Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

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ODOR MONITORING PROGRAM AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO FACILITIES DURING 2011

September 2012

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ODOR MONITORING PROGRAM AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO FACILITIES DURING 2011

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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 (SDS), one solids processing site (SPS), and five solids drying areas (SDAs). This program started in 1990. Both the Monitoring and Research Department (M&R) and Maintenance and Operations Department (M&O) personnel make subjective observations regarding the type and intensity of any odor perceived. The M&R staff records instantaneous hydrogen sulfide (H_2S) measurements using a handheld monitor at each monitoring site. 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 Avenue Solids Management Area (RASMA) to seven days per week during the summer months at the James C. Kirie (Kirie) WRP. Each odor observation is characterized as very strong, strong, easily noticeable, faint, very faint, or no odor.

During 2011, 13 very strong odors out of 5,237 observations were observed at the Stickney WRP. Three very strong odors were observed out of 2,496 at the Calumet WRP, but no very strong odor observations were made at the Calumet SDS out of 1,482 observations. One very strong odor was observed at the SDAs and SPS out of 2,747 observations. No very strong odors were observed at the John E. Egan (Egan), Kirie, or North Side WRPs out of 329, 9,627, and 575 observations, respectively. The majority of the observations at the five WRPs were characterized as faint to no odor from 72 to 98 percent of the time. At the seven SDAs, SDS, and SPS, observations were characterized as faint to no odor from 68 to 94 percent of the time.

At each of the five WRPs and SDAs, SDS, and SPS, there were specific locations which had noticeable odors. A summary of the locations that had occasional strong and very strong odors is presented in Table 1. For example, at the Calumet WRP the areas where most strong odors were observed were in the vicinity of the Sludge Concentration Building and the Preliminary Tanks. At the Stickney WRP, the areas where most strong odors were observed were the Sludge Concentration Tanks, Preliminary Tanks, Laramie Avenue and 40th Street, and the Imhoff tanks. While strong odors are generally infrequent, the monitoring shows that the potential for odors from these areas exists. 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 H_2S levels generally followed a pattern similar to the odor observations with occasional high values. The average level of H_2S ranges from 5.1 to 176.2 ppbv (parts per billion by volume) at the WRPs. At the Stickney WRP the average H_2S levels along the periphery of the plant were 5.6 to 176.2 ppbv and 7.6 to 42.9 ppbv at the majority of locations within the WRP. The highest average concentration of 176.2 ppbv was obtained at Laramie and 40th Street. The next highest average was 42.9 ppbv at the location of Preliminary 12th Avenue. The average level of H_2S ranged from 5.1 ppbv to 40.9 ppbv for all other WRPs. The average level of H_2S at the SDAs, SDS, and SPS ranged from 5.0 ppbv to 11.9 ppbv.

TABLE 1: STRONG AND VERY STRONG ODOR OBSERVATIONS – 2011

Facility	Number of Strong Odor Observations	Number of Very Strong Odor Observations	Total Number of Observations
Calumet WRP			
Sludge Concentration Building	14	2	
Lagoon No. 18 NE Corner	4		
Sludge Digester Tanks	4		
TARP Pump Station	3	1	
Preliminary Tanks	14		
Gate – near Lagoon No. 9	1		
Between Lagoons No. 7 and No. 8	1		
Lagoons No. 1 and No. 2	5		
Lagoons No. 3 and No. 4	1		
H_2S Monitor – 130^{th} St.	2		
North H_2S Monitor	2		
Total	51	3	2,496
Calumet SDS			
Drying Cell No. 1 SW	20		
Hopper Building	2		
Drying Cell No. 8 NW	1		
Drying Cell No. 8 NE	6		
Truck Scale/Centrifuge	2		
Drying Cell No. 8 SE	5		
Drying Cell No. 1 at Gate	9		
West Drying Cell No. 4	1		
Total	46	0	1,482
Egan WRP			
Near Waste Gas burner	3		
Primary Tanks	1		
Total	4	0	329

TABLE 1 (Continued): STRONG AND VERY STRONG ODOR OBSERVATIONS – 2011

Facility	Number of Strong Odor Observations	Number of Very Strong Odor Observations	Total Number of Observations
Kirie WRP			
Road C1	1		
Return Channel	1		
Road C4	1		
Airlift A1	5		
Airlift A2	4		
Total	12	0	9,627
North Side WRP			
McCormick Road	1		
Gallery Building of Battery D Mix Channel	1		
Weir Rect. Preliminary Tank 3	1		
Main St. Covered Sludge Conc. Tanks	1		
Total	4	0	575
Stickney WRP			
Imhoff Tanks	11		
Centrifuges (Pre)	4		
Centrifuges (Post)	1		
Sludge Concentration Tanks	36		
Preliminary Tanks	26	4	
Laramie Ave. and 40th St.	13	8	
Laramie Ave. and 39th St.	5	1	
Total	96	13	5,237
HASMA, Marathon, and Vulcan SDAs, and LASMA SPS			
HASMA	6		
HASMA Center	11		
Vulcan South	1		

TABLE 1 (Continued): STRONG AND VERY STRONG ODOR OBSERVATIONS – 2011

Facility	Number of Strong Odor Observations	Number of Very Strong Odor Observations	Total Number of Observations
HASMA, Marathon, and Vulcan SDAs, and LASMA SPS (Continued)			
Vulcan North	5		
Vulcan CS	7		
Lagoon No. 24	4		
Lagoon No. 30	4	1	
Cell 1E – 1W	3		
Cell 2E – 2W	4		
Cell 3E – 3W	5		
Cell 4E – 4W	2		
Cell 5E – 5W	3		
Marathon	4		
Marathon West	3		
Total	62	1	2,236
RASMA SDA[1]	N/A	N/A	
Total	N/A	N/A	0
Stony Island SDA			
Entrance 122nd St.	1		
NE Corner Cell No. 5	1		
Total	2	0	511

[1]RASMA was not used as a biosolids drying site during 2011; no observations were made.
HASMA = Harlem Avenue Solids Management Area.
LASMA = Lawndale Avenue Solids Management Area.
RASMA = Ridgeland Avenue Solids Management Area.
SDA = Solids Drying Area.
SDS = Solids Drying Site.
SPS = Solids Processing Site.
WRP = Water Reclamation Plant.
N/A = Not applicable; RASMA SDA was not monitored in 2011.

INTRODUCTION

M&R in conjunction with M&O has been conducting an odor monitoring program at various District facilities for the past 21 years. The initial program started with the solids processing and drying sites at Lawndale Avenue Solids Management Area (LASMA), Harlem Avenue Solids Management Area (HASMA), Marathon, and Vulcan in 1990, and was expanded to the WRPs and other drying sites. The latest additions were the RASMA and Stony Island SDAs in 2001.

At each location a similar procedure is followed to monitor odors. M&R personnel, and at some facilities M&O personnel, visit various monitoring 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, no odor; 1, very faint; 2, faint; 3, easily noticeable; 4, strong; and 5, very strong odor. In addition to the subjective odor measurements, the ambient air is analyzed for H_2S using a Jerome Model 631-X H_2S meter.

The objective of this program 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, the odor monitoring activities are also designed to provide early warning of odorous conditions that develop within the WRPs, and to enable control of them before they come to the notice of the surrounding residents. If a very strong odor is observed, the incident is reported at the time of observation to the respective plant operations personnel for corrective action.

A summary of the odor monitoring program is presented in Table 2. This table includes a brief description of the program with regard to the number of locations monitored, when the monitoring commenced at each facility, the frequency of monitoring, the parties responsible for the monitoring, whether H_2S was measured, the number of odor complaints received, and the number of odor complaints verified in 2011.

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

The number of monitoring locations at each facility varies from 4 to 19, depending upon the size of the facility and the history of odor episodes in those facilities. The Egan, North Side, Calumet and Stickney WRPs and SDAs are monitored from one to three days per week. At the Kirie WRP, M&O monitors the facility every day, once per shift, from the spring through fall months.

Odor complaints in 2011 at the various facilities ranged from none at the RASMA SDA and Stony Island SDA to 35 at the Stickney WRP.

TABLE 2: ODOR MONITORING PROGRAM FOR 2011

Facility	Number of Locations Monitored	Year Monitoring Began	Monitored Months of Year	Monitoring Days per Week	Departments Participating	H_2S Measured	Number of Odor Complaints in 2011	Number of Complaints Verified in 2011
Calumet WRP	15	1992	12	3 2	M&R M&O	Yes	4	3
Calumet SDS	9	1992	12	3 2	M&R M&O	Yes	1	1
Egan WRP	7	1993	12	1 NM	M&R M&O	Yes	2	1
Kirie WRP	17	1996	12	1 7[1]	M&R M&O	Yes	21	16
North Side WRP	13	1992	12	1 NM	M&R M&O	Yes	15	3
Stickney WRP[2]	19	1991	12	3 2	M&R M&O	Yes	35	18
HASMA, Vulcan, and Marathon SDAs, and LASMA SPS	17	1990	12	3	M&R	Yes	2	2

TABLE 2 (Continued): ODOR MONITORING PROGRAM FOR 2011

Facility	Number of Locations Monitored	Year Monitoring Began	Monitored Months of Year	Monitoring Days per Week	Departments Participating	H_2S Measured	Number of Odor Complaints in 2011	Number of Complaints Verified in 2011
RASMA SDA[3]	4	2001	12	1 to 2	M&R	Yes	0	0
Stony Island SDA	4	2001	12	1	M&R	Yes	0	0

Note: HASMA = Harlem Avenue Solids Management Area.
LASMA = Lawndale Avenue Solids Management Area.
NM = No monitoring.
RASMA = Ridgeland Avenue Solids Management Area.
SDA = Solids Drying Area.
SDS = Solids Drying Site.
SPS = Solids Processing Site.
WRP = Water Reclamation Plant.
M&R = Monitoring and Research Department.
M&O = Maintenance and Operations Department.

[1]At the Kirie WRP, M&O personnel conduct odor monitoring surveys seven days a week, three times a day from May through November.

[2]There are 20 monitoring locations at the Stickney WRP. However, one location on the Central Avenue Bridge was not monitored during 2011 due to safety issues and has subsequently been discontinued.

[3]The RASMA SDA was not used as a biosolids drying site during 2011, and therefore was not monitored.

This report presents the odor monitoring data for the year 2011. The odor monitoring data from M&R and M&O in terms of frequency of occurrence, locations of possible odor sources, and H_2S levels have been reviewed and summarized.

RESULTS OF ODOR MONITORING AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO FACILITIES IN 2011

The results of odor monitoring by M&O and M&R at each of the monitored District facilities for 2011 are summarized in Table 3. The results have been divided into two major groups: detected odors, which include the very strong, strong, and easily noticeable odor categories, and nondetected odors, which include the faint, very faint, and no odor categories.

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

Calumet Water Reclamation Plant

In general, the majority of the odor monitoring observations ranged from faint to no odor, 76 percent of the time by M&R personnel and 96 percent of the time by M&O personnel, respectively (Table 3). The strong odors mainly occurred around the sludge concentration building and preliminary tanks. Areas which had easily noticeable odors were mostly in the vicinity of the preliminary tanks, Lagoons No. 1 and No. 2, sludge concentration tanks, and northeast corner of Lagoon No. 18.

The H_2S measurements made at the time of the odor monitoring by the M&R personnel are summarized in Table 4. The highest instantaneous readings were at the Sludge Concentration Building and Preliminary Tanks.

