

**City of Plano, Texas
Russell Creek Interceptor – Odor Evaluation
Summary of Results**

Project No.: Plano 6674; APAI 0718-007-01

Date: February 29, 2016

Prepared For: Mr. Caleb Thornhill, Director of Engineering
City of Plano, Texas

Prepared By: Lynsy Nagle, P.E. (TX PE 113139)
Jeffrey E. Caffey, P.E.

cc: Mr. Gerald Cosgrove, PE, Director of Public Works, City of Plano, Texas
APAI File



EXECUTIVE SUMMARY

The City of Plano, Texas (City) has been receiving odor complaints from the residents of the Cross Creek Development in the north-northwest area of the City along the Russell Creek Interceptor. The City's wastewater collection system consists of residential lines and interconnecting segments feeding into the North Texas Municipal Water District's (NTMWD) system of lift stations and interceptors. The City has retained Alan Plummer Associates, Inc. (APAI) to determine the possible causes of the odors in the area and to provide options for how the odors might be addressed.

Weekly sampling and monitoring of the odor-related constituents was performed by APAI over a four-week period from late October through November 2015. The testing included liquid samples to measure the pH and total and dissolved sulfide concentrations in the wastewater, as well as continuous monitoring of the gaseous hydrogen sulfide (H₂S) concentrations inside the manholes or connections. H₂S is responsible for the rotten egg smell, typical of wastewater odors, and can be detected by humans at very low concentrations. The locations sampled consisted of manholes or vents noted to be in the vicinity of the complaints received, or were at connections where more turbulent flow conditions might be present.

The sampling data revealed that odors were being produced in the more turbulent connections of the interceptor and escaping from roof vents of nearby homes or other openings. Observations made during the sampling events also indicated hydraulic limitations at some of the connections sampled. Due to several rainfall events during the sample period, the flow and wastewater characteristics were varied and the typical or "worst-case" conditions could not be observed.

Wastewater collection system odors are typically addressed by measures such as chemical addition, physical or operational changes to the system to minimize the odor-producing conditions, or forced or

TECHNICAL MEMORANDUM

City of Plano Russell Creek Interceptor Odor Evaluation – Summary of Results

passive ventilation with foul air treatment. Chemical addition and physical or operational changes within the system by the City would require close coordination with the NTMWD and may not be feasible or cost-effective. The hydraulic limitations observed during the sampling events hinder ventilation within the system itself and would limit foul air treatment methods.

In order to address odors in the near-term, smoke testing could be performed to find the most prominent release points in the study area, and small, passive filters could be provided at those locations to address the localized odors. Such small, passive, localized treatment systems can be effective on a short-term basis, but it should be noted that the quantity and frequency at which the units or their media would need to be replaced is difficult to predict. Further evaluation is required to provide a more long-term or system-wide control method.

1 INTRODUCTION

The City of Plano (City) has been receiving odor complaints from residents in the Cross Creek Development along the Russell Creek Interceptor, located in the northern area of the City, near the Allen city limits. To address these complaints, the City has retained Alan Plummer Associates, Inc. (APAI) to evaluate the current odor-related conditions in the vicinity of the complaints.

This memorandum describes the sampling methodology used during the odor investigation, summarizes the sampling results and observations, provides an evaluation of the odor-related conditions, and provides typical options for addressing the fugitive odors observed.

2 BACKGROUND

The City's wastewater collection system consists of a network of gravity sewer mains, which receive wastewater from at least three of the North Texas Municipal Water District's (NTMWD) lift stations: (a) the Indian Creek Lift Station, located on far west edge of the City; (b) the Preston Road Lift Station, located near the intersection of Ohio Drive and Wild Briar Drive in the northwest corner of the City; and (c) the Upper White Rock Creek Lift Station, located near Spring Creek Parkway and Lorimar Drive. The pump stations are interconnected to provide multiple pathways within the City to reach the Wilson Creek Wastewater Treatment Plant (WCWWTP) northeast of the City limits in McKinney, or the Rowlett Creek Wastewater Treatment Plant (RCWWTP) in the southeast corner of the City.

The Preston Road Lift Station receives wastewater pumped directly from the Upper White Rock Creek Lift Station, via a 20-inch force main, as well as gravity flow received from Frisco and the northwest quadrant of the City. The Preston Road Lift Station has two discharge force mains: (1) one 24-inch discharge from Pumps No. 1 and 2 that feeds into the Russell Creek Interceptor; and (2) one 30-inch discharge from Pumps No. 3 and 4 to the WCWWTP. The Russell Creek Interceptor, which runs along the north side of Russell Creek, receives a majority of its flow from the Preston Road Lift Station, which splits flow to either the WCWWTP or the RCWWTP and terminates at a junction box near the Upper Rowlett Creek Lift

TECHNICAL MEMORANDUM

City of Plano Russell Creek Interceptor Odor Evaluation – Summary of Results

Station. At times, only Pumps 1 or 2 are online and the entire flow from the Preston Road Lift Station is directed to the Russell Creek Interceptor. The force mains, gravity mains, and lift stations are owned and operated by NTMWD, while the residential lines and interconnecting segments of the gravity interceptors are owned and maintained by the City.

The City does not feed any chemicals in the wastewater collection system. NTMWD maintains a chemical feed program to reduce odors and corrosion, but the chemical(s) fed and their dosages are not known. There are two passive carbon-media filters in place along the Russell Creek Interceptor: near manhole (MH) 5294 at the south end of Circleview Ct. (shown in Figure 1), and near MH 5515 at the southwest corner of the Pebble Creek Montessori School parking lot. The carbon filters treat odorous air that is released from their connections to the interceptor. They hold approximately 500 pounds of carbon media each, lasting an average of nine months before the media needs to be replaced, according to City personnel. The City also makes an effort to keep its manholes sealed to reduce the tendency for odors to be released.



Figure 1: Carbon Canister at Circleview Ct.

The City is in the process of installing Tideflex® in-line check valves at several of the residential lateral connections to the interceptor to reduce the ability for foul odors in the headspace of the interceptor to migrate back upstream and be released near the residences. The check valves that were existing or installed within the study area are listed below, with their estimated installation dates in Table 1.

Table 1: Check Valve Locations

Manhole ID	Description	Qty	Status
MH 5464	Midpoint of Circleview Ct.	1	Installed Nov. 3 rd or 4 th , 2015
MH 5477	1800 Block of Crescent Creek Ln.	2	Installed Oct. 29, 2015
MH 5485	7900 Block of Crescent Creek Ln.	2	Existing
MH 5514	Behind Pebble Creek Montessori School	2	Existing, in place approx. 4 years
MH 16292	North End of Barrymore Ln.	1	Existing

A check valve had previously been installed at MH 5294, on the south end of Circleview Ct. cul-de-sac; however, the main line was being surcharged and preventing the residential flow from going into the main interceptor. The check valve was removed after the City realized this was occurring. In 2012, the invert of the segment of pipe connecting from the midpoint of Circleview Ct. (MH 5464) to the south main connection (MH 5477) was raised to try to reduce the potential for surcharging at the connection at MH 5294. The flow condition at this connection is discussed further in Paragraph 4.7.

TECHNICAL MEMORANDUM

City of Plano Russell Creek Interceptor Odor Evaluation – Summary of Results

The 24-inch segment stretching from MH 5400 at the southwest end of 7700 Circleview Ct. to MH 5295 at the south end of Standish Ct. was plugged to reduce some of the turbulence and clogging that was occurring in that segment. Two weeks prior to the kick-off meeting of this study, debris was cleaned out of MH 5295 that had accumulated, likely as a result of the recent storm events.

3 SAMPLING PROGRAM

A sampling program was developed to quantify the odor potential of the interceptor and its connections in the study area. Each sampling location was monitored for a 1- to 2-week interval using Aptek Odalogs, which continuously monitor gaseous H₂S concentrations and temperature. The typical human recognition threshold for H₂S is 0.005 ppm, which is significantly less than the thresholds for other typical wastewater odors, such as ammonia or mercaptans. This makes H₂S the more prominent or recognizable source of wastewater odors, and so sampling was focused on quantifying the H₂S odors.

Liquid samples were collected each time a manhole was accessed, and the total and dissolved sulfide concentrations and pH were recorded. Table 2 provides details on the sampling methodologies used during this evaluation.

Table 2: Sampling Methodologies

Type	Methodology	
	Test Method/Instrument	Detection Limit
H ₂ S (Continuous)	Aptek Odalog	(a) 0-50 ppm range unit, 4% Full Scale (b) 0-200 ppm range unit, 1% Full Scale (c) 0-1000 ppm range unit, 1% Full Scale
Dissolved Sulfide	LaMotte Sulfide Test Kit (Pomeroy Method)	0-18 milligrams per liter (mg/L), without dilution
pH	pH Paper	0 to 14

The monitoring program consisted of four sampling events to install or relocate monitoring equipment and to collect grab samples. Continuous monitoring was conducted over a three-week period, with data collected and/or monitors relocated each week. Sampling events took place on October 27th, November 3rd, November 10th, and November 17th, 2015.

The initial sampling locations were selected with consideration to City input and historical odor complaints. Because H₂S is heavier than air, odors often settle in low-lying areas after being emitted from a manhole or air release valve, then are dispersed and potentially perceived when breezes start again after being still. Odalog measurements within the manhole headspaces can also reveal odor trends that may be related to the wastewater conditions and/or system operation. Therefore, initial focus on monitoring was in manholes where the complaints were most frequent.

TECHNICAL MEMORANDUM

City of Plano Russell Creek Interceptor Odor Evaluation – Summary of Results

Ambient observations within the first week of sampling were that the odors were coming at times from above ground, rather than from the manholes or other low-lying areas. As a result, Odalogs were moved to rooftop sewer vents where access was allowed by the home owners.

Table 3 lists the sampling locations and the dates of when the Odalogs were in place. Figure 2 shows the sampling locations and the extents of the study area.

Table 3: Sampling Locations

Site No.	Manhole ID	Location Description	Odalog Dates
1	16292	North End of Barrymore Ln. Cul de Sac	11/3 - 11/10
2	5514	Behind Pebble Creek Montessori School Playground	11/3 - 11/17
3	5486	SE Corner of Chattham Ct.	11/3 - 11/10
4	5477	West Intersection of Crescent Creek Ln & Linkwood	11/10 - 11/17
5	Roof Vent 1	SE 2 nd Story Bathroom Roof Vent at 1808 Crescent Creek Ln.	11/10 - 11/24
6	5481	West Intersection of Crescent Creek Ln & Pinkerton	11/3 - 11/10
7	5294	South End of Circleview Ct.	10/27 - 11/3
8	5464	Midpoint of Circleview Ct.	11/10 - 11/17
9	Roof Vent 2	NE Corner Roof Vent at 7712 Circleview Ct.	11/10 - 11/17
10	5465	South End of Radford Circle	11/3 - 11/17
11	5400	SW Corner of Front Yard at 7700 Circleview Ct.	10/27 - 11/3
12	5401	South End of Hedgcoxe Elementary Sports Field	10/27 - 11/3
13	3738	Hoblitzelle Park Near Intersection of Prescott & Mullins	11/3 - 11/17 ^a
14	3762	Hoblitzelle Park Near Intersection of Baxter & Mullins	11/3 - 11/10
15	18847	Junction Box Near Intersection of Alma & Spicewood	11/3 - 11/10

^a At MH 3738, an Odalog was in place from 11/3/2015 to 11/17/2015, but the unit was submerged and damage to the unit caused the second week of data to be lost.

Figure 2: Sampling Locations



On October 27th, three Odalogs were placed in the field, while five additional units were being shipped from a rental facility. Due to inclement weather conditions, placement of additional Odalog units within the first week of sampling was postponed. Several rainfall events took place during the study period. The dates of these events and the total rainfall quantity for each date, as measured by the City, are listed below:

- October 30, 2015: 1.59 inches
- October 31, 2015: 0.64 inches
- November 7, 2015: 0.15 inches
- November 15, 2015: 0.85 inches
- November 16, 2015: 0.51 inches
- November 17, 2015: 1.12 inches

Following completion of the sampling, operating data for the pumps at the Preston Road Lift Station was obtained from NTMWD. Individual pump status (on/off) was compared to the Odalog data. The results of this comparison are discussed in the following paragraphs. Each of the four pumps at the lift station is rated for a maximum flow of 7,900 gallons per minute (gpm) and equipped with a variable frequency drive.

