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Attorneys for the Town of Carefree

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2006 MAR -9 P 4: 37

AZ CORP COMMISSION
DOCUMENT CONTROL

BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE APPLICATION OF BLACK MOUNTAIN SEWER COMPANY, AN ARIZONA CORPORATION, FOR A DETERMINATION OF THE FAIR VALUE OF ITS UTILITY PLANT AND PROPERTY AND FOR INCREASES IN ITS RATES AND CHARGES FOR UTILITY SERVICES BASED THEREON.	No. SW-02361A-05-0657 **INTERVENING TOWN OF CAREFREE'S NOTICE OF FILING AFFIDAVITS AND EXHIBITS**

The Town of Carefree (the "Town") hereby submits to the Arizona Corporation Commission the following affidavits and exhibits in the above-captioned matter:

1. Affidavit of Stan Francom (*see attached hereto as Exhibit 1)* and its accompanying exhibits referenced in the Affidavit, the Carter Burgess Report (*see attached thereto as Exhibit A)* and the Lamb Technical Services, Inc.'s Report (*see attached thereto as Exhibit B).*

2. Affidavit of Jonathan Pearson (*see attached hereto as Exhibit 2)*

3. Affidavit of Jason C. Bethke (*see attached hereto as Exhibit 3)* and its accompanying exhibit referenced in the Affidavit, the Carter Burgess Report (*see attached thereto as Exhibit A).*

///

This Notice will be supplemented with the original Affidavits. In addition, the Town reserves the right to call Stan Francom, Jonathan Pearson, and/or Jason C. Bethke as witnesses to testify in accordance with their Affidavits included herewith.

RESPECTFULLY SUBMITTED this 9 day of March, 2006.

MOHR, HACKETT, PEDERSON, BLAKLEY & RANDOLPH, P.C.

By _____
Thomas R. Chenal
David. W. Garbarino
Suite 155
7047 East Greenway Parkway
Scottsdale, Arizona 85254
Attorneys for the Town of Carefree

ORIGINAL and 13 COPIES of the foregoing filed this 9th day of March, 2006 with:

Arizona Corporation Commission
Docket Control
1200 Washington Street
Phoenix, AZ 85007

COPY of the foregoing mailed this 9th day of March, 2006 to:

The Honorable Teena Wolfe
Administrative Law Judge
Hearing Division
Arizona Corporation Commission
1200 Washington Street
Phoenix, AZ 85007

Christopher Kempley, Chief Counsel
Legal Division
Arizona Corporation Commission
1200 Washington Street
Phoenix, AZ 85007

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Utilities Division
Arizona Corporation Commission
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///

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Sewer Company

Michael Weaver
General Manager
Black Mountain Sewer Company
111 West Wigwam Blvd., Ste. B
Litchfield Park, AZ 85340

Exhibit 1

AFFIDAVIT OF STAN FRANCOM

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Stan Francom, being first duly sworn upon his oath, deposes and says:

1. I am the Public Works Superintendent for the Town of Carefree (the "Town"). I have held the Public Works Superintendent position with the Town since February of 2005.

2. I have also been employed as General Manager of Carefree Water Company since June of 1999.

3. Before working for the Carefree Water Company I was employed by Western Environmental Technologies, Inc., for five years as a Grade Four Certified Operator and Administrative Manager, which operated the sewer facilities serving the Town. The sewer facilities described in this paragraph are now owned and operated by Black Mountain Sewer Company ("Black Mountain Sewer").

4. My work experiences with the Town, the Carefree Water Company and Western Environmental Technologies, Inc., have given me a thorough understanding of the wastewater collection and treatment operations of the system now operated by Black Mountain Sewer, its facilities, and the odor problems that have been reported by the residents of the Carefree Inn Estates and Boulders Development subdivisions. In addition, I have reviewed and am familiar with the reports regarding the cause of the odors encountered by residents of the Carefree Inn Estates and Boulders Development subdivisions prepared by Carter Burgess, commissioned by the Town and attached hereto as Exhibit A (the "Carter Burgess Report"), and Lamb Technical Services, Inc., ("LTS"), commissioned by Black

Mountain Sewer and attached hereto as Exhibit B (the "LTS Report"). I agree with the recommendations of both the Carter Burgess and LTS Reports.

5. I believe that the odor problems encountered by residents of the Carefree Inn Estates and Boulders Development subdivisions are caused by a combination of many factors, three of which occur as sewer is transported through the Black Mountain Sewer collection and pressure pumping systems.

6. First, Black Mountain Sewer's long retention times for sewage allows odorous gases to build up inside the system. The Carter Burgess Report observed that "[t]he length and design of the [Black Mountain Sewer] collection system make it particularly susceptible to these anaerobic conditions" that produce hydrogen sulfide and other odor producing compounds. Exhibit A at 4-6. Even LTS recognized that "the sewage is quite septic due to the retention time in the force mains and the high wastewater temperatures." Exhibit B at 2. I believe that both the Carter Burgess and LTS reports are correct in these assertions. Retention time is often greater than two hours, Exhibit A at 6, and during that time significant amounts of hydrogen sulfide and other odor producing compounds build up in the Black Mountain Sewer system.

7. Second, after the sewage has been retained for more than two hours and the odor causing compounds have accumulated, Black Mountain Sewer transports the sewage through its pumping system using two six inch pressure flow pipes and then gravity flow pipes to a manhole located at Quartz Valley and Boulder Drive before entering the wastewater treatment facility. As the pumped, septic sewage enters the gravity collections system manhole, at approximately 200 gallons per minute, turbulence results and noxious odors are released. Because of the large quantity of sewage, the gravity flow system

surcharges the gravity collection system causing a piston like affect in the gravity flow piping as the full pipe of sewage pushes the odorous air down the gravity collection system in front of the full pipe of sewage. Black Mountain Sewer has sealed all the manholes which precludes pressurized odors from escaping from the manholes. However the pressurized, odorous air escapes any place it can which makes every individual residential sewer connection, which vent to the atmosphere, an escape route for the odors.

8. Third, at the junction manhole located at Quartz Valley and Boulder Drive the flows from the west part of the Boulders subdivision meets the flows described above and once again turbulence and the release of noxious odors are released from the sewage flow stream.

9. Black Mountain Sewer has attempted to lessen the odor problems in the Boulders Development by adding certain chemicals to the sewage. Nevertheless, the retention time coupled with the hydraulic push still described herein in ¶ 7 cause noxious odors to escape the Black Mountain Sewer system through any possible exit, including vent stacks on residential housing. Moreover, if the effects of the chemicals diminish below a certain level during the retention and transit period, increased sewer odors will occur. The Town still regularly receives complaints from the residents of the Boulders Development and from residents around the Carefree Inn Lift Station.

