ODOR CONTROL EVALUATION REPORT

for the

NAUGATUCK WATER POLLUTION CONTROL AUTHORITY

and

VEOLIA WATER NORTH AMERICA - NAUGATUCK

November 2009

WRIGHT-PIERCE

Engineering a Better Environment

November 19, 2009
W-P Project No. 10881K

Mr. John Batorski, Plant Manager
Veolia Water North America- Northeast, LLC
Naugatuck Water Pollution Control Facility
500 Cherry Street
Naugatuck, CT 06770

Subject: Naugatuck Water Pollution Control Facility
Odor Control Evaluation Report

Dear John:

Please find enclosed one copy of the Odor Control Report and an electronic version for your use. We have also sent three copies to Mark Zimmerman and a copy to Jon Hoisak. As you are aware, the intent of this report is to satisfy the requirements of the Connecticut Department of Environmental Protection Consent Order.

This report has been revised to address the review comments on the draft reports from representatives for Veolia and the Borough of Naugatuck, and as discussed at several review meetings and phone calls through October and November. It was our understanding that the desire was for this report to provide recommendations which optimize the ability of the existing facility to comply with Connecticut Regulations Section 22a-174-23. The final recommendations do not to include improvements for on-site building interior odors that do not directly relate to off-site odors. It was also our understanding that capital improvements to processes that indirectly impact odors were not to be considered with these immediate recommendations, but that such improvements may need to be addressed in the future as part of a more extensive facility upgrade if/when needed and as funding becomes available. Also, as discussed at the meeting and conference call, there is the possibility that additional odor control improvements may still be needed in the future.

The report concludes that Veolia has implemented and continues to implement a variety of capital and operational improvements to reduce odors. The report also concludes that there are a variety of odor sources which require improved containment, ventilation and/or exhaust odor scrubbing systems to supplement the Veolia efforts. These odor sources include:

- Dewatered Sludge Cake Receiving Area.
- Septage Receiving Area (Veolia has recently completed improvements to address this source)
- Sludge Storage Tank with cloth cover
- Primary Settling Tanks with cloth cover
- Fugitive emissions from Screening and Wetwell Area during high wetwell levels

169 Main Street, 700 Plaza Middlesex
Middletown, CT 06457 USA
Phone 860.343.8297 | Fax 860.343.9504

- Fugitive emissions from various sludge handling sources
- Collection system vacuum truck dump station
- Dewatered sludge bypass pumping discharge station

The report presents the recommended improvements as well as estimated capital costs. Please let me know if you have any questions or comments.

Sincerely,
WRIGHT-PIERCE

John W. Braccio., P.E.
Vice President

Jon Hoisak
Mark Zimmerman

ODOR CONTROL EVALUATION REPORT

FOR THE

NAUGATUCK WATER POLLUTION CONTROL AUTHORITY

AND

VEOLIA WATER NORTH AMERICA - NAUGATUCK

NOVEMBER 2009

Prepared By:

Wright-Pierce
169 Main Street
Middletown, CT 06457

ODOR CONTROL EVALUATION REPORT
WATER POLLUTION CONTROL FACILITY
NAUGATUCK, CONNECTICUT
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EXECUTIVE SUMMARY

BACKGROUND

The Connecticut Department of Environmental Protection (DEP) has issued a Consent Order in response to DEP observations and periodic odor complaints from residents in the surrounding community of the Naugatuck Wastewater Treatment Facility (WWTF). Veolia Water NA operates the WWTF for the Borough of Naugatuck under a long-term agreement. The Consent Order requires the Naugatuck Water Pollution Control Authority (WPCA) to identify the sources of odors at the facility that may be responsible for off-site odor impacts, and to develop a plan and schedule for mitigating any off-site impacts associated with the WWTF. On behalf of the Naugatuck WPCA, Veolia Water NA entered into an engineering services agreement with Wright-Pierce to perform an odor control evaluation to meet the requirements of the Consent Order.

The Consent Order requires the Naugatuck WPCA to retain a qualified consultant to carry out an odor control evaluation. The requirements for the scope of the evaluation included:

- Identification of the sources, causes and characteristics of odors emanating from the facility, and the daily frequency and duration of the activity which cause the generation of such odors.
- Evaluation of alternative remedial actions to abate the odor impacts.
- Development of a recommended plan including an estimate of the cost for each proposed remedial action, and supporting justification as to why the remedial action will abate the odor impacts.
- Development of an implementation schedule to perform the recommended remedial actions.
- A detailed plan for monitoring the effectiveness of the recommended remedial actions.

SUMMARY OF FINDINGS AND CONCLUSIONS

It should be recognized that Veolia Water operating staff are working diligently to improve odor control throughout the facility. This was very evident from the wide variety of operational changes and capital improvements that have been implemented since Veolia took over the contract operations of the facility, and that were being implemented throughout the course of this evaluation. Improvements implemented by Veolia include chemical addition systems, upgrades to existing odor control scrubbing systems, new septage receiving box, odor counteractant spray system, improvements to containment and ventilation systems, and modifications to operational procedures. In fact, as noted below, a survey of ambient odor levels conducted by Wright Pierce in July/August 2009 found that odor levels were below nuisance levels as regulated by DEP. In compliance with the NOV, to assess potential odor generation and emissions from the Naugatuck WWTF, Wright-Pierce conducted the following investigatory work:

- Plant operation review of existing treatment processes and odor control systems
- Oxidation-Reduction Potential (ORP) survey of liquid streams
- Hydrogen sulfide (H_2S) survey of air emission sources
- Air flow rate survey of odor control and ventilation systems
- Community odor survey to determine off-site impacts of odors

All of the sampling was carried out in late July and August of 2009. This time frame is typically when odor generation is highest and should be representative of the worst-case odor generation and emission conditions. It was found that ambient odor levels were below nuisance levels as regulated by DEP. However, based on the field investigations, it appears that the most significant odor sources at the treatment plant that may be contributing to periodic off-site odor impacts during the sampling include the following, which are listed in the estimated order of significance:

- Dewatered Sludge Cake Receiving Area
- Septage Receiving Area (Note: Operating staff have recently completed improvements to address this source)
- Sludge Storage Tank with cloth cover
- Primary Settling Tanks with cloth cover
- Fugitive emissions from Screening and Wetwell Area during high wetwell levels
- Fugitive emissions from various sludge handling sources
- Collection system vacuum truck dump station
- Dewatered sludge bypass pumping discharge station

Based on the location and nature of some of the reported odor complaints, it appears that there may also be other sources of odors that are not attributable to the treatment plant. Possible examples include collection system odors, odorous truck traffic on Route 8 and Waterbury wastewater and sludge processes.

RECOMMENDED ACTION PLAN

As indicated above, Veolia Water has been and continues to be implementing a wide variety of capital and operational improvements to reduce periodic nuisance odor problems. Based on the identification of the remaining odor sources that may be contributing to objectionable off-site odor impact, alternative odor control measures were evaluated, and a recommended plan was developed. It is believed that the improvements, in conjunction with Veolia's ongoing and planned efforts, will help reduce the potential for off-site odor impacts, and can be completed within approximately three to four years after DEP approvals and based on the availability of funding from the Clean Water Fund or State or Federal grants. The evaluation of odor control mitigation measures also identified a number of process recommendations that would provide benefits relating to odor control, or that need to be considered in the context of long-term capital improvement needs for the facility. Detailed evaluation of these process improvements were beyond the scope of this study. This level of evaluation would be more appropriately performed as part of a comprehensive wastewater facilities plan. The following is a summary of the recommended improvements:

1. Sludge Cake Receiving Area

The recommended improvements include the following:

- Construct an exhaust ventilation hood to help contain odorous emissions generated during sludge cake receiving operations. The proposed exhaust ventilation hood will be located at the bottom of the cake storage silo.
- Install a wash down area with floor drain connected to the influent wetwell to allow trucks to wash down after disposal of the cake. This will alleviate the current practice where wash down water is discharged to the cake receiving bin.

- Reconfigure the Hot Oil Room ventilation system exhaust to treat odors from the exhaust ventilation hood for the Cake Receiving Area during sludge truck dumping.

2. Septage Receiving Area

The operating staff has recently procured and installed a new septage receiving box that will be vented to the Dewatering Area scrubber to contain and treat emissions during septage discharge. Odor release from septage in downstream processes will be less of an issue with the proposed improvements at the Screening and Wetwell Area and the Primary Clarifiers.

3. Sludge Holding Tank with Cloth Cover

The fabric cover on the circular sludge holding tanks has reached the end of its useful life, and is in need of repair or replacement. Replacement of the fabric cover is recommended.

4. Primary Settling Tanks

The odor survey identified fugitive odor emissions from the primary clarifiers as contributing to the potential for off-site odor impacts. The recommended improvements related to the primary settling tanks include the following:

- Repair the cloth covers on primary settling tanks.
- Install new exhaust duct system for each tank including the influent channel, inlet zone of the tank, effluent trough, and effluent channel.
- Eliminate the chemical day tanks, and feed the sodium hydroxide and sodium hypochlorite directly from the main storage tanks.
- Modify the existing scrubber exhaust reaction chamber with media, chemical feed and chemical recirculation provisions.
- Modify the existing blower as needed to accommodate the additional ventilation head.

5. Screening and Wetwell Area (Headworks)

The recommended improvements for the Screening and Wetwell Area include:

- Install barometric damper on the existing exhaust duct to odor control system in order to maintain ventilation when wetwell floods.
- Balance air flow to Dewatering Area Scrubber to draw 1,500 cfm from below the wetwell covers.

6. Various Sludge Handling Equipment

The recommended plan includes optimizing the exhaust air drawn from various sludge handling sources to the Dewatering Area Scrubber, as well as a number of small improvements to the scrubber system to enhance performance. In addition, the plant staff recently addressed a major need by relocating the inlet of the fluidizing air blower for the fluidized bed incinerator to the south side of the Dewatering Area to provide ventilation and odor control. However, improvements are recommended for the make-up air to the Dewatering Area and ventilation of the Thermal Dewatering Unit Building and the basement of the Filter Building.

The recommended improvements to the Dewatering Area Scrubber include:

- Install balancing dampers on the exhaust ducts and properly balance air flow from the existing locations.
- Eliminate the chemical day tanks, and feed the sodium hydroxide and sodium hypochlorite directly from the main storage tanks.
- The main sodium hydroxide storage tanks are vented within the basement of the Administrative Building. The vents for the tanks should be extended to above the roof line outside.
- Provide a continuous H_2S monitoring meter at the inlet and outlet end of the scrubber. Add hydrogen sulfide outlet concentration as a component to the chemical feed control loop.
- Increase the discharge stack height.

By optimizing the flow to the Dewatering Area Scrubber, containment and control of additional sludge odor sources can be provided including:

- Extend fluidized air blower intake into Dewatering Area. (Veolia has implemented this improvement)
- Install vent line for new septage receiving box. (Recently completed by Veolia)
- Re-direct vent lines for BFPs to the inlet of fluidizing air blower
- Remove the vent line for the polymer tanks

The recommended ventilation improvements for the Filter Building and New Incinerator Wing include:

- Adjust the existing make-up air system for the Thermal Dewatering Unit Building to provide 9,100 CFM of make up air to the three floor levels.
- Install new exhaust air system for the Thermal Dewatering Unit Building to draw 10,100 CFM from the Hot Oil Room and Sludge Receiving Area new exhaust ventilation hood and delivers the exhaust as make up air to the Dewatering Area through new ductwork on the north side at the upper and lower level.

It is important to note that the fluidizing air blower does not operate when the incinerator shuts down. Consequently, the proposed make up air system improvements will either need to incorporate interlocks or the operating staff will need to develop standard operating procedures to minimize the potential for fugitive emissions when the incinerator is not operating. This should include shutting down the belt filter presses when the incinerator is not operating.

7. Collection System Vacuum Truck Dump Station

Provide additional chemical addition and improved operational procedures to help control this infrequent but periodic odor source.

8. Dewatered Sludge Bypass Pumping Discharge Station

During the design of the Cake Receiving Area ventilation hood, options for extending the hood to include the dewatered sludge bypass station (i.e. truck loading area) will be investigated.

COST ESTIMATE

The total cost estimate for the recommended improvements to mitigate odors off-site is approximately $800,000 (2009 dollars). This total cost includes contingencies, contractor's overhead and profit, and design and construction phase engineering costs. These costs are based on planning phase level of detail that have unidentified issues that could result in final costs exceeding the contingency allowance.

Section 1

SECTION 1

INTRODUCTION

1.1 BACKGROUND

The Connecticut Department of Environmental Protection (DEP) has issued a Consent Order in response to periodic odor impacts to the surrounding community from the Naugatuck Wastewater Treatment Facility (WWTF). Veolia Water operates the WWTF for the Borough of Naugatuck under a long-term agreement. The Consent Order requires the Naugatuck Water Pollution Control Authority (WPCA) to identify the sources of odors at the facility responsible for off-site odor impacts and to develop a plan and schedule for mitigating the off-site impacts. On behalf of the Naugatuck WPCA, Veolia Water entered into an engineering services agreement with Wright-Pierce to perform an odor control evaluation to meet the requirements of the Consent Order

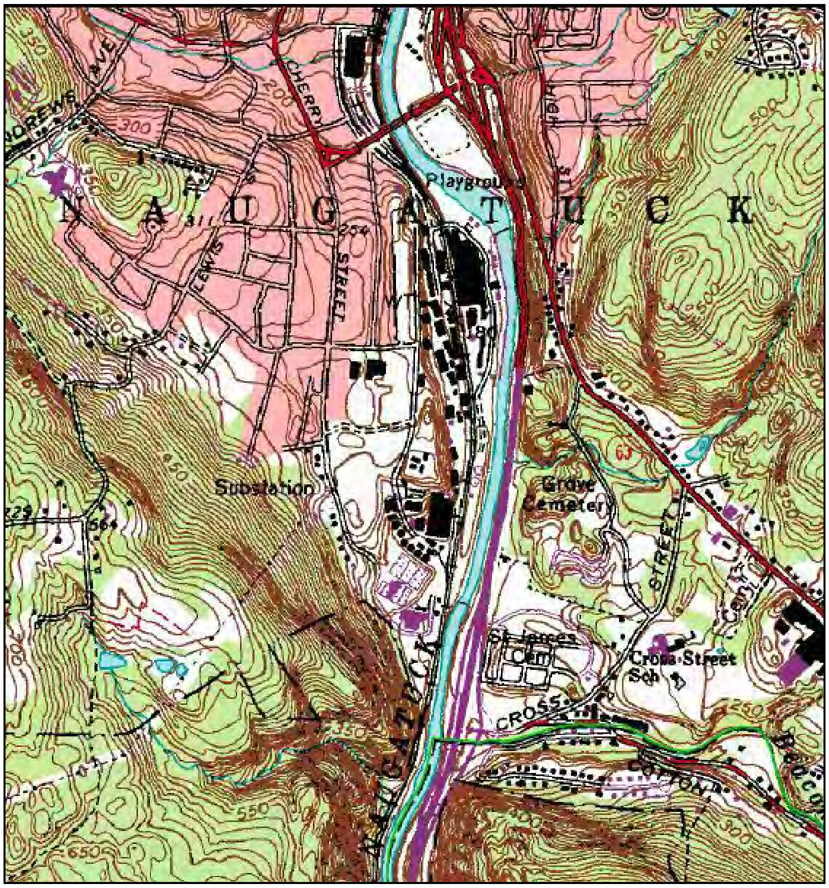
The Naugatuck WWTF is located at the south end of the Borough along the Naugatuck River as shown in Figure 1-1. An aerial view of the WWTF grounds is shown in Figure 1-2. The topography of the area surrounding the Naugatuck WWTF is a relatively steep river valley as shown in Figure 1-3. The river valley is subject to temperature inversions that limit atmospheric dispersion particularly in the early morning and early evening. In addition, the Naugatuck WWTF has residential neighbors immediately adjacent to the site.

The Consent Order is attached in Appendix A, and was executed on June 6, 2009. The Consent Order indicates that the WWTF has caused violations of Section 22a-174-23, which is the DEP's odor control regulation. The WWTF was issued a Notice of Violation (NOV) for odor impacts on November 7, 2007 and August 20, 2008. As discussed further in Section 1.3 below, odor complaints have been received from each of the residential areas surrounding the WWTF.

FIGURE 1-1
LOCATION PLAN OF NAUGATUCK WWTF

FIGURE 1-2
AERIAL VIEW OF NAUGATUCK WWTF

FIGURE 1-3
TOPOGRAPHY OF AREA SURROUNDING NAUGATUCK WWTF



The Consent Order requires the Naugatuck WPCA to retain a qualified consultant to carry out an odor control evaluation. The requirements for the scope of the evaluation included:

- Identification of the sources, causes and characteristics of odors emanating from the facility, and the daily frequency and duration of the activity which causes the generation of such odors.
- Evaluation of alternative remedial actions to abate the odor impacts.
- Development of a recommended plan including an estimate of the cost for each proposed remedial action and supporting justification as to why the remedial action will abate the odor impacts.
- Development of an implementation schedule to perform the recommended remedial actions.
- A detailed plan for monitoring the effectiveness of the recommended remedial actions.

Following review of the recommended plan developed as part of this odor control evaluation, the Naugatuck WPCA will be expected to move forward to implement the remedial actions in accordance with the proposed implementation schedule. As noted above, Veolia Water operates the WWTF for the WPCA.

1.2 EXISTING WASTEWATER TREATMENT PROCESSES

1.2.1 Description of Existing Wastewater Treatment Processes

The Naugatuck WWTF originally received a large portion of its flows and loads from the nearby former Uniroyal manufacturing plant, and Uniroyal operated the WWTF for many years for the Borough. The original WWTF appears to date back to the 1950s, but there was a major upgrade in the early 1970s where most of the existing facilities were constructed. As part of this upgrade, the original primary clarifiers were converted to chlorine contact tanks, the original headworks was converted to the effluent Parshall Flume, the original influent pump station was converted to the Drainage Pump Station, and the original anaerobic digesters were converted to gravity thickeners. This upgrade included provisions for separate treatment of pretreated wastewater from Uniroyal in Primary Settling Tank No. 3 and the second train of the activated sludge system.

In the 1980s, Uniroyal began a partnership with New England Treatment Company to utilize the two multiple hearth incinerators at the facility to provide merchant sludge disposal services. At that time, only liquid sludge was accepted which was dewatered and fed to the multiple hearth incinerators for thermal destruction.

A dewatering upgrade was implemented in the 1980s and included the replacement of the vacuum filters with belt filter presses. Odor control improvements were implemented in the early 1990s that included the packed bed scrubbers for Primary Settling Tanks No. 1 and 2 and for the sludge thickeners, storage tanks and dewatering area.

In 2001, U.S. Filter, currently Veolia Water, assumed responsibility for operation of the facility, and signed a long-term 20-year design/build/operate (DBO) contract with the Borough for the

WWTF. The DBO contract included provisions to: upgrade the secondary treatment facilities to meet nitrogen removal requirements; provide a new 75-dry-ton-per-day fluidized-bed incinerator to replace the two aging multiple hearth incinerators; and provide a variety of other sludge handling improvements and odor control measures.

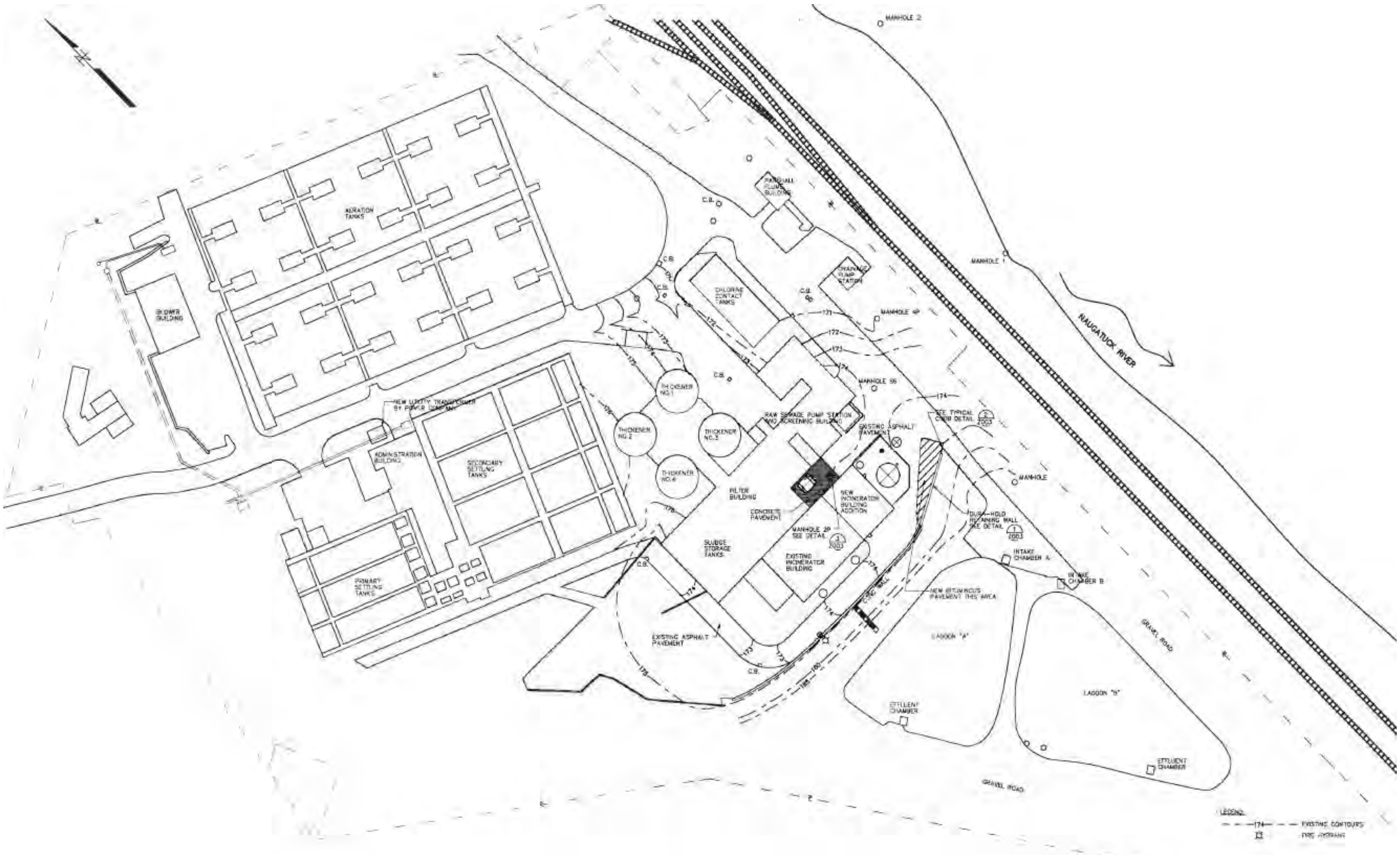
The site plan for the WWTF is shown in Figure 1-4. The current annual average flow to the facility is approximately 5.3 MGD, and the recent maximum monthly flow is 8.3 MGD. The new fluidized-bed incineration facility was designed for a minimum of 75 dry tons per day of dewatered sludge, and is permitted for and has been able to handle up to 84 dry tons per day in actual operation.

The liquid wastewater process train includes: an influent pump station; primary settling tanks; aeration basins; secondary clarifiers; chlorine disinfection; dechlorination; effluent flow measurement; and discharge to the Naugatuck River. Septage receiving is performed just north of Gravity Thickener No. 1 and is discharged into an on-site sewer that conveys it to the influent pump station. The facility currently utilizes only Primary Settling Tanks No. 1 and 2. This is due to reduction in flows since the closure of the Uniroyal facility. The two active primary clarifiers have cloth covers to contain odors and are vented to a packed-bed chemical scrubber for odor control. The scum pumping system for the primaries is not functional and the facility utilizes a vacuum truck to draw the scum from the primary scum well on a weekly basis.

Secondary treatment is provided by an activated sludge system that includes two aeration basin trains and four secondary clarifiers. The two aeration basin trains were upgraded by Veolia Water in 2002 with a new fine-bubble aeration system. In addition, the basins were configured with multiple zones for the Modified Ludzack-Ettinger (MLE) biological nitrogen removal process including submersible mixers for the anoxic zone and recirculation pumps. The aeration system is currently being upgraded with new VFDs, DO controls, diffusers and new baffle walls. There are two chlorine contact tanks and then flow passes through a Parshall flume prior to discharge to the outfall.

The sludge handling facilities include: a gravity thickener for primary sludge; three circular

FIGURE 1-4
SITE PLAN OF NAUGATUCK WWTF



sludge storage tanks; a gravity belt thickener for waste activated sludge (WAS); four rectangular sludge storage tanks for thickened WAS and liquid merchant sludge; two belt filter presses and two centrifuges for sludge dewatering; a dewatered sludge cake receiving bin, transfer screw conveyors and pumps; a sludge storage silo; thermal dewatering unit; and a fluidized-bed incinerator. The fluidized-bed incinerator upgrade which was constructed by Veolia Water includes the two centrifuges, cake receiving, cake silo, thermal dewatering unit, fluidized bed incinerator, and numerous screw conveyors, cake pumps and ancillary systems.

1.2.2 Description of Existing Odor Control Facilities

A packed-bed chemical scrubber is located in the Dewatering Area and provides odor control for the exhaust from the influent wet well, the gravity thickener and three circular sludge storage tanks, four rectangular sludge storage tanks, two belt filter presses, four polymer tanks, cake receiving bin and the cake silo. It is important to note that although exhaust air is pulled from the cake receiving bin, the truck unloading process occurs outside without containment. The thermal dewatering unit discharges its exhaust directly to the fluidized-bed incinerator for thermal destruction odor control. The fluidizing air blower for the incinerator was originally drawing make-up air from the pump room of the Thermal Dewatering Unit building and providing some odor control for the Thermal Dewatering Unit Room and Hot Oil Room which are located on the floors above. Veolia Water has recently implemented changes to draw make-up air for the fluidizing air fan directly from the Dewatering Area and to direct the exhaust from the Hot Oil Room to the Dewatering Area as make-up air. The intent of these changes is to exhaust the odorous air from these areas into the incinerator for thermal destruction. Other recent odor control improvements implemented by Veolia Water include:

- A new septage receiving box with exhaust to the existing dewatering area scrubber
- Chemical feed to the sludge feed to the dewatering systems
- Chemical feed to the primary settling tanks effluent as it enters the aeration tanks
- Chemical feed to the incinerator wastewater drain
- Odor counteracting spray system for the sludge cake receiving area

1.2.3 Frequency of Operation

The Consent Order requires that the frequency and duration of operations that contribute to odor emissions be quantified. The facility receives influent wastewater continuously, 24-hours-per-day, 365-days-per year. Thus, the liquid train has a constant potential to release odorous compounds. The facility accepts septage loads on Monday through Saturday from 6 AM to 6 PM and on Sunday by appointment. Odor emissions from septage can continue for a few hours beyond 6 PM, accounting for the lag time as the septage is processed through the plant. Similarly, most sludge handling processes are operated continuously. The liquid train generates primary sludge continuously, which is automatically transferred to the gravity thickener. The facility operates the sludge incinerator on a continuous basis as practical. This requires a constant inventory of both liquid and cake sludge. Consequently, the facility accepts merchant liquid sludge and merchant cake sludge on a 7 day per week basis, 24-hours per day. In actual operation, most liquid and cake sludge is received during weekdays from 6 AM to 6 PM, because most of the generators operate only during similar hours. The sludge dewatering systems operate continuously except when the cake silo is filled. The liquid sludge storage tanks are typically filled to some degree at all times. Consequently, the potential for odor emissions from sludge handling is continuous.

1.3 ODOR COMPLAINTS

Veolia tracks each odor complaint received at the Naugatuck WWTF. Figure 1-5 shows the current Odor Complaint Report form, which was last updated in May of 2009. The odor complaints received over the last 5 years are summarized in Appendix B, and the number of complaints per year is shown in Table 1-1. The 5-year record of odor complaints indicates that there is a consistent history of odor complaints received at the facility. There is no explanation for the low number of complaints received during 2005. However, the increase in complaints in 2009 is attributable to both the publicity associated with the Consent Order and the resulting effort by the Town and Veolia Water to alert citizen of the procedures for notifying the WWTF when off-site impacts are occurring. A copy of the notice that was published on the Borough's web site is included in Appendix A. The Town also issued a press release that was followed up by television coverage. Thus, although the odor complaints increased substantially in 2009, the magnitude of off-site odor impact is believed to have been reduced from previous years as discussed further below.

