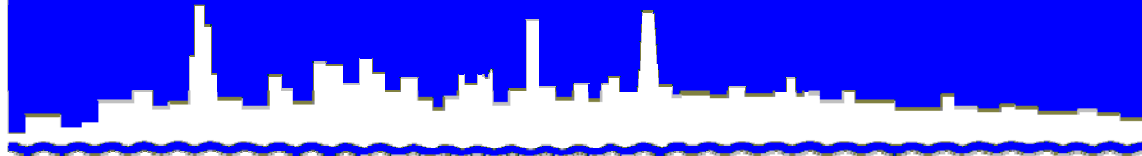


Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***RESEARCH AND DEVELOPMENT
DEPARTMENT***

REPORT NO. 07-2

*ODOR MONITORING PROGRAM AT METROPOLITAN WATER
RECLAMATION DISTRICT FACILITIES DURING 2005*

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Metropolitan Water Reclamation District of Greater Chicago

100 East Erie Street Chicago, Illinois 60611-2803 312-751-5600

ODOR MONITORING PROGRAM AT METROPOLITAN WATER
RECLAMATION DISTRICT FACILITIES DURING 2005

By

David T. Lordi
Research Scientist III

Ali K. Oskouie
Research Scientist I

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DISCLAIMER

Mention of proprietary equipment and chemicals 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) maintains a program of monitoring odors at five water reclamation plants (WRPs) one solids drying site, one solids processing site, and four solids drying areas. This program started in 1990. Both Research and Development (R&D) Department and Maintenance and Operations (M&O) Department personnel make subjective observations regarding the type and intensity of any odor perceived. In 2005 the program included five of the District WRPs and all of the Solids Drying Areas. The number of locations at each facility varies from 4 to 19. The frequency of monitoring varies from one day per week at the Ridgeland Solids Drying Area to seven days per week during the summer months at the Kirie WRP. Each odor observation is characterized as very strong, strong, easily noticeable, faint, very faint, or no odor.

During 2005 four very strong odors, out of 5,138 observations, were observed at the Stickney WRP and one very strong odor out of 2,103 was observed at the Calumet drying areas. No very strong odors were perceived at any of the other facilities being monitored. The majority of the observations at the five WRPs were characterized as faint to no odor from 59 to 99 percent of the time. At the six solids drying areas and sites, observations were characterized as faint to no odor from 64 to 97 percent of the time.

At each of the WRPs there are specific locations which have noticeable odors. A summary of the locations which had occasional strong odors is presented in Table 1. As an example, at the Calumet WRP the area where most strong odors were observed is in the vicinity of the Sludge Concentration Building and the preliminary tanks. At the Stickney WRP the areas where most strong odors were observed are the predigestion centrifuges, preliminary tanks, and Imhoff tanks. While strong odors are generally infrequent, it shows there is the potential for odors from these areas. Strong odors occurring along Laramie Avenue were identified as typical odors coming from the Koppers Industries, Inc. plant, which is just east of the Stickney WRP.

The hydrogen sulfide levels generally followed a similar pattern as the odor observations with an occasional relatively high value (greater than 100 ppbv). It appears that the average level of hydrogen sulfide is between 5 and 19 ppbv at the WRPs. At the Stickney WRP the average hydrogen sulfide levels along the periphery of the plant were 6 to 13 ppbv and 10 to 41 ppbv at the majority of locations within the WRP.

Two continuous ambient hydrogen sulfide monitors are installed at the Calumet WRP, one at the north end and the other at the south end. The majority of the hydrogen sulfide concentrations were recorded as zero. During the months of June to August, the percentage of values greater than 10 ppb varied between 0.3 to 3 percent at the North Monitor and 0.0 to 0.4 percent at the South Monitor. Spikes in the hydrogen sulfide concentrations occur more frequently in the evening and earlier morning hours.

TABLE 1: STRONG ODOR OBSERVATIONS—2005

Facility	Number of Strong Odor Observations	Total Number of Observations
Calumet WRP		
Plant Entrance	3	
Lagoon #16 SW Corner	3	
Sludge Concentration Building	14	
Preliminary Tanks	15	
Sludge Digester	1	
Aeration Battery A	2	
TARP Pump Stations	1	
Lagoons #1 and #2	<u>1</u>	
	Total 40	3,052
Calumet SDS*		
Drying Cell #1 SE	1	
Drying Cell #8 NW	3	
Drying Cell #8 NE	1	
West Drying Cell #4	<u>1</u>	
	Total 6	2,103
Egan WRP	Total 0	349
Kirie WRP	Total 0	8,375
North Side WRP		
Howard St. East of McCormick Rd.	1	
Weir Rect. Preliminary Tanks	3	
Main St. Sludge Conc. Tanks	<u>1</u>	
	Total 5	644
Stickney WRP		
Imhoff Tanks**	11	
Centrifuges (Pre)	7	
Centrifuges (Post)	8	
Sludge Concentration Tanks	13	
Preliminary Tanks**	29	
Laramie Ave. & 40th St.**	9	
Laramie Ave. & 39th St.**	<u>2</u>	
	Total 79	5,138

TABLE 1 (Continued): STRONG ODOR OBSERVATIONS—2005

Facility	Number of Strong Odor Observations	Total Number of Observations
HASMA, Marathon, Vulcan SDA, and LASMA SPS		
HASMA	2	
HASMA Center	4	
Vulcan TARP Construction Shaft	3	
Vulcan North	2	
Vulcan TARP Well	2	
LASMA Drying Cells	5	
Marathon	1	
Lagoons	<u>4</u>	
	Total 23	2,181
RASMA SDA		
North Side Cell 2W	2	
NE Corner Cell 5E	1	
South of Cell 5W	<u>1</u>	
	Total 4	189
Stony Island SDA		
NE Corner Cell #5	5	
South End Cells #4 and #7	3	
W. Side Midpt. Of Cell #3	<u>1</u>	
	Total 9	325

*There was one observation of a very strong odor in the vicinity of the hopper building at the Calumet WRP.

**There was one observation of a very strong odor at these locations at the Stickney WRP.

SDS = Solids Drying Site.

SDA = Solids Drying Area.

SPS = Solids Processing Site.

WRP = Water Reclamation Plant.

INTRODUCTION

The R&D Department in conjunction with the M&O Department has been carrying out an odor monitoring program at various District facilities for the past 15 years. The initial program started with the solids processing and drying sites at LASMA, HASMA, Marathon, and Vulcan in 1990, and was expanded to the WRPs and other drying sites. The latest additions were the Ridgeland and Stony Island solids drying sites in 2001.

At each location a similar procedure is followed to monitor odors. R&D Department personnel, and at some facilities M&O Department personnel, visit various stations 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, no odor, 1, very faint, 2, faint, 3, easily noticeable, 4, strong, and 5, very strong odor. In addition to the subjective odor measurements, an analysis of the ambient air for hydrogen sulfide using a Jerome Model 631-X hydrogen sulfide meter is also conducted.

The objective of all the programs is to collect and maintain a database of odor levels within and around each WRP, and associated solids processing areas. The data are used to study the trends in odor levels associated with WRP operations, and to correlate odor levels to conditions related to WRP operations or changing conditions within the WRP, such as installation of odor control equipment, or sometimes to conditions unrelated to the WRP. Since several residential areas surround the WRPs in the program, the odor monitoring activities are also designed to provide early warning of odorous conditions that develop within the WRPs, and to allow control of them before they come to the notice of the residents. If a very strong odor is observed, the incident is reported at the time of observation to the respective plant operating personnel.

This report presents the odor monitoring data for the year 2005. The odor monitoring data in terms of frequency of occurrence, locations of possible odor sources, and hydrogen sulfide levels has been reviewed and summarized.

A summary of the odor monitoring program is presented in Table 2. This table includes a brief description of the program with regard to when the monitoring began at each facility, the number of monitoring locations, the frequency of the monitoring, and who conducts the monitoring.

Maps showing the odor monitoring sites at each WRP and Solids Drying Area are presented in Appendix AI.

The number of monitoring locations at each facility varies from 4 to 19, depending upon the facility and previous odor conditions. The Calumet and Stickney WRPs and Solids Drying Areas are monitored from three to five days per week. At the Kirie WRP, the M&O Department monitors the facility every day, once per shift, during the spring through fall months.

TABLE 2: ODOR MONITORING PROGRAM FOR 2005

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	13	1992	12	3 2	R&D M&O	Yes	0	—
Calumet SDS	9	1992	12	3 2	R&D M&O	Yes	0	—
Egan WRP	7	1993	12	1 **	R&D M&O**	Yes	3	1
Kirie WRP	17	1996	12	1 7*	R&D M&O	Yes	9	8
North Side WRP	13	1992	12	1 **	R&D M&O**	Yes	2	0
Stickney WRP	19	1991	12	3 2	R&D M&O	Yes	5	1
HASMA, Vulcan, Marathon SDA, and LASMA SPS	17	1990	12	3	R&D	Yes	1	0
RASMA SDA	4	2001	8	1 to 2	R&D	Yes	0	—
Stony Island SDA	4	2001	7	1	R&D	Yes	0	—

Note: SDA = Solids Drying Area
 SDS = Solids Drying Site
 SPS = Solids Processing Site
 WRP = Water Reclamation Plant

*At Kirie, M&O Department 7 days a week 3 times a day from May through November.

**The M&O Department conducts periodic odor monitoring surveys at these facilities depending upon conditions, but the data are not included in this report for 2005.

Odor complaints in 2005 with regard to the various facilities were very infrequent, ranging from none to nine at a given facility during the year.

RESULTS AT DISTRICT FACILITIES IN 2005

The results of the various odor monitoring programs at each of the District facilities for 2005 are summarized in Table 3. The results have been divided into two major groups: detected odors, which includes the very strong, strong, and easily noticeable categories, and for all practical purposes nondetected odors, which are either faint, very faint, or no odor.

A general observation drawn from the table is that at those facilities where both R&D Department and M&O Department personnel conducted odor monitoring, the M&O Department personnel show a lower frequency in odors detected. This may be due to the fact that the M&O Department personnel are exposed to the specific area on a daily basis as compared to the R&D Department personnel which can result in olfactory desensitization. Thus, they may not differentiate especially well between faint and easily noticeable odors.

Calumet WRP

In general, the majority of the odor monitoring observations ranged from faint to no odor; 71 percent of the time by R&D Department personnel and 96 percent of the time by M&O Department personnel, respectively. As noted previously, the main difference between the M&O and R&D observations are between easily noticeable and nondetects. The strong odors that are observed mainly occurred around the sludge concentration building and preliminary tanks, with 5.9 and 6.3 percent, respectively, of the observations at each location registered as strong. Areas which had easily noticeable odors were in the vicinity of the preliminary tanks, 46.4 percent of observations, sludge concentration tanks, 31.8 percent of observations, sludge digester tanks, 30.8 percent of observations, Lagoon #16, 25.4 percent of observations, Aeration Battery A, 19.4 percent of observations, and the plant entrance, 18.1 percent of observations.

The hydrogen sulfide measurements made at the time of the odor monitoring by the R&D Department personnel are summarized in Table 4. The highest levels are in the vicinity of the preliminary tanks, averaging 46.9 ppbv. The next highest values were at the sludge concentration building, with an average of 19.0 ppbv. The rest of the locations averaged between 4.5 and 8.9 ppbv, with a number of nondetectable observations.

Figure 1 summarizes the monthly observations of easily noticeable, strong, and very strong odors made during 2005 in terms of frequency of occurrence. The frequency of easily noticeable observations ranged between 11.9 and 29.7 percent each month with the highest percentages occurring in April and June. No very strong odors were observed during 2005.

No odor calls pertaining to the Calumet WRP were received in 2005.

TABLE 3: ODOR MONITORING RESULTS FOR 2005

Facility	Departments Participating	Total Number of Observations	Number of Observations Odors Were Detected			Number Non-Detects*	Percent Non-Detects
			Very Strong	Strong	Easily Noticeable		
Calumet WRP	R&D	2,086	0	39	569	1,478	71
	M&O	1,318	0	2	46	1,270	96
Calumet SDS	R&D	1,267	0	2	326	939	74
	M&O	643	1	4	12	626	97
Egan WRP	R&D	349	0	0	65	284	81
	M&O**						
Kirie WRP	R&D	844	0	0	195	649	77
	M&O	7,531	0	0	39	7,492	99
North Side WRP	R&D	644	0	6	226	412	64
	M&O**						
Stickney WRP	R&D	2,614	1	74	993	1,546	59
	M&O	2,524	3	6	342	2,173	86
HASMA, Vulcan, and Marathon SDA, and LASMA SPS	R&D	2,181	0	23	726	1,455	67
RASMA SDA	R&D	189	0	4	28	157	83
Stony Island SDA	R&D	325	0	9	107	209	64

Note: SDS = Solids Drying Site
 SDA = Solids Drying Area
 SPS = Solids Processing Site
 WRP = Water Reclamation Plant

*Non-detects are all observations of faint, very faint, or no odor.

