

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***MONITORING AND RESEARCH
DEPARTMENT***

REPORT NO. 23-18

***ODOR MONITORING PROGRAM AT THE METROPOLITAN WATER
RECLAMATION DISTRICT OF GREATER CHICAGO'S SOLIDS DRYING
AND SOLIDS PROCESSING FACILITIES DURING 2022***

June 2023

Metropolitan Water Reclamation District of Greater Chicago
100 East Erie Street Chicago, Illinois 60611-2803 (312) 751-5600

ODOR MONITORING PROGRAM AT THE METROPOLITAN WATER
RECLAMATION DISTRICT OF GREATER CHICAGO'S SOLIDS DRYING AND
SOLIDS PROCESSING FACILITIES DURING 2022

By

Weizhe An
Environmental Research Scientist

Ali Oskouie
Senior Environmental Research Scientist

TABLE OF CONTENTS

| | <u>Page</u> |
|---|-------------|
| LIST OF TABLES | ii |
| LIST OF FIGURES | iii |
| LIST OF ACRONYMS | iv |
| ACKNOWLEDGMENTS | v |
| DISCLAIMER | v |
| SUMMARY | vi |
| INTRODUCTION | 1 |
| RESULTS OF ODOR MONITORING AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO’S SOLIDS DRYING AND SOLIDS PROCESSING FACILITIES IN 2022 | 4 |
| Calumet Water Reclamation Plant Solids Drying Site | 4 |
| Harlem Avenue Solids Management Area, Vulcan Solids Drying Area, Marathon Solids Drying Area, and Lawndale Avenue Solids Management Area Solids Processing Site | 5 |
| APPENDIX | |
| Location of Odor Monitoring Stations at the Metropolitan Water Reclamation District of Greater Chicago Solids Drying Areas and Solids Processing Sites | AI |

LIST OF TABLES

| <u>Table No.</u> | | <u>Page</u> |
|------------------|---|-------------|
| 1 | Strong and Very Strong Odor Observations for 2022 | vii |
| 2 | Odor Monitoring Program for 2022 | 2 |
| 3 | Odor Monitoring Results for 2022 | 6 |
| 4 | Hydrogen Sulfide Readings at the Calumet Solids Drying Site for 2022 | 8 |
| 5 | Hydrogen Sulfide Readings at the Harlem Avenue Solids Management Area, Vulcan Solids Drying Areas, Marathon Solids Drying Areas, and Lawndale Avenue Solids Management Area Solids Processing Site for 2022 | 10 |

LIST OF FIGURES

| <u>Figure No.</u> | | <u>Page</u> |
|-------------------|--|-------------|
| 1 | Percent Monthly Odor Observances at the Calumet Solids Drying Site – 2022 | 7 |
| 2 | Percent Monthly Odor Observances at the Harlem Avenue Solids Management Area, Vulcan Solids Drying Areas, Marathon Solids Drying Areas, and Lawndale Avenue Solids Management Area Solids Processing Site – 2022 | 9 |
| AI-1 | Odor Monitoring Locations at the Calumet Water Reclamation Plant and Solids Drying Sites | AI-1 |
| AI-2 | Odor Monitoring Locations in the Northern Portion of the Harlem Avenue Solids Management Area, Vulcan, and Marathon Solids Drying Areas, and Lawndale Avenue Solids Management Area Solids Processing Sites | AI-2 |
| AI-3 | Odor Monitoring Locations in the Southern Portion of the Harlem Avenue Solids Management Area, Vulcan, and Marathon Solids Drying Areas, and Lawndale Avenue Solids Management Area Solids Processing Sites | AI-3 |

LIST OF ACRONYMS

| | |
|------------------|--|
| CALSMA | Calumet Solids Management Area |
| District | Metropolitan Water Reclamation District of Greater Chicago |
| H ₂ S | hydrogen sulfide |
| HASMA | Harlem Avenue Solids Management Area |
| LASMA | Lawndale Avenue Solids Management Area |
| M&O | Maintenance and Operations |
| M&R | Monitoring and Research |
| ppbv | parts per billion by volume |
| ppmv | parts per million by volume |
| RASMA | Ridgeland Avenue Solids Management Area |
| SDA | solids drying area |
| SDS | solids drying site |
| SPS | solids processing site |
| WRP | water reclamation plant |

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of the Monitoring and Research (M&R) Department and Maintenance and Operations (M&O) Department personnel in conducting odor monitoring activities at various facilities.