TABLE 1-1
NUMBER OF ODOR COMPLAINTS PER YEAR

Year	No. of Complaints
2004	11
2005	2
2006	17
2007	33
2008	17
2009 (thru 8/18)	95

Figure 1-6 shows the locations where odor complaints have been received, and a detailed log of the complaints is attached in Appendix B. Many of the complaints are from the residences immediately to the west and northwest of the WWTF site. In addition, there have been a large number of complaints from the east and southeast. The odor complaint logs suggest that the complaints from the most distant sources are attributable to other sources. However, the odor complaint record clearly indicates that odor emissions from the WWTP have been sufficient to cause off-site odor impacts in all directions depending on the wind direction and atmospheric dispersion conditions. The location of odor complaints indicates that objectionable odor impacts have occurred as far as 1-1/2 miles away. There is a high concentration of complaints along the Cherry Street neighborhood that is immediately to the northwest of the WWTF and topographically at a slightly higher elevation which reduces the potential for atmospheric dispersion. In addition, there are a large number of complaints to the east-southeast with Meadowbrook Place having the largest number of complaints overall.

FIGURE 1-5
ODOR COMPLAINT FORM

VEOLIA WATER

ODOR COMPLAINT REPORT

CALLER INFORMATION:

DATE: ________ TIME: ________ CALL TAKEN BY: ________

NAME OF COMPLAINTANT: ____________________ PHONE NUMBER: ____________________

ADDRESS / LOCATION WHERE ODOR IS BEING DETECTED: ______________________________

____

STRENGTH OF ODOR: FAINT ___ NOTICEABLE ___ DEFINATE ___ STRONG ___ OVERWHELMING ___

DESCRIPTION OF ODOR: AMMONIA ___ DECAYED CABBAGE ___ FECAL ___ FISHY ___ GALIC ___

MEDICINAL ___ ROTTEN EGGS ___ SKUNKY ___ SOLVENT / FUEL ___ OTHER ______________

DOES THE CALLER WANT A FOLLOW-UP CALL? YES____ NO____

DON'T FORGET TO THANK THE CALLER FOR THEIR CONCERN!!!!!!!!!!

ODOR INVESTIGATION:

WIND DIRECTION: ______ WIND STRENGTH: ______ (FROM ACCU WEATHER SCREEN)

WEATHER CONDITIONS: TEMP ___ RAIN ___ HUMID ___ DRY ___ UNSEASONABLY WARM / COLD ___

COMPLETE PLANT SURVEY LISTING POSSIBLE SOURCES OF ODORS CONTRIBUTING TO THE COMPLAINT: ______________________________

____

ODOR CONTROL EQUIPMENT STATUS:

PRIMARY SCRUBBER: ON ___ OFF ___ PH ___ ORP ___ MAKE UP WATER 2-3 GPM ___

VERIFY SYSTEM OVERFLOW: ___ WC" ___

FILTER BLDG SCRUBBER: ON ___ OFF ___ PH ___ ORP ___ MAKE UP WATER 5-7 GPM ___

SPRAY CONE OK ___ WC" ___

PERMANGANATE FEEDER: ON ___ OFF ___ VERIFIED OPERATIONAL: YES ___ NO ___

ODOR COUNTERACTANT SYSTEM: ON ___ OFF ___ VERIFIED OPERATIONAL: YES ___ NO ___

____

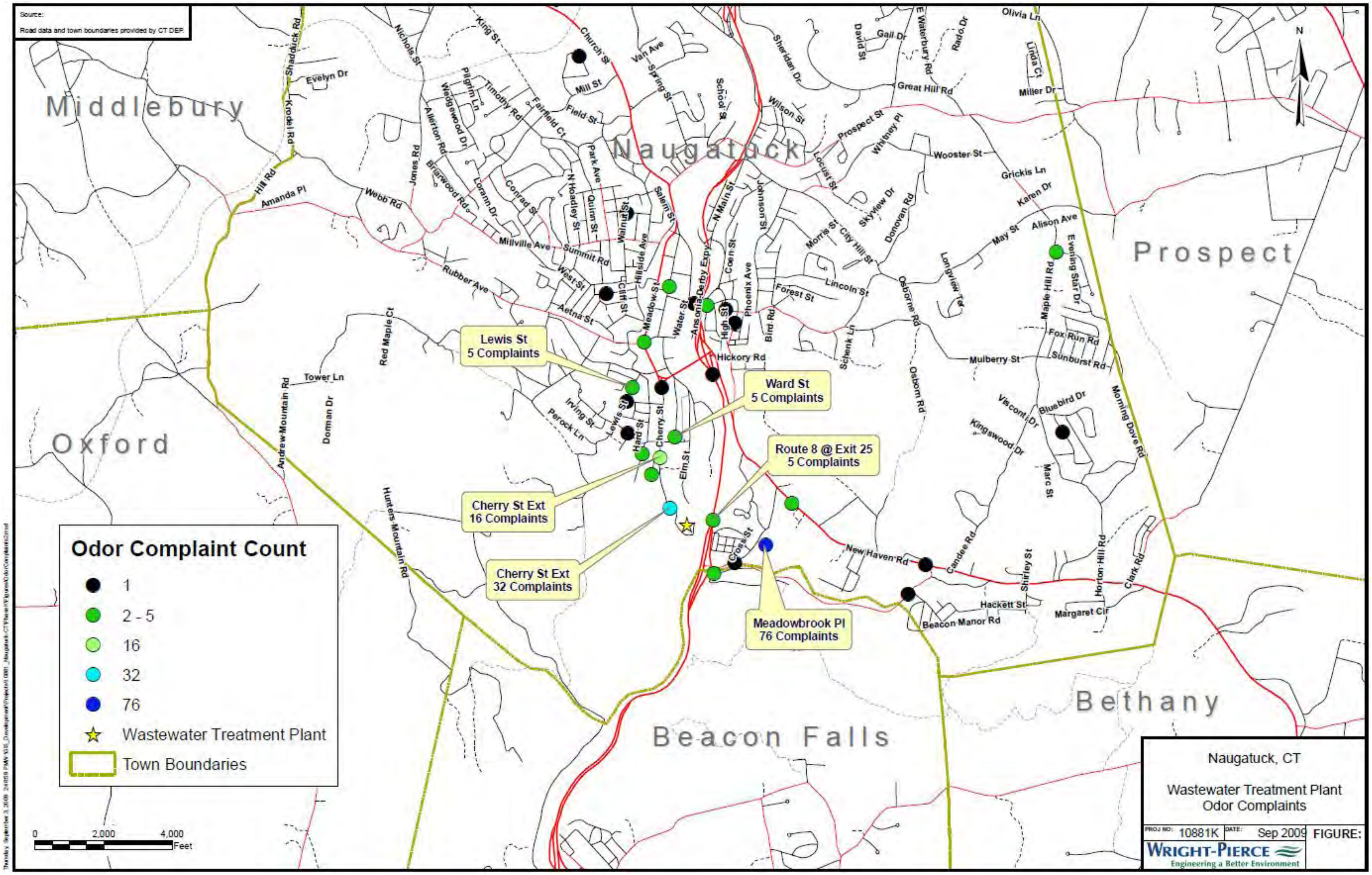
COMPLAINT REVIEWED BY: ____________________ DATE: ________ TIME: ________

RETURN CALL MADE BY: ____________________ DATE: ________ TIME: ________

RETURN CALL RESULTS: ______________________________

____

FIGURE 1-6
LOCATION OF ODOR COMPLAINTS



1.4 PAST ODOR CONTROL STUDIES AND IMPROVEMENTS

Historically, the Uniroyal complex to the north of the WWTF site dominated the character of the southerly end of the Borough. However, with the decline of the manufacturing complex and the recent demolition of most of the remaining structures, the Naugatuck WWTF is now the only industrial type of facility in this part of the Borough. The immediately surrounding areas are now characterized as residential. The existing WWTF has existing odor control systems to help mitigate off-site odor impacts including: a packed-bed scrubber treating the exhaust of the primary clarifiers; and a packed bed scrubber treating the influent wetwell, liquid sludge storage tanks, belt filter presses, four polymer tanks, cake receiving bin and cake storage silo. In addition, the fluidized bed incinerator is used for thermal destruction of odorous exhaust from the thermal dewatering unit, and the make-up air for the fluidizing air blower has been recently relocated to exhaust from the dewatering area. The two existing packed-bed scrubber systems date prior to the operation of the WWTF by Veolia Water. However, there does not appear to be any record of past odor control investigations related to these systems.

1.4.1 Background Odor Survey

Veolia Water commissioned a background odor survey in May of 2003 prior to the start-up of the new fluidized-bed incineration facilities. They also had a subsequent follow up odor survey conducted in 2004 after the fluidized bed incinerator was operated. Full copies of these reports are attached in Appendix C. The initial background odor survey was carried out by Odor Science and Engineering in May of 2003 and included measurement of hydrogen sulfide using a Jerome meter, assessment of odor intensity and documentation of atmospheric conditions. The measurements were taken at 18 locations around the perimeter of the site to document the "fence line" concentrations. Samples were taken twice per day on 10 working days over a two week period from May 14 through 28, 2003. It is important to note that the timing of the background odor survey in May does not coincide with the period of peak odor generation which typically occur during warmer weather in August, and can be high from late June through late September. In addition, the exhaust discharge from the sludge handling scrubber usually has greater impacts off-site than at the fence line.

The results for the maximum observed hydrogen sulfide concentration at each sampling location from the 2003 study are shown in Figure 1-7 and for the maximum odor intensity in Figure 1-8. For comparison, the DEP regulation on control of odors, Section 22a-174-23, indicates that odor levels will be considered to exceed acceptable levels if the odor concentration exceeds seven *dilutions to threshold* (D/T). For hydrogen sulfide, the regulation equates to an odor *threshold* concentration of 4.5 ppb. Thus, at a standard of seven *dilutions to threshold* (D/T), hydrogen sulfide concentrations exceeding 31.5 ppb at the site boundary would exceed the DEP regulations. Thus, two locations on the east side of the site exceeded this criterion during the 2003 background odor survey. However, the subsequent odor study after the fluidized bed incinerator that was completed by Veolia in 2004 did not identify odor concentrations that exceeded the criteria as indicated in Figure 1-7 and 1-7A.

The odor intensity is determined by comparison to eight standardized aqueous solutions of butanol. These eight dilutions constitute the *butanol scale* with rated intensity of odors ranging from 1 (mild odor) to 8 (strongest odor) with 3 typically considered objectionable. Performance of odor control systems are generally based on odor concentrations or specific compound removal such as hydrogen sulfide. However, the level of objection is generally a function of odor intensity. As shown in Figure 1-8, an odor intensity of 3 or greater was found at several of the sampling locations during the course of the background odor survey.

The 2003 background odor survey provides documentation that off-site odor impacts pre-date the fluidized bed incinerator upgrade operation and are reportedly a long standing issue. Given the apparent long history of odor impacts from the facility, it is important to note that perception of odor intensity is a psychosomatic phenomena that can be subject to sensitization. The relationship between odor intensity (butanol scale) and odor concentration (D/T) is known as the *Stevens Psychophysical Law*. The dose response function states that the *"intensity of a sensory response is proportional to the magnitude of the stimulus raised to some power"* as shown in Equation 1 below.

$$I = aC^b$$

where I = odor intensity (butanol scale)
a = constant
C = odor concentration (D/T)
b = constant (typically between 0.2 and 0.8)

FIGURE 1-7
MAXIMUM HYDROGEN SULFIDE CONCENTRATIONS (IN PPB)
DURING BACKGROUND ODOR SURVEY FROM MAY 14 TO 28, 2003 (OS&E, 2003)
(PRIOR TO INITIAL ODOR CONTROL IMPROVEMENTS IMPLEMENTED BY VEOLIA)

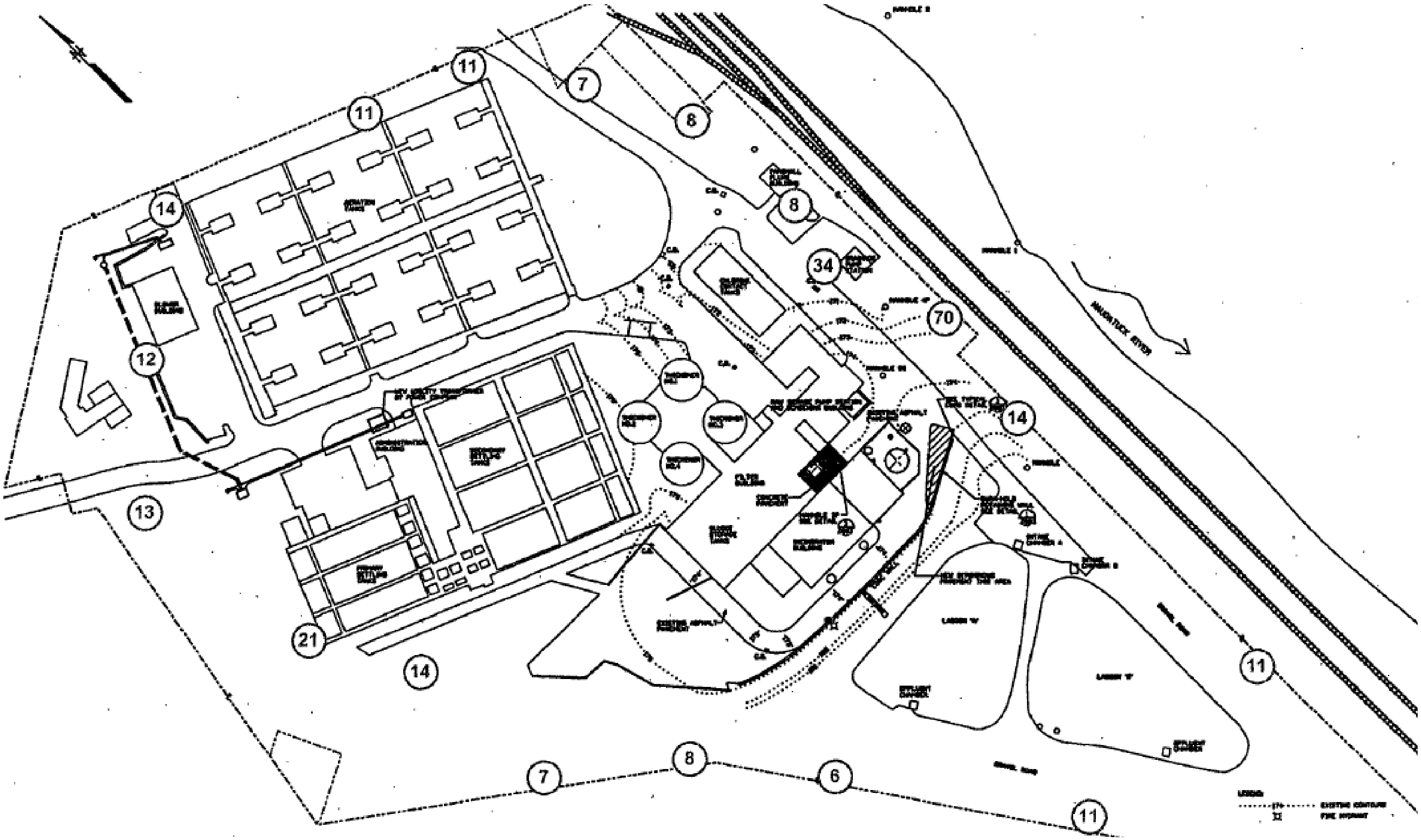


FIGURE 1-7A
MAXIMUM HYDROGEN SULFIDE CONCENTRATIONS (IN PPB)
DURING BACKGROUND ODOR SURVEY FROM NOVEMBER 22 TO DECEMBER 7, 2004 (OS&E, JANUARY 2005)
(PRIOR TO INITIAL ODOR CONTROL IMPROVEMENTS IMPLEMENTED BY VEOLIA)

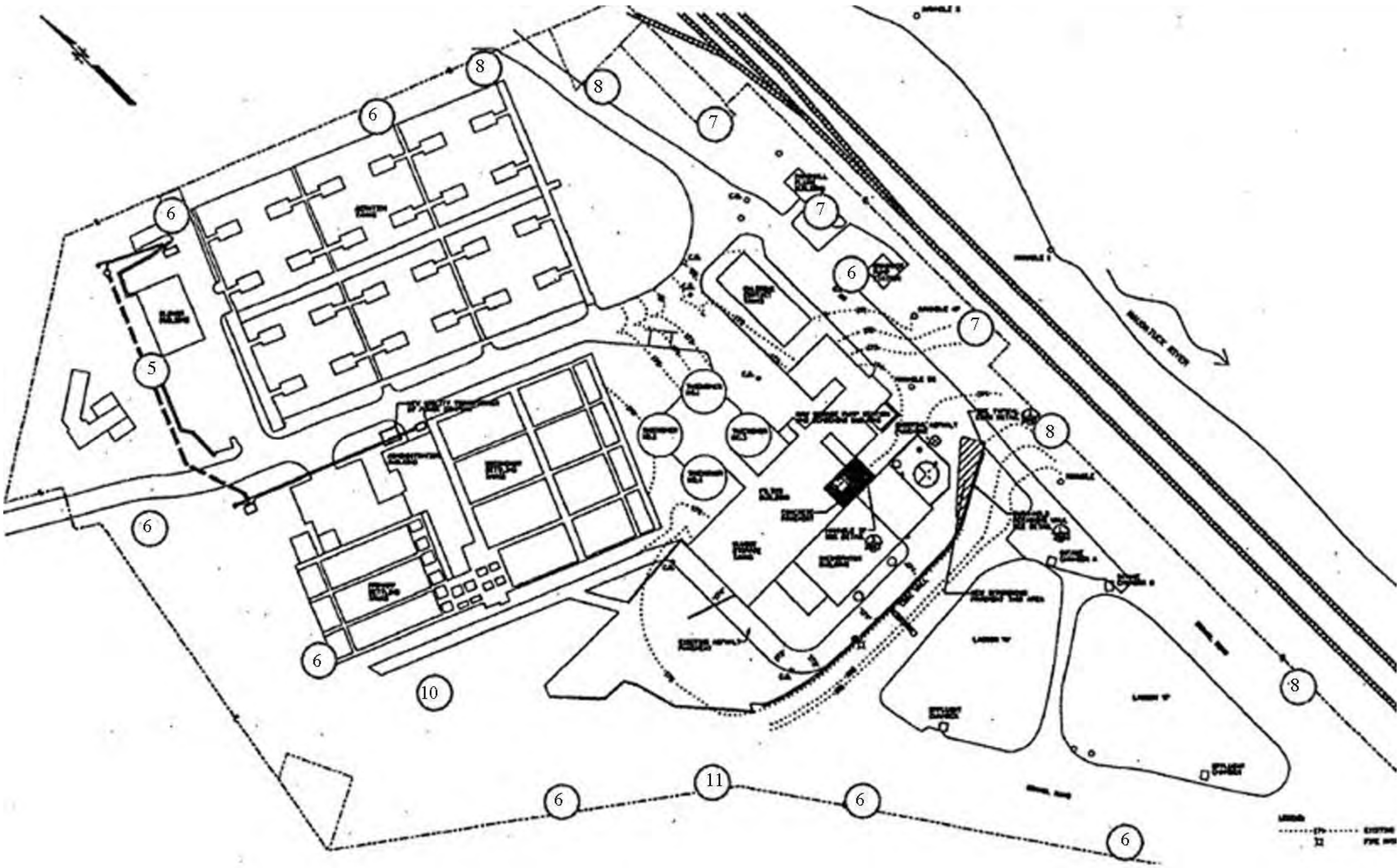


FIGURE 1-8
MAXIMUM ODOR INTENSITY DURING BACKGROUND ODOR SURVEY
FROM MAY 14 TO 28, 2003 (OS&E, 2003)
(PRIOR TO INITIAL ODOR CONTROL IMPROVEMENTS IMPLEMENTED BY VEOLIA)

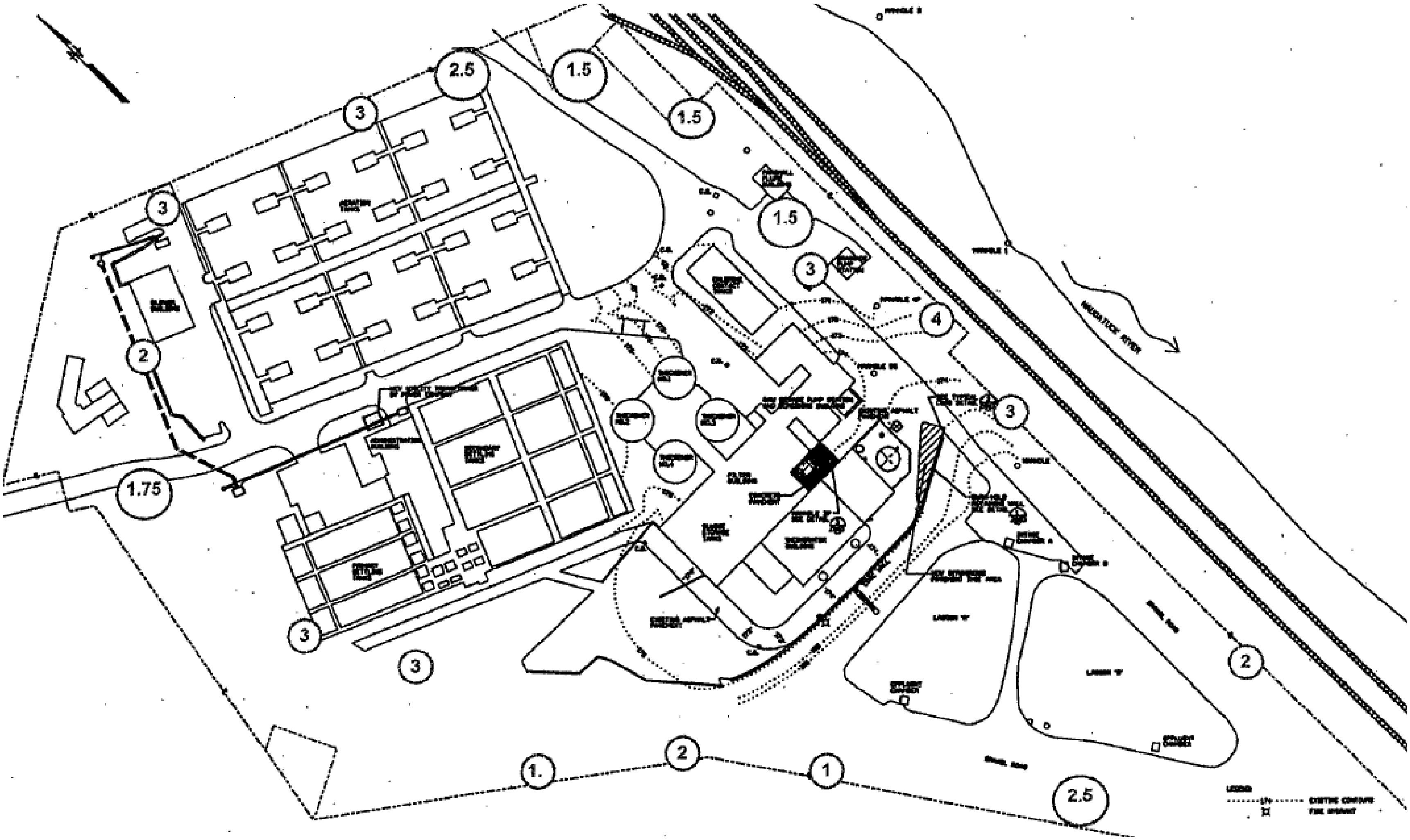
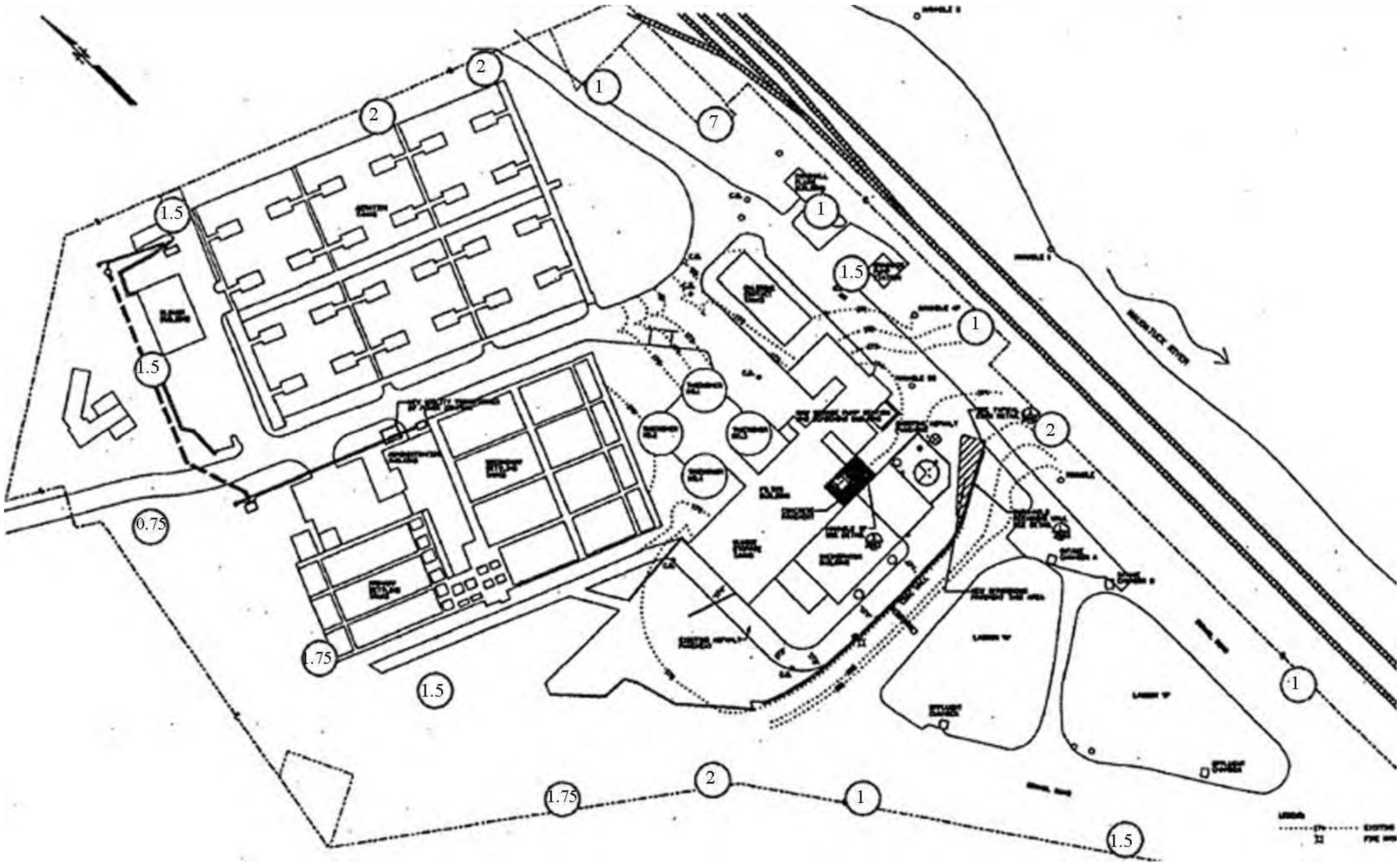
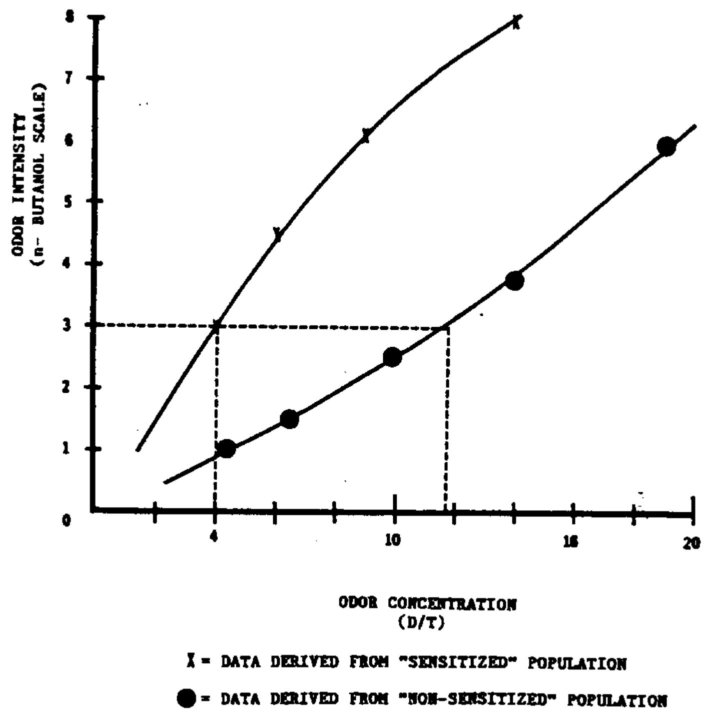


FIGURE 1-8A
MAXIMUM ODOR INTENSITY DURING BACKGROUND ODOR SURVEY
FROM NOVEMBER 22 TO DECEMBER 7, 2004 (OS&E, JANUARY 2005)
(PRIOR TO INITIAL ODOR CONTROL IMPROVEMENTS IMPLEMENTED BY VEOLIA)



The relationship between dose (odor concentration) and response (odor intensity) for both sensitized and non-sensitized populations is illustrated in Figure 1-9. Contrary to the popular conception that people are desensitized to odors, Figure 1-9 shows that populations can be sensitized to odors. The basis for sensitization is not that populations exposed to an odor source are able to detect the odor at lower concentrations. Rather the sensitized population perceives that the odor intensity at a given odor concentration is higher than the non-sensitized population.