4 RESULTS & OBSERVATIONS

This section includes a summary of neighborhood reconnaissance and data collected during the sampling period. Table 4 summarizes the Odalog monitoring and liquids sampling results collected during the study.

The liquid total and dissolved sulfide concentrations were relatively low, compared to those typical of the influent concentrations at a municipal wastewater treatment facility (typical range >3 mg/L). At an average pH of 7.5, the percentage of the sulfide that is present as aqueous H₂S is approximately 25 percent. Aqueous H₂S is the species with the highest tendency to volatilize among its relative HS⁻ and S²⁻ species, and its percentage increases as the pH is reduced. However, it should be noted that any presence of sulfide species can indicate the potential for odors within the system.

As the recognition threshold for gaseous H₂S is typically around 0.005 parts per million (ppm), the Odalog results for each site reveal that the gaseous H₂S concentrations are at high enough ranges to produce nuisance odors.

The pump status and number of pumps online at the Preston Road Lift Station are represented between the horizontal lines in the graphs provided in the following sections. Pumps No. 1 and 2 (in purple) are shown separately from Pumps No. 3 and 4 (in orange) in the graphs, since Pumps No. 1 and 2 send flow to the Russell Creek Interceptor.

Table 4: Summary of Sampling Results

Site ID	Manhole No. or Description	Sample Quantity	Liquids Samples			Gaseous H ₂ S Concentrations (ppm)				
			Avg. Total S- (mg/L)	Avg. Diss S- (mg/L)	Avg. pH (std units)	Avg.	Min.	Max.	Std.Dev.	95 th Perc.
1	16292	2	0.85	0.75	7.5	2.81	0.00	145	20.8	67.0
2	5514	3	0.47	0.33	7.7	17.1	0.00	133	15.2	44.4
3	5486	2	--	--	--	0.00	0.00	0.00	0.00	0.00
4	5477	3	--	--	--	2.91	0.00	42.0	3.56	9.00
5	Roof Vent 1	2	--	--	--	0.01	0.00	0.40	0.05	0.10
6	5481	2	--	--	--	0.00	0.00	0.00	0.00	0.00
7	5294	2	0.40	0.3	7.3	48.9	0.00	272	47.7	145
8	5464	2	--	--	--	10.9	0.00	174	15.4	38.0
9	Roof Vent 2	2	--	--	--	3.58	0.00	132	8.04	18.0
10	5465	4	--	--	--	0.38	0.00	58.8	2.47	0.90
11	5400	2	0.15	0.10	7.8	2.89	0.10	71.4	11.2	4.53
12	5401	2	0.18	Trace	7.3	40.4	0.00	2.81	49.7	158
13	3738	3	0.25	0.23	7.4	0.06	0.00	2.00	0.25	1.00
14	3762	2	0.60	0.43	7.5	0.18	0.00	2.00	0.42	1.00
15	18847	2	0.05	Trace	7.3	0.00	0.00	0.00	0.00	0.00

4.1 Site #1, MH 16292 – North End of Barrymore at Cul de Sac

MH 16292 was selected because it is a tee connection assumed to be prone to turbulence and odor-producing conditions, and was within a reasonable distance upstream to provide a baseline for the conditions entering the study area. MH 16292 is the closest location to the Preston Road Lift Station of the sites sampled. The fluctuations in the Odalog data (Figure 3) appear to correlate with the starting and stopping of a second pump at the lift station. During this period of the testing, only Pumps 1 and 2 were operating.

Figure 3: Site #1, MH 16292 Odalog Measurements, Precipitation, and Pump Operation

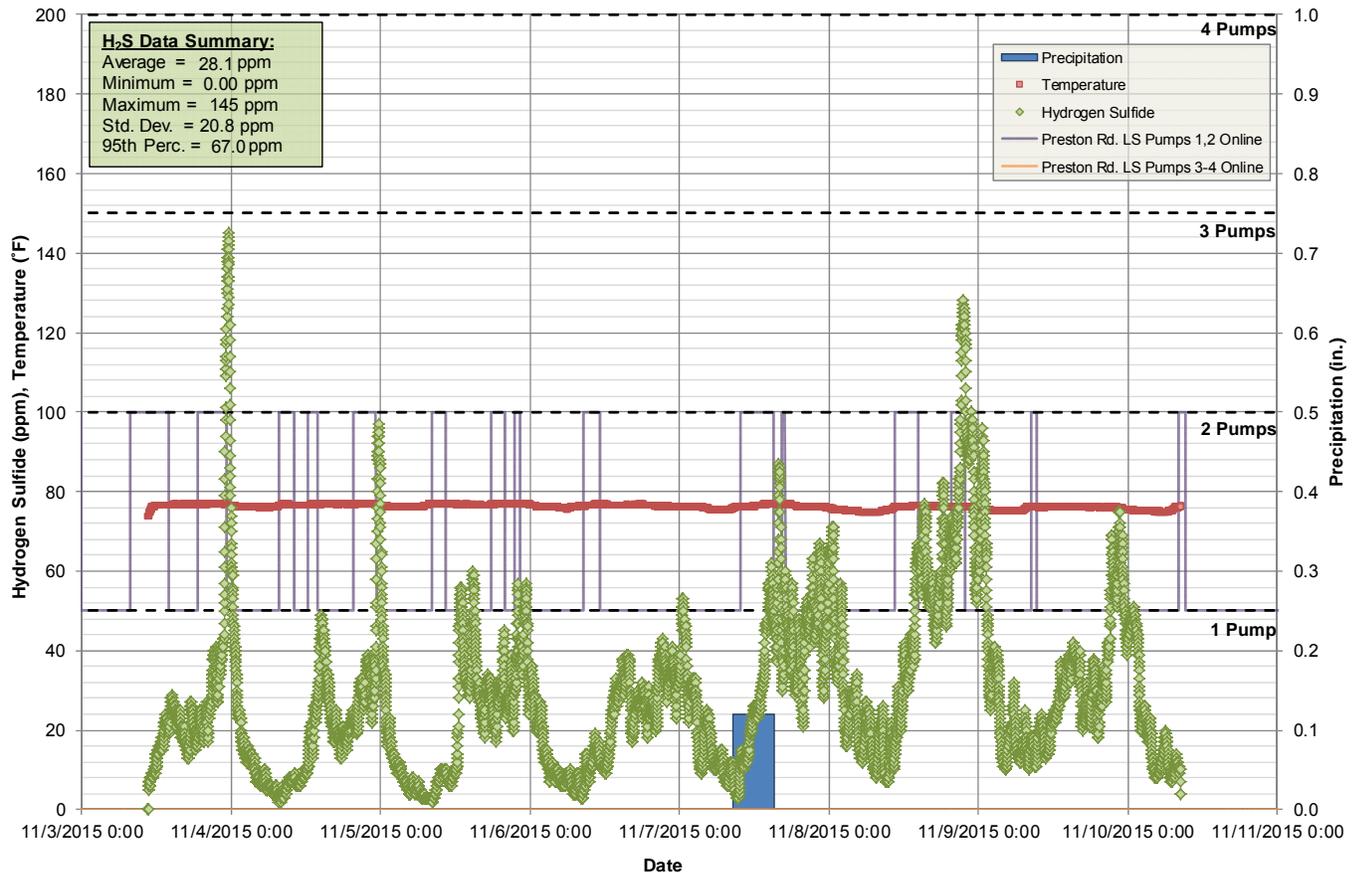


Figure 4: Site #1, MH 16292, Looking South

4.2 Site #2, MH 5514 – Behind Pebble Creek Montessori School

The City has received odor complaints in the vicinity of MH 5514 in the past, and because it is a drop manhole, it represents another site that may be prone to fugitive odors due to turbulence. Inline check valves were installed at this location approximately four years ago, and the upper penetration of the drop connection from the Montessori School was plugged at the same time.

Strong H₂S odors were present each time the manhole was opened. The water surface in the manhole was typically within a foot of the invert of the bottom penetration or higher, with noticeable swirling and turbulence. Corrosion of the manhole cover could potentially be attributed to the release of corrosive odorous gases at this location, as shown in Figure 5. The inlet from the Montessori School was submerged at the time the photo was taken in Figure 6.

Figure 5: Site #2, MH 5514 Corrosion on Cover

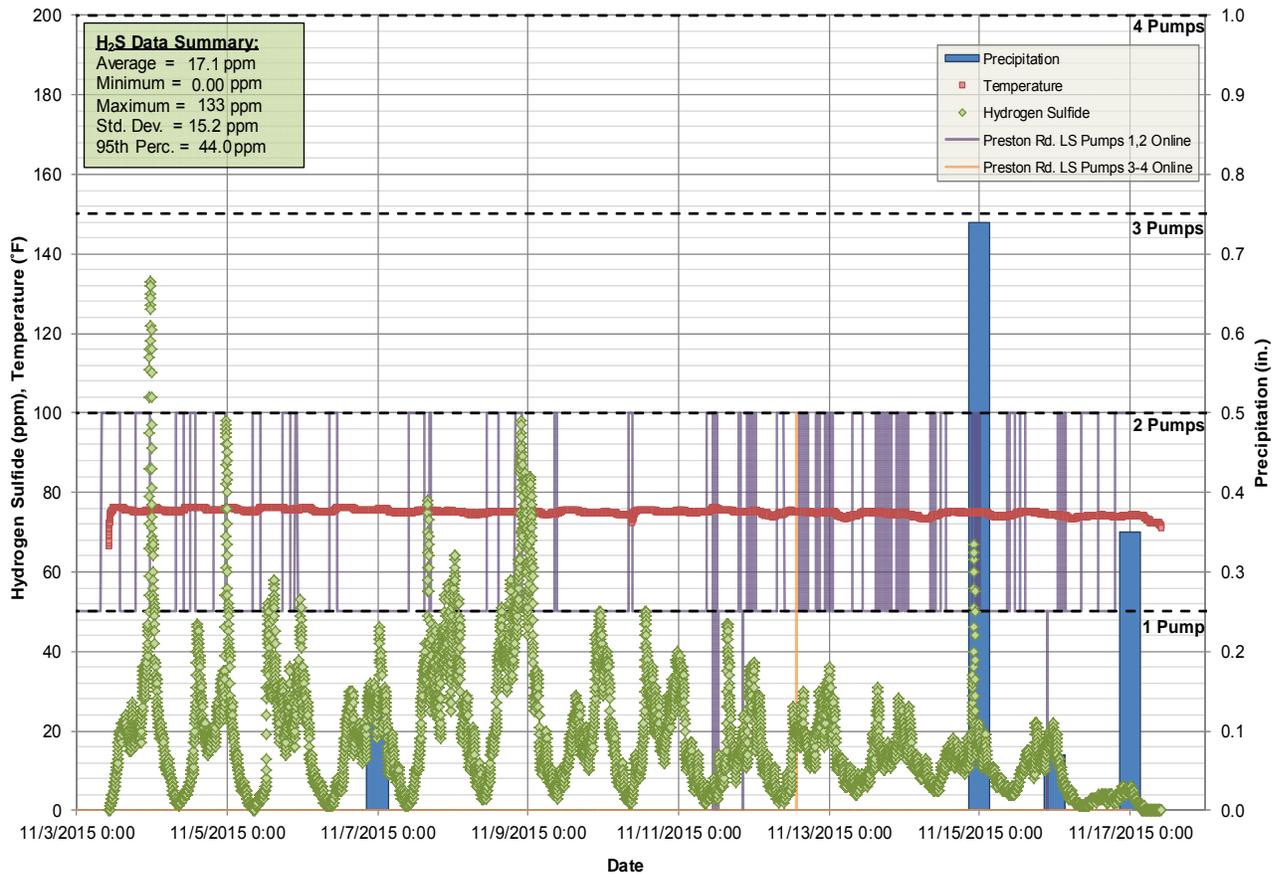


Figure 6: Site #2, MH 5514 Submerged Inlet



A two-week data set was collected for Site #2, as presented in Figure 7. Comparing the results from Site #1 (MH 16292) and Site #2 (MH 5514) from November 3rd through the 10th indicates the foul air is traveling with the wastewater flow as expected. The second week appears to have had more frequent starts and stops of the second online pump at the Preston Road Lift Station. Although the latter part of the data set shows a reduction in the H₂S concentrations that are likely attributed to the rainfall, a noticeable decrease in the concentrations prior to the rain events could also be related to the more frequent pump starts/stops (possibly due to less stagnant conditions in the wet well).