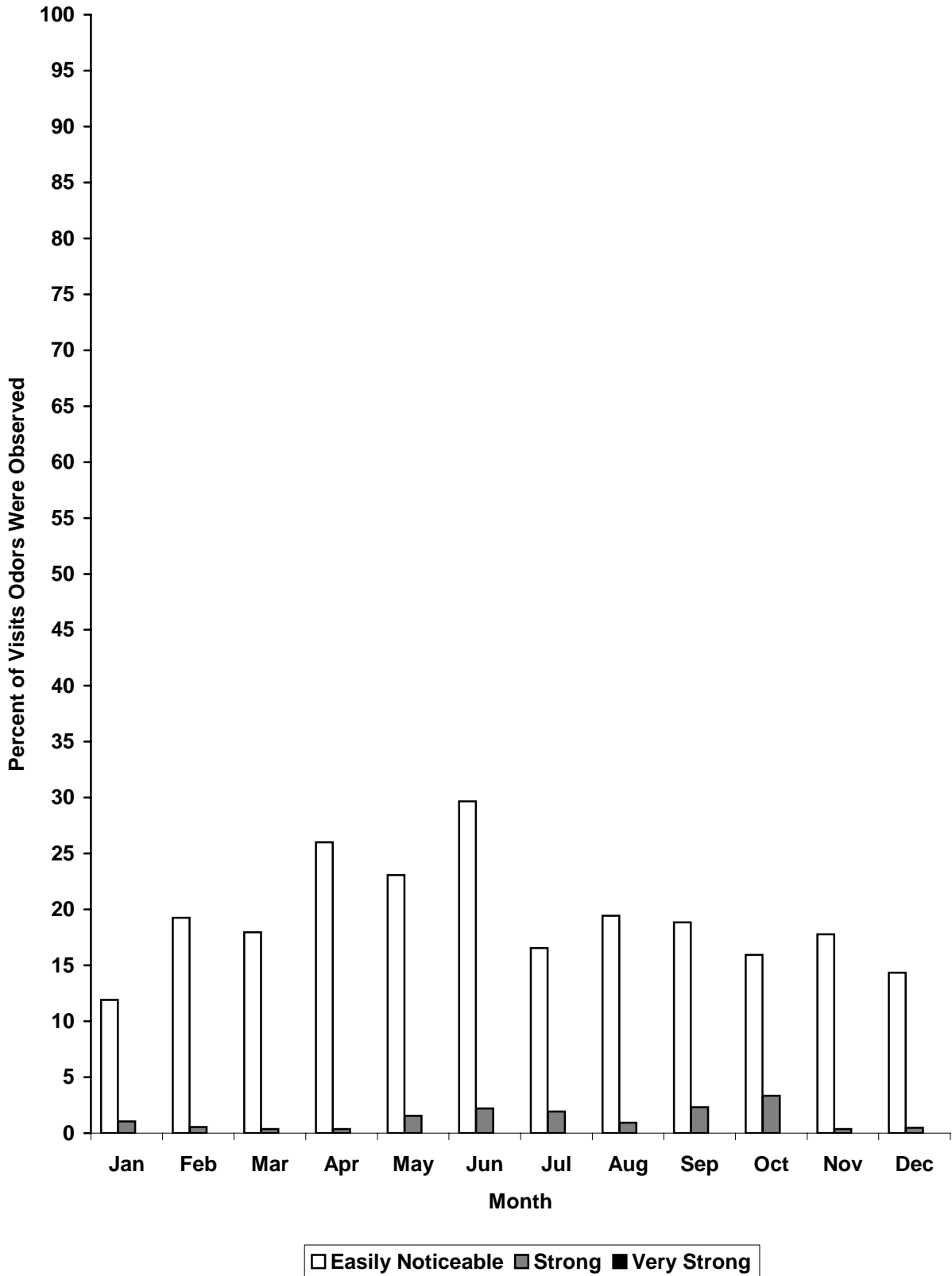
**The M&O Department conducts periodic odor monitoring surveys at these facilities, but the data are not included in this Table.

TABLE 4: HYDROGEN SULFIDE READINGS AT CALUMET WRP—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
Plant Entrance (1) ¹	8.4	0	143
Lagoon #16 SW Corner (2)	6.5	0	32
Sludge Conc. Bldg. (3)	19.0	0	210
Lagoon #16 NE Corner (4)	5.6	0	36
Sludge Digester Tanks (5)	8.9	0	130
Aeration Battery A—West (6)	6.1	0	30
TARP Pump Station (7)	8.4	0	270
Preliminary Tanks (8)	46.9	0	1,800
Gate Near Lagoon #9 (9)	5.7	0	24
Between Lagoon #7 & #8 (10)	6.2	0	33
Lagoon #1 & #2 (11)	4.5	0	12
Lagoon #3 & #4 (12)	4.9	0	18
Ellis Ave. & 130th St. (13)	6.6	0	39
H ₂ S Monitor—130th St. (23)	6.3	0	96
North H ₂ S Monitor (24)	5.7	0	110

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

FIGURE 1: ODOR OBSERVANCES AT CALUMET WRP—2005



Calumet Solids Drying Areas

The Calumet Solids Drying Site consists of the East Solids Drying Area, located east of the Calumet WRP, and the West Solids Drying Area, located west of the Calumet WRP. As with the Calumet WRP, the occurrence of strong odors at the drying areas, which also includes the centrifuge building located at the East Drying Area, was infrequent. The majority of the observations were described as faint to no odor, 74 percent by the R&D Department and 97 percent by the M&O Department, respectively. A few strong odors were observed at the drying areas during April, May and September 2005. Strong odors occurred 0.43 percent of the time at East Drying Cells #1 and #8 and West Drying Cell #4. Easily noticeable odors occurred between 2 and 32 percent of the time around the various drying area locations. The hydrogen sulfide levels averaged between 5.5 and 9.0 ppbv, as shown in Table 5. The highest values observed were in the vicinity of West Drying Cell #1 and East Drying Cell #1.

Figure 2 presents the monthly frequency of occurrence of the easily noticeable, strong, and very strong odor observations. The easily noticeable odors peaked during the spring months of 2005 and ranged from 2.1 to 23.8 percent.

No odor calls were received with regard to the Calumet Solids Drying Site.

John E. Egan WRP

There were no very strong odor or strong odor observations at the John E. Egan WRP locations in 2005. The easily noticeable odor observations occurred 65 out of 284 times, or 23 percent of the time. The easily noticeable odors were greatest in the vicinity of the primary tanks, with 22 percent of the observations being easily noticeable. At the West and East Gates easily noticeable odors were detected 7 percent and 0 percent of the time, respectively.

The percentage of observations at which easily noticeable, strong, and very strong odors were observed during 2005 are plotted by month in Figure 3. The frequency of observance of easily noticeable odors varied from 3.7 percent in February to 25 percent in May, July, and September 2005.

The average hydrogen sulfide measurements ranged from 4.9 to 8.9 ppbv, as shown in Table 6. The highest average level was observed in the vicinity of the waste gas burner.

Only three odor calls were received for the John E. Egan WRP. Only one call was verified as reporting an odor that could have originated from the John E. Egan WRP.

James C. Kirie WRP

There were no very strong or strong odor observations at the James C. Kirie WRP during 2005. Faint or no odors were reported approximately 77 percent (R&D Department) and 99 percent (M&O Department) of the time for the overall WRP. The easily noticeable odors which

TABLE 5: HYDROGEN SULFIDE READINGS AT CALUMET SOLIDS DRYING AREAS—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
East Drying Cell #1 SW (14) ¹	5.5	0	18
Hopper Building (15)	6.3	0	60
East Drying Cell #8 NW (16)	6.3	0	130
East Drying Cell #8 NE (17)	5.6	0	28
Truck Scale/Centrifuge (18)	5.8	1	14
East Drying Cell #1 SE (19)	7.9	0	300
West Drying Cell #1 @ Gate (20)	9.0	1	350
West Drying Cell #4 (21)	6.0	1	14
Bituminous Road @ Gate (22)	5.7	0	26

