



AECOM  
500 West Jefferson Street  
Louisville, KY 40202  
aecom.com

**Project name:**  
MSD Odor Control Master Plan

**Project ref:**  
60644274

**From:**  
Brett Wagner  
Jackson Allman

**Reviewed By:**  
Alex Carciumaru  
Amanda Foote  
Janet Strickland  
Maria DeLuca

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**To:**  
Robin Burch  
MSD Project Manager  
4522 Algonquin Parkway  
Louisville, KY 40211

# Memo

**Subject:** Technical Memorandum #6C – Morris Forman Service Area - Selected Pump Stations Air and Liquid Sampling Results Analysis

## 1. Introduction

### 1.1 Odor Control Master Plan Background

In response to receiving a Notice of Violation (NOV) in November 2019 for failure to control nuisance odors from the Morris Forman Water Quality Center (WQTC, Plant), pumping stations and its collection system, MSD entered into an agreed order with the Louisville Metro Air Pollution Control District (APCD) to develop and implement a phased District-wide Odor Control Master Plan. MSD has contracted AECOM to provide MSD with professional engineering services for the development of Phase I of the Odor Control Master Plan (Odor Control Master Plan), which is focused on the Morris Forman Service Area. MSD also contracted with a public relations firm to increase public engagement and communications during development and implementation of the phased Odor Control Master Plan.

MSD owns and operates 137 wastewater pump stations within the Morris Forman Service Area. These pump stations are responsible for the conveyance of wastewater flow from the Morris Forman combined sewer collection system towards the Morris Forman WQTC. Several communities in the Morris Forman Service Area have experienced nuisance odors leading to a significant amount of complaints, specifically during the summer of 2019. Primary affected residents were in the Chickasaw, California, and Park DuValle neighborhoods. These complaints led to the development of a dedicated Odor Control Master Plan for the Morris Forman Service Area.

## 1.2 Purpose

This TM is intended to document odor control sampling efforts to date for the selected pump stations part of the Morris Forman Service Area. The main objectives of this TM are to:

1. Identify specific odor sources at selected Morris Forman Pump Stations that may contribute to nuisance conditions; and,
2. Incorporate findings from this TM#6C into TM#7 - Current Odor Control Technologies Performance Evaluation, TM#8 - New Odor Control Technologies Performance Evaluation, and TM#9 - Odor Control Conceptual Design.

## 1.3 Previous Documentation and Implementation Schedule

In accordance with the agreed order, MSD has submitted several documents to APCD to demonstrate ongoing odor control efforts. **Table 1** shows MSD's completed and ongoing efforts towards the APCD agreed order.

**Table 1 – Master Plan Implementation Schedule**

<b>Title</b>	<b>Due Date</b>	<b>Status</b>
TM#1 Morris Forman WQTC Background Document Review	Q1 2021	Completed
TM#2 Collection System Background Document Review	Q2 2021	Completed
TM#3 Pump Stations Background Document Review	Q2 2021	Completed
TM#4 WQTC, Pump Stations and Combined Sewer System Planned Process Modifications	Q1 2021	Completed
TM#5 Current WQTC, Pumping Stations and Combined Sewer System Odor Impact Evaluation	Q2 2021	Completed
TM#6A, TM#6B, TM#6C Morris Forman WQTC (TM#6A), Pump Stations (TM #6C), and Collection System (TM #6B) Sampling Phase Results Analysis	Q4 2022	Completed
TM#7A Morris Forman WQTC Current Odor Technologies Performance Evaluation	Q4 2022	Completed
TM#7B Collection System Current Odor Technologies Performance Evaluation		
TM#7C Pump Stations Current Odor Technologies Performance Evaluation		
<b>TM#8 New Odor Control Technologies Recommendation</b>	<b>Q4 2022</b>	<b>Ongoing</b>
<b>TM#9 Odor Control Conceptual Design</b>	<b>Q4 2022</b>	<b>Ongoing</b>
<b>Odor Control Master Plan Phase I Final Report</b>	<b>Q4 2022</b>	<b>Ongoing</b>

## 2. Selected Pump Stations Sampling

### 2.1 Sampling Locations

Sampling locations were selected based on discussions with MSD staff and findings from the current odor impact evaluation. High-priority odor sources were included in Phase 1 of the sampling program, conducted in September of 2021. Sampling of additional high-priority and moderate-priority odor source locations were performed in Phase 2, conducted in June of 2022, and included within this report also.