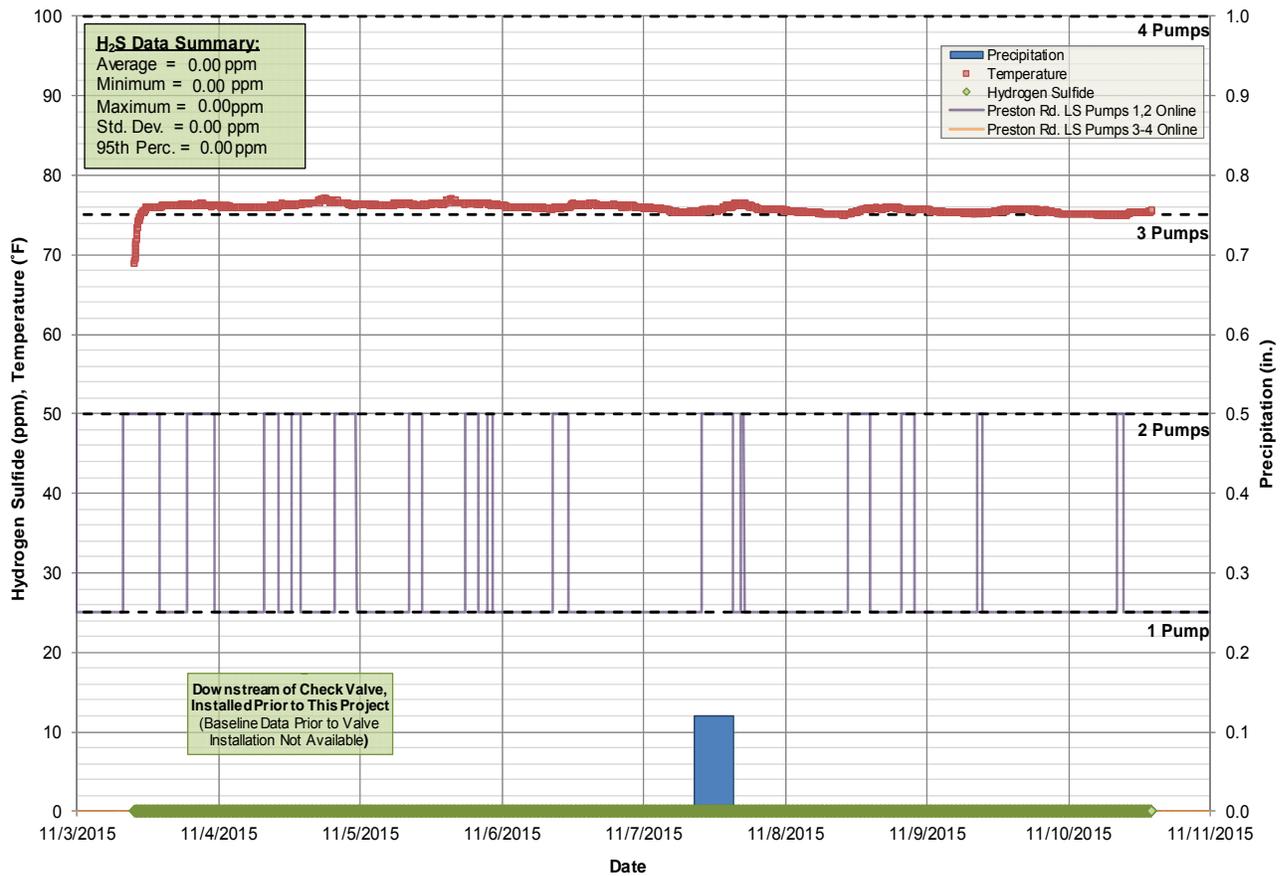
Figure 7: Site #2, MH 5514 Odalog Results, Precipitation, and Pump Operation



4.3 Site #3, MH 5486 – SE Corner of Chattham Ct.

This site was selected because of its location relative to the Montessori School and the existing check valve installed in the downstream lateral, near the intersection of Georgetown Dr. and Chattham Ct. Wastewater was not flowing through this manhole at the time of sampling, and the Odalog results confirm that the check valve is preventing foul air from migrating into this segment, as shown in Figure 8.

Figure 8: Site #3, MH 5486 Odalog Results, Precipitation, and Pump Operation



4.4 Site #4, MH 5477 – West Intersection of Crescent Creek Ln. & Linkwood

This location was selected because of the check valves that were installed on October 29th. During the check valve installation (around 2:00pm), strong ambient H₂S odors were observed by City personnel. Odors were also noted in several instances by residents and APAI during the study period, particularly around the addresses of 1800 to 1808 Crescent Creek Ln. Odors seemed to linger between the adjacent homes along the south side of the street (or back alley area). It’s unknown whether or not odors have increased with the installation of the check valves at this location.

Odors were observed on November 10th at the intersection of Georgetown Dr. and Crescent Creek Ln., when a faint breeze was coming from the south. This intersection is the midpoint along the Russell Creek Interceptor, where each of the two nearest upstream residential laterals have check valves installed, illustrated in Figure 9.

Similar to MH 5514 (behind Pebble Creek Montessori School) at times where there are more frequent starts/ stops of the Preston Road Lift Station pumps, there’s a noticeable decrease in the overall H₂S concentrations. The Odalog results for this location are shown in Figure 11.

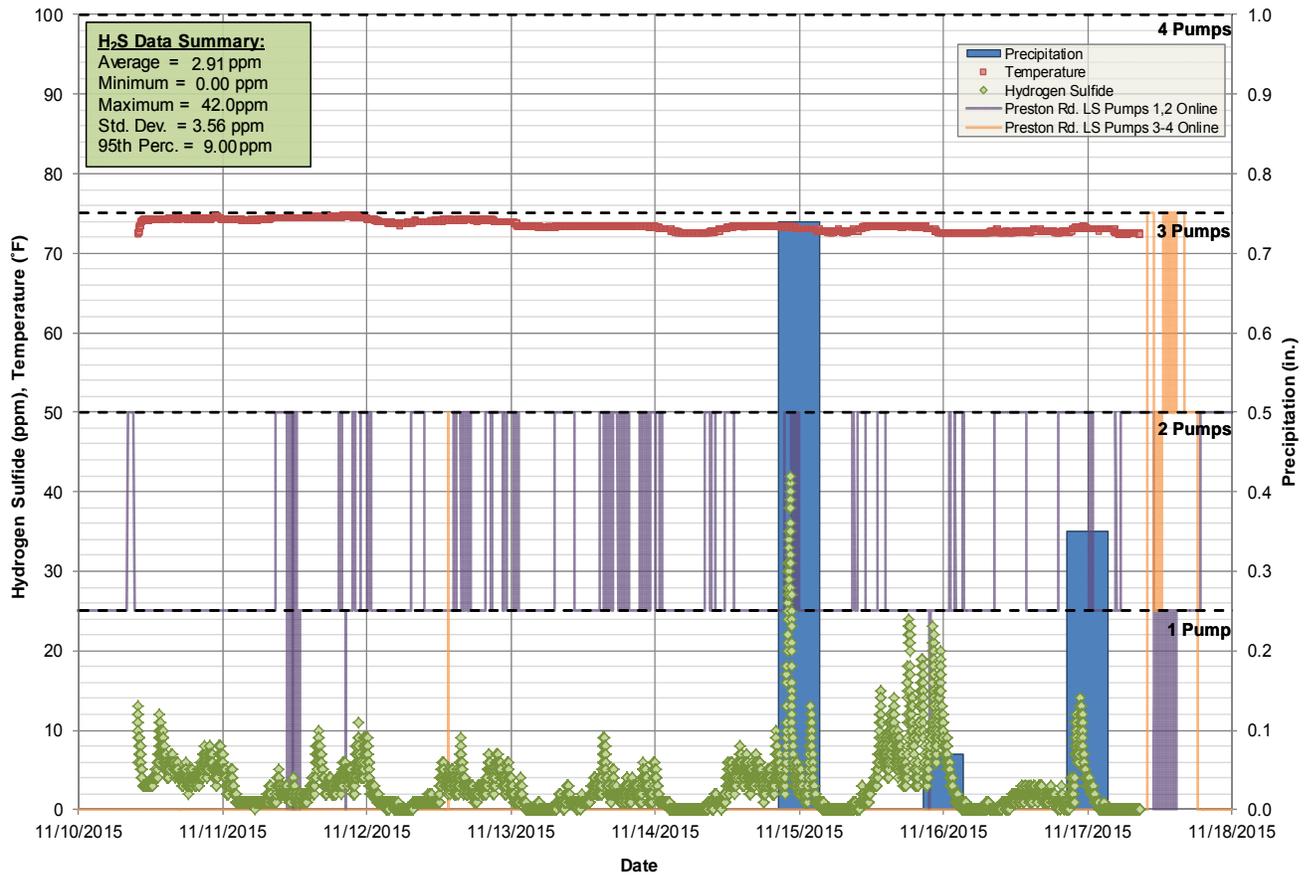


Figure 9: Location of Odors Near Georgetown Dr. & Crescent Creek Ln.



Figure 10: Site #4, MH 5477 Looking North

Figure 11: Site #4, MH 5477 Odalog Results, Precipitation, and Pump Operation



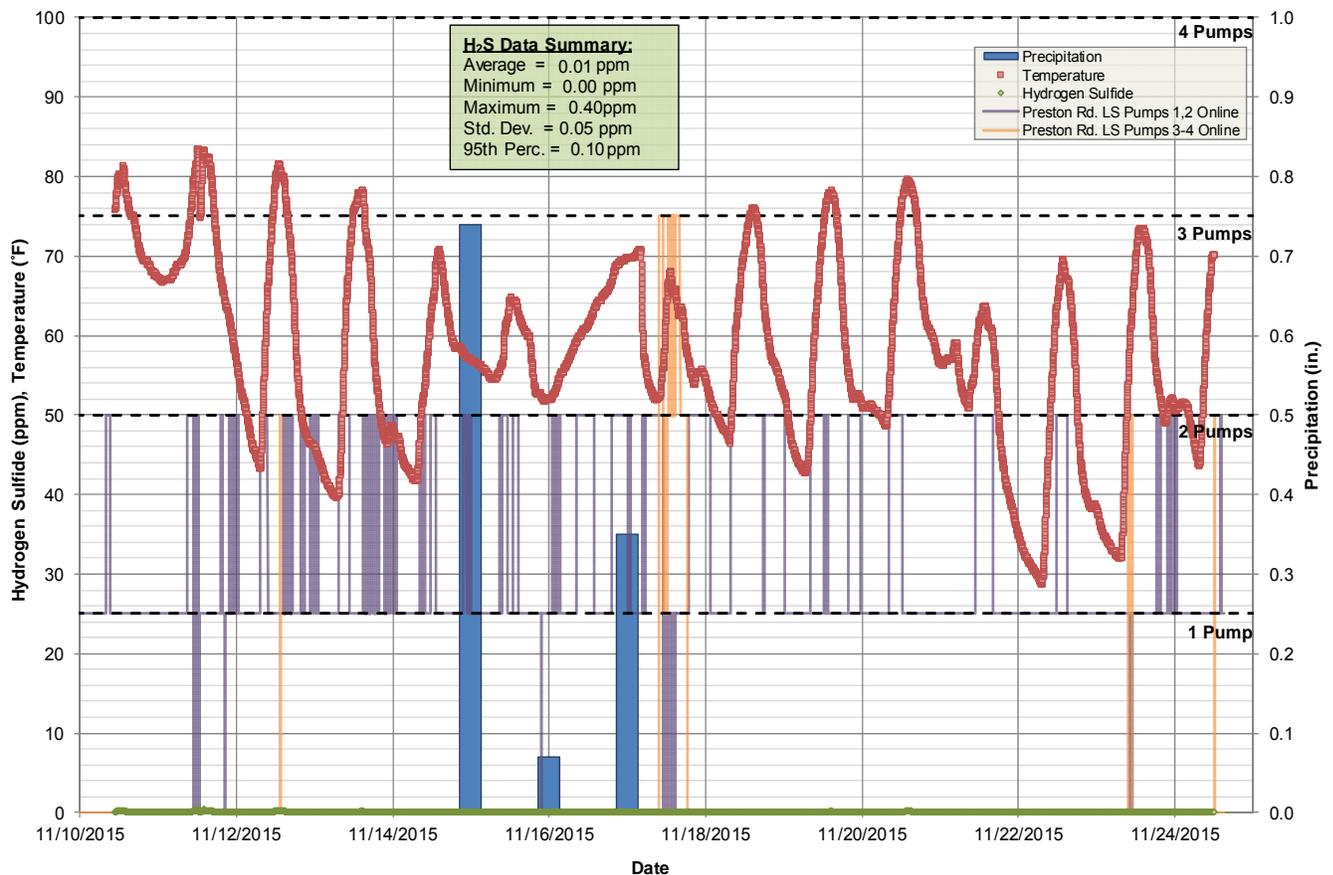
4.5 Site #5, Roof Vent 1 – 1808 Crescent Creek Ln. Upstairs Bathroom Rooftop Vent

The homeowner at 1808 Crescent Creek Ln. allowed the placement of an Odalog on the vent stack of the upstairs bathroom, near the back of the home. Because gaseous H₂S is heavier than air, the Odalog results from the second floor vent were expected to be on a lesser scale than if it were placed on a one-story vent. The homeowner indicated that odors are common in that area and are also sometimes a nuisance inside their home, namely the upstairs bathroom.