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

FIGURE 2: ODOR OBSERVANCES AT CALUMET WRP SOLIDS DRYING AREAS—2005

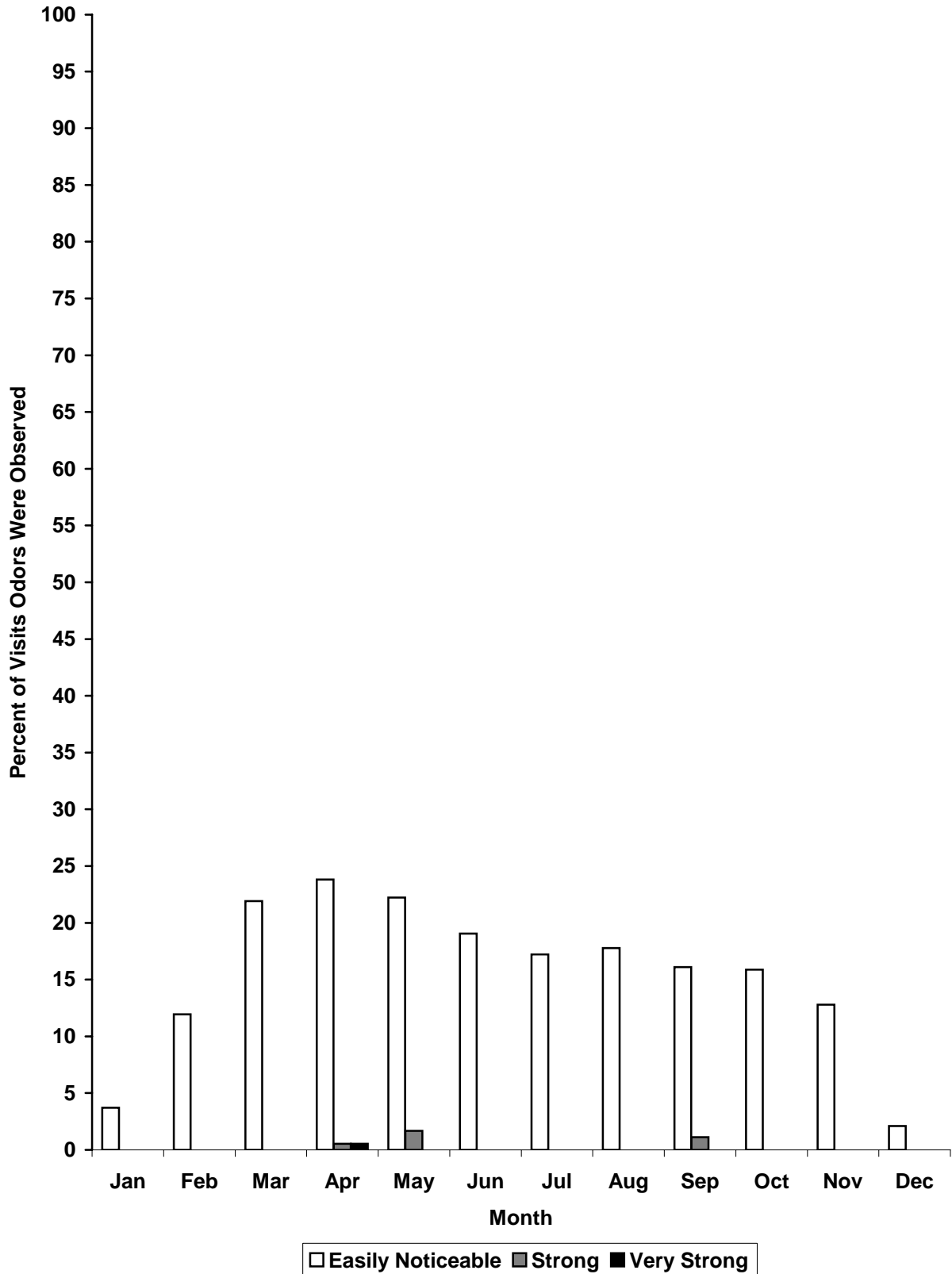


FIGURE 3: ODOR OBSERVANCES AT JOHN E. EGAN WRP—2005

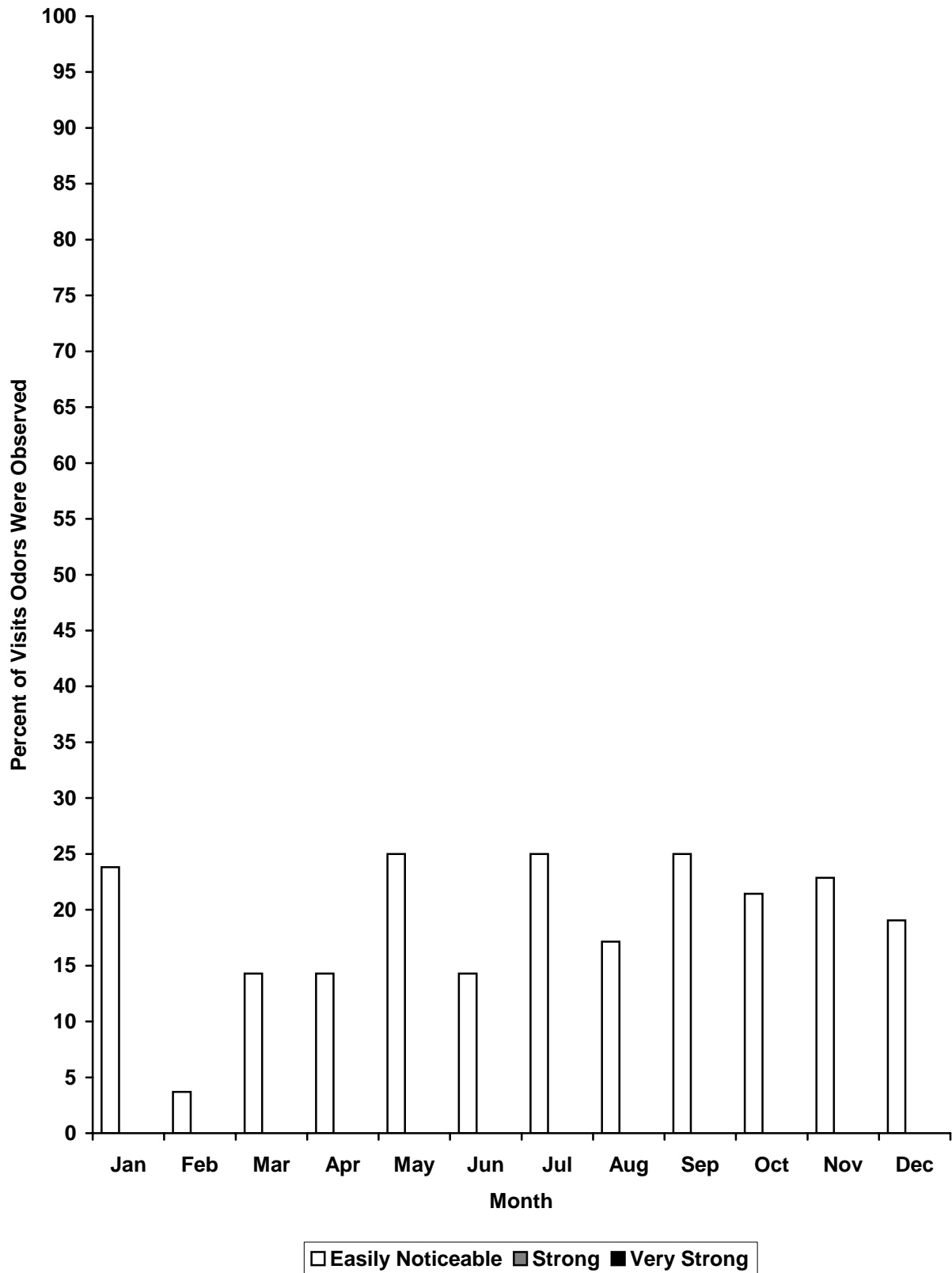


TABLE 6: HYDROGEN SULFIDE READINGS AT JOHN E. EGAN WRP—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
West Entrance Gate (1) ¹	5.0	0	28
Near Waste Gas Burner (2)	8.9	2	130
Primary Tanks (3)	4.9	0	11
South End “A” Drive (4)	5.6	0	17
Final Tanks (5)	8.1	0	190
East Entrance Gates (6)	4.9	0	11
West of Storage Building (7)	5.4	1	20

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

occurred were generally in the vicinity of the return aeration channel (8.1 percent), East Gallery North Channel (6.3 percent), and air lift stations A1 (7.9 percent) and A2 (7.5 percent).

Figure 4 summarizes the observations of odor monitoring personnel during 2005 in terms of easily noticeable odor or greater. There were very few noticeable odors. It should be noted that from June through November, M&O Department personnel conducted an odor monitoring survey three times a day, seven days a week, thus, there were a greater number of observations during these months as compared to December through March, resulting in a relatively very low percentage of easily noticeable odors during this time period. Looking at the monthly variations using only the R&D observations, which occur at the same frequency for the whole year, there is no significant pattern.

The measured hydrogen sulfide levels are summarized in Table 7. The highest average levels of hydrogen sulfide were measured in the vicinity of Road C-1 and the Return Channel, with averages of 10.4 ppbv and 9.3 ppbv, respectively. All the other locations had averages ranging from 4.6 to 6.3 ppbv.

Nine odor calls regarding the Kirie WRP were received in 2005, eight of which were verified as reporting odors that may have originated at the Kirie WRP.

North Side WRP

The majority of the observations at the North Side WRP were faint to no odor, 64 percent of the time in 2005. There were no very strong odor observations and six strong odor observations at this WRP during 2005. The easily noticeable odors account for 35 percent of the total observations, with greatest frequency around Preliminary Tank 3, 88 percent, the covered sludge concentration tanks, 71 percent, Preliminary Tank 10, 59 percent, and the gallery building of Battery D mix channel, 59 percent.

The monthly percentage of observations at which easily noticeable, strong, and very strong odors were observed are shown in Figure 5. There was no apparent trend of noticeable odors with slightly lower frequency in January through March.

The hydrogen sulfide levels are summarized in Table 8. Except for one extreme value at Howard Street east of McCormick Road, the highest levels were generally observed in the vicinity of the covered weir preliminary tanks with an average of 10.5 ppbv, Preliminary Tank 3 with an average of 46.1 ppbv, and the covered sludge concentration tanks with average of 19.0 ppbv. The average hydrogen sulfide levels at the other locations ranged between 5.0 and 7.0 ppbv. The single highest values were observed at the covered sludge concentration tanks and Preliminary Tank 3.

Neither of the two odor calls pertaining to the North Side WRP were verified as resulting from odors originating at the North Side WRP.

FIGURE 4: ODOR OBSERVANCES AT JAMES C. KIRIE WRP—2005

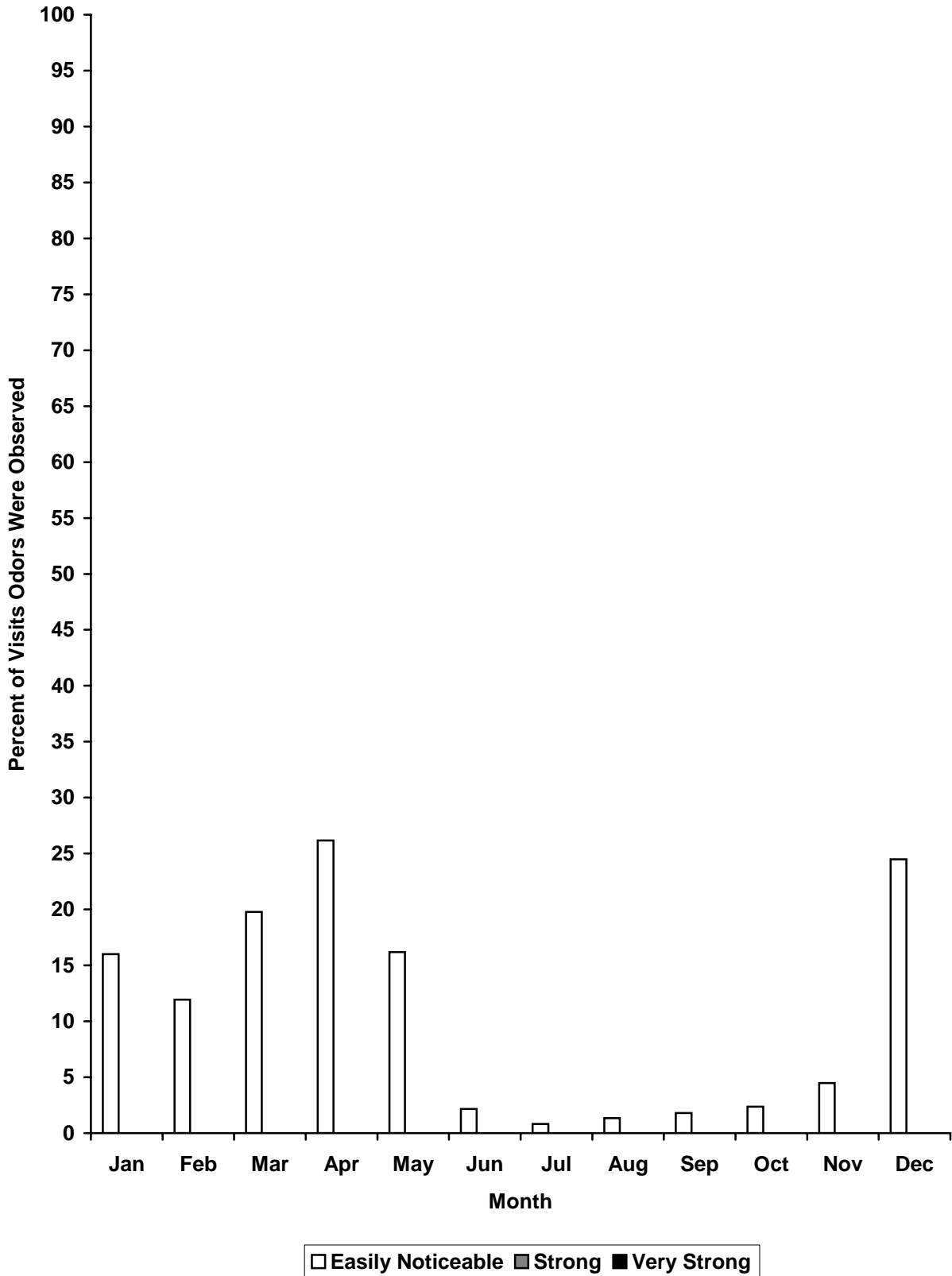


TABLE 7: HYDROGEN SULFIDE READINGS AT JAMES C. KIRIE WRP—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
Plant Entrance (1) ¹	5.6	0	13
Pump Station (2)	5.4	0	13
Air Lift B1 (3)	5.5	1	11
Road C-1 (4)	10.4	0	210
Return Channel (5)	9.3	2	210
East Gallery—North (6)	5.6	1	33
Road C-2 (7)	5.2	0	12
Road C-3 (8)	5.6	0	44
Road C-4 (9)	4.6	0	10
Air Lift A-1 (10)	5.2	1	11
Air Lift A-2 (11)	6.0	2	19
Road C-5 (12)	5.2	0	14
Road C-6 (13)	5.1	0	15
Road C-7 (14)	5.0	1	9
Air Lift B2 (15)	4.9	1	9
Ridge Lane—Point #1 (16)	5.8	0	24
Marshall and Pleasant (17) Lane—Point #2	6.3	0	13

¹Numbers in parentheses correspond to Station numbers in [Figure AI-3](#).

FIGURE 5: ODOR OBSERVANCES AT NORTH SIDE WRP—2005

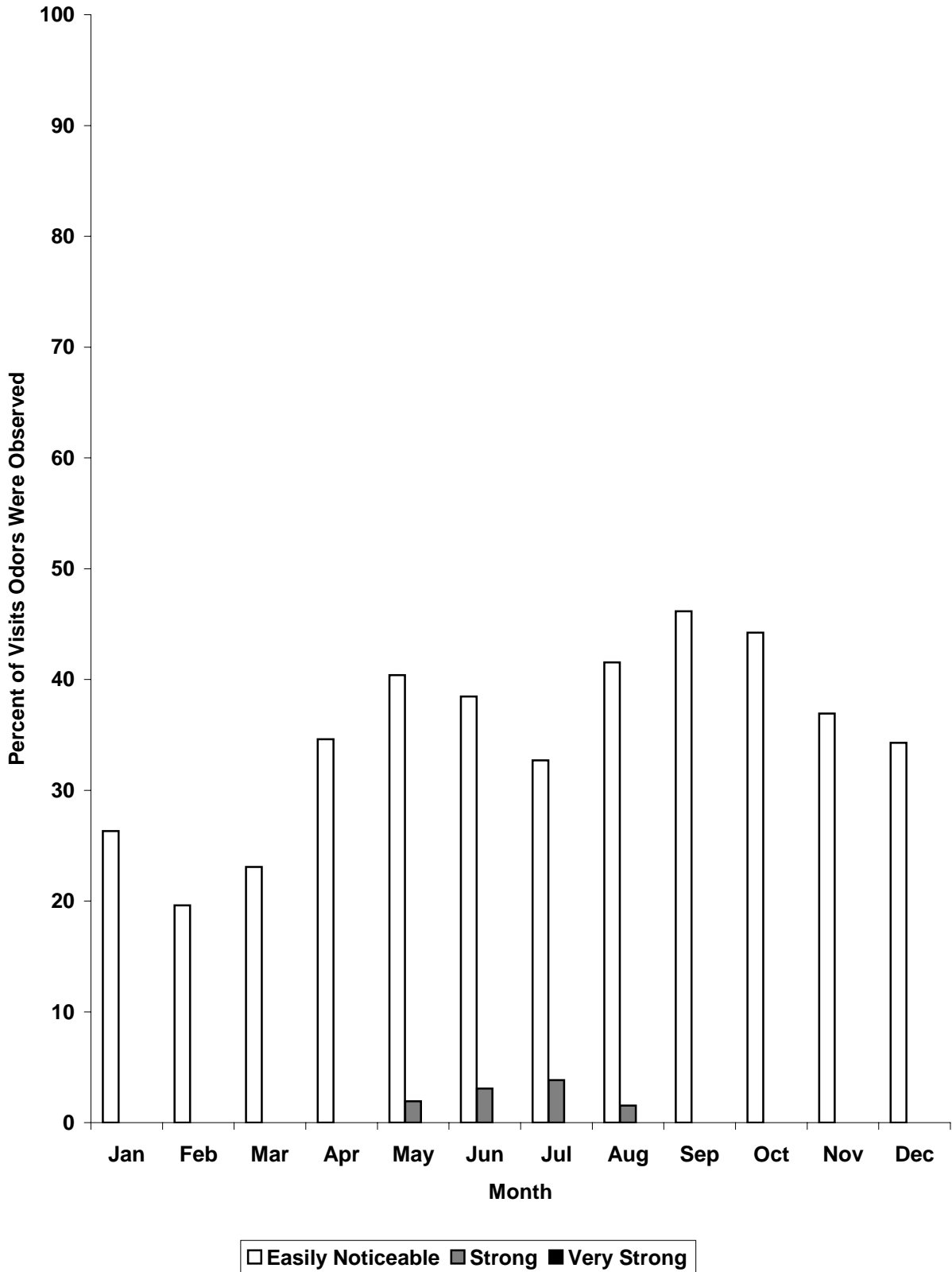


TABLE 8: HYDROGEN SULFIDE READINGS AT NORTH SIDE WRP—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
Howard Street West End (1) ¹	7.0	4	17
Howard Street East (2) of McCormick Road	43.6	0	1,500
McCormick Road (3)	6.2	0	16
P&B Building (4)	6.7	0	24
North Ave. Rect. Tank A6 (5)	6.3	0	12
North Ave. Rect. Tank B6 (6)	6.3	0	26
North Ave. Rect. Tank C6 (7)	5.3	0	12
Final Tank Batt. D3 (8)	5.6	0	15
Gallery Bldg. of Batt. D (9). Mix Channel	6.8	1	40
Main Street and Avenue E (10)	5.0	0	11
Covered Weir Prel. Tank 10 (11)	10.5	3	110
Weir Rect. Prel. Tank 3 (12)	46.1	3	1,160
Main St. Covered Sludge (13) Conc. Tanks	19.0	2	200

¹Numbers in parentheses correspond to Station numbers in [Figure AI-4](#).