10. Black Mountain claims that the sewer odors in the Boulders Development is now within legal parameters with respect to hydrogen sulfide. Although, I do not have independent evidence to verify Black Mountain Sewer's assertion, there remains an odor problem at the CIE Lift Station and in the Boulders Development.

11. The Town offered to provide and install a negative air flow filtering system (i.e. a blower or fan) that would be attached to a manhole near the Quartz Valley and Boulder Drive manhole in an attempt to test a proposed solution to the odor problem as recommended by both the Carter Burgess and LTS. This air flow mechanism would create a negative pressure in the sewer system thereby, hopefully, keeping sewer odors from escaping from residential vent stacks. The LTS Report made this suggestion: "a fan generating negative pressures will still most likely be needed at the Quartz and Boulder Drive Location to prevent odors from forced out the local vent stacks." *See* Exhibit B at 5.

12. Black Mountain Sewer rejected the Town's offer.

I declare under penalty of perjury that the foregoing is true and correct

Dated this 9 day of March, 2006.

Stan Francom

SUBSCRIBED AND SWORN to before me
this 9th day of March, 2006.

OFFICIAL SEAL
BEV PETERSON
Notary Public -- State Of Arizona
MARICOPA COUNTY
My Comm. Expires Oct. 7, 2006

Notary Public

My Commission Expires:

10-7-06

Exhibit A

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OCT - 5 2004
Town of Carefree

TOWN OF CAREFREE

FEB 2 3 2006

ODOR CONTROL REVIEW AND RECOMMENDATIONS

OCTOBER 2004

Carter Burgess
3003 N. CENTRAL AVENUE, SUITE 1700
PHOENIX, ARIZONA 85012

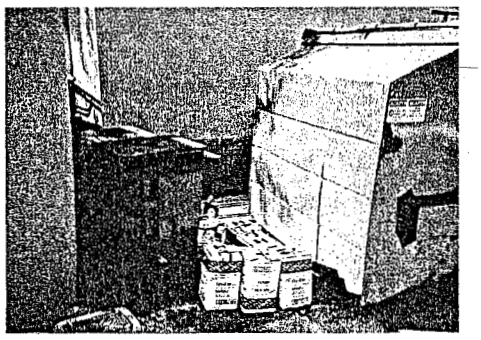
Registered Professional Engineer (Civil)
CERTIFICATE NO.
33976
JASON C.
BETHKE
Date Signed 10/5/04
ARIZONA, U.S.A.

The Town of Carefree has held discussions with Black Mountain Sewer Company (BMSC) regarding sewer odors in their community. In response to numerous resident complaints, BMSC contracted LTS, Inc. to provide an odor study of their collection and treatment system. The LTS study focused on levels of hydrogen sulfide at known problem spots within the BMSC system. Based on the study, BMSC submitted an action plan to the Town of Carefree for approval. The report briefly addresses methods of controlling odors, but does not recommend permanent solutions to stop the creation of odors at the source.

The Town of Carefree is concerned that the LTS recommendations and subsequent BMSC action plan do not represent a definite solution to the Town's odor problem. This study is meant to supplement the LTS report by providing a comprehensive analysis of the available means for preventing, treating and controlling sewer odors in the BMSC system. The main areas of concern, shown in Figure 1, include:

- The Commercial Lift Station and surrounding area;
- The Carefree Inn Estates (CIE) Lift Station and surrounding area;
- The Discharge Manhole near the Intersection of Boulder Drive and Ironwood Road; and
- The BMSC Water Reclamation Facility (WRF) in the Boulders Community.

The Commercial lift station receives sewage from downtown area residences and businesses. The sewage flows through a septic tank and two manholes upstream of the lift station, causing an increased retention time in the system. The sewage is then pumped through two force mains (one 4-inch and one 6-inch) to the CIE lift station. The design flow rate of this pump station is 200 gallons per minute (gpm) as shown on the map provided by BMSC. As noted in the LTS study and shown in the photograph to the right, numerous additional odor sources surround the lift station, including a grease trap and dumpster.

