EVALUATION OF TREATMENT PLANT OPERATION AND POTENTIAL CAUSES OF TREATMENT PLANT EFFLUENT LIMITATION VIOLATIONS (April to June 2004) FOR THE CITY OF ESCONDIDO HALE AVENUE RESOURCE RECOVERY FACILITY

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April 7, 2005

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EXECUTIVE SUMMARY

During the months of May and June 2004, the City of Escondido's Hale Avenue Resource Recovery Facility (HARRF) experienced a problem with the biological treatment process that resulted in numerous violations of its NPDES permit requirements for the discharge of treated wastewater to the Pacific Ocean through the San Elijo Ocean Outfall (Order No. 99-72, NPDES permit No CA0107981). As of August 2004, the number of violations, including the violations of daily maximum, and the average weekly and monthly limits for the carbonaceous biological oxygen demand and suspended solids concentrations, totaled 399. These violations are subject to the Mandatory Minimum Penalties (MMPs) under the California Water Code (CWC) sections 13385(h) and (i).

On November 30, 2004, the Regional Water Quality Control Board (Regional Board) issued to the City of Escondido (City) an Administrative Civil Liability Complaint recommending a liability equal to the penalty of $1,188,000 for the violations subject to the MMPs.

As of February 2005 (the date this report was drafted), the City had not yet responded to the complaint or provided any defense of these violations. However, in monthly monitoring reports submitted to comply with their NPDES permit, the City alleges that an unexpected toxic load, presumably dumped into the collection system by an unknown discharger, caused a plant upset. This is an important defense in that the Water Code contains an exemption from MMPs if the violations were caused by a third party and beyond the reasonable control of the discharger. Furthermore, the Water Code also provides for a reduction of the penalty if the violations were the result of a single operational upset (SOU) not to exceed 30 days and meeting certain criteria established in the Water Code.

The Regional Board asked the State Water Resources Control Board's (State Board) Compliance Assurance and Enforcement Unit for assistance in reviewing the HARRF's records related to the cause of the violations.

On January 5 and 6, 2005, Boris Trgovcich (State Board), Victor Vasquez and Brian Ott (Regional Board) reviewed the HARRF's records and interviewed some of the City's treatment plant and industrial pretreatment staff at the HARRF. The State and Regional Board visited the facility again on January 20, 2005, to review additional documents. Based on the information provided by the City during the file review, and the results of sampling by the City from two segments of the collection system, it appears elevated levels of chemicals may have entered certain segments of the City's sewage collection system during the months of May and June 2004. However, there is no evidence that these elevated levels caused the plant violations.

The file review did reveal that prior to and during the violation period, operators at HARRF experienced problems with low dissolved oxygen (DO) in at least two of the five aeration basins. The low DO concentration appears to be due to a combination of factors

including faulty DO probes in the aeration basins and high concentration of sulfides in the influent. This problem might have been compounded by erroneous readings obtained by one of the portable back-up DO meters that were used by plant operators. This particular meter does not accurately read the unusually low DO concentrations (0.2-0.5 mg/l) often encountered in the HARRF's aeration basins, unless special calibrating procedure or a different membrane is used. Nevertheless, it is the meter that was used most frequently by operations staff. Furthermore, it appears the City's initial operational control responses, which was to decrease the air supply to the aeration basins, increasing sludge wasting over a long period of time, and maintaining the constant sludge return rate as the solids inventory in the aeration basins was decreasing, was not helpful in responding to the failing performance of the aeration basins. These actions likely exacerbated and prolonged the poor condition of the aeration basins longer than necessary.

The length of the violation period (three months) is inconsistent with a single operational upset (which is typically a short-lived event) or the speculation of a toxic load entering the plant and killing off the aerobic microbial population in a short time span. It is more likely the violations were caused by instrument failure, which the operators did not immediately recognize. The higher-than-usual concentrations of potentially harmful pollutants in the influent to the treatment plant during this time period could have made the conditions worse, however, they were not found in concentrations that would have otherwise adversely impacted the treatment system.

Although the City maintains an exceptionally high quality of process control data at the HARRF and runs a sophisticated in-house laboratory, the specific events and conditions during the period of plant upset were poorly documented.

The City was slow to respond and investigate any source(s) of the potentially illegal discharge(s) into the sewage collection system after it attributed the effluent limitation violations to a toxic load entering the treatment plant. As of January 2005, the City has not provided the Regional Board with the data from the subsequent investigative sampling and testing. The City eventually did provide those data to the State and Regional Board staff during their January 5 and 6 visit. The failure to report investigation results in a timely manner is a significant reporting violation, which should be considered by the Regional Board.

In summary, the effluent limitation violations at the HARRF were probably caused by a combination of events, most of which could have been controlled by the treatment plant staff if all of the equipment had been functioning properly. Although a higher than normal concentration of potentially harmful pollutants may have entered the plant, there is no evidence that those chemicals were the cause of the upset. However, it is possible that elevated concentrations of certain unidentified chemicals in the influent to the treatment plant contributed to problems in the activated sludge system caused by other factors that were within the control of the treatment plant staff. The long duration of the alleged upset is also more consistent with operational control problems than with a toxic load theory.

I. INTRODUCTION

On January 5 and 6, 2005, I conducted a file review of the City of Escondido's (City) Hale Avenue Resource Recovery Facility's (HARRF) process control records and the industrial pretreatment records. I reviewed additional records on January 20, 2004. Staff from the San Diego Regional Water Quality Control Board (Regional Board) assisted during both visits. The primary objective of this inspection was to review the wastewater treatment process control records and the monitoring data for the industrial dischargers for any indications of plant upset which, according to City representatives, started around April 17, 2004 and lasted through June 2004.

The following were present during the inspection:

Name	Organization	Title	Phone No.
Bryan A. Ott	San Diego RWQCB	Water Resources Control Engineer (WRCE)	858-637-5589
Victor Vasquez	San Diego RWQCB	WRCE	858-636-3155
Rebecca Stewart	San Diego RWQCB	Sanitary Eng. Associate	58-467-2966
Charles Cheng	San Diego RWQCB	Engineering Geologist	858-627-3930
Boris Trgovcich	State Water Resources Control Board	WRCE	916-341-5893
Mary Ann Mann	City of Escondido	Utilities Manager	760-839-4528
John Burcham	City of Escondido	Plant Superintendent	760-839-6273
Jim Larzalere	City of Escondido	Operations Supervisor	
Vasana Vipatapat	City of Escondido	Laboratory Superintendent	760-839-6284
John Del Fonte	City of Escondido	WWTP Operator III	
Tom Foley	City of Escondido	WWTP Operator III	
Jennifer Davis	City of Escondido	Ind. Waste Inspector	760-839-4257
Lance Lauricha	City of Escondido	Supervisor III Ind. Pretreatment	760-839-4347
Frank Anderson	City of Escondido	Deputy Utilities Manager	760-839-4575

II. BACKGROUND

Facility description

The HARRF is located at 1521 Hale Avenue in the City of Escondido. It is an activated sludge wastewater treatment facility with a peak treatment capacity of 33 million gallons per day (mgd). The City is currently allowed to discharge 16.5 MGD through the ocean outfall and another 9.0 MGD of tertiary effluent to Escondido Creek. The actual average

influent flow is approximately 14.5 mgd. **Attachment 1** contains a site plan of the existing facilities. The City of Escondido has a contract with the City of San Diego to treat up to 5.5 mgd of wastewater from San Diego's Rancho Bernardo area. Twelve major industrial facilities contribute approximately 4% of the total plant influent.