Stickney WRP

Overall, the majority of the observations in 2005 were faint to no odor, with 59 percent of R&D Department and 86 percent of M&O Department observations meeting this classification, respectively. Overall, there were four very strong odor observations and 80 strong odor observations, or 1.6 percent of the total number of observations. These occurred in the vicinity of the Imhoff tanks, the centrifuges, the sludge concentration tanks, the preliminary tanks, and the intersection of Laramie and 39th Street. The strong odors observed at Laramie and 39th Street along with some of the strong odors in the vicinity of the Imhoff tanks were identified as a tar-like odor which was attributed to the adjacent chemical plant operated by Koppers Industries. These same locations had the majority of easily noticeable odors.

At the predigestion centrifuges, approximately 64 percent of the observations were easily noticeable odors. The Imhoff tanks (at Fourth Avenue and Third Avenue), the concentration tanks at G Street North, the preliminary tanks at Tenth and Twelfth Avenues, and the post-digestion centrifuges had easily noticeable odors 48, 45, 33, 41, 40, and 40 percent of the time, respectively.

Figure 6 is a plot of the percentage of noticeable odors observed each month at the Stickney WRP. While there appears to be no real seasonal pattern in the odor observations, some of the lowest percentages occurred in January, August, and December. The strong odor occurrences were spread out over the year.

The hydrogen sulfide levels measured in the vicinity of the sludge concentration tanks at G and D Streets and the preliminary tanks at Tenth and Twelfth Avenues had average levels of 41.2, 34.7, 77.7, and 92.7 ppbv, respectively, as shown in Table 9. The pre-digestion centrifuges had an average hydrogen sulfide concentration of 32.6 ppbv. In general, the hydrogen sulfide levels are higher than observed at the other District WRPs.

Only one odor call out of five calls regarding the Stickney WRP was verified as reporting an odor that could potentially have originated at the Stickney WRP.

HASMA, Vulcan and Marathon Solids Drying Areas, and LASMA Solids Processing Area

The HASMA, LASMA, Marathon, and Vulcan sites had 67 percent of the observations characterized as faint to no odor. There were no very strong odors and only 23 strong odor observations out of 2,181 observations. The strong odor observations were divided among the various areas (HASMA, Vulcan, LASMA Cell 2, and LASMA Cell 5) depending upon the activity at the time. Easily noticeable odors were generally observed at the west end of the Marathon site, 36 percent of the observations, around the Vulcan site, 25 to 45 percent of the observations, and at HASMA, 72 percent of the observations. The LASMA lagoon area ranged between 10 and 45 percent easily noticeable odors depending upon the location. The LASMA Drying Cell areas ranged between 18 and 40 percent easily noticeable odors.

FIGURE 6: ODOR OBSERVANCES AT STICKNEY WRP—2005

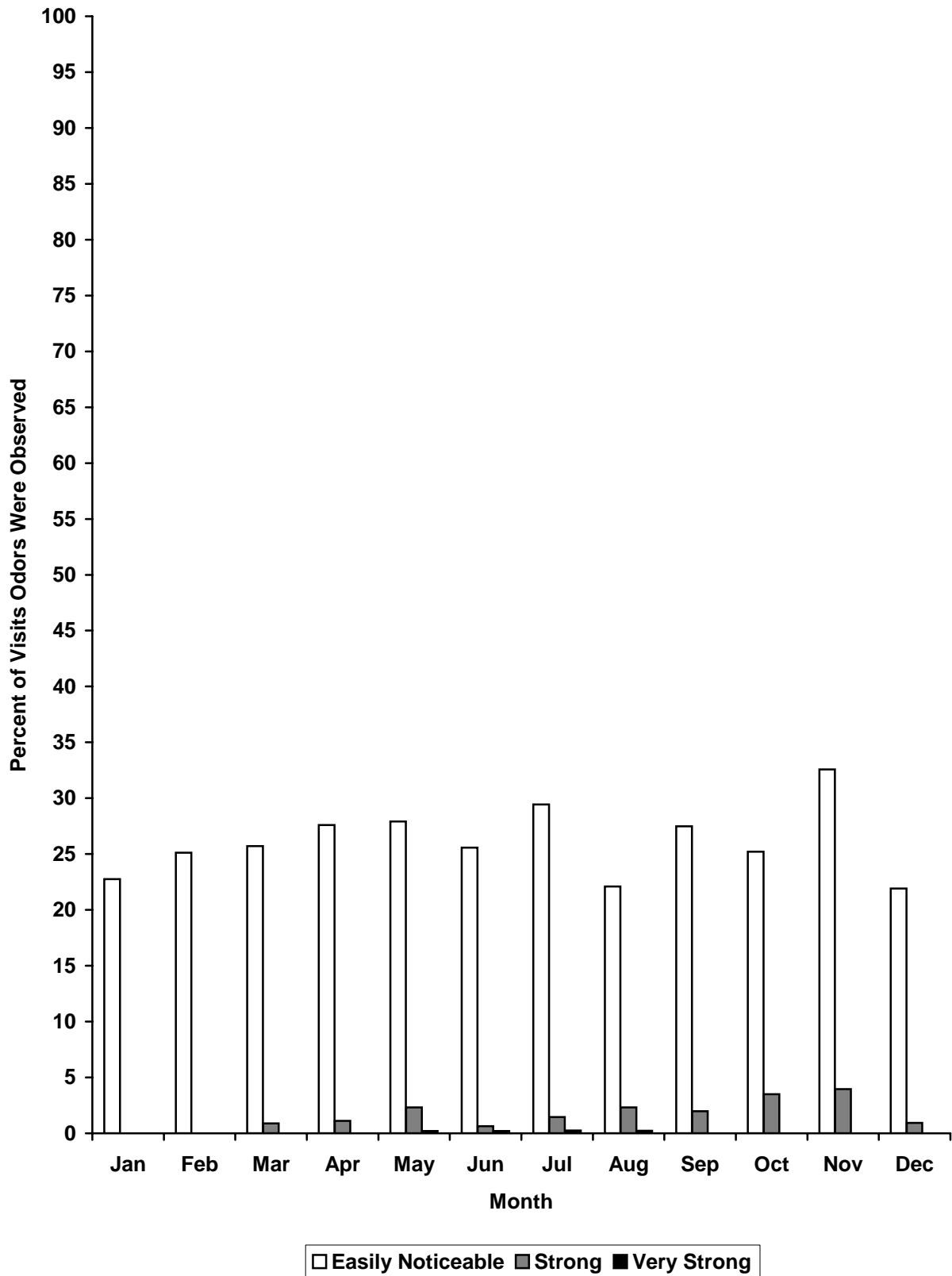


TABLE 9: HYDROGEN SULFIDE READINGS AT STICKNEY WRP—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
Imhoff B St./3rd Ave. (1) ¹	24.6	2	420
Imhoff B St./4th Ave. (2)	25.1	2	240
Imhoff B St./5th Ave. (3)	16.0	2	120
Digester 6th Ave. @ B St. (4)	10.8	1	130
West Digester Cont. Bldg. (5)	10.6	0	140
Centrifuges 6th Ave. @ Pre. (6)	32.6	0	450
Centrifuges 6th Ave. @ Post (7)	10.5	0	61
Concentration G St. North (8)	41.2	0	444
Concentration D St. South (9)	34.7	1	1,000
Preliminary 12th Ave. (10)	92.7	0	3,000
Preliminary 10th Ave. (11)	77.7	1	880
39th St./Central Ave. (12)	7.2	0	30
39th St./Morton College Ent. (13)	7.5	0	25
39th St./Dig. @ 57th Ave. (14)	7.5	0	110
39th St./Between Austin and Lombard (15)	6.0	0	13
Battery D, B St/13th Ave. (16)	9.4	0	150
Lombard Ave. @ Gate/39th St. (18)	5.9	0	19
Laramie and 40th St. (19)	32.1	0	3,283
Laramie and 39th St. (20)	12.6	0	110

¹Numbers in parentheses correspond to Station numbers in [Figure AI-5](#).

The percentage of observations at which easily noticeable, strong, and very strong odors were observed was plotted by month and are presented in [Figure 7](#). The frequency of observed odors is generally highest during the late spring through the fall months when solids processing and drying is being carried out. The few strong odor observations occurred in March and May through October.

The hydrogen sulfide concentration averages ranged between 5.0 and 7.6 ppbv as shown in [Table 10](#).

One odor call was received in 2005 reporting an odor that could have originated at the LASMA SPS. The odor it reported was not verified as originating from the LASMA SPS.

RASMA and Stony Island Solids Drying Areas

The RASMA Solids Drying Area had 83 percent of the observations characterized as faint to no odor. There were only four strong odor observations and no very strong odor observations during 2005. The easily noticeable odors were 15 percent of the total observations. A monthly summary of the observations at the RASMA Solids Drying Area of easily noticeable, strong, and very strong odors during 2005 is presented in [Figure 8](#) expressed as frequency of occurrence. Easily noticeable odors occurred mainly during the August through November period, with the highest frequency in August and September.

The average hydrogen sulfide levels at the various locations around the RASMA Solids Drying Area ranged from 6 to 10 ppbv, as shown in [Table 11](#).

The Stony Island Solids Drying Area had 64 percent of the observations characterized as faint to no odor, with nine strong odor observations or 3 percent in 2005. The easily noticeable odors accounted for approximately 33 percent of the total observations.

At the Stony Island SDA, faint to no odors were observed 64 percent of the time. A monthly summary of the observations at the Stony Island Solids Drying Area of easily noticeable, strong, and very strong odors during 2005 is presented in [Figure 9](#) expressed as frequency of occurrence. The strong odors occurred during the period of June through October. The frequency of easily noticeable odors was greatest during summer and fall months.

The average hydrogen sulfide levels around the Stony Island Solids Drying Area, as shown in [Table 11](#), varied from 7 to 33 ppbv. The average value of 33 ppbv at Cell 5 was due to one high reading.

No odor calls were received in 2005 with regard to the RASMA and Stony Island Solids Drying Areas.