The efforts of the Monitoring and Research Department environmental research technicians, Messrs. Erik Gilmore, Brian Schuetz, Peter Cashaw, Dushyant Sharma, Charles Impastato, Joseph Kadich, and Bryan Allen of the Wastewater Capital Planning and Research Section, and Mr. Atmane Bekri, Engineering Technician IV, of the M&O Department, who carried out the odor monitoring surveys and maintained the database, are greatly appreciated.

Thanks are also due to Ms. Erin Keohane, Administrative Specialist, for her diligence in proofreading and formatting this report.

DISCLAIMER

Mention of proprietary equipment in this report does not constitute endorsement by the Metropolitan Water Reclamation District of Greater Chicago.

SUMMARY

The Metropolitan Water Reclamation District of Greater Chicago (District) has maintained a program of monitoring odors at one solids drying site (SDS), one solids processing site (SPS), and five solids drying areas (SDAs) since 1990. The Ridgeland Avenue Solids Management Area (RASMA) and Stony Island SDA were removed from the odor monitoring program as they are no longer used by the District, and the land is leased by others. Both Monitoring and Research (M&R) Department and Maintenance and Operations (M&O) Department personnel made subjective observations regarding the type and intensity of any odor perceived during odor monitoring. The M&R Department staff also recorded instantaneous hydrogen sulfide (H₂S) measurements using a handheld monitor at each monitoring site.

There were ten locations monitored at the Calumet Water Reclamation Plant (WRP) SDS. There were fifteen locations monitored at the Harlem Avenue Solids Management Area (HASMA), Marathon, the Vulcan SDAs, and the Lawndale Avenue Solids Management Area (LASMA) SPS. The frequency of monitoring is one day per week at the SDS, SDAs, and SPS. Each odor observation was characterized as very strong, strong, easily noticeable, faint, very faint, or no odor.

During 2022, four very strong odors were observed at the Calumet WRP SDS, seven very strong odors were observed at the HASMA, Marathon, Vulcan SDA, and LASMA SPS, 38 strong odors were observed at the Calumet WRP SDS, and 16 strong odors were observed at HASMA, Marathon, Vulcan SDAs, and LASMA SPS. At all the sites that were monitored by the M&R Department, the observations that were characterized as faint to no odor were 77 percent at the Calumet WRP SDS and 73 percent at HASMA, Marathon, Vulcan SDAs, and LASMA SPS. At the Calumet WRP SDS, which was also monitored by the M&O Department, the observations that were characterized as faint to no odor were 88 percent.

At each of the SDS, SDAs, and SPS, there are specific locations which had noticeable odors. A summary of locations which had occasional strong or very strong odors is presented in Table 1.

The H₂S levels were mostly not higher than the detection limit of 3 parts per billion by volume (ppbv), with occasional high values. The average level of H₂S ranged from <3.0 to 38.83 ppbv at the SDS, SDAs, and SPS.