The secondary effluent is discharged through the San Elijo Ocean Outfall (SEOO) with a design hydraulic capacity of 25.5 mgd. The City of Escondido is permitted to discharge 16.5 mgd through this outfall, which terminates a little more than a mile off shore. The initial dilution at the outfall is estimated at 220: 1.

The main treatment processes include the: headworks, four rectangular primary clarifiers, five activated sludge aeration tanks, four secondary clarifiers, two dissolved air floatation (DAF) tanks, anaerobic digesters and a 9 mgd tertiary treatment system (ultraviolet disinfection which is currently awaiting certification by the Department of Health Services).

The HARRF also includes a sophisticated, well-run and maintained laboratory in which laboratory staff conducts most of the compliance and process control analyses.

April-June 2004 effluent limit violations

In late April 2004, City representatives informed the Regional Board by phone that the HARRF was experiencing problems with its activated sludge treatment process. According to the Regional Board staff, this complied with the 24-hour notification requirement in the permit. The Regional Board records show that, in its May and June 2004 self-monitoring reports, the discharger indicated it was experiencing an upset but otherwise did not submit any other detailed reports or documentation to the Regional Board. The Regional Board should determine if the lack of follow-up reporting constitutes additional reporting violations for either the SOU notification or 5-day reporting requirements.

In its Discharge Monitoring Report (DMR) submitted on June 17, 2004 for the month of May **(Attachment 2)** the City reported numerous violations of the permit's Daily Maximum limits for the Carbonaceous Biochemical Oxygen Demand (CBOD) and Total Suspended Solids (TSS) concentration and one violation of the Monthly Average limit for Acute Toxicity. These effluent violations continued into June and were reported by the City on the June 2004 DMR **(Attachment 3).** Violations of the permit's Monthly Average for TSS and CBOD continued through July and the early part of August. All of these DMRs included a brief chronology of the problems experienced during the alleged upset period and the steps that the operators were taking to correct the problem.

Under the CWC Section 13385 (h), the Regional Board is required to impose MMPs for certain types of effluent limit violations. As of August 2004, the HARRF accumulated 399 violations that are subject to MMPs. On November 30, 2004, the Regional Board issued an Administrative Civil Liability Complaint to the City for the minimum penalty

in the amount of $1,188,000 for the alleged violations of effluent limitations **(Attachment 4)**.

During the initial file review, the Regional Board files did not contain a response to the Administrative Civil Liability Complaint from the City. However, during my interviews, individual City representatives alleged the violations were caused by a toxic load(s), which caused an upset. Furthermore, the city alleges that an unnamed third party caused the upset by illegally discharging toxic chemicals into the collection system in violation of the City's pretreatment program on more than one occasion during the two-month period. This allegation will need to be evaluated when the City submits a response to the complaint.

The burden of proof for demonstrating an upset is on the discharger in accordance with the City's discharge permit (Order No. 99-72), which states that

> *"In any enforcement proceeding, the discharger seeking to establish the occurrence of an upset has the burden of proof (Standard Provisions, Section A.10.d)".*

As of February 2005, the City had provided no such evidence.

III. DISCUSSION

The primary objective of this audit/file review was to review pertinent plant records and, if possible, determine the cause of the effluent violations. Order No. 99-72 Standard Provisions, Section A.10 **(Attachment 5)**, states:

10. Upset

> *a. Definition. "Upset," means an exceptional incident in which there is unintentional and temporary noncompliance with technology–based permit effluent limitations because of factors beyond the reasonable control of the discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.*
>
> *b. An upset constitutes an affirmative defense to and action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph (c) of this provision are met. No determination made before an action for noncompliance, such as during administrative review on claims that noncompliance was caused by upset, is final administrative action subject to judicial review.*
>
> *c. A discharger that wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or any other relevant evidence that:*

(1) An upset occurred and that the discharger can identify the cause(s) of the upset;
(2) The permitted facility was at the time being properly operated;
(3) The discharger submitted notice of the upset as required in provision B.5 of the Monitoring and Reporting Requirements (24-hour notice); and
(4) The discharger complied with any remedial measures required under provision A.3 of the General Provisions.[1]

At the time of this writing, the City has yet to submit any written documentation regarding the events leading up to and including the period of poor plant performance. The Regional Board should determine the ramifications of the City's failure to provide documentation required by the permit.

Aeration basins

According to City of Escondido HARRF staff, including the Process Control Operator, Plant Superintendent and the Operations Supervisor, the first signs of operational problems were noticed on April 17, 2004, as a "significant" decrease in dissolved oxygen (DO) demand in the aeration basins. The operators responded by decreasing the amount of air to the aeration basins to meet the target DO concentration of about 0.75 mg/l. The following discussion will focus primarily on the observations and records for the month of April 2004, the time when the problems allegedly started, through the end of June when plant operation started returning to normal.

First, it should be noted that the operators' target DO concentration in the aeration basins at the HARRF is already relatively low (0.75 mg/l), compared to most activated sludge plants. Typical target levels suggested in wastewater treatment plant textbooks are usually 1-2 mg/l. The problem with the City's low target value is not necessarily the low DO concentration but the slim margin for error this affords in case of any decrease to dangerously low DO levels. In fact, HARRF's records show that the DO concentration in the aeration basins prior to our site visit often dropped well below 0.75 mg/l, sometimes as low as 0.2 mg/l. It is also not uncommon for the DO concentration to reach more than three or four mg/l, especially during morning hours. During our January 5, 2005 visit, we observed DO concentrations in the aeration basins ranging from a high of 1.2 mg/l to a low of about 0.08 mg/l.

Since the DO level in the aeration basins is currently controlled manually (air valves are adjusted from the control room keyboard) it is inevitable that the aeration basins will occasionally be subjected to fluctuating DO concentrations. However, the value of 0.08 mg/l is indicative of almost total oxygen depletion in that particular basin, and also suggests an inadequate control of the aeration process.