FIGURE 1-9
DOSE RESPONSE FUNCTION FOR SENSITIZED VERSUS NON-SENSITIZED POPULATION



SOURCE: O'BRIEN et. al. (1989)

Classic odor desensitization is the result of exposure to constant concentrations in a factory type environment. The quantity of odorous compounds released by a source like a wastewater facility typically fluctuates. More significantly, atmospheric conditions vary widely providing more dispersion during certain times of the day and varying as atmospheric conditions change on different days. In addition, the varying wind directions move the odors to different receptors on different days (or at different times during the day). Even on a short-term basis, wind speed and thus dispersion are not constant. Consequently, neighbors to a facility can be subject to a range of concentrations that can be considered objectionable. The term "*sensitized*" refers to the heightened perception of objectionability at lower concentrations, because of frequent exposure to relatively intense conditions. An unfortunate consequence is that the perceived odor impacts may be the same as a past condition, even if the facility has made significant progress in controlling odorous emissions.

1.4.2 Recent Odor Control Improvements

Veolia Water has actively been working to address the needs of the Naugatuck WWTF, including efforts to address odor control needs both in the design of the fluidized-bed incinerator upgrade and through other improvements including both capital improvements and enhanced operating procedures. The fluidized-bed incinerator upgrade incorporated provisions to vent some of the new facilities (eg. cake silo, cake receiving bin) to the existing packed-bed scrubber, direct the exhaust from the thermal dewatering unit to the fluidized bed incinerator, and draw make-up air for the fluidized bed incinerator from the incinerator feed pump area which is interconnected to the Thermal Dewatering Unit Room and Hot Oil Room.

In addition, Table 1-2 provides a chronology of recent capital and operational improvements that have been implemented by Veolia Water over the past several years as part of their efforts to reduce odor emissions from the facility. Veolia Water staff has been working diligently prior and during the course of this investigation to reduce or eliminate odor emissions from various sources at the WWTF. Some of the improvements are temporary provisions, and the final plan of this evaluation will include recommendations for permanent provisions.

TABLE 1-2
CHRONOLOGY OF CORRECTIVE ACTIONS TO MITIGATE ODOR IMPACTS

Date	Upgrades	Estimated Cost
March to June 2007	New pH/ORP controllers installed for both scrubbers and revised control parameters/training update for staff Implemented weekly calibration/cleaning of probes (pH and ORP)	$4,000[1]
March to June 2007	Replaced canvas of failed primary tank cover to help contain odors.	$3,000[1]
December 2007 to August 2009	Ended practice of exhausting potentially odorous air from Hot Oil Room to bottom of Cake Silo Converted outlet wall fan to supply make-up air Installed new ductwork to vent exhaust air to dewatering room as make-up air	$5,000[1]
March to June 2008	Corrected Cake Silo odor duct work	$1,500[1]
June to September 2008	Implemented door closed policy, cameras for exterior activity visuals without opening doors, (both a security item and for minimizing the release of fugitive odor emissions)	$ 10,000[1]
August 25, 2008	Installed Lexan panels to view scrubber(s) operation	$1,000[1]
August 28, 2008	Acid cleaning of packing in both scrubbers - (*not effective*)	$1,500[1]
September 17, 2008	Replaced packing in both chemical scrubbers to improve performance	$12,500
September 2008	Reactivated cake receiving odor counteractant spray system by installing new pump to discharge to 4 existing nozzles Bin door kept closed at all times to contain odors.	$2,500[1]
September 2008	Installed additional exhaust air ducts to the belt press rotary drum thickeners	$1,000[1]
September 2008	Increased sludge handling scrubber fan flow from ~10,000 cfm to 16,000 cfm	$2,500[2]
September 2008	Installed manometer(s) on exhaust air intakes at sludge storage tanks and other locations to ensure exhaust ventilation	$1,000[1]
October 2008	Installed new cover and odor withdrawal duct work at liquid sludge splitter box	$1,000[1]
March 2009	Started adding caustic (NaOH) to the incinerator tray scrubber to eliminate sulfur odor in exhaust	$2,500[2]
April 6, 2009	Installed potassium permanganate feeder for addition to secondary influent channel	$1,500[2]
April 2009	Installed temporary feed system to add crystal sodium permanganate to primary influent to reduce fugitive emissions	$1,500[2]
April 2009	Install temporary feed system to add crystal sodium permanganate to gravity thickener to reduce odor emissions	$1,500[2]
May 4, 2009	Installed temporary facilities for liquid sodium permanganate feed to belt presses	$1,500[2]
May 4, 2009	Installed high pressure odor counteractant system (including 12 spray nozzles) on roof above Cake Receiving Area	$ 5,000[2]

Date	Upgrades	Estimated Cost
May 4, 2009	Started using new odor log sheet	$ 1,500[1]
May to August 2009	Created new SCADA screen for odor control equipment that includes all equipment started (recirculation pump, fan), pH, ORP, event log, trend, alarm	$6,000 [1]
May 2009	Relocated pipe discharge from Uniroyal groundwater treatment system to below water line to reduce fugitive emissions	$1,500[1]
May 2009	Installed feed system to neutralize blowdown from incinerator tray scrubber	$5,000[2]
July 2009	Established new preventive maintenance protocol for Thermal Dewatering Unit utilizing potassium permanganate to eliminate odor emissions from unit washdown	$1,500[2]
July 13, 2009	Installed ductwork to draw exhaust air from Dewatering Area through fluidizing blower.	$24,000
July 20, 2009	Weather station installed, and recording data.	$1,200[1]
July to September 2009	Procured and installed new septage receiving box that will allow septage to be screened and foul air drawn into the sludge handling scrubber	$ 7,500[1]
June to September 2009	Construction of the aeration upgrade project that will allow better air control and minimize odors from the aeration basins. Also, the scum baffles will be removed eliminating an odor source.	$ 675,000
August 2009	Increased ORP set point for scrubbers based on performance monitoring; pH set point was also increased from 8.7 to 9.2	$1,500[1]
September 2009	Installed new floor drain for washdown of Thermal Dewatering Unit to allow direct discharge and screening to separate rags removed in washdown process	$12,000[1]
September 2009	Replaced the recirculation pump for the Dewatering Area scrubber	$18,000[1]
September 2009	Installed an additional dry potassium permanganate feeder for addition to sludge storage tanks that serve as blend tanks	$2,000[2]
September 2009	Placed existing makeup air handler with 14,000 cfm capacity for Thermal Dewatering Unit Building in service	$2,000[1]
October 2009	Improved septage receiving box	$10,000
	TOTAL	**$828, 700**

Notes:

1. Estimated equivalent cost of improvements performed by Veolia Staff (labor, equipment and materials.)
2. Estimated equivalent cost of improvements performed by Veolia Staff but cost does not include ongoing costs for Veolia Water to supply chemicals.

1.5 OBJECTIVES OF EVALUATION

The goal of this odor control evaluation is to assess the current odor sources at the Naugatuck WPCF as required under the Consent Order and develop a plan to mitigate odor impacts to bring the WPCF in compliance with Section 22da-174-23 of the Regulations of the Connecticut Agencies.

Based on the requirements of the DEP Consent Order, the investigatory work for this evaluation included the following:

- Collect and review design data on existing unit processes and odor control systems
- Review plant operations
- Measure hydrogen sulfide levels at locations around the site
- Measure the Oxidation-Reduction Potential (ORP) of wastewater and sludge as it passes through the WWTF
- Measure the air flow rate of the various odor control systems
- Carry out community odor survey to assess off-site impacts of odors

The results of the field investigations are summarized in Section 2 of this evaluation report.

Based on the identified current odor emission sources and the performance of the existing odor containment and treatment facilities, alternatives were evaluated to provide enhanced odor control at the WPCF. The improvements needed to minimize objectionable off-site odor impacts were assessed and a plan of recommended improvements was developed. The results of this evaluation of remedial actions are summarized in Section 3 of this evaluation report. The recommended plan and implementation schedule are summarized in Section 4.

Section 2

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SECTION 2

EVALUATION OF EXISTING CONDITIONS

2.1 BACKGROUND

To assess odor generation and emissions from the Naugatuck WWTF, Wright-Pierce conducted the following investigatory work:

- Plant operation review of existing treatment processes and odor control systems
- Oxidation-Reduction Potential (ORP) survey of liquid streams
- Hydrogen sulfide (H_2S) survey of air emission sources
- Air flow rate survey of odor control and ventilation systems
- Community odor survey to assess off-site impacts of odors

All of the sampling was carried out in late July and August of 2009. This time frame is typically when odor generation is highest and should be representative of the worst-case odor generation and emission conditions.

Many operational practices at a wastewater treatment facility can result in highly odorous conditions within the facility. Under the Consent Order, a primary goal of the evaluation was to identify the odor sources and to quantify the magnitude of emissions. This provides the information necessary to understand the operational changes and odor control improvements needed to minimize objectionable off-site odor impacts. The results of the site investigations are summarized in Section 2.2. This includes the instantaneous measurements of the ORP of the liquids in the various treatment processes and the hydrogen sulfide emissions in the air above the processes. The hydrogen sulfide loadings to the existing odor control systems were characterized using continuous monitoring. In addition, the air flow rates of the chemical odor scrubbers and from specific ventilated processes and areas were measured to determine the actual ventilation rates in order to compare them to desired design standards. The results of community odor surveys are also summarized in Section 2.2.

The operations review is summarized in Section 2.3, and Section 2.4 includes the assessment of the highest priorities for reduction of off-site odor impacts.

2.2 SITE INVESTIGATIONS

2.2.1 ORP Survey of Liquid Streams

Oxidation-reduction potential (ORP) provides an indication of the condition of the wastewater in terms of potential to produce odorous compounds. Table 2-1 provides a simplistic characterization of the odor generation potential of wastewater at varying ORP levels. ORP monitoring can be an effective means of monitoring for odor generating conditions and can also be an effective measure for process control. "Fresh" wastewater (less odorous) typically has a positive ORP. ORP typically decreases within the collection system due to biological activity. Because the biological activity is temperature dependent, ORP levels are typically higher during cold weather conditions. In warm weather, the higher temperatures result in higher microbial activity levels and lower ORP which results in a greater potential for odorous conditions.

TABLE 2-1
CLASSIFICATION OF WASTEWATER CONDITION BY ORP

ORP (mV)	Comments
+200 or Higher	Aerobic Environment
+50	No activity by anaerobic bacteria
0	Poor anaerobic activity
-100 to -200	Maximum efficiency for anaerobic activity
-50 to -300	Favored by sulfate-reducing bacteria for production of sulfides

In wastewater treatment systems, the conditions leading to negative ORP are also temperature dependent. In addition, unit processes with significant detention time without aeration, such as primary clarifiers, can also lower the ORP. The condition of the wastewater entering a treatment plant is an important factor in the potential for odor problems, particularly in the preliminary and primary treatment systems. Sludge handling operations have very high potential for negative ORP due to the concentrated nature of the waste stream, which magnifies the potential for high microbial activity levels. Another important consideration is that odor emissions may continue to occur in downstream operations following odor-generating processes.

ORP monitoring was carried out on five occasions as shown in Table 2-2 to determine how levels vary through the WWTF. The ORP survey was conducted using a Hanna 9025 pH and ORP analyzer having a detection range for pH of 0.00 to 14 standard units and ORP of ±399.9 mV as well as temperature. Table 2-2 also includes results of pH and temperature monitoring that was carried out concurrently. The field testing log for the ORP survey is listed in Appendix D.

The sampling locations varied for some of the surveys and included an effort to assess the impact of potassium permanganate addition at the primary influent channel, secondary influent channel, gravity thickener and dewatering feed. Potassium permanganate is added at these locations to reduce the odor emissions from the facility. To assess the amount of odor generated without the addition of potassium permanganate, the permanganate feed was shut down on July 31, 2009 at the above locations except for the inlet channel of the aeration tank.

The results of the ORP survey show considerable variability on the different sampling dates. The ORP of raw wastewater entering the facility varied from moderately high to moderately low to low during these events. During the last two events, the ORP of the raw influent was in a range indicative of significant hydrogen sulfide generation.

In general, it would be expected that the ORP would decrease as it passes through the primary clarifiers and then increase across the aeration basins. There was considerable variability during individual events presumably due to variability in the incoming wastewater characteristics and the impact of septage loads as they pass through the facility. In general, the condition of the wastewater as it passed through the primaries to the secondary influent channel was indicative of low to moderate levels of hydrogen sulfide production. The ORP levels of the wastewater in the secondary clarifiers and chlorine contact tanks were above levels indicative of hydrogen sulfide production.

TABLE 2-2
OXIDATION-REDUCTION POTENTIAL SAMPLING RESULTS

Location	7/28/2009			7/31/2009			8/12/2009			8/14/2009			8/17/2009		
	ORP (mv)	pH	Temp F	ORP (mv)	pH	Temp F	ORP (mv)	pH	Temp F	ORP (mv)	pH	Temp F	ORP (mv)	pH	Temp F
Influent Manhole (Wetwell)	92	7	68	---	---	---	30	6.2	101	-101	6.9	72	-113	4.4	164
Primary Settling Tanks - Inlet End (without Permanganate)	---	---	---	-72	6.6	89	---	---	---	---	---	---	---	---	---
Primary Settling Tanks - Inlet End (with Permanganate)	64	6.6	87	-30	6.5	87	-95	6.7	90	-60	6.5	89	26	6.9	87
Primary Settling Tanks - Outlet End	81	6.8	90	35	6.5	87	-61	6.8	83	41	6.5	91	48	6.8	88
Influent Channel to Aeration Basin (without Permanganate)	---	---	89	-60	6.7	90	-41	6.8	94	-43	6.8	94	-24	6.8	95
Influent Channel to Aeration Basin (with Permanganate)	---	---	---	-63	6.6	89	-79	3.5	89	-75	6.7	93	-33	6.9	91
Secondary Clarifier - Inlet End	84	6.6	90	---	---	---	145	6.9	93	87	6.8	96	139	6.7	97
Secondary Clarifier - Outlet End	80	6.7	90	---	---	---	165	6.9	90	65	6.7	95	117	6.7	96
Chlorine Contact Tanks	145	6.7	90	---	---	---	340	6.9	93	274	6.8	95	317	6.8	95
Gravity Thickener (with Permanganate)	30	6.4	88	-125	6.2	91	-155	6.5	88	-143	6.3	93	-92	6.5	89
Sludge Storage/Thickener	-400	5.3	77	---	---	---	-180	5.2	80	-147	5.2	82	-423	5.8	79
Dewatering Feed (without Permanganate)	---	---	---	-187	5.2	81	---	---	---	---	---	---	---	---	---
Dewatering Feed (with Permanganate)	6.8	5.4	78	---	---	---	-245	5.2	84	-163	5.4	82	-125	5.4	89
Filtrate	27	5.5	86	---	---	---	-85	5.2	85	-73	5.3	85	-40	5.3	91
Incinerator Scrubber Blowdown	115	6.1	106	---	---	---	60	6.5	119	-47	9.9	111	-94	9.9	100

The sludge thickener, sludge storage tanks and dewatering feed had ORPs indicative of high levels of hydrogen sulfide production. The dewatering filtrate is returned to the influent wetwell and had moderately low ORP.

The tray scrubber blowdown from the incinerator had moderately low ORP, and also has elevated temperature that impacts the overall wastewater temperature after it combines with the raw influent in the wetwell of the main pump station. The elevated temperature contributes to higher levels of microbial activity that are conducive to hydrogen sulfide production, but also has benefits to the secondary treatment process by allowing the facility to nitrify more readily under cold weather conditions.

2.2.2 Hydrogen Sulfide Survey of Air Emissions

The hydrogen sulfide survey of air emissions included different locations throughout the WWTF. This included the emission sources that are connected to existing odor control systems. Hydrogen sulfide is by far the most prevalent odorous compound associated with wastewater collection and treatment systems and is typically used to characterize odor emissions. The overall intent of the hydrogen sulfide monitoring was to identify high concentration or mass emission sources which may need improved odor containment and control to avoid objectionable off site impacts.

Continuous monitoring of scrubber inlet concentrations is described in Section 2.2.3. The hydrogen sulfide surveys were carried out on five occasions as shown in Table 2-3. The hydrogen sulfide survey was conducted using a Jerome 631-X Hydrogen Sulfide Analyzer having a detection range of 0.003 to 50 ppm. The detection threshold concentration for hydrogen sulfide is defined in Section 22a-174-23 of the Regulations of Connecticut Agencies at 0.0045 ppm, which is a commonly reported value. Field testing logs for the H_2S survey are listed in Appendix D.

TABLE 2-3
HYDROGEN SULFIDE MONITORING RESULTS

Sampling Locations	Field Survey H2S (ppm) Readings					Average
	20-Jul	27-Jul	31-Jul	12-Aug	17-Aug	
Influent Channel - Below Covers	5.000	0.810	0.140	---	2.800	2.188
Screening Area - Above Cover	0.013	0.810	0.003	0.007	0.000	0.167
Wetwell Area - Above Cover	0.030	0.830	0.002	---	0.000	0.216
Primary Clarifier Inlet - Below Covers[a]	0.430	2.300	---	0.024	0.014	0.692
Primary Clarifier Inlet - Without KMnO4[a]	---	---	0.016	---	---	0.016
Primary Clarifier Inlet - Above Covers[a]	---	---	---	0.010	0.012	0.011
Primary Settling Tanks Outlet[a]	0.270	0.500	0.114	0.015	0.480	0.276
Primary Skimming Building	0.094	0.014	0.013	0.001	0.100	0.044
Primary Scrubber - Outlet (08/20/09)						0.013
Aeration Tank 1 & 3[a]	0.050	0.011	0.003	0.001	0.004	0.014
Aeration Tank 2 & 4[a]	0.060	0.010	0.001	0.000	0.002	0.015
Aeration Tank 5 & 6[a]	0.070	0.005	0.001	0.000	0.000	0.015
Secondary Settling Tanks Inlet End	0.007	---	0.000	0.000	0.004	0.003
Secondary Settling Tanks Outlet End	0.016	---	0.001	0.000	0.000	0.004
Secondary Scum Well	0.006	---	0.002	0.003	0.002	0.003
Chlorine Contact Tanks	0.030	0.007	0.001	0.009	0.002	0.010
Septage Receiving Area-Reading 1	0.055	0.007	0.005	0.040	1.110	0.243
Septage Receiving Area-Reading 2	---	0.007	0.000	---	0.470	0.159
Septage Receiving Area-Reading 3	---	0.029	---	---	---	0.029
Solids Receiving Area	0.072	0.280	0.002	0.080	0.003	0.087
Solids Receiving Area - In Receiving bin	HL	---	---	---	---	---
Solids Receiving Area - Silo Platform[b]	1.210	---	---	---	---	1.210
Solids Receiving Area - Silo Platform[b]	4.600	---	---	---	---	4.600
Thickener 1	1.550	0.170	---	0.410	0.013	0.536
Thickener 1 - Without Permanganate	---	---	0.160	---	---	0.160
Four Rectangular SSTs - Below Covers	3.050	1.100	0.140	0.640	0.560	1.098
Sludge Storage Tank - With cloth cover	---	13.100	0.240	0.120	0.160	3.405
Sludge Dist. Box - Sludge Storage Tanks	0.430	HL	0.170	6.800	0.033	1.858
Dewatering Area	2.900	12.000	---	5.200	4.700	6.200
Dewatering Area (Without Permanganate)	---	---	1.400	---	---	1.400
Dewatering Area Scrubber-Outlet	---	---	0.029	0.057	0.140	0.075
Hot Oil room	1.065	0.860	0.037	0.350	0.007	0.464
Thermal Dewatering Room	0.050	0.410	0.018	0.240	0.004	0.144
Feed Pump Area	0.016	0.001	0.000	0.008	0.001	0.005
Ash Lagoon	0.001	0.001	0.001	0.000	0.000	0.001
Ash Lagoon	0.002	0.011	0.001	0.001	0.000	0.003
Easterly Fence Line - Plant Entrance	0.003	---	0.001		0.002	0.002
Westerly Fence Line	0.020	---	0.001	0.001	0.000	0.006

Notes: a. Reading obtained approximately 1-foot above the wastewater level.
b. Measurements were taken on the silo platform above the receiving bin during cake disposal.

The results in Table 2-3 indicate elevated (but below nuisance levels) of hydrogen sulfide levels in the following areas:

- Screening and Wet Well Area
- Primary clarifiers and scum handling
- Septage Receiving Area
- Sludge thickening and storage tanks
- Dewatering Area including cake conveyors
- Cake Receiving Area
- Dewatered cake storage silo
- Thermal Dewatering Unit Area including the Hot Oil Room and Feed Pump Area

The odor emissions for each source are discussed in greater detail in the review of operations in Section 2.3. It should be noted that hydrogen sulfide odor concentrations at the site fence line were less then the peak hydrogen sulfide concentrations measured during the background odor survey in 2003 as shown in Figure 1-7. Also, the higher hydrogen sulfide concentrations were below nuisance levels, which implies that the hydrogen sulfide concentrations measured at this time should not result in nuisance odor problems.

2.2.3 Continuous Hydrogen Sulfide Monitoring

Continuous hydrogen sulfide monitoring was used to better assess the loadings to the existing odor control systems. Table 2-4 shows the locations and timing of the continuous hydrogen sulfide monitoring. Data logging was conducted by using a V-Rae, H_2S analyzer having a detection range of 0 to 100 ppm. Field testing results for the locations in Table 2-4 are listed in Appendix D. The purpose of this monitoring was to help determine the adequacy of the existing odor control systems to handle the inlet odor concentrations.

TABLE 2-4
LOCATIONS OF CONTINUOUS HYDROGEN SULFIDE MONITORING

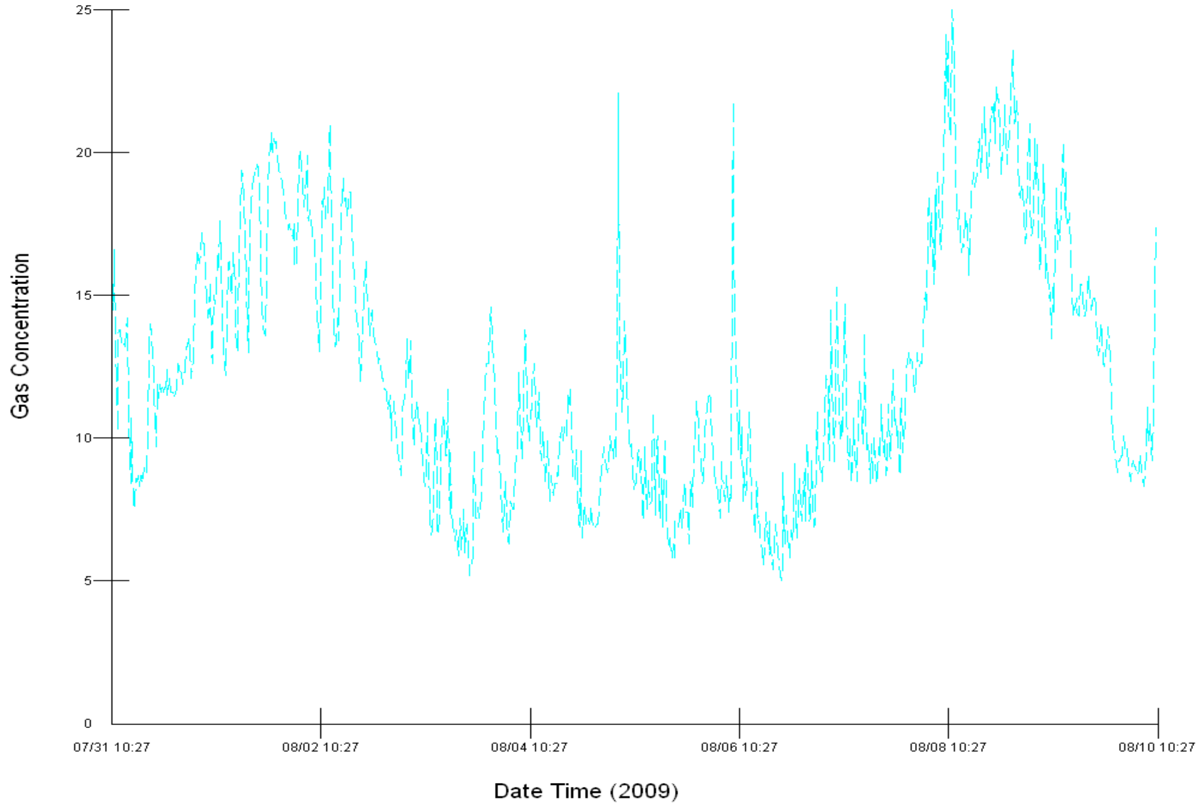
Sampling Locations	Sampling Dates
Dewatering Area Scrubber - Inlet	July 31 to August 10, 2009
Primary Scrubber - Inlet	August 10 to August 12, 2009
Sludge Storage Tank - With Cloth Cover	August 12 to August 17, 2009
Dewatering Area Scrubber - BFP Exhaust	August 17 to August 21, 2009

2.2.3.1 Dewatering Area Scrubber - Inlet

The Dewatering Area scrubber is located in the Dewatering Area of the Filter Building, and it receives exhaust air from the influent wetwell, belt filter presses, sludge storage tanks, thickener, polymer tanks, sludge silo and sludge cake receiving bin. This scrubber is a packed tower chemical odor scrubber which utilizes a solution with sodium hydroxide and sodium hypochlorite to remove and oxidize odorous compounds. The tower is packed with plastic media and the chemical solution is fed to the top of the media as the odorous air is fed at the bottom. The chemical solution is automatically controlled using ORP and pH measurements.

The inlet of the scrubber was monitored for hydrogen sulfide using the V-Rae analyzer for a 10-day period as shown in Figure 2-1. A peak value of 25 ppm of H_2S was recorded entering the inlet of the scrubber and the average concentration was about 10 ppm. The scrubber outlet was measured for H_2S concentrations using the Jerome meter as summarized in Table 2-3. The average of three measurements at the outlet indicated a concentration of 0.075 ppm of H_2S leaving the scrubber outlet. This corresponds to greater than 99% removal. However, operating staff have subsequently increased the ORP setting of the scrubber to try to further improve hydrogen sulfide removal rates.