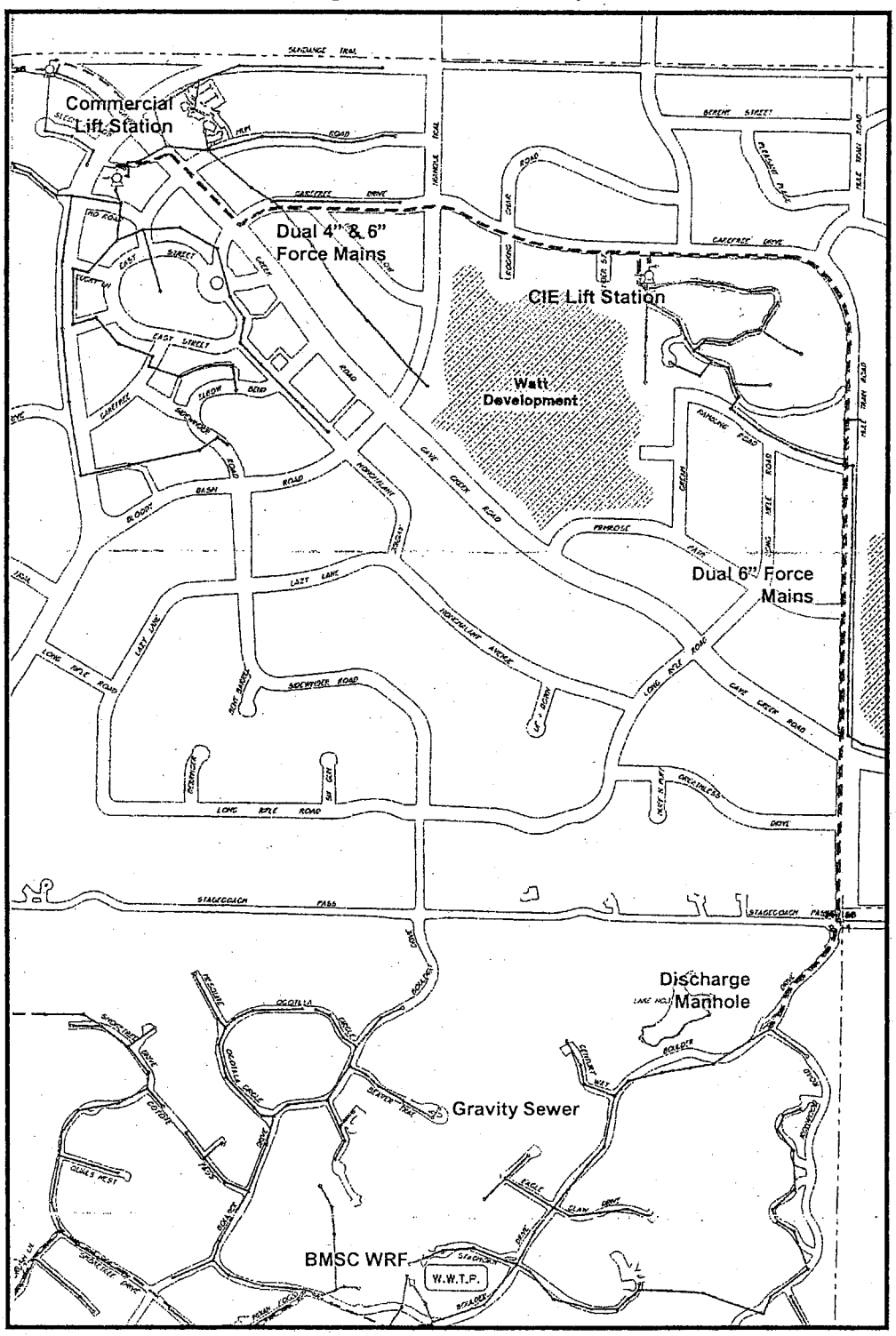


Additional Odor Sources at Commercial Lift Station

As with the Commercial lift station, the wet well at CIE is preceded by a 1000-gallon septic tank and an 8-ft diameter x 12-ft deep manhole directly upstream. In addition to receiving flow from the dual force mains, the CIE lift station collects sewage from the Carefree Inn Estates and the Carefree Airport. The combined sewage is then pumped through dual 6-inch force mains to a manhole near the intersection of Ironwood Road and Boulder Drive in the Boulders Community. Flow exiting this manhole travels by gravity to the BMSC WRF located off Boulder Drive, west of Staghorn Lane. The

design flow rate of the CIE lift station is 250 gpm with one force main open, and 440 gpm with two as shown on the map provided by BMSC. Currently, both force mains are operational.

Figure 1: Location Map



Scale: 1" = 1000'

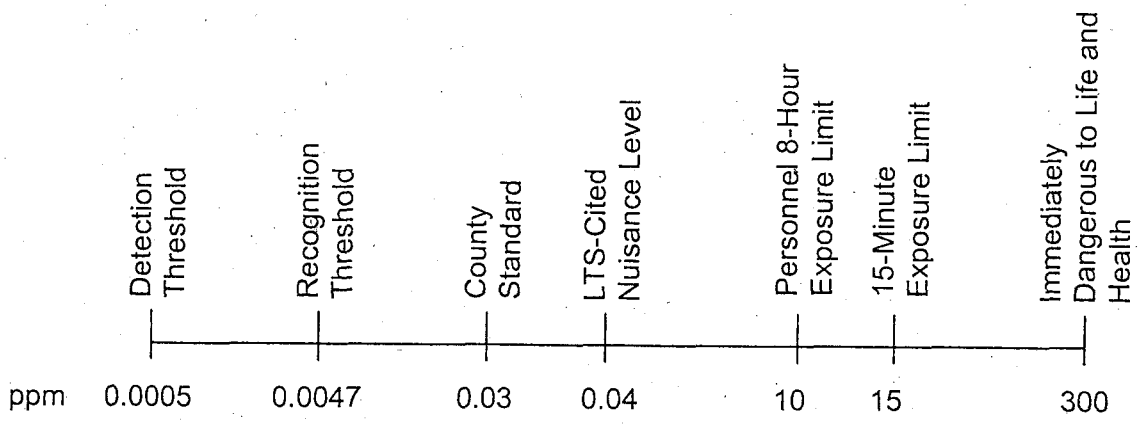
II. Sewer Odors: Types and Causes

All wastewater collection, conveyance and treatment facilities have the potential to emit bothersome odors. The anaerobic conditions associated with collection systems and primary treatment makes these portions of the system particularly problematic. Sulfate-reducing bacteria thrive in anaerobic environments, where no dissolved oxygen is available for respiration. These bacteria use the sulfate ion, which is naturally abundant in most waters, as an oxygen source for respiration. The byproduct of this activity, highly corrosive hydrogen sulfide gas (H_2S), has a strong rotten-egg odor. The gas is released to the atmosphere in areas such as wet wells, manholes and headworks facilities.

In collection systems, most sulfide generation occurs in the slime layer on the pipe wall or in sludge deposits on the pipe invert. The contribution of sulfide from the bulk liquid is relatively small. If the wastewater contains dissolved oxygen (DO), an aerobic slime layer exists closest to the bulk wastewater. Therefore, even if sulfide is generated in the anaerobic layer closer to the pipe wall, it is biologically oxidized as it passes through the aerobic layer. However, if this aerobic layer does not exist, as in the case where wastewater contains little or no DO, sulfide can diffuse into the bulk wastewater.

Odor is measurable using objective, scientific methods. Four objective parameters of perceived odor include concentration, intensity, persistence and character descriptors. Additional measurable but subjective parameters of odor perception include hedonic tone (pleasantness vs. unpleasantness), annoyance and strength. These parameters are subjective because they are reported by individuals who must rely on their interpretation of word scales and their personal feelings, beliefs, memories, experiences and prejudices. Guidelines and legal definitions of subjective odor parameter scales can often assist individuals in reporting observed odor; however, the nature of these parameters remains subjective. The values presented in Figure 3 are commonly used to describe levels of human exposure to H_2S.

Figure 3: Hydrogen Sulfide Concentration Scale



As shown in Figure 3, the LTS study cited the H_2S nuisance level as 0.04 ppm; however, the recognition level is an order of magnitude lower. Due to the subjective nature of individual response to odor stimuli, it is difficult to determine what level of prevention and control will be sufficient to satisfy the community. It is possible that an emission that meets county standards could result in an odor complaint. The goal of the Town of Carefree is not to reach a predetermined H_2S level, but to maintain a sewer system that results in no resident complaints. Therefore, this study will present odor control measures in order of cost and ease of implementation, under the premise that if BMSC succeeds in eliminating further complaints after instituting one or more of the recommended measures, more costly methods may not be required.

