St. Croix Sensory, Inc., is the “state-of-the-art” in field olfactometry for confidently measuring and quantifying odor strength in the ambient air using the Operating Principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios called “Dilution-to-Threshold” ratios (D/T ratios).

Field olfactometry with the Nasal Ranger® Field Olfactometer is a cost effective means to quantify odor strength. Facility operators, community inspectors, and neighborhood citizens can confidently monitor odor strength at specific locations around a facility’s property line and within the community.

The following information allows an informed user to quickly understand the operation of the Nasal Ranger Field Olfactometer. It assumes the user has some familiarity with field olfactometry and odor monitoring concepts. [See also “Operation Principles” and “Application Guide”]

1. Hold the Nasal Ranger Field Olfactometer parallel to the ground and press the power button which is located below the nasal mask. All four LED lights should illuminate for one second, and then the 1<sup>st</sup> (left) Power LED will stay illuminated.
2. Follow the Test Procedure Flow Chart for the sequenced testing procedure.
3. The LED’s on the Nasal Ranger Field Olfactometer provide feedback for the user to inhale at the “factory calibration flow rate”. The LED’s are labeled as follows:



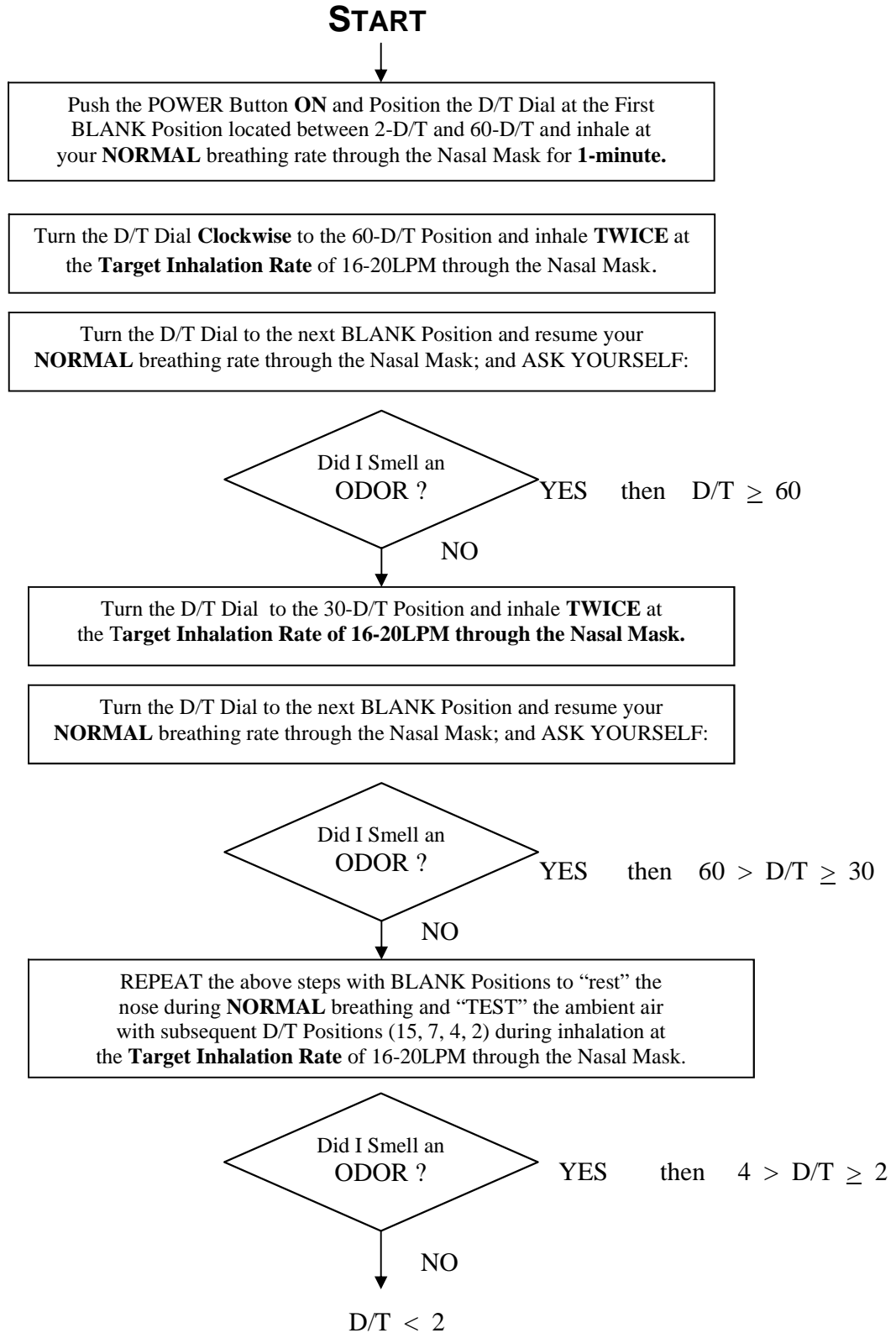
1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Power ON	Inhalation Rate too low Need to increase Inhalation Rate	Correct Inhalation Rate 16-20 LPM	Inhalation Rate too high Need to decrease Inhalation Rate

4. After 45 seconds of non-use, the 1<sup>st</sup> LED will blink slowly in a “Power Save” mode.
5. After five minutes of non-use, the Power will automatically turn OFF.
6. To turn off the Nasal Ranger Field Olfactometer manually, press and hold the power button for 3 seconds. All four LEDs will illuminate and then power off. The Nasal Ranger Field Olfactometer is now OFF.

Thank you for joining the ranks of Nasal Ranger® owners. The Nasal Ranger® Field Olfactometer is a precision calibrated tool and will yield reliable odor strength results for your monitoring and measurement needs.

# NASAL RANGER® FIELD OLFACTOMETER

## TEST PROCEDURE FLOW CHART



# NASAL RANGER® FIELD OLFACTOMETER

## OPERATING PRINCIPLE

The Nasal Ranger® Field Olfactometer, a nasal organoleptic instrument, directly measures and quantifies odor strength in the ambient air using the Operating Principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios. The discrete volume ratios are called “Dilution-to-Threshold” ratios (D/T ratios).

The user’s nose is placed firmly inside the nasal mask against the replaceable “comfort seal”. The user inhales through the nasal mask at a comfortable breathing rate while standing at rest. The nasal mask has an outlet for exhaled air to exhaust downward. Therefore, the user inhales through the Nasal Ranger and exhales downward through the outlet check valve. The user can stand at rest and continue comfortable breathing exclusively through the Nasal Ranger Field Olfactometer.

A Power Button located on the Nasal Ranger Housing, directly below the nasal mask, is pushed once by the user to turn the Power ON. To turn the Power OFF manually the Power Button must be pressed for 3-seconds. After 5-minutes of non-use the Power will automatically turn OFF.

A set of LED lights that are recessed on top of the Nasal Ranger housing indicate when the inhalation flow rate is within the “factory calibration flow rate” of 16-20 liters per minute. The four (4) LED lights have the following functions:

**1<sup>st</sup> LED** (on Left): Indicates POWER ON. After 45-seconds of non-use this first LED blinks slowly in a “Power Save Mode”. When the user inhales and initiates flow the LED will “wake” from the Power Save Mode and remain ON. After 5-minutes of non-use the Power will turn OFF. The Power Button must be pushed once by the user to restart the Power.

**2<sup>nd</sup> LED**: ON when the user is inhaling at a flow rate of less than 16-lpm.

**3<sup>rd</sup> LED**: ON when the user inhales at a flow rate of greater than 16-lpm and less than 20-lpm.

**4<sup>th</sup> LED**: ON when the user inhales at a rate greater than 20-lpm.

Therefore, the user of the Nasal Ranger Field Olfactometer learns to inhale at a rate sufficient to ONLY light up the third LED and be assured that the inhalation is within the factory calibrated flow rate range of 16-20lpm.

The Nasal Ranger’s Operating Principle of mixing odorous ambient air with odor-free filtered air in discrete volume ratios is achieved using two airflow paths:

1. Flow through the odor-filter cartridge and
2. Flow through one of the orifices in the D/T (Dilution-to-Threshold) Dial.

The first airflow path is the “filtered air” path through both odor-filter cartridges that are attached to each side of the Nasal Ranger housing. Ambient air, that may be odorous, enters through the outside of both odor-filter cartridges and travels through the multi-media odor-filter cartridges to remove odors.

The filtered odor-free air then flows forward inside the Nasal Ranger® and mixes with the second flow path, which is the odorous air that has entered through one of the orifices on the D/T Dial. The mixture of filtered air and odorous air then travels down the PTFE Barrel to the users nose that is in place inside the Nasal Ranger® mask.

# NASAL RANGER® FIELD OLFACTOMETER

## OPERATING PRINCIPLE (CONTINUED)

A precision electronic flow meter that is built in to the Nasal Ranger® Barrel measures the “total volume” of mixed airflow that is traveling down the PTFE Barrel on the way to the nasal mask. The LED lights recessed on top of the Nasal Ranger housing indicate to the user when the inhalation flow rate is within the “factory calibration flow rate” of 16-20 liters per minute.

The rotational position of the Nasal Ranger D/T Dial determines the orifice size and, therefore, the volume of odorous air that enters through the selected orifice. A large orifice allows more odorous air through the D/T Dial to mix with odor-free filtered air. A small orifice allows less odorous air through the D/T Dial to mix with odor-free filtered air. The volume ratio of the filtered odor-free air and odorous air is called the Dilution-to-Threshold (D/T) ratio. The principle of field olfactometry calculates the “Dilution to Threshold” (D/T) ratio as:

$$\text{D/T} = \frac{\text{Volume of Carbon-Filtered Air}}{\text{Volume of Odorous Air}}$$

The D/T Dial contains twelve (12) orifice positions. Six (6) positions are “BLANK” positions for the user to inhale only odor-free filtered air. Alternating on the D/T Dial with the six “BLANK” positions are six “D/T” positions with discrete “Dilution-to-Threshold” (D/T) orifices with traceable calibration.

The following table summarizes the “Dilution-to-Threshold” (D/T) ratios on the standard Nasal Ranger® D/T Dial.

