ATTACHMENT 4

ORANGE WATER & SEWER AUTHORITY

Quality Service Since 1977

November 22, 2006

Mr. Roger L. Stancil, Town Manager
Town of Chapel Hill
405 Martin Luther King Jr. Boulevard
Chapel Hill, NC 27514

Subject: Progress Report on Eliminating Off-site Objectionable Odor from the Mason Farm Wastewater Treatment Plant

Dear Mr. Stancil:

In preparation for the Town Council's Public Forum on December 4th, 2006, we are pleased to submit the enclosed information about our odor elimination program at the Mason Farm Wastewater Treatment Plant (WWTP) including:

- ✓ Odor elimination actions since the Town Council's Public Forum on November 14th, 2005;
- ✓ The odor study which the consulting firm of Black & Veatch began in May, 2006;
- ✓ Additional odor elimination measures which are scheduled for completion by the summer of 2007; and
- ✓ Our plans for further discussions with neighbors of the WWTP to develop a definition of successful odor elimination.

We appreciate the opportunity to provide information to you and to the community at the Public Forum on December 4th, and we look forward to receiving comments and questions from citizens and the Town.

Sincerely,

Ed Kerwin
Executive Director

Enclosure

Copy: OWASA Board of Directors

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(30)

November 22,2006

OWASA'S ODOR ELIMINATION PROGRAM AT THE MASON FARM WASTEWATER TREATMENT PLANT (WWTP)

This information is submitted to the Town of Chapel Hill in preparation for the Public Forum to be held by the Chapel Hill Town Council on Monday, December 4th, 2006.

Summary

- ✓ **OWASA** is continuing the process of making substantial improvements to eliminate objectionable off-site odor from the Mason Farm Wastewater Treatment Plant (WWTP) in accord with the facility's Special Use Permit as modified by the Town Council on March 1, 2004.

- ✓ In late November, 2005, our contractor for the three-year, $50 million WWTP improvement project completed the installation of new, fixed cover structures at our solids digesters, where solids from wastewater are treated and converted into recyclable biosolids. The new cover structures addressed the primary odor source identified as of the spring of 2004.

- ✓ Our highest current priority in the odor elimination program is the completion of a new, enclosed "headworks" in the summer of 2007. The headworks is the area where wastewater enters the treatment plant. The enclosed headworks will capture foul air for treatment in our odor scrubber. Odor sampling at the WWTP in June, 2006 showed that the headworks has a daily pattern of elevated odor from the late afternoon through early morning due to hydrogen sulfide levels in wastewater entering the plant.

- ✓ On September 27, 2006, OWASA representatives and our odor study consultants met with 16 of our neighbors to discuss a draft report by our odor consultant, a conceptual draft of a proposed definition of successful odor elimination and related items. Elements of the draft definition were not acceptable, and we will work further with our neighbors on this matter in coming months with the benefit of information from our consultants about odor standards used at other WWTPs.

- ✓ On November 9, 2006, the OWASA Board of Directors received comments from WWTP neighbors and authorized staff to proceed with odor elimination improvements identified by our staff and consultants in addition to those that are already under contract. The additional improvements will cost about $300,000.

Background

In March, 2004, the OWASA Board of Directors formally adopted a goal of eliminating off-site objectionable odors from the Mason Farm Wastewater Treatment Plant.

In May, 2004, following approval of the Special Use Permit Modification by the Chapel Hill Town Council, the Pizzagalli Construction Co. began a three-year, $50 million improvement project at the Mason Farm Wastewater Treatment Plant. The project includes:

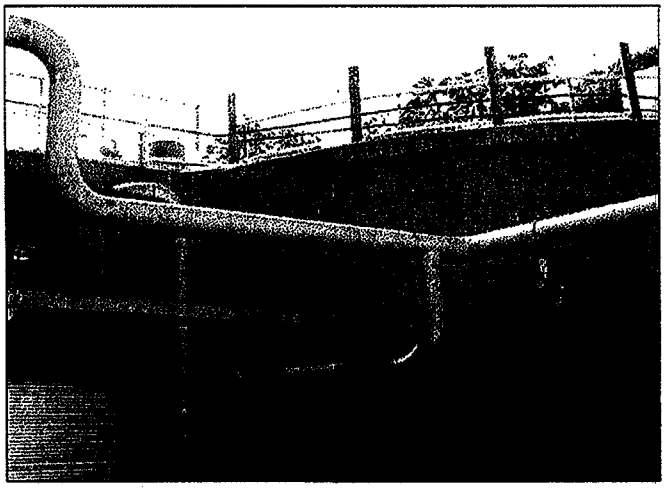
- ✓ odor-related improvements,
- ✓ expansion of the plant's capacity,
- ✓ enhancements in wastewater treatment processes to meet expected higher standards and enable future use of reclaimed water to meet non-drinking water needs, and
- ✓ additional back-up power to increase our operating reliability during storms and other conditions.

Odor elimination actions since the Town Council's Public Forum on November 14, 2005

In late November, 2005, our contractor completed the installation of new, fixed cover structures for our four solids digesters. Previously, the covers moved up and down as solids volume fluctuated in the digesters. Foul air was released at times through the gap between a cover and a digester's outside wall.

In September, 2006 a contractor completed the installation of new, aboveground pipes to carry foul air away from our solids digesters. The old, underground pipes were subject to blockages that resulted in odor releases. We determined that the old pipes were an odor source soon after installation of the digester covers.

The installation of aboveground pipes to carry foul air away from our solids digesters resolved an odor source that became apparent in December, 2005 due to releases from the old, underground pipes.



OWASA staff has monitored the WWTP site for odor as set forth in the Odor Monitoring and Evaluation Plan that we submitted to the Town in November, 2005 and summarized in our quarterly reports to the Town in September and November, 2006. Due to an oversight, off-site odor checks were not initially done in accord with the plan but were initiated in August, 2006.

As discussed in more detail in the next section, we hired the consulting firm of Black & Veatch to do an odor study that began in June, 2006.

2006 Odor Study by Black & Veatch

In May, 2006, OWASA retained the firm of Black & Veatch to do a new odor study at the WWTP. The executive summary of the consultant's draft report dated September 18, 2006 is enclosed as Attachment 1. The complete version of the consultants' draft report of September 18, 2006 is available to anyone on request and is posted on the Wastewater section of o w Website, www.owasa.org.

The Black and Veatch report includes information on odor sampling at the WWTP, OWASA's odor monitoring at the WWTP using hydrogen sulfide monitors, ranking of odor sources, a survey and assessments of odor elimination technologies at other WWTPs, options for defining successful odor elimination, odor control evaluation, and the consultants' recommendations for odor program additions.

Black & Veatch conducted air and liquid sampling in June, 2006 to gather additional information about the treatment processes and their potential to release odors that may be noticeable off-site. The samples were analyzed and the results were used to rank the sources of odor at the WWTP. The draft report identified four areas as actual or potential off-site odor sources. The area of greatest estimated severity of off-site odor impact is the headworks, which contributes almost half of the overall odor at the WWTP. The headworks is followed in the odor rankings by the primary clarifiers, intermediate pump stations, and aeration basins.