Figure 1 summarizes the monthly observations of easily noticeable, strong, and very strong odors made during 2011 in terms of frequency of occurrence. The frequency of easily noticeable observations ranged between 9.3 and 24.8 percent each month with the highest percentage occurring in September. Strong odors were observed two percent of the time on average, and very strong odors were observed less than one percent of the time during 2011.

Four odor complaints from the vicinity of vent shafts and an interceptor in the Calumet WRP service area were received in 2011, of which three were verified (Table 2).

Calumet Solids Drying Site

The Calumet SDS consists of the East SDA, located east of the Calumet WRP, and the West SDA, 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 SDA, was infrequent. The majority of the observations were described as faint to no odor. No very strong odor was detected in 2011. Except for May, the strong odors were observed at the

TABLE 3: ODOR MONITORING RESULTS FOR 2011

Facility	Departments Participating	Total Number of Observations	Number of Observations Odors were Detected			Number Non-Detects[1]	Percent Non-Detects
			Very Strong	Strong	Easily Noticeable		
Calumet WRP	M&R	1,900	3	47	412	1,438	76
	M&O	596	0	4	21	571	96
Calumet SDS	M&R	1,176	0	34	241	901	77
	M&O	306	0	12	8	286	93
Egan WRP	M&R M&O[2]	329	0	4	45	280	85
Kirie WRP	M&R	810	0	2	93	715	88
	M&O	8,817	0	10	131	8,676	98
North Side WRP	M&R M&O[2]	575	0	4	87	484	84
Stickney WRP	M&R	2,536	12	77	614	1,833	72
	M&O	2,701	1	19	259	2,422	90
HASMA, Vulcan and Marathon SDAs, and LASMA SPS	M&R	2,236	1	62	663	1,510	68

TABLE 3 (Continued): ODOR MONITORING RESULTS FOR 2011

Facility	Departments Participating	Total Number of Observations	Number of Observations Odors were Detected			Number Non-Detects[1]	Percent Non-Detects
			Very Strong	Strong	Easily Noticeable		
RASMA SDA[3]	M&R	0	N/A	N/A	N/A	N/A	N/A
Stony Island SDA	M&R	511	0	2	30	479	94

Note: HASMA = Harlem Avenue Solids Management Area.
LASMA = Lawndale Avenue Solids Management Area.
RASMA = Ridgeland Avenue Solids Management Area.
SDA = Solids Drying Area.
SDS = Solids Drying Site.
SPS = Solids Processing Site.
WRP = Water Reclamation Plant.
N/A = Not applicable.
M&R = Monitoring and Research Department.
M&O = Maintenance and Operations Department.

[1]Non-detects are all observations of faint, very faint, or no odor.

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

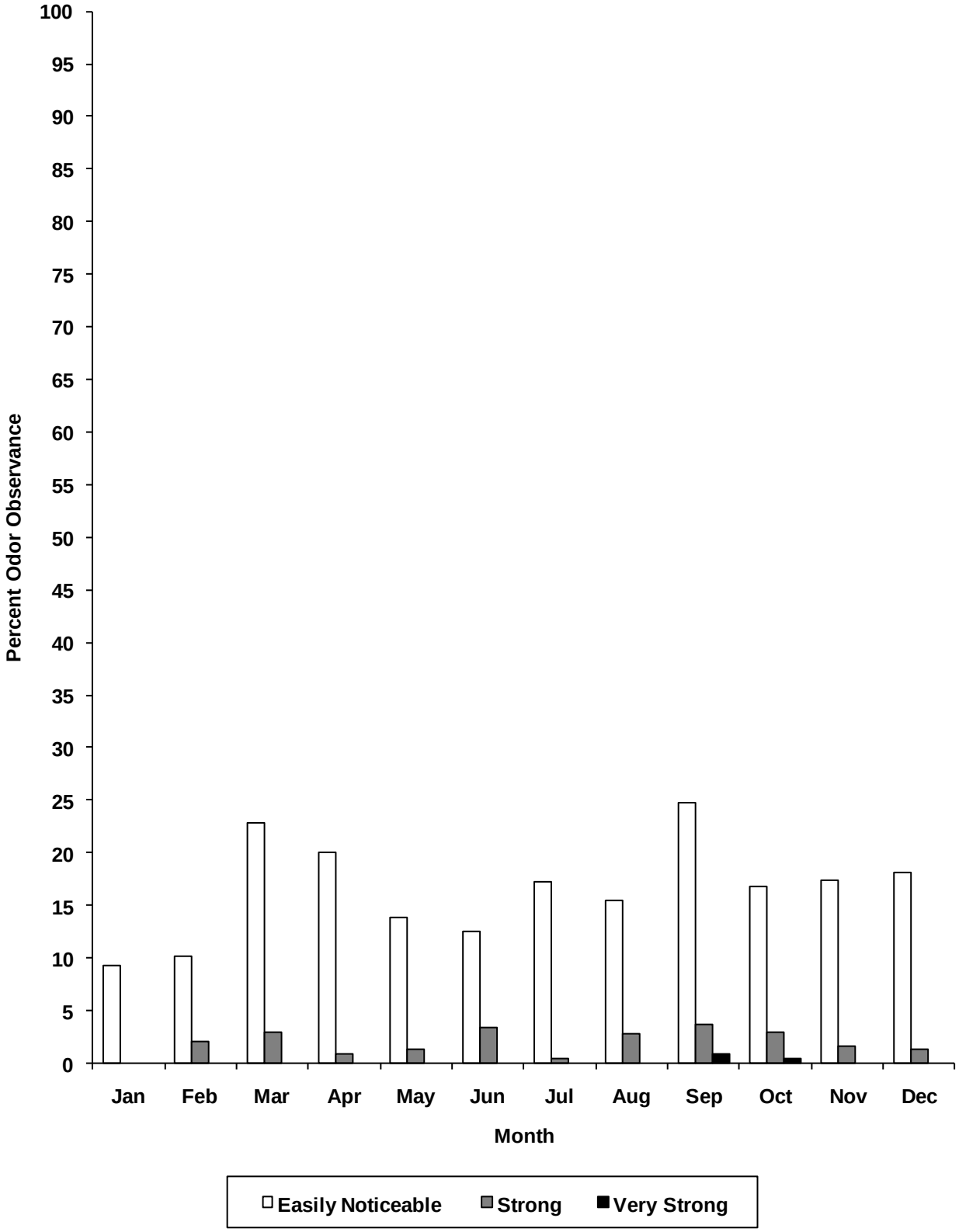
[3]RASMA was not used as a biosolids drying site during 2011; no observations were made.

TABLE 4: HYDROGEN SULFIDE READINGS AT THE CALUMET WATER RECLAMATION PLANT – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
Plant Entrance (1)[2]	6.1	0	27
Lagoon No. 19 SW Corner (2)	7.5	2	25
Sludge Conc. Bldg. (3)	20.6	1	650
Lagoon No. 18 NE Corner (4)	8.4	2	39
Sludge Digester Tanks (5)	7.6	2	30
Aeration Battery A – West (6)	8.2	2	110
TARP Pump Station (7)	10.3	2	46
Preliminary Tanks (8)	40.9	2	560
Gate Near Lagoon No. 9 (9)	6.9	0	23
Between Lagoon No. 7 and No. 8 (10)	8.6	0	34
Lagoon No. 1 and No. 2 (11)	11.6	1	74
Lagoon No. 3 and No. 4 (12)	8.3	0	60
Ellis Ave. and 130th St. (13)	6.0	0	18
H_2S Monitor – 130th St. (23)	5.1	0	12
North H_2S Monitor (24)	9.4	1	48

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-1.

FIGURE 1: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE CALUMET WATER RECLAMATION PLANT – 2011



drying areas in February through December. Strong odors were observed under 5.2 percent of the time on a monthly basis with the exception of April 2011 (9.6 percent). Easily noticeable odors occurred between 4.6 and 23.9 percent of the time throughout the various drying area locations. Figure 2 presents the monthly frequency of occurrence of the easily noticeable, strong, and very strong odor observations. The easily noticeable odors were highest during July through November 2011.

The average H_2S levels were between 6.1 and 8.8 ppbv, as shown in Table 5. The highest value observed (83 ppbv) was at West Drying Cell No. 4.

One odor complaint was received and verified with regard to the Calumet SDS during 2011 (Table 2).

John E. Egan Water Reclamation Plant

There were four strong and no very strong odor observations at the Egan WRP in 2011 (Table 3). Faint, very faint, or no odors were reported 85 percent of the time (Table 3). The easily noticeable odor observations occurred 14 percent of the time and occurred most frequently in the vicinity of the primary tanks and near the waste gas burner.

The percentage of observations at which easily noticeable, strong, and very strong odors were observed during 2011 is presented by month in Figure 3.

The average H_2S measurements ranged from 6.2 to 7.3 ppbv, as shown in Table 6. The highest average level and highest instantaneous reading were observed at the location of the waste gas burner.

Two odor complaints pertaining to the Egan WRP operations were received in 2011, of which one was verified as being associated with odors originating in the WRP (Table 2).

James C. Kirie Water Reclamation Plant

There were 12 strong odor observations at the Kirie WRP during 2011, and there were no very strong odor observations (Table 1). Faint, very faint, or no odors were reported 88 percent (M&R) and 98 percent (M&O) of the time (Table 3). The easily noticeable odors generally occurred in the vicinity of air lift stations A-1 and A-2, and at the location of the Return Channel.

Figure 4 summarizes the observations of easily noticeable, strong, and very strong odors observed by month during 2011. The 12 strong odor episodes that were observed by M&R and M&O personnel occurred during July through November 2011. Based on Kirie M&O, the high frequency of easily noticeable odors at the Kirie WRP during December 2011 could be a result of a shutdown of the ozonators at air lift A-1, the pump station, and unusually warm weather conditions.

FIGURE 2: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE CALUMET WATER RECLAMATION PLANT SOLIDS DRYING SITE – 2011