In addition to H_2S, several other odor-producing compounds exist in typical wastewater. These include organic sulfides; mercaptans; nitrogen compounds including ammonia and amines; acids such as acetic and butyric; and acetaldehyde. Not all odor control technologies are efficient at removing the full array of odor-producing compounds. This study will focus primarily on odor control technologies for H_2S removal, since this was determined to be the main problem in the LTS study. Where available, information regarding removal efficiencies of other compounds will be cited for specific odor control technologies.

Retention Time

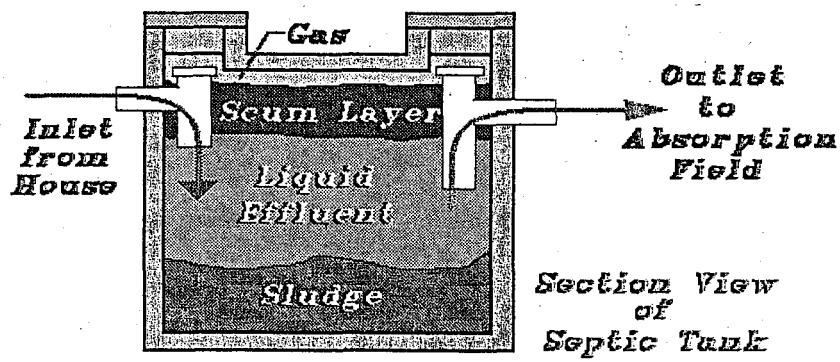
H_2S production requires an anaerobic environment, typically resulting from long retention times in the collection system. The length and design of the BMSC collection system make it particularly susceptible to these anaerobic conditions. Identified main contributors to the creation of H_2S in the BMSC system are:

- The existence of upstream septic tanks at the two largest lift stations;
- The existence of one or more manholes upstream of these lift stations;

- The long pump cycle times; and
- The dual force mains leaving both pump stations.

Septic tanks are anaerobic digesters by design. As shown in Figure 2, in a typical domestic application, the tank would accept raw sewage from the house; over time the sludge settles out and the scum floats to the top, leaving a clarified effluent. The sludge and scum are retained for further treatment. The issue that arises from the presence of a septic tank in the collection system is that it yields anaerobic sewage. Furthermore, it is likely that the septic tanks upstream of the pump stations are full of sludge, so that anaerobic sludge is flowing into the pump station, rather than clarified liquid.

Figure 2: Typical Septic Tank Installation



From Septic Information Website (http://www.inspect-ny.com/septbook.htm)

In addition to the retention time provided by a septic tank, the Commercial lift station combines the wet well and two upstream manholes, resulting in increased retention time between pump cycles. A manhole is also located upstream of the CIE lift station. The long residence time created by the additional manholes and septic tanks results in an anaerobic environment and sewage high in H_2S concentration. The manholes also provide additional areas for the hydrogen sulfide gas that is generated to escape to the atmosphere.

Lift station pumps are designed based on peak flow, wet well capacity and allowable pump cycle time. The pump cycle time is the time between pump starts, or the time it takes the wet well to fill plus the time it takes the pump to empty it. Typical pump cycle times are 4 to 6 minutes, or 10 to 15 cycles per hour. Longer pump cycle times are desirable because they result in longer pump life and lower electrical costs. However, in wastewater applications, it is ideal to use the shortest pump cycle time recommended by the pump manufacturer to cut down on the wet well residence time and the potential for anaerobic conditions. While observing the CIE lift station, a pump run time of 3 minutes, 40 seconds was noted. Based on a design pumping rate of 440 gpm, over 1600 gallons

of sewage must accumulate in the wet well and upstream manhole between pump cycles. During periods of low flow, this provides more than sufficient time for the sewage to turn septic.

All force mains in a sewer collection system should be designed to provide velocities between 2 and 5 feet per second (fps). Velocities below 2 fps allow solids in the pumped fluid to settle out. Based on the design pumping rates at the Commercial and CIE lift stations, the velocity from Commercial to CIE is 1.1 to 2.5 fps, and from CIE to the effluent manhole is 2.5 fps. As shown in Figure 1, each of the force mains from the Commercial to the CIE lift station is approximately 3,500 feet long. From CIE to the effluent manhole, the force mains are approximately 6,000 feet long. Based on capacity of the force mains[1], the Commercial lift station must pump 7,420 gallons before the lines discharge into the CIE station. The pumps must cycle over 10 times[2] for the flow to reach the CIE station, therefore, the retention time in the force main is well over two hours.[3] At least 17,640 gallons (or 11 pump cycles) must be pumped from the CIE lift station prior to exiting the force mains; resulting in a mean residence time in excess of two hours.[3]

As verified by the LTS study, the long residence times observed in the BMSC collection system, which are exacerbated by the four items discussed above, result in exceptionally high H_2S levels. At the Commercial lift station, H_2S levels reach 102 parts per million (ppm); the CIE lift station reaches 101 ppm H_2S with no chemical addition at the Commercial lift station, or 24 ppm with the addition of Thioguard. Hydrogen Sulfide levels at the force main discharge location were found to be 700 ppm.

Reducing retention time in a collection system is not always feasible; therefore several odor control technologies exist.

III. Primary Types of Odor Control Technologies

The many technologies available to control odors from wastewater collection and treatment systems can be divided into two categories: vapor-phase and liquid-phase. Vapor-phase technologies are used to control odors in air or gas, and are typically used in point source applications including wastewater treatment plants and pump stations. Liquid-phase technologies are used to control odors in wastewater and typically are used in collection systems where controlling odors and corrosion over a widespread area is necessary and multiple-point odor control may be required.

[1] A 4-in force main has a capacity of 0.65 gallons per linear ft; a 6-in main has a capacity of 1.47 gallons per linear ft.
[2] Assumes a pump run time equal to CIE Lift Station (3.67 minutes)
[3] Assumes pump cycle time of 11 minutes

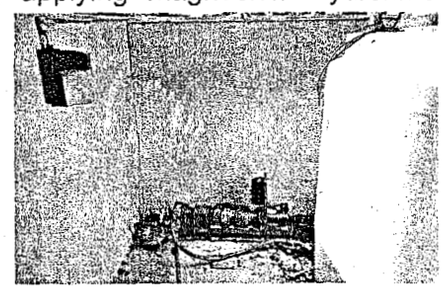
A. Liquid Phase Odor Control Technologies

Liquid-phase odor control technologies include pH adjustment, air and oxygen injection, chemical oxidation, nitrate additions, iron salts and biological controls. A discussion of each of the methods follows, including maintenance and performance issues.