[1] General Provision A.3: Duty to mitigate (40 CFR 122:41 (d)) – The discharger shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

Computer records (**Attachment 6**) show that, on April 17, at 00:00 hours (midnight), DO concentration among the five aeration basins ranged between 0.65 and 1.53 mg /l. By 02:00 hours, the average DO concentration in the five basins increased from about one to approximately two mg/l, however, only basins 222 (basin #2) and 232 (basin #3) showed a significant increase in DO concentrations at 2.88 and 4.47 mg/l, respectively. According to the operators, shortly afterwards, they reduced the air supply to the tanks and the DO levels decreased. By 09:00 hours, the DO concentration was normal (less than one mg/l) in all of the basins and stayed that way for the remainder of the day.

On January 20, 2005, the operators, stated that occasional "spikes" in the DO concentration occurred prior to April 2004. A quick review of the aeration basin DO data for April and May 2003, revealed several DO concentration spikes of larger magnitude than during April 2004 period.

The operator logbooks did not reveal anything unusual about the DO concentration in the aeration basins for April 17, 2004 or for the rest of the month of April. An April 19 logbook entry states that aeration basin #2 is "going septic" but that DO concentration is normal. The same day, operators increased sludge wasting (removal of excess microorganisms from the activated sludge process) by 20 gallons per minute (gpm) and calibrated the DO meter. The logbook indicates that effluent quality started to deteriorate slightly indicated by higher turbidity and sludge settleability readings. The logbook records also document that, on April 24 and 25, the dissolved air flotation (DAF) tank was septic. The logbook did not document any other unusual problems.

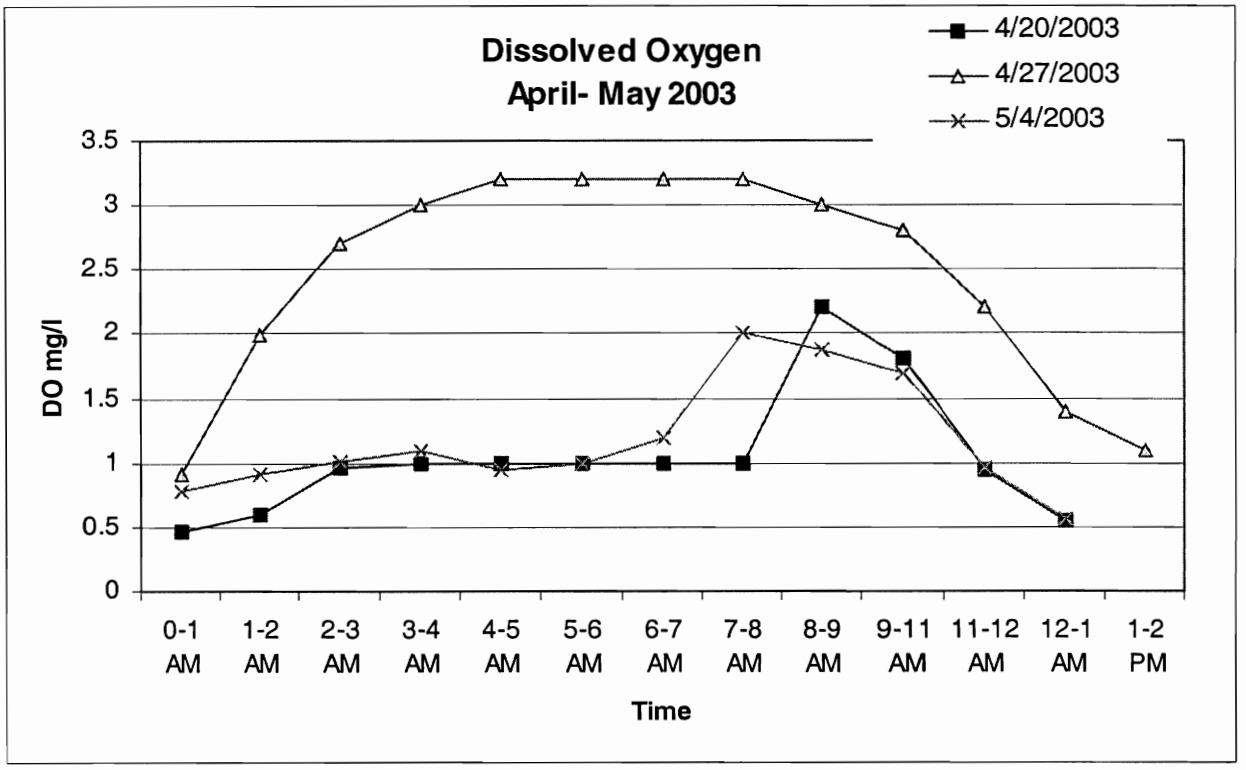
However, the computer records for hourly average DO readings in the aeration basins show that on the late morning of April 28, there was another brief increase in the DO concentration in most of the aeration basins but more prominent in basins 222 and 232 (**Attachment 7**). The following morning, on April 29, the DO meter in aeration basin 222 was showing a negative value of 1.13 for at least five hours, followed by average hourly readings of about 0.2 mg/l for the next 20 hours. Subsequently, the DO readings stabilized at a constant value of 0.38 - 0.39 mg/l until May 5. Then the readings suddenly jumped to 1.1 mg/l and remained at that value until May 12. Both of these readings are highly improbable, if not impossible, because slight variations in DO concentration are normal and to be expected under typical operating conditions.

Plant records (**Attachment 7**) indicate a similar trend in aeration basin 242 (basin # 4) starting on May 7 with a negative 1.13 mg/l reading followed by consistent readings of 1.8 and another period of consistent readings of 2.5 mg/l until the end of the month. Again the constant levels are highly improbable, if not impossible, because slight variations in DO concentration are normal and to be expected under typical operating conditions.

The treatment plant personnel's claim that the decrease in DO demand (meaning a high DO concentration readings) in the aeration tanks was likely due to toxic substances in the wastewater is not substantiated by the plant process control data. The temporary increase in DO concentration on April 17 was very brief and did not last more than a few hours. Those types of variations can be found at this facility during any given week without

noticeable effect on the plant performance. For example, **Figure 1** shows DO "spikes" at this facility for selected days during three consecutive weeks, one year prior to the alleged April –June upset. During that three week period the plant experienced was no appreciable decrease in performance and no documented effluent limit violations.

Figure 1 – Example of DO "spikes" at HARRF during three days, one week apart in April-May 2003. The average DO concentration for the remainder of each day was approximately 1 mg/l.



Likewise, the monitoring records show that the final effluent quality during the month of April 2004 was not affected appreciably on April 17 or even the following few days. More significantly, the temporary increase in the DO concentration was only observed in two of the five aeration basins. If the microorganisms were dying off at the time due to toxic shock, all five aeration basins should have been affected at least to some degree.

There are other potential reasons for the temporary increase in DO concentration in the two aeration basins. These include but are not limited to: Lower flows that typically occur during early morning hours; uneven flow and/or air distribution among the aeration basins; and faulty DO probes. During the January 5, 2005 interview the treatment plant personnel acknowledged that around the same time that the plant's performance deteriorated, some of the DO probes in the aeration basins were giving inaccurate readings and were eventually replaced. This is clear from the computer records **(Attachments 6 and 7)** documenting DO concentrations in the aeration basins. DO probes in aeration tank 222 appeared to be malfunctioning during the entire month of

May while the probe in tank 242 apparently started to malfunction around May 7 and continued to give unreliable readings through the end of the month.