<u>Position Number</u>	<u>D/T</u>
1	Blank
2	60
3	Blank
4	30
5	Blank
6	15
7	Blank
8	7
9	Blank
10	4
11	Blank
12	2

A raised arrow is on the rim of the D/T Dial adjacent to the Blank “Starting Position”, Position No. 1.

A Braille raised DOT is on the rim of the D/T Dial adjacent to each of the D/T Positions.

Please contact St. Croix Sensory, Inc. at 1-800-879-9231 (+651-439-0177), or visit [www.NasalRanger.com](http://www.NasalRanger.com) with inquiries regarding Nasal Ranger D/T Dials with other “Dilution-to-Threshold” (D/T) ratios.

# NASAL RANGER® FIELD OLFACTOMETER

## APPLICATION GUIDE FOR FIELD OLFACTOMETRY

### ODOR MONITORING

Field olfactometry with the Nasal Ranger® Field Olfactometer is a cost effective means to quantify odor strength in terms of “Dilution-to-Threshold” (D/T) ratios. Facility operators, community inspectors, and neighborhood citizens can confidently monitor odor strength at specific locations around a facility’s property line and within the community.

The following “protocols” are presented in brief form as an application guide:

- (1) **On-Site Monitoring** – Operators have the unique ability to monitor odors throughout the day with field olfactometry. Operator monitoring can include odor observations of arriving materials, outdoor process activities, and fugitive air emissions. Monitoring with a Nasal Ranger® Field Olfactometer on-site may include odor observations at predetermined locations, i.e. open doorways, driveways, storage areas, and fence lines.
- (2) **Random Monitoring** – A frequently used method for ambient odor monitoring is the “random inspection” approach. Random monitoring leads to a compilation of data that can be correlated with meteorological information and on-site activities. Managers and regulators alike find that random odor monitoring with a Nasal Ranger® Field Olfactometer is a cost effective protocol.
- (3) **Scheduled Monitoring** – Well-planned scheduled monitoring can be limited to a daily “walk-about” or “drive around”, or structured with several visits to predetermined monitoring locations. Data from a Nasal Ranger® Field Olfactometer can be used to correlate the many parameters that influence odor episodes, including meteorological conditions and on-site operating activities.
- (4) **Intensive Odor Survey** – An in-depth evaluation of on-site odor generation and off-site odor impact may be needed for permit renewal or facility expansion. Extensive data collection with the Nasal Ranger® Field Olfactometer will identify which sources or operations cause odor and which ones do not cause odor off-site. All potential odor sources and operations could be ranked and their relative contributions determined. Short term trials or tests of odor mitigation measures, e.g. odor counteractants, would also require an intensive period of data collection using a Nasal Ranger® Field Olfactometer.
- (5) **Citizen Monitoring** – The implementation of citizen odor monitoring with Nasal Ranger® Field Olfactometers can be part of an interactive community outreach program. The primary function of citizen odor monitoring is to collect information, through accurate record keeping, which represents real conditions in the community. Citizens recruited and trained to measure odors using Nasal Ranger® Field Olfactometers would also report odor descriptors. Citizen odor monitoring will assist in determining prevalent times and prevalent weather conditions of odor episodes. Citizen odor monitoring with Nasal Ranger® Field Olfactometer will also help in understanding the odor strength at which an odor first becomes a nuisance.
- (6) **Complaint Response** – The use of “Odor Compliant Hot Lines” is a common method used by facilities and communities to respond to odor episodes. A complaint response plan, with designated “on-call” responders, creates opportunities for verifying odor episodes, tracking odor sources, and quantifying odor strength with a Nasal Ranger® Field Olfactometer.
- (7) **Plume Profiling** – Standard and specialized air dispersion modeling predicts the transport and dilution of odors by the wind. A protocol, known as plume profiling, supplements and “calibrates” air dispersion modeling. Several inspectors with Nasal Ranger® Field Olfactometers, spaced cross wind and down wind from an odor source, would measure and record the odor strength as “D/T” values. The odor plume profile would then be documented and overlaid on the local terrain map. Therefore, the air dispersion modeling and the local topography would be integrated with actual odor measurements from the Nasal Ranger® Field Olfactometer.

# NASAL RANGER® FIELD OLFACTOMETER

## APPLICATION GUIDE FOR FIELD OLFACTOMETRY

(CONTINUED)

### ODOR REGULATIONS

A field olfactometer device (“scentometer”) is referenced in a number of existing state odor regulations. The “Dilution to Threshold” (D/T) terminology and the method of calculating the D/T are also referenced.

The criteria of an odor regulation often defines compliance as

**“...ambient air that is less than 7 D/T”** (7 used for exemplary purpose only).

The exact wording in a regulation is important and may be stated in two ways:

**Compliance criteria:** “...compliance if...less than 7 D/T.”

**Nuisance criteria:** “nuisance if...equal to or greater than 7 D/T.”

In these two examples, if an air pollution inspector observed “odor” with the field olfactometer set at a 7 D/T

**The “odor” would meet the criteria for nuisance or**

**The ambient air would be “non-compliant”.**

Odor regulations that utilize field olfactometry and a calibrated field olfactometer, e.g. Nasal Ranger Field Olfactometer, also define the number of observations needed and the time frame of the observations.

For example, a regulation may read:

**“...Two field olfactometer observations in a one-hour period separated by 15 minutes each...” OR**

**“...Two field olfactometer observations not less than 15 minutes apart within a 1-hour period...”**

The “protocols” in this Application Guide for Field Olfactometry are presented in brief example form and are not mutually exclusive, often being integrated into a comprehensive odor management program. Likewise, the “odor regulation” criteria for compliance and nuisance are presented as examples only and are taken from actual odor regulations.

**Please contact St. Croix Sensory, Inc. at 1-800-879-9231 (+651-439-0177), or visit [www.NasalRanger.com](http://www.NasalRanger.com), if you have any questions about the use and application of the Nasal Ranger® Field Olfactometer or if you need additional information or referral to industry or regulatory specialists.**

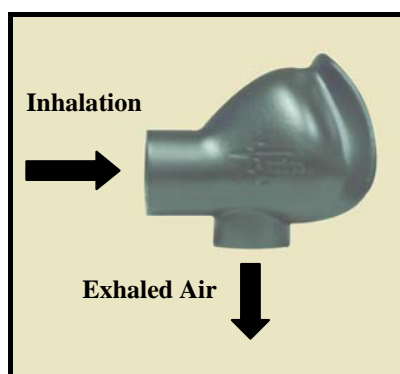
# Nasal Ranger® Nasal Mask

## INSTRUCTIONS OF USE AND MAINTENANCE

The Nasal Ranger® Nasal Mask is made of a carbon-fiber/epoxy polymer with a fluoropolymer coating. The Nasal Mask was specifically designed for use with the Nasal Ranger® Field Olfactometer. The Nasal Mask has three openings:

- 1) **Nasal Port** – ergonomically designed to match the geometry of the human nose and face,
- 2) **Inhalation Inlet** – opposite the nasal port, this port allows air into the mask from the Field Olfactometer, and
- 3) **Exhalation Outlet** – when the nose is placed in the nasal port, the exhalation outlet is the opening above the upper lip, which allows air exhaled through the nose to exit the mask.

A check valve is placed in both the inhalation inlet and the exhalation outlet in order to control the direction of air flow while using the Nasal Ranger® Field Olfactometer. The check valve placed inside the inhalation inlet allows air to pass from the Nasal Ranger® Field Olfactometer into the Nasal Mask during inhalation and prevents air from passing back into the Nasal Ranger® Field Olfactometer during exhalation. The check valve in the exhalation outlet allows air exhaled through the nose to pass out of the Nasal Mask and prevents ambient air from getting into the mask through this port during inhalation.



The check valves are replaceable if they become dirty or damaged. The valves are pressed into the respective ports and can be removed by applying pressure to the outer rim of the valve from inside the Nasal Mask. The inhalation and exhalation check valves are supplied by St. Croix Sensory as Part Numbers NR0041 and NR0042.

**Attachment:** To ensure long lasting o-rings give mask a half turn clockwise when mounting to Nasal Ranger.

**Cleaning:** St. Croix Sensory recommends cleaning the Nasal Mask using disposable wipes wetted with isopropyl alcohol. St. Croix Sensory provides specified wipes as Part Number NR0063. Moist towelettes and other wipes purchased in stores usually contain a fragrance that may leave a background odor on the Nasal Mask. Store purchased wipes should be avoided.

**CAUTION:** The Nasal Mask is fragile. The mask could break if dropped onto a hard surface.

**WARNING:** Cleaning the Nasal Mask in a dishwasher or autoclave or otherwise exposing the Nasal Mask to extreme heat (e.g. >120°F) will damage the Nasal Mask.

### The Comfort Seal

The Comfort Seal is a disposable accessory designed to improve the mask sealing and comfort during use with the Nasal Ranger® Nasal Mask and Nasal Ranger® Field Olfactometer. The Comfort Seal is manufactured of unique super-soft foam that has been used for years in skin contact applications in the medical industry. The seal is shaped to match the geometry of the Nasal Ranger® Nasal Mask used for the Nasal Ranger® Field Olfactometer. The seals are easy to apply with a pressure sensitive adhesive on one side that attaches to the mask.

To install the Comfort Seal, follow these simple steps:

1. GRIP the pull-tab on the paper backing.
2. PEEL off the paper backing.
3. ALIGN the seal with the mask rim.
4. PRESS the seal onto the mask firmly.

## Nasal Ranger® Nasal Mask

### INSTRUCTIONS OF USE AND MAINTENANCE

(CONTINUED)

The Comfort Seal “installed” to accommodate noses of all sizes.



**WIDE**

**NARROW**

The Comfort Seal is designed for use by one person ONLY. The Comfort Seal needs to be wiped at least daily and changed weekly or more frequently in order to be odor-free. Remove and dispose of the seal when it becomes dirty or if another person will be using the mask. Remove the comfort seal; rub off the gummy glue residual; and wipe the face of the mask with an isopropyl wipe.

**Mask Fit Test (LEAK TEST) for Best Results:**



**With the stopper in place (LEAK TEST), you should not be able to inhale through your nose.**



# NASAL RANGER® REPLACEABLE ODOR-FILTER CARTRIDGES

## INSTRUCTIONS OF USE AND MAINTENANCE

**NOTICE: The replaceable odor-filter cartridges are ONLY for use with the Nasal Ranger® Field Olfactometer manufactured by St. Croix Sensory, Inc.**

The replaceable odor-filter cartridges contain a proprietary blend of granular activated carbon multi-media, which is designed to remove odors from the ambient air.