1. pH Adjustment

The pH of wastewater has an important role in determining the amount of H_2S gas available for release to the atmosphere. At pH 6.0, over 90% of dissolved sulfide is present as dissolved gas; at pH 8.0, less than 10% is available as gas. Therefore, a decrease of one pH unit can significantly increase the release of H_2S gas, causing odor and corrosion problems. There are two approaches to controlling pH in sewer collection systems. One approach involves continuous pH adjustment to hold H_2S in solution; the second involves using intermittent slug doses of caustic to inactivate the slime layer and minimize sulfide generation.

Several base chemicals can be used to provide continuous pH adjustment, including calcium hydroxide or lime ($Ca(OH)_2$), magnesium hydroxide ($Mg(OH)_2$), and sodium hydroxide or caustic (NaOH). Studies have shown that the less soluble characteristics of magnesium hydroxide result in a timed-release effect that is particularly valuable in collection system applications. BMSC is currently applying magnesium hydroxide (Thioguard) at the Commercial Lift Station. The product is effective as long as the increased pH in the wastewater is maintained. As additional flows are encountered, including the CIE lift station where gravity mains from the airport and Carefree Inn Estates also feed the wet well, the pH is reduced, thereby decreasing the effectiveness of the chemical addition.



Chemical Addition Equipment at the Commercial Lift Station

Periodic slug dosing with caustic can effectively remove all sulfide forms. It is not added to shift the equilibrium, but to kill the biological slime layer that reduces sulfate to sulfide. Exposure to high pH levels will destroy the slime layer and cause it to slough. The slime layer will immediately begin to reform, but it may take days or weeks to reach full sulfide production again. The time required for slime layer regeneration after slug dosing is a function of pH, temperature and time of contact.

Lime and sodium hydroxide are the typical chemicals of choice for slug dosing due to their quick solution time, which maximizes contact time. Caustic slugging can adversely

affect pH-sensitive treatment processes and effluent discharge limits, necessitating equalization basins to receive the caustic slug for slow release to the treatment facility. Because of this added maintenance requirement, caustic slugging is not used as often as continuous dosing, and is not recommended for the BMSC system.

2. Air and Oxygen Injection

Most odor production in wastewater can be prevented if a minimum DO concentration of 0.5 to 1.0 mg/L is maintained. As previously discussed, because it is difficult to maintain oxygen concentrations naturally, supplemental sources of oxygen may be used. Wastewater oxygen levels may be increased through the addition of air, oxygen or chemicals containing bound oxygen, such as nitrate (NO_3) or hydrogen peroxide (H_2O_2) (see Chemical Oxidation and Nitrate Addition, below).

Air is a readily available source of oxygen that has been used to successfully control odors in gravity sewers and force mains. Air will not completely dissolve in water at normal pressures, resulting in the release of some residual gases. If odorous compounds are present in the wastewater at the point of air injection, odors will diffuse into undissolved air and escape to the atmosphere, sometimes causing increased odor. Depending on the method of air injection, turbulence can also release odors, thereby worsening the problem. Due to this potential to intensify odor production, the addition of air for odor control is not recommended for use in the BMSC system.

The addition of pure oxygen to improve DO levels and reduce odors has been in use for over 20 years. Oxygen has a major advantage over air when added to wastewater because it is five times more soluble in water, resulting in a smaller volume of gas required to achieve equal oxygen transfer. Reductions in biochemical oxygen demand (a measure of oxygen being consumed by microorganisms breaking down organic matter) have also been reported following installation of oxygen injection equipment. Oxygen can either be generated on-site for requirements greater than 2,000 pounds per day (lb/d) or purchased commercially and delivered by truck for lesser quantities.

3. Chemical Oxidation

Chemical oxidants attack and destroy odor-causing compounds through chemical reactions. Although some of the chemicals in this category contain oxygen as part of their molecular structure, their primary action is to chemically react with the odorous compound in the dissolved form rather than release oxygen for use by bacteria. Chlorine, hypochlorite and hydrogen peroxide are examples of chemical oxidants.

Chlorine is relatively inexpensive and powerful, and the necessary equipment to administer it is widely available. It is obtainable as pure gas, hypochlorite solution, or hypochlorite granules or tablets. Chlorine gas is commonly used at wastewater treatment facilities for disinfection, but storage and handling requirements make it less desirable for collection system odor control. Hypochlorite solutions are much safer to use for collection system applications and the equipment is relatively simple to operate and maintain. Negative aspects of chlorine addition include its indiscriminate oxidation of any reduced compound in wastewater, necessitating overfeeding to ensure complete sulfide oxidation (typically 5 to 15 parts chlorine to each part sulfide). Depending on point of application and dosage, chlorine can kill organisms beneficial to wastewater treatment processes, resulting in process upset. Also, the reaction between chlorine and wastewater can produce potentially toxic and carcinogenic compounds, which may impart their own objectionable odors.

Hydrogen peroxide is commonly used to oxidize H_2S to sulfur or sulfate depending on the pH of the wastewater. Most wastewater applications theoretically require 1 part peroxide per part hydrogen sulfide; however, like other oxidants, peroxide reacts with other organics in the wastewater, so higher dosages (typically 2 to 4 parts peroxide to 1 part sulfide) are required. Peroxide is fast-acting, making it suitable for injection immediately upstream of problem locations. However, it is also quickly consumed, requiring multiple injection sites for treatment in collection systems. The maintenance and repair of H_2O_2 systems require special training; therefore, feed systems are often contract-operated by suppliers.

4. Nitrate Addition

Nitrate addition controls sulfide through two reaction mechanisms: prevention and removal. Nitrate is added to fresh wastewater as a substitute source of oxygen, preventing the reduction of sulfate to sulfide. Anaerobic bacteria responsible for odor and sulfide generation use dissolved oxygen, nitrate and sulfate as oxygen sources, in that order of preference. Dissolved Oxygen and nitrate, available in minimal quantities in typical wastewater, are quickly depleted, allowing bacteria to consuming oxygen from sulfate and causing odor and corrosion problems. When nitrate is added to wastewater, the bacteria consume it instead of sulfate, resulting in the production of nitrogen gas rather than sulfide.

Nitrate can also be added to wastewater to remove dissolved $H_2S$by a biochemical process, which converts the sulfide to sulfate. The nitrate supplies oxygen to bacteria present in wastewater to metabolize H_2S. The removal reaction is a biochemical process, and as such, may require a reaction time of one to two hours for optimum

performance. However, the removal mechanism requires one-third the amount of nitrate as the prevention mechanism. Due to its long reaction time, nitrate addition for sulfide removal may be ideally suited for BMSC collection system application.