FIGURE 7: ODOR OBSERVANCES AT HASMA, LASMA, VULCAN,
AND MARATHON SITES—2005

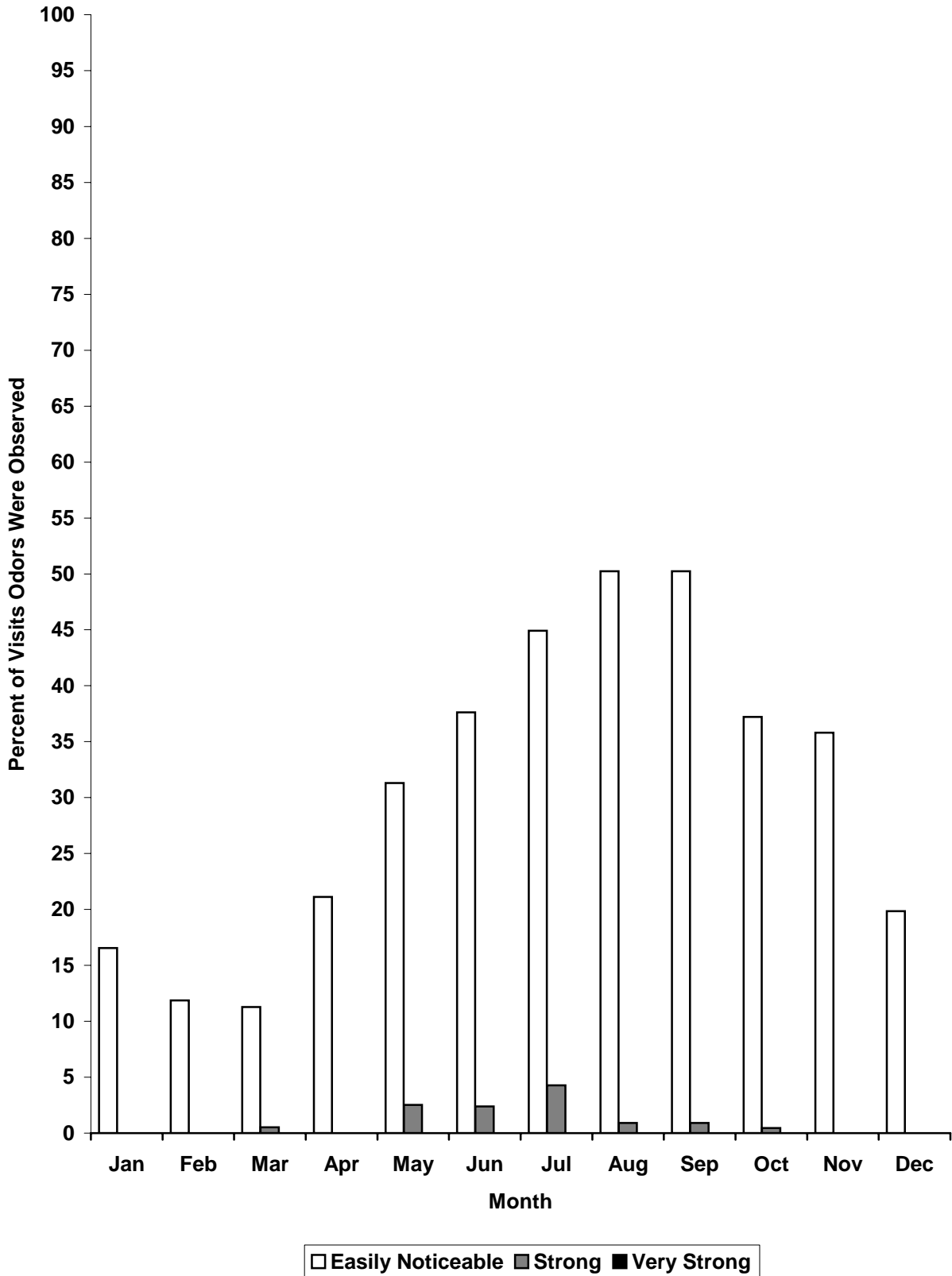


TABLE 10: HYDROGEN SULFIDE READINGS AT HASMA, VULCAN,
MARATHON SOLIDS DRYING AREAS AND LASMA SOLIDS PROSESSING
SITE—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
HASMA (1) ¹	6.4	0	22
HASMA Center (1.5)	6.4	0	27
Vulcan South (2)	6.4	0	20
Vulcan North (3)	6.5	0	20
Vulcan TARP Drop Shaft (4)	6.2	0	25
Vulcan TARP Well (5)	5.8	0	20
LASMA Lagoon 1 (6)	6.9	0	120
LASMA Lagoon 16 (7)	6.2	0	30
LASMA Lagoon 24 (8)	6.8	0	120
LASMA Lagoon 30 (9)	6.2	0	37
LASMA Cell 1E-1W (10)	7.6	0	130
LASMA Cell 2E-2W (11)	6.7	0	120
LASMA Cell 3E-3W (12)	5.4	0	28
LASMA Cell 4E-4W (13)	5.3	0	19
LASMA Cell 5E-5W (14)	5.2	0	23
Marathon (15)	5.0	0	23
Marathon West (16)	5.7	0	32

¹Numbers in parentheses correspond to Station numbers in [Figure AI-6](#).

FIGURE 8: ODOR OBSERVANCE AT RASMA SOLIDS DRYING AREA—2005

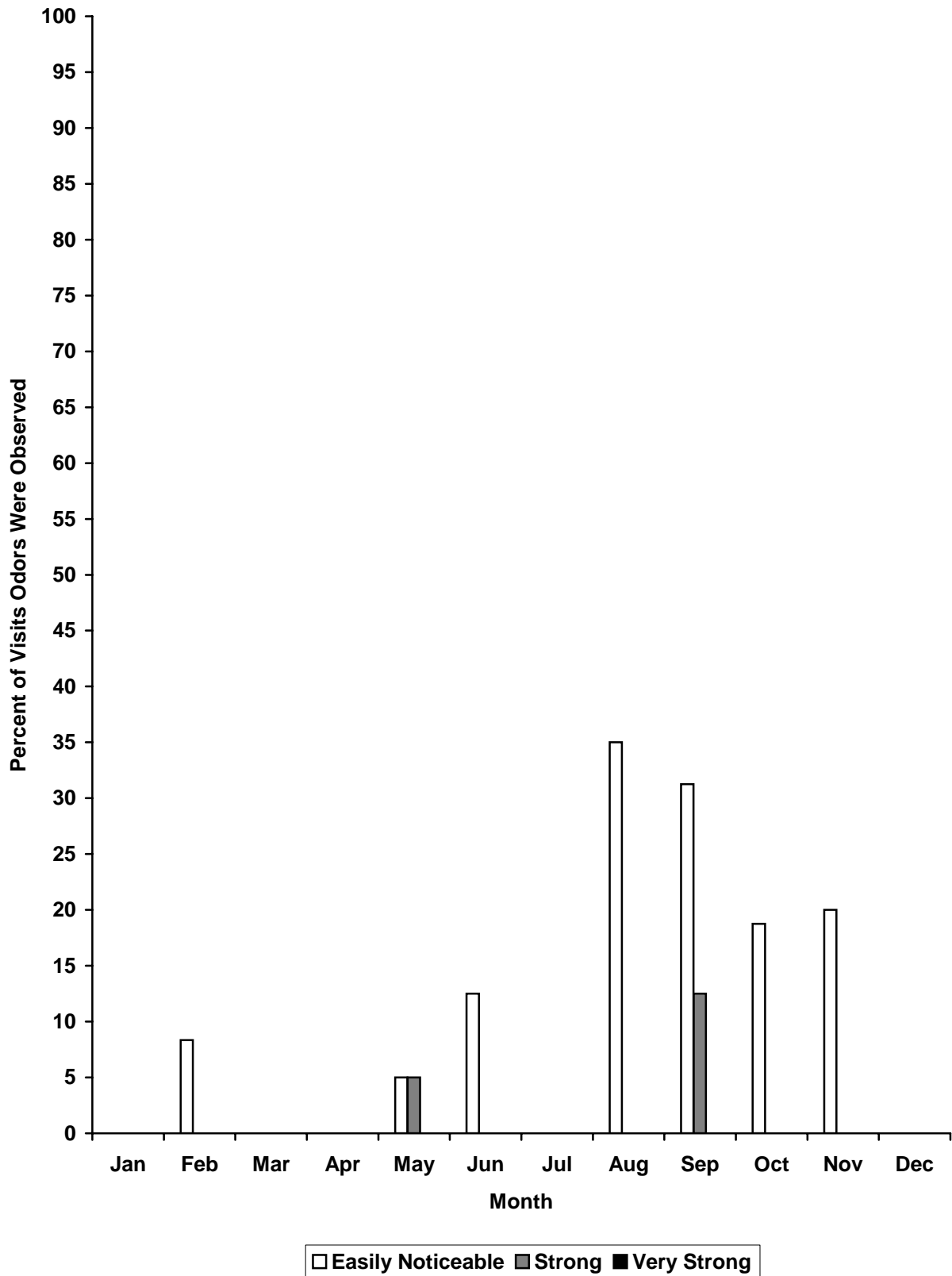


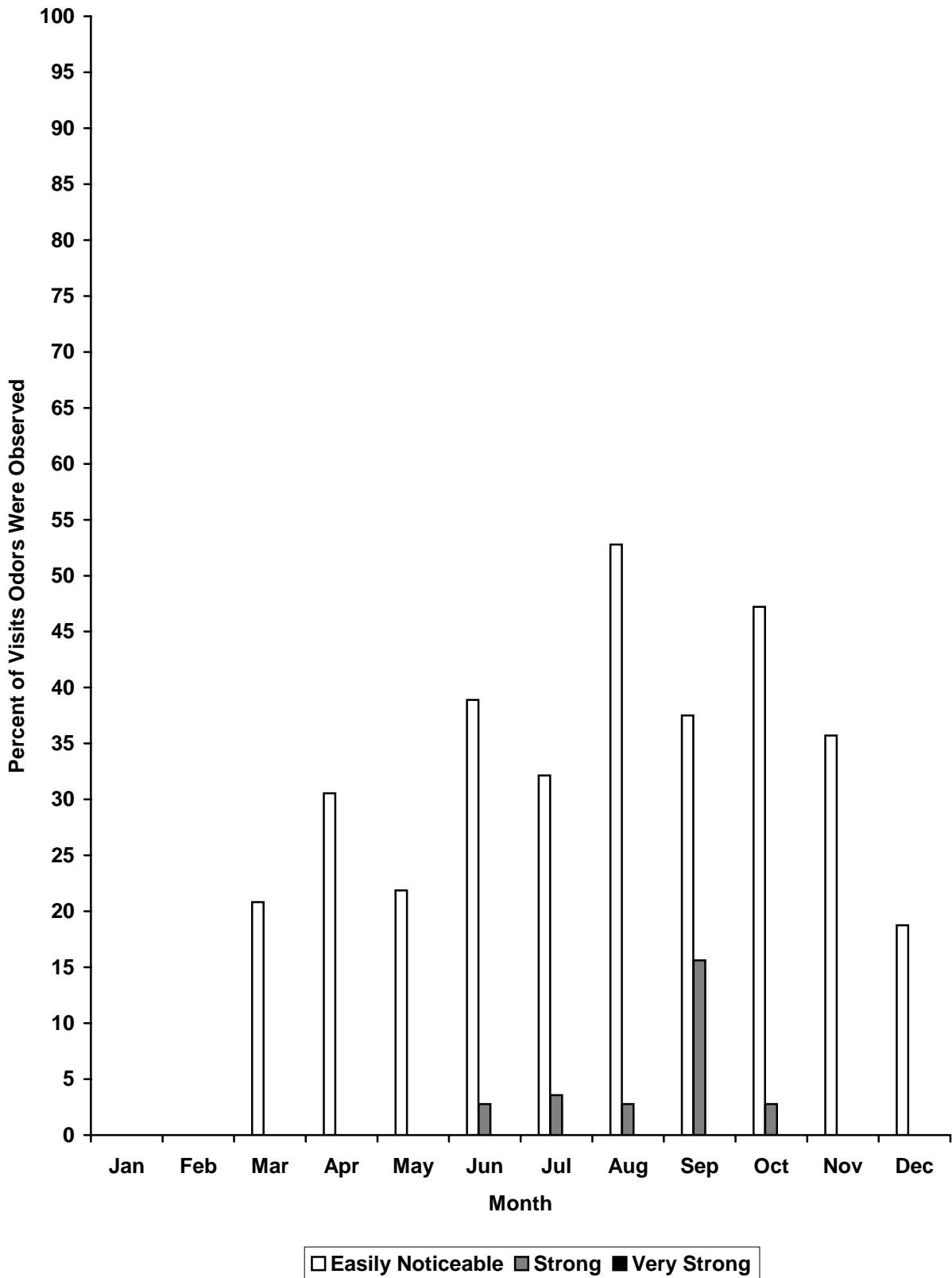
TABLE 11: HYDROGEN SULFIDE READINGS AT RASMA AND STONY ISLAND
SOLIDS DRYING AREAS—2005

Location	Hydrogen Sulfide, ppbv		
	Mean	Minimum	Maximum
<u>RASMA</u>			
SW Parking Area (1) ¹	6	2	11
North of Cell 2W (2)	7	0	13
NE Corner Cell 5E (3)	7	1	24
South of Cell 5 (4)	10	1	120
<u>Stony Island</u>			
Entrance 122nd St (1) ²	7	0	17
NE Corner Cell 5 (2)	33	0	1,900
South End Cells 4 & 7 (3)	8	0	160
West Side of Cell 3 (4)	7	0	25

¹Numbers in parentheses correspond to Station numbers in [Figure AI-7](#).

²Numbers in parentheses correspond to Station numbers in [Figure AI-8](#).

FIGURE 9: ODOR OBSERVANCES AT STONY ISLAND SOLIDS DRYING AREA—2005



CALUMET CONTINUOUS AMBIENT HYDROGEN SULFIDE MONITORS

Two hydrogen sulfide monitoring stations were set up in October 2002 for the continuous monitoring and recording of ambient air hydrogen sulfide. One station (North Monitor) is located at the northern boundary of the Calumet WRP, and the second station (South Monitor) is located outside of the plant fence line near 130th Street. Each station consists of a hydrogen sulfide analyzer in a temperature-controlled shelter. The monitors are Zellweger Instrument's Single Point Monitors. Lead acetate impregnated tape is used for the measurement of hydrogen sulfide with a concentration range of 0 to 100 parts per billion. Measurements are recorded every two minutes.