FIGURE 2-1
HYDROGEN SULFIDE CONCENTRATIONS (PPM)
IN INLET OF DEWATERING AREA SCRUBBER



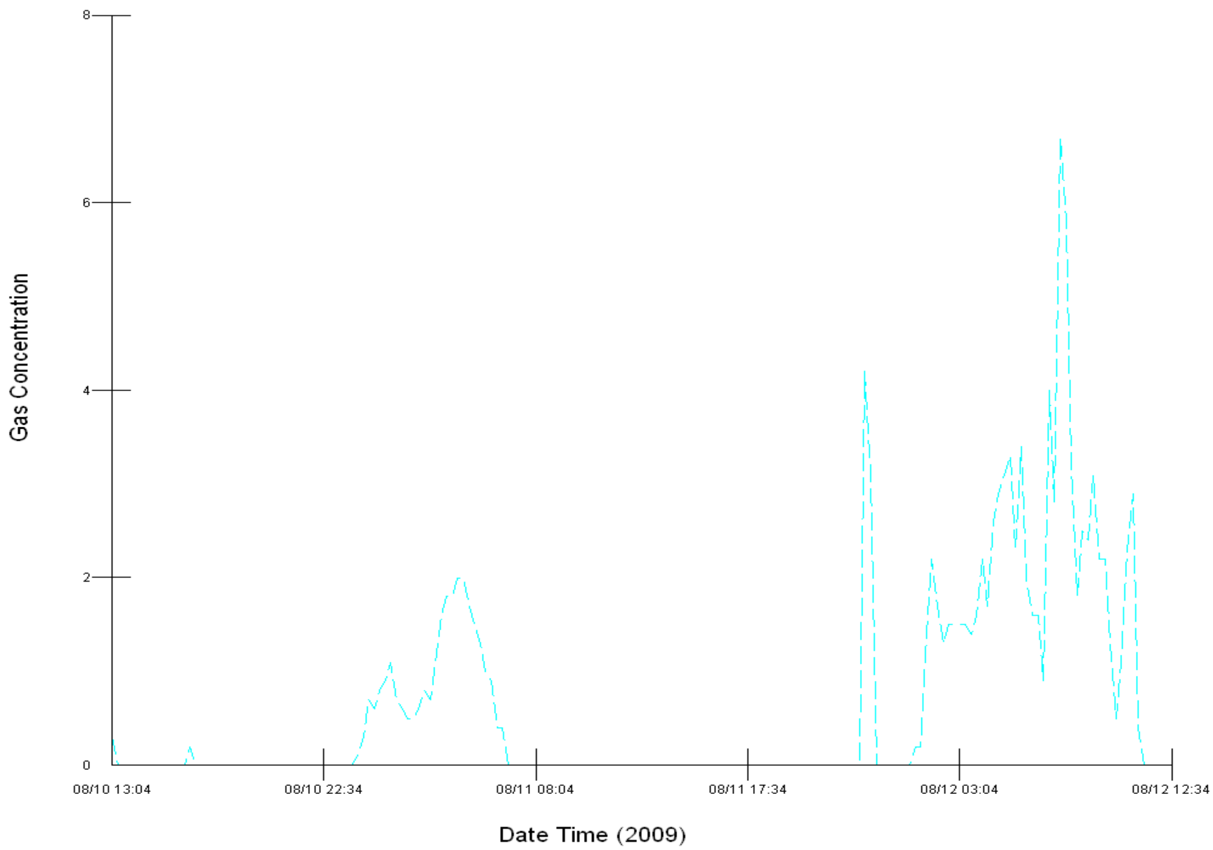
2.2.3.2 Primary Scrubber - Inlet

The primary scrubber (Figure 2.2) is located in a building adjacent to the primary settling tanks and treats exhaust drawn from below the cloth covers at the outlet end of the primary settling tanks. This scrubber is similar to the Dewatering Areas scrubber using plastic media with a sodium hypochlorite solution to oxidize odorous compounds, but it is oriented horizontally instead of vertically.

FIGURE 2-2
PRIMARY SETTLING TANK PACKED BED SCRUBBER

The inlet of the primary scrubber was monitored for H_2S for a two-day period as shown in Figure 2-3. A peak value of 6.7 ppm of H_2S was recorded entering into the scrubber inlet and overall levels varied widely showing the benefit of continuous monitoring. The concentration of H_2S in the scrubber outlet was measured at 0.033 ppm. This also corresponds to greater than 99% removal. Operating staff also increased the ORP setting of the primary scrubber to try to further improve hydrogen sulfide removal rates based on the outlet monitoring results as noted in Table 1-2.

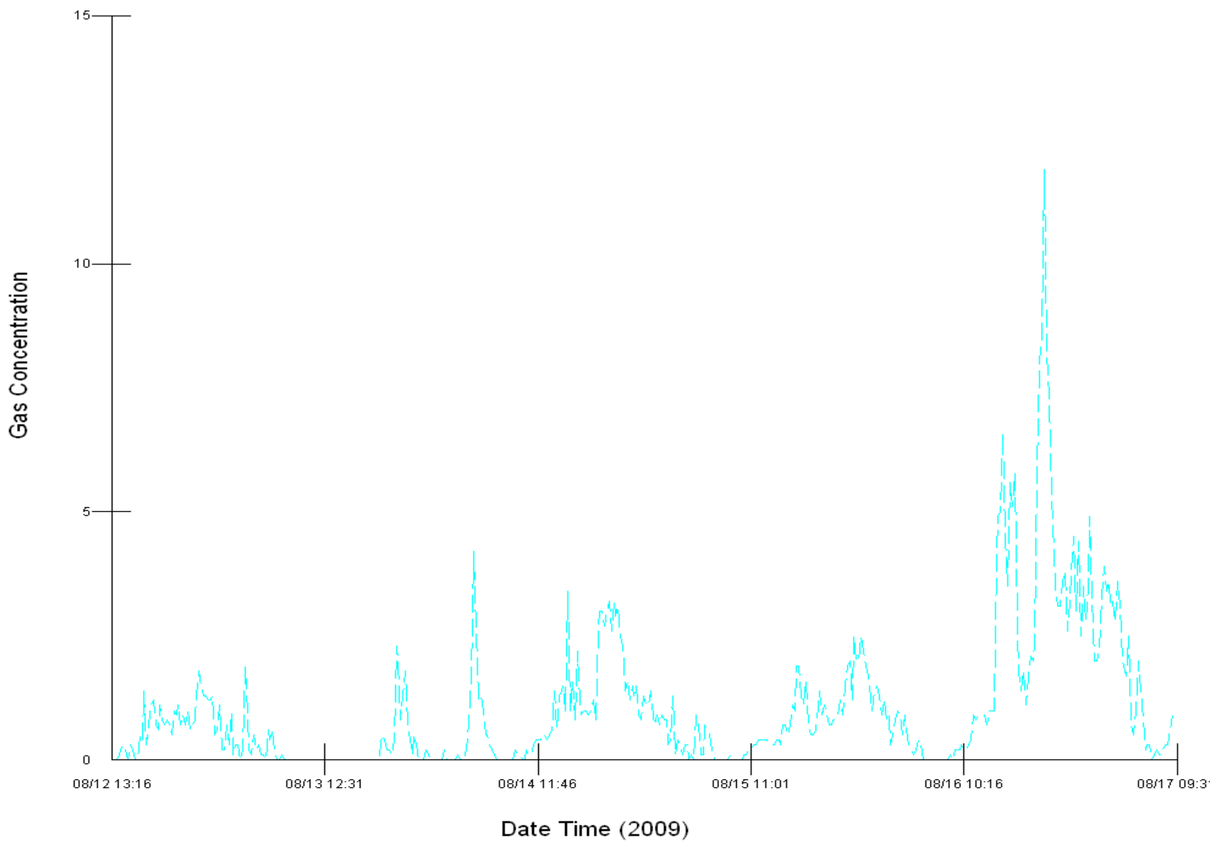
FIGURE 2-3
HYDROGEN SULFIDE CONCENTRATIONS (PPM)
IN INLET OF PRIMARY SCRUBBER



2.2.3.3 Sludge Storage Tank - With Cloth Cover

The hydrogen sulfide levels in the sludge storage tank/thickener located by the Filter Building, which has a cloth fabric cover, was monitored for a six-day period as shown in Figure 2-4. Readings obtained from the V-Rae showed a peak H_2S concentration of 11.9 ppm, indicative of highly odorous conditions. The cover of this tank is in poor condition and allows the release of fugitive odor emissions.

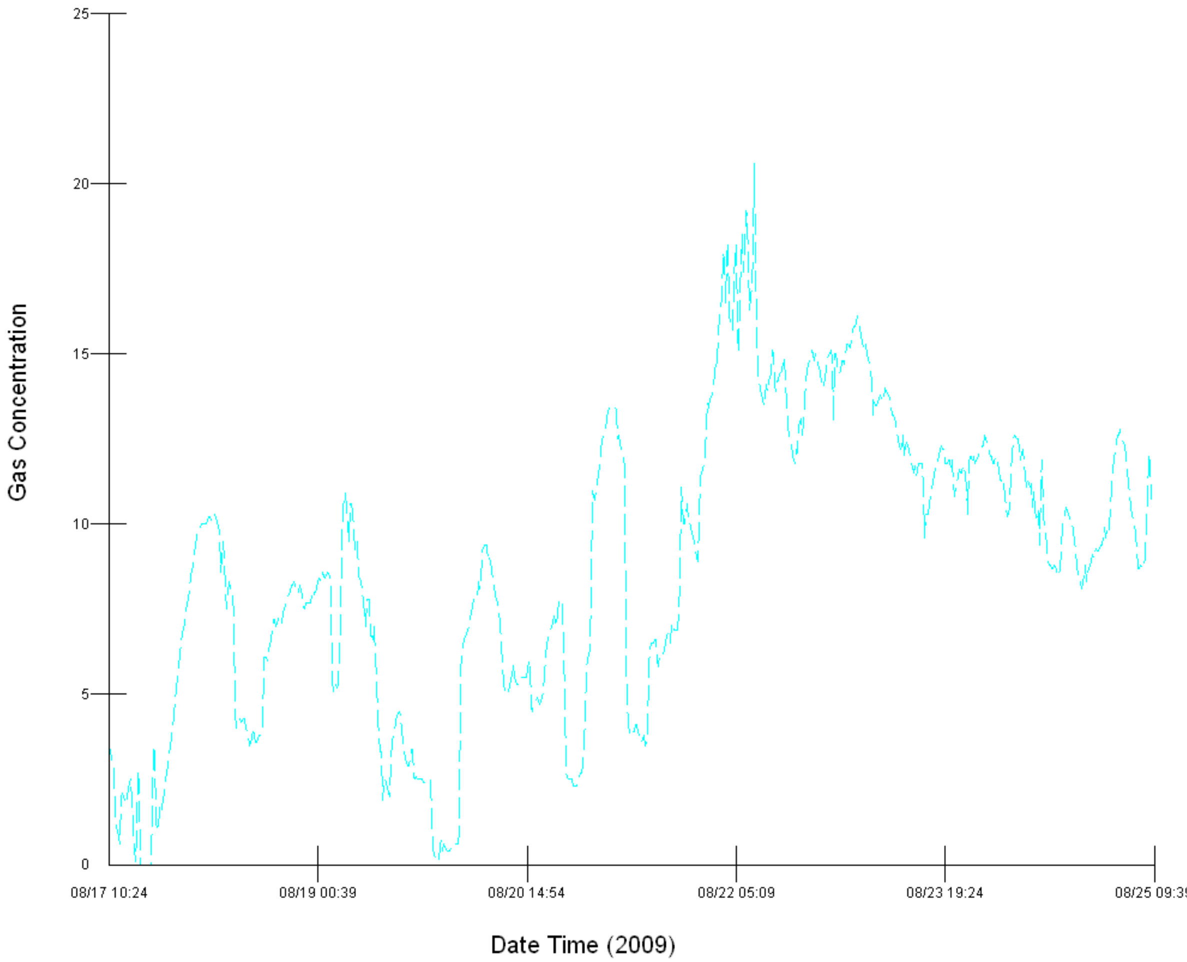
FIGURE 2-4
HYDROGEN SULFIDE CONCENTRATIONS (PPM)
IN HEADSPACE OF SLUDGE STORAGE TANK



2.2.3.4 Filter Building - Belt Filter Presses

The belt filter presses are located in the Dewatering Area of the Filter Building. These dewatering devices are not enclosed and release hydrogen sulfide and other off-gases during the dewatering process directly into the Dewatering Area Room. There are two exhaust air intakes at each belt filter press; one at the rotary drum thickener and one at the bottom of the frame. The hydrogen sulfide concentration in the exhaust duct which carries the exhaust air from both the belt filter presses was recorded for a nine-day period as shown in Figure 2-5. Readings obtained from the V-Rae showed a peak H_2S concentration of 20.6 ppm, indicative of highly odorous conditions.

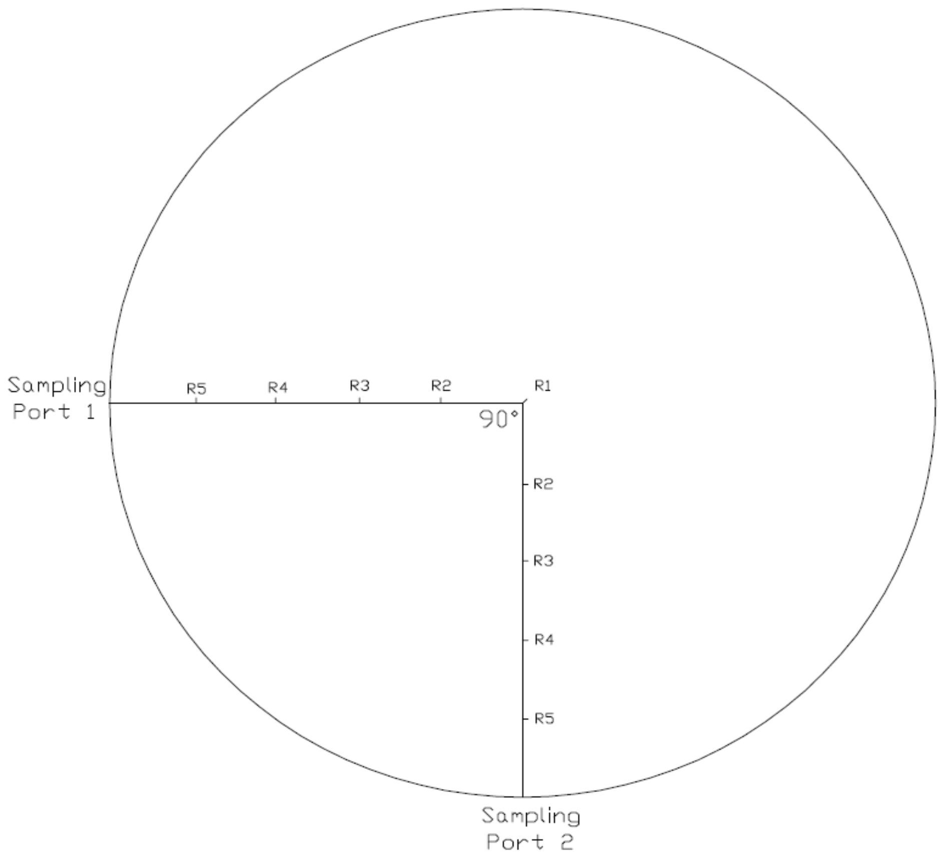
FIGURE 2-5
HYDROGEN SULFIDE CONCENTRATIONS (PPM)
IN EXHAUST FROM BELT FILTER PRESSES



2.2.4 Air Flow Rate Survey

The air flow rate survey was conducted at selected locations on ventilation ducts to determine the actual ventilation rates. This information is used to determine if there is sufficient ventilation rate to maintain negative pressures in order to prevent fugitive odor release. Air flow measurements were conducted by using a Velocicalc Multi-Function Series 9555 Velometer. Air velocity measurements were collected by drilling two small holes at a 90 degree angle into each duct. The graduated probe on the Velocicalc was completely inserted in one of the sampling locations to measure the internal diameter of the pipe. A total of five velocity readings were collected for each hole at evenly space intervals from the center to the outside edge as shown in Figure 2-6.

FIGURE 2-6
SAMPLING LOCATIONS FOR AIR VELOCITY MEASUREMENTS



The air flow rate in each duct was calculated by using the flow rate formula given below:

$$Q = VA$$

Where

Q = Flow in the pipe (cubic feet per minute)

V = Velocity in the pipe measured using the Velocicalc (ft/min)

A = Area of the pipe (square feet)

The air flow rate results are shown in Table 2-5. These air flow measurements appear to have some significant margin of error. The exhaust air flow rate on the outlet of the scrubber was measured at 14,247 cfm, but the fan curve information and other recent measurements indicate that the actual flow is approximately 17,000 cfm. Likewise, the air flow rate of the fluidizing air blower was recently measured at approximately 18,000 cfm, and the pressure head measured at that time is consistent with a flow rate of approximately 17,500 cfm based on the fan curve information. This results in a very strong negative pressure in the dewatering area.

TABLE 2-5
RESULTS OF AIR FLOW RATE MONITORING

Location	Average Velocity (fpm)	Duct Area (sq.ft.)	Flow Rate (cfm)
Primary Scrubber Inlet	2,004	0.92	1,847
Dewatering Area Scrubber:			
Four Circular Sludge Storage Tanks / Thickener	2,297	1.23	2,817
Belt Filter Presses	2,502	0.55	1,364
Polymer	545	0.35	190
Scrubber Outlet	3,108	4.58	14,247
Fan from Hot Oil Room	1,797	2.88	5,182
Fluidizing Air Blower to Incinerator	4,481	2.88	12,923

2.2.5 Community Odor Surveys

Several community odor surveys were performed in order to assess the magnitude of odor impacts in the surrounding residential areas. The location of odor impacts during any particular survey is dependent on the wind direction. The results of the community odor surveys are summarized in Table 2-6. During the community odor surveys, the atmospheric conditions were noted along with the odor concentration in *dilutions-to-threshold* (D/T). The odor concentration was determined using a Scentometer as shown in Figure 2-6. As noted in Section 1, under Section 22a-174-23 of the Regulations of Connecticut Agencies, a D/T level of 7 or greater is considered a nuisance.

As shown in Figure 2-7, the Scentometer is a rectangular, clear plastic box containing two activated carbon beds. The box contains two ½" diameter air inlets to the activated carbon beds (one on top and one on the bottom of the box). There are six odorous air inlet holes on one end of the box for six different D/T levels (2, 7, 15, 31, 170, and 350). The opposite end of the box contains two glass nostril tubes for sniffing. The Scentomer allows the observer to determine the range of the odor concentration based on the six D/T levels.

The community odor surveys focused on the area downwind of the WWTF, and all observed detectable odors were believed to be attributable to the WWTF. During the odor surveys, low level detectable odors were observed on a number of occasions. The observed odor concentration levels were below the nuisance level under Section 22a-174-23 of the Regulations of Connecticut Agencies. The results confirm that there are detectable odor impacts in the surrounding residential areas to the east, southeast, northwest and west, but that the odor concentration did not exceed the nuisance levels per the DEP regulations.

FIGURE 2-7
SCENTOMETER FOR DETERMINING ODOR CONCENTRATION

TABLE 2-6
RESULTS OF COMMUNITY ODOR SURVEYS

Location	Date	Time	Wind Direction	Wind Speed (mph)	Cloud Cover	Temp (F)	Humidity (%)	Odor Conc. (D/T)	Comments
Cross Street	7/28/2009	3:10	SW	10	Clear	85	63	0	No Odor
Beacon Valley Road	7/28/2009	3:18	SW	10	Clear	85	63	0	No Odor
Meadow Brook Lane	7/28/2009	3:23	SW	10	Clear	85	63	0	No Odor
Cemetery (By Route-8)	7/28/2009	3.35	SW	10	Clear	85	63	2	Light Odor
Cherry Street & Spencer Street Intersection	7/28/2009	4:10	SW	10	Clear	85	63	2	Light Odor
Cherry Street	7/28/2009	4:20	SW	10	Clear	85	63	0	No Odor
Hunter Mountain Road	7/28/2009	4:35	SW	10	Clear	85	63	0	No Odor
Ann Street & Cherry Street Intersection	7/29/2009	2:13	S	14	Partially cloudy	81	77	2	Light Odor
Charles Street	7/29/2009	2:19	S	14	Partially cloudy	81	77	0	No Odor
Lewis Street	7/29/2009	2.33	S	14	Partially cloudy	81	77	0	No Odor
Vagini Drive	7/29/2009	2.20	S	14	Partially cloudy	81	77	2	Light Odor
Fairfield Street	7/29/2009	2.25	S	14	Partially cloudy	81	77	2	Light Odor
Hard Street	7/29/2009	2.27	S	14	Partially cloudy	81	77	2	Light Odor

TABLE 2-6
RESULTS OF COMMUNITY ODOR SURVEYS

Location	Date	Time	Wind Direction	Wind Speed (mph)	Cloud Cover	Temp (F)	Humidity (%)	Odor Conc. (D/T)	Comments
Ward Street	8/25/2009	12:30	NW	6	Clear	85	65	0	No Odor
Elm Street	8/25/2009	12:37	NW	6	Clear	85	65	0	No Odor
Pond Street	8/25/2009	12:50	NW	6	Clear	85	65	0	No Odor
Maple Street	8/25/2009	1:35	NW	6	Clear	85	65	0	No Odor
Carroll Street	8/25/2009	1:45	NW	6	Clear	85	65	0	No Odor
Old Firehouse Road	8/25/2009	1:10	NW	6	Clear	85	65	0	No Odor
Arch Street	8/25/2009	1:20	NW	6	Clear	85	65	0	No Odor
Cliff Street	8/25/2009	1:25	NW	6	Clear	85	65	0	No Odor

2.3 OPERATIONS REVIEW

The Naugatuck WWTF currently processes an average flow of 5.3 MGD. Raw wastewater is received from the interceptor sewers running along the east and west side of the Naugatuck River. Flows from the east interceptor connect to the west interceptor just upstream of the WWTF. The ORP monitoring determined that at times the incoming wastewater appears to be odorous and generating additional hydrogen sulfide. The odorous compounds generated in the collection system can then be "stripped" out of the wastewater when it is agitated over weirs or at other hydraulic disturbances. This also suggests the potential for odor emissions from the collection system which typically occurs at high points in the system due to drafting within the sewer pipes or at force main and siphon discharges. Additional ORP monitoring within the collection system may be warranted to determine if there are any particular portions of the collection system with problems that should be addressed as part of the efforts to mitigate objectionable odor impacts.

2.3.1 Influent Screening and Wetwell Area

The raw influent flow passes to the Screening Area and then to the wetwell of the Raw Influent Pump Station. The Raw Influent Pump Station and Screening Building is located on the west side of the site as shown in Figure 1-4, and is contiguous with the Filter Building. The raw influent pumps transfer the flow to the primary settling tanks for further treatment. The Screening Area currently lacks any screening equipment. As part of the major 1970's upgrade, the Screening Area was constructed and included a multi-story chain and flight screen to move the screenings to the ground level. This was apparently demolished in the mid 1980s, and the influent channel and wetwell were covered with a cypress wooden floor that acts as a platform to contain odors.

Exhaust air from each of the two wetwells is drawn through two 18-inch ducts connected to a common header and is treated by the Dewatering Area scrubber. When the wetwell floods, these ventilation inlets also flood and there is no way to draw exhaust air to the odor control system. This issue could be addressed by installing a barometric damper in the common header at the ceiling level to draw exhaust air from above the covers when flooding occurs.

Hydrogen sulfide monitoring was carried out in three locations within the Screening and Wetwell Area as shown in Table 2-3 and Figure 2-8. The hydrogen sulfide levels below the covers indicate relatively high odor emissions. As previously noted, it appears that the raw wastewater often reaches the facility in a highly odorous condition. In addition, septage is discharged upstream of the influent channel as well as a number of return flows including the tray scrubber blowdown. The readings in the Screening Area and Wetwell Area above the covers indicate that odor emissions are typically well contained, except when high wetwell levels occur. The sampling event conducted on July 27, 2009 occurred at a time when the influent wetwell was high which resulted in relatively high levels of hydrogen sulfide in the Screening and Wetwell Area. This can result in fugitive emissions and off-site odor impacts.

FIGURE 2-8
H2S MEASUREMENT IN THE WET WELL AREA

2.3.2 Primary Settling Tanks

Two of the three primary settling tanks are currently used to treat primary effluent. As previously noted, the third tank was originally intended for separate treatment of the flows from the Uniroyal complex and use of this tank was discontinued when the facility closed. These settling tanks are located on the west side of the site just south of the plant entrance as shown in Figure 1-4. The primary clarifiers are the odor source closest to the Cherry Street residential neighborhood.

The two active tanks have a fabric cloth cover over the majority of the surface with a fiberglass cover at the outlet end as shown in Figure 2-8. The tanks are vented from the outlet end to a packed bed scrubber rated for 2,000 cfm located in a small building adjacent to the tanks. The air flow rate monitoring confirmed that the actual flow rate is in the rated range at about 1,846 cfm. The covers and scrubber were installed in 1993. The covers are in relatively poor condition as shown in Figure 2-9 with a number of openings to atmosphere. Portions of the cloth have been replaced in the past. The existing ventilation rate does not appear to maintain a strong negative pressure especially at the inlet end, due to the holes in the cloth covers. Potassium permanganate is currently being added to the influent channel entering the primary settling tanks to minimize odorous fugitive emissions. The covers should be repaired or replaced and a higher ventilation rate may be warranted even with a tight cover system.

The scum skimmings from the primary clarifier are currently removed from the scum well weekly by a vacuum truck and are hauled offsite in a closed container for disposal. The clarifiers have manual rotating scum troughs at the outlet end that discharge to the adjacent scum well. During this operation, hatches in the covers must be opened to view the scum troughs. This results in fugitive emissions that have caused odor complaints in the past. The scum well is covered but does not have an exhaust duct to the odor control system. Thus, a higher ventilation rate is warranted to provide better containment of odors during the scum removal process and across the primary settling tanks. A higher exhaust rate and an improved exhaust ductwork system are needed that includes a direct exhaust duct from the scum well.

FIGURE 2-9
VIEW OF PRIMARY CLARIFIER COVERS FROM INLET END

The former Uniroyal property has a groundwater treatment system that discharges to the inlet of the primary clarifiers. The discharge contains aniline contaminated groundwater which originated from the Uniroyal manufacturing process. The end of the discharge pipe was above the surface of the primary settling tank water level, resulting in "stripping" of aniline odors. In order to minimize the release of aniline odors at the discharge location, during the summer of 2009 plant staff relocated the discharge line to below the primary settling tank influent water surface. This has significantly reduced fugitive emissions. However, it is important to consider aniline when evaluating the type of odor control system treating the exhaust from the primary clarifiers.

The inlet air to the existing packed bed scrubber (Figure 2-10) was monitored for hydrogen sulfide as discussed in Section 2.2.3.2. The overall removal rate was excellent at greater than 99%. However, the residual odors in the scrubber exhaust as well as the fugitive emissions from the cover system are considered problematic due to the close proximity of the adjacent residential area. Section 3 includes an evaluation of continued use of the packed bed scrubber versus a new system operating at a higher exhaust air rate to provide better odor containment.

At a minimum, the following improvements to the existing packed-bed scrubber are needed:

- Eliminate the existing chemical feed day tanks and install new chemical feed pumps to deliver caustic and sodium hypochlorite directly from the main chemical storage tanks
- Provide a new continuous hydrogen sulfide monitoring system on the inlet and outlet of the scrubber

There is available space for a variety of alternative odor control technologies on the south side of the primary tanks.

FIGURE 2-10
PRIMARY SETTLING TANK PACKED BED SCRUBBER

2.3.3 Aeration Basins and Secondary Settling tanks

The aeration basins (Figure 2-11) include two trains of three tanks each (six total) and are located on the north side of the site as shown in Figure 1-4. The secondary clarifiers are rectangular units located just to the east of the Administrative Building. The aeration basins are set up for biological nitrogen removal using the MLE process as shown in Table 2-7. Odor emissions from aeration basins can be due to the release of odorous compounds in the primary effluent or due to sulfide generation in the tanks, typically in the anoxic zone of an MLE process.

Influent from the primary settling tanks flows into the aeration basins by gravity. The ORP monitoring listed in Table 2-2 indicates that the primary effluent can be a source of odors. Potassium permanganate is currently added to the influent channel of the aeration tanks to reduce odors from the influent channel and aeration basins.

Hydrogen sulfide levels were measured at the surface of each of the tanks of each train as indicated in Table 2-3. During the testing on July 20, 2009 there were high odor levels on the WWTF grounds, but this condition is not considered representative of normal operation of the aeration basins. On the other dates, the results are as expected with the highest level above the anoxic zone (tanks 1 and 3) and lower levels as the flow passes through the train.

FIGURE 2-11
AERATION BASINS

TABLE 2-7
CONFIGURATION OF AERATION BASINS

Train 1		Train 2	
Tank 1	Anoxic Zone	Tank 4	Anoxic Zone
Tank 2	Aerobic Zone	Tank 5	Aerobic Zone
Tank 3	Aerobic Zone	Tank 6	Aerobic Zone

The inlet of the secondary clarifiers is located between the Administrative Building and the Filter Building (Figure 2-12). The observed hydrogen sulfide odor levels were generally very low across the clarifiers as shown in Table 2-3. Operating staff indicated that scum builds up at the inlet channel to the clarifiers and can result in volatile organic acid odors. Staff has implemented operational procedures to address this scum build up issue. The scum well of the secondary clarifier is a relatively minor odor source. A rotating trough system gathers the scum from the secondary clarifiers and collects it in the scum well. The hydrogen sulfide odors from the scum well were relatively low with a maximum of 0.004 ppm.

FIGURE 2-12
SECONDARY SETTLING TANKS WITH FILTER BUILDING
IN THE BACKGROUND

2.3.4 Sludge Storage and Thickener Tanks

The WWTF includes two sets of sludge storage and/or thickener tanks. The first set is a grouping of four circular tanks that were originally constructed as gravity thickeners and digesters, and are located on the north side of the Filter Building. At the present time, only one of these tanks still has an operating thickener mechanism. The second set of storage tanks consists of four rectangular sludge storage tanks, located on the west side of the Filter Building.