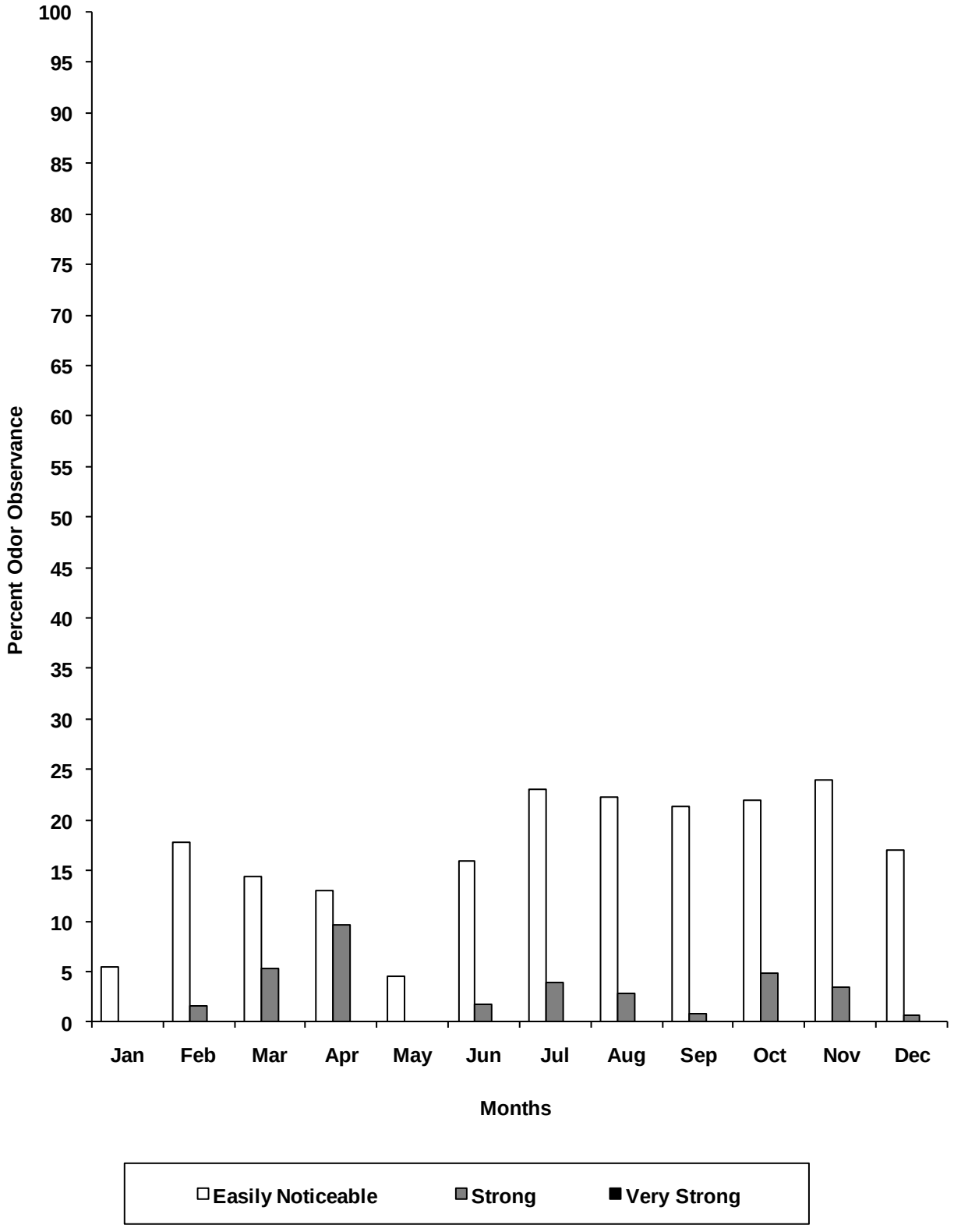


TABLE 5: HYDROGEN SULFIDE READINGS AT THE CALUMET SOLIDS DRYING SITE – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
East Drying Cell No. 1 SW (14)[2]	8.0	2	49
Hopper Building (15)	6.6	0	14
East Drying Cell No. 8 NW (16)	7.6	0	32
East Drying Cell No. 8 NE (17)	7.0	1	23
Truck Scale/Centrifuge (18)	7.7	1	31
East Drying Cell No. 1 SE (19)	8.8	2	46
West Drying Cell No. 1 at Gate (20)	7.7	0	70
West Drying Cell No. 4 (21)	8.1	2	83
Bituminous Road at Gate (22)	6.1	0	19

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-1.

FIGURE 3: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE JOHN E. EGAN WATER RECLAMATION PLANT – 2011

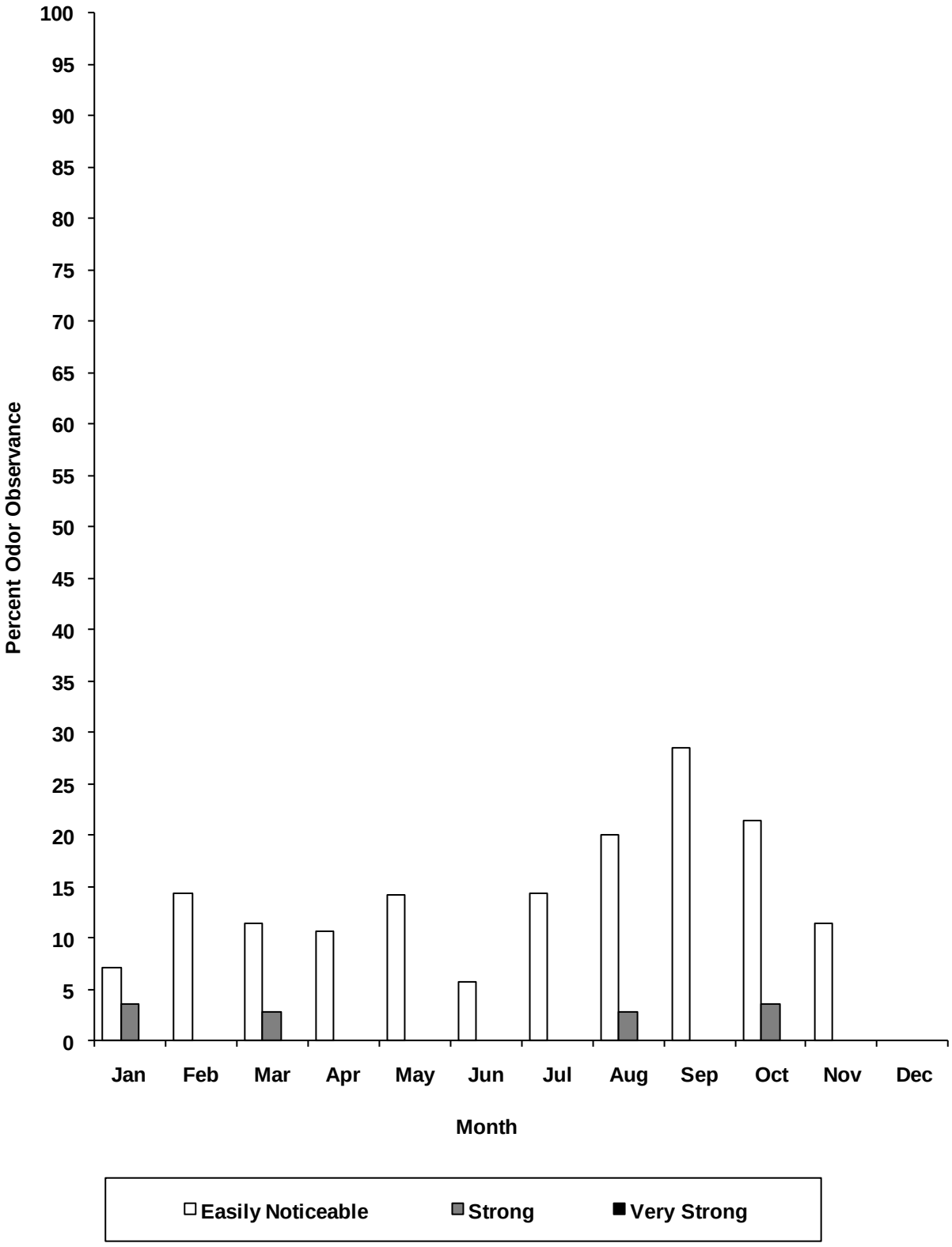
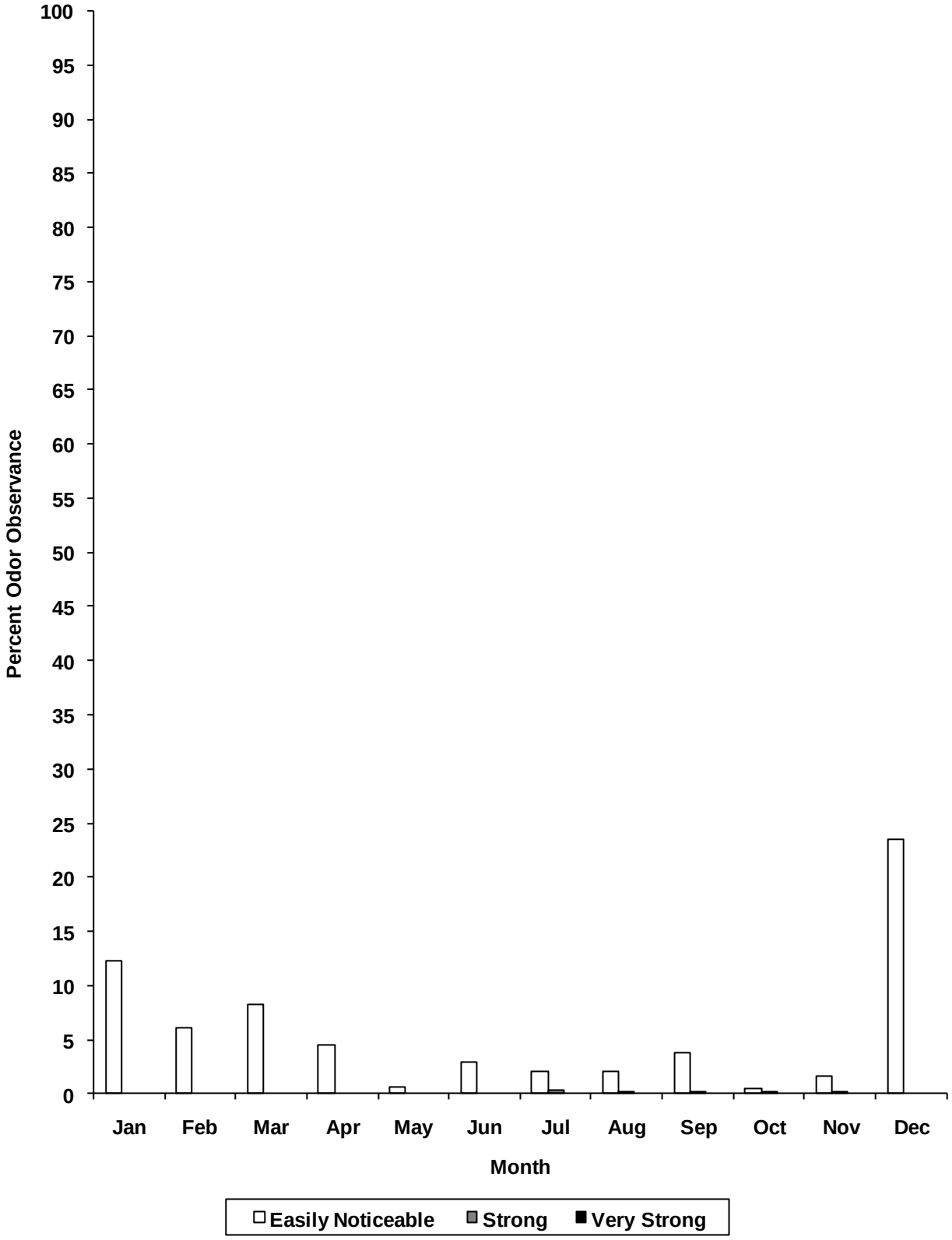


TABLE 6: HYDROGEN SULFIDE READINGS AT THE JOHN E. EGAN WATER RECLAMATION PLANT – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
West Entrance Gate (1)[2]	6.5	0	14
Near Waste Gas Burner (2)	7.3	0	21
Primary Tanks (3)	6.6	1	14
South End "A" Drive (4)	6.4	0	14
Final Tanks (5)	6.4	0	12
East Entrance Gates (6)	6.2	1	13
West of Storage Building (7)	6.9	0	21

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-2.

FIGURE 4: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE JAMES C. KIRIE WATER RECLAMATION PLANT – 2011



The measured H_2S levels are summarized in Table 7. The highest maximum and average levels of H_2S, 27 ppbv and 7.3 ppbv, respectively, were measured in the vicinity of the return channel. All the other locations had averages ranging from 6.0 to 6.9 ppbv.

Twenty-one odor complaints were received regarding the Kirie WRP, of which 16 were verified as emissions from the location of Drop Shaft (DS) 5, DS 3, sewer manholes in the Kirie WRP service area, and at the plant during low-flow conditions (Table 2).