A summary of the monthly hydrogen sulfide concentrations measured during 2005 is presented in [Table 12](#). The North Monitor was in operation through October, and the South Monitor was operated through August. All the minimum values were zero.

Except for some occasional blips, the majority of the values were relatively low, less than 10 ppb. As indicated in [Table 13](#) for the months of June through August 2005, at the North Monitor the percentage of values greater than 10 ppb varied from 0.3 to 3 percent. The higher concentrations were found in the summer months. The North Monitor levels were generally higher than the South Monitor, reflecting the predominant wind direction from the south. The monthly maximum hydrogen sulfide concentrations ranged from 0 ppb to 90.2 ppb for the North Monitor and from 0 ppb to 41.6 ppb for the South Monitor ([Table 12](#)). The range of values is less than the range observed by the manual H₂S measurements during the odor monitoring ([Table 4](#)), indicating dilution of H₂S which occurs as air moves from the H₂S sources in the plant to the boundaries of the plant property where the continuous monitors are located.

As an example of the occurrence of hydrogen sulfide peaks, a time series plot of the 2-minute recorded concentrations at the North Monitor during the month of July is presented in [Figure 10](#). As previously noted the majority of the values are below 10 ppb with about 10 significant spikes. The hydrogen sulfide concentrations at the South Monitor are plotted in [Figure 11](#). There are fewer spikes than observed at the North Monitor. Most of the peaks occurred for short durations, generally less than 20 minutes.

The highest recorded hydrogen sulfide concentration of 90.2 ppb occurred on September 12, 2005, at the North Monitor between 19:50 (7:50 p.m.) and 20:10 (8:10 p.m.), as shown in [Table 14](#). In general, the majority of the higher hydrogen sulfide concentrations occurred in the evening and early morning hours.

TABLE 12: CALUMET WRP HYDROGEN SULFIDE CONTINUOUS
 AMBIENT MONITORING—2005*

Month	<u>H₂S at North Monitor, ppb</u>		<u>H₂S at South Monitor, ppb</u>	
	Mean	Maximum	Mean	Maximum
January	0.017	1.8	0.000	0.1
February	0.012	3.2	0.004	4.6
March	0.005	1.8	0.019	9.9
April	0.000	0.0	0.008	8.5
May	0.000	0.0	0.024	7.5
June	0.130	16.7	0.137	25.2
July	0.898	39.0	0.200	41.6
August	1.353	41.4	0.000	0.0
September	2.071	90.2	NR	NR
October	0.274	19.8	NR	NR

*Summary of hydrogen sulfide readings taken every 2 minutes.

Minimum values are all zero.

NR = No readings.

TABLE 13: PERCENT OF HYDROGEN SULFIDE CONCENTRATIONS ABOVE STATED VALUES AT THE CALUMET CONTINUOUS MONITORING STATION—2005

Month	Total Number of Observations	Percent Observations		
		> 0 ppb	> 3 ppb	> 10 ppb
North Monitor				
June	21,598	3.2	1.2	0.3
July	22,317	20.4	7.8	2.1
August	21,598	25.6	15.3	3.0
South Monitor				
June	21,594	3.3	1.6	0.2
July	22,319	3.5	1.7	0.4
August	20,557	0.0	0.0	0.0

FIGURE 10: CALUMET NORTH MONITOR HYDROGEN SULFIDE TIME SEQUENCE - JULY 2005

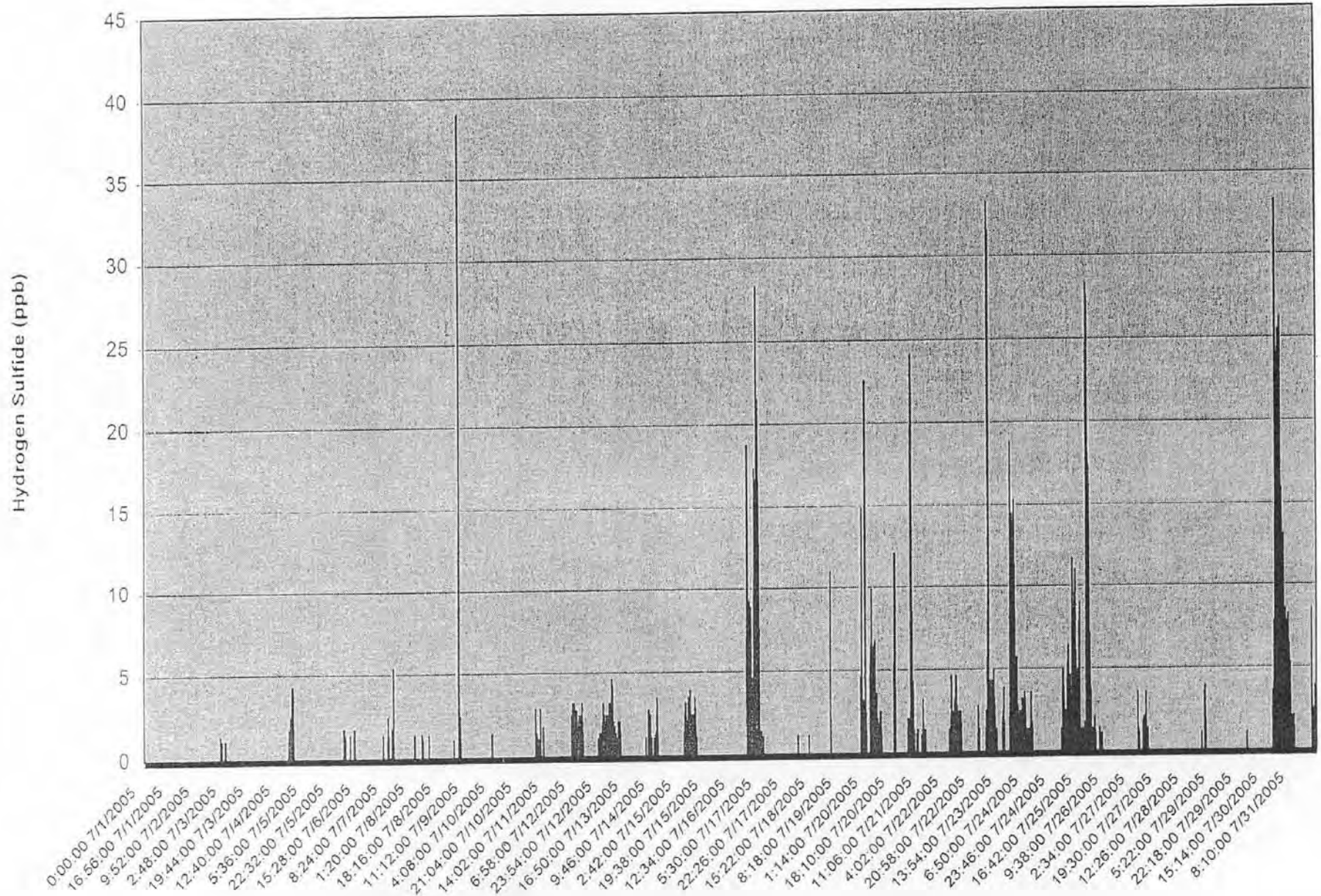


FIGURE 11: CALUMET SOUTH MONITOR HYDROGEN SULFIDE TIME SEQUENCE - JULY 2005

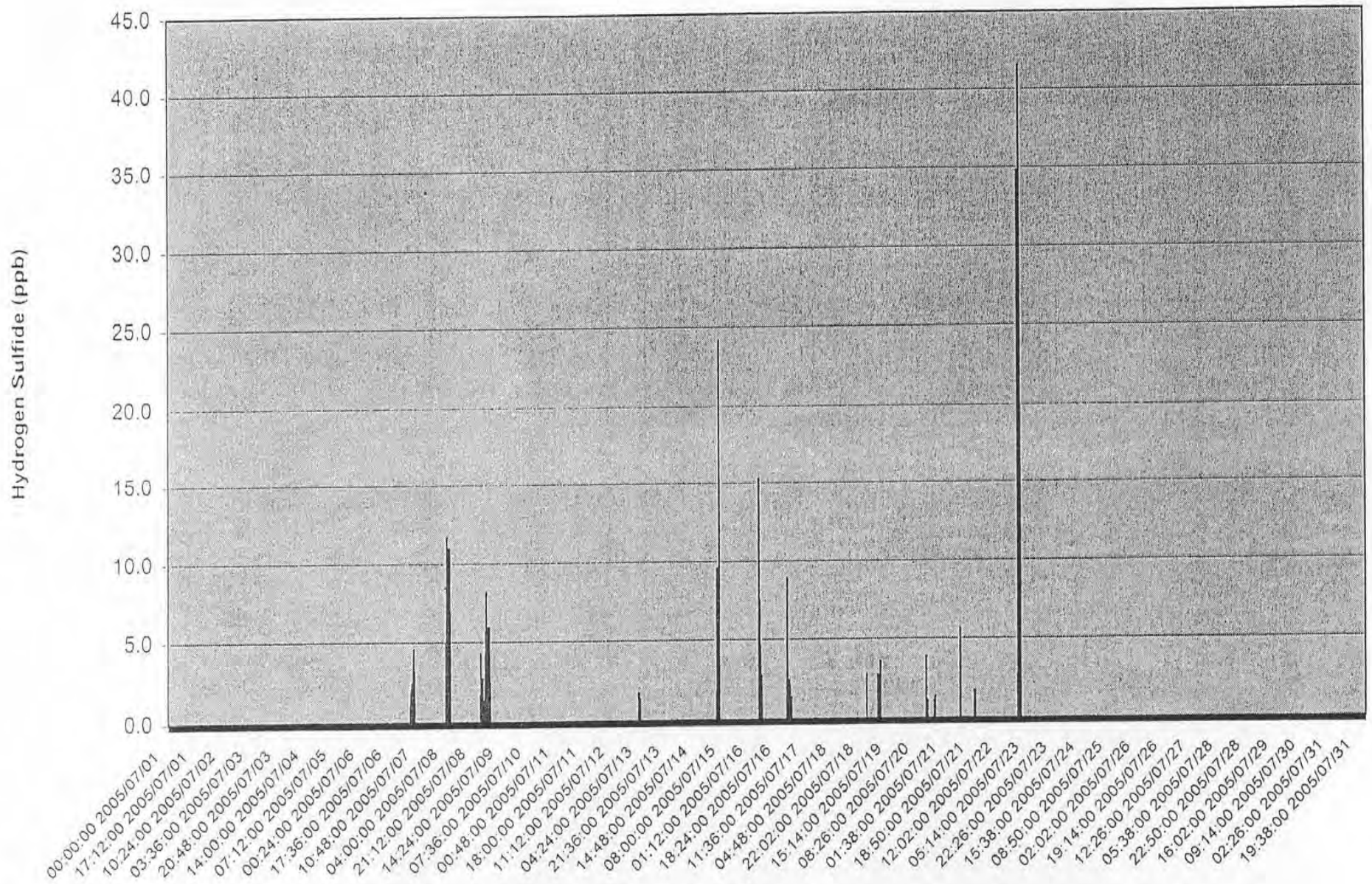


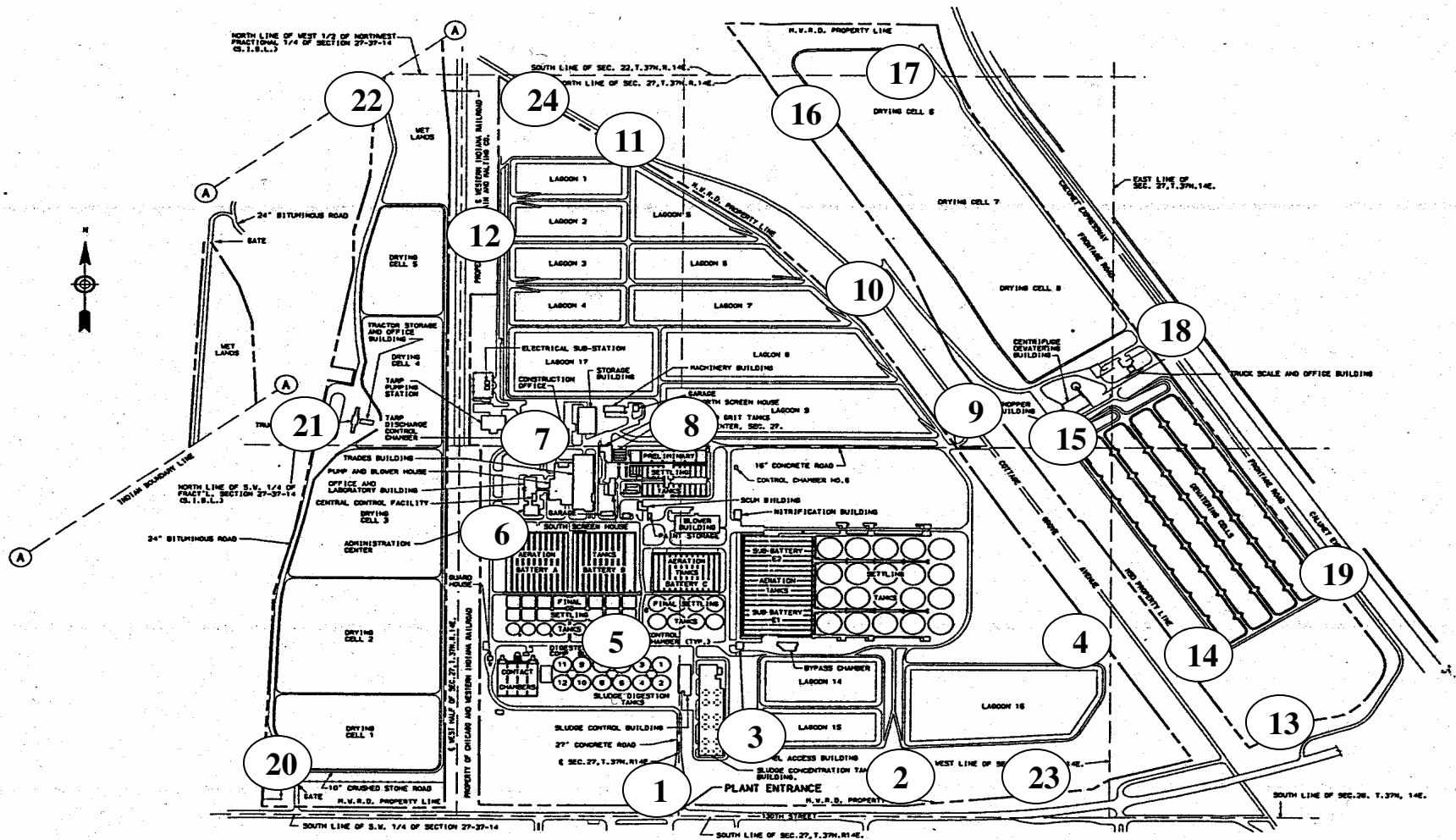
TABLE 14: HYDROGEN SULFIDE SPIKE AT THE CALUMET NORTH MONITORING STATION, SEPTEMBER 12, 2005