The four circular tanks include a distribution structure, and are all covered with the ventilation exhaust directed to the Dewatering Area scrubber. All of the primary sludge from the primary settling tanks is directed to the one operating gravity thickener. This tank has an FRP dome cover that is in good condition (Figure 2-13). Potassium permanganate is added to the surface of the thickener in order to reduce odor emissions from the overflow which flows back to the influent wetwell.

FIGURE 2-13
CIRCULAR THICKENER TANK WITH DOME COVER

The two circular storage tanks immediately adjacent to the Filter Building are used as blend tanks for primary sludge, secondary sludge and liquid merchant sludge prior to dewatering. These tanks have flat FRP covers that are in good condition. The fourth circular sludge storage tank is used to store merchant sludge and has a cloth cover as shown in Figure 2-14. The fabric cover is in poor condition with openings to the atmosphere as shown in Figure 2-14 and is a source of fugitive emissions. The hydrogen sulfide levels in this tank can be very high at times as shown in Table 2-3 and Figure 2-4, particularly the results from July 27, 2009 with a reading of 13.1 ppm. Repair or replacement of this cover is recommended to minimize the release of fugitive odor emissions.

FIGURE 2-14
CIRCULAR SLUDGE STORAGE TANK WITH CLOTH COVER

The four rectangular sludge storage tanks are enclosed in a concrete dome, and also have cloth covers over the surface of each tank. The exhaust air is drawn from below the cloth covers as shown in Figure 2-15. These tanks store merchant liquid sludge, as well as thickened waste activated sludge. A large proportion of the air flow to the Dewatering Area scrubber is apparently exhausted from these tanks, and as a result the current atmospheric condition within the space was excellent. However, it may be possible to rebalance the ventilation air flow to allow better containment of odors from other sources, as discussed in further in Section 3.

FIGURE 2-15
EXHAUST AIR EXHAUSTED FROM BELOW CLOTH COVER OF RECTANGULAR SLUDGE STORAGE TANKS

2.3.5 Sludge Dewatering

The sludge dewatering facilities are located in the Filter Building and include two 1-meter belt filter presses and two centrifuges. The Dewatering Area also houses the single gravity belt thickener that is used for thickening waste activated sludge as shown in Figure 2-16 The operating staff currently rely on the belt filter presses for the majority of the dewatering because they are better able to handle the rags and heavy grit loading in the sludge feed. The belt filter presses are an open dewatering technology that results in high levels of odorous emissions into the Dewatering Area. There are four exhaust air intakes to the Dewatering Area scrubber, located at the top and bottom of the belt filter presses. Even with these exhaust intakes, the odors in the Dewatering Area were substantial as shown in Table 2-3. Figure 2-17 shows the location where these measurements were taken. The average hydrogen sulfide level was 6.2 ppm, and the level on July 27, 2009 exceeded the OSHA short-term exposure limit of 10 ppm.

Note that the Borough of Naugatuck is considering the need to upgrade the headworks facility with improved grit removal and mechanical screening. This would allow for more consistent use of the enclosed centrifuges for sludge dewatering, reducing the release of odors into the Dewatering Area.

FIGURE 2-16
TWO BELT FILTER & CENTRIFUGE PRESSES WITH A GRAVITY BELT THICKENER LOCATED IN THE FILTER BUILDING

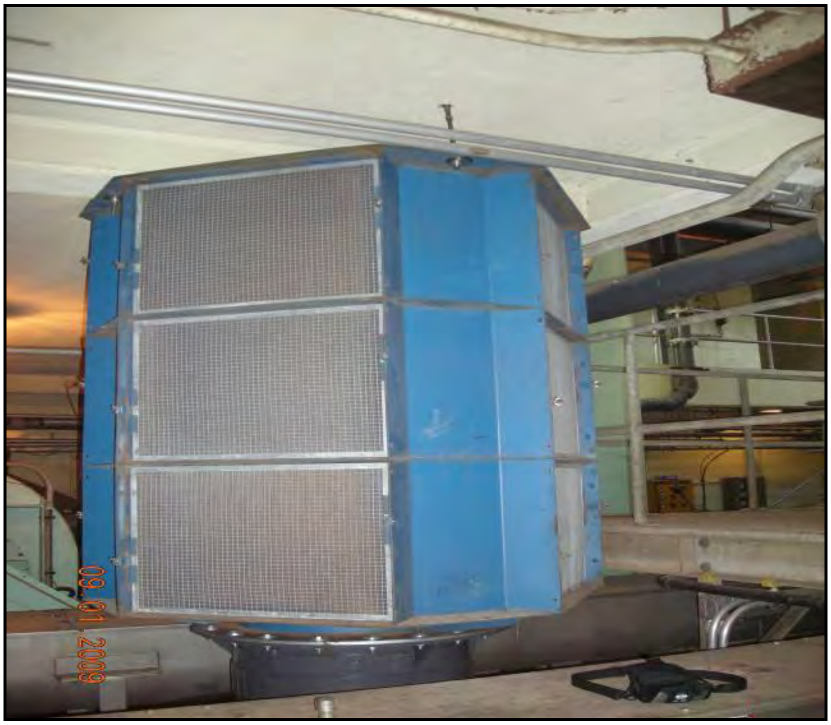
FIGURE 2-17
HYDROGEN SULFIDE MEASUREMENT IN DEWATERING AREA

As noted in Section 1, operating staff has set up a temporary system for sodium permanganate injection into the feed sludge just prior to dewatering in order to help reduce odors. The staff has reported a notable benefit from this practice, although the one sampling event reported in Table 2-3 without the permanganate actually had the lowest hydrogen sulfide levels in the Dewatering Area. Actual odorous conditions from the belt filter presses are a function of the quality of the feed sludge which can vary considerably depending on how long it was stored, and the different characteristics of the merchant sludge deliveries.

Also, as noted in Section 1, the staff has moved forward with improvements to provide much better ventilation of the Dewatering Area by relocating the inlet of the fluidizing air blower (Figure 2-18) for the fluidized bed incinerator. The intent is to exhaust the Dewatering Area room into the fluidized bed incinerator for thermal destruction of odorous compounds. Nevertheless, the sulfide emissions from the belt filter presses are relatively high, and the workplace exposure levels are higher than desired. One important limitation of this system is that there is no exhaust ventilation and odor control when the incinerator is out of operation. In the long-term, a number of additional improvements appear to be warranted, as discussed further in Section 3 and which include:

- Improve the make-up air system to deliver exhaust ventilation from the Hot Oil Room (and other portions of the Thermal Dewatering Unit Building) to the north side of the Dewatering Area so that the space is "flushed" more effectively. Also, provide control provisions to reduce ventilation from the Hot Oil Room and other makeup air sources when the incinerator is not in operation, and/or provide additional odor scrubber provisions.
- Install exhaust vents to the scrubber from all of the screw conveyors

FIGURE 2-18
FLUIDIZED AIR BLOWER FAN EXHAUSTS FOUL AIR FROM DEWATERING ROOM TO FLUIDIZED BED INCINERATOR



The basement of the Filter Building is connected to the Administration Building by means of a tunnel. Currently, there is no ventilation in the basement of the Administration Building, the tunnel or the basement of the Filter Building. Both the basements of the Administration Building and Filter Building house sludge pumping and chemical storage facilities and should be ventilated.

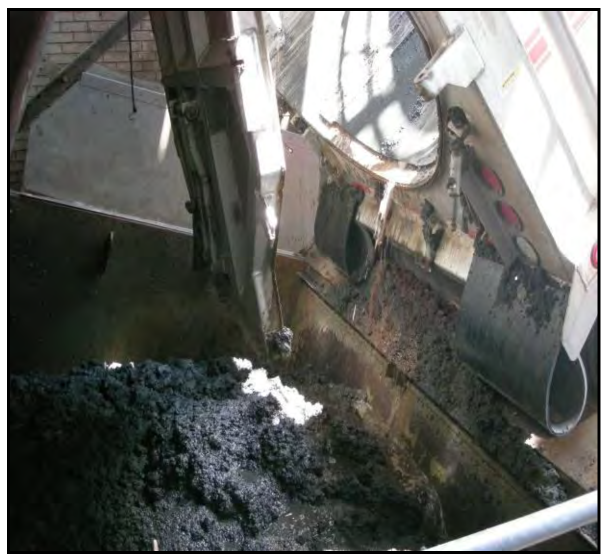
2.3.6 Cake Receiving

Merchant cake sludge is accepted from various wastewater treatment plant facilities into the Cake Receiving Bin as shown in Figure 2-19. The receiving bin is located just outside of the Filter Building adjacent to the Raw Influent Pump Station and Screening Building. The cake deliveries vary in condition depending on their source, and some have relatively low odor emissions. However, as shown in Table 2-3, the odor emissions from some of the trucks can be extremely high and staff has correlated the occurrence of nuisance odor complaints to cake deliveries on a number of occasions.

All of the sludge that is dewatered on-site is also passed through the receiving bin under normal operations to promote mixing of the on-site and merchant sludge. The receiving bin has a 6-inch exhaust duct that is directed to the Dewatering Area scrubber. The exhaust ventilation rate appears to be adequate during normal operations when the cover of the bin is closed.

Operating staff has reactivated an existing odor counteractant spray system to provide some mitigation of the odors from the sludge cake receiving area. However, this system is not sufficient for the magnitude of odors that can occur during cake receiving or the different atmospheric conditions. Given the high level of odors during some truck discharge operations, and the known correlation to odor complaints, improved enclosure of cake receiving appears to be necessary.

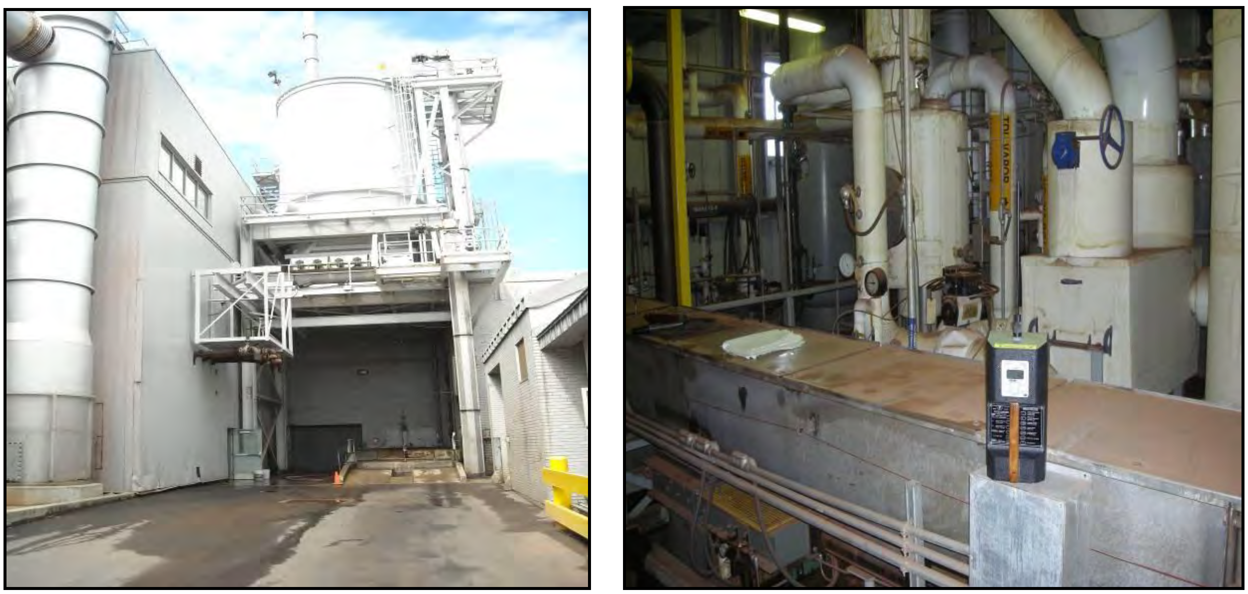
FIGURE 2-19
CAKE RECEIVING BIN



2.3.7 Cake Conveying and Storage Silo

All of the dewatered sludge cake is transferred from the cake receiving bin to the cake storage silo using screw conveyors as shown in Figure 2-20. The cake silo has an exhaust duct that is directed to the Dewatering Area Scrubber. This vent is believed to provide adequate odor containment of the headspace of the silo. It is recommended that an exhaust vent be added to all of the feed screw conveyors to ensure containment of odors. The live bottom screws and discharge screw conveyor for the storage silo are also an occasional odor source. The discharge screw conveyor is located partially outside and partially within the Hot Oil Room. It is recommended that an exhaust vent be added to the discharge end of this screw as well. In addition, the possibility of enclosing the live bottom area of the silo including the current exterior section of the discharge screw conveyor is discussed in Section 3 as part of the potential enclosure of the cake receiving area.

FIGURE 2-20
CAKE STORAGE SILO LOCATED ON THE UPPER LEVEL OF THE FILTER BUILDING AND ENCLOSED SCREW CONVEYORS IN HOT OIL ROOM



2.3.8 Thermal Dewatering Unit

The Thermal Dewatering Unit (TDU) is a sludge dryer that was designed to operate on heat recovered from the incinerator exhaust in order to further dry the incinerator feed sludge to above the autogenous point by increasing the solids content. With autogenous conditions, no fuel is needed to operate the fluidized bed incinerator, resulting in reduced operational costs. The TDU building has three stories and is contiguous to the old multiple hearth area of the Filter Building. The TDU building was designed with an air supply unit intended to feed 14,000 cfm of fresh air for the incinerator fluidizing air blower which is located on the first floor. The original system included provisions to direct 7,000 cfm of this make-up air to the Dewatering Area, and then to exhaust 7,000 cfm back to the TDU building as part of the make up air for the fluidizing air blower. The intent was to provide fresh air to the Dewatering Area and exhaust odorous air into the incinerator for thermal combustion. For a variety of reasons, this system was never operated as intended.

As noted in Section 1, the operating staff has recently relocated the air intake of the fluidizing air blower to provide improved ventilation of the Dewatering Area. The operating staff has also activated the original ventilation fan that was intended to exhaust 7,000 cfm from the Hot Oil Room to the Dewatering Area. The discharge duct has been relocated to the east side of the Dewatering Area, but this does not allow the make up air to "sweep" across the room to the exhaust. Thus, as discussed in Section 2.3.5, a new make up air system is evaluated in Section 3 that would deliver the make-up air to the south side of the Dewatering Area. This would allow the room to be "swept" with the exhaust drawn from the north side of the room. The intent is to provide fresh air to the Dewatering Area to improve the atmosphere and exhaust odors to the incinerator for thermal combustion. Section 3 includes an evaluation of the make-up air rate needs for the TDU building, and to better match the exhaust rate of the fluidizing air blower. An important limitation is that when the incinerator is not operating, this ventilation does not operate. It may be possible to address this issue since the thermal dewatering unit also does not operate at these times, and it may be possible to shut down the belt filter presses. However, it may be desirable to still consider alternative odor control provisions.

It should be noted that the Thermal Dewatering Unit currently has an exhaust air stream that is directed to the fluidized bed incinerator. This appears to operate effectively both in containing odors from the TDU and providing adequate exhaust air treatment. As noted above, the screw conveyor that feeds the TDU should be vented to directly to the Dewatering Area scrubber. In addition, the discharge screw from the TDU and hoppers for the two incinerator feed pumps should be vented to the scrubber. This will also help to ensure that the supply air to the Dewatering Area has low hydrogen sulfide levels.

2.3.9 Sludge Incineration

The fluidized-bed incinerator (Figure 2-21) is located adjacent to the TDU building. The exhaust from the incinerator is cooled in the heat exchangers and treated in the tray scrubber located in the TDU Building. The exhaust is also treated in a wet electrostatic precipitator (ESP) prior to discharge to the exhaust stack, but typically meets permit requirements following the tray scrubber. In March 2009, operating staff started adding caustic solution to the tray scrubber in order to improve sulfide removal. In addition, they started neutralizing the pH of the blow-down from the scrubber in order to avoid excessive pH swings in the influent wastewater which can result in process upsets and/or reduce the solubility of hydrogen sulfide.

As previously noted, plant staff have recently extended the intake of the fluidizing bed blower into the Dewatering Area in order to exhaust air from this area into the incinerator for thermal destruction of odorous compounds. The incinerator also has an additional blower that supplies about 1,500 cfm of supply air to above the fluidized bed. This over-bed air blower currently draws outside air, but could also be used for treatment of the exhaust from an odorous area. Potential uses for this are discussed in Section 3.

FIGURE 2-21
FLUIDIZED BED INCINERATOR

2.3.10 Septage Receiving

The WWTF receives an average of about 50,000 gallons per day (gpd) of septage during the summer. The septage receiving area is located near the gravity thickener as shown in Figure 2-22. The operation has been to discharge into the drain line which directs the flow to the influent sewer into the Wet Well Area. Although the odor levels observed during the field investigations as shown in Table 2-3 were relatively low with the exception of August 17th, 2009, operating staff has correlated a number of nuisance odor complaints to septage receiving. To address this problem, staff is in the process of procuring a receiving box that will provide some screening of the incoming septage and will allow a vent line to be connected to the Dewatering Area scrubber. This is expected to contain the odorous emissions from septage dumping operations that have caused nuisance odor events when a highly odorous load is received.

FIGURE 2-22
SEPTAGE RECEIVING AREA

2.3.11 Dewatering Area Scrubber

The Dewatering Area scrubber (Figure 2-23) is located in the Filter Building and treats the exhaust from a wide range of sources including the influent wetwell, sludge storage tanks and thickener, belt filter presses, cake receiving bin and the cake silo.

FIGURE 2-23
DEWATERING AREA SCRUBBER

There are a number of other smaller odor sources that could be connected directly to the scrubber including the planned septage receiving box, dewatered sludge cake screw conveyors, and the hoppers for the dewatered sludge cake pumps. The intent would be to maintain enough negative pressure to prevent fugitive emissions from these sources. The air flow monitoring summarized in Table 2-5 indicates that there may also be some opportunity to rebalance the amount of exhaust air being ventilated from some areas to allow the additional sources to be connected. In addition, a number of improvements to the operation of the scrubber could be provided including:

- Eliminate the chemical feed day tanks and install new chemical feed pumps to deliver caustic and sodium hypochlorite directly from main chemical storage tanks
- Provide a new continuous hydrogen sulfide monitoring system on the inlet and outlet of scrubber
- Increase the height of the discharge stack

2.3.12 Collection System Vacuum Cleaning Truck Dump Station

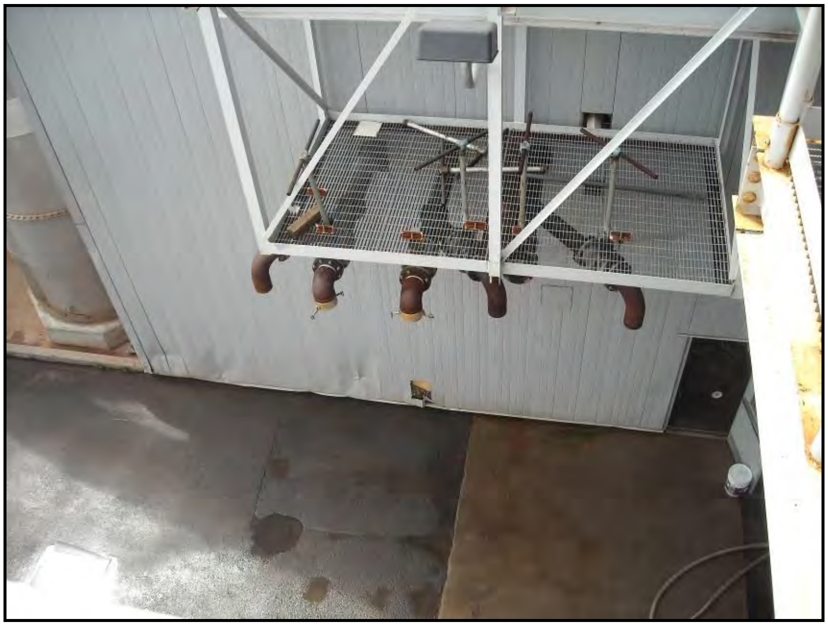
Veolia Water is responsible for periodic maintenance and cleaning of the Naugatuck wastewater collection system which includes use of a vacuum truck to remove debris from the sewers. The vacuum truck discharges its contents onto a debris collection tray located next to the sludge holding tanks where rocks, rags and other debris are removed with the liquid portion discharging into the plant influent. This operation is reported to be a source of periodic off-site nuisance odor complaints. In order to reduce the odors from this operation, additional chemical addition could be used to minimize this periodic but infrequent odor source.

2.3.13 Dewatered Sludge Bypass Pumping Discharge Station

The Naugatuck facility receives merchant sludge deliveries on a daily basis, and merchant and WWTF sludge is dewatered, conveyed and incinerated on a continuous basis seven-days-per-week, twenty-four-hours-per-day. It should be noted that continuous operation of the incinerator is more efficient and works better than intermittent operation, allowing for more consistent control of exhaust quality and reducing or eliminating the need for supplemental fuel addition.

When the incinerator is out of operation for maintenance or equipment problems, the facility still needs to process and dispose of sludge. During incinerator down time and when the sludge storage tanks and silo are full, dewatered sludge may at times be hauled off-site for disposal. A bypass dewatered sludge discharge station is located in the sludge cake receiving area as shown in Figure 2-24. When necessary, dewatered sludge is pumped into dump trailers at this location for hauling off-site. This system is infrequently used but has been a source of nuisance odors. Veolia reportedly has addressed this issue through chemical addition.

FIGURE 2-24
DEWATERED SLUDGE BYPASS PUMPING DISCHARGE STATION



2.4 SUMMARY OF ODOR SOURCES

Veolia Water operating staff is working diligently to improve odor control throughout the facility. This was very evident from the operational changes and capital improvements that were being implemented throughout the course of this evaluation. Based on the field investigations, it appears that the most significant odor sources contributing to off-site odor impacts include the following, which are listed in the estimated order of significance:

- Dewatered Sludge Cake Receiving Area
- Septage Receiving Area (Note: Operating staff have addressed this source)
- Sludge Storage Tank with cloth cover
- Primary Settling Tanks with cloth cover
- Fugitive emissions from Screening and Wetwell Area during high wetwell levels
- Fugitive emissions from various sludge handling sources
- Collection system vacuum truck dump station
- Dewatered sludge bypass pumping discharge station

Section 3

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SECTION 3

EVALUATION OF ALTERNATIVES

This Section summarizes the evaluation of the options for containment and control of odorous emissions for each of the significant sources throughout the treatment facility. Table 3-1 is a summary of all the options that were initially considered. Based on the results of the evaluation of existing conditions, some of these options were ruled out for detailed evaluation and others have been prioritized.

As part of this evaluation, the ventilation rates required or recommended in the following standards/guidelines for the different unit processes were considered for all new or upgraded odor control facilities.

- *National Fire Protection Association (NFPA) 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities.* This standard provides guidance intended to minimize fire and explosion hazards, and is referenced by the National Electrical Code (NEC) as a requirement for code compliance.
- *New England Interstate Water Pollution Control Commission Technical Report #16 (TR-16), Guides for the Design of Wastewater Treatment Works, Latest Edition*. This guidance document provides recommendations on good design practices and is referenced in Connecticut Department of Environmental Protection guidance documents.
- Water Environment Federation (WEF) Design of Municipal Wastewater Treatment Plants, Manual of Practice No. 8 (MOP 8) suggests ventilation rates for various unit processes.

TABLE 3-1
SUMMARY OF ODOR CONTROL AND PROCESS MODIFICATION ALTERNATIVES

Unit Process	Alternatives: Containment	Alternatives: Ventilation and Treatment
Screening & Wetwell Area	Retain existing Cyprus plank covers.	Balance air flow to Dewatering Area Scrubber to provide 12 AC/hr from below the covers over the influent channel and wetwell.
		Install barometric damper on the existing exhaust duct to odor control system in order to maintain ventilation when wetwell floods.
Primary Settling Tanks	Continue to utilize existing cloth covers over the tanks and rubber mats over the influent and effluent channels.	Install new exhaust duct system for each tank including the influent channel, inlet zone of the tank, effluent trough, scum well, and effluent channel, and connect it to a existing or new odor control system.
	Repair or replace fabric covers on 2 primary settling tanks	Continue to utilize existing scrubber, eliminate chemical day tank, install H_2S monitoring, and extend discharge stack.
		Install new odor control system with higher exhaust air capacity. Consider biofilter, bio-scrubber, chemical wet scrubbing and activated carbon.
		Continue addition of potassium permanganate at the influent channel of the primary clarifiers
Aeration & Secondary Settling Tanks	Continue to utilize existing rubber mats over the influent channels in both treatment processes.	Do not treat.
		Continue addition of potassium permanganate at the influent channel of the aeration tanks.
Dewatering Area Scrubber		Install balancing dampers on the exhaust ducts to properly balance air flow from the existing treatment locations.
		Extend vents for sodium hydroxide storage tanks to above the roof line outside the Administrative Building.
		Eliminate chemical day tanks, install H_2S monitoring, and extend discharge stack
Sludge Thickener & Storage Tanks	Repair or replace fabric cover on circular sludge storage tank.	Balance exhausting air from thickener and all sludge storage tanks to the Dewatering Area Scrubber.
Belt Filter Presses	Enclose existing belt filter presses using strip curtains	Continue to add permanganate to sludge area
Septage Receiving Facility	Install a septage receiving box with bar grates to contain odors during and after septage disposal.	Exhaust foul air from the septage receiving box to the Dewatering Area Scrubber.
Cake Screw Conveyors		Install vents to exhaust foul air from conveyors to Dewatering Area Scrubber.
		Do not treat.

TABLE 3-1
SUMMARY OF ODOR CONTROL AND PROCESS MODIFICATION ALTERNATIVES

Filter Building & New Incinerator Addition		Balance the existing make-up air system for the Thermal Dewatering Unit Building.
		Install new exhaust air system for the Thermal Dewatering Unit Building that draws air primarily from the Hot Oil Room, and delivers the exhaust as make up air to the Dewatering Area through new ductwork on the north side at the upper and lower level.
		Install a ventilation system that draws make-up air from the basement of the Filter Building to provide additional make-up air to the Dewatering Area.
		Install a heated make-up air unit that will deliver the make-up air to the far end of the basement of the Administrative Building. This air will be drawn through the basement of the Administration Building, the tunnels, and the Sludge Thickener/Storage Tank Pump Area to the exhaust system transferring air to the Dewatering Area.
Sludge Cake Receiving Facility	Provide exhaust ventilation hood over sludge receiving hopper	Modify Hot Oil Room supply and exhaust ventilation systems to exhaust from new hood
	Enclose the existing Sludge Cake Receiving with a building enclosure that also encompasses bottom of the silo, and a new Screening Building. Move the vactor truck dump box to this facility.	Provide ductwork to exhaust air from the enclosed Cake Receiving Area utilizing the Over-bed Air Blower that discharges to the fluidized-bed incinerator to provide continuous odor control of this area when there is no sludge truck dumping. Provide a new activated carbon system rated for 6,000 CFM to treat exhaust odors from the Cake Receiving Area during sludge truck dumping

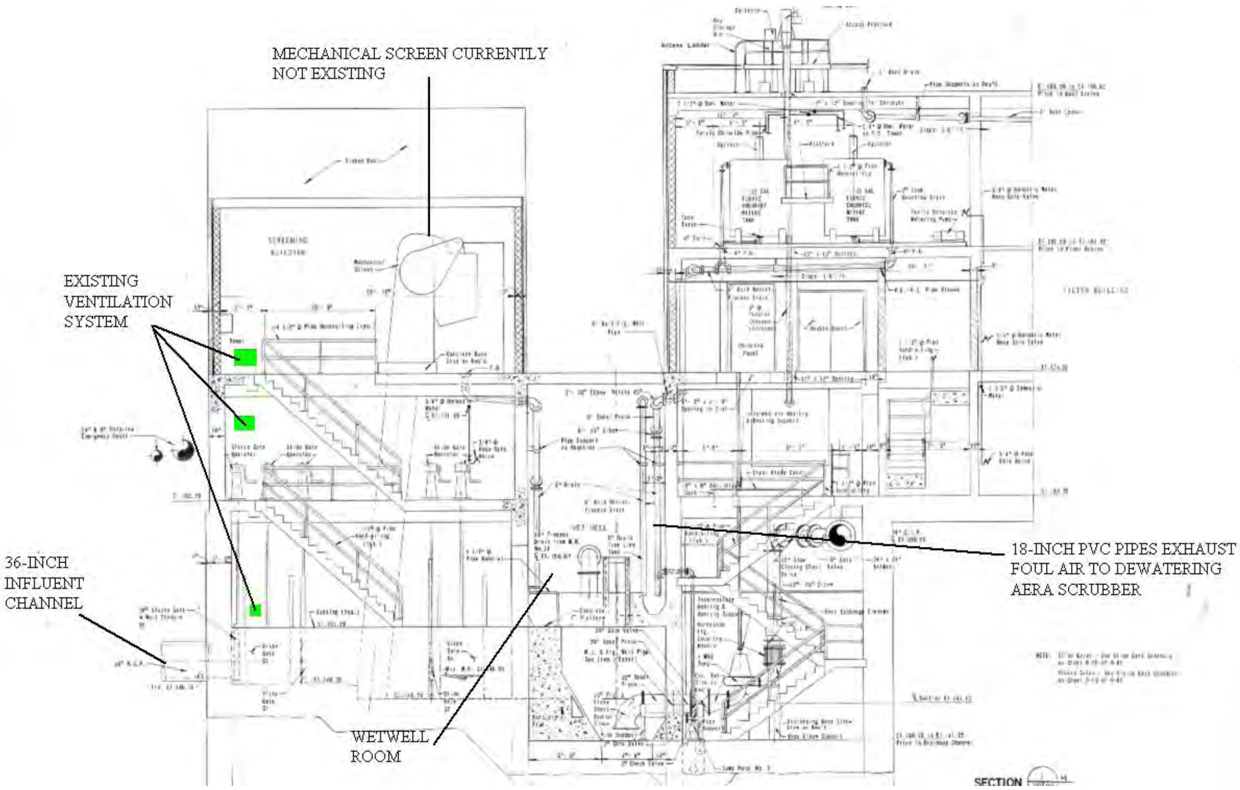
3.1 SCREENING AND WETWELL AREA

The Screening and Wetwell Areas are part of the Raw Sewage Pump Station and Screening Building as shown in Figure 1-4 and 3-1. The key elements of the Screening and Wetwell Areas include the following:

- 36-inch influent interceptor sewer connection to the influent channel in the existing Screening Area;
- 4'-0" wide influent channel that formerly included a multi-story mechanical bar rack;
- Bypass channel with a manual bar rack;
- Two (2) 4'-0"-wide channels to the two wetwells;
- Slide gates to direct flow to either main or bypass channel and to either wetwell; and

- Two wetwells for the raw sewage pumps.