North Side Water Reclamation Plant

The majority (84 percent) of the observations at the North Side WRP were faint to no odor (Table 3). There were no very strong odor observations and four strong odor observations at this WRP during 2011 (Table 1). The easily noticeable odors accounted for 15 percent of the total observations, with the greatest frequency around Preliminary Tank 3.

The monthly percentage of observations at which easily noticeable, strong, and very strong odors were observed is shown in Figure 5. The frequency of occurrence of easily noticeable odors was highest in June through September 2011.

The measured H_2S levels are summarized in Table 8. The highest mean and maximum readings were at the Main Street Covered Sludge Concentration Tanks (17.5 ppbv and 230 ppbv, respectively). All other locations had averages between 5.6 ppbv to 8.0 ppbv.

Fifteen odor complaints regarding the North Side WRP were received in 2011, of which three were verified as being associated with odors originating in the North Side WRP and from the drop shafts in the service area of the North Side WRP (Table 2).

Stickney Water Reclamation Plant

At the Stickney WRP, the majority of the observations in 2011 were faint to no odor, with 72 percent of M&R and 90 percent of M&O observations being in this classification, respectively (Table 3). Overall, there were 13 very strong odor observations and 96 strong odor observations, which accounts for two percent of the total number of observations (Table 1). Most of these strong odors occurred in the vicinity of the preliminary tanks, sludge concentration tanks, and Laramie Avenue and 40th Street. The strong odors observed at Laramie Avenue and 40th 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, Inc.

Figure 6 shows the percentage of easily noticeable, strong, and very strong odors observed each month at the Stickney WRP. The frequency of occurrence of easily noticeable odors ranged from 12.1 percent to 18.9 percent of the time. The easily noticeable odors were mostly observed at the predigestion and postdigestion centrifuges, preliminary tanks, concentration tanks, both Laramie locations, and Imhoff tanks with the highest occurring in April. Fewer than

TABLE 7: HYDROGEN SULFIDE READINGS AT THE JAMES C. KIRIE WATER RECLAMATION PLANT – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
Plant Entrance (1)[2]	6.4	0	13
Pump Station (2)	6.4	1	13
Air Lift B1 (3)	6.5	0	12
Road C-1 (4)	6.4	0	14
Return Channel (5)	7.3	0	27
East Gallery – North (6)	6.6	0	15
Road C-2 (7)	6.4	0	17
Road C-3 (8)	6.0	0	20
Road C-4 (9)	6.2	1	14
Air Lift A-1 (10)	6.7	1	14
Air Lift A-2 (11)	6.5	0	14
Road C-5 (12)	6.7	0	15
Road C-6 (13)	6.2	0	16
Road C-7 (14)	6.2	0	17
Air Lift B2 (15)	6.3	0	18
Ridge Lane – Point No. 1 (16)	6.7	0	19
Marshall and Pleasant Lane – Point No. 2 (17)	6.9	0	20

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-3.

FIGURE 5: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE NORTH SIDE WATER RECLAMATION PLANT – 2011

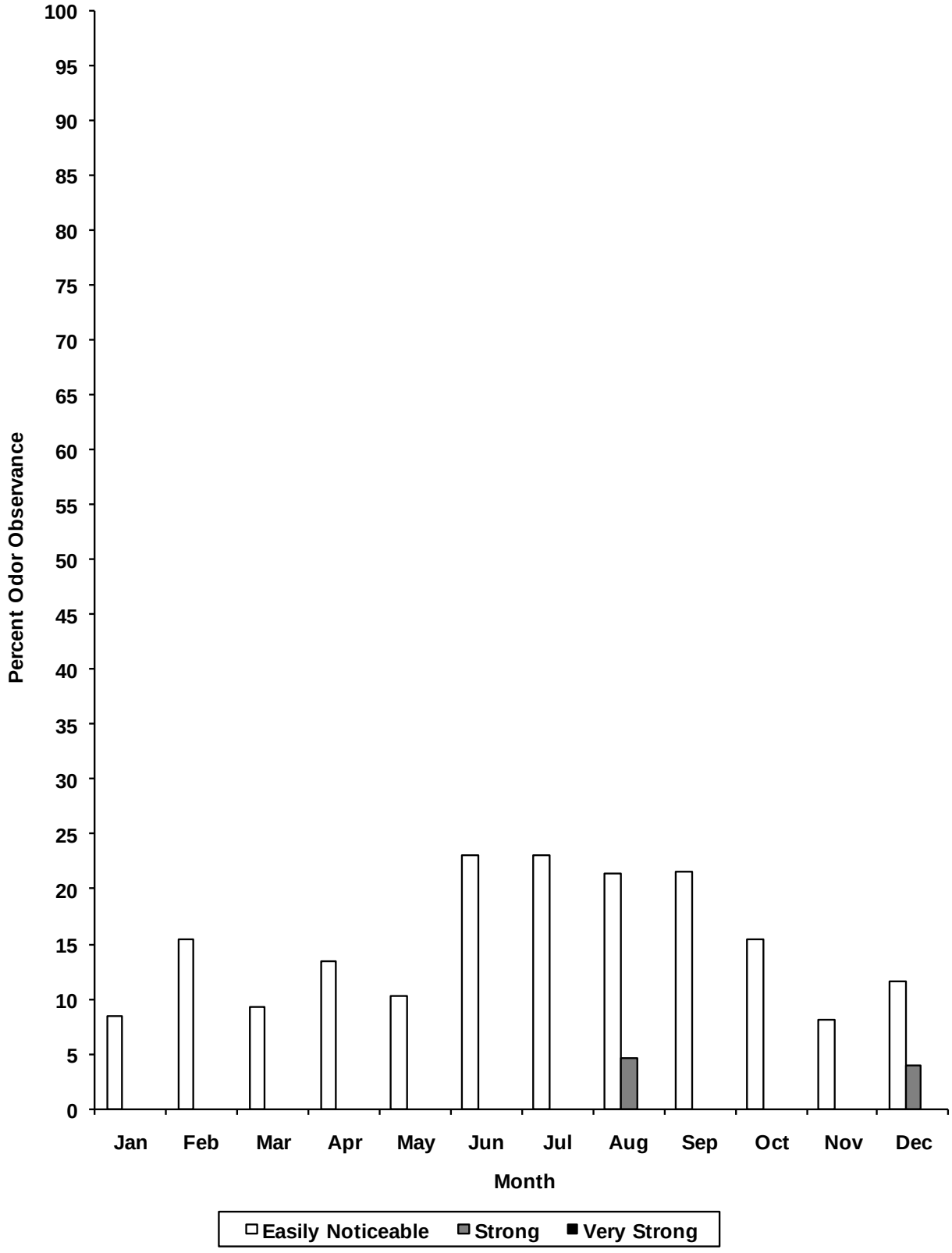
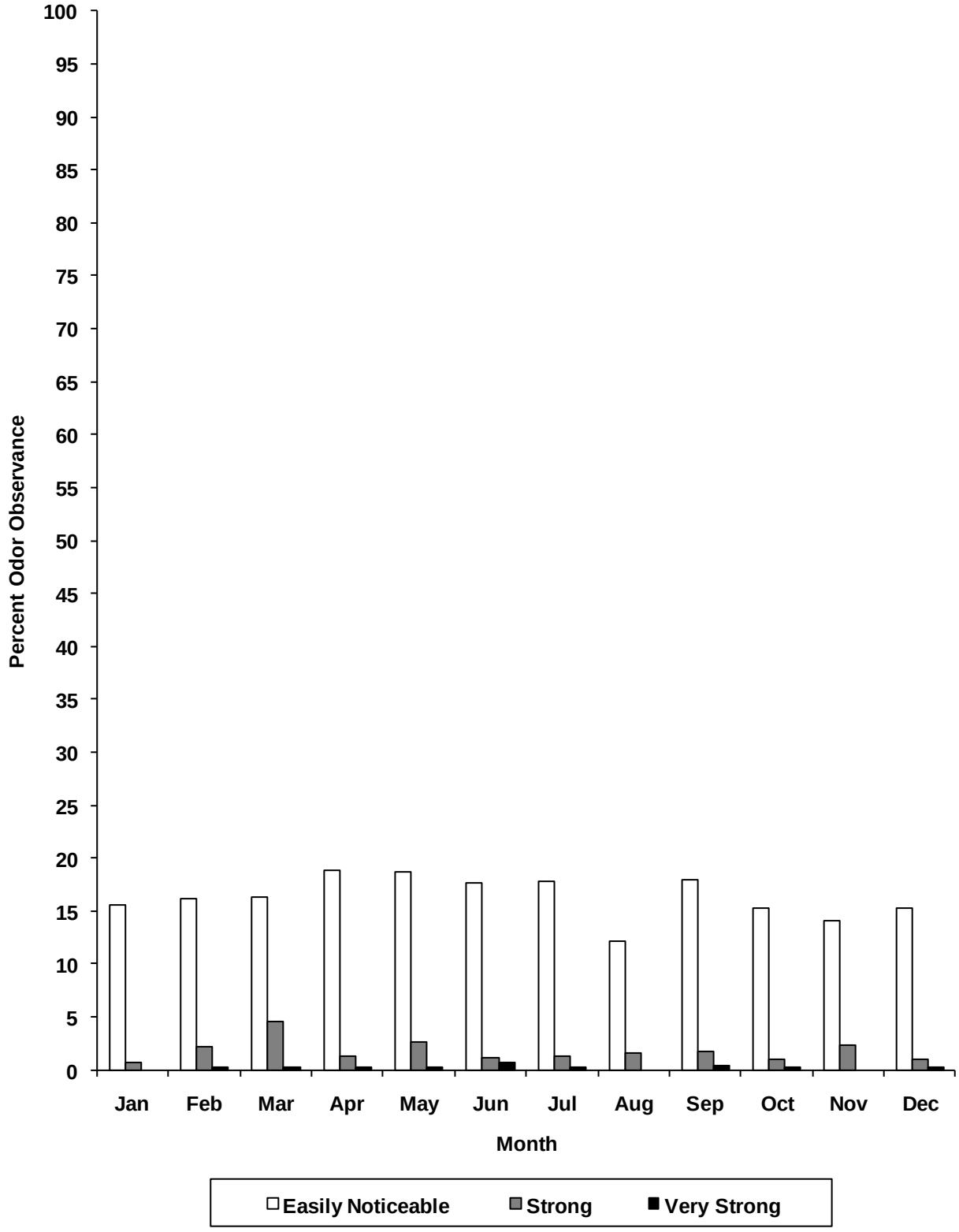


TABLE 8: HYDROGEN SULFIDE READINGS AT THE NORTH SIDE WATER RECLAMATION PLANT – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
Howard Street West End (1)[2]	5.8	0	11
Howard Street East of McCormick Road (2)	8.0	1	19
McCormick Road (3)	7.1	1	14
P&B Building (4)	5.8	0	12
North Ave. Rect. Tank A6 (5)	5.6	0	10
North Ave. Rect. Tank B6 (6)	5.8	0	11
North Ave. Rect. Tank C6 (7)	5.9	0	12
Final Tank Batt. D3 (8)	5.8	0	12
Gallery Bldg. of Batt. D Mix Channel (9)	6.0	0	13
Main Street and Avenue E (10)	6.1	0	11
Covered Weir Prel. Tank 10 (11)	7.0	0	21
Preliminary Tank 3 (12)	7.1	2	19
Main St. Covered Sludge Conc. Tanks (13)	17.5	0	230

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-4.

FIGURE 6: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE STICKNEY WATER RECLAMATION PLANT – 2011



ten strong odor occurrences were observed each month, except for March and May 2011, with 22 and 13 strong odor occurrences, respectively.