#### 2.1.1 Phase 1 Sampling

Sampling and laboratory analyses was performed at high-priority areas in September 2021 which included three (3) locations at Pump Station #5. Liquid sampling was performed by MSD staff and vapor sampling was contracted to a third party. A summary of the Phase 1 sampling program locations and characteristics is shown in **Table 2** and overview maps of the sampling locations are shown in **Figure 1**.

**Table 2 – Pump Stations Phase 1 Sampling Summary**

Sample ID	Location	Description	Odor Control System	Date of Sampling	Sample Type	
					Vapor	Liquid
S1	PS #5	Dumpster Room	Carbon Adsorber (2013)	9/13/2021	✓	✓
S2	PS #5	Splitter Structure #1		9/13/2021	✓	✓
S3	PS #5	Influent Junction Structure		9/13/2021	✓	✓

#### 2.1.2 Phase 2 Sampling

Sampling and laboratory analyses were performed at six (6) locations at selected pump stations in June 2022 which are summarized in **Table 3**. These structures were selected for vapor sampling based on recommendations and discussions with MSD staff and high-priority odor impact ratings determined during previous TMs (refer to TM#5). Site plans of the Morris Forman Pump Stations are included in **Figure 1**, in addition to a select manhole from the Morris Forman Collection System liquid sampling for clarification on assumptions made for liquid sampling results of select pump stations.

Vapor sampling was contracted to a third-party sampling consultant.

**Table 3 – Pump Stations Phase 2 Vapor Sampling Summary**

Sample ID	Location	Description	Odor Control System	Date(s) of Sampling	Sample Type
					Vapor
F1	PS #8	Lower Level	None	6/28/2022	✓
F2	PS #8	Roof Exhaust	None	6/28/2022	✓
ST1	PS #6	Lower Level	None	6/28/2022	✓
ST2	PS #6	Roof Exhaust	None	6/28/2022	✓
G1	PS #2	Carbon Inlet		6/21/2022	✓

Sample ID	Location	Description	Odor Control System	Date(s) of Sampling	Sample Type
					Vapor
G2	PS #2	Carbon Outlet	Carbon Adsorber (2017)	6/21/2022	✓
N1	PS #3	System 1 Inlet		6/21/2022	✓
N2	PS #3	System 1 Outlet	Carbon Adsorber (2013; Updated in 2018)	6/21/2022	✓
N3	PS #3	System 2 Inlet		6/21/2022	✓
N4	PS #3	System 2 Outlet		6/21/2022	✓
ND1	PS #4	Lower Level	None	6/22/2022	✓
U1	PS #7	Wet Well Room	None	6/22/2022	✓
U2	PS #7	Bar Screen Channel Exhaust	None	6/22/2022	✓