TABLE 1: STRONG AND VERY STRONG ODOR OBSERVATIONS FOR 2022

| Facility (Station Number) | Number of Strong Odor Observations | Number of Very Strong Odor Observations | Total Number of Observations |
|--|------------------------------------|---|------------------------------|
| Calumet WRP SDS | | | |
| CALSMA West, Drying Cell #4 (02) | 4 | | |
| CALSMA East, SW of Cell #5 (19) | 2 | 2 | |
| CALSMA East, SE of Cell #5 (20) | 2 | 1 | |
| CALSMA East, NW of Cell #8 (22) | 1 | | |
| CALSMA East, East of Cell #1 (23) | 3 | | |
| CALSMA East, South of Cell #1 (24) | 3 | | |
| CALSMA East, West of Cell #1 (25) | 1 | 1 | |
| Total | 16 | 4 | 499 |
| HASMA, Marathon, and Vulcan SDAs, and LASMA SPS | | | |
| HASMA-East (01) | 2 | 1 | |
| HASMA Center (02) | 3 | | |
| Vulcan Construction Shaft (04) | 2 | | |
| Vulcan Northwest (05) | 3 | | |
| Vulcan TARP Well (06) | 4 | 2 | |
| LASMA Lagoon 24 (11) | 9 | 2 | |
| LASMA Lagoon 30 (12) | 7 | 1 | |
| LASMA Cell 3E-3W (15) | 3 | 1 | |
| LASMA Cell 4E-4W (16) | 2 | | |
| LASMA Cell 5E-5W (17) | 1 | | |
| Marathon Northeast (18) | 1 | | |
| Marathon Southwest (19) | 1 | | |
| Total | 38 | 7 | 743 |

Note: CALSMA = Calumet Solids Management Area.
 HASMA = Harlem Avenue Solids Management Area.
 LASMA = Lawndale Avenue Solids Management Area.
 SDA = Solids Drying Area.
 SDS = Solids Drying Site.
 SPS = Solids Processing Site.
 WRP = Water Reclamation Plant.

INTRODUCTION

The M&R Department, in conjunction with the M&O Department, has been conducting an odor monitoring program at various District solids drying and processing facilities for the past 30 years. The program was initiated by the M&R Department to monitor the solids processing and drying sites at LASMA, HASMA, Marathon, and Vulcan SDA in 1990, and was expanded to the Calumet WRP SDS in 1992 and to RASMA and the Stony Island SDA in 2001 as part of the District's SDA operating permits. Odor monitoring for RASMA and the Stony Island SDA was terminated as they are no longer used as biosolids drying sites and the land is leased by others.

At each location, a similar procedure is followed to monitor odors. The M&R Department personnel, and at some facilities M&O Department personnel, visit various locations at each facility on a regular basis. The odor monitoring personnel make subjective observations regarding the character and intensity of odors at each of the stations. The odor intensities are ranked on a scale of 0 to 5, corresponding to no odor, very faint, faint, easily noticeable, strong, and very strong. In addition to the subjective evaluation of odors in terms of intensity and character, the ambient air is sampled and analyzed for H₂S concentration using Jerome Model 631-X and Model J605 H₂S analyzers. The monitoring range of the Model 631-X is 3 ppbv to 50 parts per million by volume (ppmv). The monitoring range of the Model J605 is 3 ppbv to 10 ppmv.

The objective of the program is to collect and maintain a database of odor levels within and around each solids drying and processing facility as part of a permit requirement by the Illinois Environmental Protection Agency for odor management at the District's biosolids drying facilities. This data can also be used to study the trends in odor levels associated with solids drying and processing operations and to correlate odor levels with conditions related to solids drying and processing operations or changing conditions within the facility that in turn can be used for applying deodorizing agents or designing facilities for composting of biosolids. Composting operations commenced at HASMA in 2014 and at the Calumet WRP SDS in 2018.

A summary of the odor-monitoring program for the solids drying and processing facilities is presented in [Table 2](#). This table includes a brief description of the program with regard to when the monitoring commenced at each facility, the number of monitoring locations, the frequency of the monitoring, who conducts the monitoring, if H₂S is measured by Department personnel, and the number of odor complaints in 2022. Monitoring activities were conducted as described in this report.

Maps showing the odor monitoring locations are presented in [Appendix AI](#).

TABLE 2: ODOR MONITORING PROGRAM FOR 2022

| Facility | Number of Locations Monitored | Year Began | Months of Year | Days per Week | Departments Participating | H ₂ S Measured | Number of Odor Complaints | Number of Complaints Verified |
|---|-------------------------------|------------|----------------|---------------|---------------------------|---------------------------|---------------------------|-------------------------------|
| Calumet WRP SDS | 10 | 1992 | 12 | 1 Varies | M&R M&O | Yes No | 10 | 3 |
| HASMA, Marathon, Vulcan SDAs, and LASMA SPS | 15 | 1990 | 12 | 1 | M&R | Yes | 0 | 0 |

Note: HASMA = Harlem Avenue Solids Management Area.
 LASMA = Lawndale Avenue Solids Management Area.
 M&O = Maintenance and Operations Department.
 M&R = Monitoring and Research Department.
 SDA = Solids Drying Area.
 SDS = Solids Drying Site.
 SPS = Solids Processing Site.
 WRP = Water Reclamation Plant.