The highest average and highest instantaneous H_2S levels were recorded at the Laramie and 40th Street sampling location, with a value of 176.2 ppbv and 7,900 ppbv, respectively (Table 9). The odor monitoring at the Central Avenue bridge (monitoring location 16) was terminated several years ago due to safety issues for the odor patrol.

Thirty-five odor complaints were received regarding the Stickney WRP, of which 18 were verified as originating from Stickney WRP operations and the Tunnel and Reservoir Plan (TARP) system. Almost all verified complaints were made in afternoon and evening hours and originated from the sludge concentration tanks, centrifuge buildings, TARP pumpback, and Battery D.

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

The HASMA, Vulcan, and Marathon SDAs and the LASMA SPS had 68 percent of the total observations characterized as faint to no odor (Table 3). There were one very strong and 62 strong odor observations out of 2,236 total observations (Table 1). The strong odor observations were spread among the various locations (HASMA, HASMA Center, Vulcan, Lagoons 24 and 30, drying cells 1W through 5W, and Marathon West) 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 7. The frequency of observed odors is generally highest during the spring through the fall months (April through November) when solids processing and drying is being carried out. The easily noticeable odor observations ranged from 24.3 to 47.0 percent during this time period.

The average H_2S levels at the various locations around these SDAs and SPS ranged from 6.9 and 11.9 ppbv as shown in Table 10.

Two odor complaints were received and both were verified in 2011 with regard to the LASMA SPS and Marathon SDA, respectively (Table 2).

Ridgeland Avenue Solids Management Area and Stony Island Solids Drying Area

The RASMA SDA was not used as a biosolids drying site during 2011 and therefore was not monitored.

The Stony Island SDA had 94 percent of the observations characterized as faint to no odor, with two strong and no very strong odor observations in 2011 (Table 3). There were no very strong and two strong odor observations out of 511 total observations (Table 3). The strong odor observations were at the Entrance on 122nd Street and northeast corner of Cell No. 5.

TABLE 9: HYDROGEN SULFIDE READINGS AT THE STICKNEY WATER RECLAMATION PLANT – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
Imhoff B St./3rd Ave. (1)[2]	13.1	2	140
Imhoff B St./4th Ave. (2)	10.9	2	67
Imhoff B St./5th Ave. (3)	9.0	1	75
Digester 6th Ave. at B St. (4)	8.9	1	330
West Digester Cont. Bldg. (5)	8.4	1	200
Centrifuges 6th Ave. at Pre. (6)	15.7	1	160
Centrifuges 6th Ave. at Post (7)	7.6	0	77
Concentration G St. North (8)	25.4	1	220
Concentration D St. South (9)	14.0	0	180
Preliminary 12th Ave. (10)	42.9	0	1,340
Preliminary 10th Ave. (11)	34.4	0	1,100
39th St./Central Ave. (12)	7.4	0	81
39th St./Morton College Ent. (13)	6.7	0	24
39th St./Dig. at 57th Ave. (14)	6.5	0	13
39th St./Between Austin and Lombard (15)	6.2	0	18
Battery D, B St/13th Ave. (17)	5.8	0	150
Lombard Ave. at Gate/39th St. (18)	5.6	0	14
Laramie and 40th St. (19)	176.2	2	7,900
Laramie and 39th St. (20)	27.4	1	1,700

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-5.

FIGURE 7: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN, MARATHON SOLIDS DRYING AREAS AND LAWNDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITE – 2011

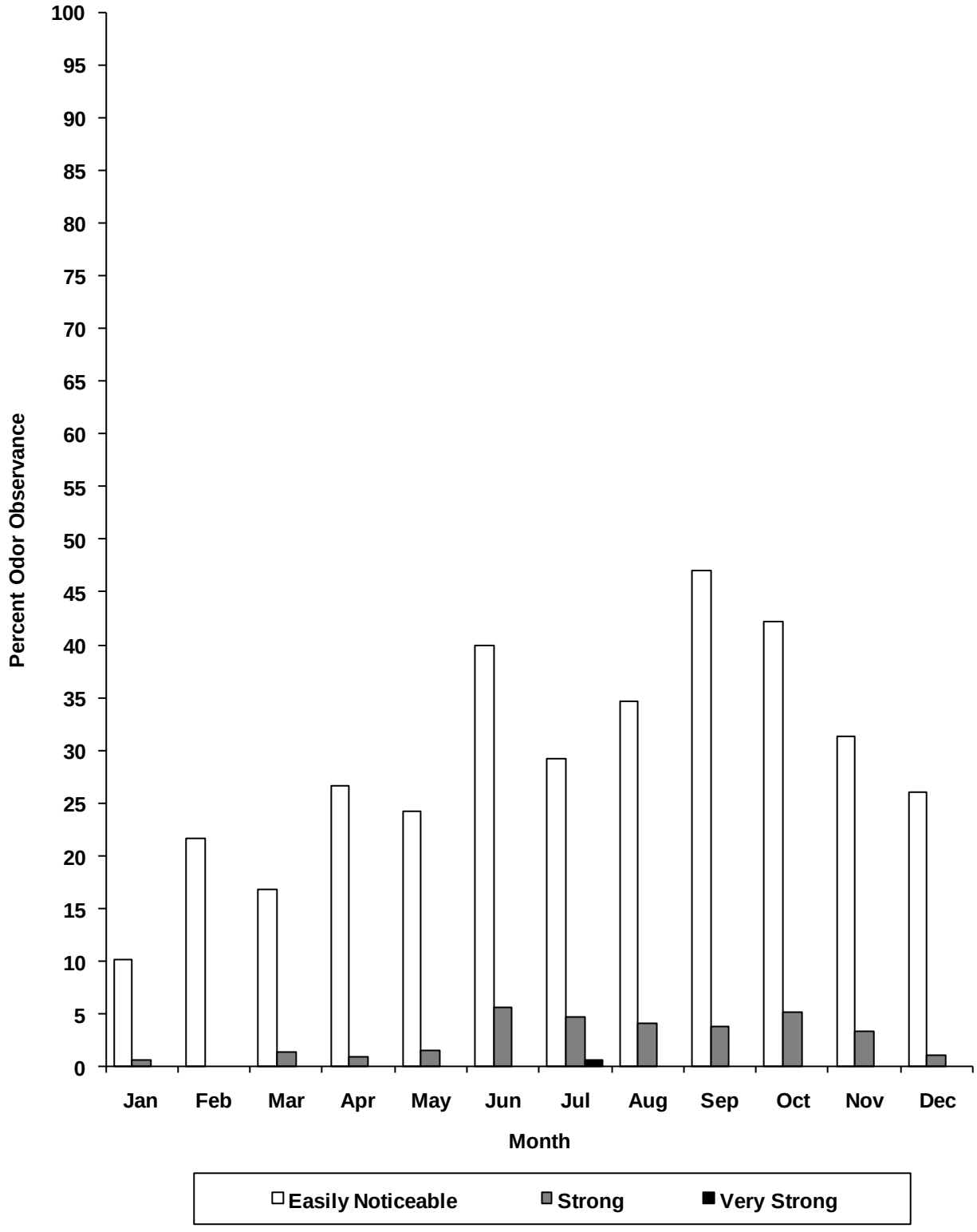


TABLE 10: HYDROGEN SULFIDE READINGS AT THE HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN, MARATHON SOLIDS DRYING AREAS AND LAWNDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITE – 2011

Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
HASMA (1)[2]	11.8	0	200
HASMA Center (1.5)	9.7	0	75
Vulcan South (2)	7.5	0	55
Vulcan North (3)	11.9	0	395
Vulcan TARP Drop Shaft (4)	9.3	1	64
Vulcan TARP Well (5)	9.3	0	122
LASMA Lagoon 1 (6)	7.4	0	21
LASMA Lagoon 16 (7)	6.9	0	14
LASMA Lagoon 24 (8)	11.5	0	111
LASMA Lagoon 30 (9)	8.7	0	42
LASMA Cell 1E-1W (10)	10.4	0	400
LASMA Cell 2E-2W (11)	8.2	2	63
LASMA Cell 3E-3W (12)	8.2	2	81
LASMA Cell 4E-4W (13)	8.1	1	120
LASMA Cell 5E-5W (14)	7.7	2	64
Marathon (15)	8.6	2	83
Marathon West (16)	9.4	1	58

[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-6.

The percentage of observations at which easily noticeable, strong, and very strong odors were observed was plotted by month and is presented in Figure 8. The easily noticeable odors accounted for approximately six percent of the total observations over the course of the year.

The average H_2S levels at various locations around the Stony Island SDA ranged from 5.0 to 5.4 ppbv as shown in Table 11.

No odor complaints were received with regard to the Stony Island SDA in 2011.

FIGURE 8: PERCENT OF MONTHLY ODOR OBSERVANCES AT THE STONY ISLAND SOLIDS DRYING AREA – 2011

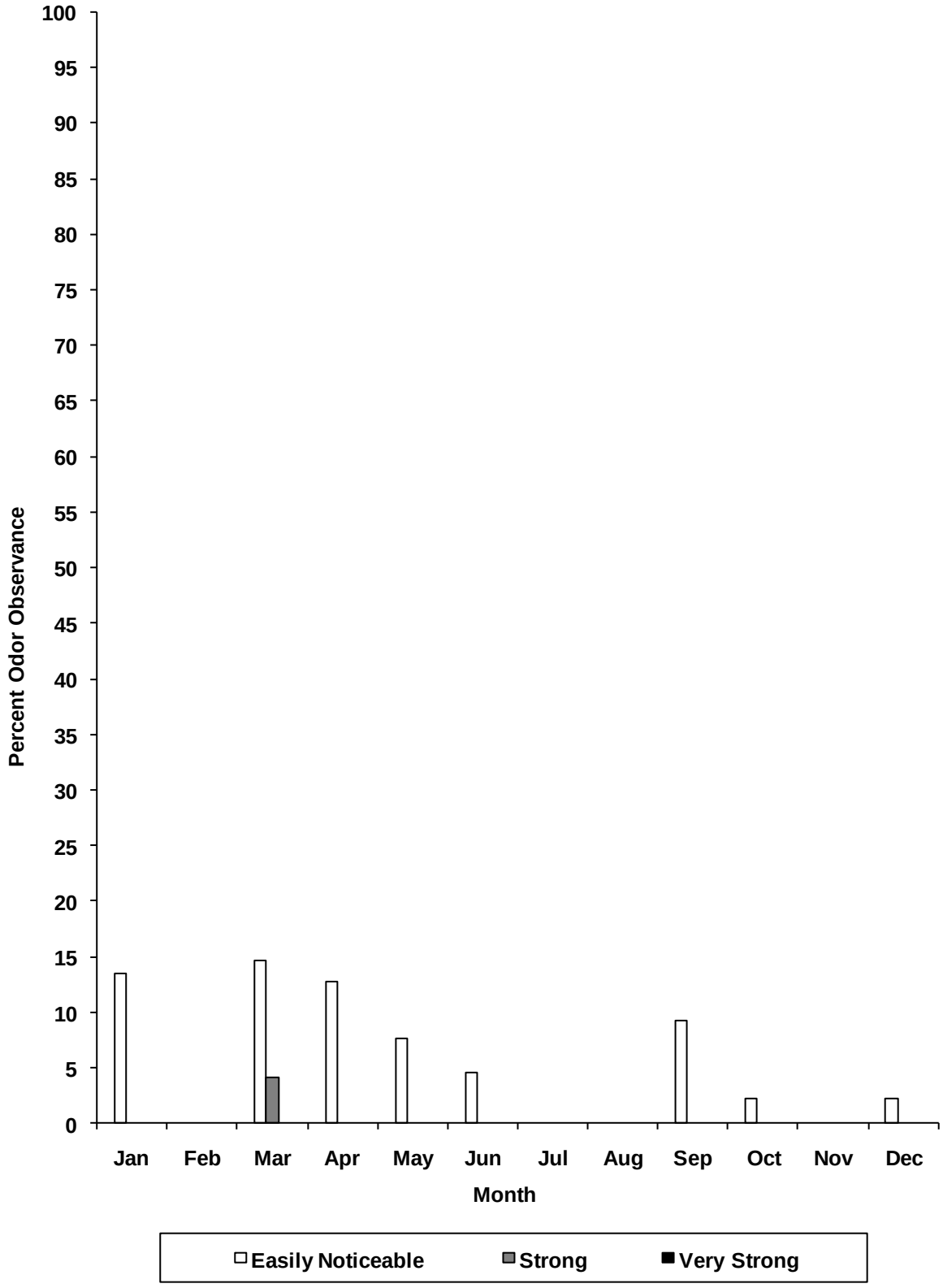


TABLE 11: HYDROGEN SULFIDE READINGS AT THE RIDGELAND AVENUE SOLIDS MANAGEMENT AREA AND STONY ISLAND SOLIDS DRYING AREAS – 2011