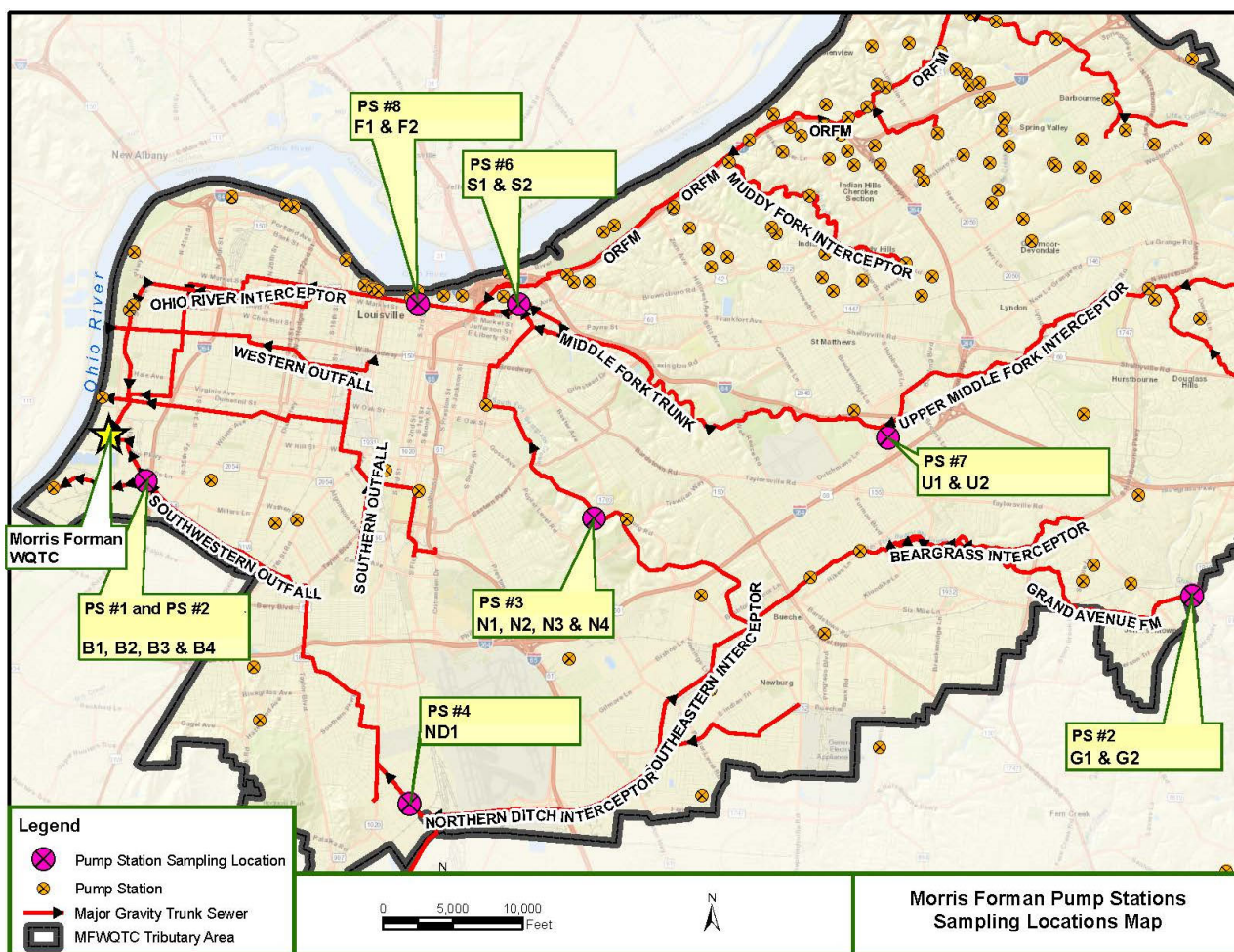


Figure 1 – Pump Station and Select Collection System Sampling Locations

## 2.2 Sampling Parameters

Sampling parameters included in the selected pump stations sampling program are listed in **Table 4** (vapor parameters) and **Table 5** (liquid parameters).

**Table 4 – Sampling Program Parameters – Vapor**

Sampling Parameter	Description	Standard/ Guideline
1 Odor	10-liter Tedlar bag grab samples collected and shipped to sensory consultant to measure odor detectability as Detection-to-Threshold (D/T)	ASTM E679-91/ E544-99
2 Reduced Sulfur Compounds (RSC)	3-liter Tedlar bag grab samples collected and shipped to laboratory for analytical analysis	ASTM 5504-12
3 Volatile Organic Compounds (VOCs)	3-liter Tedlar bag grab samples collected in pre-calibrated canisters and shipped to laboratory for analytical analysis	EPA TO-15
4 Ammonia	Air samples pulled from odor and RSC grab sample bags and tested on-site using GASTEC detector tubes and pump model GV-100S	EPA CTM 027 (Vapor); APHA 4500-NH3 (Liquid)
5 Amines	Sorbent tubes used to collect air samples and shipped to laboratory for analytical analysis	OSHA Method 40
6 Aldehydes	Sorbent tubes used to collect air samples and shipped to laboratory analytical analysis	EPA TO-11A
7 Instantaneous Hydrogen Sulfide (H <sub>2</sub> S)	H <sub>2</sub> S analyzers used to measure and instantaneous H <sub>2</sub> S concentration using Arizona Instruments Jerome 631X	-