During the January 20, 2005 site visit, treatment plant staff explained the unusual DO readings in basins 222 and 242 noted above. According to treatment plant staff, the negative value of 1.13 occurred while the existing GLI (probe manufacturer) probes in the aeration tanks were being replaced with new (Hach) instruments. The GLI probes were experiencing problems, particularly in aeration basin # 2 (basin 222). The parts for these probes were also becoming difficult to obtain and the plant staff decided to transition to the Hach probes. By the end of July 2004, they replaced all GLI probes with Hach probes.

After installing the Hach instruments, the technicians started suspecting a problem with the new probes because of the unusually consistent reading. During the next few weeks the staff determined that the DO readings at the computer inside the control room was twice as high as the actual DO concentration because of an improperly set range on the instruments.

Another problem was with the "dampening" of the instantaneous reading. The new instruments have a built-in dampening feature that averages instantaneous DO readings over pre-determined time intervals in order to provide less erratic and more meaningful average values. However, the plant's Programmable Logic Controller (the local data acquisition instrument) also has a built-in dampening system of its own, which meant that the data that were sent to the main computer in the control room were "dampened" twice. The result was the unusually consistent readings observed in **Attachment 7**.

Portable DO meters

Realizing that there was a problem with the DO probes in the aeration basins, the treatment plant operators started relying more on portable DO meters (YSI models 55 and 85) calibrated in the plant's laboratory. If they noticed a significant discrepancy in readings, they calibrated the probes using the portable meter as reference. It was not until sometime in late July that treatment plant staff realized the portable DO meter which had been in use most of the time (YSI Model 55), was giving inaccurate (high) readings when the basins were actually at low DO concentrations.

Until July, the operators would routinely bring the YSI 55 meter into the lab for weekly calibrations (comparing the readings to those using the Winkler Method for determining DO concentration). The laboratory staff would calibrate the meter at a DO concentration of about 8 mg/l and return it to the operators. However, in July 2004, when the laboratory staff calibrated the Model 55 in a sample fully depleted of oxygen, the meter read 1 mg/l. According to the laboratory superintendent, that was when they realized that YSI 55 was not appropriate for reading DO concentrations below 0.5 mg/l, which are often encountered in the aeration basins.

The specifications in the Operations Manual for YSI 55 (**Attachment 8**) state the meter accuracy as +/- 0.3 mg/l at a range of 0-20 mg/l. The meter was supplied from the

manufacturer with the YSI Model 5775 Standard Membrane Kit (1 mil membranes) recommended "for most applications." However, the manual also states that for special conditions (when data is routinely collected at sample temperatures below 15°C and at DO levels below 20% saturation), a 0.5 mil high-sensitivity membrane was available. Using the high sensitivity membranes in this situation will decrease the percentage of error due to the probe's background current.[2]

Although HARRF operates the aeration basins at low DO concentrations, the temperature is normally above 15°C. According to the YSI technical representative, both the temperature and low DO conditions need to be satisfied before YSI would recommend switching to the thinner membrane.[3] However, the representative also pointed out that users should keep in mind the meter's +/- 0.3 mg/l accuracy when reading low DO concentrations. She recommended switching to the thinner membrane only if problems are encountered with the standard membrane.

Based on these facts, I conclude that at times, the treatment plant operators inadvertently depleted the oxygen in the aeration basins by reducing the airflow. This would account for the septic conditions in the basins and the DAF unit (as indicated in the logbooks) and would have produced and adverse effect on the microbial population in the basins.

Air supply system (blowers)

I originally assumed that the low DO concentration was maintained to save on power costs. However, treatment plant staff indicated the reason is partially because the treatment plant's aeration capacity is limited to about 14,000-15,000 cubic feet per minute (when operated at a current draw of about 300 amperes).

A September 2002 study by ALLIS Engineering concluded that most of the blowers were in poor condition and needed to be replaced (**Attachment 9**). Only two of the original four blowers are currently in operation and the blower output is further limited by the piping restriction. During the day, the two blowers normally run close to "wide open," but during the early morning hours (during lower sewage flow into the plant) only one blower is used. According to the plant staff, operating the third blower would not appreciably increase the amount of air reaching the activated sludge system.

Another problem with the existing system is that the air valves cannot be controlled automatically and the operators need to make adjustments manually from the control room. The City is in the process of replacing the old blowers with three new blowers that will give it reliable capacity and better operational control.

Microscopic examination

Both the operators and the laboratory superintendent stated that a microscopic examination of the activated sludge revealed that certain microorganisms (ciliates and

[2] YSI Model 55 Handheld Dissolved Oxygen and Temperature Systems Operations Manual, January 02.
[3] Conversation between Boris Trgovcich and YSI representative (Laura) on January 27, 2005, 13:20 hours. YSI phone No. 800-765-4974

rotifers, for example) were either absent or showed reduced activity around April 17 and subsequently during the period of poor plant performance. However, with a couple of exceptions (log book entries), no one documented or quantified these observations during the two months when the plant was performing poorly. The main benefit of documenting the type and number of microorganism in the activated sludge is to evaluate the various operational parameters and adjust them as necessary. The documentation then provides a quick reference if a similar situation occurs in the future. Despite the lack of documentation, there is no reason to doubt the plant staff's recollection of the microscopic examination results. However, the absence or reduced activity of certain microorganisms does not necessarily mean that a toxic load entering the plant killed them off. A lack of oxygen or other changes in certain operational parameters would have produced similar results. The presence of new species in the activated sludge system can also provide important clues and should be carefully documented. Specifically, during the upset conditions, microorganisms *Beggiotoa* and *Thiothrix* species appeared in the activated sludge. Both are indicators of septic wastes and sulfides.[4]

Sulfides in the plant influent

Most of the operational and laboratory staff interviewed confirmed that, prior to and during the violation period, high levels of sulfides were detected in the plant influent. Most odor-producing sulfides are the result of the breakdown of inorganic sulfur compounds such as sulfate. The absence of oxygen and a pH of less than 7.5 favor conversion of sulfate to sulfide.[5]

According to the operators, one source of sulfides in the HARRF collection system may be the decant water from the storm drains that is discharged from the Vactor trucks. This is referring to the practice of cleaning out the storm drains by Vactor trucks, settling out the solids and discharging the supernatant back to the storm drain. The long trunk line from Ranch Bernardo further promotes formation of sulfides

The influent testing **(Attachment 10)** conducted by the HARRF laboratory during the months of June and July 2004, shows sulfide concentrations in the influent as high as 13,800 mg/l (Rancho Bernardo trunk line on June26 and 30).