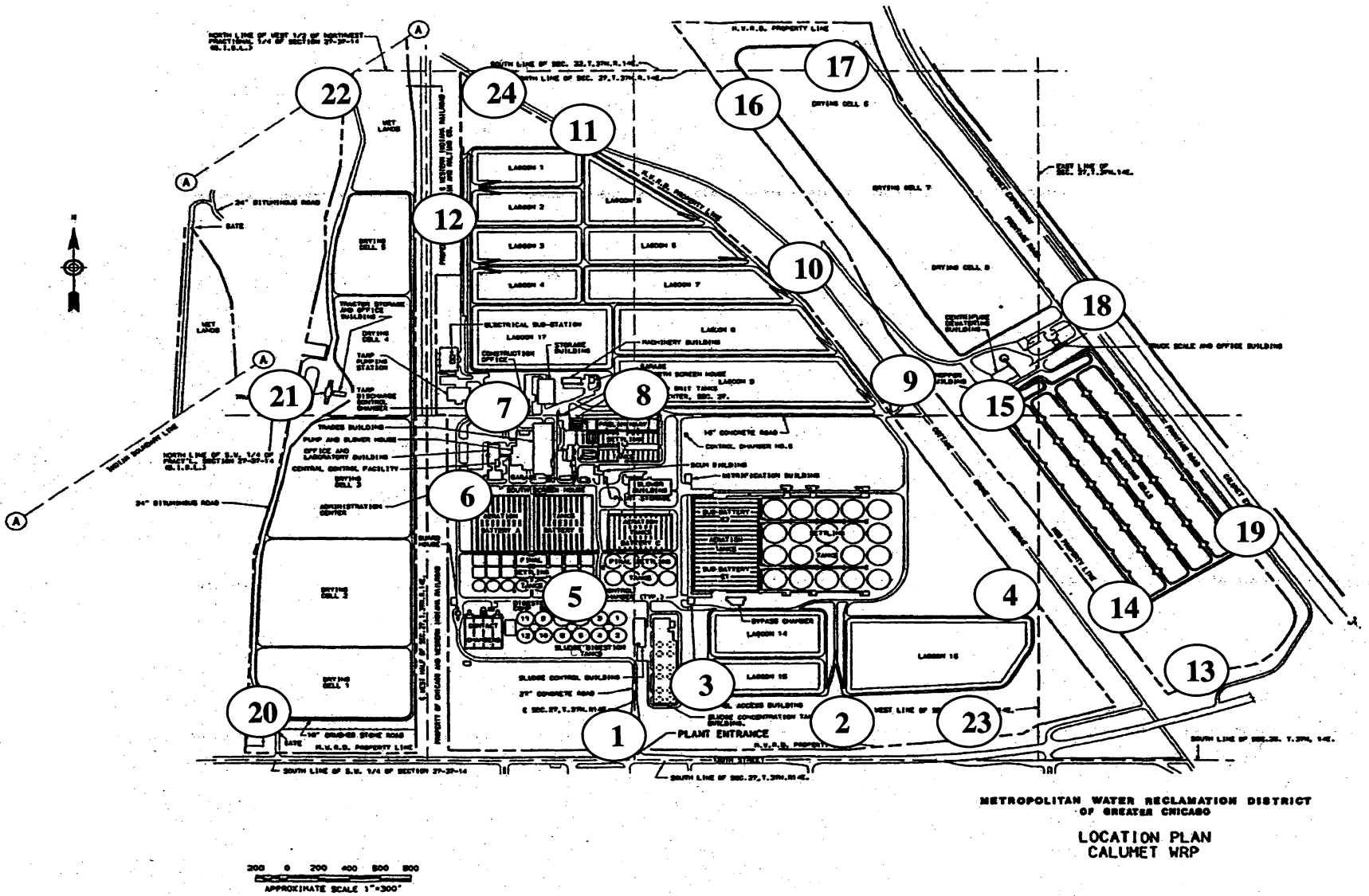
Location	Hydrogen Sulfide, ppbv[1]		
	Mean	Minimum	Maximum
RASMA			
SW Parking Area (1)[2]	N/A	N/A	N/A
North of Cell 2W (2)	N/A	N/A	N/A
NE Corner Cell 5E (3)	N/A	N/A	N/A
South of Cell 5 (4)	N/A	N/A	N/A
Stony Island			
Entrance 122nd St. (1)[3]	5.4	0	13
NE Corner Cell 5 (2)	5.0	0	11
South End Cells 4 and 7 (3)	5.4	0	11
West Side of Cell 3 (4)	5.2	0	12

N/A = Not applicable.
[1]ppbv = Parts per billion by volume.
[2]Numbers in parentheses correspond to Station numbers in Figure AI-7.
[3]Numbers in parentheses correspond to Station numbers in Figure AI-8.

APPENDIX AI

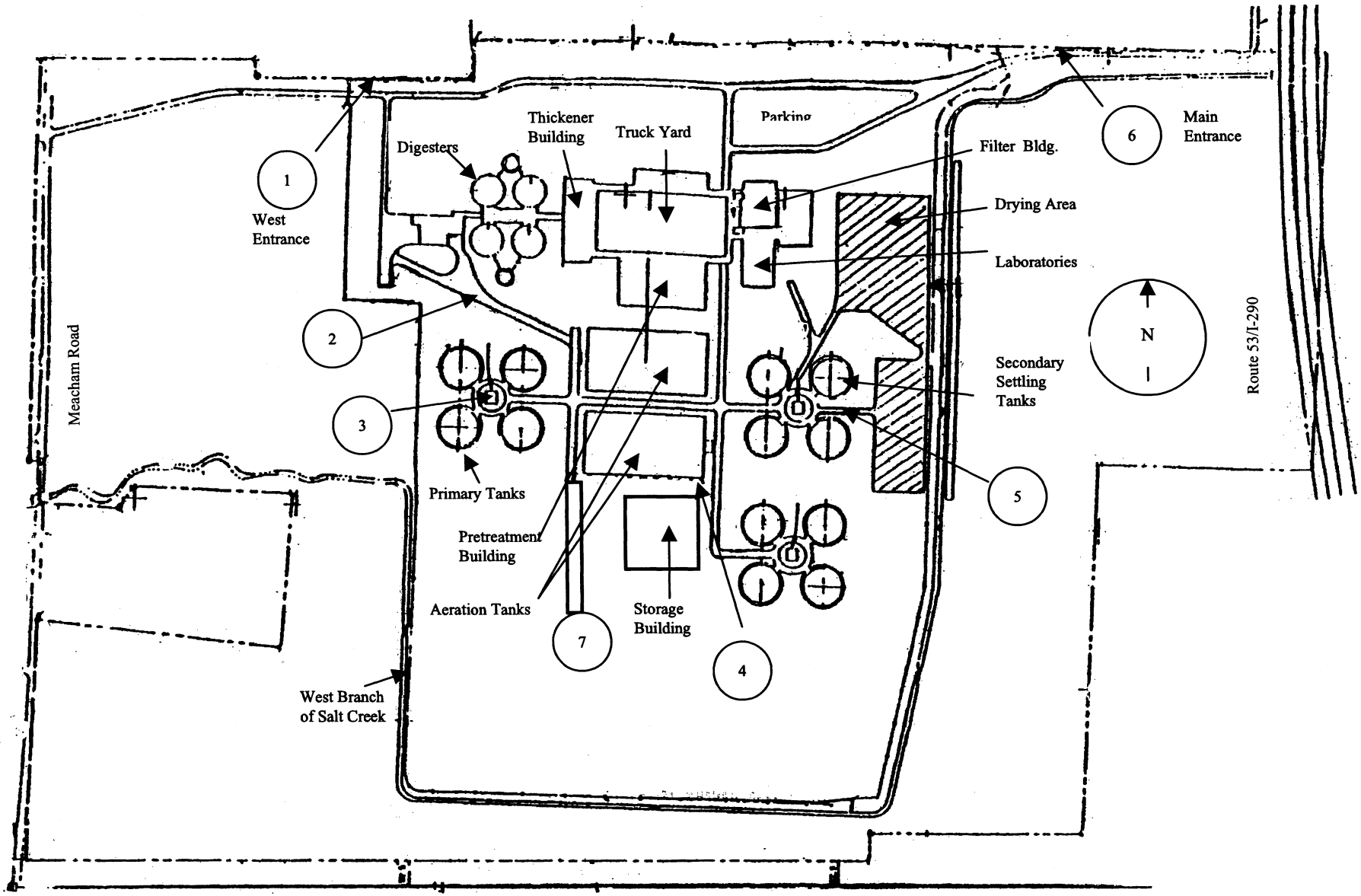
LOCATION OF ODOR MONITORING STATIONS AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO WATER RECLAMATION PLANTS, SOLIDS DRYING SITE, SOLIDS DRYING AREAS, AND SOLIDS PROCESSING SITE