These cartridges are NOT to be used under the following conditions or scenarios:

1. As respirator cartridges for the reduction or elimination of hazardous chemicals in the air.
2. In atmospheres where contaminant concentrations are unknown, immediately dangerous to life/health, or exceed applicable local standards or U.S. Occupational Safety and Health Administration (OSHA) standards.
3. In atmospheres that contain less than 19.5% oxygen.

### Replacement Instructions

The replaceable cartridges are attached to the Nasal Ranger® Field Olfactometer with a right hand thread. The following instructions are used to replace a set of cartridges:

1. Remove the used cartridges by loosening the right hand thread (**Turn Counterclockwise**)
2. Dispose of the used cartridges.
3. Remove the new cartridges from the plastic packaging.
4. Install the new cartridges by inserting the threaded end into the cartridge holder on the Nasal Ranger® Field Olfactometer and turning the cartridge in the direction of the arrow on the label (**Turn Clockwise**).
5. Tighten the cartridge **HAND TIGHT ONLY**. The cartridge will tighten against the o-ring inside the cartridge holder on the Nasal Ranger® Field Olfactometer.

Replace both cartridges in accordance with an established “cartridge change schedule”. The user may decide to replace the cartridges before each use of the Nasal Ranger® Field Olfactometer, or may chose a convenient time frame for replacement. Cartridges should be changed immediately if the user detects a smell when inhaling through the Nasal Ranger® Field Olfactometer set on a blank position (odor-filtered air only).

Leave the odor-filter cartridges in factory packaging before they are used. Once the cartridge packages are opened, store the cartridges away from odorous areas when not in use.

Do not alter, misuse or abuse these replaceable odor-filter cartridges.

Please contact St. Croix Sensory, Inc. if you have any questions about the use, application, or maintenance of the Nasal Ranger® Replaceable Odor-Filter Cartridges at 1-800-879-9231 (+651-439-0177), or visit [www.NasalRanger.com](http://www.NasalRanger.com).

# NASAL RANGER® FIELD OLFACTOMETER

## TROUBLESHOOTING GUIDE

If any problem is not resolved with these suggested solutions, contact St. Croix Sensory for technical support at 1-800-879-9231 (+651-439-0177) or info@nasalranger.com.

<b>Problem</b>	<b>Possible Solutions</b>
Nasal Ranger has no power (Power LED doesn't light up)	Press the power button again to confirm the unit will not restore power.
	Check to be sure the battery is properly connected. Open the battery compartment and check the battery connection.
	The battery may be low on power. Install a new battery.
Power LED is blinking	This is normal. The Nasal Ranger will go into a "Power Save" mode if the unit is not used for 45 seconds.
Power only stays on for a short time	The Nasal Ranger does have an Auto Shut-Off mode if the unit does not sense inhalation over a five-minute period.
	The battery may be low on power. Install a new battery.
Flow Sensor LED's not responding to inhalation by the user.	The battery may be low on power. Install a new battery.
	The nasal mask may not be properly sealing to the user's face. Try to reposition the unit against the face. Try different positions to see if the LED's respond to inhalation.
	The nasal mask check valve(s) may be loose or leaking air. Inspect the check valves to be sure they are properly positioned inside the mask ports. Inspect the check valves for any damage or loose debris (i.e. dust). Check valves may need replacing.
Flow Sensor LED's responding erratically to inhalation.	The battery may be low on power. Install a new battery.
	The nasal mask may not be properly sealing to the user's face. Try to reposition the unit against the face. Try different positions to see if the LED's respond to inhalation.
	The nasal mask check valve(s) may be loose or leaking air. Inspect the check valves to be sure they are properly positioned inside the mask ports. Inspect the check valves for any damage or loose debris (i.e. dust).

<b>Problem</b>	<b>Possible Solution</b>
An odor is detected while the dial is set at a “blank” position	The nasal mask may not be properly sealing to the user’s face allowing ambient air to leak around the mask diameter. Try to reposition the unit against the face. Try different positions to see if the LED’s respond to the inhalation.
	The nasal mask check valve(s) may be loose or leaking air. Inspect the check valves to be sure they are properly positioned inside the mask ports. Inspect the check valves for any damage or loose debris (i.e. dust). Check valves may need replacing.
	The replaceable odor-filter cartridges may not be properly seated in the Nasal Ranger housing. Inspect the position of cartridges. Be sure they are threaded into the housing correctly. Be sure they are threaded tight (Hand Tight ONLY) against the housing O-rings.
	The odor-filter cartridges may need replacing. The odor-filter cartridges have a limited life span, which is dependent on amount and frequency of use. Replace the odor-filter cartridges (Part Number: NR8).
	The ambient odor may be too strong or of the type that exceeds the design of the odor-filter cartridges. Contact St. Croix Sensory for assistance.
	The internal seals may be leaking. Contact St. Croix Sensory for assistance.
The D/T Dial does not turn	The dial mounting screw may be too tight. Loosen the dial mounting screw.
	Debris may be impeding movement of the dial. Inspect the dial for loose debris. The dial may need to be removed in order to inspect and clean the dial turning area. Contact St. Croix Sensory for assistance.
The D/T Dial does not stop at a specific position (dial spins freely).	The dial mounting screw may be too loose. Tighten the dial mounting screw.

# NASAL RANGER® FIELD OLFACTOMETER

## Sales Terms & Conditions St. Croix Sensory

### **Offer and Acceptance.**

This document is an offer to enter into an agreement. For an effective agreement to be reached a duly authorized agent of Purchaser must accept all of the terms and conditions set forth below, none of which can be altered or amended without St. Croix Sensory's prior written agreement.

### **Quotations and Prices.**

The price stated on a St. Croix Sensory quotation form is firm for the initial order for a Nasal Ranger® Field Olfactometer or related product only. Prices are subject to change without notice and orders calling for future delivery will be billed according to the price in effect at the time of delivery. Oral quotations will not be honored by St. Croix Sensory and written quotations will automatically expire sixty (60) calendar days from the date issued and are subject to earlier termination by written notice. All prices are FOB, St. Croix Sensory's manufacturing facility.

### **Payment Terms.**

The net amount of each invoice is due in full with the order, by credit card payment or other method acceptable to St. Croix Sensory.

### **Taxes.**

All present or future sales, use, revenue, excise or other taxes applicable to the Nasal Ranger® Field Olfactometer or related products which are the subject of this Agreement shall be added to the purchase price and shall be paid by Purchaser, unless Purchaser provides St. Croix Sensory with a tax exemption certificate acceptable to the relevant taxing authorities.

### **Shipment.**

Both the method and the route of shipment are at the discretion of St. Croix Sensory, unless Purchaser supplies explicit instructions to the contrary. All insured shipments will be made at Purchaser's expense. Identification of the particular Nasal Ranger® Field Olfactometer or related products to this agreement and the risk of loss will pass to Purchaser at the time of delivery to the carrier.

### **Governing Law and Venue.**

This agreement shall be governed by and construed under and in accordance with the laws of the State of Minnesota, United States of America (without regard to conflicts of laws principles). The venue of any legal action arising out of this agreement shall be the Federal or State Courts located in Hennepin or Ramsey County in Minnesota, U.S.A., and the parties consent to the jurisdiction of these courts.

### **Nasal Ranger® Field Olfactometer Limited Warranty.**

St. Croix Sensory warrants to Purchaser that in normal and contemplated use and service, the Nasal Ranger® Field Olfactometer purchased from St. Croix Sensory will be free from defects in material or workmanship for a period ending 365 days from the date of original shipment by St. Croix Sensory. Subject to the conditions and exclusions contained in this document, St. Croix Sensory will, at its option, either repair or replace any defective Nasal Ranger® Field Olfactometer or part thereof, or refund the purchase price of the defective Nasal Ranger® Field Olfactometer. Parts, devices or equipment that are supplied by vendors other than St. Croix Sensory, shall carry only the applicable warranties and limitations provided by the relevant vendor. Expendable and/or consumable items or parts included or used in connection with the Nasal Ranger® Field Olfactometer are not covered under this limited warranty. This limited warranty does not cover a Nasal Ranger® Field Olfactometer that has been misused, altered, disassembled, neglected, handled carelessly, or used for purposes other than its intended purpose. This limited warranty also does not cover loss or damage resulting from any casualty loss or from unauthorized use or service. Under no circumstances shall St. Croix Sensory be liable for consequential or other damages, losses, or expenses in connection with or by reason of the use or inability to use the Nasal Ranger® Field Olfactometer for any purpose.

**WARNING:** Unscrewing and disassembling the Nasal Ranger® Field Olfactometer housing will break and alter the pressure seal of the instrument (6 screws visible on the left-housing and 2 under the battery door). Doing so will void the limited warranty and require the instrument to be shipped back to St. Croix Sensory to be re-sealed and re-calibrated at Purchaser's expense.

### **Warranty Service Procedures.**

If a defect should appear during the warranty period, Purchaser should return the defective Nasal Ranger® Field Olfactometer, freight and insurance prepaid, if possible in the original shipping container, to such address as shall be specified from time to time by St. Croix Sensory. The appropriate warranty service address may be determined by calling 1-800-879-9231 (+651-439-0177) or by consulting [www.nasalranger.com](http://www.nasalranger.com). Any returned Nasal Ranger® Field Olfactometer must be accompanied by a written statement including: the name of Purchaser; a description of the problem(s); and the action desired. St. Croix Sensory shall not be responsible for any loss or damage incurred in shipping. Any warranty work to be performed by St. Croix Sensory shall be subject to St. Croix Sensory's confirmation that the returned Nasal Ranger® Field Olfactometer meets St. Croix Sensory's warranty requirements. If a defect is covered by this limited warranty, the repaired or replaced Nasal Ranger® Field Olfactometer will be returned to Purchaser at St. Croix Sensory's cost. Following a warranty repair or replacement, this limited warranty shall continue in effect until the end of the original warranty period or for sixty (60) days after the repair or replacement, whichever is later.