FIGURE 3-1
SECTION OF RAW SEWAGE PUMP STATION AND SCREENING BUILDING



3.1.1 Ventilation Standards

Odor control requires containment of odorous sources and ventilation to an odor control (treatment) system. As noted above, the evaluation of odor containment included review of the appropriate ventilation standards for comparison with the existing ventilation system, compliance with current standards will be necessary consideration for any for improvements. The applicable standards identified for the Screening and Wetwell Area include the following:

- *NFPA 820* - This standard requires a continuous ventilation rate of 12 air changes per hour (AC/hr) or greater in a headworks and pumping stations to reduce the electrical classification to Class I, Division 2, Group D. Lesser ventilation rates are allowable, but require Class I, Division 1, Group D electrical classification.
- *TR-16* - Chapter 3 recommends continuous ventilation at 12 AC/hr for influent wetwells.

- MOP 8 - Suggests a continuous ventilation rate of 12 AC/hr for headworks with the use of a two-speed motor on the fan that can provide a peak of 24 AC/hr.

The use of continuous ventilation at 12 AC/hr throughout the Screening and Wetwell Area would result in a relatively high flow rate for an odor control system. If the wetwells and influent channels are covered, continuous ventilation at 12 AC/hr from below the covers provides good containment with a relatively small exhaust air stream to treat, and is recommended for this application. This air change rate will also minimize the potential for corrosion, particularly for exposed concrete below the containment that does not have a protective coating. For the space above the wetwell containment area, the ventilation system is recommended to have the capacity to provide make-up air and exhaust air at a rate of 12 AC/hr, but it is typically acceptable to utilize this general ventilation system intermittently when staff enters the space.

3.1.2 Existing Facilities and Improvement Needs

The existing Screening Building consists of three (3) main levels: screening and wetwell level, intermediate level and ground level. The influent screening channel and wetwell are currently enclosed with Cyprus wood planks, and the space below the covers is vented to the Dewatering Area scrubber. The exhaust stream is drawn continuously from below the Cyprus covers through two (2) 18-inch ducts. Make-up air is drawn from openings in the cover system, especially at the slide gates of the influent channel and also from the influent sewer. The wetwell has a total volume of 4,160 cubic feet and the influent channels have a total volume of 3,451 cubic feet. An exhaust air rate of 1,522 cfm is needed to provide 12 AC/hour from beneath the cover system. The air flow rate from this area was not measured during the field investigations. However, as discussed below, the Dewatering Area scrubber appears to have adequate capacity to allow the air flow to be balanced to provide this exhaust rate.

As noted in Section 2, the duct openings located just below the Cyprus boards become submerged when the wetwell floods preventing odorous air from being drawn to the odor control system. Installation of a barometric damper at the level that the duct exits the Wetwell Area is recommended to ensure that exhaust air is drawn to the odor control system even when the wetwell is flooded.

The Screening and Wetwell Areas still have the original ventilation system from the early 1970s upgrade, but this system is aging. The heated make-up air unit is rated for 8,000 CFM and designated ID #32.4.2.6. The system was designed to provide 2,000 CFM of forced fresh air to the Screening Area, 2,000 CFM to the intermediate level, and 4,000 CFM at the ground level. The exhaust air fan is rated for 8,476 CFM and designated by ID #32.6.6.8. At the lowest level, exhaust is drawn from the Wetwell Area to sweep both the Screening and Wetwell Area. The exhaust rates are intended to slightly exceed the make up air on each floor level to achieve an essentially neutral, but slight negative, pressure.

The lowest level has a combined approximate volume of approximately 12,000 cubic feet. At an air change rate of 12 AC/hr, the required ventilation rate is approximately 2,400 CFM. The intermediate level has an approximate volume of 4,400 cubic feet, and the ground floor 7,300 cubic feet. The required ventilation rate to provide 12 AC/hr is approximately 900 CFM for the intermediate level and 1,500 cfm for the ground level. The existing ventilation system was designed for greater than 12 AC/hour, which corresponds to approximately 6,300 CFM (including area below covers), except that the distribution of air should have been greater to the lower level. With the current odor control system, the air change rate at the lower level is likely greater than 12 AC/hr when the general ventilation system is activated, but the 2,000 cfm provided by the general ventilation system is only about 10 AC/hr above the cover system.

3.1.3 Recommended Improvements

The existing odor containment with covers on the influent channel and wetwell appears to be effective, except when the water surface in the wetwell floods the air intake to the odor control system. As noted above, this can be readily addressed by installing a barometric damper on the odor control duct at the elevation where it exits the Wet Well Area. The exhaust rate to the Dewatering Area scrubber should be set at 1,500 CFM as part of an effort to better balance all of the exhaust air flow. This is discussed further in Section 3.4.

The recommended improvements are as follows:

- Install barometric damper on the existing exhaust duct to odor control system in order to maintain ventilation when wetwell floods.

- Balance air flow to Dewatering Area Scrubber to draw 1,500 cfm from below the wetwell covers.

3.2 PRIMARY SETTLING TANKS

The primary settling tanks are located on the west side of the site just south of the access road as shown in Figure 1-4 and Figure 3-2. The primary settling tanks include the following structures:

- Influent channel, the primary flocculation basin, and the inlet zone to each clarifier;
- Three (3) rectangular primary clarifiers each 120.5’ long by 29.5’ wide with chain and flight sludge collection and scum skimming;
- Rotating scum trough operated manually and discharging to scum well;
- Effluent weir troughs; and
- Effluent channel.

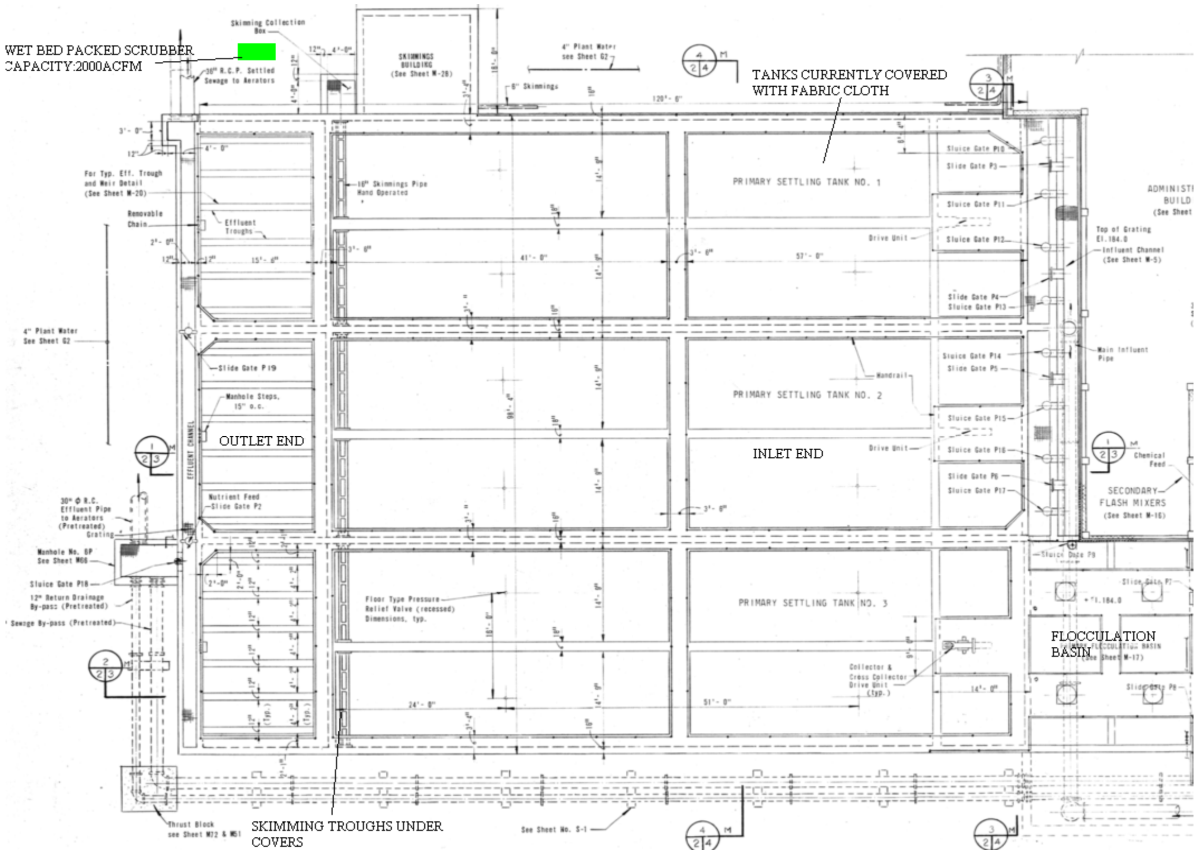
The odor survey determined that there were significant fugitive emissions from the existing cover system. This appears to be due in part to the poor condition of the existing fabric covers and in part to an exhaust air rate that may be too low even with a better cover system.

3.2.1 Ventilation Standards

For the primary clarifiers, the only applicable standard for ventilation identified was:

- *NFPA 820* - This standard requires a continuous ventilation rate of 12 AC/hr or greater in primary sedimentation tanks to reduce the electrical classification to Class I, Division 2, Group D. Lesser ventilation rates are allowable, but require Class I, Division 1, Group D electrical classification.

FIGURE 3-2
PRIMARY SETTLING TANKS



The ventilation requirements for covered primary clarifiers depend primarily on the needs for odor containment and reduction of corrosion potential. An air change rate of 12 AC/hr is typically sufficient for odor containment and provides a reasonable air change rate to reduce corrosion potential. It is possible to use lower ventilation rates through the use of low leakage covers and maintain a negative pressure under normal operating conditions. However, the scum removal process requires a hatch to be opened to observe the operation of the scum trough. The face velocity into a hatch when open should be at least 200 fpm to maintain sufficient negative pressure, and 500 fpm is considered ideal. Thus, a target ventilation rate based on 12 AC/hr rate is recommended, but could be adjusted upward or downward depending on the expected face velocity when a hatch is opened. It is important to note that a protective coating is advisable to exposed concrete surfaces beneath a containment cover regardless of the air change rate.

3.2.2 Existing Facilities and Improvement Needs

3.2.2.1 Containment

The existing containment system consists of a combination of fabric and fiberglass covers, and rubber mats as follows:

- The influent channel has grating covered with rubber mats;
- The "quiescent" zones of Clarifiers No. 1 and 2 have fabric covers;
- The rotating scum trough has 2'-wide aluminum covers across with width of the clarifiers;
- The effluent troughs for Clarifiers No. 1, 2, and 3 are covered with fiberglass launder covers;
- The scum well has grating covered with rubber mats; and
- The effluent channel has grating with rubber mats.

Primary Clarifier No. 3 and the associated flocculation tank are not in use and are not covered. This clarifier was originally designed to handle the flow from Uniroyal separately, and its use was discontinued as flows from Uniroyal dropped. The tank does not have a working sludge collection mechanism and is not planned for use as a primary clarifier for the foreseeable future. Consequently, the analysis of odor control needs was based on the two active tanks only.

Exhaust air is drawn from the effluent channel at Tank No. 1 to the existing packed-bed wet scrubber located in a small building at the northeast corner of the tanks. The packed-bed scrubber is rated for 2,000 CFM and utilizes chemical addition with a combination of sodium hydroxide and sodium hypochlorite to enhance removal and oxidize hydrogen sulfide and other odorous compounds from the exhaust air. As discussed in Section 2, the performance of this packed-bed scrubber has been adequate at the design flow rate of 2,000 CFM. The inlet of the primary scrubber was monitored for hydrogen sulfide (H_2S) levels for a two-day period and concentrations above 6 ppm of H_2S were recorded. Currently, potassium permanganate is added to the influent channel of the primary setting tanks in order to reduce the scrubber inlet odor concentration and minimize fugitive odors. A concentration of 0.13 ppm of H_2S was recorded on 08/20/2009 at the exhaust stack of this scrubber which indicates that at current ventilation rates the scrubber is performing adequately.

The key concern is that fugitive emissions occur with the current system, especially when the aluminum hatches over the scum troughs are opened to observe the scum removal operation. Part of the problem appears to be the high leakage rate with the cloth covers, especially at the many holes in the cover. An additional problem is the design of the ductwork for drawing off of the exhaust. The system appears to have only the one draw off point in the effluent channel at the outlet end of Clarifier No. 1. This is not adequate to maintain negative pressure in Clarifier No. 2 and at the inlet end of Clarifier No. 1. Thus, the ductwork should be revised as well to draw directly from both tanks at both the inlet and outlet end. The final issue is whether the overall exhaust air rate is adequate.

The ventilation requirements to provide 12 AC/hr under a flat cover system for Primary Clarifiers 1 and 2 include the following:

Inlet Channel	62 CFM
Inlet Zone of Each Clarifier	62 CFM
Quiescent Zone of Each Clarifier	2,790 CFM
Effluent Trough Zone	522 CFM
Effluent Channel	115 CFM
Total	3,551 CFM - round to 3,600 CFM

The total ventilation requirement of 3,600 CFM is 78% higher than the current ventilation rate of 2,000 CFM. When one of the approximately 2' by 5' hatches is opened, the face velocity would be about 360 fpm with the proposed ventilation rate, but only 200 fpm with the current ventilation rate. Given the numerous additional openings in the cover system, the current ventilation may not be sufficient to maintain negative pressure with an open hatch. Higher ventilation would clearly provide better containment.

The odor survey identified fugitive odor emissions from the primary clarifiers as contributing to off-site odor impacts. The first step to improve odor containment is through repair or replacement of the cloth cover system.

The influent channel and effluent channel have aluminum grating covered by rubber mats. The rubber mats are an effective and low cost means of providing containment when there is grating already in place. The existing system appears sufficient to meet odor control needs at this time and no improvements are recommended. The aluminum hatches over the scum trough do not appear to seal tight. It would be desirable to add additional gaskets to improve the seal. This is a low cost improvement. The fiberglass launder covers over the effluent troughs are in good condition and no improvements are needed other than minor repairs.

The exhaust air removal system also needs to be modified with a duct system that draws directly from the influent channel, inlet zone to each tank, effluent trough zone of each tank, the scum well, and the effluent channel. The duct system should include dampers to allow the air flow to be balanced. Provision should be included for a make-up air inlet at the center of each tank, but this inlet should be adjustable depending on the amount of leakage in the cover system.

3.2.2.2 Odor Control

The existing packed-bed scrubber is rated for 2,000 CFM, and can not be expanded or adapted to treat the desired 3,600 CFM exhaust rate for the primary clarifiers. It is important to note that the odor containment should be improved with the cover repairs or replacement and ductwork improvements, even with the existing ventilation rate of 2,000 cfm. However, a 3,600 CFM exhaust rate is clearly desirable, but would require a new odor control system. One option is to proceed incrementally with the cover and ductwork improvements, and determine if the lower 2,000 CFM exhaust rate provides adequate containment to avoid objectionable off-site impacts.

As noted in Section 2, there are a number of small improvements that would further enhance the performance and reliability of the primary scrubber if the WWTF continues to rely on this including:

- Eliminating the chemical day tanks and feeding the sodium hydroxide and sodium hypochlorite directly from the main storage tanks;
- Providing continuous monitoring of hydrogen sulfide levels on the inlet and outlet of the scrubber;
- Modify the existing scrubber reactant chamber to operate as a packed scrubber;
- Extending the discharge stack by about 20 feet if possible to improve dispersion.

Thus, this level of investment in the existing scrubber must be compared to the cost of a new odor control system with a higher flow rate capacity. It is also important to note that wet scrubbing has relatively high on-going operating costs due to use of the sodium hydroxide and sodium hypochlorite. There are also safety concerns with the chemical handling both at the scrubbers and with the relatively long lines that transfer the chemicals from the main storage tanks to the scrubber.

The existing scrubber is located in a small building at the northwest corner of the primary clarifiers. There is not sufficient space to locate a new odor control system at this location. Consequently, the proposed location for a new odor control system is along the south side of the primary clarifiers as shown in Figure 3-3. If the new ductwork is designed to deliver the exhaust air to the existing scrubber and the exhaust air rate does not prove sufficient, then there will also be the need to redo the ductwork to deliver the exhaust to the south side of the primary clarifiers.

The alternatives for a new odor control system designed for 3,600 CFM include a new biofilter, packed-bed chemical scrubber or activated carbon system. The design loading to the new system was quantified based on hydrogen sulfide, which is by far the largest component of the odorous gases. The key criteria include both the peak loading and the average loading. During the limited monitoring data for the existing scrubber, the peak concentration was about 6.2 ppm. It is likely that higher peak loadings occur at times. However, the exhaust rate would also be increasing, which will tend to reduce the concentration. The peak hydrogen sulfide level was projected to be 25 ppm or less. The annual average loading is also important, especially for quantifying the expected life of activated carbon media. Odor emissions are expected to drop significantly during colder weather when the influent wastewater is not expected to be as odorous. The evaluation of odor control systems was based on an estimated average loading for hydrogen sulfide of 2 ppm.

A comparison of the three potential odor control technologies is shown in Table 3-2. The key considerations are that they can all provide the necessary level of control, and there is adequate space on the south side for any option. Given the current reasonable performance of the existing scrubber system, it is recommended that modifications be made to enhance the operations of the existing scrubber before considering a new scrubber with either a new activated carbon or biofilter odor control system.

FIGURE 3-3
PROPOSED ODOR CONTROL SYSTEM LOCATION

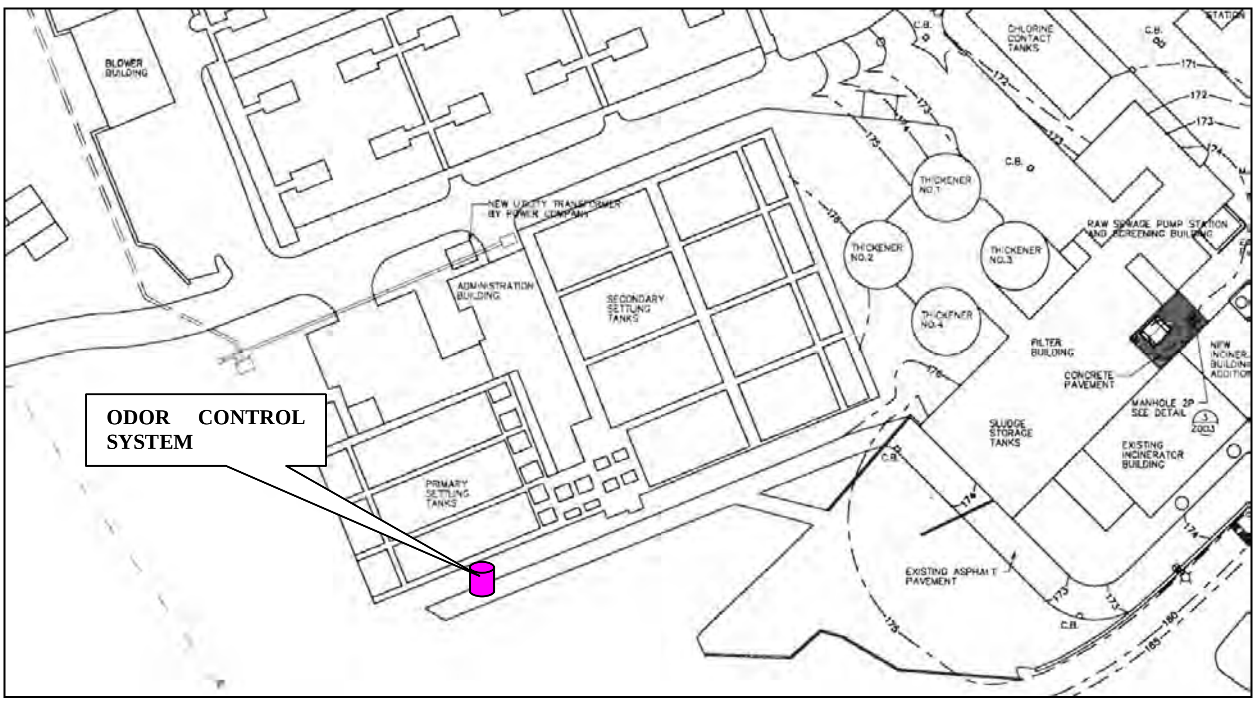


TABLE 3-2
COMPARISON OF ODOR CONTROL TECHNOLOGIES

Item	Biofilters	Wet Scrubbers	Activated Carbon
Frequency of Use	Now commonly used for all WWTF applications	Most often used for strong odors	Most often used for low to moderate odors
Capital Cost	Medium to low	Medium to High	Medium
O&M Cost	Lowest for strong odors	High due to chemical cost	Low for mild odors, and high for strong odors
Effectiveness	High if properly maintained	High for strong odors, but sometimes residual chemical odor is concern	High
Complexity	Medium – primarily focused on moisture control	High due to chemical handling and control considerations	Low

3.2.3 Recommended Improvements

The recommended improvements are as follows:

- Repair or replace the existing fabric covers on primary settling tanks
- Install new exhaust duct system for each tank
- Modify the existing odor control system to enhance its performance

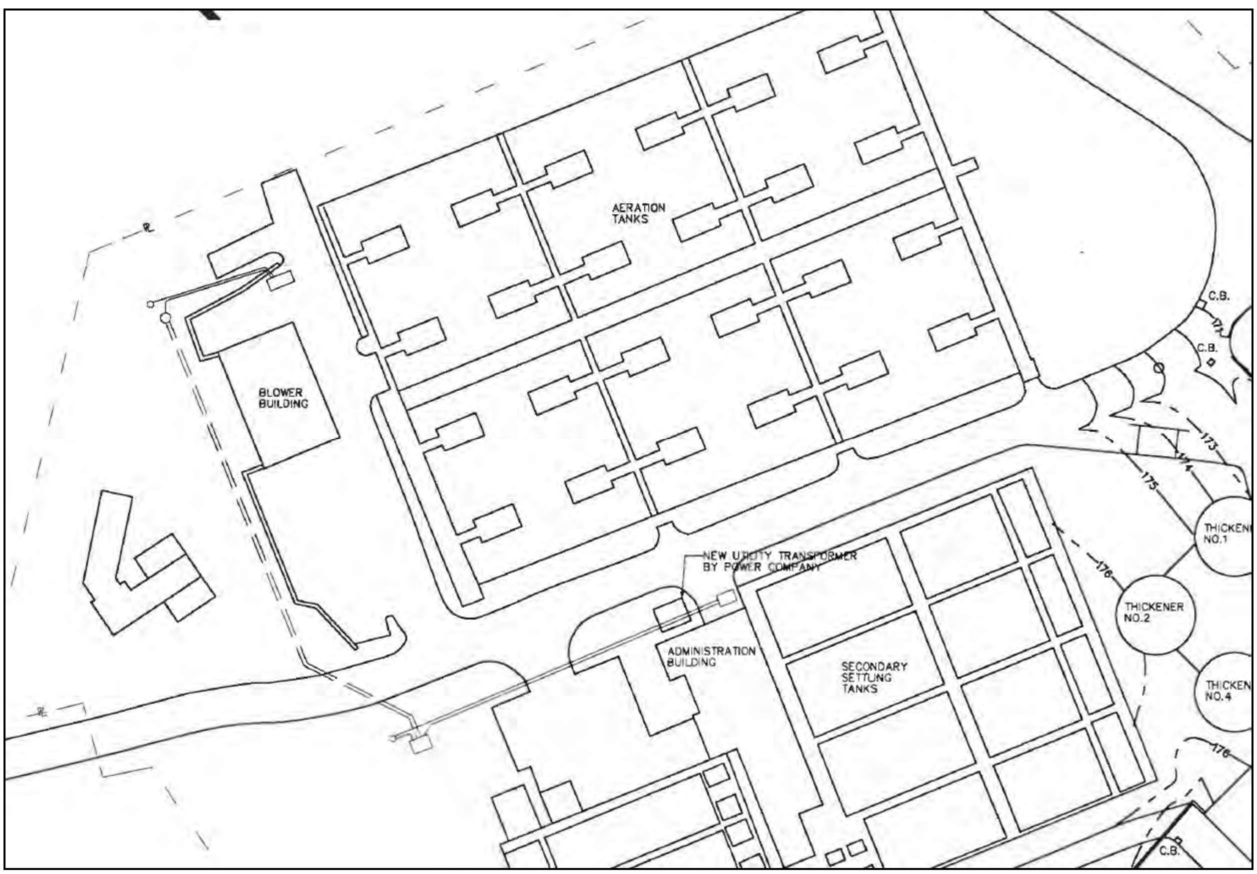
3.3 SECONDARY TREATMENT SYSTEM

The secondary treatment system is an activated sludge process with aeration basins and secondary settling tanks as shown in Figure 1-4 and 3-4. The evaluation of odor emissions from the aeration basins and secondary settling tanks included the following areas:

1. Aeration basin influent channel.
2. Aeration basins anoxic and aerobic zones.
3. Secondary settling tanks, including influent and effluent channel.
4. Secondary scum well.

In general, the only areas with significant odor emissions were in the aeration basin influent channel, the secondary clarifier influent channel and the secondary clarifier scum well. There were also low level emissions from the aeration basins and secondary clarifiers, but it was not clear that they are contributing to objectionable off-site impacts. In fact, the odor emissions from the aeration basin influent channel during the odor survey were also quite low. However, as discussed in Section 1, the operating staff had implemented the addition of potassium permanganate to the secondary influent channel in April 2009, and this appears to have addressed the most significant impacts from the secondary system. The aeration basins and secondary clarifiers are currently not considered to be sources contributing to the objectionable off-site odor impacts. At the present time, the only emission sources that warrant consideration of containment are the aeration basin influent channel, the secondary clarifier influent channel and the secondary clarifier scum well.

FIGURE 3-4
AERATION AND SECONDARY SETTLING TANKS



3.3.1 Ventilation Standards

The standards for ventilation of wastewater treatment facilities do not have any minimum ventilation recommendations or requirements for secondary treatment facilities as long as there are primary treatment facilities prior to the aeration basins. This includes NFPA 820. Thus, the only criteria for enclosing any portion of the tankage is the needs for odor containments. As previously noted, for effective containment the minimum face velocity at any opening should be 200 fpm and 500 fpm is considered ideal. It is important to note that higher face velocities should be avoided, because excessively high negative pressures can cause problems with slamming doors, or even structural issues.

3.3.2 Existing Facilities and Improvement Needs

The existing tankage is predominantly open as summarized below:

1. Aeration tanks: the existing aeration basin influent channel, anoxic and aerobic zones and the effluent channel are not currently covered. Low odor emissions were recorded in these areas.
2. Secondary settling tanks: the existing influent and effluent channels are covered with rubber mats. The tanks are not covered. Low odor emissions were recorded in these areas.
3. Secondary scum well: The existing scum well is open to the atmosphere. Low odor emissions were recorded in this area.