The number of monitoring locations at each facility varies from 10 to 15 depending upon the size of the facility and the history of odor episodes at those facilities. The solids drying and processing facilities are monitored one day per week by the M&R Department and at a variable frequency by the M&O Department.

In 2022, ten odor complaints were received at the Calumet WRP SDS, three of which were verified, while seven were unverified. Among the seven unverified odor complaints, three were investigated on the same day, and no odor was detected at the time of investigation. For the other four odor complaints, staff were not available at the time of complaints. They were investigated on a different day, and no odor was detected at the time of investigation. In 2022, no odor complaints were received at the HASMA, Marathon, and Vulcan SDA, and LASMA SPS.

This report presents the odor monitoring data for the year 2022. The odor monitoring data has been reviewed and summarized in terms of frequency of occurrence, locations of possible odor sources, and H₂S levels.

RESULTS OF ODOR MONITORING AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S SOLIDS DRYING AND SOLIDS PROCESSING FACILITIES IN 2022

The results of the various odor monitoring programs at each of the monitored sites for 2022 are summarized in [Table 3](#). The results have been divided into two major groups: significant odors, which include the very strong, strong, and easily noticeable odors, and insignificant odors, which comprise no odors, very faint, or faint odors.

A general observation drawn from the table is that at the Calumet WRP SDS, where both M&R and M&O Department personnel conducted odor monitoring, M&O Department personnel did not observe any significant odors, while M&R Department personnel observed a few episodes of significant odors. This may be due to the fact that M&O Department personnel are exposed to the specific areas on a daily basis, which can result in olfactory desensitization, as compared to the M&R Department personnel who visit the sites occasionally.

Calumet Water Reclamation Plant Solids Drying Site

The Calumet WRP SDS consists of the East SDA, located east of the Calumet WRP, and the West SDA, located west of the Calumet WRP. In M&R Department monitoring records, the Calumet WRP SDS had 77 percent of the total observations characterized as faint to no odor. In M&O Department monitoring, the Calumet WRP SDS had 88 percent of the total observations characterized as faint to no odor. The occurrence of strong odors at the drying areas, which also include the nonoperational centrifuge building located at the East SDA, was infrequent. The majority of the observations were described as faint to no odor. There were four very strong odor observations and 15 strong odor observations out of 439 total observations in M&R Department monitoring records. There was one very strong odor observation and no strong odor observations out of 60 total observations made by the M&O Department. The very strong and strong odors were observed in various months and were spread among the various locations depending upon the activity at the time.

Very strong odors were observed under four percent of the time on a monthly basis. Strong odors were observed under eight percent of the time on a monthly basis. [Figure 1](#) presents the monthly frequency of occurrence of the easily noticeable, strong, and very strong odor observations. The easily noticeable odor observations during this period ranged from 0 to 34 percent. The easily noticeable odors were more frequent during the months of April through October, and highest frequency was observed during June 2022, at 34 percent.

The average H₂S levels ranged from 1.46 ppbv to 7.76 ppbv. The highest H₂S levels ranged from 7.61 to 132 ppbv. Both the mean and maximum values of all observations are shown in [Table 4](#). The highest value observed (132 ppbv) was at Calumet SMA Location 19 Southwest Corner of Cell 5 on July 14, 2022.

There were 10 odor complaints related to the Calumet WRP SDS during 2022, three of which were verified, three unverified soon after the complaints, while the other four were investigated on a later day with no odor detection. Two verified odor complaints happened in

September. One verified odor complaint happened in October. One unverified odor complaint happened in May, November, and December, respectively. Four unverified odor complaints happened in June.