The existing headworks is on schedule to be replaced with a new structure in the summer of 2007. The new headworks will be covered and the air beneath the covers will be exhausted to the existing odor scrubber. The 24-hour odor monitoring at the headworks in June, 2006 showed increasing hydrogen sulfide emissions from the late afternoon through early morning, and the new enclosed headworks is therefore expected to essentially eliminate this potential odor source.

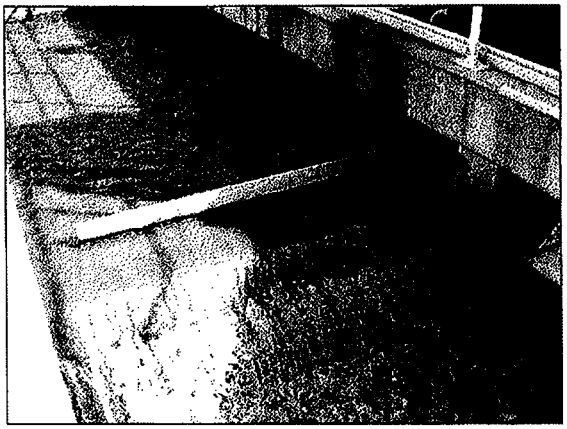
As an interim measure, OWASA staff is evaluating modifications to the existing chemical (hydrogen peroxide) application points to reduce the hydrogen sulfide emissions at the headworks until the new, odor controlled structure is completed.

Recently, the consultant provided information about odor standards and goals at various WWTPs where odor elimination is considered to be successful (Attachment 2). We believe this information will be very useful in defining successful odor elimination for the Mason Farm WWTP.

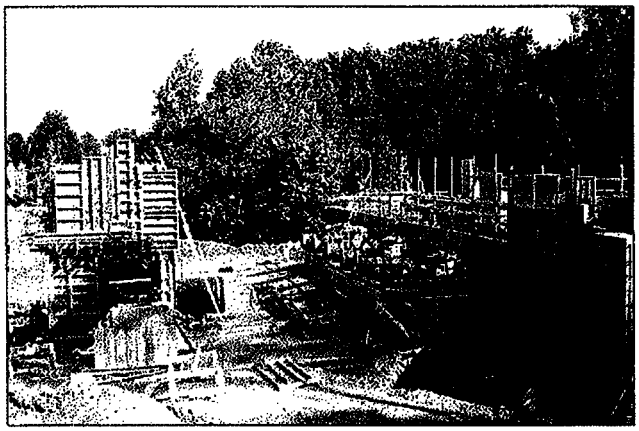
We estimate that the consultants' study will be complete in the spring of 2007. Additional items in the study will include use of computer modeling to estimate potential off-site odor conditions from on-site odor levels.

Improvements to be completed in summer of 2007

Our contractor has begun work on and is scheduled to complete a new headworks facility by the summer of 2007. The new headworks will be enclosed, and foul air from it will be treated in our odor scrubber installed in 2004.



Above: The existing open-air headworks, a significant odor source.



Above: The new enclosed headworks under construction in October, 2006.

Completion of the new headworks is now our highest priority for odor elimination. We expect this improvement will be a major step forward in successfully eliminating off-site objectionable odor.

Our contractor is also on schedule to complete in the summer of 2007 the installation of a foam removal system at the WWTP aeration basins, where wastewater undergoes biological treatment, in accord with the Special Use Permit.

Additional improvements authorized bv the OWASA Board of Directors

On November 9, 2006, based on odor sampling information from our consultants, the OWASA Board of Directors authorized staff to proceed with the following additional improvements as shown on Attachment 3:

- ✓ covering the exposed holding tanks at two wastewater pump stations in the interior of the WWTP site,
- ✓ covering devices called "splitter boxes" where wastewater from the headworks is channeled to and from solids settling tanks called "primary clarifiers," and
- ✓ installation of piping to capture and transport foul air from the enclosed "inlet" channel at the aeration basins for treatment.

We estimate that these improvements will cost $300,000 and will be complete in 2007. The next steps will include the detailed design work, bidding and contracting processes.

Communications with customers; definition of successful odor elimi

We held our most recent community meeting on September 27th as noted above. We provided a summary of our neighbors' comments and our responses as part of our quarterly report to the Town Council on November 1, 2006. On November 9th, the OWASA Board also received a staff report and neighbors' comments about our odor elimination program.

The next step in our public process will be further discussion of defining successful odor elimination. We expect to meet next with interested WWTP neighbors early in 2007. We expect to reach agreement with the neighbors on a proposed definition in the winter or spring, depending on the extent of discussion that is needed.

We maintain a Hotline, 537-4376, for citizens who wish to report odor from the WWTP and/or get project status information. We also send e-mail notices to our neighbors for whom we have electronic addresses about construction work and expected odor releases that may affect the nearby neighborhoods.

Conclusion

We believe that successfully eliminating objectionable off-site odor from the WWTP is a process that necessarily involves periodic evaluations and feedback from the community as key actions are completed.

Attachment 4 summarizes our expenditures totaling more than $4 million since 2000 for odor elimination at the Mason Farm WWTP and commitments for an additional $2.9 million of work by the summer of 2007. We believe that OWASA has demonstrated good faith and diligence in the odor elimination process by systematically identifying priority odor sources; determining and implementing odor elimination options; and then carefully assessing the effectiveness of improvements.

We look forward to additional discussions with WWTP neighbors and other interested stakeholders including the Town of Chapel Hill. We welcome any comments on this report and would be glad to respond to any questions.

Attachments:

1. Executive Summary of draft report dated September 18, 2006 from Black & Veatch, odor consultants
2. Odor elimination standards/goals at 34 wastewater treatment plants in the United States
3. Mason Farm Wastewater Treatment Plant Site Plan including additional improvements approved on November 9, 2006
4. OWASA's expenditures since 2000 for odor elimination purposes at the Mason Farm Wastewater Treatment Plant

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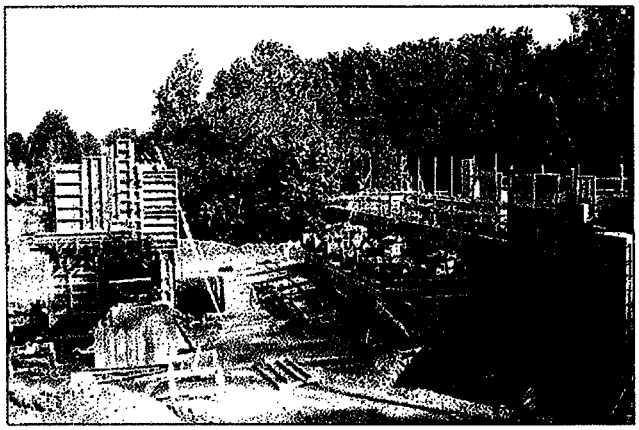