Plant logbooks also indicate that sulfide control is an ongoing concern at the HARRF. Operators routinely add bleach, ferric chloride and enzyme products to the influent to control the sulfides. On June 7, 2004, laboratory staff were asked to take a special sample from the primary and secondary clarifiers to determine the cause of an orange color and a strange odor in the wastewater. The laboratory determined that the color was caused by high concentration of iron (component of ferric chloride which is normally added to the plant influent for sulfide control), which would suggest that the plant staff added more ferric chloride that usual. Plant records show that on June 7, the plant staff added 165

[4] Water Pollution Control Federation, *Operation of Municipal Wastewater Treatment Plants*, Manual of Practice (MOP 11, Volume II), 1990, page 583.
[5] Sawyer and McCarty, *Chemistry for Environmental Engineering*, Third Edition, McGraw –Hill, New York.1978, pages 476-479.

gallons of ferric chloride, which was not unusually high compared with the typical dosage for this facility.

However, during the January 5, 2005 interview, the operators stated that occasionally the City of Escondido potable water treatment plant releases a load of ferrous chloride sludge into the collection system. Ferrous chloride sludge is a waste product normally generated during a potable water treatment process and if released slowly into the collection system, it should not adversely affect wastewater treatment operation. Therefore, it is likely that the high concentration of iron detected in the plant's influent on June 7 was due to a combination of ferric chloride added at the wastewater plant and an unexpectedly high load of ferrous chloride sludge released into the sewer system by the potable water treatment plant.

According to the City's chronology, on May 20 the City sent a sample of the primary effluent and activated sludge to Dr. Jenkins, a known expert in the area of wastewater treatment. According to Mr. Burcham, HARRF Superintendent, Dr. Jenkins informed the City that the activated sludge contained high concentrations of *Beggiatoa* and *Thiothrix* organisms. These types of organisms are generally associated with low DO conditions and the presence of sulfides. *Thiothrix* can be generated in aeration tanks with low DO for excessive periods of time[6]. Beggiatoa is found where both oxygen and hydrogen sulfide are present.[7] Dr. Jenkins did not provide a written report.

Chlorination

Attachment 10 also raises a question about the City's practice of chlorinating plant influent to control sulfides. Although chlorination is a common and acceptable practice, it has to be done carefully in order to avoid killing the beneficial microorganisms in the activated sludge. **Attachment 10** shows that on June 16, chlorine residual in the primary effluent averaged 1.1 mg/l through the four clarifiers and was 2.2 mg/l in clarifier #4. It is not known what effect, if any, such a chlorine concentration might have had on the activated sludge system. However, chlorine residual of 2.2 mg/l suggests a much higher chlorine dose (10 mg/l or more) considering the potentially high chlorine demand exerted by typical wastewater. A chlorine residual of 2 mg/l is a fairly common target for plant effluents where complete disinfection is required. It is possible that excessive influent chlorination, combined with low DO concentration and various chemicals normally released into the collection system could have had a detrimental effect on the microbial population in the activated sludge. Although maintaining a chlorine residual of 2 mg/l in the influent did not appear to be a common practice at this facility, even a single overdose could have been more toxic to the microorganisms than any industrial waste discharged into the collection system. This is a possibility that should be further evaluated.

Influent analysis for metals (April 2004)

[6]Kenneth D. Kerri, Operation of Wastewater Treatment Plants, A Field Study Training Manual, Volume II, Fourth Edition, 1993, page 89.
[7]American Public Health Association, *Standard Methods for the Examination of Water and Wastewater* 18th edition, 1992, page 9-77

During the entire month of April 2004, starting well before the operators observed indications of plant malfunction conditions, laboratory staff were analyzing composite influent samples for certain metals (copper, chromium, lead and nickel), which would normally be discharged into the collection system by industrial dischargers within the HARRF service area. The results of the analyses done on about 30 composite influent samples did not show any unusually high concentration of those metals (**Attachment 11**). When compared to the analyses for the same constituents performed a year earlier (**Attachment 12**) the concentrations of these metals in the plant influent were not significantly different. These tests, therefore, exclude this group of metals as the cause of an alleged plant upset during the month of April.

Comparison of CBOD to Chemical Oxygen Demand (COD) of the plant influent

The laboratory routinely tests for both COD and CBOD of the plant influent and effluent **(Attachment 13).** COD test is a chemical digestion test that does not rely on living microorganisms while the CBOD tests depend on active microorganisms present in the sample. Over a period of time it is generally possible to establish a reasonably reliable correlation between the COD and CBOD results for specific wastewater samples. In the case of HARRF, the COD to CBOD ratio for the influent samples is approximately 2.5: 1 under normal operating conditions.

CBOD analysis requires suitable environmental conditions for the living organisms to function in an unhindered manner at all times. One of these conditions is the absence of toxic substances.[8]

If the plant experienced a toxic shock that killed off or slowed down the metabolism of the microbial population in the activated sludge, the COD/CBOD ratio should have theoretically increased due to false low CBOD results (the absence of active microorganisms in the sample bottle would result in lower oxygen consumption during the test), at least around the days when the toxic load entered the plant. However, during the last part of April (April 18-30) the ratio for the composited influent samples remained virtually unchanged at about 2.4: 1. During the following month when most of the CBOD Daily Maximum limit violations occurred, the ratio actually decreased slightly to approximately 2:1.

The correlation between COD and CBOD for the effluent samples at HARRF is normally about 6.5: 1. That correlation is normally higher than for the influent samples because the final effluent has different characteristics than the influent. That correlation also did not change significantly after the deterioration of the plant's performance. In May, the correlation between COD and CBOD dropped slightly to 5.6: 1, an anticipated change considering the plant effluent quality started to approach that of the influent. Again, because the effluent CBOD samples are "seeded" with the microorganisms from the primary sludge, one would have expected to see some noticeably different results in the

[8] Sawyer and McCarty, Chemistry for Environmental Engineering, Third Edition, McGraw –Hill, New York.1978, page 417.

effluent CBOD tests if the plant was experiencing an upset due to toxic shock. This would be particularly likely if the plant experienced several toxic loads over a prolonged period of time as suggested by the City.

The available COD and CBOD data do not support City's claim that the activated sludge process was killed by a toxic shock. On the contrary, the available data show normal influent organic loadings and suggest the presence of viable microbial population in the plant influent.

Results of sampling by the industrial waste inspectors

Sometime in late April the plant superintendent requested that the in-house laboratory collect additional influent samples in order to identify the source of any potentially toxic substances in the plant influent. According to the information contained in the May 2004 self-monitoring report, this sampling "showed spikes in methylene chloride, chloroform, chromium, copper, and lead entering the plant."

On the January 5-6, 2005, I reviewed treatment plant data (**Attachment 14),** and was able to confirm a significant spike in methylene chloride. Table 1, is a summary of data collected by the City from the main influent lines:

Table 1 – Comparison of Daily Maximum Concentrations of plant influent data for May 2004 to 2002 and 2003 values for the specific constituents identified by the City as the possible causes of the upset conditions.