Harlem Avenue Solids Management Area, Vulcan Solids Drying Area, Marathon Solids Drying Area, and Lawndale Avenue Solids Management Area Solids Processing Site

The HASMA facility consists of HASMA, LASMA SPS, Vulcan SDA, and Marathon SDA, located near the intersection of South Harlem Avenue and the Chicago Sanitary and Ship Canal on the north bank of the Canal. The HASMA, Vulcan SDA, and Marathon SDA and LASMA SPS had 73 percent of the total observations characterized as faint to no odor. The occurrence of strong odors at these facilities was infrequent. The majority of the observations were described as faint to no odor. There were seven very strong and 38 strong odor observations out of 743 total observations. The very strong and strong odors were observed in various months and were spread among the various locations depending upon the activity at the time.

The percentage of observations at which easily noticeable, strong, and very strong odors were observed was plotted by month and is presented in [Figure 2](#). Very strong odors were observed under six percent of the time on a monthly basis. Strong odors were observed under 11 percent of the time on a monthly basis. The easily noticeable odor observations ranged from 2.2 to 44.8 percent during this time period. The easily noticeable odors were highest during November 2022, at 44.8 percent.

The average H₂S levels at the various locations around these SDAs and SPS ranged from 1.18 ppbv to 38.83 ppbv. The highest H₂S levels at the various locations around these SDAs and SPS ranged from 5.45 to 1,646 ppbv. Both are shown in [Table 5](#). The highest value observed (1,646 ppbv) was at HASMA-East on August 30, 2022.

There were no odor complaints related to the HASMA WRP SDS during 2022.

TABLE 3: ODOR MONITORING RESULTS FOR 2022

| Facility | Departments Participating | Total Number of Observations | Number of Observations Significant Odors Detected | | | Number Insignificant Odors ¹ | Percent Insignificant Odors |
|---|---------------------------|------------------------------|---|--------|-------------------|---|-----------------------------|
| | | | Very Strong | Strong | Easily Noticeable | | |
| Calumet WRP SDS | M&R | 439 | 4 | 15 | 81 | 339 | 77% |
| | M&O | 60 | 0 | 1 | 6 | 53 | 88% |
| HASMA, Marathon, Vulcan SDAs, and LASMA SPS | M&R | 743 | 7 | 38 | 157 | 541 | 73% |

Note: HASMA = Harlem Avenue Solids Management Area.
 LASMA = Lawndale Avenue Solids Management Area.
 M&O = Maintenance and Operations Department.
 M&R = Monitoring and Research Department.
 SDA = Solids Drying Area.
 SDS = Solids Drying Site.
 SPS = Solids Processing Site.
 WRP = Water Reclamation Plant.

¹Insignificant odors are all observations of faint, very faint, or no odor.