Figure 12: Odalog Inside PVC Pipe on Site #5 1808 Crescent Creek Ln. 2nd Story Bathroom Vent

Figure 13: Site #5, Crescent Creek Ln. Roof Vent Odalog Results, Precipitation, and Pump Operation

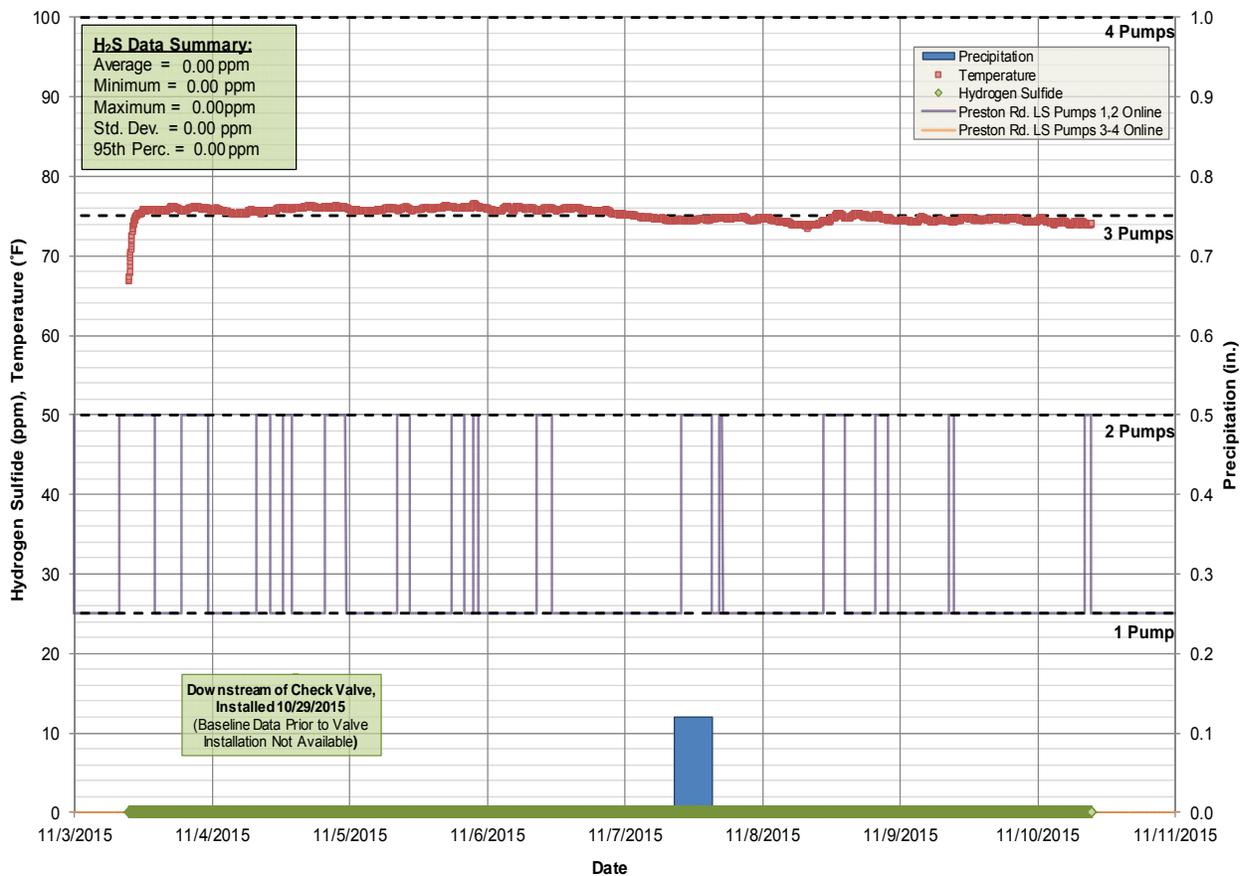


Although the odors measured at the roof vent are very low at 0.40 ppm (Figure 13), the readings were more than eight times the human perception range despite the longer path taken out of the second-story vent. It can be assumed that the adjacent one-story homes are capable of releasing odors with significantly higher concentrations, which could be responsible for the foul odors in this immediate area.

4.6 Site #6, MH 5481 – West Intersection of Crescent Creek Ln. & Pinkerton

MH 5481 is located directly upstream of MH 5477 along Crescent Creek Ln. Although data was not collected prior to the installation of the check valve in MH 5481, it can be assumed that the difference between the H₂S concentrations in this manhole and the adjacent MH 5477 can be attributed to the check valve separating them. Flow was not present at the times of the liquid sampling events for this location.

Figure 14: Site #6, MH 5481 Odalog Results, Precipitation, and Pump Operation



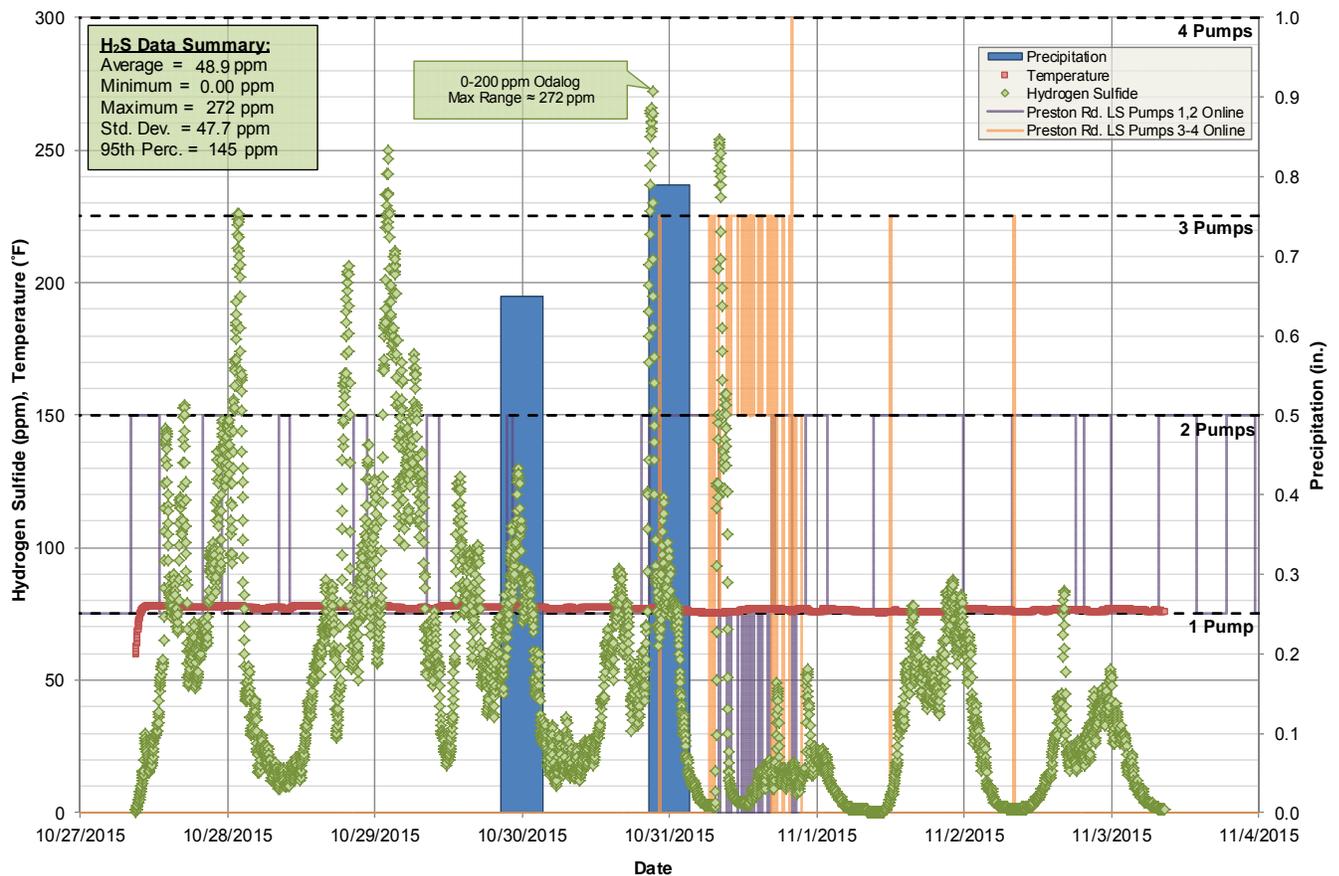
4.7 Site #7, MH 5294 – South End of Circlevue Ct.

This location was selected as one of the first sampling locations, because it is in the immediate vicinity of one of the carbon canisters and is a location from where several odor complaints have originated over the last several years. On the first day of sampling on October 27th, flows were moderate to low when the manhole was first opened around 8:10 am. Shortly thereafter, the flows increased and the inlet to the manhole from the interceptor became submerged. The increased flow volume is related to an additional pump starting up at the Preston Road Lift Station at 8:17am, according to the Preston Road Lift Station operational data. Figure 15 shows the conditions inside the manhole at 8:42 am. Turbulence and countercurrents because of the submerged outlet are visible.



Figure 15: Site #7 MH 5294 Looking Northwest

Figure 16: Site #7, MH 5294 Odolog Results, Precipitation, and Pump Operation



4.8 Site #8, MH 5464 – Midpoint of Circlevue Ct.

On the afternoon of October 26th, odors were observed in the northern half of Circlevue Ct., starting near the middle of the street, and ending at the intersection of Circlevue Ct. and Georgetown Dr. At the time of the observation, the wind was blowing from the southeast, but no odors were in immediate vicinity of the carbon filter enclosure or manholes at the far south end of the street (MH 5294 and MH 5400). The