FIGURE AI-1: CALUMET WATER RECLAMATION PLANT AND CALUMET WATER RECLAMATION PLANT SOLIDS DRYING SITE*



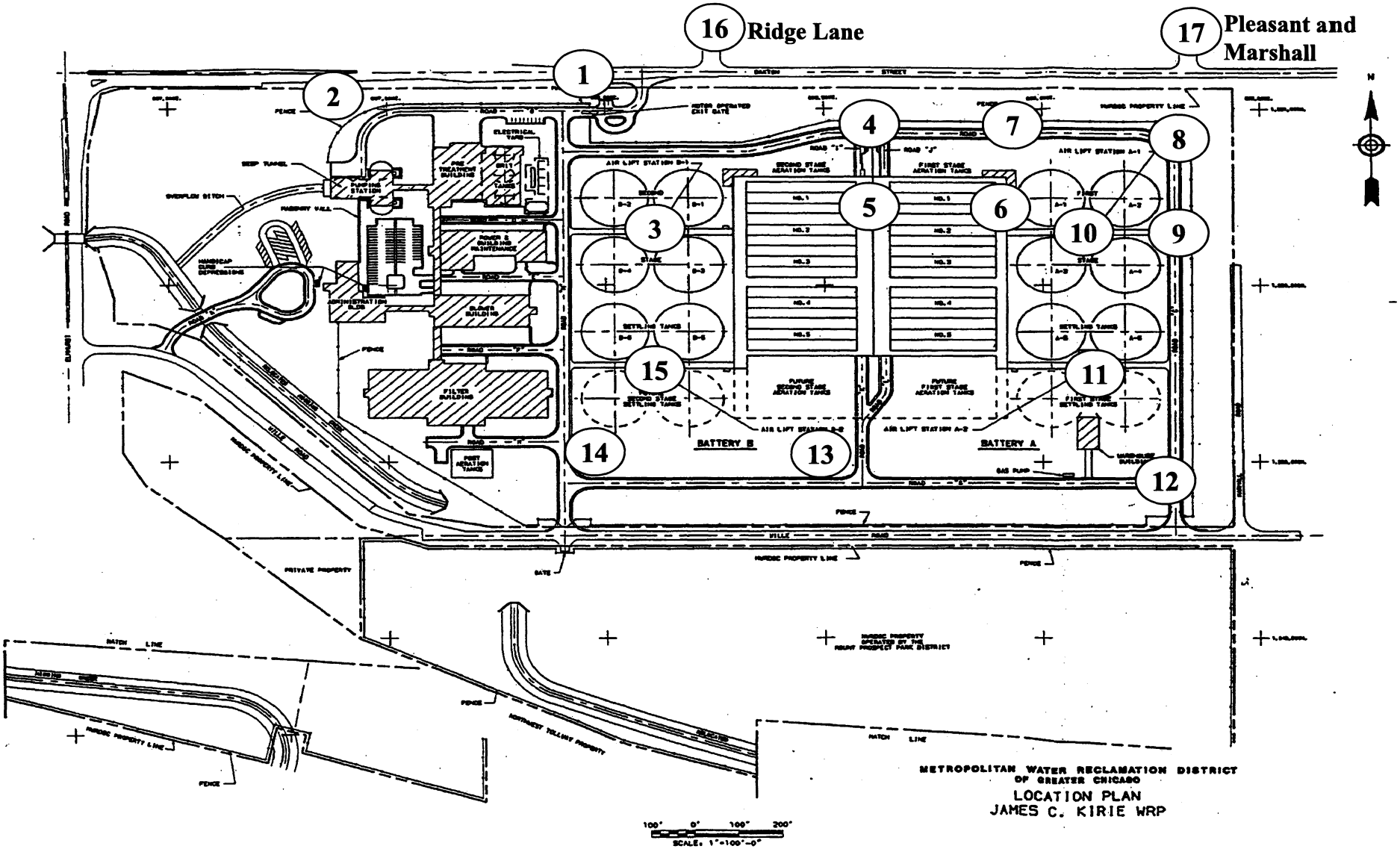
*Numbered circles indicate odor monitoring stations.

FIGURE AI-2: JOHN E. EGAN WATER RECLAMATION PLANT AND SOLIDS DRYING AREA*



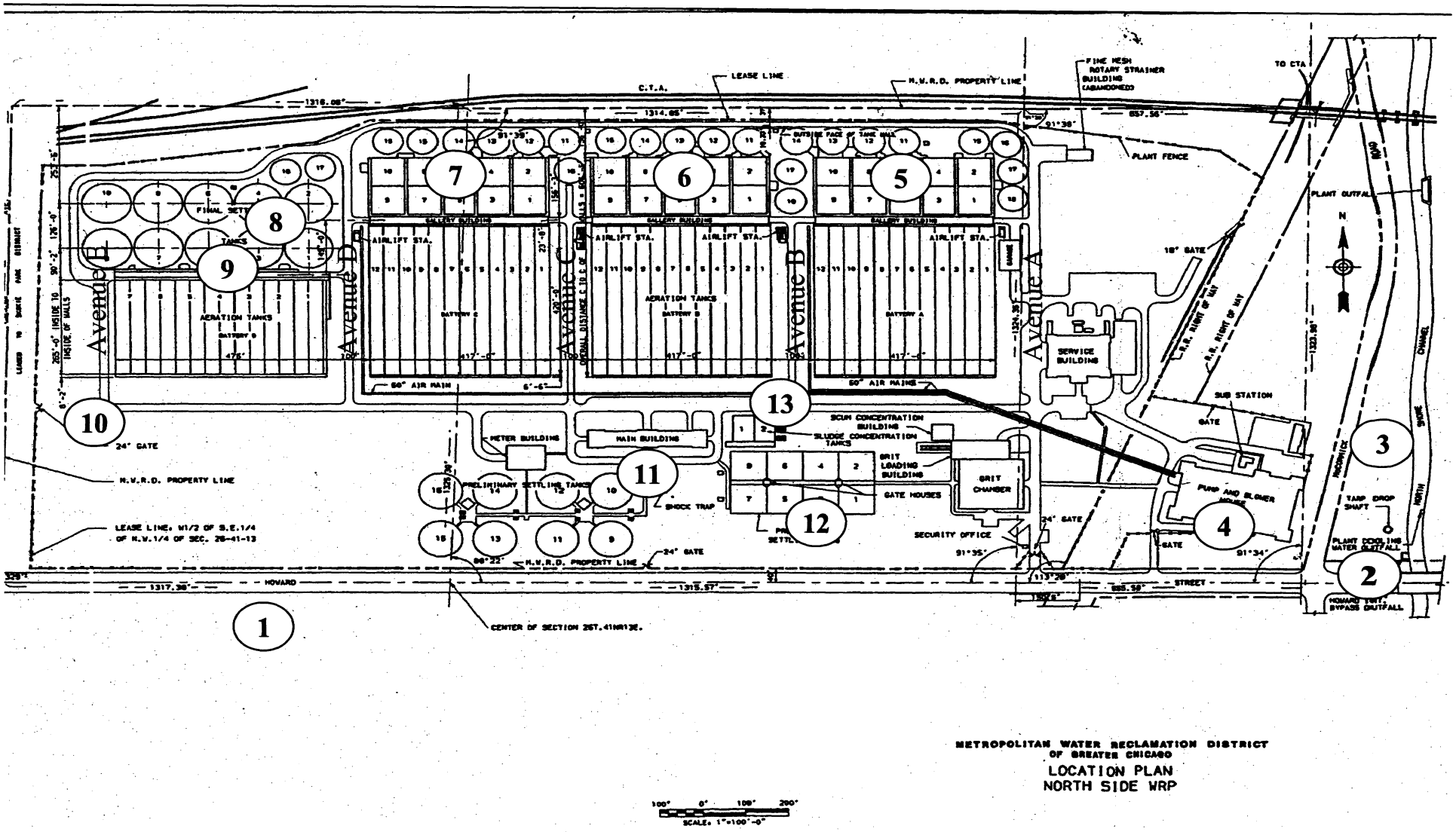
*Numbered circles indicate odor monitoring stations.

FIGURE AI-3: JAMES C. KIRIE WATER RECLAMATION PLANT*



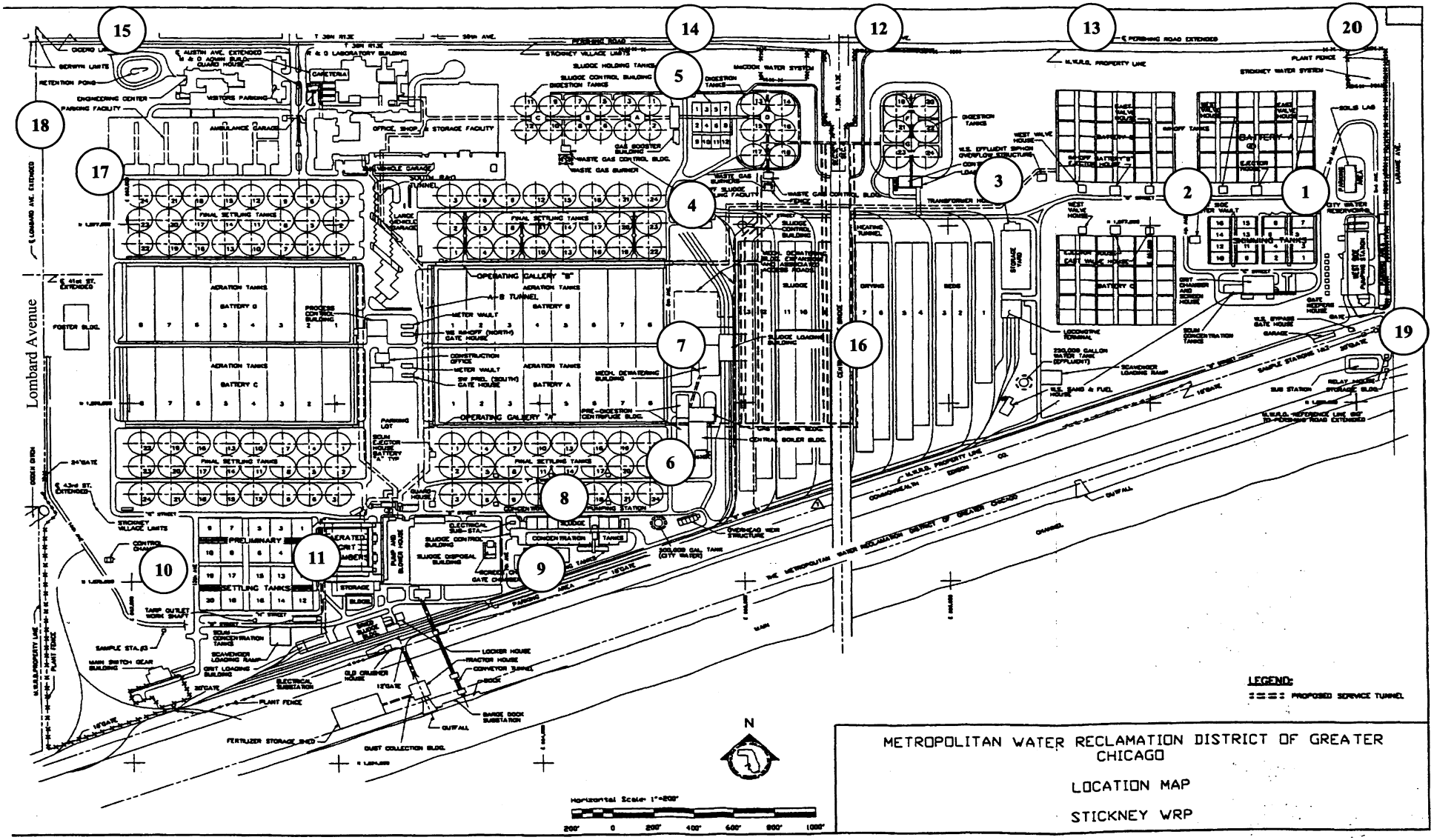
*Numbered circles indicate odor monitoring stations.