**Table 5 – Sampling Program Parameters – Liquid**

Sampling Parameter	Description	Standard/ Guideline
1 pH	pH meters used to measure pH within (2) hours of sampling	APHA 4500-H
2 Dissolved Oxygen (DO)	Azide modification to the Winkler Titration Method	APHA 4500-O
3 Dissolved Sulfides	Samples collected directly from manhole/catch basin and shipped to laboratory for analytical analysis	APHA 4500-S2
4 Sulfates	Samples collected directly from manhole/catch basin and shipped to laboratory for analytical analysis	APHA 4110B
5 Ammonia	Ammonia-selective electrode method used to analyze liquid samples within 24 hours	APHA 4500-NH3
6 5-day Biological Oxygen Demand (BOD <sub>5</sub> )	Difference in DO before and after incubation of liquid samples for five days	APHA 5210B
7 Volatile Organic Compounds (VOCs)	GC/MS instrumentation used to analyze VOCs in liquid samples	EPA 624/625

Sampling Parameter	Description	Standard/ Guideline
8 Total Suspended Solids (TSS)	-	APHA 2540-D

### 3. Selected Pump Station Sampling Results Analysis

**Table 6 and Table 7** were developed to summarize the analyzed results from the September 2021 and Summer 2022 Pump Station sampling events in comparison to target limits for each sampling parameter. Values are reported as low or high. In the event that the sampling location showed both non-detect (ND) and detectable values, the values were averaged by replacing the ND value with the maximum reporting limit. Red text indicates instances where sampling results exceeded target limits at the odor source.

Liquid sampling results were directly collected at the PS #5. Liquid sampling results for the PS #8 and PS #6 were based upon liquid sampling of a downstream manhole in the same sewer system, sampled Summer 2022. These results for the liquid sampling near these two pump stations are based on proximity to the manhole ( $\approx$  3.5miles) and shared connection to the Ohio River Interceptor sewer system. The liquid sampling results at the pump stations would likely yield different values; however, these results are recorded here since they are in the vicinity of the pump stations. The recommendations for next steps at these two pump stations (PS #6 and PS #8) will be based on the vapor sampling results. No other liquid sampling results were collected for the other selected pump stations.

**Table 6 – Selected Pump Station Air Sampling Results Evaluation**

	Sampling Parameter	Sampling Location															
		S1 Dumpster Room	S2 Splitter Structure #1	S3 Influent Junction Structure	F1 Lower Level	F2 Roof Exhaust	ST1 Lower Level	ST2 Roof Exhaust	G1 Carbon Inlet	G2 Carbon Outlet	N1 System Inlet 1	N2 System Outlet 1	N3 System Inlet 2	N4 System Outlet 2	ND1 Lower Level	U1 Wetwell Room	U2 Bar Screen Channel Exhaust
Vapor Sampling	Odor (Average)	High	High	-	High	High	High	High	High	High	High	High	High	High	High	High	High
Reduced Sulfur Compounds	H2S	Low	High	-	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Carbonyl Sulfide	Low	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Methyl Mercaptan	Low	Low	-	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Ethyl Mercaptan	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Low	Low
	Dimethyl Sulfide	Low	Low	-	ND	ND	ND	ND	Low	Low	Low	Low	Low	Low	Low	ND	ND
	Carbon Disulfide	Low	ND	-	Low	ND	ND	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Dimethyl Disulfide	0.143	ND	-	High	Low	Low	Low	Low	Low	Low	Low	ND	Low	ND	ND	ND
Pressure	Max Pressure	-	-	-	0.186	-	0.015	-	0.005	0.427	.563	-	0.043	-	0.655	- 0.067	- 0.185
	8-day Average Pressure	-	-	-	- 0.012	-	- 0.006	-	- 0.03	0.196	- 0.233	-	- 0.023	-	0.017	- 0.189	- 0.285

**\*Red text indicates sampling location exceeded analyte target limit at the odor source.**

**\*Target Limit Resources:**

1. Air Pollution Control District (APCD) Ambient Air Quality Standards, Regulation 3.01 Section 7
2. American Industrial Hygiene Association (AIHA), 1989
3. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits, Annotated Table Z-1
4. Louisville MSD Wastewater/ Stormwater Discharge Regulations
5. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value
6. Approaches to Total VOC Guidelines, Alberta Environment-Based on Effects Screening Level (ESL)
7. National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit
8. United States Department of Energy (DOE) Protective Action Criteria for Chemicals (PACs) PAC-1

**Notes:**

ND= Non-Detect – Compound was analyzed for, but not detected above the method detection limit  
 - = Substance was not sampled for or has not been analyzed by the appropriate laboratory  
 SL= Sample Loss – Air sample was damaged during shipment to laboratory  
 NL=No Liquid – no liquid was present at sample location.