# NASAL RANGER® FIELD OLFACTOMETER

## Sales Terms & Conditions St. Croix Sensory

(Continued)

### **Related Product Limited Warranty.**

St. Croix Sensory warrants to Purchaser that in normal and contemplated use and service any product related to the Nasal Ranger® Field Olfactometer purchased by Purchaser (“related products” includes components, consumables and similar items such as odor-filter cartridges, nasal masks, check valves, carrying straps, and carrying case) shall be free from defects in material or workmanship for a period ending (i) 90 days from the date of original shipment by St. Croix Sensory, or (ii) upon expiration of the time specified with respect to a particular product, as applicable. Subject to the conditions and exclusions in this document, St. Croix Sensory will, at its option, repair or replace any related product that is defective, or refund the purchase price. Under no circumstances shall St. Croix Sensory be liable for consequential or other damages, losses, or expenses in connection with or by reason of the use or inability to use a related product purchased for any purpose.

### **Exclusion of Warranty of Fitness for any Purpose.**

St. Croix Sensory makes no warranty as to the suitability or fitness of any of its equipment or products, including specifically the Nasal Ranger® Field Olfactometer, for any particular purpose specific to the Purchaser. The Purchaser is solely responsible for the selection, use, efficiency, fitness and suitability of St. Croix Sensory’s equipment and products. The Purchaser assumes all risks and liabilities in connection with the use of St. Croix Sensory’s equipment and products, including specifically the Nasal Ranger® Field Olfactometer.

### **Exclusion of Liability for Consequential and Similar Damages.**

In no event shall St. Croix Sensory be liable to Purchaser for any indirect, special or consequential damages or lost profits arising out of or relating to the Nasal Ranger® Field Olfactometer or related products, or their performance or non-performance, even if St. Croix Sensory has been advised of this possibility.

**Limitation** to Amounts Paid. St. Croix Sensory’s liability, if any, to Purchaser or to the customers of Purchaser or any other person under this limited warranty shall in no event exceed the total amount paid to St. Croix Sensory by the Purchaser for a defective or non-conforming Nasal Ranger® Field Olfactometer or related product.

**THE LIMITED WARRANTY AND REMEDIES SET FORTH IN THIS DOCUMENT ARE THE SOLE AND EXCLUSIVE REMEDIES AVAILABLE TO ANY PERSON FOR ANY DAMAGES OF ANY KIND AND NATURE, INCLUDING INCIDENTAL, CONSEQUENTIAL OR SPECIAL, RELATED TO THE NASAL RANGER® FIELD OLFACTOMETER OR RELATED PRODUCTS, WHETHER ARISING FROM WARRANTY, CONTRACT, NEGLIGENCE, TORT OR OTHERWISE. ST. CROIX SENSORY SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER IMPLIED WARRANTY. NO WAIVER, ALTERATION, OR MODIFICATION OF THE FOREGOING CONDITIONS SHALL BE VALID UNLESS MADE IN WRITING AND SIGNED BY AN EXECUTIVE OFFICER OF ST. CROIX SENSORY.**

In the event any implied warranties (including, but not limited to the implied warranties of merchantability or fitness for a particular purpose) are found to exist, such warranties are limited (i) in duration to the period of the limited warranties set forth in this document, and (ii) in amount to the total amount paid to St. Croix Sensory by the Purchaser for the Nasal Ranger® Field Olfactometer or related product in question. (Some States do not permit the exclusion of incidental or consequential damages, and in those States the foregoing limitation may not apply. The limited warranties as set forth in this document give the Purchaser specific legal rights, and the Purchaser may have other legal rights which vary from State to State.)

# NASAL RANGER® FIELD OLFACTOMETER

## PARTS AND ACCESSORIES

<u>Part Number</u>	<u>Description</u>
NR0009	9-Volt Battery
NR0010	Carry Bag
NR0011	Odor Sensitivity Test Kit
NR0020	O-Ring, Mask Connection (2-pair)
NR0021	O-Ring, Odor-Filter Cartridge (pair)
NR0023	Battery Cover
NR0024	Screw, Battery Cover
NR0031	Barrel Brush
NR0032	Shoulder Strap
NR0041	Check Valve Kit, Inhalation
NR0042	Check Valve Kit, Exhalation
NR0046	Nasal Ranger Mask Package
NR0049	Stopper
NR0050	Standard D/T Dial Assembly
NR0051	Torx Driver for Obsolete Dial Screw
NR0052	Dial Screw-Springs-Washer Set
NR0053	T-Handle Hex Key (Allen Wrench) for Dial Assembly
NR0054	High D/T Dial Assembly
NR0062	Comfort Seal Package (10)
NR0063	Isopropyl Alcohol Mask Cleaning Wipes Package (10)
NR0081	Type I Universal Odor-Filter Cartridge (pair)
NR0082	Type II Organic Vapor Odor-Filter Cartridges (pair)
NR0083	Type III Hydrogen Sulfide Odor-Filter Cartridges (pair)
NR0084	Type IV Ammonia Odor-Filter Cartridge (pair)
NR0091	Type I Universal Odor-Filter Cartridge (case of 6 pairs)
NR0092	Type II Organic Vapor Odor-Filter Cartridge (case of 6 pairs)
NR0093	Type III Hydrogen Sulfide Odor-Filter Cartridge (case of 6 pairs)
NR0094	Type IV Ammonia Odor-Filter Cartridge (case of 6 pairs)

For pricing and availability, send email request to [info@nasalranger.com](mailto:info@nasalranger.com)

## **Nasal Ranger® Field Olfactometer Technical Specifications**

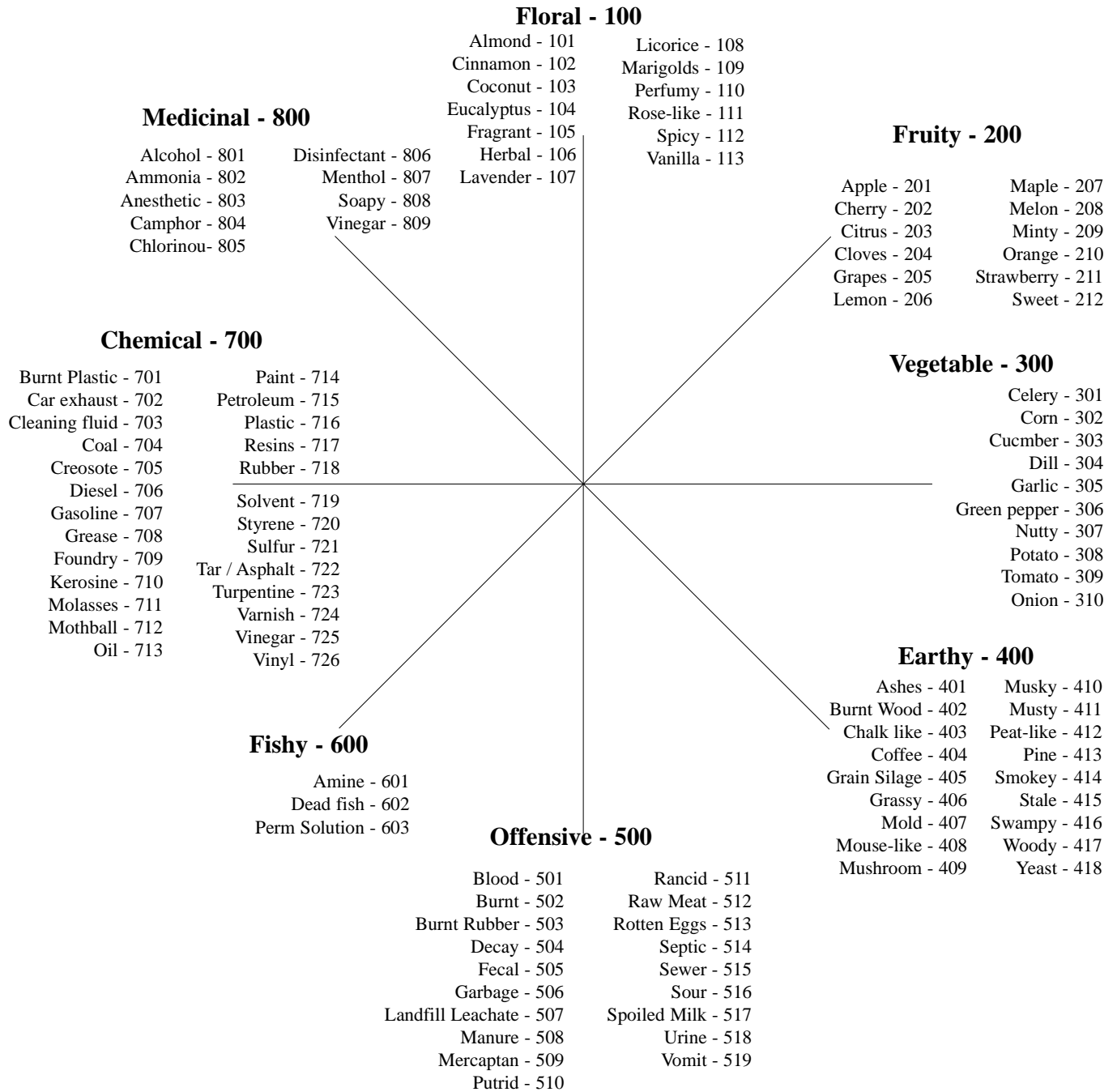
Detection Technique:	Human Nose
Discrete Dilution Ratios:	2, 4, 7, 15, 30, 60 D/T's (Standard Dilution-to-Threshold Ratios)
Response Time:	As fast as 3-seconds (2 inhalations)
Accuracy:	+/- 10% of D/T
Repeatability:	+/- 2%
Inhalation Rate:	16-20 liters per minute
Operating Temperature Range:	32° to 104°F, 0° to 40°C
Power Requirements:	Standard 9-Volt Alkaline Battery
Dimensions:	14"(L) x 7.5"(H) x 4"(W) (35.5 x 19 x 10 cm)
Weight:	2.0 lbs ( 0.91 kg)
Materials of Construction:	PTFE and Polymer Alloys
Odor Filter Cartridge:	3.5" diameter x 1.5" (H) (8.9 cm diameter x 7 cm)
Nasal Mask:	2.75" (H) x 2.25" (W) (7 cm x 5.7 cm)
Patent:	U.S. Patent No.: 6,595,037
Calibration Verification:	Recommended Annually
EMC Verification:	Emissions: EN 61326: 1997, Class B Immunity: EN 61326:1997, Industrial Location
Markings:	89/336/EEC (EMC) 92/59/EEC (General Product Safety)