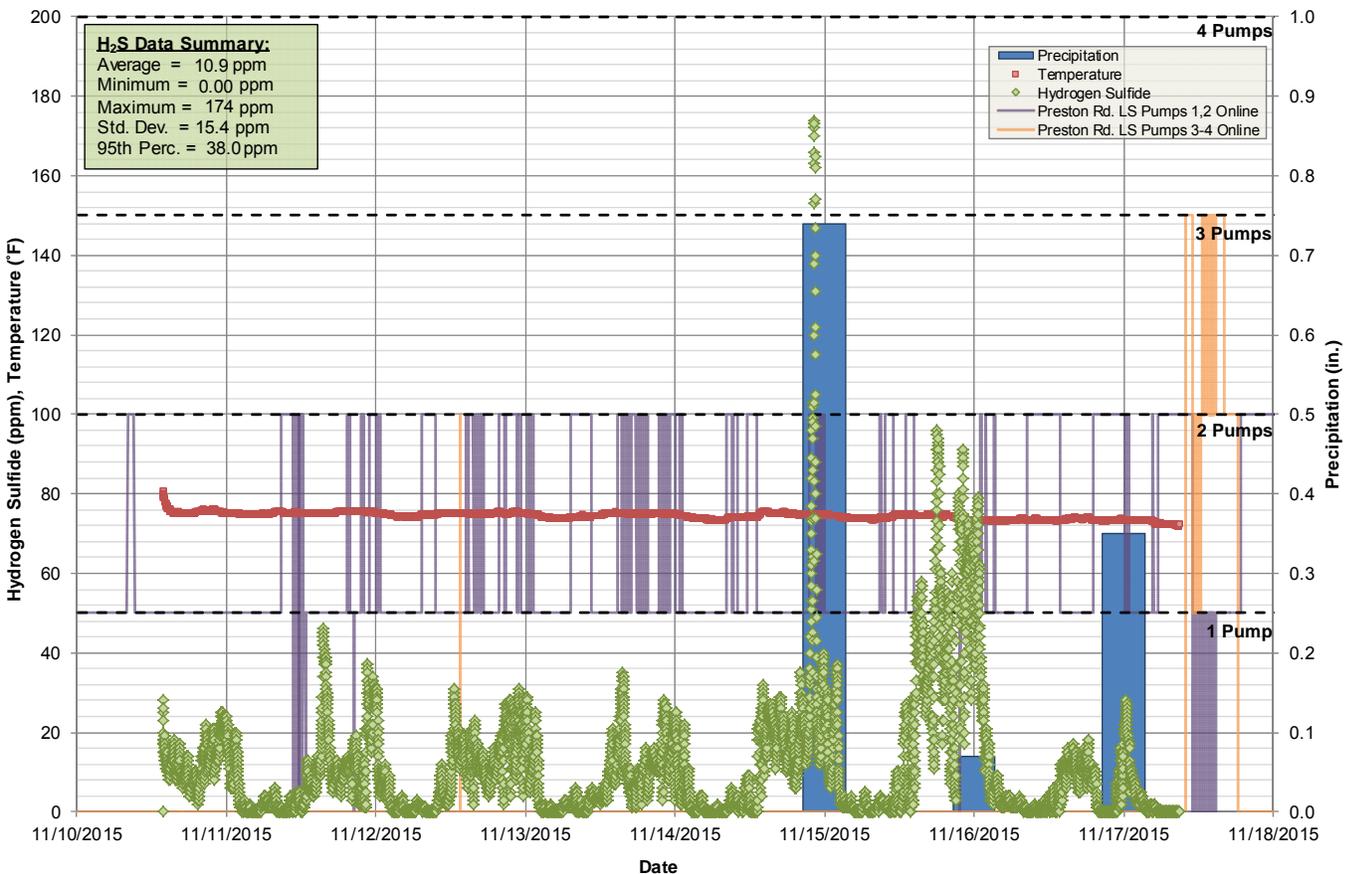
wind path seemed to be coming from between the houses near 7712 Circlevue Ct., and it was believed that odors may have been released from the rooftop sewer vents, with dispersion inhibited by the trees directly over the homes.



On November 4th, a check valve was installed in this manhole to reduce odors flowing into the lateral from Radford Circle to the west. Figure 17 shows the check valve in MH 5464.

Figure 17: Site #8, MH 5464 Looking North-Northwest on November 10th

Figure 18: Site #8, MH 5464 Odalog Results, Precipitation, and Pump Operation



When the Odalog was retrieved from MH 5264, the unit was partially submerged. The wastewater was not flowing, and was not sampled. It was assumed that the stagnant condition at this location was due to the downstream MH 5294 being surcharged, though this assumption was not confirmed. A significant rainfall event occurred over the last three days of the monitoring period of this site. Figure 19 shows the standing water inside MH 5264.



Figure 19: Site #8, MH 5264 Looking Northwest on November 17th

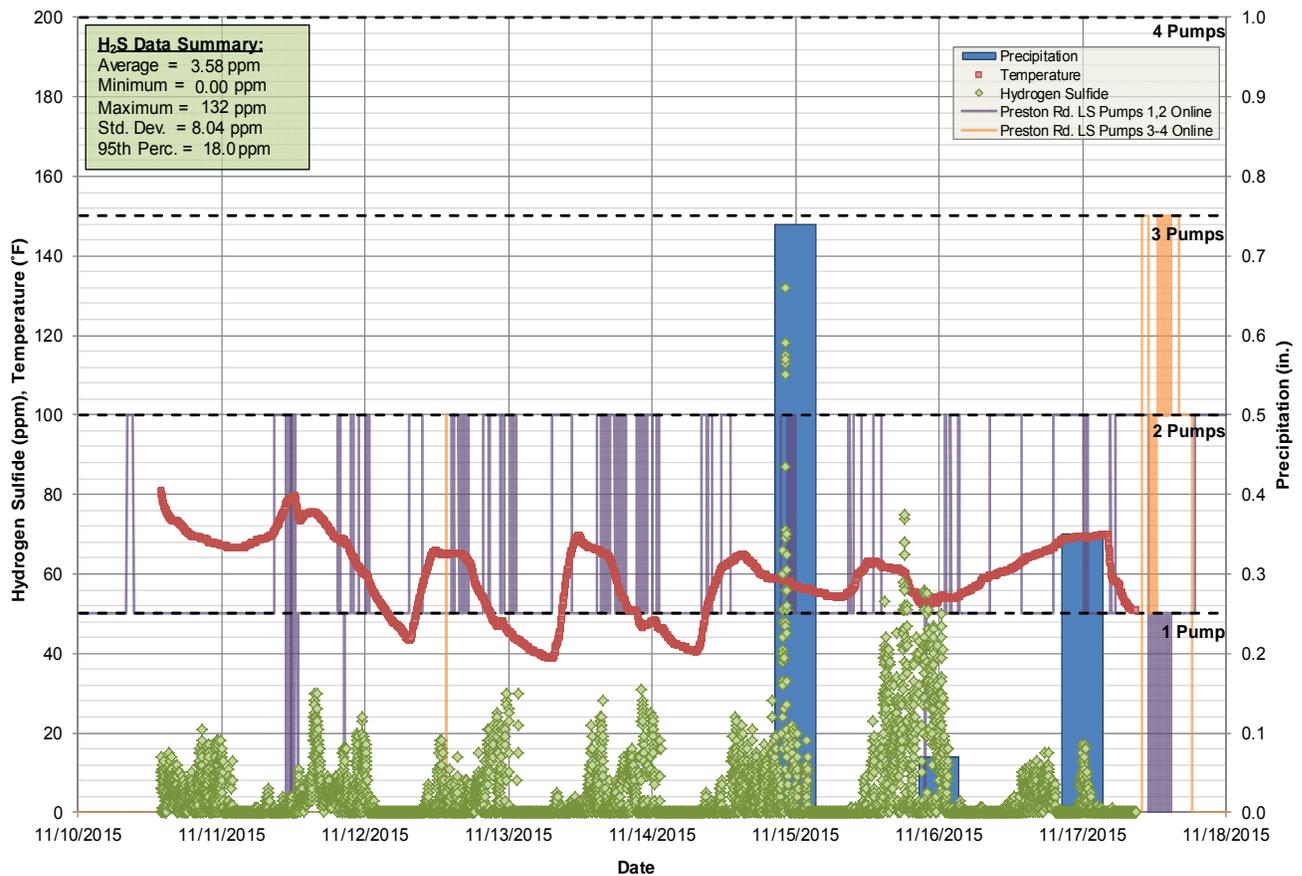
4.9 Site #9, Roof Vent 2 – 7712 Circleview Ct. First Floor Roof Vent at Northeast Corner

Because of the observations previously discussed in Paragraph 4.8, the homeowner was approached for permission to place an Odalog on their roof (Figure 20).

Figure 20: Site #9, Odalog Inside PVC Pipe on 7712 Circleview Ct. NE Rooftop Vent



Figure 21: Site #9, Circleview Ct. Roof Vent Odalog Results, Precipitation, and Pump Operation

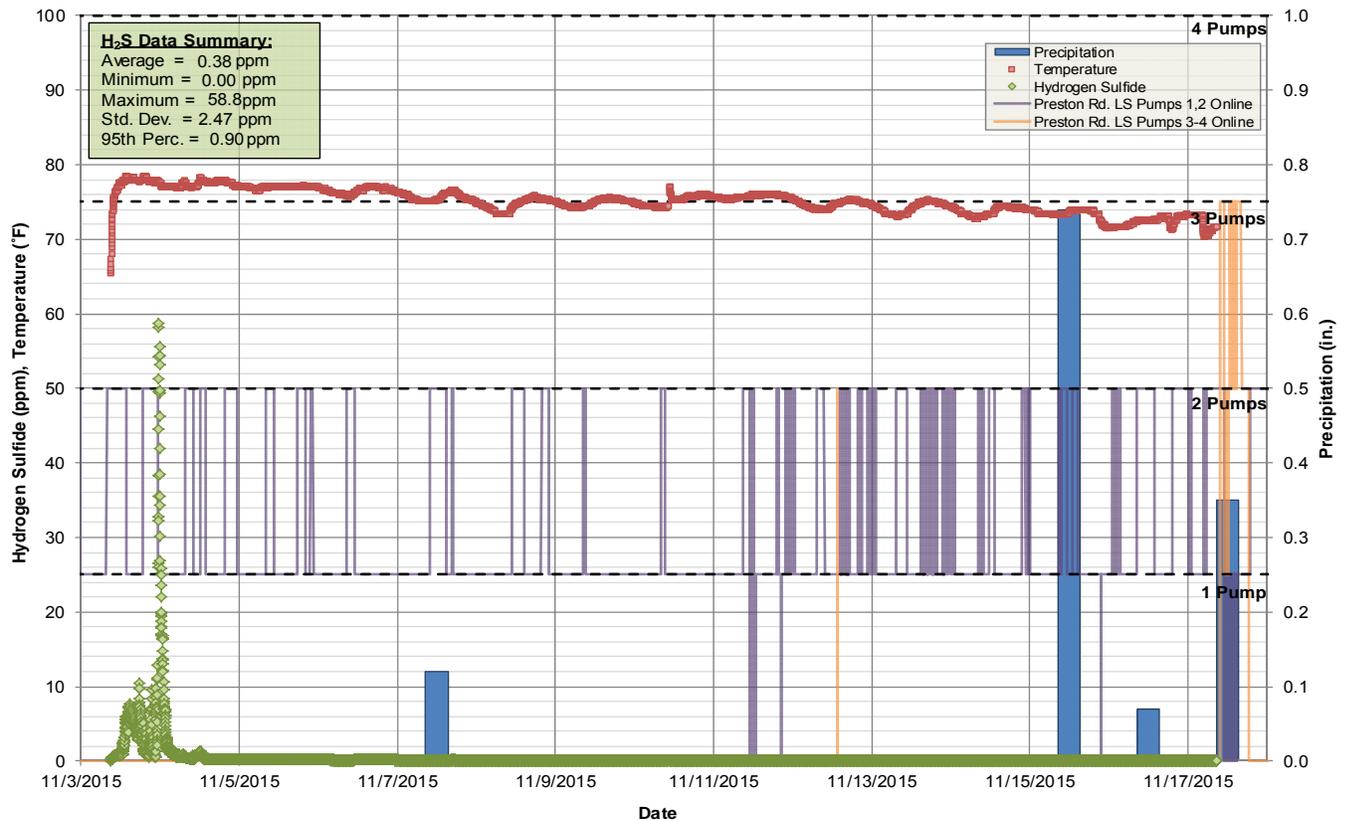


The fluctuations in the H₂S concentrations measured at this location are similar to those measured at MH 5464, directly downstream. Because of these similarities, it can be assumed that the foul air that does not migrate further upstream toward the segment terminating at the north end of Circleview Ct. is released in the vents in the immediate vicinity. On several occasions, odors were observed along the length of Circleview Ct.

4.10 Site #10, MH 5465 – South End of Radford Circle

On the afternoon of November 3rd, odors were observed coming from the entrance of Radford Circle or from between the houses at the corner, but not the manholes in the street. Residents also indicated prior to sampling beginning that odors seem to come from between the homes and are worse when the wind is from the south or southeast. Residents’ observations after the installation of the check valve at MH 5264 (midpoint of Circleview Ct.) were not available at the time this memorandum was prepared.

Figure 22: Site #10, MH 5465 Odalog Results, Precipitation, and Pump Operation



The check valve in the upstream MH 5264 (midpoint of Circleview Ct.) appears to have a significant effect on preventing the odors from flowing into this location at MH 5465. Another Odalog in the immediate vicinity was not available for the same time period of the spike on November 3rd, before the check valve was installed. However, the Odalog results at MH 5514 (behind Pebble Creek Montessori School) show a spike at the same time in the range of 145 ppm.

The turbulence observed upstream of the Radford Circle and Circleview Ct. laterals, primarily at the south end of Circleview Ct. (MH 5294) and in the downstream manhole in the front yard of 7700 Circleview Ct. (MH 5400), may be responsible.

At the time when the Odalog was retrieved, there was standing water in the recessed area of the manhole floor, assumed to be related to the submerged conditions noted in Paragraph 4.8.