FIGURE 1: PERCENT MONTHLY ODOR OBSERVANCES AT THE CALUMET SOLIDS DRYING SITE – 2022

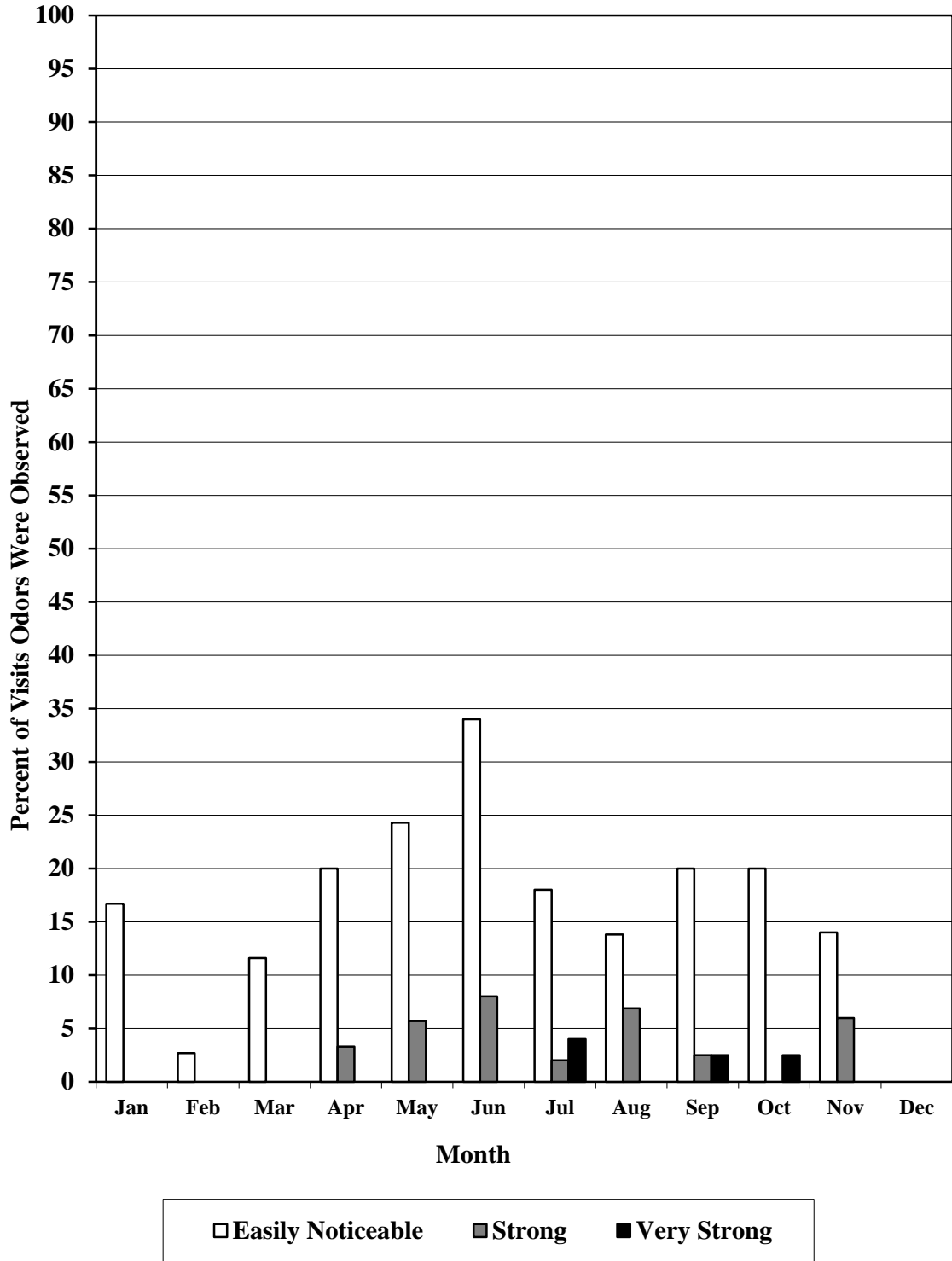


TABLE 4: HYDROGEN SULFIDE READINGS AT THE CALUMET SOLIDS DRYING SITE FOR 2022

| Location ² | Hydrogen Sulfide, ppbv ¹ | | |
|------------------------------------|-------------------------------------|---|---------|
| | Mean ³ | Percent of Readings Below the Detection Limit | Maximum |
| CALSMA W Cell 1 Gate (1) | 2.14 | 52% | 8.2 |
| CALSMA W Cell 4 @ Scale House (2) | 3.00 | 67% | 62.89 |
| N. of CALSMA W. At N. Gate (3) | 1.46 | 72% | 7.61 |
| CALSMA E. SW Corner of Cell 5 (19) | 7.76 | 36% | 132 |
| CALSMA E. SE Corner of Cell 5 (20) | 4.67 | 33% | 46.76 |
| CALSMA E. NE Corner of Cell 8 (21) | 3.85 | 48% | 28.13 |
| CALSMA E. NW Corner of Cell 8 (22) | 3.42 | 61% | 36.32 |
| CALSMA E., E. of Cell 1 (23) | 2.86 | 55% | 21.65 |
| CALSMA E., S. of Cell 1 (24) | 2.11 | 69% | 19.27 |
| CALSMA E., W. of Cell 1 (25) | 3.39 | 62% | 31.45 |

Note: CALSMA = Calumet Solids Management Area.