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Table ES1- Summary of Odor Sampling Data				
Location	**Sulfide (mg/L)**	**H_2S (ppm)**	**Detection Threshold (DT)**	**Remarks**
Liquid Process Units				
South Headworks (Pre Aerated Grit)	0.4 – 0.8	0.034 – 3.5	–	Liquid and air measured upstream of parshall flumes
North Headworks (Post Aerated Grit)	ND – 0.1	0.18 – 0.7	–	Liquid and air measured upstream of parshall flume
Primary Clarifier Influent Splitter Box (PC SB #1)	ND	0.27 – 1.1	1900 [2500]	H_2S & odor sampled @ parshall flume. Liquid sample downstream of parshall flume
Primary Clarifier – Inlet Well	–	0.06	1400	
Primary Clarifier – Surface	0.1 – 0.6	0.012 – 0.27	1900 [440]	
Primary Clarifier – Weir	–	0.07 – 0.47	450 [1200]	
Primary Clarifier Effluent Splitter Box (PC SB #2)	ND – 0.2	0.11 – 0.42	1600 [1200]	H_2S & odor sampled downstream of weirs. Liquid sampled upstream of weirs
Trickling Filter Inlet	–	0.025		
Intermediate Pump Station #1	–	0.006		
Intermediate Pump Station #2	ND	0.004 – 0.67	3100 [2800]	
Aeration Basin – Infl. Channel	ND	0.002 – 0.26	1500 [290]	
Aeration Basin – No Air Zones	–	0.004 – 0.39	1300 [1900]	Measured at cell 2A
Aeration Basin – Air Zones	–	0.001 – 0.007	150 – 320 [60-290]	Measured at cells 2C & 2D
Secondary Clarifier	–	0.002 – 0.003	140 [75]	Measured at surface
Secondary Scum Pump Station	–	ND	–	
Solids Processing Units				
Primary Sludge Fermenter PRV	–	> 250	–	
Anaerobic Digester PRVs	–	0.1	–	
Digester Gas Storage – Ambient	–	0.006	–	
Gravity Belt Thickener (GBT) – Waste Activated Sludge	–	2.9 – 4.1	–	2.9 measured when GBT was not in operation
Gravity Belt Thickener (GBT) – Primary Sludge	–	30 – 31	–	
Gravity Belt Thickener (GBT) – Room	–	4.9	–	
Sludge Loadout Truck Vent	–	20	–	
Existing Odor Control Units				
Scrubber Inlet	–	4.2 – 5.5	–	With mixing
Scrubber Outlet	–	0.03 – 0.08	–	
Biofilter Outlet	–	0.005 – 1.1	320 [85]	
Carbon Outlet	–	ND	–	

GBT = Gravity Belt Thickener; ND = Not detected; PRVs = Pressure Relief Valves.

[ ] Previous Hazen and Sawyer odor values shown in brackets

ODOR SURVEY DISCUSSION

Liquid Processes

Influent Structure. The two existing unenclosed headworks structures will be abandoned and replaced by new covered headworks facilities with foul air treated by the existing scrubber. H_2S near the parshall flumes ranged from 0.034 to 3.5 parts per million (ppm) at the south structure and 0.18 to 0.7 ppm at the north structure. The H_2S values are some of the highest at the plant, but are low compared to other facilities. No hydrogen peroxide was added to the influent at the time of sampling.

Primary Clarifier Influent Splitter Box (PC SB #1). Sulfide was non-detectable in samples taken downstream of the parshall flume in the splitter box, which indicates that most of the influent sulfide was released at the headworks. H_2S at the parshall flume ranged from 0.27 to 1.1 ppm. An odor value of 1900 detection threshold (D/T) was associated with an H_2S of 0.27 ppm. The threshold odor for H_2S is often reported as 0.0005 to 0.001 ppm, so 0.27 ppm H_2S would equal an odor value of 270 to 540 D/T. This indicates that other odorous compounds are present.

Primary Clarifiers. Sulfide ranged from 0.1 to 0.6 milligrams per liter (mg/L) in the basin, which indicates that sulfide is generated in the unit. The odor values at the inlet and quiescent surface are higher than from H_2S alone, so this indicates the presence of other compounds. In contrast, the odor at the weir is due to H_2S. Typically, most of the odor at primary clarifiers is from the weirs, but the Mason Farm WWTP has less odor at the weirs, perhaps due to a short drop. The H_2S at WWTP primary clarifiers is relatively low compared to other plants.

Primary Clarifier Effluent Splitter Box (PC SB #2). The high odor value of 1600 D/T associated with 0.12 ppm H_2S indicates that other compounds are present. High turbulence at PC SB#2 could strip out some compounds that were not emitted at the weirs.

Intermediate Pump Stations #1 & #2. Both intermediate pump stations are open to the atmosphere. The high odor value of 3100 D/T associated with 0.67 ppm H_2S indicates the presence of other compounds. Fermentate is discharged at this location to feed the "no air" zone of the aeration basins for biological phosphorus removal, so this could contribute to the odor.

Aeration Basins. The inlet channel odor value of 1500 D/T associated with 0.26 ppm H_2S indicates that other odorous compounds are present. The aeration in the influent channel would cause compounds to be stripped from solution. In the no air zones, the odor value of 1300 D/T associated with 0.39 ppm H_2S indicates the presence of other compounds. The no air zone odor is higher than similar tanks at other facilities, possibly due to a thick layer of scum. At the aerobic cells the odor values of 150 and 320 D/T are higher than for H_2S alone and are due to other organic compounds. These low odor values are typical for well-operated aeration basins.

Secondary Clarifiers. An odor value of 140 D/T associated with 0.002 ppm H_2S, indicates that the odor is due to organic emissions. The low odor value measured is typical for final clarifiers.

Solids Handling Processes

Primary Sludge Fermenter. H_2S samples were taken at the vent located on the top of the fermenter roof and the readings were greater than 200 ppm. This problem will be corrected by preventative maintenance of the vents.

Solids Thickening. H_2S inside the plastic screens of the GBT units in operation at the time of sampling averaged about 30 ppm for the fermenter sludge, and 4 ppm for the WAS. Ambient air samples taken in the room averaged about 5 ppm.

Anaerobic Digesters. The H_2S samples taken at the vents of digesters no. 2, 3, and 4 averaged about 0.1 ppm. An ambient air sample near digester no. 1 showed 0.006 ppm H_2S.

Digested Biosolids Storage Tanks. The air inside the storage tanks is sent to a scrubber for odor treatment. No samples were taken at this location.

Sludge Loadout Truck. H_2S measurements at the top of the truck next to the vent while the truck was filling averaged about 20 ppm. The air volume is relatively low at about 67 cfm.

Existing Odor Control Units

Biofilter. The odor value at the biofilter was 320 D/T associated 0.039 ppm H_2S, indicates the odor was due to compounds other than H_2S. The low outlet odor indicates good removal based on the bag sample, which is collected over a 5 minute period. The higher H_2S measurements found at some locations indicates that H_2S may be breaking through in places where the media has dried out. Increased media sprinkling appears to alleviate this problem.