Figure 23: Site #10, MH 5465 on November 17th

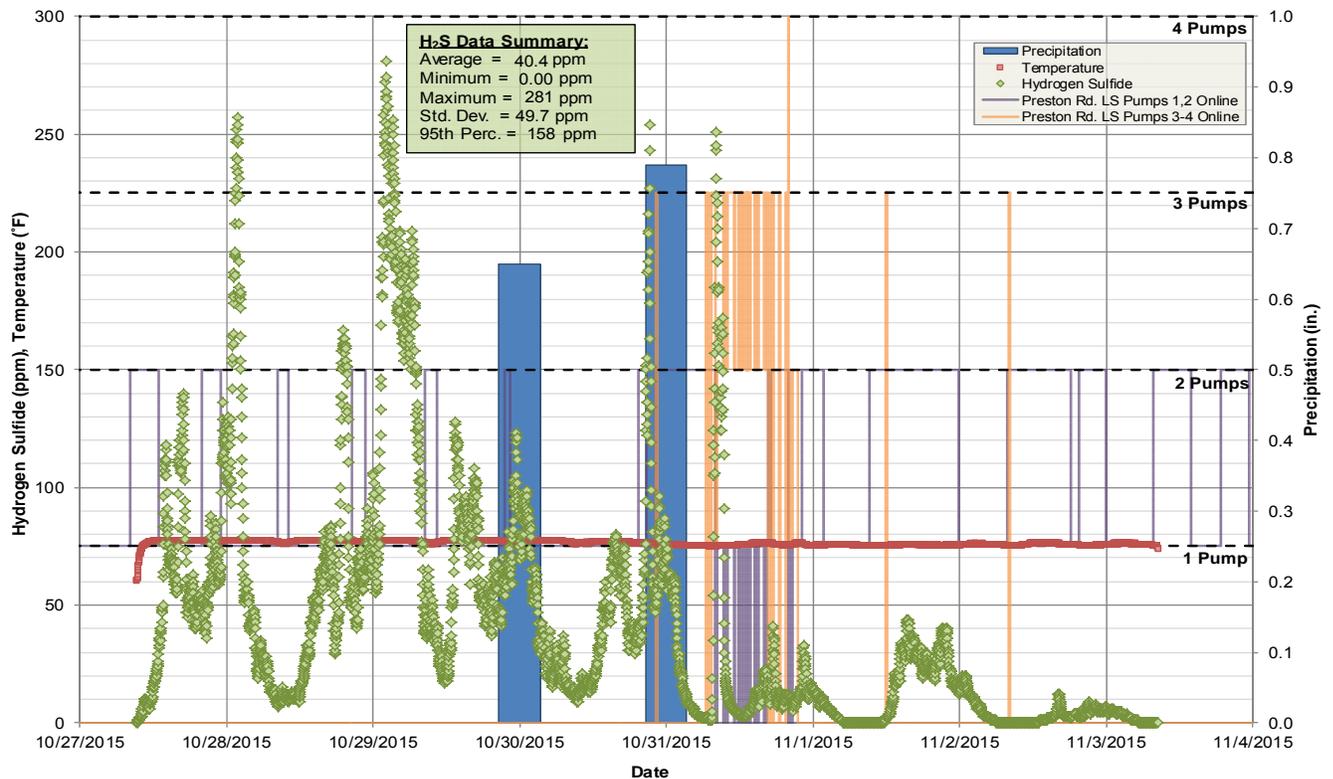
4.11 Site #11, MH 5400 – SW Corner of Front Yard at 7700 Circlevue Ct.

The conditions at MH 5400 were very similar to those observed at MH 5492 at the south end of Circlevue Ct. Figures 24 and 25 show the difference in the water surface before and after the increase in flow, with the photos taken at 8:21 am and 9:20 am, respectively. According to the City, the object in the middle of MH 5400 is part of the plug installed when the segment from MH 5400 to MH 5295 was plugged.



Figure 24: Site #11, MH 5400 at 8:21 am Figure 25: Site #11, MH 5400 at 9:20 am

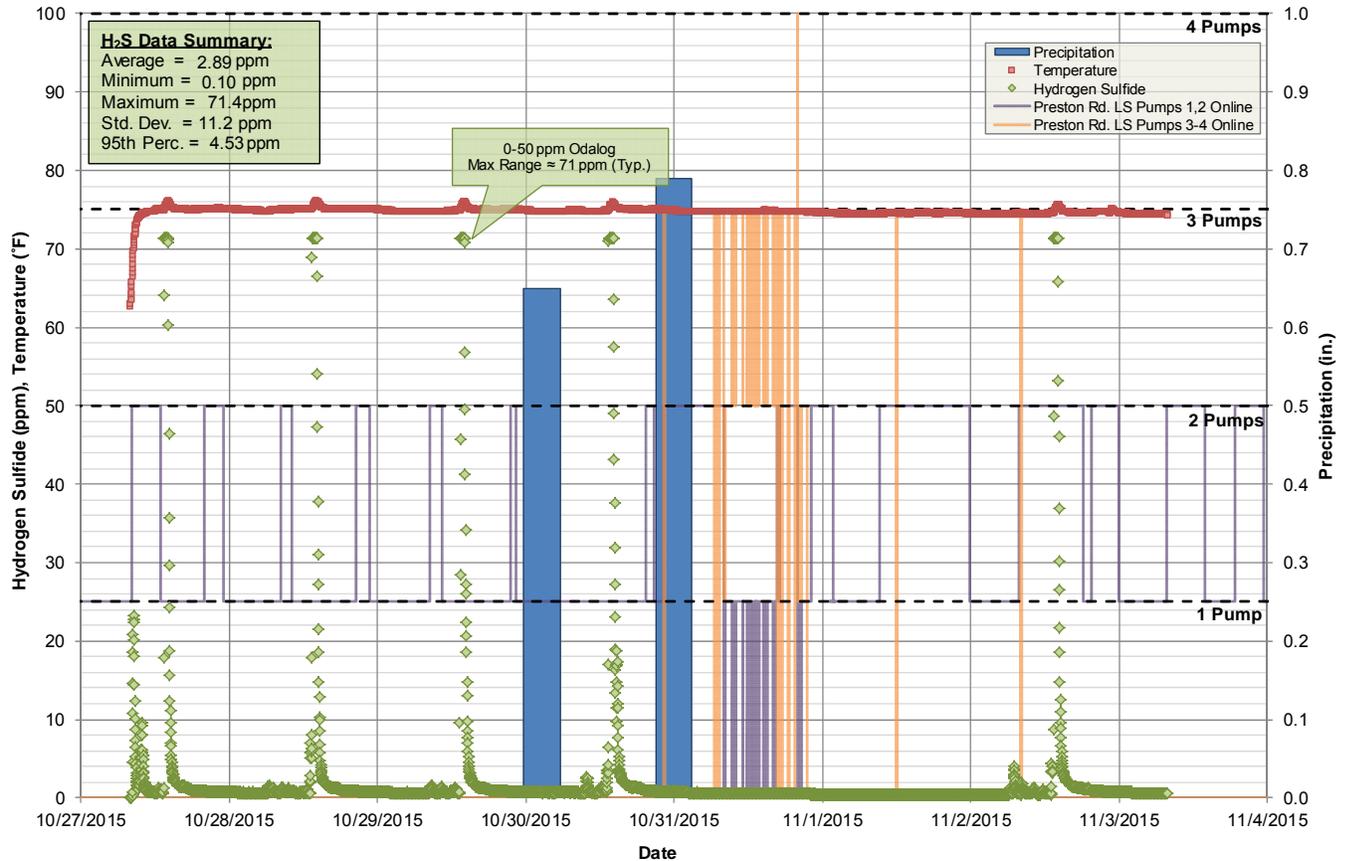
Figure 26: Site #11, MH 5400 Odolog Results, Precipitation, and Pump Operation



4.12 Site #12, MH 5401 – South Edge of Hedgcoxe Elementary Sports Field

This location was selected because of historical odor complaints in the vicinity, where it has been the assumed culprit, as it is located directly alongside the walk path from Hoblitzelle Park. It is also the endpoint of the plugged segment stretching from MH 5400 (front yard at 7700 Circleview Ct.). Since the upstream plug has been installed, this manhole only receives flow from the upstream residential laterals and Hedgcoxe Elementary school.

Figure 27: Site #12, MH 5401 Odalog Results, Precipitation, and Pump Operation



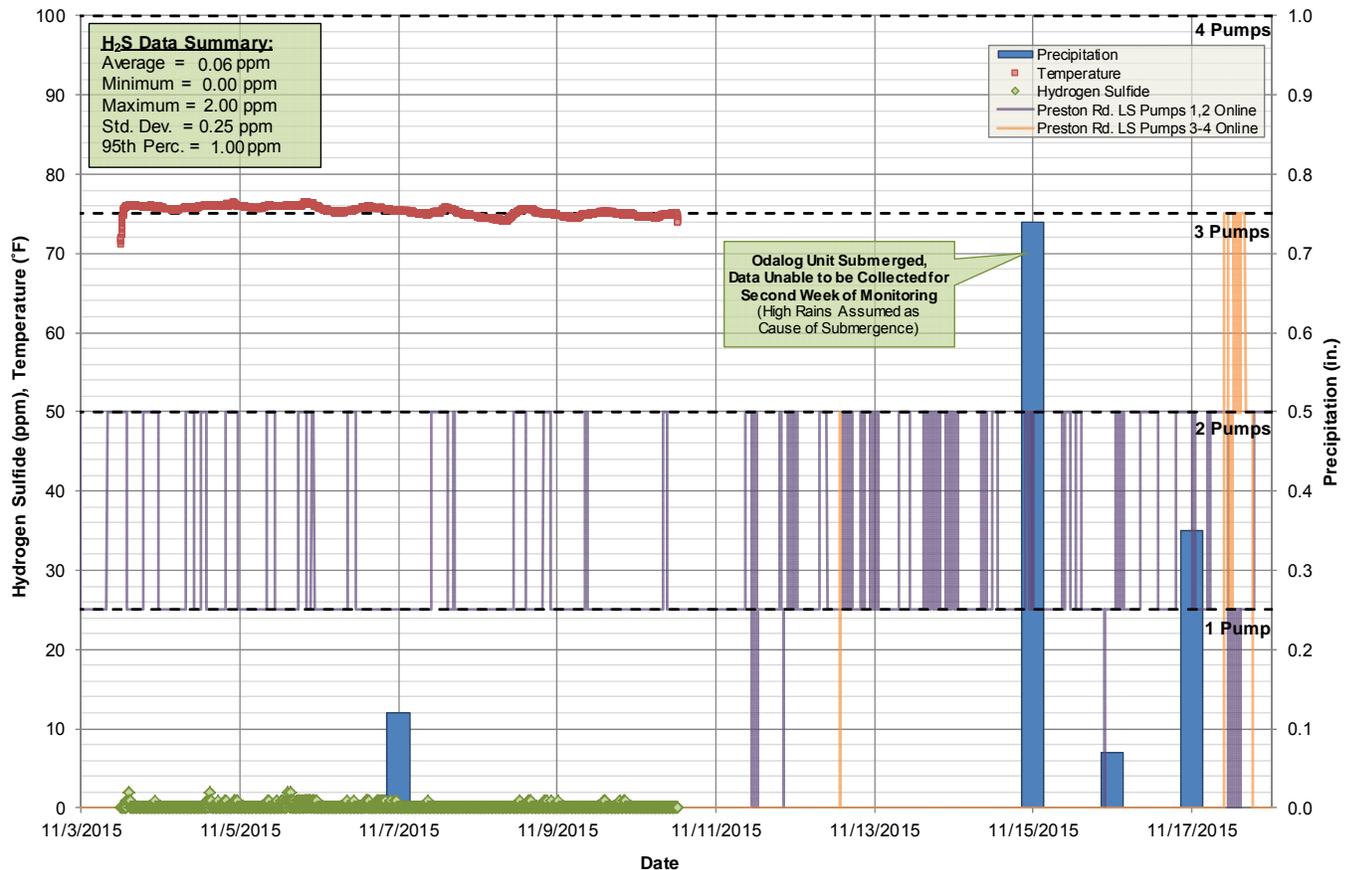
Overall, the H₂S concentrations at this site are relatively low; however, spikes as high as 71 ppm were measured. It's not obvious whether or not these spikes in H₂S are related to the pump station operation. The odor spikes occur between 1:00 pm and 2:30 pm on weekdays, suggesting that the odors may be as a result of the cleanup activities from the lunchroom. When the grease trap is disturbed after sitting dormant overnight, significant odors can be produced.