# Odor Descriptors





**County Environmental Dept.**

Date: 1/4/08

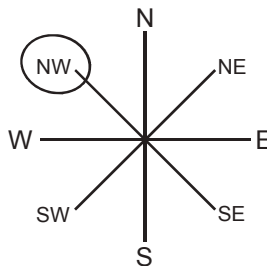
Time	Location	D/T							Descriptors	Comments
		60	30	15	7	4	2	<2		
7:05 AM	1 - Industrial Park								X	
7:10 AM	2 - " "								X	718
7:15 AM	3 - " "								X	
7:20 AM	4 - " "				X					718, 723
7:25 AM	5 - Intersection					X				705
7:30 AM	6 - Intersection								X	
7:35 AM	7 - Co. Rd. 20		X							718, 723, 515
7:40 AM	8 - Intersection			X						718, 723, 515
7:45 AM	9 - Junction Rd.				X					718, 723
7:50 AM	10 - Co. Rd. 28			X						718, 515, 601
7:55 AM	11 - Division Ave.					X				718, 601
8:00 AM	12 - Intersection								X	
8:05 AM	13 - Parking Lot					X				104, 304
8:10 AM	14 - Intersection							X		707
8:15 AM	15 - Intersection								X	
8:20 AM	16 - Intersection								X	
8:25 AM	17 - Housing Devel.							X		201
8:30 AM	18 - 3rd & Oak					X				706, 404

**Weather Conditions**

- Sunny
- Partly Cloudy
- Mostly Cloudy
- Overcast
- Hazy

- Precipitation:
- None
  - Fog
  - Rain
  - Sleet
  - Snow

Wind Direction  
Blowing From: (circle one)



- Wind Speed:
- Calm
  - Light Breeze (1-5 mph)
  - Moderate Wind (5-15 mph)
  - Strong Winds (15 or higher mph)

Temperature: 55 °F/°C

Relative Humidity: 60 %

Barometric Pressure: 30.1

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

008  
Code

Nigel Mackenzie  
Name

Nigel Mackenzie  
Signature

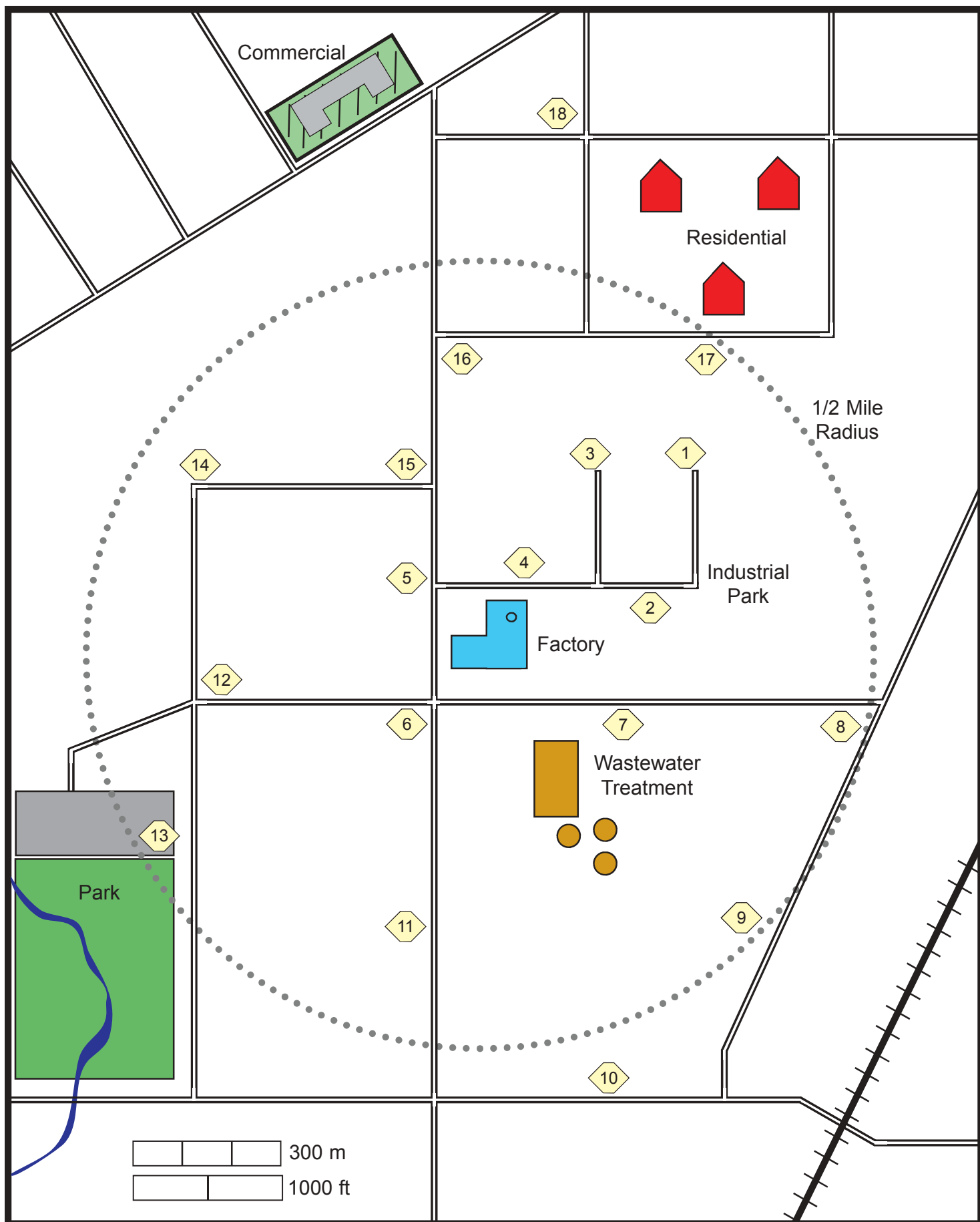


Exhibit F

## **ATTACHMENT 2**



St. Croix Sensory, Inc.

A sensory testing and training company.

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## ODOR PARAMETERS

St. Croix Sensory specializes in quantification of perceived odors of air samples and commercial products and materials. Odors are the sensory perception caused by odorants (chemicals) stimulating olfactory receptors in the nose.

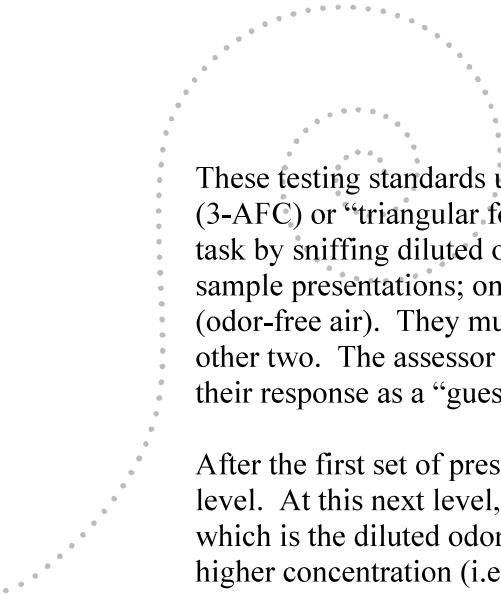
Odors can be quantified by five parameters that profile the human response. These parameters include: odor thresholds, odor intensity, odor persistency, hedonic tone, and odor characterization.

The following is a brief explanation of these parameters of the odor evaluation services provided by St. Croix Sensory. For environmental odor samples, an odorous air sample collected in a Tedlar air sample bag is evaluated. For product and material testing, the sample may also be from a Tedlar air sample bag or it may be a direct observation of a headspace developed around the sample or from an environmental test chamber.

### Odor Thresholds

The most common measure of odors is the odor threshold value (OTV), also referred to as the odor concentration or odor strength. Odor strength is quantified by determining the amount of dilution needed to bring the odorous air sample to its threshold. The higher the threshold value, the more dilution is needed to bring the odor to threshold, thus the stronger the odor.

The odor threshold is determined by trained human assessors observing presentations of the odorous air sample dynamically diluted with an olfactometer. The testing procedures follow ASTM International E679-04, *Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits*, and EN13725:2003, *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry*. EN13725, the official standard of all European Union countries, exceeds the requirements of ASTM E679-04. The standardization organizations of Australia and New Zealand have also adopted an identical standard (AS/NZ 4323.3-2001).



These testing standards utilize a presentation method called “3-alternative forced-choice” (3-AFC) or “triangular forced-choice (TFC). Each assessor performs the odor evaluation task by sniffing diluted odorous air from the olfactometer. The assessor sniffs three sample presentations; one contains the diluted odor while the other two are “blanks” (odor-free air). They must then select the one of the three that is “different” from the other two. The assessor is required (forced) to choose one of the three and acknowledge their response as a “guess”, “detection”, or “recognition”, as defined by ASTM E679-04.

After the first set of presentations, the assessor is then presented with the next dilution level. At this next level, the assessor is again presented with three sample choices, one of which is the diluted odor sample. However, this next dilution level presents the odor at a higher concentration (i.e. two times higher). This is one-half the dilution ratio (fewer number of dilutions = higher concentration). The first dilution level presented to the assessors is below the odor threshold (subthreshold). The assessor proceeds to higher levels of sample presentation following these methods until the odor concentration is above the recognition threshold. This statistical approach is called “ascending concentration series.”

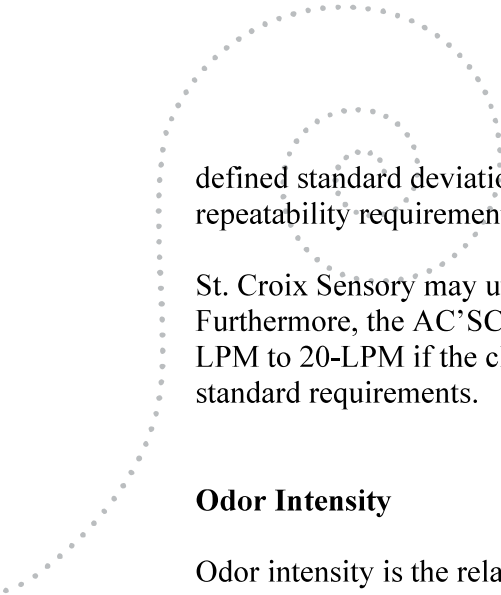
Results are computed for each assessor based on the dilution levels where correct “detection” or “recognition” responses are recorded. The responses of all assessors are averaged to determine the sample’s detection and recognition thresholds.