FIGURE AI-4: NORTH SIDE WATER RECLAMATION PLANT*



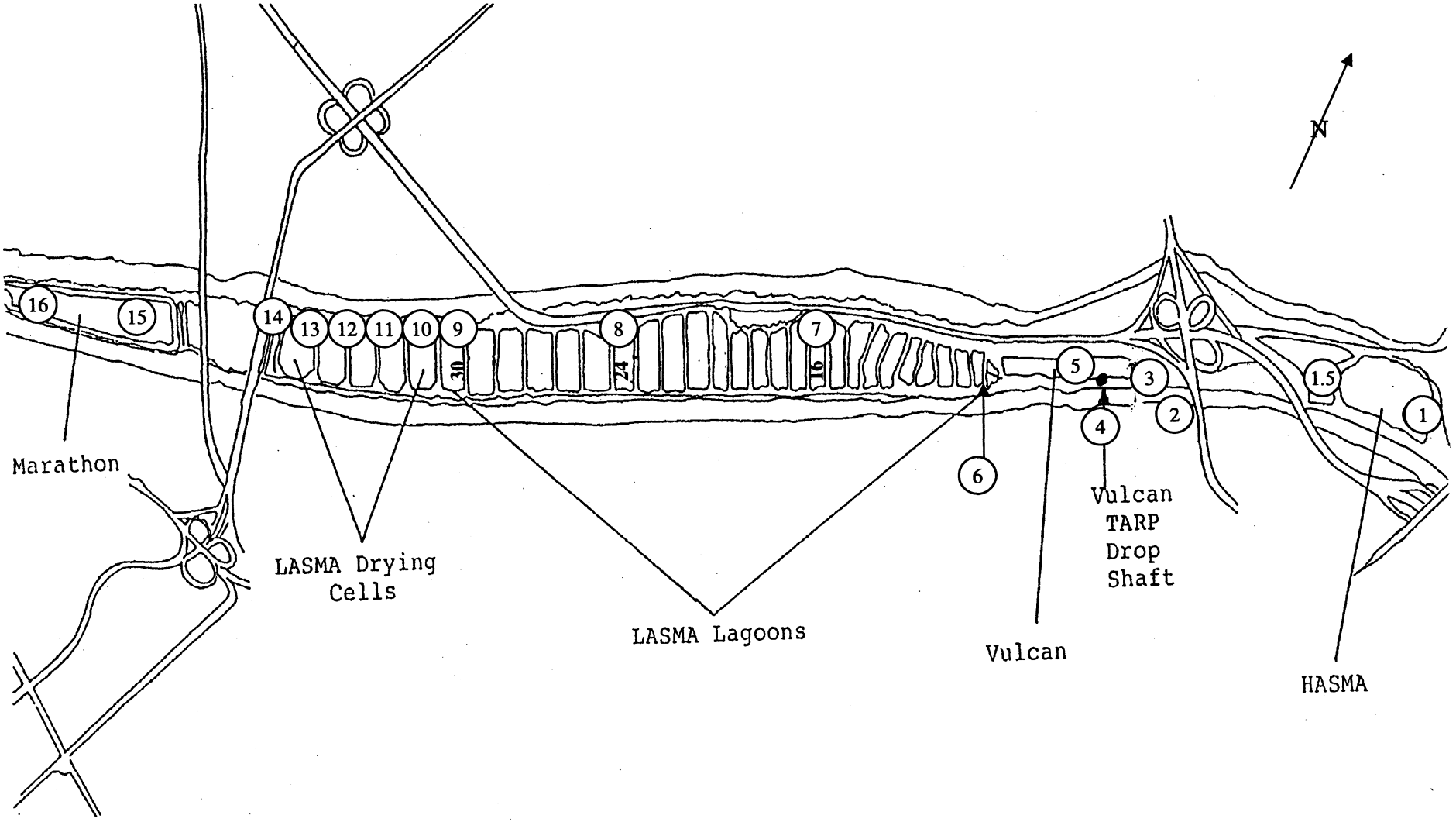
*Numbered circles indicate odor monitoring stations.

FIGURE AI-5: STICKNEY WATER RECLAMATION PLANT*



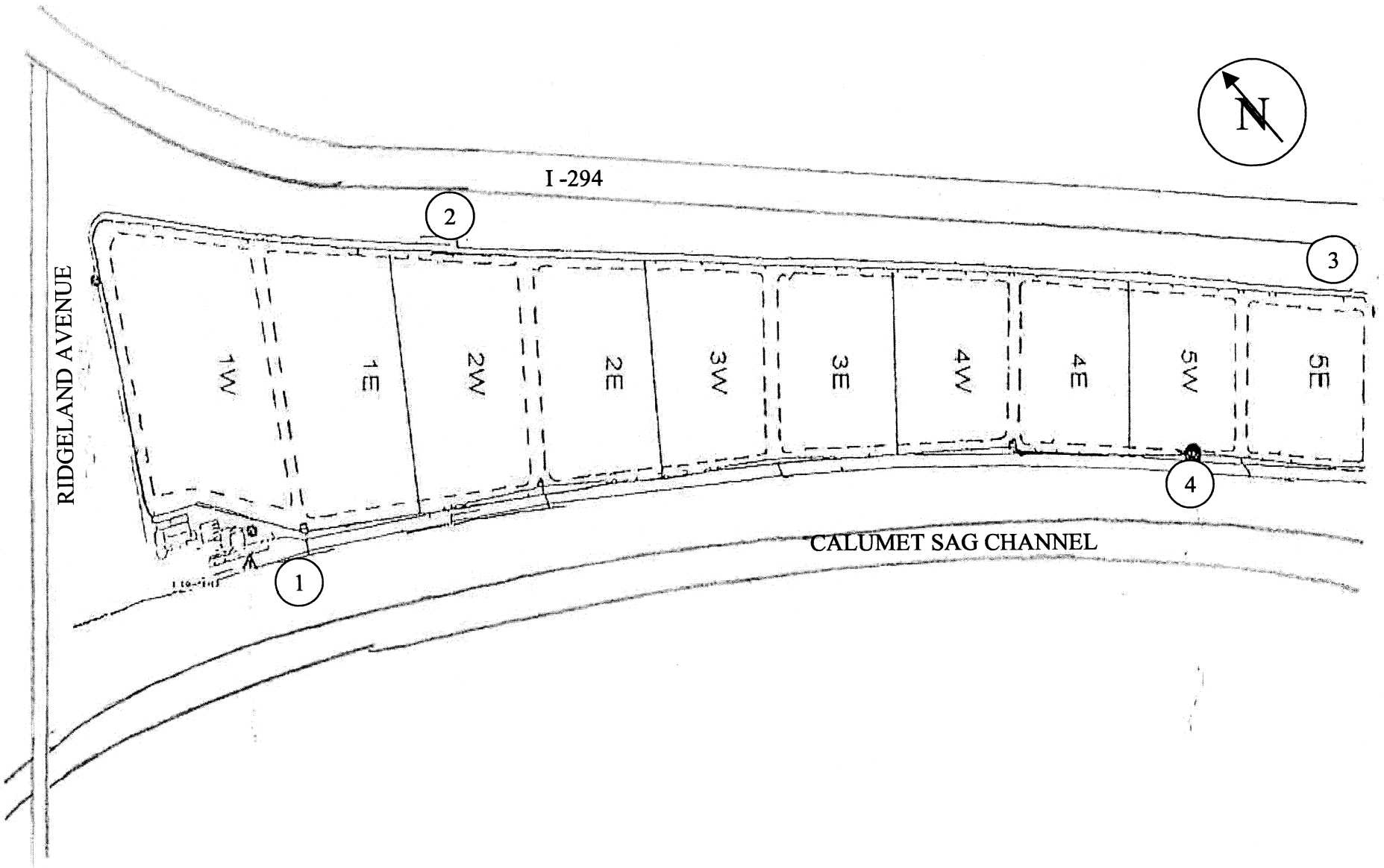
*Numbered circles indicate odor monitoring stations.

AI-6: HARLEM AVENUE SOLIDS MANAGEMENT AREA, VULCAN AND MARATHON SOLIDS DRYING AREAS, AND LAWNDALE AVENUE SOLIDS MANAGEMENT AREA SOLIDS PROCESSING SITE*



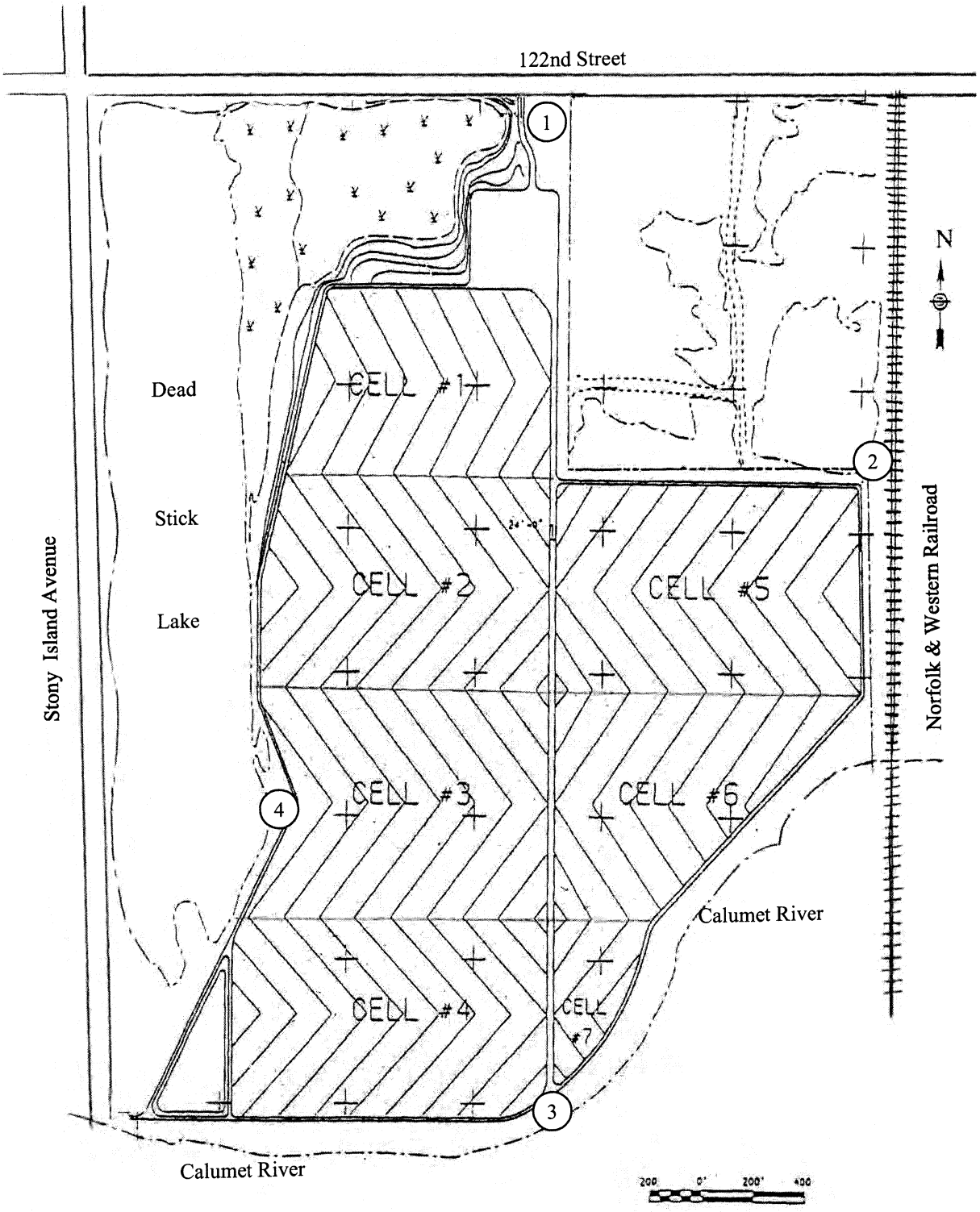
*Numbered circles indicate odor monitoring stations.

FIGURE AI-7: RIDGELAND AVENUE SOLIDS MANAGEMENT AREA SOLIDS DRYING AREA*



*Numbered circles indicate odor monitoring stations.

FIGURE AI-8: STONY ISLAND SOLIDS DRYING AREA*



*Numbered circles indicate odor monitoring stations.