Date (2004)	Sample location	Constituent	2004 Reported Concentration (ppb)	2002 high result (ppb)	2003 high result (ppb)	Daily Max. eff. limitation (ppb)
April 30	Rancho Bernardo	Methylene chloride	31.5	NA	NA	NA
April 30	**Combined influent**	**Methylene chloride**	**7.3[+]**	**6.0 May 13**	**5.0 Nov. 5**	99,000
May 2	**Combined influent**	**Methylene chloride**	**39.6**	**6.0 May 13**	**5.0 Nov. 5**	99,000
May 2 (2-7 pm)	Escondido line	Methylene chloride	68.6	NA	NA	NA
May 2 8pm-2am	Escondido line	Methylene chloride	20.9	NA	NA	NA
April 30	Rancho Bernardo	Chloroform	2.8	NA	NA	NA
April 30	**Combined influent**	**Chloroform**	**5.1**	**8.0 Feb. 4-5**	**17.0 Aug 4-5**	29,000
May 2	**Combined influent**	**Chloroform**	**4.8**	**8.0 Feb. 4-5**	**17 Aug. 4-5**	29,000
May 2 2-7 pm	Escondido line	Chloroform	3.4	NA	NA	NA
May 2 8pm-2am	Escondido line	Chloroform	5.4	NA	NA	NA
April 30	Rancho Bernardo	Toluene	0.6	NA	NA	NA
April 30	**Combined influent**	**Toluene**	**1.4**	**6.0 May 13-14**	**13 May 6-7**	19,000,000
May 2	**Combined influent**	**Toluene**	**0.8**	**6.0 May 13-14**	**13 May 6-7**	19,000,000
May 2 2-7 pm	Escondido Line	Toluene	0.7	NA	NA	NA
May 1 8-2 pm	Escondido line	Chromium	56.8	9.0 * Nov.6-7	58.3 * Nov. 5-6	1,800 *
May 2 2-7 pm	Escondido line	Chromium	26	9.0 * Nov.6-7	58.3 * Nov. 5-6	1,800 *
May 1 8-2 pm	Escondido line	Copper	331	158 * Aug 5-6	244 * May 6-7	2,200 *
May 2 8-2 pm	Escondido line	Copper	215	158 * Aug 5-6	244 * May 6-7	2,200 *
May 2 2-7 pm	Escondido line	Nickel	147	23.5* Aug. 5-6	49.1* Nov. 5-6	4,400 *
May 1 8-2 pm	Escondido line	Lead	37.5	23.5* Aug. 5-6	19* Aug 4-5	1,800 *

*For combined influent only. There are no data or permit limits specifically for the Escondido line. Influent from the Rancho Bernardo line would provide additional dilution.

[+]Rows in **bold** indicate values for the combined influent. The other values are for samples taken at various sections of the collection system, which do not accurately represent the concentration of those constituents entering the treatment plant.

Table 1 shows that, with the exception of methylene chloride, combined influent concentrations for the constituents that the City identified as possible causes of the plant upset are generally within the typical historical values detected in 2002 and 2003. In some cases (chloroform and toluene), higher concentrations were detected in the plant influent in previous years.

On May 2, 2004, the concentration of methylene chloride in the combined influent was significantly higher than in previous years. However, there is no evidence that even a concentration of 39.6 parts per billion (ppb) would have been responsible for an alleged plant upset. The effluent limitation in the HARRF's NPDES permit for methylene chloride is 99,000 ppb. According to the pretreatment staff, methylene chloride is generally not used in large quantities by the industrial users covered by the City's pretreatment program.

Laboratory research by others shows that methylene chloride is not toxic to the activated sludge system at concentrations that are at least 100 times greater than those found in Escondido's influent on May 2, 2004. The activated sludge bacteria can acclimate to concentrations of methylene chloride ranging between 1 and 1000 mg/l and can use it as carbon source (food).[9]

After the initial sampling, the plant superintendent called the pretreatment department and, during a May 5, 2004 meeting, it was decided that the pretreatment staff would collect additional samples upstream of the treatment plant. On May 6, 18, 19, 20, 21 and 23 pretreatment staff collected samples at different trunk lines upstream of the treatment plant. Analyses from those sampling events (**Attachment 14**) only showed relatively high copper concentrations in Manhole No. 4102. The two "spikes" (1,230 and 1,300 ppb on May 18 and 19, respectively) are significant because they exceed the City's local pretreatment limit of 840 ppb. The effluent limitation in the HARRF's NPDES permit for copper is 2,200 ppb.

However, when viewed as part of the entire collection system and the plant's final effluent permit limits, these concentrations become less significant. According to the pretreatment department supervisor, Manhole No. 4102 is located along a 12-inch trunk line, the smallest of the four trunk lines, which range from 40 inches to 12 inches in diameter. Therefore, by the time the flow from this line combined with that of the remaining three trunk lines, the copper concentration would have been greatly diluted. Had the flows been measured or estimated at the time of sampling (or if a composite sample of the combined influent was analyzed at the same time), a more precise estimate of the concentration of various constituents in the combined influent and their effect on the treatment processes would have been possible.

The semiannual monitoring report (**Attachment 15**) submitted to the Regional Board by the City, also does not show any unusually high concentrations of potentially toxic

[9] Gary M. Klecka, *Fate and Effects of Methylene Chloride in Activated Sludge*, Applied and Environmental Microbiology, Sept. 1982, p. 701-707.

substances for the influent samples taken on May 26, 2004, when the plant final effluent quality was very poor at 70 mg/l of TSS and 73.7 mg/l of CBOD.

Results of investigative sampling conducted by the City's pretreatment department did not identify any toxic substances in unusually high concentrations that could have caused a serious disruption at the HARRF. The results of the sampling do suggest an intermittent discharge of wastes containing relatively high concentrations of copper (May 1, 18 and 19) and methylene chloride (May 2 and 19), however, the City has not conducted any studies to determine the toxic threshold of these chemicals on the activated sludge microorganisms, and as noted earlier, other research shows that methylene chloride is not a factor at concentrations found on those dates.

The City conducted two more follow up sampling investigations on June 4-8 and on June 21-23 at the manholes further upstream in the collection system. During the June 4-8 sampling they found nothing significant. During the June 21-23 sampling period the samples contained what appears to be high concentrations of methylene chloride, acetone, lead, zinc, and trichloroethane (**Attachment 16**). Another sample contained 25.1 mg/l of TRPH (total recoverable petroleum hydrocarbons). Their investigation did not estimate the flows at the time of sampling so the significance of the results is difficult to determine. However, using the pipe sizes as rough indicators of potential flows, most of the concentrations do not appear to be significant when compared to the total combined influent flow. According to the pretreatment department supervisor, the four trunk lines leading to the plant have diameters of 12, 18, 28 and 40 inches and the flows from those lines would provide substantial dilution for any chemicals found in the 10-inch line. (According to the treatment plant superintendent there are three main trunk lines entering the plant: 21", 27" and 40")

For example, the highest concentration of zinc (3.37 mg/l) found during this sampling event was detected on June 23 in a 10-inch line (manhole No. 4937). For comparison, in 2003 the typical concentrations of zinc in the combined influent ranged from about 0.18 to 0.6 mg/l.