The dynamic dilution of an odorous emission is the physical process that occurs in the atmosphere down-wind of the odor source. An individual, or citizen from the community, observes the diluted odor. The dilution ratio is an estimate of the number of dilutions needed to make the actual odor emission just detectable. This is known as the Detection Threshold (DT). The Recognition Threshold (RT) is the dilution ratio at which the assessor first detects the odor’s character (“smells like...”). The recognition threshold value is always lower than the detection threshold value. It takes more dilution to bring an odor to its detection threshold (no odor present) compared to its recognition threshold (odor is not recognizable).

The odor threshold is reported as a dimensionless dilution ratio; however, often the pseudo-dimensions of “Odor Units’ (O.U.) are used. Units of “Odor Units per cubic meter” (O.U./m<sup>3</sup>) are also commonly applied in order to calculate odor emission rates.

For this testing, St. Croix Sensory utilizes an AC’S<sub>CENT</sub>® International Olfactometer, a dynamic dilution triangle olfactometer, operating at 20-LPM with 5 assessors, who complete the threshold determination a minimum of two times (EN13725:2003). Final results are retrospectively screened in order to evaluate and identify assessors who may have a specific hypersensitivity or anosmia to the odor sample presented.

The assessors are tested and “certified” with a standard odorant (n-butanol) and are required to meet specific sensitivity criteria outlined in the European testing standard, EN13725. These assessors are required to have an average n-butanol detection threshold between 20-80 ppb based on their last 20 evaluations. Assessors also must maintain a



defined standard deviation of n-butanol threshold measurements in order to satisfy repeatability requirements of the standard.

St. Croix Sensory may utilize more assessors when necessary for a specific project. Furthermore, the AC'SCENT International Olfactometer is capable of operating from 3-LPM to 20-LPM if the client requires a specific flow rate that deviates from the EN13725 standard requirements.

### **Odor Intensity**

Odor intensity is the relative strength of the odor above the Recognition Threshold (suprathreshold). The intensity of an odor is referenced on the ASTM Odor Referencing Scale described in ASTM E544-99, *Standard Practice for Referencing Suprathreshold Odor Intensity*. The IITRI Dynamic Dilution Binary Olfactometer (Butanol Wheel) is the dynamic presentation method St. Croix Sensory utilizes for the procedure of odor intensity referencing.

The odor referencing is accomplished by comparison of the odor intensity of the odor sample to the odor intensity of a series of concentrations of the reference odorant n-butanol. The Butanol Wheel olfactometer delivers the butanol in air to 8 glass sniffing ports that make-up a series of increasing concentrations of the butanol. The series starts at 12-ppm butanol and has an increasing concentration ratio of 2 (binary scale).

Each assessor observes the odorous air sample and determines the odor intensity. The average value of the panel of assessors is the reported intensity for the odor sample, expressed in units of parts per million (PPM) butanol equivalent. A larger value of butanol concentration means a stronger odor, but not in a simple numerical proportion, i.e. twice the butanol concentration does not mean twice the perceived odor intensity.

The Odor Intensity Referencing Scale serves as a standard method to quantify the intensity of odors for documentation and comparison purposes.

### **Odor Persistency (“Dose Response”):**

Odor is a psychophysical phenomenon; the perceived odor intensity changes with concentration. Odor persistency is a term used to describe the rate at which the perceived intensity decreases as the odor is diluted, i.e. in the atmosphere down-wind from the odor source. The rate of change in intensity versus odor concentration is not the same for all odors.

The odor intensity is related to the odor concentration by the following equation (Steven's Law),

$$I = k (C)^n$$

Where:

I is the odor intensity expressed in ppm n-butanol,

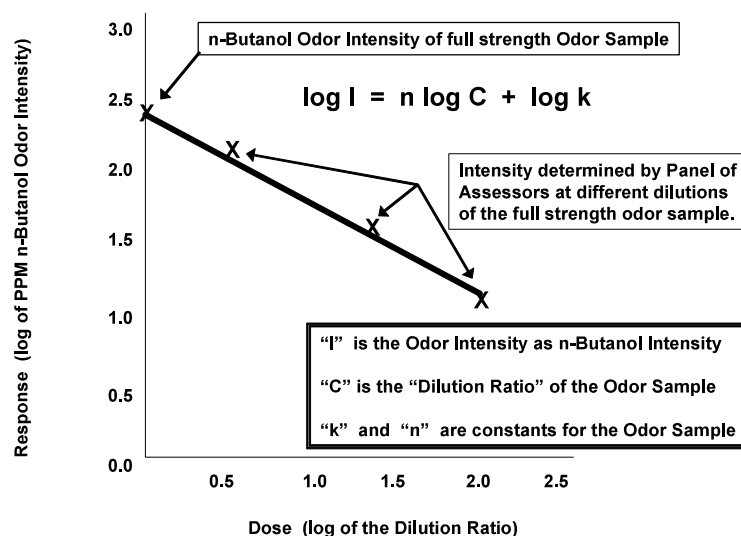
C is the odor concentration expressed in number of dilutions (dilution ratio), and

k and n are constants that are different for every specific odorant or mixture of odorants.

This odor persistency relationship is a “Dose-Response” function (a psychophysical power function), which is linear on a log-log scale with the following equation:

$$\text{Log } I = n \text{ Log } C + \text{log } k$$

The “Dose-Response” function is determined from intensity measurements of an odor at a minimum of three dilutions and possibly at the full strength concentration, utilizing ASTM E544, *Standard Practice for Referencing Suprathreshold Odor Intensity*. The plotted logarithmic values of the odor intensities and the odor dilution ratios (concentrations) create the “Dose-Response” function of the odor sample. The resultant straight line of the log-log plot is specific for each odor, with the slope of the line, n, representing relative persistency and the y-axis intercept, k, representing the full strength intensity. A flatter slope of an odorant mixture represents a more persistent odor.



This “Dose-Response”, persistency, graph can be converted to a Power Law graph showing how the intensity changes with the odor concentration, represented in “Odor Units.” This conversion is completed by taking the recognition threshold of the odorous air sample, the full strength odor concentration, into consideration.

The number of odor units presented at each diluted odor presentation can be determined by dividing the Recognition Threshold (RT) by the Dose-Response dilution ratio test points. For example, if the RT (full strength odor concentration) is 2000 O.U. and the



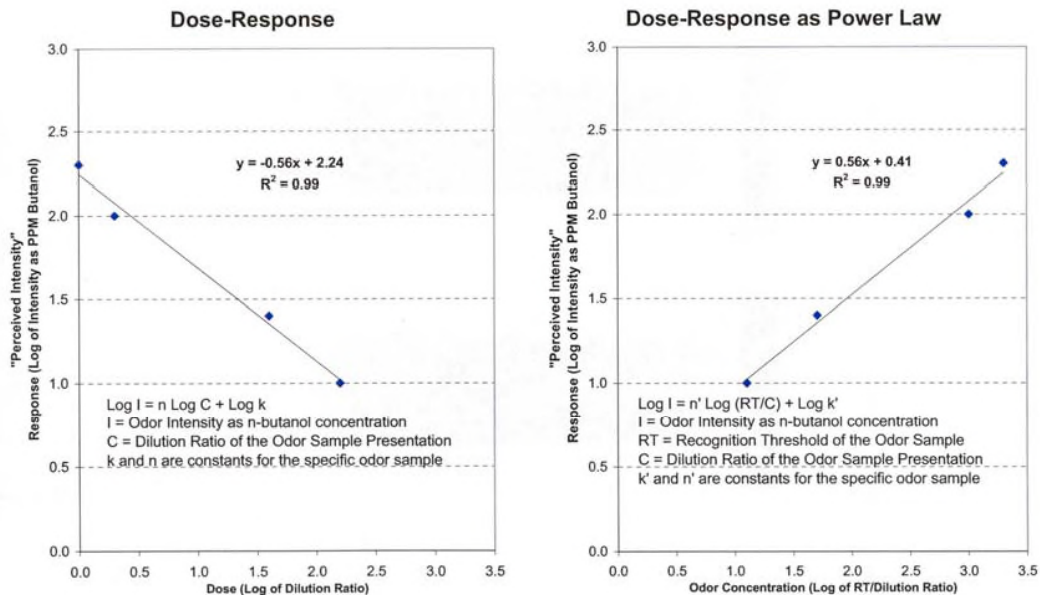
assessor is presented with this odor at 40 dilutions, then the assessor was presented with an odor that is equivalent to 50 O.U. The power law relationship can then be represented as:

$$\text{Log } I = n' \text{ Log } (RT/C) + \text{Log } k'$$

This equation will have a positive slope. The slopes of the two curves are related by:

$$n = -n'$$

The following pair of graphs illustrates the example of an odor that has a recognition threshold of 2000 O.U. The assessors were presented with this odor sample at full strength and at dilutions of 2, 40, and 160.



The positive slope of the Power Law graph illustrates that the odor intensity of odorants increase as the mass concentration increases. The slope of the Dose-Response and Power Law graphs is less than one for most odors since it takes larger and larger increases in concentration to maintain a constant increase in perceived intensity.



## Hedonic Tone HT

Hedonic Tone (HT) is a measure of the pleasantness or unpleasantness of an odor sample. An arbitrary but common scale for ranking odor by hedonic tone is the use of a 21 point scale:

+10	Pleasant
0	Neutral
-10	Unpleasant

The assigning of a hedonic tone value to an odor sample by an assessor is “subjective” to the assessor. An assessor uses her/his personal experiences and memories of odors as a referencing scale. The assessor, during training, becomes aware of their individual odor experience and memory referencing.

The average value of all assessors is the reported hedonic tone (HT) for the odor sample.