Scrubber. The odor scrubber treats odors generated by the existing biosolids storage tanks. The scrubber is oversized and will be used to treat the new headworks structure and new Morgan Creek pump station scheduled to be completed in the summer of 2007. Scrubber inlet H_2S was 4.2 to 5.5 ppm when the air in the biosolids storage tanks was turned on. The outlet H_2S ranged from 0.03 to 0.08 ppm, which yields an H_2S removal efficiency above 98 percent, and demonstrates good response to a slug load and effective treatment in the existing scrubber.

Carbon Adsorption. A carbon adsorption unit is currently used to treat the biogas storage tanks (digester no. 1) odors. The H_2S reading at the outlet of the carbon unit was non-detectable.

OWASA MONITORING

In addition to the sampling data collected during the B&V survey, extensive additional H_2S data was collected by OWASA both before and after the survey. This data was collected using continuous recording OdaLog meters, so that 24 hour data was collected. The meters were placed at various unit processes at the plant to measure how emissions vary at different times of day. This information was applied to adjust the odor values measured during the B&V survey to be more representative of the peak values that occur over a longer time span.

ODOR SOURCE RANKING

Based on the measured and calculated H_2S and odor values, odor sources at the Mason Farm WWTP were ranked according to the estimated severity of off-site impact. At the Mason Farm WWTP, all the remaining untreated sources of odor are relatively close to the ground with a low-velocity discharge from an open liquid surface. The main difference in the sources is their size, so a comparison must consider the overall surface area. The surface areas of the untreated sources at Mason Farm are shown in ***Table ES2***, along with the peak odor values measured during the B&V survey or calculated from the extended OWASA OdaLog data. The surface area is then multiplied times the odor value to obtain the relative magnitude of severity.

Table ES2 – Maximum Detection Threshold (D/T) x Surface Area (SA)

Group ID	Units	Total Surface Area (SA, ft²)	Maximum Detection Threshold (D/T)	DT x SA x 1000	
				Subtotal	Total
Influent /Headworks					**62,688**
Old Headworks	1	2,188	28,350	62,030	
Old Morgan Creek PS	1	57	11,550	658	
Primary Clarifiers (PCs)					**30,308**
PC Influent Splitter Box	1	251	24,750	6,212	
PC Inlet Well	3	236	1,400	330	
PC Surface	3	10,989	1,900	20,879	
PC Weir	3	1,696	450	763	
PC Effluent Splitter Box	1	472	4,500	2,124	
Intermediate Pump Stations (IPSs)					**27,456**
IPS No. 1	1	140	62,400[1]	8,736	
IPS No. 2	1	300	62, 400	18,720	
Aeration Basins (ABs)					**14,088**
AB Influent Channel	1	1,925	1,500	2,888	
AB No Air Zones[2]	2	5,000	1,300	6,500	
AB First Aerobic Zones[3]	4	10,000	320	3,200	
AB Last Aerobic Zones[4]	4	10,000	150	1,500	

Notes:
(1) Odor data not available. Assume D/T value equal to IPS No. 2.
(2) Include AB Cells 2B & 2A
(3) Include AB Cells 1E, 1F, 2D & 3A
(4) Include AB Cells 1C, 1B, 3B & 2C

ODOR CONTROL TECHNOLOGY ASSESSMENT

The vapor-phase treatment technologies that are typically considered for wastewater applications include: wet scrubbers, carbon adsorption, biofiltration and biotrickling filter treatment. The report describes these technologies in detail and discusses their main advantages and disadvantages.

ODOR CONTROL METHODOLOGIES SURVEY

As part of the OWASA odor study project, Black & Veatch compiled information on odor control from 31 wastewater treatment facilities in the U.S. The purpose of the investigation was to determine how "best in class" facilities are addressing odor control. The key findings of the plant survey are summarized in ***Table ES3***.

Facility Survey Findings

All but one of the facilities surveyed have covered and treated headworks. The existing headworks at the Mason Farm WWTP is not covered and treated, so it may be a strong source of off-site odor. In keeping with the best practice at other facilities, OWASA has planned to cover the new headworks and treat the exhaust air in the existing wet scrubber which was sized to accommodate the airflow and H_2S loading. When this is accomplished in 2007, the Mason Farm WWTP will have provided headworks treatment equal to the best in class.

Nineteen of the facilities have contained and treated solids handling processes. Similar to the most conscientious facilities, OWASA currently provides odor control for their solids processes. Eighteen facilities have covered and treated primary clarifiers. The H_2S emissions measured at the Mason Farm facility are low compared with other facilities we have tested. At the present time, the primary clarifiers at the Mason Farm WWTP are not covered and treated, but the units are operated to minimize sulfide generation and were found to have lower H_2S emissions than most plants.

Few of the plants have covered and treated aeration basins. Emissions from aeration basins are organic odors that are not strong or offensive. Like most of the facilities surveyed, the Mason Farm aeration basins have low odor levels and are not covered and treated.

The odor control technologies at the plants surveyed are generally accepted technologies that can be considered "best in class." The odor control technologies currently employed at the Mason Farm WWTP are well suited to their specific applications and recent measurements verified that they are providing highly effective treatment.

One element that "best in class" facilities share is a strong commitment to maintaining good odor control. OWASA has demonstrated their commitment to the public by setting an odor elimination goal of no offensive off-site odor from the Mason Farm WWTP. As part of the Mason Farm expansion, OWASA included extensive new odor control improvements. OWASA has kept neighbors well informed and has encouraged participation in public meetings to discuss odor issues and obtain feedback, so that further improvements can be implemented, if necessary.

Table ES3 – Plant Survey Summary

Number	Facility Name	Capacity mgd	Location	Receptor Data: Buffer	Neighborhood	Complaints	Covered Processes: H	P	A	F	S	Odor Control: H	P	A	F	S
1	Central San WWTP	45	CA	M	I, H	Few	●		●		●	WS		NT		NT
2	Corona WWTP #1/#2	10	CA	W	I	0	●	●			●	BF	BF			WS
3	El Toro Water Recycling Plant	6	CA	M	P,H	Few	●	●				BF	BF			
4	Elsinore Regional WRF[1]	8	CA	M	I,R	0	●					WS				
5	Encina Water Pollution Control Facility	36	CA	N	R,H	2	●	●	●		●	BT,AC	BT,AC	WS		WS,AC
6	Goleta WWTP[2]	6	CA	W	U	0	●					AC				
7	Hale Ave. Resource Recovery Facility	18	CA	N	R	0	●	●				WS	WS			
8	Joint Water Pollution Control Plant	350	CA	N	R,H,I	Few	●	●	●[3]		●	WS,AC	WS,AC			AC,BF
9	Meadowlark Water Reclamation Plant	2	CA	N	R,I	Few	●			●		WS			WS	
10	Moreno Valley WRF	16	CA	W	U,I,A	0	●				●	WS				WS
11	Orange Co. San District - Plant 2	153	CA	N	R	0	●	●				WS	WS			
12	Oso Creek WRP	2	CA	N	R	0	●				na	WS				
13	Oxnard Wastewater Treatment Plant	32	CA	N	R,I,A	0	●				●	WS				WS
14	San Luis Obispo WRF	5	CA	N	R,I	Few										
15	Ina Road Plant	40	AZ	N	I,R,H	0	●	●			●	WS,AC	WS			AC
16	Kyrene Water Reclamation Plant	5	AZ	N	I	0	●					BF				
17	Mesa Northwest WRP	30	AZ	N	R	0	●	●	●		●	WS	WS	AC	AC	WS
18	Scottsdale Water Campus	12	AZ	N	R	0	●	●	●	●	●	WS	WS	AC	AC	
19	Wildcat Hill WWTP[2]	8	AZ	W	I,U	Few	●	●				P[4]	[5]			
20	Clark County WWTP	88	NV	N	R	0	●	●			●	BF	BF			WS
21	Las Vegas WPCF[2]	71	NV	N	P	0	●				●	BF				WS
22	Mandarin Water Reclamation Facility	19	FL	N	R,H	24	●	na			●	BF				BF
23	St. Pete's Southwest WRF	14	FL	N	R,H,P	Few	●					WS,BF				
24	Southwest WWTP	10	FL	W	U,R	0	●					BF				
25	Arlington East WWTP	13	FL	M	R,I	Few	●	●			●	BT	BT			WS
26	Indian Creek Middle Basin	20	KS	N	R	Few	●	●	●		●	WS	WS	WS[6]		WS
27	Springfield Southwest WWTP	10	MO	M	R,H	Few	●	●			●	WS	BT			BF
28	Rowlett Creek WWTP	15	TX	M	R,P	Few	●	●			●	WS	ASD			WS
29	Wilson Creek WWTP	34	TX	M	R	Few	●	●			●	ASD	ASD			WS
30	Broomfield WWTP	10	CO	M	R	Few	●	●			●	BF	BF			BF
31	Reading WWTP	27	PA	M	R	Few	●	●			●	WS	WS			WS