Using acetone as another example, 0.430 mg/l was detected on June 22, in a 28-inch line (Manhole No. 4101). By the time the flow from that trunk line was combined with the other flows one would have expected roughly 3:1 dilution so the acetone concentration of the combined influent would have been probably somewhat less than 0.430 mg/l (assuming lower concentrations in the other trunk lines). For comparison, in 2003, acetone concentration in the combined influent ranged from 0.088 to 0.189 mg/l. In 2002 it ranged from 0.151 to 0.480 mg/l.

The mere presence of potentially toxic chemicals in the plant influent does not mean that these were the cause of an alleged plant upset. In fact, the activated sludge system employs the concept of toxic threshold, which means that below certain concentrations all materials are nontoxic.[10] The research previously mentioned for methyl chloride

[10] Sawyer and McCarty, Chemistry for Environmental Engineering, Third Edition, McGraw –Hill, New York.1978, page 112.

(footnote 9) indicates that the toxic threshold for methylene chloride is at least 100 times the concentrations found during the June 2004 sampling. Also, the fact that the CBOD tests were at no time affected by the concentration of chemicals listed in Table 1 suggests that the toxic threshold for those chemicals was not reached.

The most persuasive evidence suggesting that the elevated concentrations of chemicals that were found during June 21-23 sampling event were not the primary cause of the upset is the fact that, by that time, the plant was steadily recovering from the upset and continued to do so after June 23. Some of the recovery signs included relatively normal and stable mixed liquor volatile suspended solids (MLVSS) concentration in the aeration basins (MLVSS is an indicator of biological mass in the system), increase in the number and types of microbes, and steadily improving effluent quality.

Illegal industrial dischargers - The Iron Factory

On August 24, 2004, the City's industrial waste inspectors discovered an illegal sewer connection at one of the metal plating shops it regulates (The Iron Factory). Although no discharge was observed at the time and the owner did not admit to discharging any hazardous materials through this illegal connection, the industrial waste inspectors observed some circumstantial evidence (stains in the discharge pipe) of past illegal discharges. The Iron Factory is listed as a "zero discharger," which implies that all of the hazardous waste is hauled off by a registered hazardous waste transporter. The inspectors did not find any manifests showing that The Iron Factory complied with this requirement.

During the January 5 and 6 interview, the City staff subsequently suggested that the illegal discharge from The Iron Factory could have contributed to an alleged plant upset. However, as of January 2005, the City offered no evidence to show that the discharge did in fact occur, and provided no information regarding the volume and concentrations of potentially toxic substances and what effect they would have at the plant. Industrial pretreatment records indicate this particular discharger probably uses less than 1,000 gallons per day (gpd) of water in its operation. This volume discharged into the sewer (continuously or in bulk batches) would not be significant when compared to the entire HARRF influent flow of 14.5 mgd (1,000 gpd is less than 1/10 of 1% of the total Plant flow). The Iron Factory may have accumulated a larger quantity of waste and discharged it all at once. However, this is pure speculation and there is no information in the City's records to indicate how much waste the Iron Factory could have potentially stored at the site. Additional investigation into the Iron Factory practices would be needed to speculate on their impact to the City's plant.

Plant staff's operational response to the upset

If the operators did in fact believe that the plant experienced a toxic waste load on April 17, and again on April 25 and May 1, they failed to properly document these incidents and report their findings to the Regional Board. As noted earlier, plant logbooks generally did not document (with a couple exceptions) any observations typically associated with a toxic load entering the plant for that time period. Some of the typical

signs of an upset caused by a toxic load include a significant increase in DO residual throughout the aeration basins, dead or inactive microorganisms and a sudden deterioration of secondary effluent quality. However, deterioration in the secondary effluent quality, particularly an increase in the secondary effluent TSS concentration, can also be caused by anaerobic conditions in the aeration basins or taking a clarifier out of service. In this particular case the effluent quality deteriorated gradually and the recovery period was extremely long (activated sludge plant start-up generally does not require more than 2-4 weeks).

The April logbook documents that the operators observed anaerobic conditions in one of the aeration basins and the DAF tank; detected odors at the plant; and removed # 3 clarifier from service. These are all conditions that suggest anaerobic or anoxic conditions and that could lead to a gradual deterioration in effluent quality. The computer records for April 17 show a sudden increase in DO concentration, but only in two aeration basins for a period of a few hours. This was followed by a strong indication that starting on April 29 at least one of the DO probes in the aeration basins was giving inaccurate readings. It has now been confirmed that a problem with both the DO probes in the aeration basins and the portable DO meter have in fact occurred around that time, however, the HARRF staff did not immediately realize it.

Throughout this time, there was no documentation of the results of microscopic analyses even though microscopic observations become extremely important during periods of any plant upsets. Later on in May and June, operators started documenting in the logbooks their microscopic observations.

The operators' response to their perceived toxic load scenario was to increase sludge wasting and decrease air supply to the aeration basins. This is contrary to standard operating procedures. *Operation of Wastewater Treatment Plants*, a standard operator's manual for operating wastewater treatment plants (also commonly referred to as the "Ken Kerri Manual"), states that when toxic load is detected, *"sludge wasting should be stopped immediately and all available solids returned to the aerator."*[11]

The treatment plant staff also did not follow standard protocol for sampling during a plant upset. Ken Kerri also offers the following advice regarding sampling during the plant upset:

"When a toxic substance is known to have entered the treatment plant, the operator should make every effort to obtain a sample of wastewater and have it analyzed as soon as possible to determine the toxic constituents. A record of these upset conditions and the constituents involved is very important so that if uncontrollable problems develop at the treatment plant, the records can be reviewed in an attempt to determine the input sources."[12]

[11] Kenneth D Kerri, Operation of Wastewater Treatment Plants, A Field Study Training Manual, Volume III. Fourth edition, page 61.
[12] Ibid, page 89

The plant process control data show that the MLVSS concentration in the aeration basins did not start to decrease significantly until the second week in May (**Attachment 17)** reaching the low point (around 400 mg/l) during the last week of May. However, throughout that period, the return activated sludge (RAS) flow was maintained fairly constant at about 4 mgd, even though the RAS concentration decreased to around 1,500 mg/l (half the normal). At the beginning of June, both the recycle rate and MLVSS started to show a steady increase and by August 31 reached 5.8 mgd and 1,200 mg/l, respectively. These data suggest that the loss of solids in the aeration tanks was not met with an increase in the sludge return rate, which would be the normally expected operational response.