Date	Time	Elapsed Minutes	Hydrogen Sulfide, ppb
9/12/2005	19:10 to 19:24	14	4.6
	19:26 to 19:38	12	12.8
	19:40 to 19:48	8	88.8
	19:50 to 20:10	20	90.2
	20:12 to 20:26	14	6.1

APPENDIX AI

LOCATION OF ODOR MONITORING STATIONS AT DISTRICT WRPs,
SOLIDS DRYING AREAS, AND SOLIDS PROCESSING SITES

FIGURE AI-1: CALUMET WRP AND CALUMET WRP SOLIDS DRYING AREAS
 (NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)



METROPOLITAN WATER RECLAMATION DISTRICT
 OF GREATER CHICAGO
 LOCATION PLAN
 CALUMET WRP

200 0 200 400 600 800
 APPROXIMATE SCALE 1"=300'

FIGURE AI-2: JOHN E. EGAN WRP AND SOLIDS DRYING AREA
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

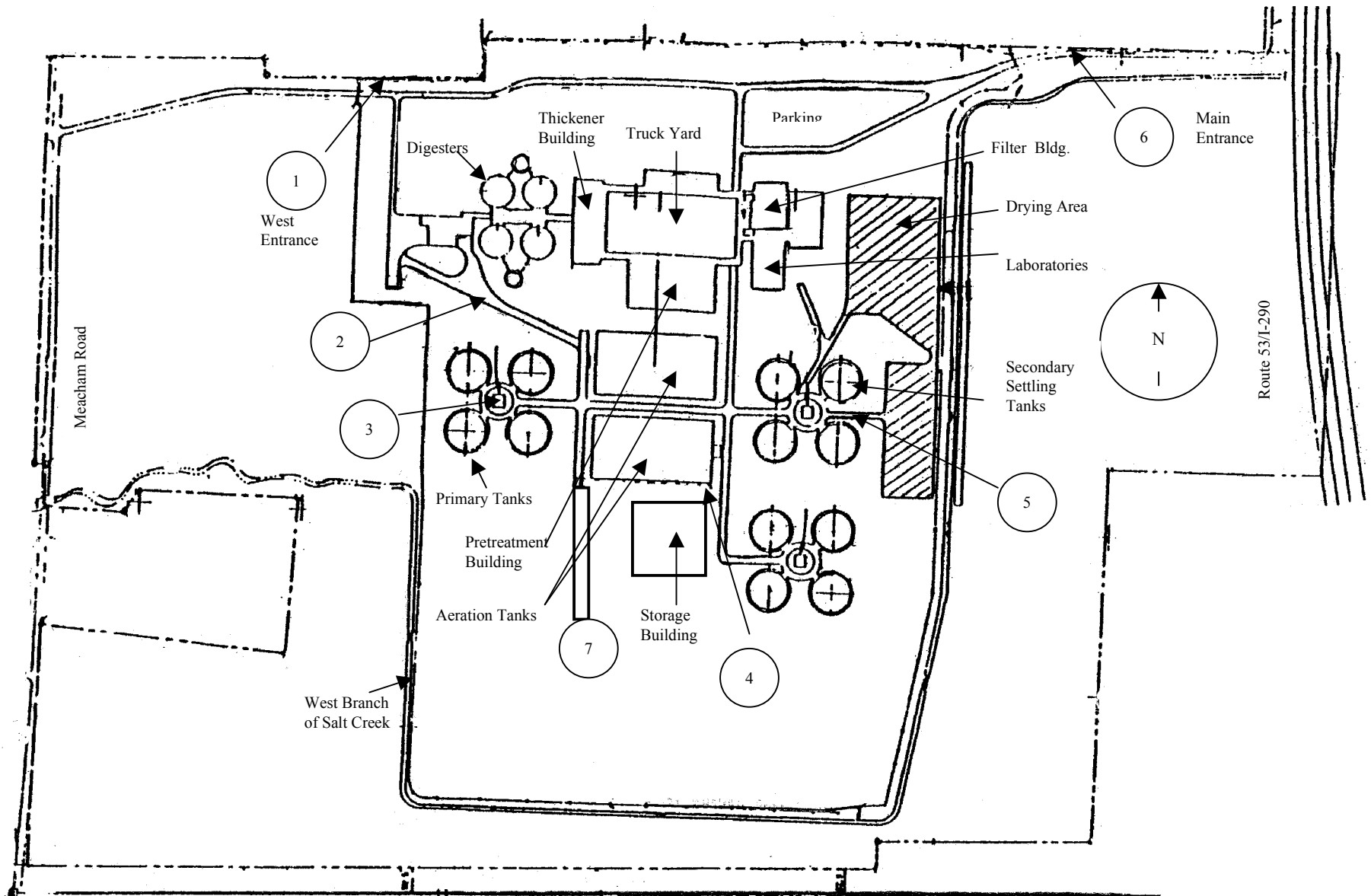


FIGURE AI-3: JAMES C. KIRIE WRP
 (NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

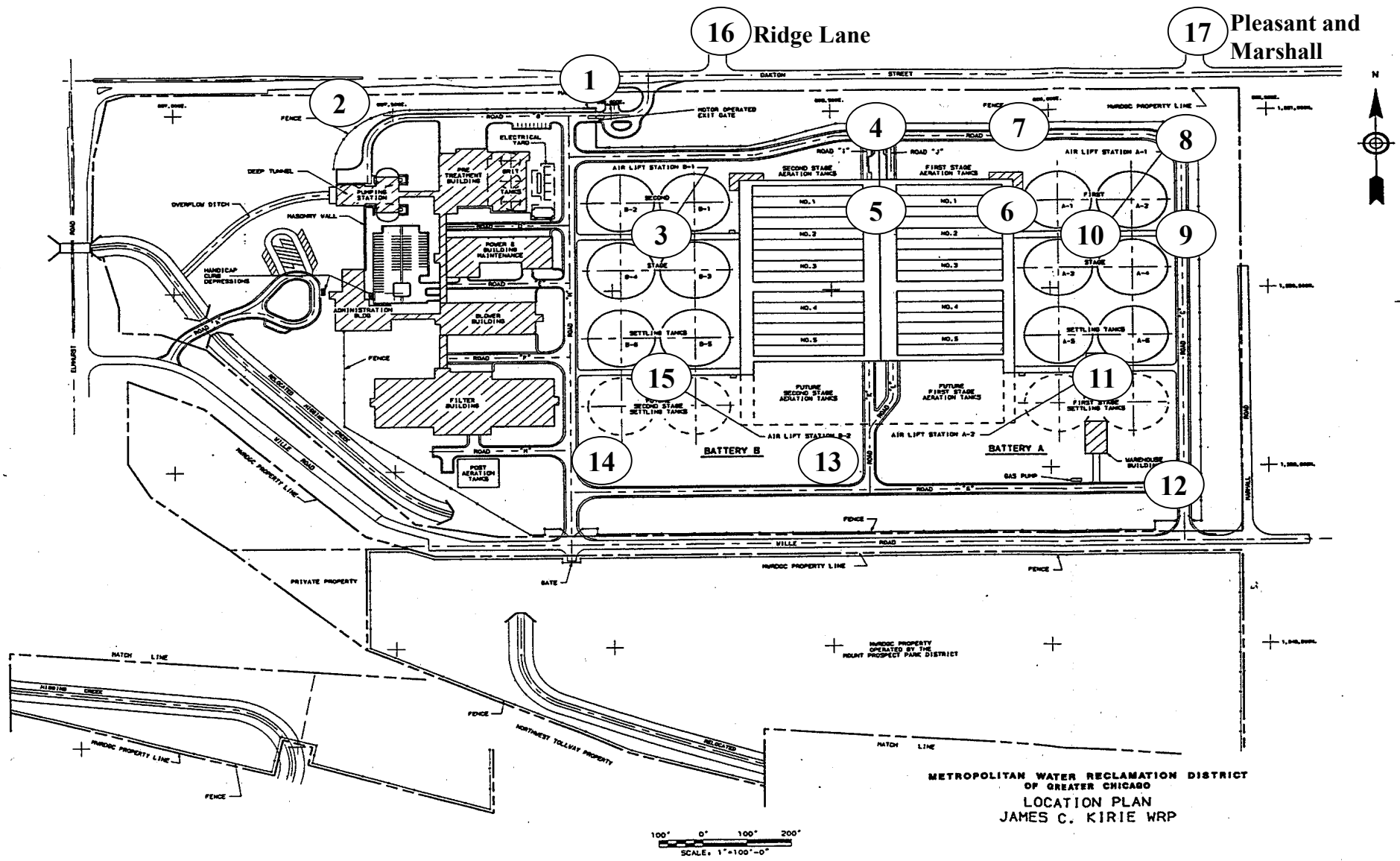
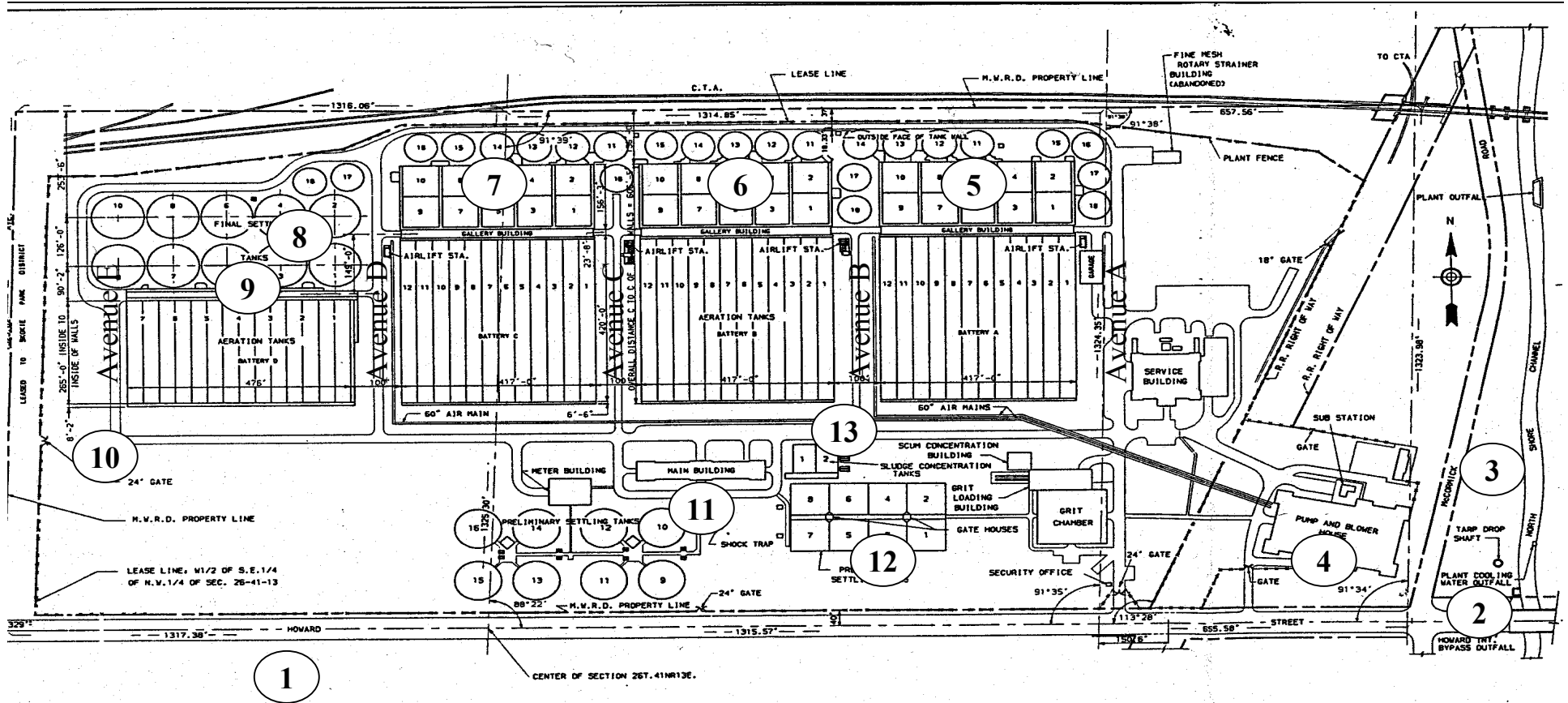