Footnotes:
1. Ozidation Ditch
2. Trickling Filter
3. Pure Oxygen Process
4. Airflow Vented to Primary Clarifier
5. Primary Vented to Atmosphere
6. Wet Scrubber provides no treatment

Buffer:
- N No Buffer
- M Moderate (<2,000 ft)
- W Wide (>2,000)

Complaints:
- Annual basis

Neighborhood:
- A Agricultural
- H Highway
- I Industrial
- P Park/Golf Course
- R Residential
- U Undeveloped

Covered Processes:
- H Headworks
- P Primary Clarifiers
- A Aeration Basin
- F Final Clarifiers
- S Solids Processing

Odor Control:
- WS Wet Scrubber
- BF Biofilter
- AC Activated Carbon
- BT Biotrickling Filter
- ASD Activated Sludge Diffusion
- NT No Treatment

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OPTIONS FOR DEFINING SUCCESSFUL ODOR ELIMINATION

Odor regulations and guidelines are most effective when specific criteria are used to define compliance. The report discusses several well-defined approaches in detail including:

1. Annoyance criteria (subjective categories),
2. Complaint criteria (numbers of complaints),
3. Ambient odor detection threshold criteria,
4. Ambient odor intensity criteria,
5. Compound criteria (mass concentration)
6. Episode duration-frequency criteria ("odor-hours")
7. Equipment performance criteria
8. Source emission criteria (threshold or mass concentration)
9. Best available control technology criteria (i.e. industry standard).

ODOR CONTROL EVALUATION

This section discusses odor treatment technologies that can be used for specific applications at the Mason Farm WWTP. For purposes of consideration, solutions were developed for each of the remaining uncovered and untreated odor sources.

Alternative Development

The areas for odor treatment included the primary clarifiers, intermediate pump stations, and the aeration basins. In a workshop meeting with OWASA on August 29, 2006, various treatment technologies were reviewed and it was determined that for the relatively low H_2S concentrations, activated carbon offered the best solution. OWASA determined that activated carbon would be employed for all the new applications. The odor control options are listed on ***Table ES4.***

Economic Evaluation

Capital costs included the entire carbon system equipment including vessel, media, fan, and local ductwork, and concrete pad. The carbon system costs are based on deep-bed units of fiberglass construction. High capacity media was used for the primary clarifier and intermediate pump station areas, while virgin carbon media was assumed for the aeration basin sources.

The base equipment costs were increased by 30 percent to account for a concrete pad and installation costs. Cover costs for small areas were obtained by multiplying the surface area by $25/sf, which is typical for flat aluminum covers. For the larger areas a cost of $35/sf was assumed to include extra ductwork. Weir cover costs are based on similar installations. Final construction costs estimate, the installed equipment and cover costs were increased 40 percent to account for site work, electrical, engineering, legal costs, and contingencies. Capital costs for covers and odor control systems are shown in ***Table ES4.***

Table ES4 – Summary of Capital and O&M Costs

	S.A.	Air Flow	Capital Cost			O&M Cost	Odor x S.A. x 1000	% of Total
			Cover	O.C. System	Total			
	sf	cfm	$	$	$	$	-	%
Primary Clarifiers								
Splitter Boxes #1 & #2	723	766	25,000	56,000	81,000	6,900	8,336	11.1
PC Basins Full Covers	12,921	5,045	630,000	140,000	770,000	12,800	21,972	29.1
PC Basins Weir Covers[1]	1,696	515	280,000	50,000	330,000	6,100	763	1.0
Intermediate Pump Stations								
IPS #1 & #2	440	602	15,000	50,000	65,000	7,300	27,456	36.5
Aeration Basins								
Influent Channel	1,925	1,200	Covered	66,000	66,000	6,800	3,234	4.3
New No Air Zones	10,000	3,920	490,000	125,000	615,000	12,000	6,500[2]	8.6
Aerobic Zones	30,000	22,176	1,470,000	420,000	1,890,000	50,000	7,050[3]	9.4
Total Odor							75,311	100