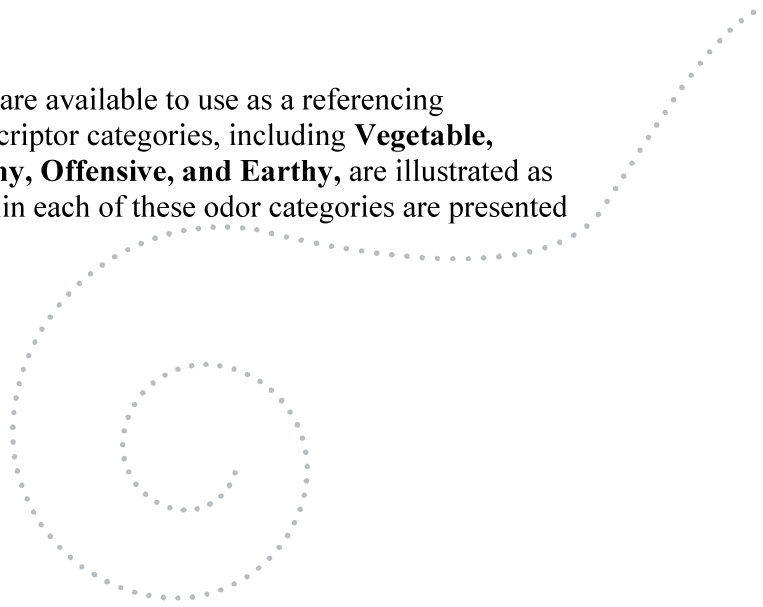
It is important to note that the hedonic tone values provided by the trained assessors should not be considered to represent the opinions of the general population. The values should be used for relative comparison of the pleasantness between samples within one test session since they would be observed by the same panel of assessors.

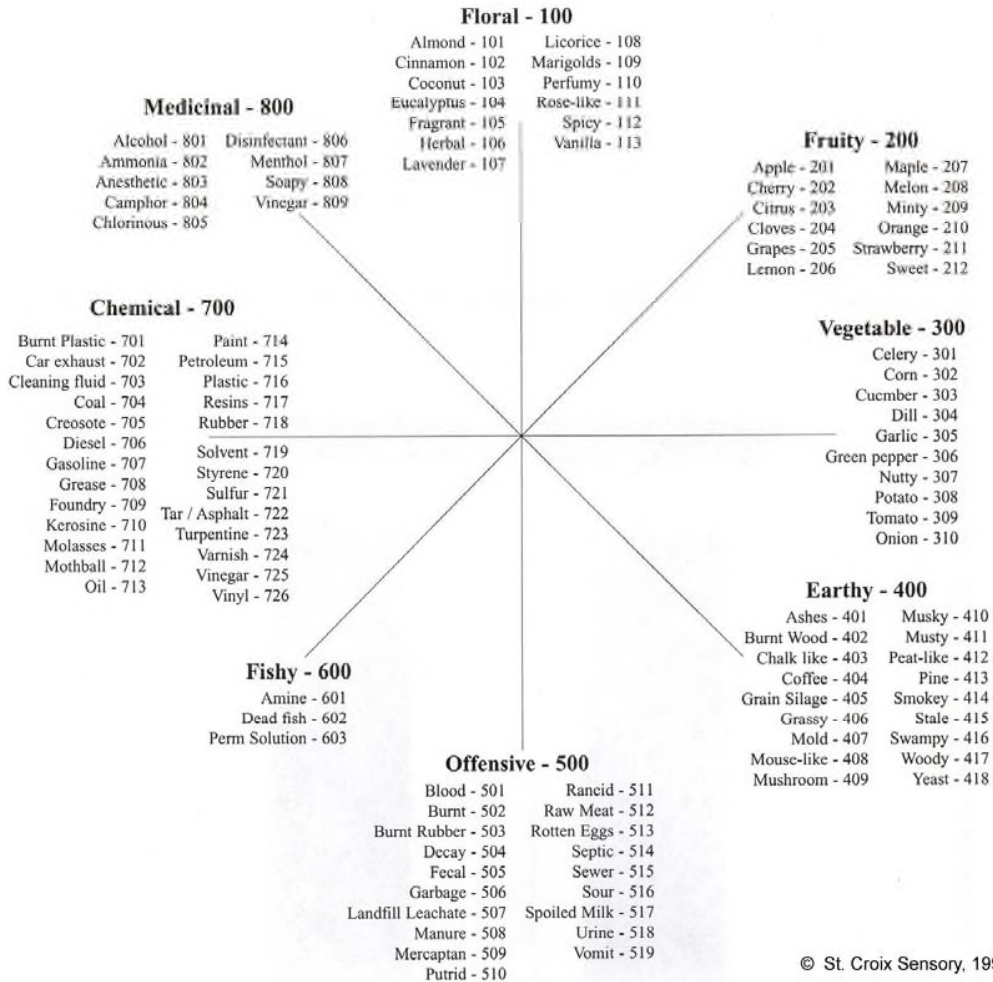
## Odor Characterization

The character of an odor, also referred to as “odor quality,” is reported using standard descriptor lists. Assessors report both what the odor “smells like” (e.g. sewer, banana, etc.) and what the odor “feels like” (e.g. burning, cooling, etc.) Assessors also report relative strengths of the different characters identified.

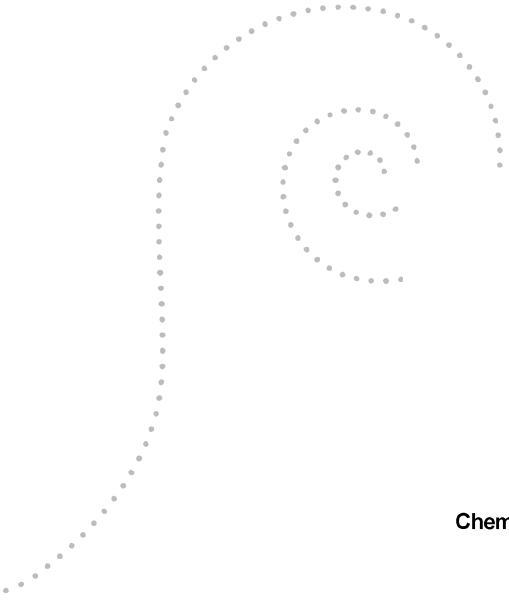
### Odor Descriptors

Numerous “standard” *odor* descriptor lists are available to use as a referencing vocabulary. Eight (8) recognized odor descriptor categories, including **Vegetable, Fruity, Floral, Medicinal, Chemical, Fishy, Offensive, and Earthy**, are illustrated as an “odor wheel”. Specific descriptors within each of these odor categories are presented in the subsequent diagram.

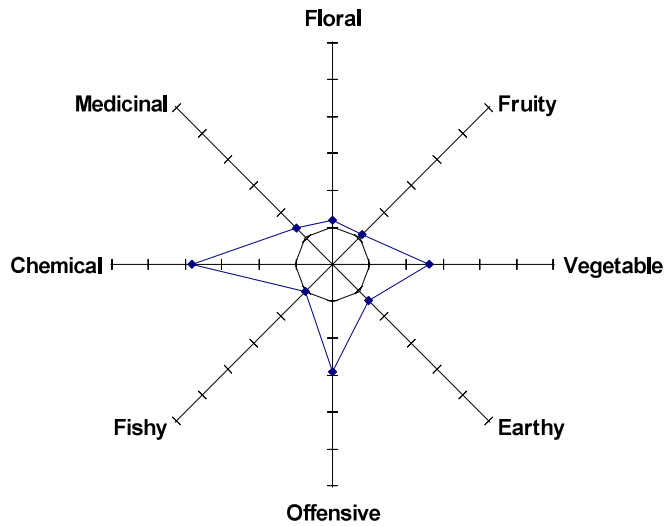




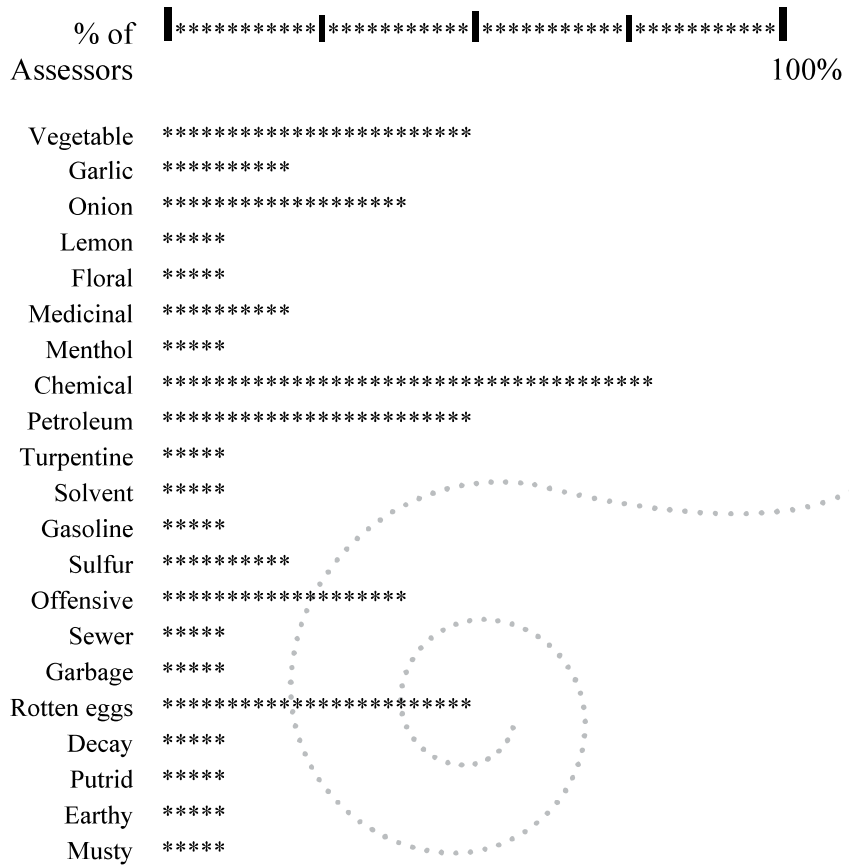
Each assessor rates these eight main odor descriptor categories on a relative strength scale of zero to five, where zero is “not present”, 1 = faint, 3 = moderate, and 5 = strong. The average results of the panel of assessors are plotted on a spider graph (polar plot). The axis on the spider graph, for example in the direction of Offensive, is the average relative strength on the 0 to 5 scale.