This manhole was the first location sampled on October 27th, so the increase in flows discussed in Paragraphs 4.7 and 4.11 had not yet occurred at the time the grab samples were collected.

4.13 Site #13, MH 3738 – Hoblitzelle Park, Near Intersection of Prescott and Mullins

This site was chosen to determine if the conditions immediately downstream of the area of interest near Circleview Ct. were similar to the areas upstream, and because residents had noted odors in this area. This location is deeper than those upstream, and moderate H₂S odors were observed when the manhole was opened.

Figure 28: Site #13, MH 3738 Odalog Results, Precipitation, and Pump Operation



The H₂S odors in this location are significantly less than upstream, indicating that a majority of the odors may be released upstream prior to the plug at MH 5400, where flows split into two segments before recombining downstream of the study area. It's not clear on Figure 1, but Figure 29 shows how when the plug was installed between MH 5400 and MH 5295, it isolated flows into only the 27-inch segment before reconnecting at the junction box at MH 15027. At the time the sampling locations were selected, the configuration of the parallel pipelines and their downstream connection location was not known.

A significant rainfall event occurred during the second week of sampling in this location. When the Odalog was retrieved, it had been submerged and the data was lost for the latter duration.

TECHNICAL MEMORANDUM
City of Plano Russell Creek Interceptor Odor Evaluation – Summary of Results

DRAFT

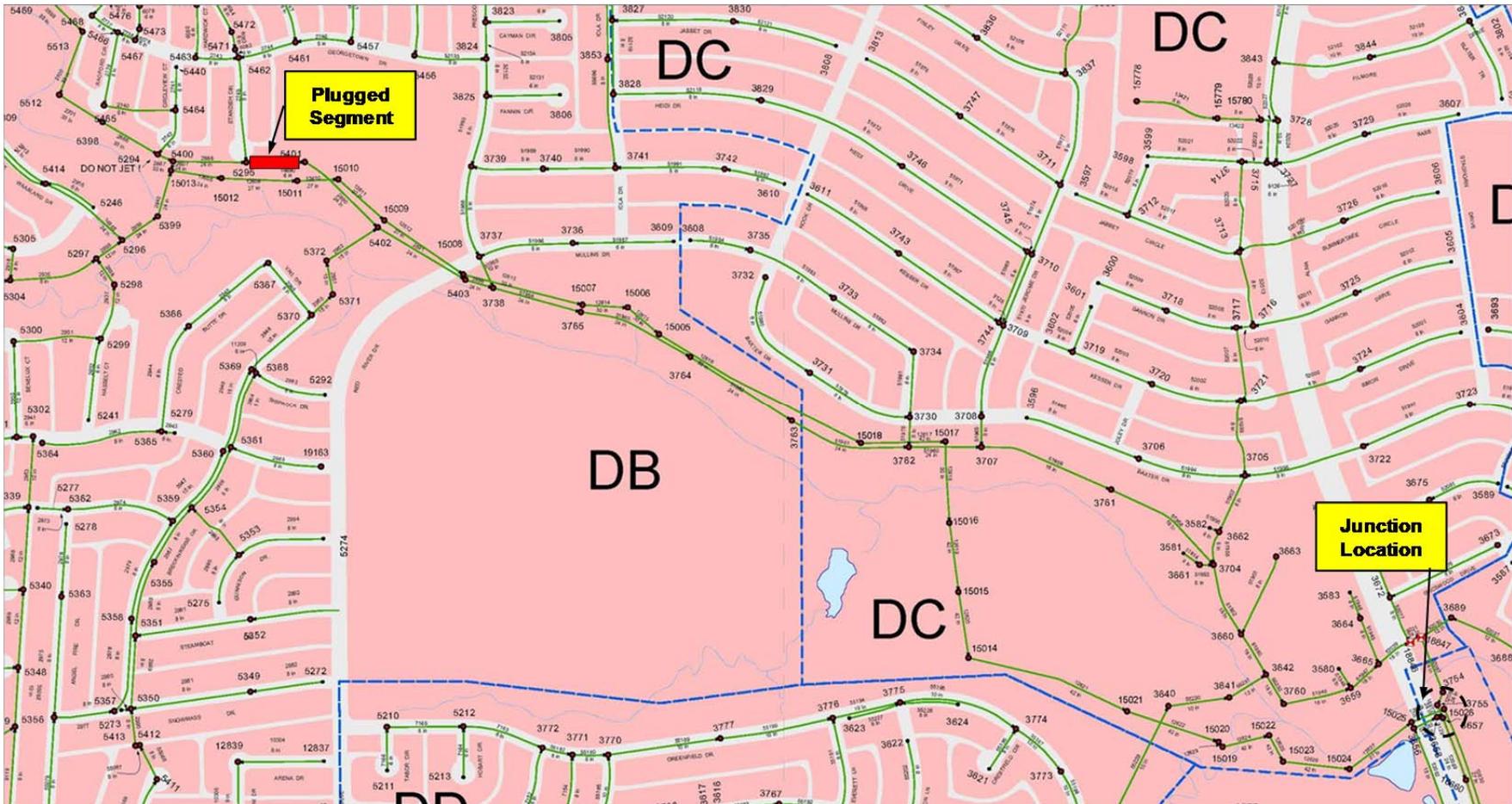
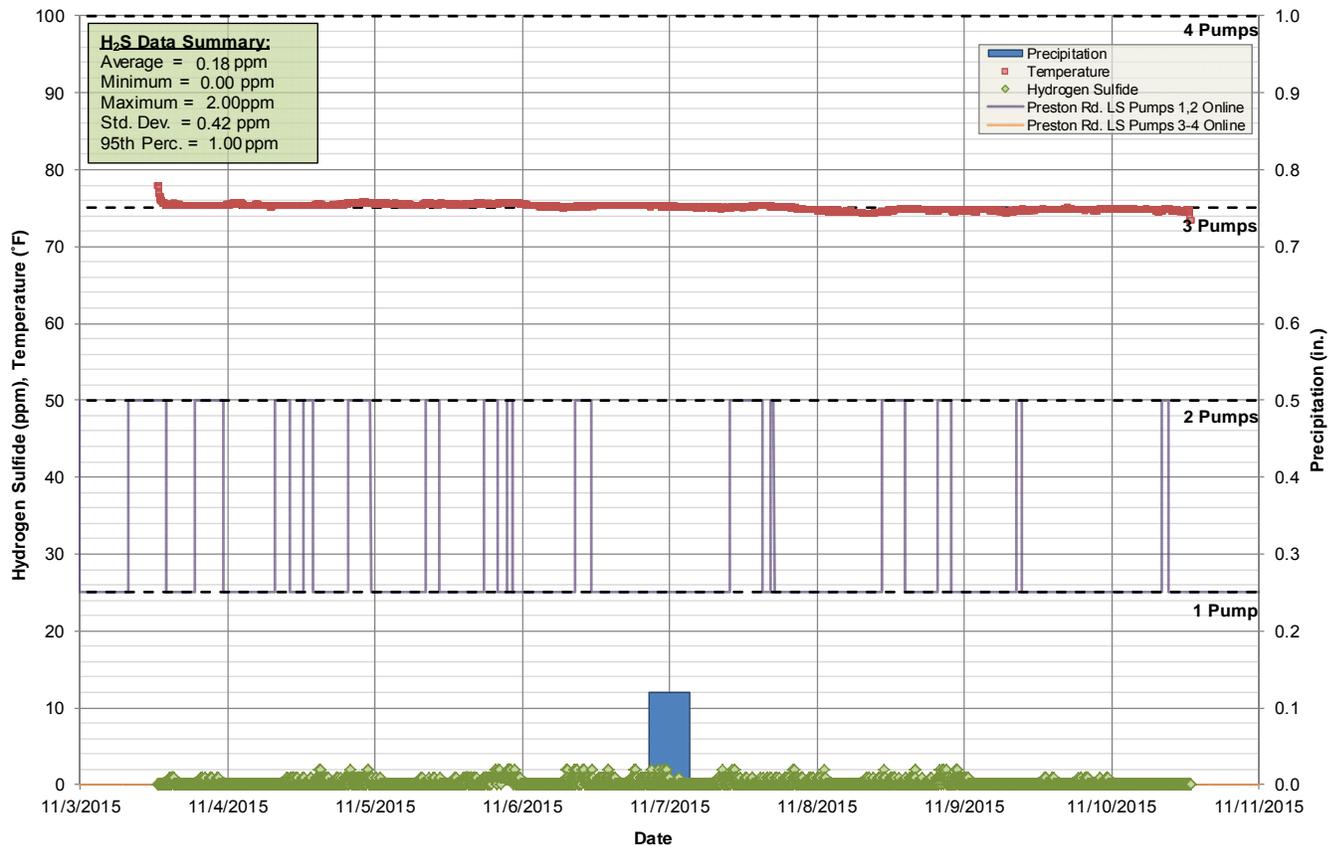


Figure 29: Parallel Russell Creek Interceptor Segments From MH 5401 to MH 15026

4.14 Site #14, MH 3762 – Hoblitzelle Park, Near Intersection of Baxter and Mullins

This site is similar to the conditions at MH 3738 (at Preston and Mullins), but is several feet deeper and nearer to Russell Creek. It's assumed that the flow velocities could be higher because of the greater depth and higher associated slopes. In addition, the deeper manholes leave more space for foul air to stay beneath the manhole lid, rather than be released.

Figure 30: Site #14, MH 3762 Odalog Results, Precipitation, and Pump Operation



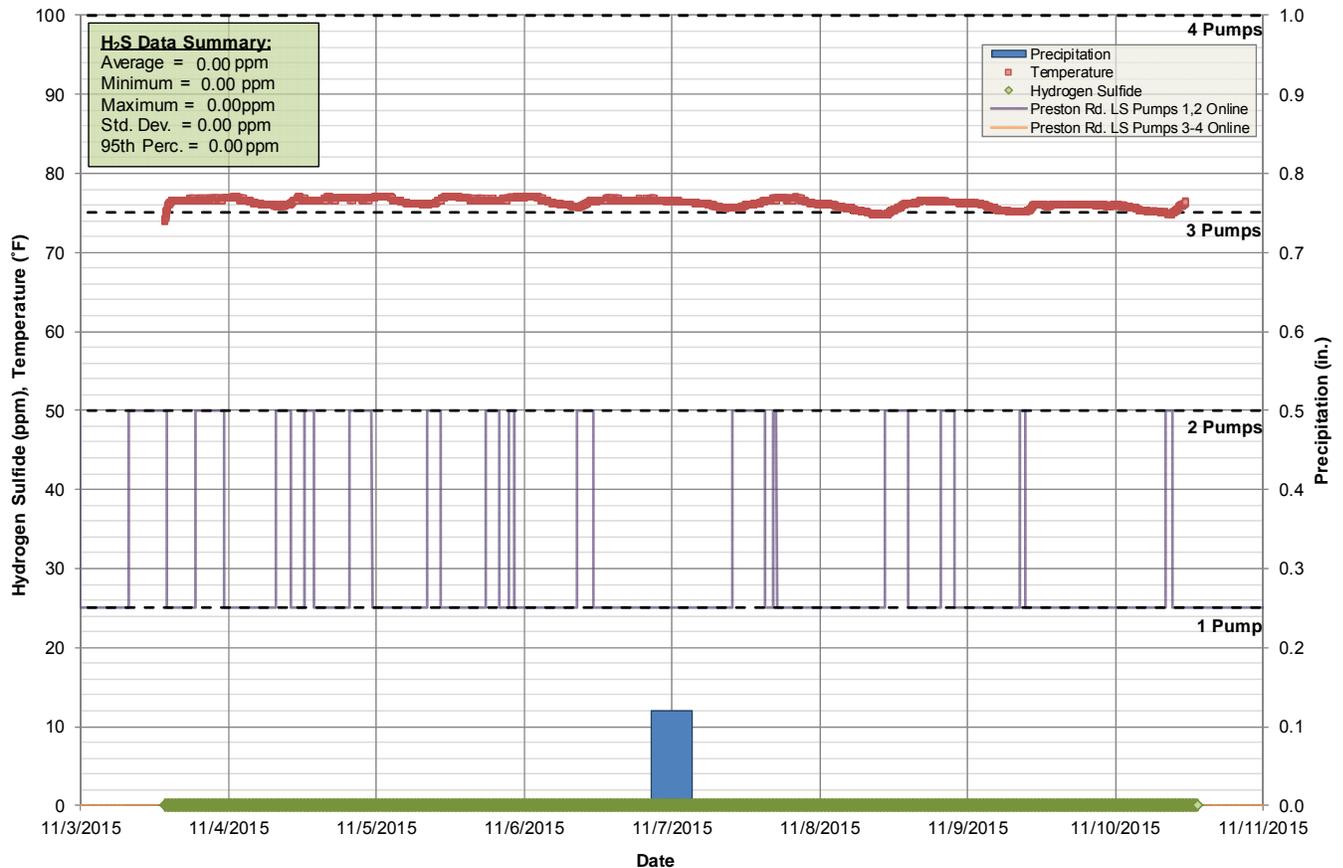
4.15 Site #15, MH 18847 – Junction Box Near Intersection of Alma & Spicewood

This location was selected, because it is on the further limits of the study area. Manholes slightly further upstream from this location were considered as alternative sampling locations, but they could not be easily accessed due to their location, or were too deep to be considered a likely odor source. This location was ultimately selected to provide a downstream baseline and because odor complaints had been received in its general area 2-3 weeks prior to the start of sampling. The junction where the two segments shown in Figure 29 connect is likely the cause of odors previously mentioned in this area.