[1]The weirs are included in the full cover option

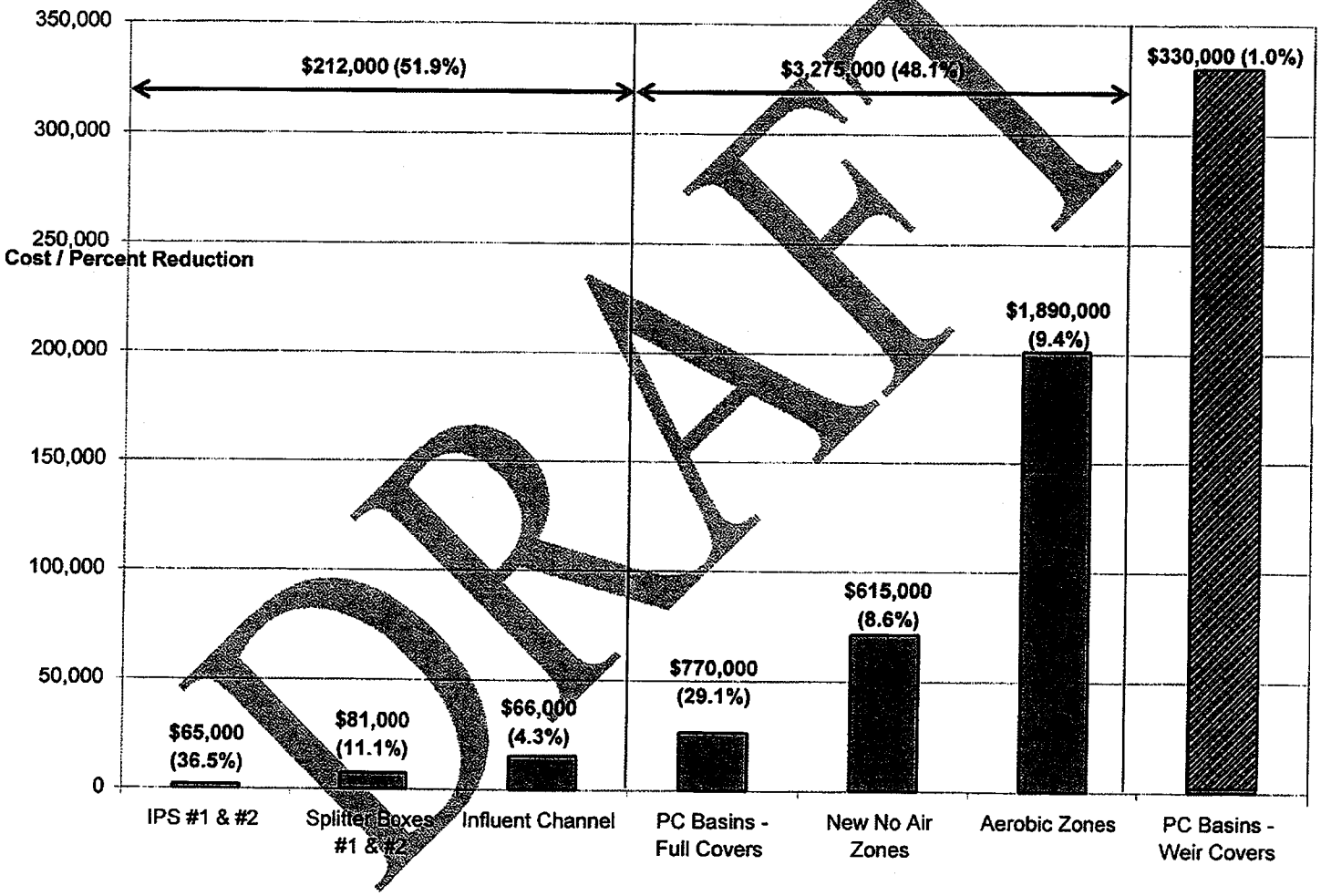
[2]It was assumed that improved scum removal would reduce odor by half at the new "no air zones" while the surface area doubles, so the odor magnitude remained the same as with the current "no air zones"

[3]Value of 4,700 for S.A. of 20,000 s.f. adjusted upwards by 1.5 for S.A. of 30,000 s.f.

The operation and maintenance (O&M) costs include power, parts, and carbon replacement as needed. The O&M costs assume all maintenance including media replacement is done by plant staff, but a service contract could be obtained with various equipment vendors to perform these tasks. The O&M costs for each of the designated alternatives are presented in ***Table ES4***. The last column lists the percentage that each component contributes to the total odor magnitude of the sum of all the new sources being considered for treatment.

To illustrate cost/benefit the cost can be divided by the percent reduction as shown in ***Figure ES1***. The numerical values of cost and percent reduction are shown for each alternative. IPS #1 & #2, PC Splitter Boxes #1 & #2, and aeration influent channel have the lowest cost benefit values and also the lowest costs. The total cost of all three alternatives is $212,000 with an odor reduction of 51.9 percent. The alternative of PC Basins –Full Covers has a relatively low cost benefit, but the cost is much higher at $770,000. The PC Basin – Full Covers, New No Air Zones, and Aerobic Zones have a total cost of $3,275,000 with an odor reduction of 48.1 percent. The last alternative of PC Basins –Weir Covers has a very high cost/benefit value.

Figure ES1 - Cost Benefit Chart



ODOR ELIMINATION PROGRAM ADDITIONS

In response to public concerns about odor at the Mason Farm WWTP, OWASA established a comprehensive odor elimination program. The complete odor elimination program addresses all aspects of odor control at the facility including: odor control improvements, operational issues, monitoring requirements, and odor complaint recording and response. The odor elimination program is dynamic and OWASA will continue to update the program as necessary to improve the effectiveness of their odor control and their response to the public.

Currently Planned Odor Improvements

As part of their current odor elimination program, OWASA installed new odor scrubbers designed with extra capacity, so they could treat selected additional processes as they were completed and put into operation. Those facilities are scheduled for completion in summer 2007.

The planned odor improvements include:

- Covering the new headworks with exhaust air treated in the existing wet scrubber
- Conveying the new biosolids dewatering facility exhaust air to the scrubbers
- Covering the aeration basin inlet channel
- Improving scum removal on all aeration cells including new "no air zones."
- New digester gas piping (to be completed in 2006).

The odor improvements currently planned will result in a significant drop in off-site odor both in intensity and frequency. The planned improvements could reduce odor to the degree that they are no longer a nuisance.

Odor Monitoring Program

OWASA has developed a comprehensive odor monitoring program at the Mason Farm WWTP using several continuous readout OdaLog H_2S meters. The units can be employed for both ambient air monitoring and odor control system performance verification.

Ambient Air Monitoring. The portable meters have been placed at several process locations at the Mason Farm WWTP to measure the variations in process emissions and determine when peak odors occur. The portable meters will continue to be used in this manner with the meters rotated to different process locations, so that they are monitored on a periodic basis. In addition to the portable OdaLog units OWASA has purchased a fixed OdaLog system. After discussion between B&V and OWASA staff, it was determined that the most useful location for this instrument was the roof of the digester building, where it will alert operators of any problems with the pressure relief valves, so they can take quick action to repair or replace them.

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Odor Control System Performance Verification. The moveable OdaLog meters have also proven useful in monitoring "around the clock" performance of odor control systems such as the biofilter. OdaLog monitoring at the biofilter showed that there was some odor breakthrough when peak odors occurred. A timer was installed on the sprinkler system to ensure that the biofilter was more consistently wetted.

OWASA will continue to use their portable OdaLog monitors for odor control system performance verification as follows:

- Monitor biofilter periodically to ensure adequate moisture is maintained. Track long-term performance to anticipate media replacement.
- Monitor wet scrubbers, performance periodically by measuring inlet and outlet H_2S. Automatic controls maintain pH and ORP, so the performance remains stable.
- Periodically monitor the performance of the proposed new carbon units. The carbon units will have three sample taps, so operators can track the depletion of the media.
- Periodically monitor the headworks to confirm that influent chemical treatment is effective. The monitoring will allow operators to adjust chemical dosages seasonally in response to changes in the influent sulfide loads.

Attachment 2

Odor standards and/or goals for various wastewater treatment plants in the U.S.