FIGURE AI-4:NORTH SIDE WRP
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)



METROPOLITAN WATER RECLAMATION DISTRICT
OF GREATER CHICAGO
LOCATION PLAN
NORTH SIDE WRP

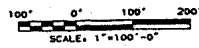


FIGURE AI-5: STICKNEY WRP
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

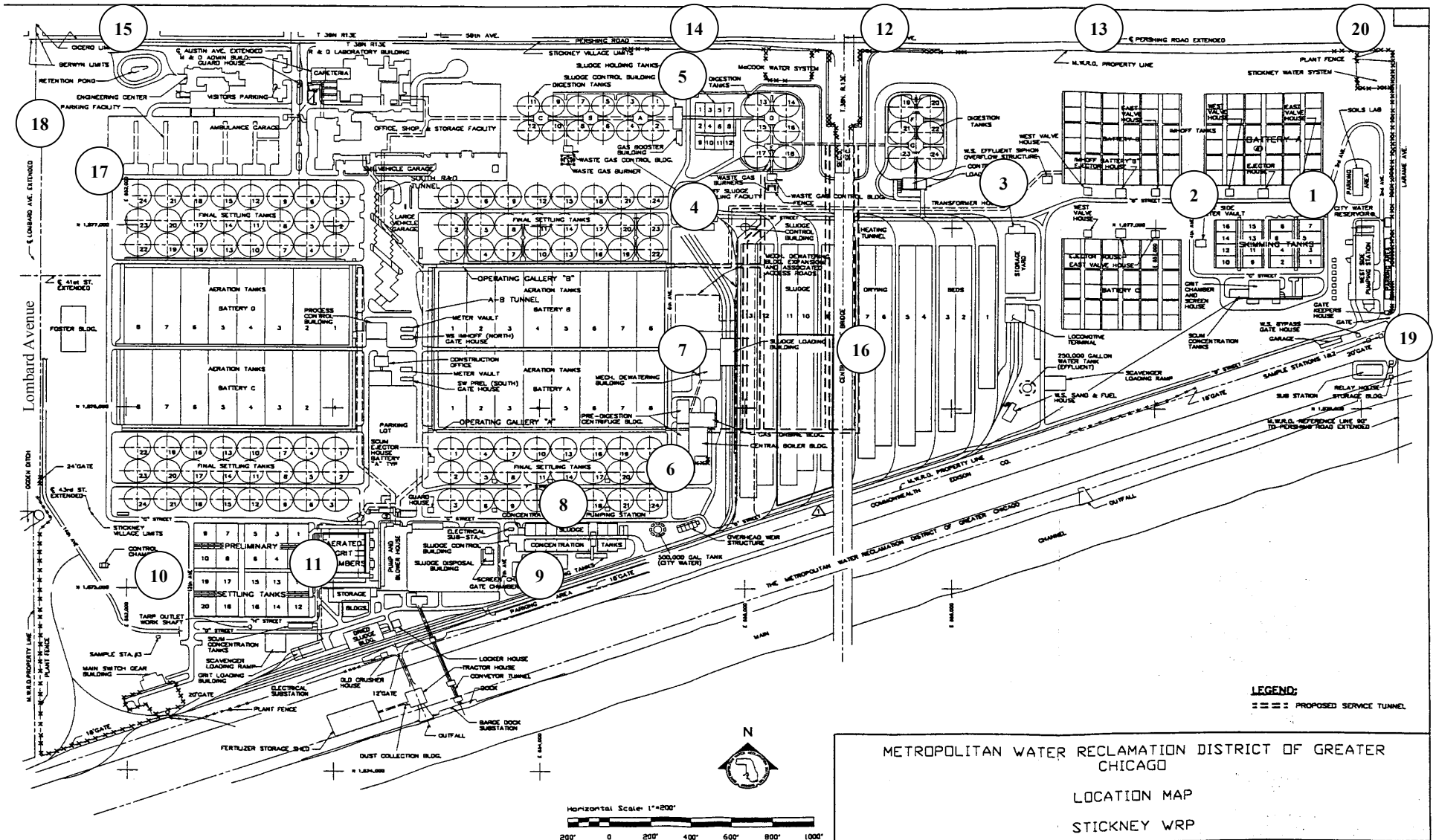


FIGURE AI-6: HASMA, VULCAN, AND MARATHON SOLIDS DRYING SITES AND LASMA SOLIDS PROCESSING SITE
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

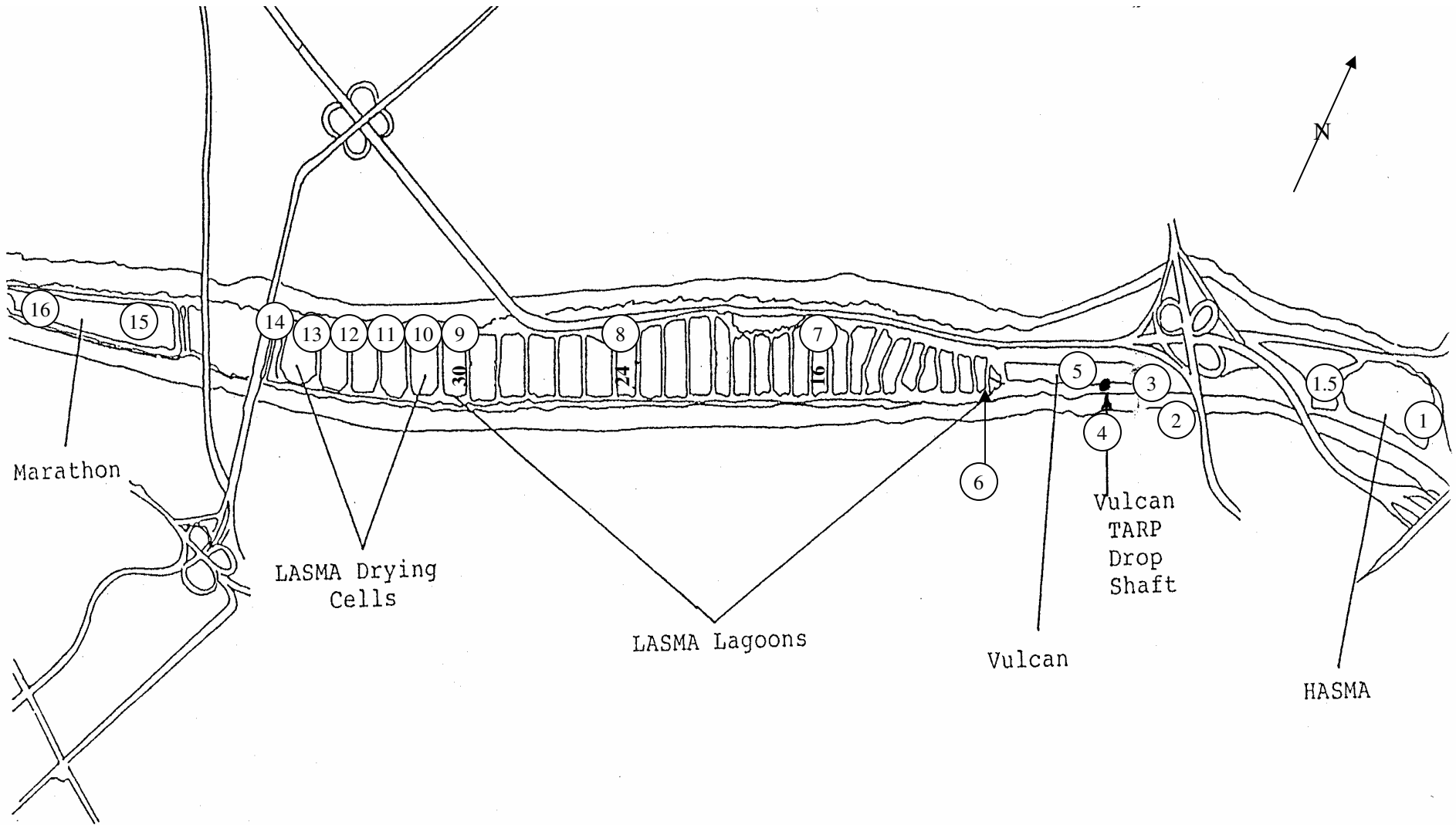


FIGURE AI-7: RASMA SOLIDS DRYING AREA
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

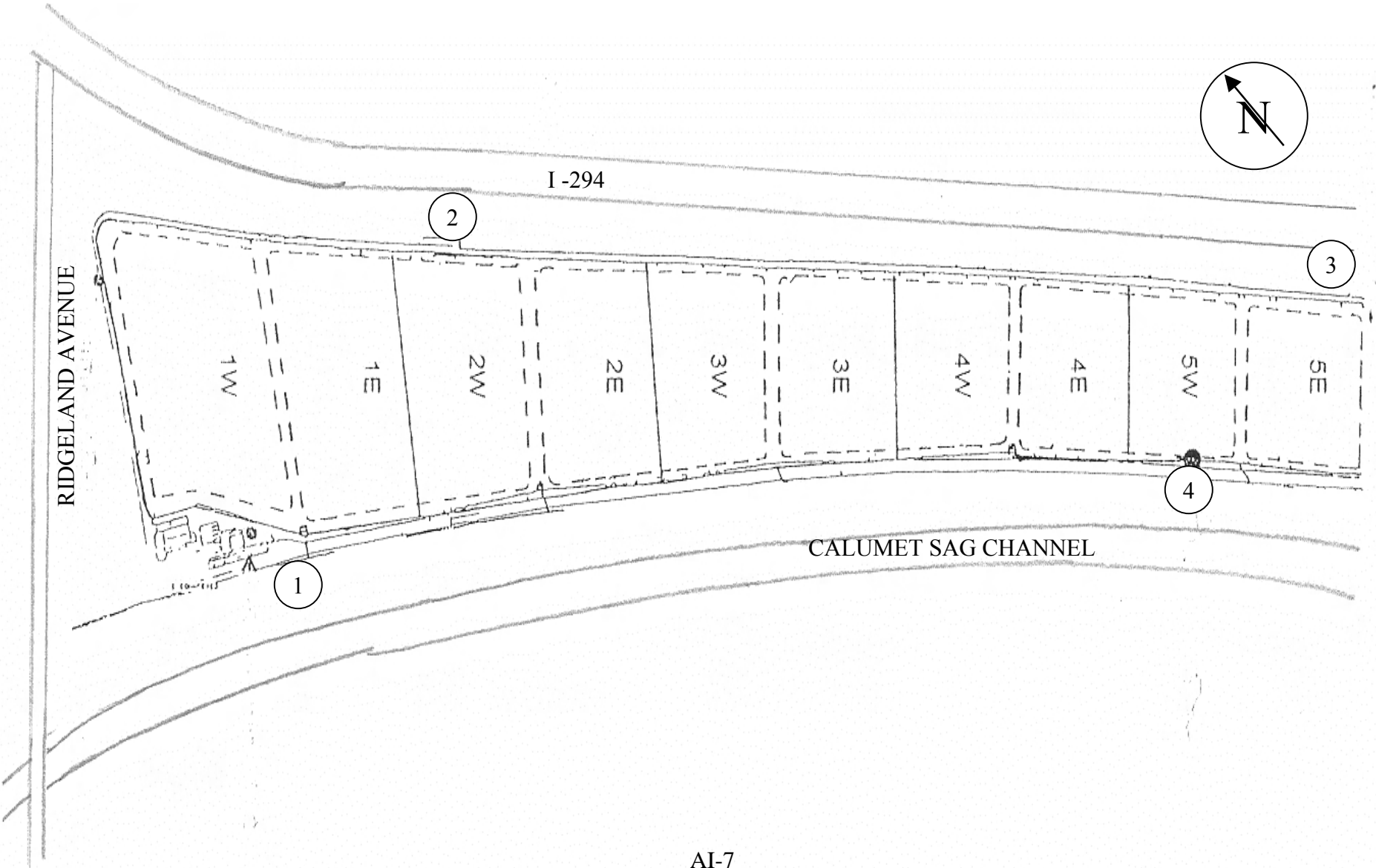


FIGURE AI-8: STONY ISLAND SOLIDS DRYING AREA
(NUMBERED CIRCLES INDICATE ODOR MONITORING STATIONS)