Odors were not significant during sampling in this location. The Odalog results in Figure 31 also indicate that odors may not be a concern in this location. It should be noted that this manhole was several feet deeper than the others upstream and the high water mark for this manhole was several feet higher than the other sampling locations. As such, the Odalog could not be hung very deep and would be several

feet above the water surface a majority of the time it was in place. Because H₂S is heavier than air, the H₂S may not have reached the sensor. In addition, because the flow from the Russell Creek Interceptor does not flow from this segment, the wastewater is “fresher” and less likely to produce odors.

Figure 31: Site #15, MH 18847 Odolog Results, Precipitation, and Pump Operation



4.16 Additional Observations

The following observations were compiled from discussions with residents, City personnel, and APAI observations. They pertain to the study area around the Cross Creek residential area in general, but were not directly associated with a particular sampling location.

- Odors began around 3 years ago and occur year-round, but are most prominent in the fall season.
- Odors were worse during the drought conditions prior to March 2015 and have been dramatically reduced since the rain began again in mid-October 2015. Several days pass after a rain event before the odors are noticeable again.
- Odors have been somewhat reduced at Standish Circle since the manhole at the end of Circleview Ct. has been cleaned out.
- Odors can sometimes last all day, but is worse in the mornings and evenings, or when the wind is from the south.

- Along the walk path that follows Russell Creek (between Standish Circle and Baxter Dr., to the east), odors have been noticeably stronger near the following manholes, according to one resident:
 - MH 5401 (centered at the south end of the Hedgcoxe Elementary sports field)
 - MH 3764 (along the 24-inch line adjacent to the round children's park playground at Hoblitzelle Park)
 - MH 3763 (along the 24-inch line west of the connecting path that crosses Russell Creek and leads to a turtle pond, south of Russell Creek)

Residents noted that following all the rainfall events, beginning in the spring and summer of 2015, nuisance odors were less frequent. Several days would pass after a rain event before odors were noticeable or offensive.

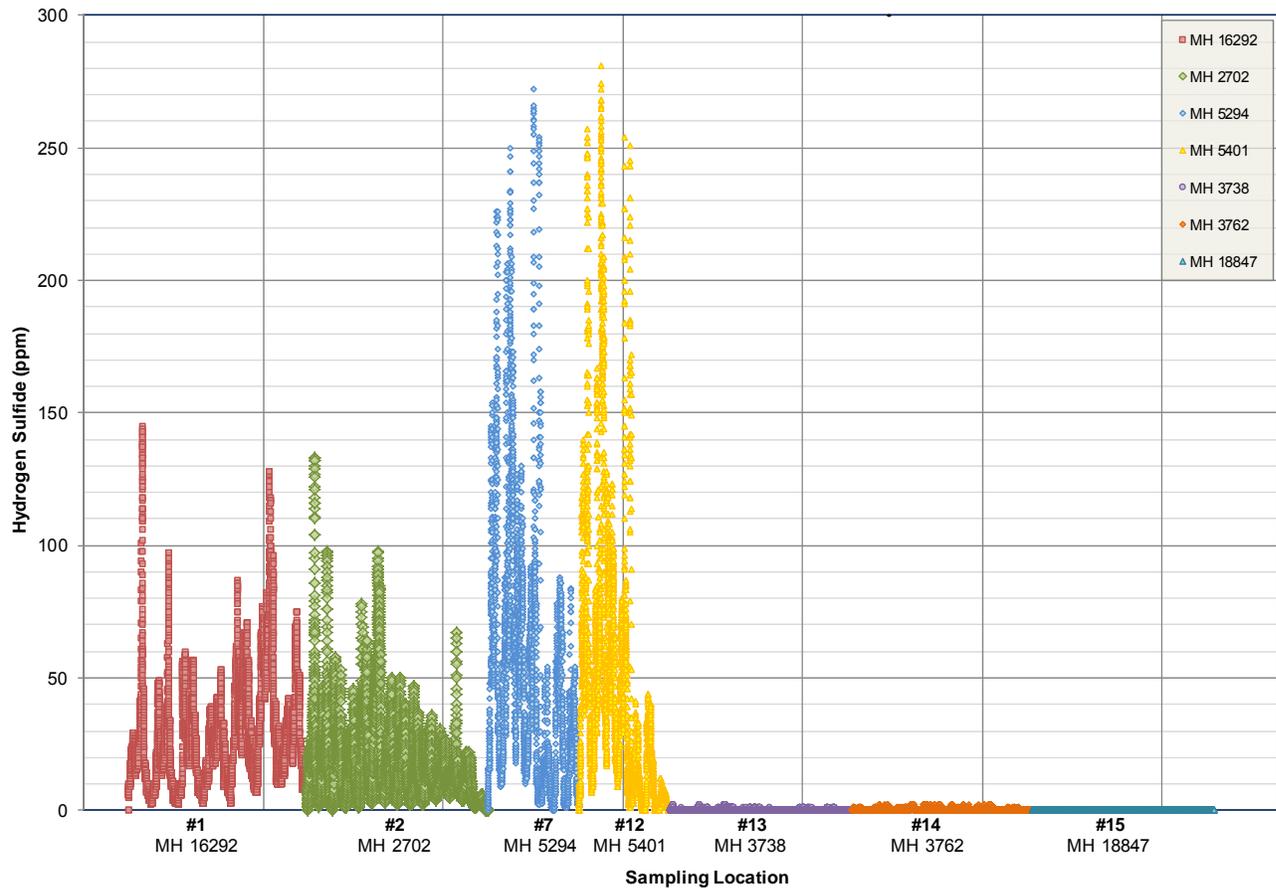
5 SUMMARY

Based on the observations and Odalog results, odors are being released from the Russell Creek Interceptor and its connections. While foul air may be released from some of the manholes, the data results strongly suggest that odors are escaping from household sewer vents in the area. The check valves that have been installed appear to be successful at reducing the release of odors in the segments upstream of where they have been installed, but they may also contribute to limiting the available headspace volumes where odors might be contained. As the lateral connections to the interceptor become surcharged or the check valves prevent the air from flowing back into the laterals, changes in the headspace air pressure force the odors out of the nearest household vents within the segments between the surcharged or valved connections. Figure 32 shows the combined Odalog results for the sampling locations along the Russell Creek Interceptor main line in order of the direction of flow, irrespective of time.

Assuming the results for each individual site are demonstrative of typical conditions, it's clear that the turbulence that occurs at the interconnections near MH 5294 and MH 5400 may be where the odors are being produced and released. The parallel segment from MH 5401 (shown in Figure 29) does not carry wastewater from the Russell Creek Interceptor main line, so the reduced wastewater age does not have the same odor-producing potential.

Along the Russell Creek Interceptor at Circleview Ct., the check valves prevent foul air from migrating into the residential laterals upstream. As the lateral inlets to the Interceptor are occasionally submerged, odors become forced into and/or trapped in the laterals, and as the water level rises into these segments, the air is displaced through the rooftop vents.

Figure 32: Combined Consecutive Odalog Results Along Russell Creek Interceptor



6 AVAILABLE CONTROL OPTIONS

The following paragraphs discuss available odor control options that may reduce or alleviate odors in the study area. It should be noted that for most of the options discussed below, further evaluation is required to provide a long-term solution.

6.1 Chemical Addition

Although the NTMWD employs a chemical feed program in their system, the details of it were not available at the time of this study. Any chemical addition by the City would need to be closely coordinated with the NTWMD. Also, the chemical feed points would need to be located far enough upstream of the area where odors are being controlled to provide the necessary reaction time of the additives. Oftentimes, the chemical feed points are located at a lift station. Because of the complexity of the collection system and the City’s role in its operation, such action is not suggested at this time.

6.2 Piping Modifications and/or Improvement of Flow Conditions

The turbulent conditions in the main segments of the Russell Creek Interceptor promote volatilization of the sulfides present in the wastewater. Once the oxygen in the wastewater is depleted, any turbulence in

the line will produce odors. Lower pHs also increase volatilization of the H₂S. Reducing the perpendicular connections within the system or sudden changes in direction of the flow will help to reduce turbulence of the wastewater and H₂S volatilization.

Under normal flow conditions, the headspace in gravity segments of a pipeline will pull the air along with the flow. When the inlets/outlets of the interconnecting manholes become submerged, there is nowhere for the air to go within the system and odors are forced out through any openings or vents. Reducing the flow through the system to prevent surcharging in the manholes will likely reduce the release of odors, though it will not eliminate them.

6.3 Forced Ventilation

The carbon units installed along the Russell Creek Interceptor are passive units and treat the foul air that flows through them directly. At times when the foul air volume being forced out of the system is greater than the throughput that the canister(s) will allow, the odors will escape at other locations. Throughput of the carbon units is dictated by the headloss through the filter media and the rated capacity, typically in cubic feet per minute (cfm). In order to prevent fugitive odors from the system, a fan can be installed to force an air flow volume greater than what the system will produce and release on its own, and pass it through a treatment unit. The flow volume must be greater in order to pull a vacuum on the system and prevent the odors from being able to escape from other openings. Testing is required to establish the required air volume and to size the treatment unit.

Forced ventilation does not work well when submergence of the inlets/outlets within the manholes prevents the free movement of air through the treated length of the interceptor. The submerged conditions must be addressed or separate ventilation and treatment systems must be used for each free-flowing connection or shared headspace.

6.4 Smoke Testing and Passive Ventilation at Manholes or Roof Vents

The check valves in the manholes appear to be successful at preventing odors from migrating upstream from the Interceptor to the outer reaches of the system. However, segments where check valves cannot be easily placed may be at risk for fugitive odors. While single-story homes in the immediate vicinities are the likely release points, smoke testing would provide confirmation of this. Special attention should be paid in locations where trees are very close to the rooftops, because dispersion of odors that are released is inhibited.

Passive carbon-media filters are available that can be purchased for the homes whose vents are the most at risk for emitting odors. Manufacturers of rooftop vent filters include the Rex-Bac-T Poly-Air™ Filter, Wolverine, Odorhog™, and Septic Solutions, Inc. Figure 33 shows one of these filters installed.

Figure 33: Installed Polylok Poly-Air™ Activated Carbon Vent Filter

(Photo from www.rex-bac-t.com)

In order to address odors in the near-term, smoke testing could be performed to find the most prominent release points in the study area, and small, passive filters could be provided at those locations to address the localized odors. Such systems can be effective on a short-term basis, but it should be noted that the quantity and frequency at which the units or their media would need to be replaced is difficult to predict. In addition, it is recommended to place filters on every vent of each home where odor releases are suspected. Ultimately, the quantity of the filters required and the need for their regular replacement may make this option cost prohibitive.

**6.5 Public Outreach Program**

The Cross Creek residents have been outspoken about the odors in their neighborhood and communicated to APAI that they have met in the past in small groups to discuss how the odors might be addressed. Communities such as theirs are excellent candidates for a public outreach program, because they show a willingness to work with the City to find a solution. Meetings can be held or individuals can be contacted to not only inform them on what might be causing the odors in their area, but also for insight on what other conditions might be present that the City does not know about.

When the initiative is taken on the part of the City or facility owner, it is often well-received and reciprocated with cooperation and positive feedback on behalf of the residents.