Nitrate is typically available as an aqueous solution of calcium nitrate containing varying concentrations of nitrate-oxygen. Nitrate is one of the safest sulfide control chemicals to handle, with most nitrate salt solutions considered to be nonhazardous substances. Nitrate can be injected into force main discharges or directly to pump station wet wells.

5. Iron Salts

Iron salts combine with dissolved sulfide to form relatively insoluble precipitates. The precipitates are black or reddish-brown floc particles that do not deposit in the collection system, but readily settle with other solids at the treatment plant. Four types of iron salt solutions are commercially available: ferrous sulfate, ferrous chloride, ferric sulfate and ferric chloride. The addition of sulfate-based salts is typically not a concern in wastewater systems because sulfate is present in excess and sulfide generation is not increased significantly. The amount of ferric (Fe^{+++}) salts required for reaction with sulfide is typically slightly less than the amount of ferrous (Fe^{++}) salts required to precipitate an equal amount.

Iron salts are fast-acting and may be injected just upstream of a treatment plant to remove sulfide before the headworks facility, or added upstream in the collection system to realize greater odor and corrosion control. Unlike oxidants, iron salts do not react with organic materials in the wastewater; therefore, they can be overdosed at one upstream location to treat long stretches in a collection system. Regardless of the amount added, iron precipitates will remain suspended in the collection system, and will not form deposits. The iron precipitate adds to the overall solids production at the treatment facility, with the volume dependent on the amount of sulfide treated. The increase in solids generation typically does not exceed 5% of the plant's overall solids production.

Ferrous sulfides have been shown to only allow control of H_2S to 0.05 to 1 mg/L. In most cases, this level of treatment is satisfactory to prevent odors and corrosion; however, in areas of turbulence, H_2S release may still be a problem. Furthermore, in areas of pH depression, such as anaerobic waste streams in which the pH drops below 6.5, ferrous sulfide partially dissociates and may release sulfide to the wastewater. Since areas of turbulence (such as drop manholes and force main discharges, and dilution of high-pH flows from the Commercial lift station with low-pH anaerobic flows) are believed to be occurring at the CIE lift station, the addition of iron salts is not recommended without further testing to verify satisfactory pH values.

6. Biological Controls

Numerous biological controls on the market are purported to control sulfide and odor in collection systems. One available product alters the metabolism of the existing bacteria in the slime layer, so they no longer reduce sulfate. The product is only effective as a preventive measure, and has therefore been applied in conjunction with nitrates to perform removal. Other products composed of specially developed bacteria that are intended to replace the existing bacterial slime layer have not been shown to provide effective treatment in full-scale applications. Due to the experimental nature of biological controls, they are not recommended for use in the BMSC system, without full-scale testing prior to implementation.

B. Vapor-Phase Odor Control Technologies

Liquid-phase treatment can significantly reduce sulfide formation and release in collection systems; however, in highly turbulent locations, even trace amounts of sulfide can yield H_2S concentrations high enough to cause odor and corrosion issues. Treatment units include packed tower scrubbers, activated carbon units, biofilters and ionization. Considerations for residential areas include noise reduction for fans and pumps and shorter stacks to maintain visual aesthetics.

1. Packed Tower Scrubber

Packed tower scrubbers have been used for numerous applications and have demonstrated good performance. They offer high-efficiency removal in a compact footprint, and several manufacturers provide low-profile systems ideal for residential applications. Disadvantages for wet scrubbers include the use of chemicals and potable water, which require additional space and maintenance considerations such as chemical storage tanks, pumps and drive space for delivery trucks. Due to the increased maintenance requirements associated with this type of vapor-phase treatment, packed tower scrubbers will be considered mainly for use at the BMSC WRF.

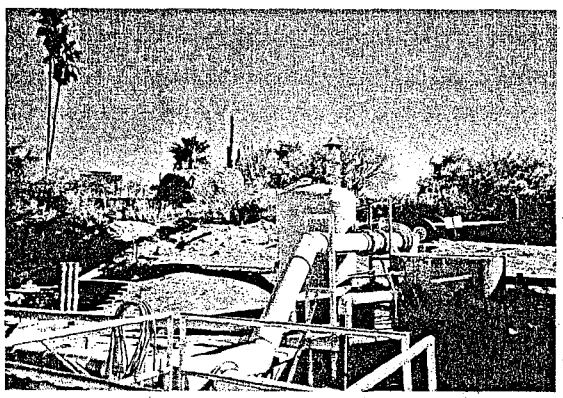
2. Activated Carbon Units

Activated carbon units are well-suited for many treatment and collection system applications. Although larger than wet scrubbers, they do not require chemicals, resulting in a similar overall footprint. Because no chemicals are involved, fewer security concerns arise from outdoor installation of carbon units. Carbon inserts are available for manholes, but are only suitable for low strength odors due to the small amount of carbon. A major maintenance concern associated with carbon units is the rapid media

depletion that results at high H_2S levels. An available water washable media is projected to last over two years at H_2S levels of 10 ppm; however, regeneration is required every six months. The vendor has developed a replaceable canister system that allows for sequential washing, while the remaining units are still in service. The low pH discharge of the canister unit is a concern for collection system applications, requiring neutralization to avoid damage to pipelines during low flow periods. A low cost neutralization system has been developed to address this concern.

3. Biofilters

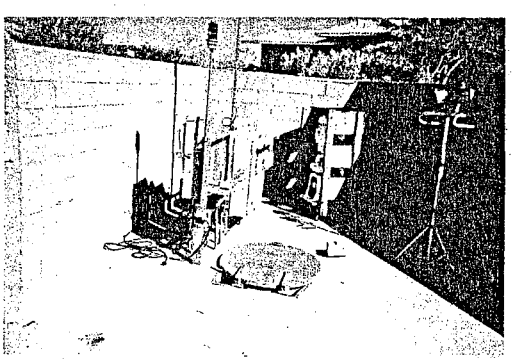
Traditional biofilters require considerably lower velocities than wet scrubbers and carbon units, and therefore occupy a larger footprint. Where adequate space is available, biofilters offer simple operation with no chemical addition, low operation costs and no hazardous materials to dispose. However, biofilters carry an intrinsic earthy odor, which may be detected by nearby residents. Several vendors have developed enclosed systems that may be better suited for collection system applications and treatment works located in residential areas, such as the BMSC WRF. The units have a high-velocity stack discharge, so any residual odor is well dispersed.