¹ppbv = parts per billion by volume.

²Numbers in parentheses correspond to Station numbers in [Figure AI-1](#).

³Mean values are calculated using the average of all recordings by the Jerome hydrogen sulfide analyzer. The detection limit for the Jerome's is 3 ppbv but may display 0~3 ppbv on the meter. If the measurement was below the detection limit, the value displayed was used to calculate the mean whether it was 0 or some other number in between 0 and 3. (The Royal Society of Chemistry, Analytical Methods Committee Technical Brief No. 5, Apr 2001.)

FIGURE 2: PERCENT MONTHLY ODOR OBSERVANCES AT HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN SOLIDS DRYING AREAS, MARATHON SOLIDS DRYING AREAS, AND LAWDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITE – 2022

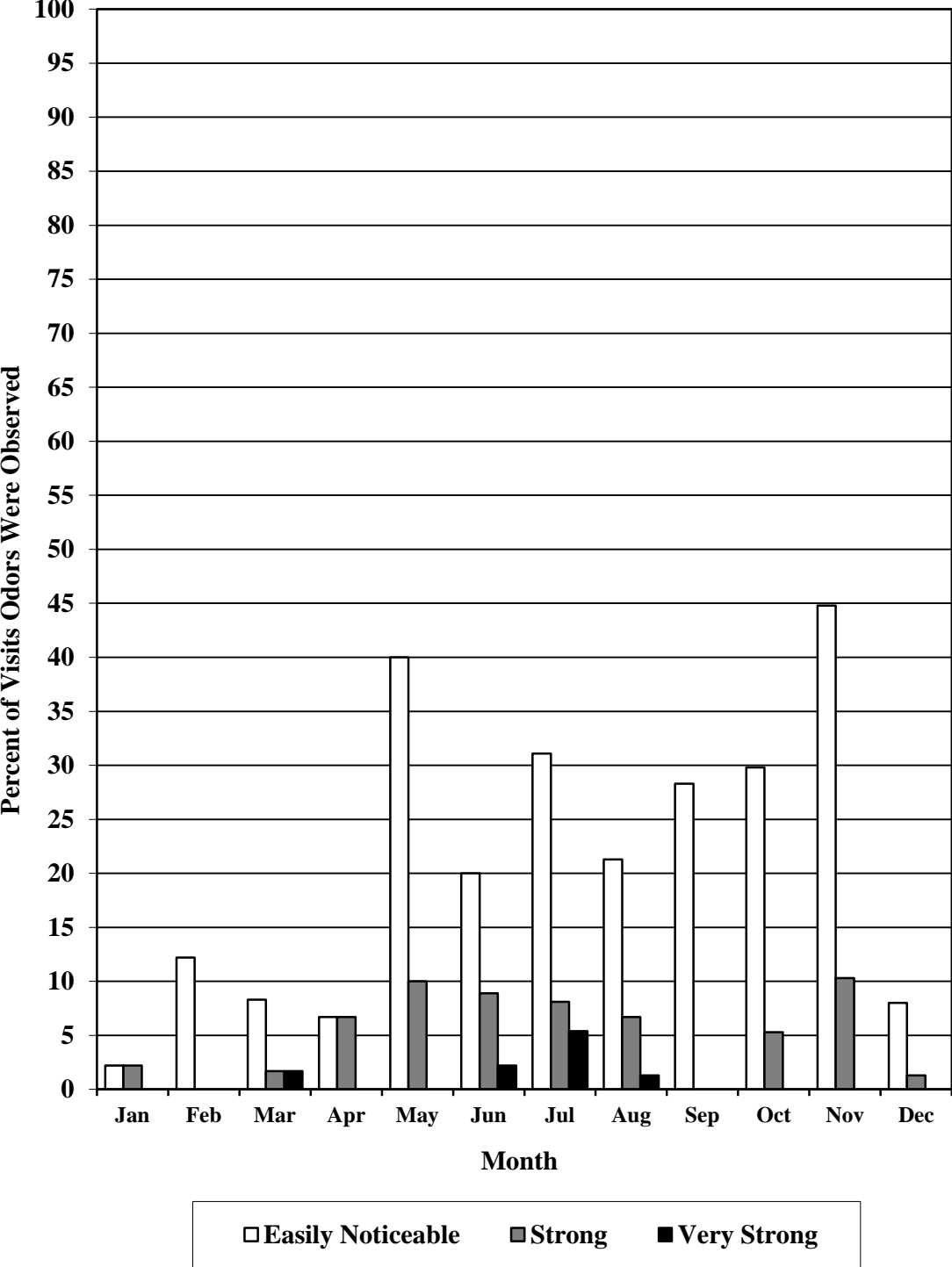


TABLE 5: HYDROGEN SULFIDE READINGS AT THE HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN SOLIDS DRYING AREAS, MARATHON SOLIDS DRYING AREAS, AND LAWNSDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITE FOR 2022

| Location ² | Hydrogen Sulfide, ppbv ¹ | | |
|-------------------------------|-------------------------------------|---|---------|
| | Mean ³ | Percent of Readings Below the Detection Limit | Maximum |
| HASMA E. (1) | 38.83 | 38% | 1,646 |
| HASMA Center (2) | 2.77 | 50% | 18.49 |
| Vulcan NE (3) | 2.77 | 53% | 16.02 |
| Vulcan Construction Shaft (4) | 3.79 | 48% | 42.78 |
| Vulcan NW (5) | 2.94 | 55% | 16 |
| Vulcan TARP Well (6) | 3.86 | 43% | 32.16 |
| LASMA Lagoon 24 (11) | 3.95 | 44% | 34.6 |
| LASMA Lagoon 20 (12) | 3.09 | 60% | 56.65 |
| LASMA Cell 1E-1W (13) | 1.69 | 68% | 7.37 |
| LASMA Cell 2E-2W (14) | 1.54 | 74% | 7.36 |
| LASMA Cell 3E-3W (15) | 2.04 | 72% | 29.77 |
| LASMA Cell 4E-4W (16) | 1.48 | 70% | 7.3 |
| LASMA Cell 5E-5W (17) | 1.65 | 70% | 7.26 |