The following compounds were tested for but not detected in the vapor at any location in the distribution system:

1,3-Butadiene, Bromomethane, Chloroethane, Ethanol, Acetonitrile, Acrolein, Acetone, Trichlorofluoromethane (CFC 11), 2-Propanol (Isopropyl Alcohol), Acrylonitrile, 1,1-Dichloroethene, Methylene Chloride, 3-Chloro-1-propen (Allyl Chloride), Trichlorotrifluoroethane (CFC 113), trans-1,2-Dichloroethene, 1,1-Dichloroethane, Methyl tert-Butyl Ether, Vinyl Acetate, 2-Butanone (MEK), cis-1,2-Dichloroethene, Ethyl Acetate, n-Hexane, Chloroform, Tetrahydrofuran (THF), 1,2-Dichloroethane, 1,1,1-Trichloroethane, Benzene, Carbon Tetrachloride, Cyclohexane, 1,2-Dichloropropane, Bromodichloromethane, Trichloroethene, 1,4-Dioxane, Methyl Methacrylate, n, Heptane, cis-1,3-Dichloropropene, 4-Methyl-2-pentanone, trans-1,3-Dichloropropene, 1,1,2-Trichloroethane, Toluene, 2-Hexanone, Dibromochloromethane, 1,2-Dibromoethane, n-Butyl Acetate, n-Octane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m,p-Xylenes, Bromoform, Styrene, o-Xylene, n-Nonane, 1,1,2,2-Tetrachloroethane, Cumene, alpha-Pinene, n-Propylbenzene, 4-Ethyltoluene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, Benzyl Chloride, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 1,2-Dichlorobenzene, d-Limonene, 1,2-Dibromo-3-chloropropane, 1,2,4-Trichlorobenzene, Naphthalene, Hexachlorobutadiene

An extensive list of VOC compounds and aldehyde compounds were tested for as part of the sampling program, but the results were well below the target limits; therefore, the results were excluded from this table for clarity.

**Table 7 – Liquid Sampling Results Evaluation**

	Sampling Parameter	Sampling Location						
		S1 Dumpster Room	S2 Splitter Structure #1	S3 Influent Junction Structure	Collection System MH			
					F1 Lower Level	F2 Roof Exhaust	ST1 Lower Level	ST2 Roof Exhaust
Liquid Sampling	pH	-	-	-	7.79	7.79	7.79	7.79
	Sulfide	-	-	-	ND	ND	ND	ND
	Naphthalene	-	-	Low	-	-	-	-
	BOD 5	-	-	Low	Low	Low	Low	Low
	Dissolved Oxygen	-	-	Low	Low	Low	Low	Low
	Sulfate	-	-	Low	Low	Low	Low	Low
	TSS	-	-	Low	Low	Low	Low	Low
	Ammonia	-	-	Low	Low	Low	Low	Low
	Acetone	-	-	Low	Low	Low	Low	Low
	Toluene	-	-	-	ND	ND	ND	ND

\*Red text indicates sampling location exceeded analyte target limit at the odor source.

**\*Target Limit Resources:**

1. Air Pollution Control District (APCD) Ambient Air Quality Standards, Regulation 3.01 Section 7
2. American Industrial Hygiene Association (AIHA), 1989
3. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits, Annotated Table Z-1
4. Louisville MSD Wastewater/ Stormwater Discharge Regulations
5. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value
6. Approaches to Total VOC Guidelines, Alberta Environment-Based on Effects Screening Level (ESL)
7. National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit
8. United States Department of Energy (DOE) Protective Action Criteria for Chemicals (PACs) PAC-1

**Notes:**

H<sub>2</sub>S= Hydrogen Sulfide

BOD= Biological Oxygen Demand

TSS= Total Suspended Solids

ND= Non-Detect – Compound was analyzed for, but not detected above the method detection limit

- = Substance was not sampled for or has not been analyzed by the appropriate laboratory

SL= Sample Loss – Air sample was damaged during shipment to laboratory

NL=No Liquid – no liquid was present at sample location.