View of nearby residence from BMSC WRF Aeration Basins

4. Ionization

Ionization technology involves the use of ion tubes with an alternating current to produce negative and positive ions and form clusters of oxygen molecules. While other vapor-phase technologies treat the exhaust air prior to discharge, ionization treats the supply air. The ionized air disassociates a variety of gaseous compounds and has been shown to effectively treat H_2S, ammonia and a wide range of other odorous compounds. Benign end products such as carbon dioxide, nitrogen and water vapor are formed. Typical treatment involves injecting enough treated air to form a layer above the foul air in wet wells and manholes. Ionization tubes require cleaning once



CIE Lift Station with Residence in Background

every two to three months. Reported case studies include installation of an ionization system at a pump station within 50 ft of a residence, which produced consistent odor complaints prior to installation. No odor incidents have occurred since system startup, indicating this technology might be helpful for the BMSC system.

IV. Proposed Odor Control Projects

Following completion of the LTS study, BMSC submitted an action plan to correct the sewer odor issue to the Town of Carefree. The action items include the following:

- Water Reclamation Facility
  - Install Fan Cover
  - Install Louvers
  - Install New Grating
  - Install Sound Material
- Sage Brush Lift Station
  - Install Chemical Feed

Although these actions will help to reduce the odors emitted from the collection and treatment system, they do not represent all items covered by the LTS study. Based on the findings of this report and the LTS study, Carter & Burgess has prepared a list of proposed odor control projects. The projects are categorized as general, preventive measures, liquid phase treatment and vapor phase treatment. Approximate implementation costs are provided with each project description.

• General

- **G1 – Community Feedback Website**

  Create and maintain a website at which Town of Carefree residents can view information about causes of sewer odor; current odor control projects in the community; and measures accomplished to date. The website should include a form that residents can complete and send electronically to issue a complaint. The form should contain the date, time, nature and location of the odor, and the complainant's name, at a minimum, and should be routed to BMSC and the Town Council. Keeping the community informed of improvement measures and providing a constructive means of informing BMSC of problem spots will facilitate better relations between BMSC and the community.

  Implementation Cost: $20,000

- ## Preventive Measures

  - **P1 – Grease Trap Policy and Enforcement**
    Institute a policy under which all restaurants are required to maintain a grease trap. This will reduce the amount of grease dumped into the sewers, thereby reducing secondary odors and pipe cleaning costs.
    Implementation Cost: $4,000

  - **P2 – Sewer Cleaning Program**
    Institute a regular sewer cleaning program in which all pipes in the collection system are jetted. This will reduce sewer odors by eliminating the slime buildup on the pipe wall.
    Implementation Cost: $6 per linear foot of pipe

  - **P3 – Demolish Septic Tanks and Manholes at Lift Stations**
    Replace the septic tank and manholes upstream of the Commercial and CIE lift stations with pipe. Demolition of the septic tanks will remove a major contributor to anaerobic conditions in the collection system. Removal of the manhole(s) will reduce the effective size of the lift station wet well, reducing hydraulic residence times. Both actions will result in less potential for the sewage to turn septic and produce H_2S odors.
    Implementation Cost: $200,000

  - **P4 – Redesign Lift Stations**
    Redesign the Commercial and CIE lift stations, including cleaning and plugging one of the force mains exiting each pump station (4-in leaving Commercial and 6-inch leaving CIE); modifying the wet well size and/or level controls to reduce residence time; and replacing the pumps to decrease pump cycle time. These actions will reduce retention time in the wet wells and force mains, thereby decreasing the likelihood of sulfide generation.
    Implementation Cost: $500,000

- **P5 – Collection System Capacity Evaluation**

  Prior to performing any additional reconstruction within the collection system, a system-wide capacity evaluation should be performed to resolve conflicting capacity information cited in correspondence between the Town of Carefree and BMSC (see Appendix B). The capacity evaluation will verify any locations experiencing siphons or surcharging of gravity mains, and confirm which portions of the system are producing odors due to turbulence and other rectifiable design features. This evaluation will validate the necessity of the following proposed action items:

  - Redesign influent manhole at Quartz Drive and Boulder Drive to eliminate turbulence causing the escape of H_2S;
  - Redesign gravity line and discharge manhole at Ironwood Road and Boulder Drive to prevent surcharging lines and positive pressures; and
  - Extend CIE force main to plant to eliminate odor issues at discharge manhole at Ironwood Road and Boulder Drive.

  Implementation Cost: $150,000

• Liquid Phase Treatment

- **L1 – pH Control**

  Add Thioguard (Magnesium Hydroxide) to CIE and discharge manhole at Ironwood Road and Boulder Drive intersection. Maintaining a pH of 8.3 to 9.0 in the sewer will keep over 90% of present sulfide in suspension, reducing H_2S odors.

  Implementation Cost: $50,000 capital cost + $45,000 annual cost

- **L2 – Preventive Nitrate Addition**

  Add calcium nitrate feed at the Commercial lift station, causing anaerobic bacteria to consume the nitrate-oxygen instead of sulfate-oxygen and thereby decreasing sulfide production.

  Implementation Cost: $45,000 + $60,000 annual cost

- **L3 – Nitrate Addition for Removal**

  Add calcium nitrate feed at the CIE lift station, allowing hydrogen sulfide to be reincorporated into the bulk wastewater as sulfate. The one to two hour reaction time is provided in the force main, reducing odors at the downstream discharge manhole.

  Implementation Cost: $45,000 capital cost + $45,000 annual cost

- **L4 – Pilot Study**

  Due to the potential for process upset and/or additional odor generation, the following technologies are proposed, but are not recommended for implementation without a pilot study to verify their odor removal efficiencies.

  - Oxygen Addition
  - Hydrogen Peroxide
  - Iron Salts

  Implementation Cost: $150,000

• Vapor Phase Treatment

- **V1 – Seal Manholes**

  Seal manholes to prevent positive pressures in the system from causing odors to escape through manhole covers. However, it should be noted that if H_2S forms, it will escape; therefore, if all manholes are sealed, odors will back up into residents' vents.

  Implementation Cost: $250 per manhole

- **V2 – Residential Vent Carbon Filters**

  Install carbon filters on residential vents to intercept and treat odorous emissions. Replacement carbon packs are required when carbon is spent; replacement frequency is dependent on quantity and concentration of odors.

  Implementation Cost: $60 per vent + $30 per replacement

- **V3 – H_2S Monitor**

  Install a low-level monitor at the fence line of the wastewater treatment plant to track concentration and frequency of odors escaping from the facility. Provide additional monitors as needed to adequately record odors at problem spots in the collection system. Monitors are portable, so monitoring locations can be moved as odor issues are resolved. Sycamore Technologies' low-level indicator is accurate from 10 ppb to 2 ppm and should be used at the plant fence line; their traditional model displays H_2S levels from 0 to 200 ppm and may be required at problem spots with high concentrations.