No.	Facility Name	Location	Complaints/Year	State, Local, or Agency Regulation	Self-imposed Standards or Goals
1	Central San WWTP	CA			
2	Corona WWTP #1/#2	CA	~1-2	• AQMD (Air Quality Management District)	• Measure success by conducting daily tests and meeting permit requirements
3	El Toro Water Recycling Plant	CA	0 (but some complaints in the collection system)	• Need to measure H_2S for their permit, always have readings of 0	
4	Elsinore Regional WRF	CA			
5	Encina WPCF	CA			
6	Goleta WWTP	CA	0		• Measure success by public comment • Don't feel like they need a formal odor control program
7	Hale Ave. Resource Recovery Facility	CA			
8	Joint WPCP	CA			
9	Meadowlark WRP	CA	~2	• No limits or rules imposed by local government	• Want to be "good neighbors" • No measure of "success", but goal is 0 odor events
10	Moreno Valley WRF	CA			
11	Orange Co. San District - Plant	CA			
12	Oso Creek WRP	CA			
13	Oxnard WWTP	CA	Occasional; can't think of last one	Imposed by State • APCD (Air Pollution Control District) • H_2S must be less than 5 ppm • Only violate standard when odor control equipment is down	• Odor control response protocol • Plant measures its success by making their customers happy
14	San Luis Obispo WRF	CA			
15	Ina Road Plant	AZ	NA	NA	NA
16	Kyrene WRP	AZ	0 (have proven that odor complaints are in collection system, not the plant)	• Must follow state air pollution regulations for generators and scrubbers	• Don't have a written definition of success, but success would probably no more than 2 complaints per year
17	Mesa Northwest WRP	AZ	None (over the past 3 years)	Imposed by County (Maricopa) • < 0.03 ppm H_2S at the fence line	• Zero odor complaints • pH and ORP are kept at about 9 and 800 mV for packed tower scrubbers • To meet County requirements at all times
18	Scottsdale Water Campus	AZ	≤ 1 (on average)	Imposed by County (Maricopa) • < 0.03 ppm H_2S at the fence line • Monitoring records maintained on site • O&M plan on site for odor control system	• Zero odor complaints • 99% H_2S removal efficiency for the wet scrubber
19	Wildcat Hill WWTP	AZ	None	A.A.C. R18-2-730.H • The permittee shall not allow H_2S to be emitted from any location in such a manner and	• Zero odor complaints • Replace activated carbon media when H_2S breakthrough occurs at 75% of the carbon bed

				amount that the concentration of such emissions into the ambient air at any occupied place beyond the premise on which the source is located exceeds 0.03 ppmv for any average period of 30 minutes or more	
20	Clark County WWTP	NV			
21	Las Vegas WPCF	NV	≤ 2	• No numerical limit for H_2S at the fence line • Air Quality Permit/Section 43 – Facility shall be operated in a manner such that odors will not cause a nuisance – On-site, ambient air monitoring is required. Nine years of monitoring data for H_2S and ammonia have been recorded at or near the fence line of this facility. In 2002, DAQEM and the City of Las Vegas agreed to discontinue the monitoring due to the low level of pollutant concentrations being detected after controls had been added to the facility. No further monitoring is required by this modification • NPDES Permit – There shall be no objectionable odors from collection system, treatment facility or disposal area, or biosolids treatment, use, storage, or disposal area that the Permittee owns or operates	• Zero odor complaints • Have a policy in place to do an immediate check of the plant and report back to the person that called; explain if a problem is found and what have been done to correct the problem • ORP is set at 2,000 mV and pH at 7.2 for packed tower chemical scrubbers
22	Mandarin WRF	FL	NA	• No limits but rules imposed by local government • Rules: – 5 complaints within 90 days about a facility will initiate a cease and desist order with potential fines – The complaints must be validated by City staff with a "sniff" test. The same person can call 5	• 0 ppm H_2S at the fenceline • 98% removal efficiency for H_2S with no secondary treatment • 95% H_2S removal efficiency for H_2S with secondary treatment and secondary phase polishing systems

				times in one day about an incident and an order will be issued	
23	St. Pete's Southwest WRF	FL			
24	Southwest WWTP	FL	NA	• No limits but rules imposed by local government • Rules: – 5 complaints within 90 days about a facility will initiate a cease and desist order with potential fines – The complaints must be validated by City staff with a "sniff" test. The same person can call 5 times in one day about an incident and an order will be issued	• 0 ppm H_2S at the fenceline • 98% removal efficiency for H_2S with no secondary treatment • 95% H_2S removal efficiency for H_2S with secondary treatment and secondary phase polishing systems
25	Arlington East WWTP	FL	NA	• No limits but rules imposed by local government • Rules: – 5 complaints within 90 days about a facility will initiate a cease and desist order with potential fines – The complaints must be validated by City staff with a "sniff" test. The same person can call 5 times in one day about an incident and an order will be issued	• 0 ppm H_2S at the fenceline • 98% removal efficiency for H_2S with no secondary treatment • 95% H_2S removal efficiency for H_2S with secondary treatment and secondary phase polishing systems
26	Indian Creek Middle Basin WWTP	KS	4 in year 2005	No	No
27	Springfield Southwest WWTP	MO	2 to 3 per year	• No limits but rules imposed by local government	Maintain "good neighbors" status
28	Rowlett Creek WWTP	TX	3 to 4 per year	• 0.3 ppm at the fence line	Try to keep discharge from scrubbers below 0.1 ppm
29	Wilson Creek WWTP	TX	3 to 4 per year	• 0.3 ppm at the fence line	Try to keep discharge from scrubbers below 0.1 ppm
30	Broomfield WWTP	CO		• Colorado Air Quality Control Regulation 2 limits the D/T at the property line to 7 for municipal WWTPs adjacent to residential or commercial property • The allowable D/T is 15 if the adjacent land is zoned for non-commercial and non-residential uses	
31	Reading WWTP	PA	1 to 2 per year	• State Department of Environmental Protection requires monitoring and reporting of wet scrubber performance • Two-stage Primary	Measure success by conducting daily tests and meeting permit requirements

				Scrubber System – 99% H_2S removal for inlet H_2S >20 ppm Max outlet H_2S 0.2 ppm for inlet H_2S <20 ppm • Single-stage Solids Scrubber System – 90% H_2S removal for inlet H_2S >10 ppm Max outlet H_2S 1 ppm for inlet H_2S <10 ppm	
32	Santa Cruz WPCF[1]	CA	< 5	No	No
33	Conway WWTP[2]	SC	2	No	No
34	Myrtle Beach WWTP[3]	SC	Couple	No	• Respond to all complaints by investigating the surrounding area and equipment to possibly identify the source and make any corrections or changes to minimize odor • Try to maintain the pH @ 10 or more for the wet scrubbers • Goal is to maintain ≤ 1.0 ppm dissolved sulfides in incoming wastewater with Bioxide addition at major pump stations

Abbreviations:

A.A.C = Arizona Administrative Code
DAQEM = Department of Air Quality and Environment Management
NA = Not Available
WRF = Water Reclamation Facility
WRP = Water Reclamation Plant
WPCP = Water Pollution Control Plant
WWTP = Wastewater Treatment Plant