| Marathon NE (18) | 1.64 | 71% | 7.91 |
| Marathon SW (19) | 1.18 | 80% | 5.45 |

Note: HASMA = Harlem Avenue Solids Management Area.
LASMA = Lawndale Avenue Solids Management Area.
TARP = Tunnel and Reservoir Plan.

¹ppbv = parts per billion by volume.

²Numbers in parentheses correspond to station numbers in [Figure AI-2](#).

³Mean values are calculated using the average of all recordings by the Jerome hydrogen sulfide analyzer. The detection limit for the Jerome's is three ppbv but may be displayed as zero ppbv on the meter. If the measurement was below the detection limit, the value displayed was used to calculate the mean whether it was zero or another number between zero and three. (The Royal Society of Chemistry, Analytical Methods Committee Technical Brief No. 5, Apr 2001.)

APPENDIX AI

LOCATION OF ODOR MONITORING STATIONS AT THE METROPOLITAN WATER
RECLAMATION DISTRICT OF GREATER CHICAGO SOLIDS DRYING AREAS AND
SOLIDS PROCESSING SITES

FIGURE AI-1: ODOR MONITORING LOCATIONS AT THE CALUMET WATER RECLAMATION PLANT AND SOLIDS DRYING SITES*



AI-1

*Location 1–3 and 19–25 are odor monitoring locations for solids drying sites.

FIGURE AI-2: ODOR MONITORING LOCATIONS IN THE NORTHERN PORTION OF THE HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN, AND MARATHON SOLIDS DRYING AREAS, AND LAWNSDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITES*

AI-2



*Locations 1–6 are odor monitoring locations for solids drying areas.

FIGURE AI-3: ODOR MONITORING LOCATIONS IN THE SOUTHERN PORTION OF THE HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN, AND MARATHON SOLIDS DRYING AREAS, AND LAWNSDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITES*

AI-3



*Locations 11–19 are odor monitoring locations for solids drying areas and solids processing sites.