According to the operators who were interviewed, the logic behind the wasting of solids was based on their assumption that toxic chemicals were entering the plant on a continuous basis and the increased sludge wasting was an attempt to purge the toxic chemicals from the system. However, this response could not have really been justified at the time. First, if an intermittent or continuous toxic load was suspected throughout this period, the investigative sampling should have been intensified. This did not occur. More importantly, the City had no basis for assuming either a sporadic or continuous introduction of potentially toxic chemicals into the collection system until at least the second round of sampling/monitoring they started in mid-May, when, what initially appeared to be, elevated concentrations of copper and methylene chloride were discovered in one of the trunk lines.

The operators eventually imported two loads of about 30,000 gallons each (on May 12 and 20) of "seed" sludge from the City of Fallbrook's Wastewater Treatment Plant. However that amount was of questionable value, considering the typical RAS flow of 4-5 mgd. Plant staff also noted that by the time the sludge was delivered from Fallbrook (about an hour drive), it probably lost much of its viability due to the lack of aeration experienced during transportation.

The first batch of sludge, delivered into primary clarifier #4 also ended up primarily in aeration basin #5 because of short-circuiting that, according to the HARRF staff is inherent in the plant design.

HARRF staff did not initiate the investigative sampling procedure until about April 29, almost two weeks after they suspected that a toxic load affected the plant's performance. The pretreatment staff was not notified until May 5, when a more cohesive sampling strategy was initiated. After the initial round of sampling, the investigation was then temporarily suspended on May 23 and did not resume until June 4. The sampling resumed again on June 21 for an additional two days.

According to the treatment plant and pretreatment department representatives, one reason why they discontinued sampling in June was because the results of sample analyses did not suggest the presence of potentially toxic substances at unusually high concentrations. The other reason was that the additional sampling and testing would have overwhelmed the pretreatment and laboratory staff. Even though the laboratory appears well equipped

and staffed, their resources could not have sustained the prolonged industrial pretreatment investigation.

Industrial pretreatment program

One of the objectives of this audit was to review the industrial dischargers' files for compliance. The pretreatment program was audited in August 2004 for compliance with other Federal and State regulations by the Regional Board and TetraTech Inc. (a US EPA contractor providing services to the Regional Board). Their findings are summarized in **Attachment 18.**

The City's industrial pretreatment program staff is administered from within the Department of Public Works and regulates 16 non-domestic dischargers, 12 of which are classified as significant industrial users (SIUs). One of these SIUs (Sony Corporation) is located in the Rancho Bernardo The other four non-domestic dischargers are groundwater remediation sites. The City of San Diego has responsibility for implementing all aspects of pretreatment program in Rancho Bernardo area.

The City inspects each SIU at least twice per year. All of the SIU files were well organized and inspections were properly documented. The City has initiated enforcement actions against dischargers that were found in non-compliance with the City's ordinance.

The pretreatment department also regulates about 450 food service establishments (oil and grease management) and 400 automotive shops. Other responsibilities include investigations of overflows and storm water inspections.

The staff includes two pretreatment inspectors, an industrial waste inspector and a half-time temporary pretreatment inspector. This level of staffing does not appear to be adequate to perform all the required duties. When asked if the pretreatment department has an adequate staffing, the Industrial Pretreatment Supervisor, Mr. Luricha acknowledged that additional two positions are needed in order to adequately regulate the automotive repair shops. Further compounding the inadequate resources is redirection of staff. For example, recently one of the inspectors was transferred from the food services inspections to focus on the automotive shops. This means that the food service establishments would not be receiving as much attention.

The Regional Board/Tetra Tech audit (**Attachment 18**) pointed out that, organizationally, the pretreatment program would be more effective if managed under the same administration as the wastewater treatment department. I concur with this assessment and the City should seriously consider this suggestion. The recent plant disruption exemplifies why the pretreatment staff should be working more closely with the treatment plant staff. The two departments did not initially discuss the potential problems together in a timely manner, which probably delayed the two departments working together on the investigative sampling project . Working more closely, preferably at the HARRF would benefit both teams.

IV. CONCLUSIONS

The following conclusions are based on the information provided by the City representatives on January 5-6 and the follow-up visit on January 20, as well as the records maintained by the Regional Board. I asked the City representatives to provide me with any additional information that would support their claim that the alleged effluent violations were caused by a plant upset due to a toxic load

1. The plant process control data do not suggest that a toxic load was the primary cause of the violations affecting the plant performance during the months of May and June of 2004. The only "spike" detected during the early stages of effluent violations, was for methylene chloride at a concentration of 39.6 ppb on May 2. This is approximately eight times higher than the high historical values detected in 2002 and 2003.
2. Samples of wastewater collected by the City from the sewage collection system (various manhole and trunk line locations) further upstream suggested the presence of certain constituents in concentrations that could have been higher than normal. Because the flow at individual manholes was not measured or estimated at the time of sampling, it is difficult to estimate the diluted concentrations of those constituents in the combined influent or to determine the potential impact on the plant's performance. However, most of those spikes were detected during the June 21-23 sampling event, the period of time when the plant appeared to be recovering.
3. Analyses of additional samples of the combined plant influent performed by the City did not reveal any potentially toxic constituents in concentrations significantly higher than observed during the prior two years of operation.
4. Process control data or other plant records provided by the City indicate a slow progressive deterioration of plant performance and effluent quality rather than evidence of a toxic "shock," (a sudden upset).
5. The correlation between the COD and CBOD test results for both the plant influent and effluent samples collected during the period of upset remained consistent with the historical correlation for the period prior to the plant upset. This suggests the microorganisms in the plant influent and the primary clarifier sludge were still active and viable.
6. Although the HARRF maintains comprehensive and well-organized records for the entire plant, the written records documenting the April – June 2004, alleged upset conditions are uncharacteristically sparse. During the initial stages of the upset, the operators did not document, either in the log books or any other plant records, unusual changes in the key indicators of toxic load (sudden increase in DO concentrations and the absence of certain types of microorganisms from the activated sludge).
7. Plant process control data indicate that, prior to and during the plant disruption conditions, operators did not have adequate control of the DO concentration in some of the aeration basins. The lack of control might have been caused by a combination of factors, including faulty oxygen probes in the aeration basins, defective or improperly calibrated portable oxygen meter, high levels of sulfides

in the plant influent and a relatively low target (set point) for the DO concentration in the aeration basins.

8. The initial operational adjustments (increase in wasting and decrease in the DO concentration) in response to the perceived toxic load were contrary to the standard industry response to such incidents.
9. The plant operators/management did not respond in a timely manner with an investigation of the effluent violations. If, as they assert, indications of toxic load first became apparent on, or before, April 17, samples should have been collected and analyzed immediately.
10. After indicating that a toxic load caused the effluent violations, the City failed to submit the results of additional testing that would provide the Regional Board with documentation to evaluate that claim.
11. The City's pretreatment program is understaffed and the fact that it is not managed directly by the wastewater treatment department is likely to reduce its effectiveness and efficiency.