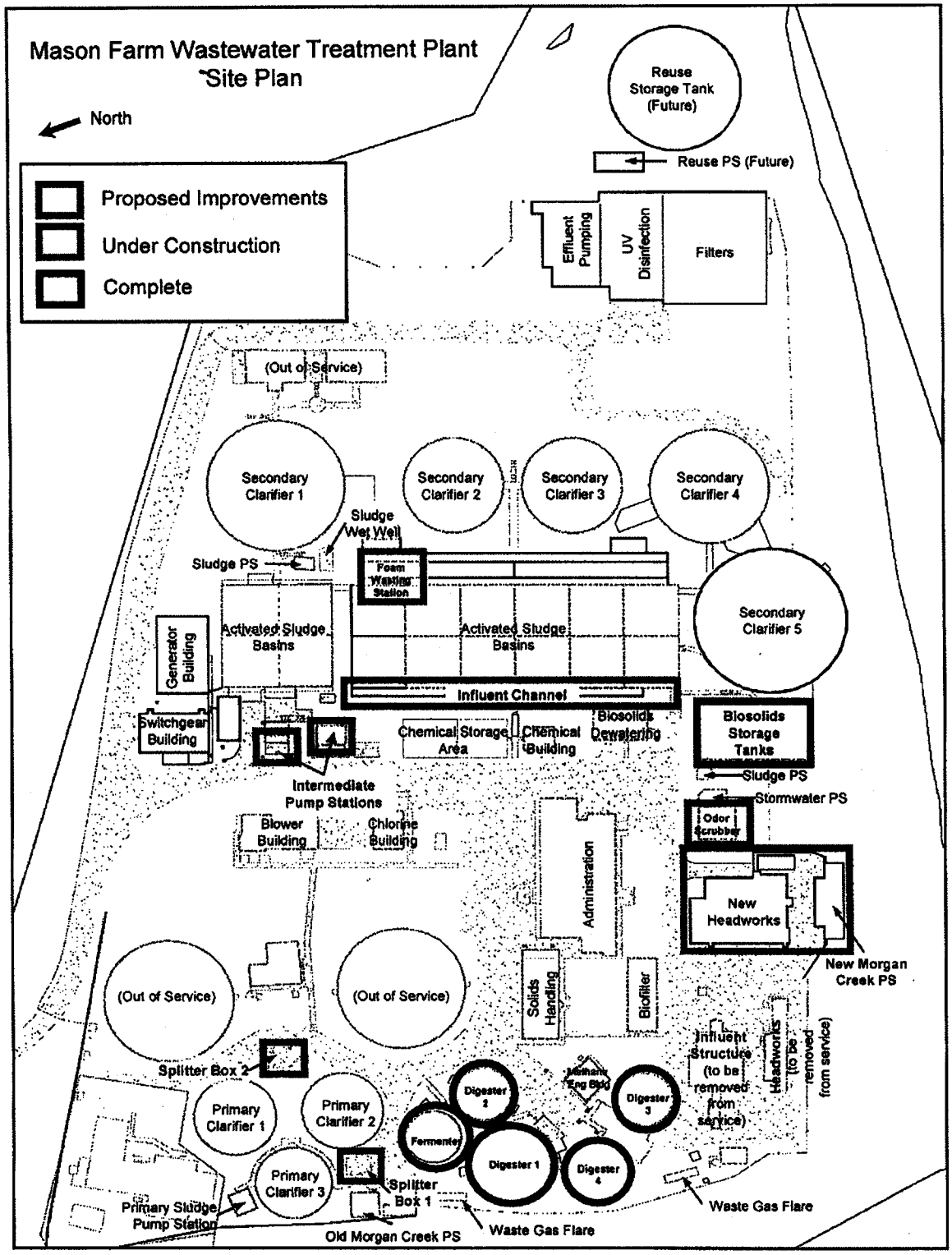
Footnotes:

[1] A 17 MGD plant with a buffer distance of 200 ft. Neighborhood consists of parks and residential area. The secondary treatment process includes trickling filters with solids contact. Anaerobic digesters and centrifuges are used for solids processing. The plant currently covered all processes except for secondary clarifiers. The plant completed an odor control project about two years back and is currently using vapex hydroxyl fog odor control system and ORT with bleach followed by carbon filters.

[2] A 4 MGD plant with a buffer distance of 800 ft. Residential neighborhood. The plant currently does not have any odor control nor covered processes. Planning to cover headworks in the future.

[3] A 17 MGD plant with a buffer distance of 200 to 500 ft. Neighborhood includes residential, commercial, and some undeveloped area. It is an activated sludge plant with extended aeration, rotating biological contactors, and aerated lagoon. Solids handling processes consist of aerobic holding tanks, dissolved air floatation, belt filter presses, and composting facilities (to compost belt press cake). The plant currently covers headworks, grit tanks, and splitter boxes. Wet scrubbers are used for the covered areas and a masking agent is used for the uncovered areas. Bioxide is injected into the incoming waste stream at a couple of major pump stations to minimize amount of H_2S released.

Attachment 3



Attachment 4

Odor elimination program costs at the Mason Farm Wastewater Treatment Plant

IMPROVEMENTS COMPLETED AT THE WWTP AS OF SEPTEMBER, 2006	YEAR COMPLETED	APPROXIMATE COST
Construction of a biofilter to treat foul air from the solids handling facility	2000	$350,000
Abandonment of "trickling filter" (open air facility) treatment process.	2002	--
Covering biosolids storage tanks and installing an odor scrubber to treat foul air from them	2004	$666,000
Hazen & Sawyer odor study	2004	$78,000
Installation of natural gas pilot light to ensure more reliable burning of gas from digester	2004	$4,000
Improvements in fermentation and gravity belt thickener operation to reduce the quantity of odorous solids returned to the aeration basins	2005	$500,000
Establishment of an in-house odor monitoring program	2005	$20,000
Replacement of one digester cover	2005	$578,000
Installation of fixed cover structures on solids digesters	2005	$1,600,000
Purchase of "OdaLog" odor monitoring equipment and odor sampling at various locations around the WWTP	2006	$9,000
Replacement of underground digester gas piping with new aboveground pipes	2006	$214,000
Total costs for completed improvements		***$4,019,000***

IMPROVEMENTS TO BE COMPLETED BY SUMMER, 2007; CURRENT ODOR STUDY	ESTIMATED COMPLETION	ESTIMATED COST
Construction of new, covered "headworks" where wastewater enters the plant (captured foul air to be treated in the odor scrubber)	Summer 2007	$2,200,000
Covering "splitter boxes" that carry wastewater to and from "primary clarifiers" (settling tanks for removal of wastewater solids); captured foul air to be treated in carbon filters	Summer 2007	$300,000
Improved foam removal at aeration basins (tanks where biological treatment occurs)	Winter 2006-07	$196,000
Tie-in of exhaust air pipe from the new Morgan Creek Pump Station to the odor scrubber	Summer 2007	$50,000
Septage receiving station improvements (improved washdown area and odor containment)	Summer 2007	$30,000
Treat foul air from the biosolids dewatering equipment to be installed in 2007	Summer 2007	$50,000
Black & Veatch odor study (costs to date)	Spring 2007	$73,000
Total costs for improvements underway and pending		***$2,899,000***
Overall costs of completed and committed work		***$6,918,000***