Liquid sampling results for remaining pump stations were not currently available.



## 4. Conclusions

The initial air sampling results indicated the exceedance of analyte target limits at several locations. The pressure monitoring results indicate that most of the pump station sampling locations operate at positive pressure compared with the atmospheric pressure which causes the release of the untreated air into the surrounding environment. It is important to notice that high odor levels have been measured at several locations.

**Table 6** and **Table 7** summarize the vapor and liquid sampling results evaluation, respectively, for each of the sampling locations. These results will be used in the odor control master plan to prioritize the pump stations and aid in the selection of odor control improvements.

The liquid sampling was performed at the PS #5 wet well and the liquid results for PS #8 and PS #6 were based on liquid sampling results from a downstream manhole, and the results indicate moderate exceedances of analyte target limits at PS #5 and no exceedances at PS #8 and PS #6. The vapor sampling results yielded high target limit exceedances at the PS #5, PS #4, PS #6, and PS #8 locations.

The sampling locations are presented in order of highest to lowest estimated vapor odor impacts in **Table 8** and **Table 9**.

**Table 8 – Selected Pump Station Air Sampling Results Summary**

Sampling Location	Potential Odor Receptors	Target Limit Exceedance(s)	Odor Control Priority
S2: PS #5 Splitter Structure #1	Park DuValle residents; Adjacent properties	Odor, H <sub>2</sub> S, Methyl Mercaptan	High
ND1: PS #4 Lower Level	Wyandotte/Beechmont residents; Adjacent properties	Odor	High
S1: PS #5 Dumpster Room	Park DuValle residents; Adjacent properties	Odor, Methyl Mercaptan	High
ST1: PS #6 Lower Level		Odor	High
F1: PS #8 Lower Level	Downtown residents; Adjacent Properties	Odor	High
ST2: PS #6 Roof Exhaust		Odor	High
F2: PS #8 Roof Exhaust		Odor	High
G1: PS #2 Carbon Inlet	Jeffersontown; Adjacent properties	Odor	Moderate
N4: PS #3 System 2 Outlet		Odor	Moderate

N3: PS #3 System 2 Inlet	Germantown & Deer Park residents	Odor	Moderate
S1: PS #5 Dumpster Room	Park DuValle residents; Adjacent properties	Odor, Methyl Mercaptan	Moderate
G2: PS #2 Carbon Outlet	Jeffersontown residents; Adjacent properties	Odor	Moderate
N1: PS #3 System 1 Inlet	Germantown & Deer Park residents	Odor	Moderate
N2: PS #3 System 1 Outlet		Odor	Low
U2: PS #7 Bar Screen Channel Exhaust	Deer Park residents; Adjacent properties	Odor	Low
U1: PS #7 Wet Well Room		Odor	Low
S3: PS #5 Influent Junction Structure	Park DuValle residents; Adjacent properties	-	N/A

**Table 9 – Pump Station Liquid Sampling Results Summary**

Sampling Location	Potential Odor Receptors	Target Limit Exceedance(s)	Odor Control Priority
S3: PS #5 Influent Junction Structure	Park DuValle residents; Adjacent properties	-	Moderate
S2: PS #5 Splitter Structure #1		-	Low
S1: PS #5 Dumpster Room		-	Low
ST1: PS #6 Lower Level	Downtown residents; Adjacent properties	-	N/A
F1: PS #8 Lower Level		-	N/A
ST2: PS #6 Roof Exhaust		-	N/A
F2: PS #8Roof Exhaust		-	N/A

## 5. Recommendations

The findings from the 2021 and 2022 sampling events in the Morris Forman pump stations indicate that odor control improvements are recommended at , PS #2, PS #4, PS #6, PS #8, PS #3, and PS #5. The odor detection values obtained from the sampling efforts will also be incorporated into the air

dispersion model for the highest odor results to assess community odor impacts at critical receptors. The pump station that will be included in the air dispersion model is Pump Station #4.

TM#8 - New Odor Control Technologies Performance Evaluation, and TM#9 - Odor Control Conceptual Design will be focused on technologies specifically used for pumping stations for consideration in reducing the odors in these locations.