In April 2009, the plant staff installed facilities to add potassium permanganate to the aeration basin influent channel. The primary purpose of this is to oxidize hydrogen sulfide and other odorous compounds that are already present in the primary effluent to prevent them from being stripped in the influent channel or the initial zone of the aeration basin. The additional of potassium permanganate has been effective in controlling odors from this source at a relatively low dosage rate that is considered affordable.

As noted in Section 2, the secondary influent channels were identified during the odor survey as a location where scum accumulates resulting in the emission of volatile organic acids, more than hydrogen sulfide. The operating staff is working to address this build up through standard operating practices that transfer the scum into the clarifiers for removal through the skimming mechanism. The secondary scum well was also identified as a source of volatile organic acid emissions.

3.3.3 Recommended Improvements

The existing permanganate feed system is effective in addressing emissions from the aeration basin influent channel and aeration basins. It is recommended that plant staff continue with this odor control method on an as needed basis. It would be possible to enclose the aeration basin influent channel and vent this to an activated carbon system for odor control. However, this would not prevent the emissions from the aeration basins themselves, and thus it would still be necessary to add the potassium permanganate. Consequently, no odor control improvements are recommended at the aeration basins given the relatively low-level impacts that were observed during the odor survey and experience at many other facilities.

Although the recorded odor emissions from the secondary scum well are low, the grating on top of the secondary scum well should be covered with rubber mats to minimize any fugitive odor emissions. The matting over the secondary influent channels should be maintained as well. It would also be desirable to ventilate both the secondary scum well and the secondary influent channel to a small odor control system, although it is not clear that the volatile organic acid emissions are contributing to off-site odor impacts. An activated carbon canister utilizing conventional activated carbon is recommended as an easy to install and low cost option. A small conventional biofilter is another possibility that might be more effective than activated carbon with the volatile organic acid odors.

3.4 DEWATERING AREA SCRUBBER

The Dewatering Area scrubber treats the odorous emissions from the raw influent and sludge handling facilities that are within or adjacent to the Filter Building including the following processes/locations:

- Screening and Wetwell Area

- Four circular sludge thickener / storage tanks
- Four rectangular sludge storage tanks
- Polymer tanks
- Belt filter presses
- Sludge cake receiving bin
- Sludge cake silo

The containment issues in the Screening and Wetwell Area are addressed in Section 3.1. The containment issues for all of the remaining areas that contribute exhaust to the Dewatering Area scrubber are addressed in this Section. The Dewatering Area scrubber is located in the existing Dewatering Area, but only draws a small amount of exhaust air directly from this space associated with the vents for the belt filter presses. Ventilation and odor control of the Dewatering Area itself is addressed in Section 3.5. However, the potential for adding the exhaust from a number of smaller sources to the Dewatering Area scrubber is also evaluated in this Section including:

- Septage Receiving
- Cake Screw Conveyors and Feed Pump Hoppers

The existing Dewatering Area scrubber has a capacity of 17,000 cfm and has performed well. The inlet to this scrubber was monitored for H_2S levels for a 10-day period and concentrations above 25 ppm of H_2S were recorded. Readings collected at the outlet exhaust stack on August 20, 2009 showed 0.14 ppm of H_2S being released into the atmosphere which indicates approximately 99% removal of H_2S. The scrubber appears to be in relatively good condition, and thus optimizing the overall performance of this system appears to be desirable.

3.4.1 Ventilation Requirements

The applicable ventilation guidelines for sludge thickening and storage tanks include the following:

- *NFPA*. This standard requires a continuous ventilation rate of 12 AC/hr or greater in sludge storage wetwells, pits and holding tanks to reduce the electrical classification to

Class I, Division 2, Group D. Lesser ventilation rates are allowable, but require Class I, Division 1, Group D electrical classification.

- *TR-16*. Chapter 11 of the 1998 edition is dedicated to odor control and recommends 12 AC/hr for all occupied areas having exposed sewage or sludge surfaces.

As noted in Sections 3.1 and 3.2, the use of continuous ventilation with 12 AC/hr typically provides reasonable odor containment, while minimizing the negative impacts of corrosive damage from hydrogen sulfide (H_2S) breakdown. For all of the sludge thickening and storage tanks, continuous ventilation at 12 AC/hr is recommended. These spaces are recommended to remain electrically classified as Class 1, Division 1, Group D spaces in spite of the high air change rate.

The electrical classification of the Screening and Wetwell Area is essentially the same as for the sludge thickening and storage tanks, and consequently it is not considered problematic for them to be cross connected from a code perspective.

The Dewatering Area does not have any ventilation requirements, and is not required to be classified based on NFPA 820. The centrifuges are totally enclosed, and can be maintained under negative pressure by drawing exhaust from the discharge cake conveyor and filtrate drain. The belt filter press is an open dewatering technology, and currently there are two vents at each of the two belt filter presses to draw exhaust to the odor control system. The cross connection of these dewatering area vents to the other spaces that are Class 1, Division 1, Group D spaces requires that the Dewatering Area be classified as a Class 1, Division 1, Group D space. The existing equipment within the Dewatering Area does not meet this requirement. The classification of the Dewatering Area could be reduced to Class 1, Division 2, Group D by ventilating the entire space at 12 AC/hr.

The Dewatering Area scrubber is located within the Dewatering Area as previously noted. Because the scrubber is treating exhaust air from Class 1, Division 1, Group D spaces, NFPA 820 requires that a 3-foot envelop around potential leakage sources, such as fans, dampers, flexible connectors, and flanges, be rated a Class 1, Division 1, Group D, and the remainder of the enclosed area be classified as Class 1, Division 2, Group D. Some of the existing equipment in the Dewatering Area likely complies with the Division 2 requirement. The electrical classification requirements would be eliminated if the Dewatering Area is ventilated at 6 AC/hr. This issue is also somewhat resolved by implementing the recommendations discussed in Section 3.4.2.3. Also, though not related to nuisance odors, there are still some other electrical classification issues with the existing installation that need to be addressed as part of the facility's long-term improvement needs.

The criteria for septage handling are essentially the same as for liquid sludge handling as noted above.

3.4.2 Existing Facilities and Improvement Needs

3.4.2.1 Dewatering Area Scrubber

Because wet scrubbing is considered highly appropriate for the odor sources being treated, alternative odor control technologies were not evaluated. In contrast to the primary scrubber, the Dewatering Area scrubber treats a relatively large air flow with relatively high odor concentrations. The additional complexity of packed-bed scrubbers is justified in the case due to the effectiveness. As noted in Section 2, the operating staff has identified a number of potential improvements to enhance the performance and address operational or maintenance issues:

- Install balancing dampers on the exhaust ducts to properly balance air flow from the existing locations
- Eliminate the chemical day tanks, and feed the sodium hydroxide and sodium hypochlorite directly from the main storage tanks. This is technologically feasible, and will eliminate a pumping step that has sometimes caused loss of chemical to the scrubber.
- The main sodium hydroxide storage tanks are vented within the basement of the Administrative Building. The vents for the tanks should be extended to above the roof line outside.
- Provide a continuous H_2S monitoring meter at the inlet and outlet end of the scrubber. The outlet concentration will be added as a component to the chemical feed control loop.

By having instantaneous data on the inlet and outlet concentration, the operating staff will be able to identify problems with the system more quickly.

- Increase the discharge stack height by 10 ft to 20 ft. The existing stack discharges only a few feet above the roof line, and may be subject to building downwash. A higher stack height will improve atmospheric dispersion reducing the potential for objectionable off-site impacts.

The possibility of increasing the air flow treated by the Dewatering Area Scrubber was evaluated, but is not recommended. The scrubber was supplied by Ceilcote and rated at 17,000 CFM, which is the current and proposed capacity. For wastewater odor control applications, a face velocity of about 300 CFM is considered optimum for removal performance, even though higher face velocities are used for other scrubbing applications. The face velocity of the 8-foot diameter Dewatering Area Scrubber is 338 fpm at 17,000 CFM, and thus increasing the flow rate does not appear advisable. In addition, the packing depth is 5-feet, which is adequate, but an 8-foot to 10-foot depth would be preferable for this application. Overall, it appears that the scrubber has adequate capacity for the rated flow of 17,000 CFM, but is not considered expandable for higher flows without reduction in treatment performance.

3.4.2.2 Sludge Thickener and Storage Tanks

The containment of the sludge thickener and storage tanks includes the following systems:

- Four circular thickener / storage tanks:
    - One distribution structure with rubber mats over grating
    - One gravity thickener with FRP dome
    - One sludge storage tank with fabric cover in poor condition
    - Two sludge storage tanks with flat FRP covers
- Four rectangular sludge storage tanks:
    - Concrete dome over all four tanks as one space
    - Flat cloth covers over each tank inside of dome

The condition of the covers of the four circular tanks is good for the FRP covers, and very poor for the one tank with a fabric cover. The fabric is torn in several areas allowing fugitive odors to escape to the atmosphere. The fabric cover is in need of repair or replacement.
Table 3-3 shows the measured exhaust rates available for the subsections of the ducts to the Dewatering Area scrubber. The exhaust air that is currently being drawn from the four circular thickener / storage tanks is providing about 5 AC/hr within these spaces. The thickener tank is covered with a fiber glass dome roof and has a 1-foot by 2-foot opening on top of the dome to provide supply make-up air. It appears that there is sufficient air being drawn from these tanks to maintain an adequate negative pressure for this opening. However, as previously noted the fabric cover has numerous openings and appears to be resulting in fugitive emissions that contribute to objectionable off-site impacts.

The four rectangular sludge storage tanks have excellent containment provided by the concrete dome over the four tanks. The approach of drawing exhaust air from beneath the flat fabric cover over each tank within the dome is currently resulting in very good air quality within the dome. There is evidence that the exhaust air rate drawn from beneath covers may be greater than the target level for 12 AC/hr shown in Table 3-3. This presents the possibility to rebalance flows, and to add a few small sources as noted above.

TABLE 3-3
EXISTING AND DESIRED EXHAUST RATES TO DEWATERING AREA SCRUBBER

Location	Containment Volume (ft3)	Air Change Rate (AC/hr)	Target Air Flow Rate (CFM)	Measured Flow Rate (CFM)
Existing Containment Areas:				
Screening and Wetwell Area	7,612	12	1,500	No Data
4 Circular Sludge Thickener / Storage Tanks & Distribution Structure	31,400	12	6,280	2,817
4 Rectangular Sludge Storage Tanks	24,417	12	4,883	No Data
Polymer Storage Tanks	403	--	--	190
Belt Filter Press Vents	704	--	--	1,364
Sludge Sludge Receiving Bin	2,275	12	455	No Data
Cake Storage Silo	2,289	12	458	No Data
Existing System Totals:	**69,100**		**13,576**	~17,000[a]
Proposed Containment Areas				
Septage Receiving/Transfer Tank	1,000	12	200	N/A
Cake Screw Conveyors and Pump Hoppers	1,750	12	350	N/A
Add'l for New Cover for Circular Sludge Storage Tank	14,340	12	2,868	N/A
Additional System Totals:	**17,090**		**3,568**	N/A
Total Capacity Required:	**86,190**		**16,994**	N/A

Notes:
a. Capacity based on fan curve and flow measurements by others.

3.4.2.3 Dewatering

The necessary exhaust rate for the belt filter presses is difficult to assess. Based purely on the air space occupied by the presses, only a small flow rate of about 150 cfm would be needed to achieve 12 AC/hr. However, the actual ventilation rate is much higher than this as shown in Table 3-3, and still the presses result in major emissions into the Dewatering Area. Thus, it appears that improved containment or higher permanganate application rate is needed. Improved containment could be provided using strip curtains around BFP. One possibility is to provide strip curtain containment around the BFP. This discussed further in Section 3.5. It is important to note that this issue does not affect offsite odor impacts only working conditions.

As noted in Section 3.4.1, the exhaust duct for the belt press creates a cross connection to electrically classified spaces that is a code problem. The desirable approach is to separate the BFP exhaust from the Dewatering Area scrubber, and tie it directly to the make-up air duct for the fluidizing air blower. This is discussed further in Section 3.5. However, this change is not expected to change odor emissions, except that it will ensure adequate scrubber capacity as shown in Table 3-3. The polymer tanks are currently tied into the Dewatering Area scrubber. This is not considered necessary, and it is recommended that the connection be removed in the future.

3.4.2.4 Septage Receiving

The existing septage receiving operation consists of a outside area drain where septage trucks dump their septage loads. This results in fugitive emissions during septage discharge. Plant staff are in the process of installing a stainless steel septage receiving box with a bar rack. The septage receiving box will be enclosed and include provision to draw exhaust to Dewatering Area scrubber. As shown in Table 3-3, it appears that there is adequate exhaust air capacity if the air flows to the scrubber can be balanced to the target levels. An inlet pipe with a quick disconnect and cap will be provided for the septage trucks to directly connect to this pipe during septage disposal.

This system will reduce fugitive odors from the septage delivery process. However, the odorous septage loads will still flow through the downstream wastewater treatment unit processes, with potential odor release. Direct chemical addition with an oxidant is a common approach to reduce odorous emissions from septage. The current septage receiving location is not ideal for chemical addition, but it would be possible to route a liquid chemical feed line out to the receiving area with a local control panel to activate the chemical feed pump during septage receiving. The WWTF currently uses sodium permanganate for addition to the dewatering feed, and one possibility would be to extend this to the septage receiving area, or provide a small separate feed system.

3.4.2.5 Cake Screw Conveyors and Pump Hoppers

There is no odor control on any of the cake screw conveyors or the feed pump hoppers. A very small draft on these sources could eliminate possible fugitive emissions. The following locations could be considered for additional vents:

- Two large screw conveyors in Dewatering Area just beyond main discharge location,
- Two first stage vertical screw conveyors,
- Two second stage vertical screw conveyors,
- Silo outfeed screw conveyor at discharge end, and
- Two hoppers for incinerator feed pumps.

As shown in Table 3-3, the existing Dewatering Area scrubber appears to have adequate capacity for these sources by better balancing of flows and redirecting the BFP exhaust directly to the inlet for the fluidizing air blower.

3.4.3 Recommended Improvements

Because the Dewatering Area scrubber is considered highly suitable for the sludge handling odors, evaluation of alternative odor control technologies was not considered necessary. There are a number of recommended improvements to the existing scrubber to further enhance performance that should be included as part of Phase I as follows:

- Install balancing dampers on the exhaust ducts and properly balance the air flow from the existing locations.
- Eliminate the chemical day tanks, and feed the sodium hydroxide and sodium hypochlorite directly from the main storage tanks.
- The main sodium hydroxide storage tanks are vented within the basement of the Administrative Building. The vents for the tanks should be extended to above the roof line outside.
- Provide a continuous H_2S monitoring meter at the inlet and outlet end of the scrubber. The outlet concentration will be added as a component to the chemical feed control loop.
- Increase the discharge stack height.

The containment of the existing sludge storage tanks is generally good, except for the fabric cover over the circular sludge storage tank which is recommended to be repaired or replaced with a new cover.

As shown in Table 3-3, the existing scrubber capacity of 17,000 CFM is sufficient to allow the addition of exhaust from septage receiving, the cake screw conveyors and feed pump hoppers as well as the additional exhaust rate required for a new cover on the circular sludge storage tank. The BFP exhaust should be redirected to inlet of the fluidizing air blower to address NFPA code issues with cross connections to a rated space. The polymer tanks should also be removed from the Dewatering Area scrubber.

The new septage receiving box will reduce fugitive odors from the septage receiving area. Odor release from septage in downstream processes will be less of an issue with the proposed improvements at the Screening and Wetwell Area and the Primary Clarifiers.

3.5 FILTER BUILDING AND NEW INCINERATOR ADDITION

The existing Filter Building and Incinerator Wing Addition includes four major components:

1. ***Dewatering Area:*** This space is located in the original Filter Building, and includes two belt filter presses, two centrifuges, one gravity belt thickener and polymer tanks as shown in Figure 3-5. The sludge feed pumps are located in a basement level below the Dewatering Area.
2. ***New Thermal Dewatering Unit (TDU) Building:*** This building abuts the original Filter Building and consists of three levels. The incinerator feed pump area is located in the first floor level, the second level houses the thermal dewatering unit, and the third level includes the Hot Oil Room that also has the cake screw conveyor that feeds the thermal dewatering unit from the cake storage silo.
3. ***Incinerator Wing:*** The Incinerator Wing houses the new fluidized bed incinerator. It includes three floor levels that match the floor levels in the Thermal Dewatering Building. However, the Incinerator Wing does not have walls, and thereby is open to the outside.

4. ***Multiple Hearth Area:*** This area is located in the original Filter Building. This space houses the two abandoned multiple hearth incinerators, plus certain fans and ducts associated with the new fluidized bed incinerator.

As discussed in Section 2, the Dewatering Area lacked an effective ventilation system until the operating staff recently relocated the inlet for the fluidizing air blower of the fluidized bed incinerator to draw from the south side of the room. However, there are issues with make-up air as well as ventilation of the Thermal Dewatering Unit Building that need to be addressed to complete this change. As noted in Section 3.4, the exhaust vents from the belt filter presses to the Dewatering Area scrubber create electrical classification issues that need to be addressed. The recommended plan is to redirect the ducts from the BFPs to the inlet of the fluidizing air blower. In addition, there are electrical classification related issues associated with the Dewatering Area Scrubber that is located within the Dewatering Area. These issues are addressed further in this Section.

FIGURE 3-5
DEWATERING AREA

3.5.1 Ventilation Standards

For the Dewatering Area, the applicable guidelines identified were as follows:

- *TR-16*. Chapter 11 of the 1998 edition is dedicated to odor control and recommends 12 to 30 AC/hr for belt presses.
- *NFPA 820*. The standard does not have any ventilation requirements related to Dewatering Buildings Containing Centrifuges, Gravity Belt Thickeners, Belt and Vacuum Filters, and Filter Presses. Past versions of NFPA 820 have required 12 AC/hr; but this provision was dropped in recent versions. However, as noted in Section 3.4, the Dewatering Area Scrubber is treating exhaust air from Class 1, Division 1, Group D spaces. This requires that a 3-foot envelop around potential leakage sources, such as fans, dampers, flexible connectors, and flanges, be rated a Class 1, Division 1, Group D, and the remainder of the enclosed area be classified as Class 1, Division 2, Group D. The electrical classification requirements can be eliminated if the Dewatering Area is ventilated at 6 AC/hr, although the 3-foot envelop around potential leakage sources would be rate Division 2. NFPA also requires combustible gas detection and a fire detection system in this case.

For dewatering areas with belt filter presses, Wright-Pierce typically designs the ventilation system for 6 AC/hr in summer and 3 AC/hr in winter. This balances the size of the odor control and heating system needs. The dewatering area heating and ventilating system are usually shut down when not in use. Chemical addition to the sludge feed can be used to reduce emissions when working conditions are problematic. When all of the dewatering devices are enclosed, the ventilation rate can be reduced to 3 AC/hr throughout the year, and odor control needs are greatly reduced.

For the Naugatuck WWTF, a ventilation rate of 6 AC/hr in the Dewatering Area is desirable to alleviate the electrical classification issues associated with the Dewatering Area Scrubber.

The thermal dewatering unit is an indirect sludge dryer, but the target level of drying is only to the mid-20% level. NFPA 820 has requirements for drying operations when there is the potential for combustible dust. The operation at the Naugatuck WWTF does not dry the sludge to a level where this is a concern. Consequently, there are no ventilation requirements and no electrical classification issues. As discussed in Section 3.4, the cake screw conveyors and pump hoppers are recommended to be vented to the Dewatering Area Scrubber. In addition to the fugitive emission from the conveyors, pumps, and the thermal dewatering unit, there is an issue with significant excess heat particularly in the Hot Oil Room that warrant a minimum of 6 AC/hr during warm weather conditions to ensure that peak temperatures are safe both for staff and for equipment longevity, particularly electrical components.

3.5.2 Existing Facilities and Improvement Needs

Based on the recently implemented improvements, the Dewatering Area is now ventilated by the Fluidizing Air Blower, which delivers the odorous air to the fluidized bed incinerator for thermal destruction. This is a proven and highly effective approach to odor control for the Dewatering Area exhaust. The Fluidizing Air Blower is a multi-stage centrifugal unit that was originally rated for 14,730 ICFM at 5.35 PSIG. The operating staff has reported that the actual flow rate is higher at approximately 17,500 ICFM due to the headloss through the incinerator being lower in the range of 4.2 PSIG. This corresponds to an air change rate of just greater than 6 AC/hr in the Dewatering Area. This is highly fortuitous, because it provides sufficient air change to allow the Dewatering Area to be unclassified, even though the Dewatering Area Scrubber is handling exhaust air from Division 1 spaces. As noted in Section 3.4, the exhaust ducts from the BFPs should be redirected from the Dewatering Area scrubbed to the inlet of the fluidizing air blower. This should not contribute to off-site odor emissions, but will address the NFPC classification concerns with cross connections to a Division I rated space.

It is important to note that the fluidizing air blower is shut down when the incinerator is off-line. Thus, relying on this approach to odor control requires careful coordination of make up air from other process areas. In addition, belt filter press dewatering should be suspended when there is no ventilation. The additional vent lines from the screw conveyors and pump hoppers to the Dewatering Area Scrubber would reduce the potential for fugitive emissions during a shut down of the incinerator compared to current conditions. Nevertheless, the make up air to the Dewatering Area will either need to be interlocked to the operation of the incinerator, or there will need to be clear standard operating practices for operators to shut them down as soon as practical.

Currently, approximately 5,200 CFM of make-up air is drawn from the Hot Oil Room and transferred to the Dewatering Area. This make-up air system provides about 2 AC/hour. However, the make-up air is introduced along the east side of the room, and is believed to short circuit directly to the intake for the exhaust in the south side of the room. It is unclear where the remaining make-up is being drawn at this time, but some portion may be from the Multiple Hearth Incinerator Area. The belt filter presses are the major emission source and are located in the north part of the room. The working conditions inside the Dewatering Area are often very poor as discussed in Section 2, although there has been a notable improvement with the new exhaust system. A new make-up air system is needed that provides about 10 percent less air than the exhaust system, or about 15,500 cfm. This make-up air should be distributed along the north side of the Dewatering Area at both the upper and lower level. This will allow the make-up to sweep across the Dewatering Area to the inlet for the Fluidizing Air Blower on the south side.

The Thermal Dewatering Unit Building has a make-up air unit that is designed to deliver 14,000 CFM. As discussed in Section 2, this unit had not been utilized since start up, but the intent was to deliver 4,000 CFM to the Hot Oil Room, 5,000 CFM to Thermal Dewatering Unit Room, and 5,000 CFM to the Pump Feed Area. This corresponds to about 7 AC/hr in the Hot Oil Room and Thermal Dewatering Unit Room, and about 11 AC/hr in the Pump Feed Area. At an air change rate of 6 AC/hr, the total ventilation rate is about 10,100 CFM, which would be the target exhaust rate, and the make-up air rate would be 9,100 CFM. It is likely that the existing make-up air unit can be adjusted to provide the lower air flow rate, and balanced to deliver about 6 AC/hr to each space. A new exhaust air system is needed to transfer the 10,100 cfm to the north side of the Dewatering Area. The exhaust air should be drawn primarily from the Hot Oil Room to remove the waste heat. The three levels of the Thermal Dewatering Unit Building are open to each other, so there should not be a problem if most of the exhaust is drawn from the Hot Oil Room, and lower rates from the two lower levels.

The basement level below the Dewatering Area does not have any ventilation, and as noted in Section 3.5.1, should be considered a Division 2 space unless 6 AC/hr are provided. It appears that the remaining make up air for the Dewatering Area could be drawn from the lower level of the Dewatering Area, and potentially the adjacent Sludge Thickener/Storage Pumping Area, the tunnels, and even from the basement of the Administration Building. All of these spaces currently lack ventilation. Though not directly related to offsite nuisance odors, ventilation of these spaces should be addressed as part of long-term upgrade needs for the facility.

Another recent improvement is the use of temporary chemical feed equipment to add sodium permanganate to the dewatering feed to reduce emissions to the Dewatering Area. The operating staff has identified an alternative approach for adding potassium permanganate to the two circular sludge storage tanks that serve as blend tanks for the dewatering feed. It appears that this would also be effective at reducing odor emissions to the Dewatering Area.

One option to further improve working conditions would be to enclose the existing BFP units using strip curtains. The existing vents would provide a high air change rate that would reduce corrosion of the units. This would reduce odors within the Dewatering Area, but would not affect off-site emissions.

3.5.3 Recommended Improvements

The recent extension of the intake for the Fluidizing Air Blower to the south side of the Dewatering Area provides a ventilation rate of about 17,500 CFM, which corresponds to about 6 AC/hr. This addresses important electrical classification concerns with the existing Dewatering Area Scrubber that would otherwise require a Division 2 rating of the Dewatering Area. The treatment of the exhaust from the Dewatering Area in the fluidized bed incinerator is expected to be highly effective. The primary concern with this approach to odor control is corrosion of the Fluidizing Air Blower. The redirection of the vents from the belt filter presses to the inlet of the fluidizing air blower are also needed both to provide optimum containment of the sources tied into the Dewatering Area Scrubber, and also to alleviate the NFPA / NEC electrical classification issue with the cross connection to Division 1 spaces.

The recommended improvements for the Filter Building and New Incinerator Wing are focused on providing improved make-up air for the Dewatering Area, and providing improved ventilation of the Thermal Dewatering Unit Building as follows:

- Adjust the existing make-up air system for the Thermal Dewatering Unit Building to provide 9,100 CFM of make up air to the three floor levels.
- Install new exhaust air system for the Thermal Dewatering Unit Building that draws 10,100 CFM primarily from the Hot Oil Room, and delivers the exhaust as make up air to the Dewatering Area through new ductwork on the north side at the upper and lower level.
- Consider installing an exhaust fan from the Sludge Thicker/ Storage Tank Pump Area to the Dewatering Area to make up the additional supply air to the fluidizing blower. As part of long-term facility upgrade improvements, additional ventilation improvements should be provided for the Administration Building basement and tunnel, and for the Sludge Thickener/Storage Tank Pump Area.
- Continue to utilize permanganate either in the liquid sodium permanganate form or crystal potassium permanganate to reduce odors in the sludge feed to the belt filter presses. This will reduce hydrogen sulfide emissions to the Dewatering Area.

3.6 SLUDGE CAKE RECEIVING FACILITY

The sludge cake receiving bin is located outside on the east side of the Filter Building as shown in Figure 3-6. The bin is partially located below the ground level and a hinged door covers the container to minimize the odor being released by the wet sludge cake. As noted in Section 2, the odor emissions from trucks discharging into the bins appears to be the most significant source of odor emissions leading to objectionable off-site odor impacts. Immediately adjacent to this area is the truck loading facility that is utilized to transfer sludge cake to trucks for off-site disposal when necessary. Both of these areas were identified as causing off-site odor complaints at times, although the sludge cake receiving bin is utilized daily, while the truck loading facility is utilized relatively infrequently. Enclosure of the cake receiving and truck loading area is complicated by the many adjacent facilities including the Raw Sewage Pump Station and Screening Building on the north side, the sodium biosulfite storage building on the north side, the new Incinerator Wing on the south side, and the cake storage silo which is located above the sludge cake receiving bin.

FIGURE 3-6
SLUDGE CAKE RECEIVING BIN

3.6.1 Ventilation Standards

As discussed in Section 3.4, the sludge cake receiving bin is proposed to be vented at 12 AC/hr to the Dewatering Area Scrubber. However, to contain the odors from the cake receiving and truck loading areas, this area should be enclosed to the extent possible in a new structure, and then vented to odor control. The minimum acceptable ventilation is recommended to be based on 3 AC/hr or as needed for odor containment. As previously noted, the minimum face velocity for effective containment at any opening should be 200 fpm, and 500 fpm vs. considered ideal. Higher face velocities should be avoided, because excessive negative pressures can cause problems with slamming doors and even structural issues.