### Odor Descriptor Graph



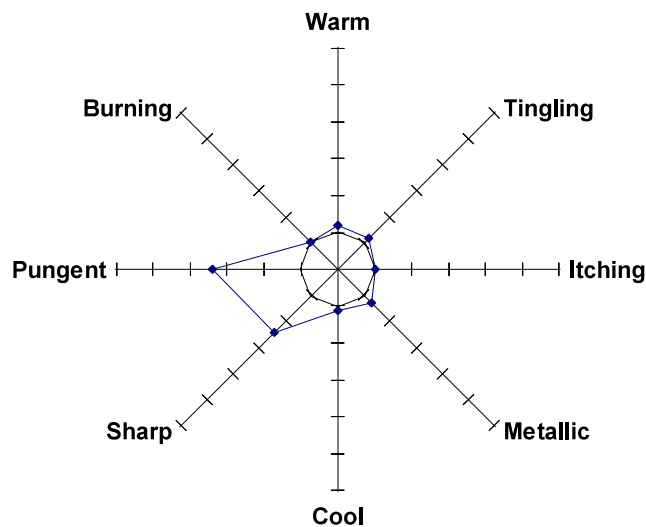
Each assessor also reports the specific Odor Descriptors observed. A histogram presents the percentage of assessors in the panel that assigned specific descriptors to the odor sample.



## Sensation Descriptors

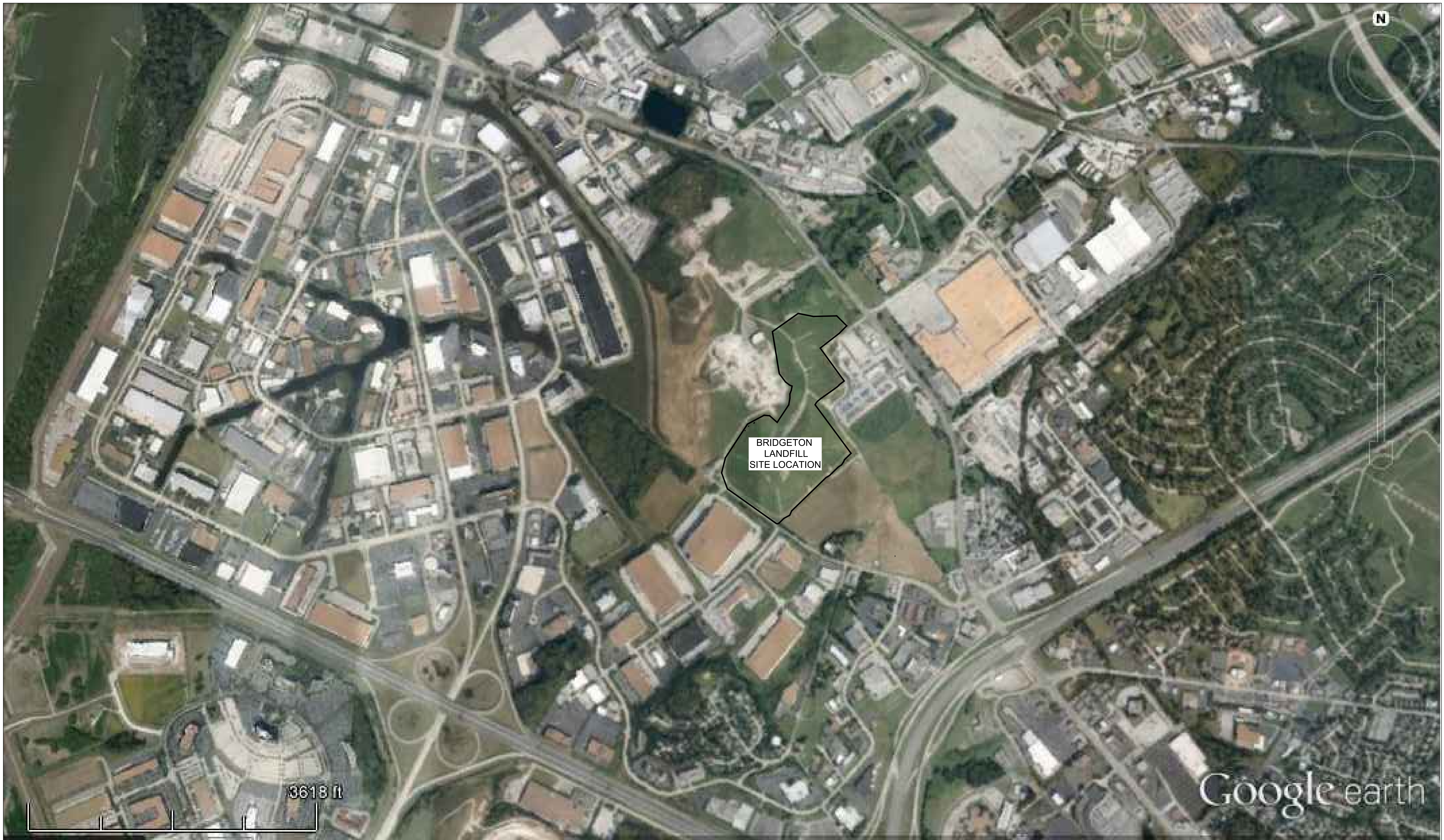
The Trigeminal Nerves (Fifth Cranial Nerve), located throughout the nasal cavity and in the upper palate, and the other nerves in these areas sense the presence of some odors (i.e. “feels like...” rather than “smells like...”). Eight (8) common *sensation descriptors* that can be reported include: **Itching, Tingling, Warm, Burning, Pungent, Sharp, Cool, and Metallic**. Each assessor rates each of these sensations on a relative strength scale of zero to five, where zero is “not present”, 1 = faint, 3 = moderate, and 5 = strong. The average results of the panel of assessors are plotted on a spider graph (polar plot). The axis on the spider graph, for example in the direction of **Burning**, is the relative strength scale.

**Sensation Descriptor Graph**



St. Croix Sensory technical staff works closely with our clients to discuss the specific odor evaluation needs of each project to provide valuable results.

**FIGURE 1**



BRIDGETON  
LANDFILL  
SITE LOCATION

3618 ft

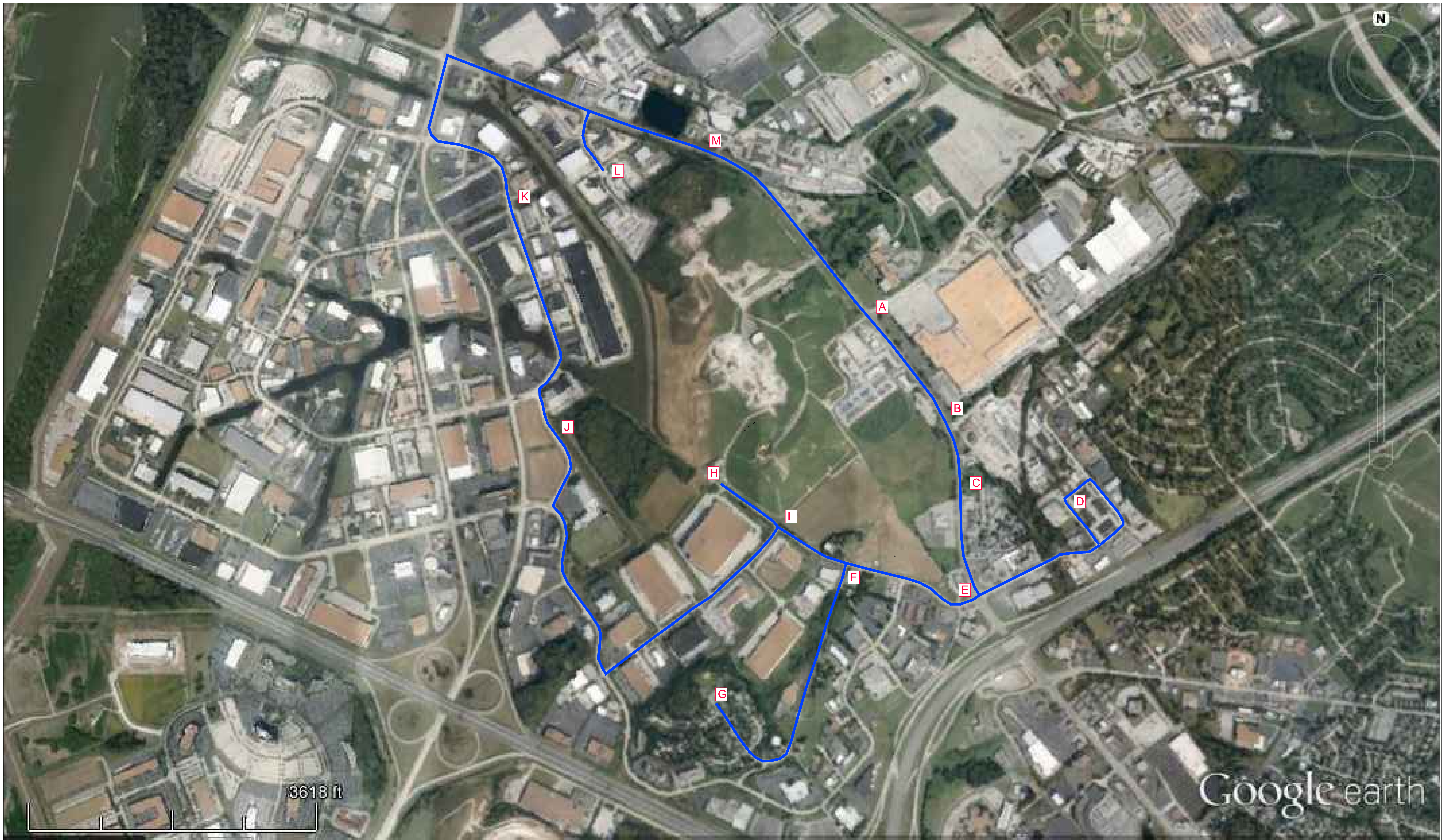
Google earth



BRIDGETON LANDFILL, LLC 13670 SAINT CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL	DATE: MARCH 2014	DRAWING NO.:
		DESIGNED BY: DMK	001
FACILITY SITE PLAN		APPROVED BY: ALK	
PROJECT NUMBER: BT-001   FILE PATH:		REVISION	DATE

**FIGURE 2**





**LEGEND**

- A ODOR MONITORING LOCATION
- ROUTE



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<b>DAILY ODOR SELF-INSPECTION DESIGNATED ROUTE</b>		REVISION	DATE
PROJECT NUMBER: BT-021   FILE PATH:			