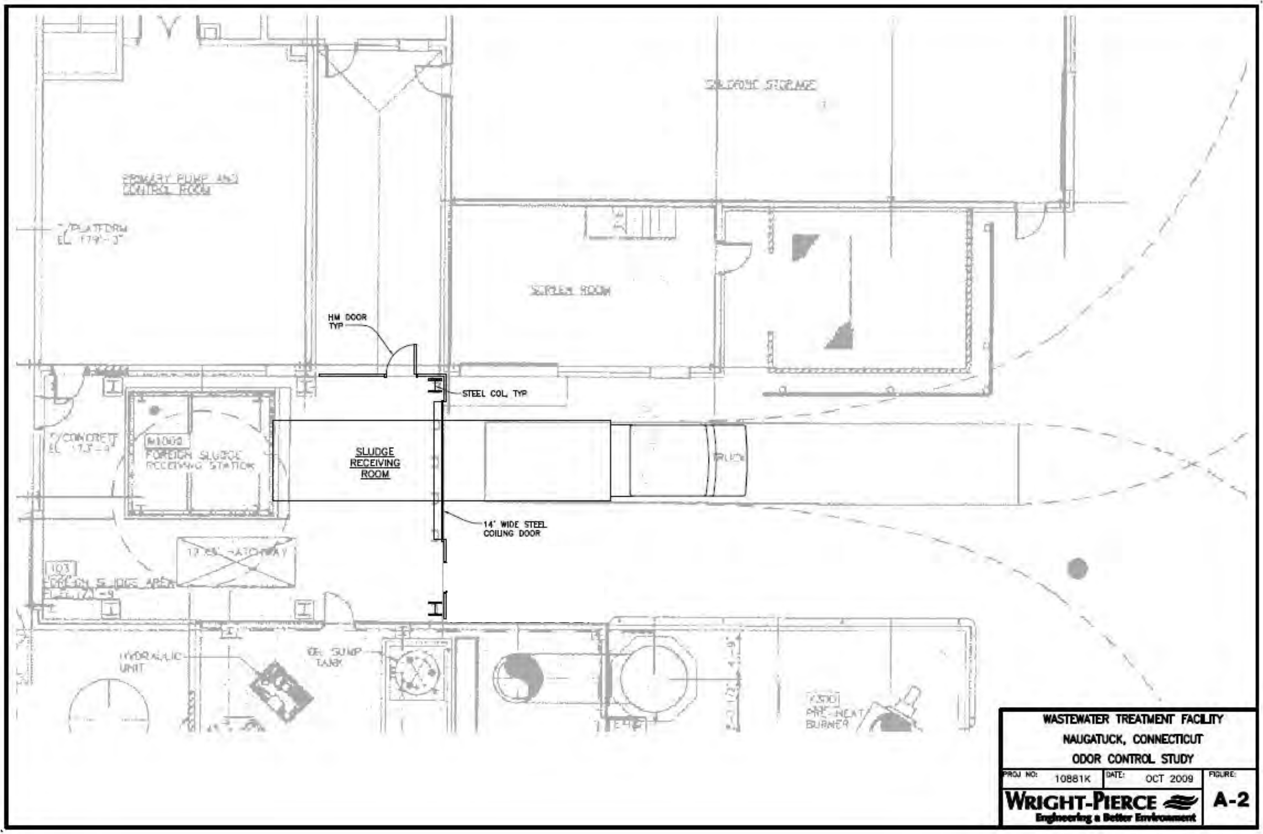
3.6.2 Existing Facilities and Improvement Needs

Odors generated from this location are mostly caused from trucks disposing sludge cake in the sludge receiving bin. As discussed in Section 2, dewatered sludge deliveries result in significant odor releases with some of the loads. The magnitude of odor emissions depends primarily on the source and characteristics of the sludge, and also on the amount of sludge cake being disposed. The time period that a truck is stationed at the receiving bin before and after disposal can also be a factor, and if trucks are lined up to discharge consecutively without a break. To minimize odor emissions while a truck is discharging at the current time, the trucks are hosed out as the cake is dumped. All of this wash water ends up in the cake receiving bin. and typically is incorporated into the sludge cake for incineration. The cost of "incinerating" this washdown water is incurred to minimize odor emissions.

As discussed in Section 2, the magnitude of emissions from cake receiving requires containment and subsequent treatment. The existing emission levels have been shown to correlate with off-site odor complaints. In order to contain the odors generated from trucks disposing dewatered cake sludge, some form of enclosure is needed. The first option considered was the possibility of enclosing the entire sludge receiving area with a prefabricated metal building with a rapidly opening/closing rolling door. The rolling door would be closed before and after the trucks dispose wet cake in the receiving bin. This would contain the odors generated from the truck disposal within the new building.

Because of the tight site constraints, this option would require demolition of the first floor of the screening building and the Sodium Bisulfate Storage Building. Because of construction constraints and the excessive cost required, partial enclosure or an exhaust ventilation hood options were considered more feasible. A conceptual plan for partial enclosure was developed as shown in Figure 3-7 that would not require demolition of the Screening Building and Sodium Bisulfate Storage Building. Another alternative would be to provide an exhaust hood above the sludge receiving bin in order to capture and exhaust odors through the Hot Oil Room.

FIGURE 3-7
PROPOSED CAKE RECEIVING AREA ENCLOSURE



The proposed improvements would also include a separate wash down area for trucks after disposal of the wet sludge cake. After disposal, the trucks would move forward to the wash down area, which would simply have a sloped floor that directs the wash down to one or more floor drains that would discharge to the adjacent influent channel. This would allow for this excess wastewater to be removed from the sludge providing a sludge feed with a higher solids content to the Thermal Dewatering Unit, and ultimately the fluidized bed incinerator.

In evaluating the requirements for a new enclosure or exhaust hood, it was determined that the roof height requirements to allow the sludge trucks to dump would bring the roof or exhaust hood to a level that would involve enclosing the bottom of the sludge storage silo. This appears to be highly desirable, since there are occasional fugitive emissions from the outfeed screw conveyors on the bottom of the silo, and there are occasional problems with freezing conditions that would be alleviated with the cake receiving enclosure. However, it will be important to consider future maintenance needs in this area as part of the enclosure design.

The proposed partial enclosure or exhaust hood at the cake receiving area will not encompass the truck loading area to avoid the structure problems that would require demolition of the Screening Building.

The supply and exhaust ventilation system for the Hot Oil Room would be modified to provide exhaust ventilation from the hood or partial enclosure. The intent would be for this exhaust air to be conveyed to the dewatering area and to the fluidized bed blower for treatment in the incinerator. As discussed in Section 2, there is an odor counteractant system that is currently utilized to reduce the impacts from emissions during cake receiving. This system should continue to be utilized to mitigate any fugitive emissions.

3.6.3 Recommended Improvements

The cake receiving area was determined to be a significant odor emission source at the WWTF, and control is a high priority. However, the options for enclosing the Cake Receiving Area are limited due to structural considerations with the Screening Building and the Sodium Bisulfite Storage Area. The recommended improvements include the following:

- Construct an exhaust ventilation hood or partial enclosure above the sludge receiving bin in order to contain odorous emissions generated during sludge cake receiving and truck loading operations. The proposed hood or enclosure will allow partial enclosure of the bottom of the cake storage silo.
    - Install a wash down area with floor drain connected to the influent wetwell to allow trucks to wash down after disposal of the cake. This will alleviate the current practice where wash down water is discharged to the cake receiving bin.
    - Provide ductwork and ventilation modifications to exhaust the Cake Receiving Area to the Hot Oil Room that discharges to the fluidized-bed incinerator to provide continuous odor control of this area. Also provide an exhaust ventilation system from the Hot Oil Room to the fluidized bed blower.

The proposed new exhaust ventilation hood or partial enclosure will also require careful consideration of construction sequencing to maintain cake receiving during as much of the construction process as possible.

3.7 CONSTRUCTION COST ESTIMATE

The estimated costs for the recommended improvements are summarized in Table 3-4. These total costs include contingencies, contractor's overhead and profit, and design and construction phase engineering costs. These cost estimates are based on planning phase level of detail, and may have unidentified issues that could result in final costs exceeding the contingency allowance.

TABLE 3-4
ESTIMATE CAPITAL COST OF RECOMMENDED IMPROVEMENTS[1]

Location	Estimated Costs
Headworks	
Balance Air Flow	$3,000
Barometric and Balancing Foul Air Dampers	$4,000
Primary Settling Tanks	
Repair Primary Clarifiers Tanks Covers	$15,000
Improved Exhaust Duct Work to the Odor Control System	$30,000
Modifications to Scrubber Reactor Chamber	$6,000
Modifications to Exhaust Ventilation Blower	$2,000
New Peristaltic Feed Pumps & Piping from Main Storage	$15,000
H_2S Gas monitoring - Inlet & Outlet	$21,000
Dewatering Area Scrubber Improvements	
New Peristaltic Feed Pumps & Piping from main Storage Tanks & New Controls	$10,000
Increase Discharge Stack Elevation	$15,000
H_2S Gas Monitor- Inlet & Outlet	$21,000
New Dampers and Balancing of Air Flow	$5,000
Thickener and Sludge Storage Tanks	
Repair or Replace Cover	$95,000
Filter & Incinerator Building	
Ductwork and In-Line Transfer Fan for Moving 10,080 CFM	$50,000
Additional Ductwork for Belt Filter Presses	$5,000
Septage Receiving Facility	
New Receiving Box with Exhaust to Dewatering Area Scrubber	(2)
Cake Receiving Area	
Site work and relocate Grit Receiving Bin	$5,000
Exhaust Ventilation Hood Enclosure	$125,000
Plumbing and Drain	$20,000
Exhaust Ventilation System	$50,000
Odor Counteractant Spray System	(2)
Sub-total	**$497,000**
Contingency (20%)	$101,000
Contractor O&P (20%)	$101,000
Engineering Cost (20%)	$101,000
Total Project Cost (2009 Dollars)	**$800,000**

Notes:
1. Does not include costs related to odor control measures within existing buildings
2. Improvements Completed by Veolia Water

Section 4

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SECTION 4

SUMMARY AND RECOMMENDED PLAN

4.1 GENERAL

The Connecticut Department of Environmental Protection (DEP) has issued a Consent Order in response to periodic nuisance odor problems from the Naugatuck Wastewater Treatment Facility (WWTF). Veolia Water NA operates the WWTF for the Borough of Naugatuck under a long-term agreement. The Consent Order requires the Naugatuck Water Pollution Control Authority (WPCA) to identify the sources of odors at the facility responsible for off-site odor impacts, and to develop a plan and schedule for mitigating the off-site impacts. The Consent Order was executed on June 6, 2009. Veolia Water entered into an engineering services agreement with Wright-Pierce to perform an odor control evaluation meeting the requirements of the Order on the behalf of the Naugatuck WPCA.

The Consent Order requires Veolia NA to retain a qualified consultant to carry out an odor control evaluation. The requirements for the scope of the evaluation included:

- Identification of the sources, causes and characteristics of odors emanating from the facility, and the daily frequency and duration of the activity which cause the generation of such odors.
- Evaluation of alternative remedial actions to abate the odor impacts.
- Development of a recommended plan including an estimate of the cost for each proposed remedial action, and supporting justification as to why the remedial action will abate the odor impacts.
- Development of an implementation schedule to perform the recommended remedial actions.
- A detailed plan for monitoring the effectiveness of the recommended remedial actions.

Based on the requirements of the DEP Consent Order, the investigatory work for this evaluation included the following:

- Plant operation review including assessment of design data for existing unit processes and odor control systems;
- Oxidation-Reduction Potential (ORP) survey of liquid streams throughout the facility;
- Hydrogen sulfide survey of emissions from treatment processes throughout the facility;
- Air flow rate survey of the existing odor control systems;
- Community odor survey to assess off-site impacts of odor impacts from the Naugatuck WWTF.

Based on the results of the review of the existing conditions and investigatory work, alternatives to mitigate objectionable off-site odor impacts were evaluated. This resulted in the development of a recommended plan for improvements that are expected to mitigate the current impacts.

The required monitoring plan is to continue to track odor complaints from the community as the most direct indicator of performance. Community odor surveys by objective outside parties may be warranted if nuisance odors persist. Continuous H_2S monitors are also recommended for the chemical scrubber exhausts.

4.2 SUMMARY

The review of existing conditions and investigatory work conducted at the facility indicated that the following sources contribute to objectionable periodic off-site odor impacts, and are listed in order of estimated significance:

- Dewatered Sludge Cake Receiving Area.
- Septage Receiving Area (Note: Operating staff have addressed this source).
- Sludge Storage Tank with cloth cover.
- Primary Settling Tanks with cloth cover.
- Fugitive emissions from Screening and Wetwell Area during high wetwell levels.
- Fugitive emissions from various sludge handling sources.
- Collection system vacuum truck dump station.
- Dewatered sludge bypass pumping discharge station.

The key issues with each of these sources are summarized below. It is important to note that the operating staff have and continue to implement numerous operational and capital improvements to reduce odorous emissions compared to past conditions, and continued to work on improvements during the course of this evaluation. Odor complaints were notably higher this year, but this is believed to be attributable to the publicity associated with the project, which included a concerted effort by the Borough and Veolia Water to encourage neighbors to notify the WWTF when objectionable impacts are occurring. Based on the investigatory work, it appears that the magnitude of objectionable impacts was reduced in 2009 compared to past years. However, the Connecticut Section 22a-174-23 regulation indicates that objectionable periodic off-site odor impacts must be addressed regardless of whether the condition was pre-existing. The only notable changes over the long-term are the addition of cake receiving as part of the Fluidized Bed Incinerator upgrade, and the degraded condition of fabric covers on the primary clarifiers and one of the circular sludge storage tanks.

4.3 RECOMMENDED PLAN

- The recommended improvements to mitigate the objectionable off-site odor impacts are summarized in Table 4-1 at the end of this section, which also show the estimated capital cost. Based on the results of the investigatory work, two areas of further study were identified:
    1. Monitoring of the ORP of the wastewater in the collection system as the first step to determine if emissions from the collection system contribute to the complaints received at the plant.
    2. Additional air flow rate monitoring of the odor control systems. This additional investigatory work will be addressed through portions of the recommended plan that address balancing of air flows to the Dewatering Area Scrubber and the Dewatering Area.

The recommended improvements are described further in the following sections.

4.3.1 Screening and Wetwell Area

The existing odor containment with covers on the influent channel and wetwell appears to be effective, except when the water surface in the wetwell floods the air intake to the odor control system. The odorous exhaust air is directed to the Dewatering Area scrubber. The recommended improvements include the following:

- Install barometric damper on the existing exhaust duct to odor control system in order to maintain ventilation when wetwell floods.
- Balance air flow to Dewatering Area Scrubber to draw 1,500 cfm from below the wetwell covers.

The costs for recommended improvements are shown in Table 4-1.

4.3.2 Septage Receiving

The odor survey identified fugitive emissions from the septage receiving drain as a cause of occasional complaints of off-site odor impacts. The operating staff has recently moved forward to procure and install a new septage receiving box that allows exhaust air to be drawn from the box to the Dewatering Area scrubber to control emissions from the septage receiving area drain. This improvement is now operational. Odor released by septage in downstream processes will be less of an issue with the proposed improvements at the Screening and Wetwell Area and the Primary Clarifiers. It would also be possible to provide direct addition of permanganate to the septage if desired to further reduce odorous emissions. The costs for recommended improvements are included in Table 4-1.

4.3.3 Primary Settling Tanks

The odor survey identified fugitive odor emissions from the primary clarifiers as contributing to off-site odor impacts. The primary clarifiers are covered and exhausted to a packed bed scrubber which performs effectively. However, odor containment is compromised by the existing cloth covers and the relatively low exhaust rate. The cloth cover system is in need of repair or replacement.

The exhaust air removal system also needs to be modified with a duct system that draws directly from the influent channel, the inlet zone to each tank, the effluent trough zone of each tank, the scum well and the effluent channel. The duct system should include dampers to allow the air flow to be balanced.

The existing packed-bed scrubber is rated for 2,000 CFM, and can not be expanded or adapted to treat the desired 3,600 CFM exhaust rate for the primary clarifiers. In addition, a number of improvements would be recommended for the facility to continue to rely on this equipment for odor control.

The recommended improvements are summarized as follows:

- Repair the cloth covers on primary settling tanks
- Install new exhaust duct system for each tank
- Eliminate the chemical day tanks and feed sodium hypochlorite and sodium hydroxide directly from the main storage tanks
- Modify the existing scrubber exhaust reactor chamber with media, chemical feed, and recirculation provisions
- Modify the existing blower as needed to accommodate the additional ventilation headloss

The cost for recommended improvements related to primary settling tanks is shown in Table 4-1.

4.3.4 Secondary Treatment System

In the spring of 2009, the operating staff installed a new permanganate feed system for addition to the influent channel of the aeration basins. This permanganate feed system has been effective in addressing emissions from the aeration basin influent channel and aeration basins. It is recommended that plant staff continue with this odor control method on an as needed basis. With the control system in place, odor emissions do not appear to be contributing to objectionable off-site impacts.

Although the recorded odor emissions from the secondary scum well are low, the grating on top of the secondary scum well should be covered with rubber mats to minimize any fugitive odor emissions. The rubber matting over the secondary influent channels should be maintained as well. It would also be desirable to ventilate both the secondary scum well and the secondary influent channel to a small odor control system, although it is not clear that the volatile organic acid emissions are contributing to off-site odor impacts. An activated carbon canister utilizing conventional activated carbon is recommended as an easy to install and low cost option.

4.3.5 Dewatering Area Scrubber

The Dewatering Area Scrubber treats the exhaust air from the screening and wetwell area, the circular sludge thickener / storage tanks, the rectangular sludge storage tanks, the belt filter presses, the merchant cake receiving bin and the cake storage silo. Because the Dewatering Area scrubber is considered highly suitable for these sludge handling odors, evaluation of alternative odor control technologies was not considered necessary. The capacity of the Dewatering Area Scrubber is currently 17,000 CFM, and it is not recommended to process higher flow rates through this unit. However, there appears to be opportunity to better balance the exhaust air to the scrubber to allow addition of a few small sources. It appears that these sources contribute to fugitive emissions at times.

The containment of existing sludge handling sources vented to the Dewatering Area Scrubber is generally good, except for the fabric cover over the circular sludge storage tank. It is recommended that the existing cover be repaired or replaced with a new cover.

The ductwork system to the scrubber should be modified as follows:

- Redirect the vent line for the BFPs to the inlet for the fluidizing air blower; and
- Remove the vent line for the polymer tanks.

The plant staff should continue to utilize permanganate either in the liquid sodium permanganate form or crystal potassium permanganate to reduce odors in the sludge feed to the belt filter presses. This will reduce hydrogen sulfide emissions to the Dewatering Area.

The recommended improvements include a number of modifications to the existing scrubber to further enhance performance as follows:

- Install balancing dampers on the exhaust ducts to properly balance air flow from the existing locations;
- Eliminate the chemical day tanks, and feed the sodium hydroxide and sodium hypochlorite directly from the main storage tanks;
- The main sodium hydroxide storage tanks are vented within the basement of the Administrative Building. The vents for the tanks should be extended to above the roof line outside;
- Provide a continuous H_2S monitoring meter at the inlet and outlet end of the scrubber. Add hydrogen sulfide outlet concentration as a component to the chemical feed control loop; and
- Increase the discharge stack height to the extent possible.

The cost for recommended improvements are shown in Table 4-1.

4.3.6 Filter Building and New Incinerator Addition

The Filter Building and New Incinerator Addition are a source of occasional fugitive emissions. The operating staff recently implemented an important change by relocating the inlet for the fluidizing air blower to the south side of the Dewatering Area. This provides approximately 6 AC/hr of ventilation capacity to improve working conditions and control fugitive emissions. The recommended improvements for the Filter Building and New Incinerator Wing are focused on providing adequate make-up air for the Dewatering Area, and providing adequate ventilation of the Thermal Dewatering Unit Building as follows:

- Adjust the existing make-up air system for the Thermal Dewatering Unit Building to provide 9,100 CFM of make up air to the three floor levels.
- Install new exhaust air system for the Thermal Dewatering Unit Building that draws 10,100 CFM from the Hot Oil Room and Sludge Receiving Area exhaust ventilation hood, and delivers the exhaust as make up air to the Dewatering Area through new ductwork on the north side at the upper and lower level.

It is important to note that the fluidizing air blower does not operate when the incinerator shuts down. Consequently, the proposed make up air system improvements will either need to incorporate interlocks or the operating staff will need to develop standard operating procedures to minimize the potential for fugitive emissions when the incinerator is not operating.

4.3.7 Sludge Cake Receiving Facility

The cake receiving area was determined to be the most significant odor emission source at the WWTF, and control is a high priority. The recommended improvements include the following:

- Construct an exhaust ventilation hood or partial enclosure to help contain odorous emissions generated during sludge cake receiving operations. The proposed exhaust ventilation hood would be located at the bottom of the cake storage silo.
- Install a wash down area with floor drain connected to the influent wetwell to allow trucks to wash down after disposal of the cake. This will alleviate the current practice where wash down water is discharged to the cake receiving bin.
- Reconfigure the Hot Oil Room ventilation system to treat exhaust odors from the exhaust ventilation hood for the Cake Receiving Area during sludge truck dumping.

The costs for the recommended improvements are shown in Table 4-1.

4.4 COST ESTIMATE

Table 4-1 summarizes the estimated capital costs for the recommended improvements. The total capital costs include contingencies, contractor's overhead and profit, and design and construction phase engineering costs. These cost estimates are based on planning phase level of detail, and may have unidentified issues that could result in final costs exceeding the contingency allowance. The total cost estimate for the recommended improvements is approximately $800,000 (2009 dollars). A listing of improvements that have already been implements by Veolia Water and the estimated costs for these improvements are summarized in Table 4-2 at the end of this section.

TABLE 4-1
ESTIMATE CAPITAL COST OF RECOMMENDED IMPROVEMENTS[1]

Location	Estimated Costs
Headworks	
Balance Air Flow	$3,000
Barometric and Balancing Foul Air Dampers	$4,000
Primary Settling Tanks	
Repair Primary Clarifiers Tanks Covers	$15,000
Improved Exhaust Duct Work to the Odor Control System	$30,000
Modifications to Scrubber Reactor Chamber	$6,000
Modifications to Exhaust Ventilation Blower	$2,000
New Peristaltic Feed Pumps & Piping from Main Storage	$15,000
H_2S Gas monitoring - Inlet & Outlet ends	$21,000
Dewatering Area Scrubber Improvements	
New Peristaltic Feed Pumps & Piping from main Storage Tanks & New Controls	$10,000
Increase Discharge Stack Elevation	$15,000
H_2S Gas Monitor- Inlet & Outlet	$21,000
New Dampers and Balancing of Air Flow	$5,000
Thickener and Sludge Storage Tanks	
Repair or Replace Cover	$95,000
Filter & Incinerator Building	
Ductwork and In-Line Transfer Fan for Moving 10,080 CFM	$50,000
Additional Ductwork for Belt Filter Presses	$5,000
Septage Receiving Facility	
New Receiving Box with Exhaust to Dewatering Area Scrubber	(2)
Cake Receiving Area	
Site work and relocate Grit Receiving Bin	$5,000
Exhaust Ventilation Hood Enclosure	$125,000
Plumbing and Drain	$20,000
Exhaust Ventilation System	$50,000
Odor Counteractant Spray System	(2)
Sub-total	**$497,000**
Contingency (20%)	$101,000
Contractor O&P (20%)	$101,000
Engineering Cost (20%)	$101,000
Total Project Cost (2009 Dollars)	**$800,000**

Notes:
1. Does not include costs related to odor control measures within existing buildings
2. Improvements completed by Veolia Water; See Table 4-2 for details

TABLE 4-2
COSTS FOR RECENT IMPROVEMENTS IMPLEMENTED BY VEOLIA

Date	Upgrades	Estimated Cost
March to June 2007	New pH/ORP controllers installed for both scrubbers and revised control parameters/training update for staff Implemented weekly calibration/cleaning of probes (pH and ORP)	$4,000[1]
March to June 2007	Replaced canvas of failed primary tank cover to help contain odors.	$3,000[1]
December 2007 to August 2009	Ended practice of exhausting potentially odorous air from Hot Oil Room to bottom of Cake Silo Converted outlet wall fan to supply make-up air Installed new ductwork to vent exhaust air to dewatering room as make-up air	$5,000[1]
March to June 2008	Corrected Cake Silo odor duct work	$1,500[1]
June to September 2008	Implemented door closed policy, cameras for exterior activity visuals without opening doors, (both a security item and for minimizing the release of fugitive odor emissions)	$ 10,000[1]
August 25, 2008	Installed Lexan panels to view scrubber(s) operation	$1,000[1]
August 28, 2008	Acid cleaning of packing in both scrubbers - (*not effective*)	$1,500[1]
September 17, 2008	Replaced packing in both chemical scrubbers to improve performance	$12,500
September 2008	Reactivated cake receiving odor counteractant spray system by installing new pump to discharge to 4 existing nozzles Bin door kept closed at all times to contain odors.	$2,500[1]
September 2008	Installed additional exhaust air ducts to the belt press rotary drum thickeners	$1,000[1]
September 2008	Increased sludge handling scrubber fan flow from ~10,000 cfm to 16,000 cfm	$2,500[2]
September 2008	Installed manometer(s) on exhaust air intakes at sludge storage tanks and other locations to ensure exhaust ventilation	$1,000[1]
October 2008	Installed new cover and odor withdrawal duct work at liquid sludge splitter box	$1,000[1]
March 2009	Started adding caustic (NaOH) to the incinerator tray scrubber to eliminate sulfur odor in exhaust	$2,500[2]
April 6, 2009	Installed potassium permanganate feeder for addition to secondary influent channel	$1,500[2]
April 2009	Installed temporary feed system to add crystal sodium permanganate to primary influent to reduce fugitive emissions	$1,500[2]
April 2009	Install temporary feed system to add crystal sodium permanganate to gravity thickener to reduce odor emissions	$1,500[2]
May 4, 2009	Installed temporary facilities for liquid sodium permanganate feed to belt presses	$1,500[2]
May 4, 2009	Installed high pressure odor counteractant system (including 12 spray nozzles) on roof above Cake Receiving Area	$ 5,000[2]

Date	Upgrades	Estimated Cost
May 4, 2009	Started using new odor log sheet	$ 1,500[1]
May to August 2009	Created new SCADA screen for odor control equipment that includes all equipment started (recirculation pump, fan), pH, ORP, event log, trend, alarm	$6,000 [1]
May 2009	Relocated pipe discharge from Uniroyal groundwater treatment system to below water line to reduce fugitive emissions	$1,500[1]
May 2009	Installed feed system to neutralize blowdown from incinerator tray scrubber	$5,000[2]
July 2009	Established new preventive maintenance protocol for Thermal Dewatering Unit utilizing potassium permanganate to eliminate odor emissions from unit washdown	$1,500[2]
July 13, 2009	Installed ductwork to draw exhaust air from Dewatering Area through fluidizing blower.	$24,000
July 20, 2009	Weather station installed, and recording data.	$1,200[1]
July to September 2009	Procured and installed new septage receiving box that will allow septage to be screened and foul air drawn into the sludge handling scrubber	$ 7,500[1]
June to September 2009	Construction of the aeration upgrade project that will allow better air control and minimize odors from the aeration basins. Also, the scum baffles will be removed eliminating an odor source.	$ 675,000
August 2009	Increased ORP set point for scrubbers based on performance monitoring; pH set point was also increased from 8.7 to 9.2	$1,500[1]
September 2009	Installed new floor drain for washdown of Thermal Dewatering Unit to allow direct discharge and screening to separate rags removed in washdown process	$12,000[1]
September 2009	Replaced the recirculation pumps for the Dewatering Area scrubber	$18,000[1]
September 2009	Installed an additional dry potassium permanganate feeder for addition to sludge storage tanks that serve as blend tanks	$2,000[2]
September 2009	Placed existing makeup air handler with 14,000 cfm capacity for Thermal Dewatering Unit Building in service	$2,000[1]
October 2009	Improved Septage receiving box	$10,000
	TOTAL	**$828,700**

Notes:

1. Estimated equivalent cost of improvements performed by Veolia Staff (labor, equipment and materials.)
2. Estimated equivalent cost of improvements performed by Veolia Staff but cost does not include ongoing costs for Veolia Water to supply chemicals.

4.5 IMPLEMENTATION SCHEDULE

Veolia Water has been actively implementing odor control improvements over the past several years and is in the process of proceeding with the recommended improvements to the primary covers and thickener cover; these improvements are anticipated to be completed in the next six months. Veolia is also proceeding with the recommended improvements to the dewatering area scrubber, with anticipated completion within the next six months. The proposed implementation schedule shown in Table 4-3 is for the remaining recommended future mitigation measures.

TABLE 4-3
IMPLEMENTATION SCHEDULE

Task	Estimated Duration
Design Phase	6 months[1]
Borough Review & Approval of Design	3 months[2]
Bidding & Procurement Phase	6 months
Construction Phase	12 months
Acceptance Testing Phase	12 months

Notes:
1. After DEP review and approval of report
2. Schedule dependent on Clean Water Funding availability

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