  Implementation Cost: $4,000 per monitor, including weatherproof housing and computer software

- **V4 – Seal Aeration Basins**
  Seal the cutouts in the aeration basins with aluminum checker plate tohelp prevent odor emissions and create a negative pressure beneath the covers.
  Implementation Cost: $50,000

- **V5 – Wet Scrubber at WRF**
  Add a dual-stage scrubber to known odor producing areas to sufficiently reduce odor production and ensure negative pressures in problem areas such as the headworks facility, aeration basins and influent manhole.
  Implementation Cost: $300,000 + $150,000 annual cost

- **V6 – Carbon Units at Lift Station or Manhole**
  Carbon units ensure that any escaping odors will be treated before reaching residents. Where carbon units exist, add a fan to increase negative pressures in manhole and flow through carbon.
  Implementation Cost: $50,000 + $4,000 annual cost

- **V7 – Wet Scrubber at Lift Station or Manhole**
  Add a dual-stage scrubber to known odor producing lift stations and wet wells to reduce odor production and ensure negative pressures.
  Implementation Cost: $110,000 + $18,000 annual cost

- **V8 – Ionization**
  Ionization will help to reduce odors escaping from sewers by treating all air in the headspace, or by adding a layer of treated air over the existing H_2S. Larger systems are also available for treatment facilities, if required.
  Implementation Cost: $85,000 + $3,000 annual cost

V. Recommended Short Term Projects

Carter & Burgess has arranged the proposed projects in the recommended order of implementation. It is recommended that the projects shown in Table 1 be implemented within three months. It should be noted that projects have been ordered in consideration of ease of implementation, likelihood of solving or helping to resolve odor issues, capital costs, operation and maintenance costs and ease of maintenance. Estimated capital cost associated with implementing each project is shown. These are in addition to the BMSC proposed projects, and those recommended in the LTS study are noted in the table.

Table 1: Recommended Short Term Odor Control Projects

Project Designation	Project Description	Estimated Implementation Cost
G1	Community Feedback Website	$20,000
P1	Grease Trap Policy and Enforcement	$4,000
V1	Seal Manholes (LTS)	$250 per manhole
V2	Residential Vent Carbon Filter	$60 per vent
V3	H_2S Monitor (LTS)	$4,000
V4	Seal Aeration Basins (LTS)	$50,000
P2	Regular Sewer Cleaning Program	$6 per linear foot of pipe
L1	pH Control	$50,000

VI. Recommended Long Term Projects

Projects that will take more than three months to implement are shown in Table 2. Proposed projects are arranged in the recommended order of implementation. BMSC should proceed with project implementation until odor complaints cease.

Table 2: Recommended Long Term Odor Control Projects

Project Designation	Project Description	Estimated Implementation Cost
P3	Demolish Septic Tanks and Manholes at Lift Stations	$200,000
P4	Redesign Lift Stations	$500,000
P5	Collection System Capacity Evaluation	$150,000
V5	Wet Scrubber at WRF (LTS)	$300,000
L2	Preventive Nitrate Addition	$45,000
L3	Nitrate Addition for Removal	$45,000
V6	Carbon Units at Lift Station or Manhole (LTS)	$50,000
L4	Pilot Study	$150,000
V7	Wet Scrubber at Lift Station or Manhole	$110,000
V8	Ionization	$85,000

VII. Recommended Projects by Ascending Capital Cost

Table 3 lists recommended projects in order of ascending capital cost. It should be noted that projects with the lowest capital cost might have associated operational/maintenance costs.

Table 3: Recommended Projects by Ascending Capital Cost

Project Designation	Project Description	Estimated Implementation Cost
P2	Regular Sewer Cleaning Program	$6 /LF
V1	Seal Manholes	$250/manhole
V2	Residential Vent Carbon Filter	$60/vent
P1	Grease Trap Policy and Enforcement	$4,000
V3	H_2S Monitor	$4,000
G1	Community Feedback Website	$20,000
L2	Preventive Nitrate Addition	$45,000
L3	Nitrate Addition for Removal	$45,000
V6	Carbon Units at Lift Station or Manhole	$50,000
L1	pH Control	$50,000
V4	Seal Aeration Basins	$50,000
V8	Ionization	$85,000
V7	Wet Scrubber at Lift Station or Manhole	$110,000
L4	Pilot Study	$150,000
P5	Collection System Capacity Evaluation	$150,000
P3	Demolish Septic Tanks and Manholes at Lift Stations	$200,000
V5	Wet Scrubber at WRF	$300,000
P4	Redesign Lift Stations	$500,000

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APPENDIX A

LTS, INC. ODOR CONTROL STUDY

LTS, INC.
5102 SOUTH FERN COURT
CHANDLER, AZ 85248

Odor and Hydrogen Sulfide Monitoring Specialists Since 1991

TOWN OF CAREFREE

SEWAGE COLLECTION AND CONVEYANCE SYSTEM

AND BOULDERS WATER RECLAMATION FACILITY

ODOR AND HYDROGEN SULFIDE

PHASE 2 STUDY

Performed for Black Mountain Sewer Company

Final Draft Report

July 28, 2004

Lamb Technical Services, Inc. 5102 South Fern Court, Chandler, AZ 85248 Phone 800-609-2635 / 480-802-2789 Fax 480-802-2790 elambits@aol.com

EXECUTIVE SUMMARY

Background

On March 12, 2004, Black Mountain Sewer Company (BMSC) requested that Lamb Technical Services, Inc. (LTS) review the current condition, relevant to odor control of the sewage collection and conveyance system and the associated treatment plant located in The Boulders development in Carefree, AZ. The odor situation that BMSC inherited eighteen months ago has been an ongoing problem for the community for some period of time.

LTS and Joel Wade, Engineering Manager for BMSC, spent the morning reviewing the condition of each area, and a detailed explanation of past odor problems was presented to LTS. BMSC also discussed some of the short-term solutions that had been implemented to reduce or eliminate past odor emission problems, which the residents had been experiencing in many areas of Carefree. The Phase Two study is designed to perform a thorough odor evaluation by providing hydrogen sulfide (H_2S) data at multiple sewer line, fenceline and in-plant locations and the associated risks of odor emissions from each location. LTS was also asked to recommend any further action that Black Mountain Sewer Company may implement to further reduce the odor emissions from the treatment facility and its associated collection lines.

Phase 2 Data Review

Collection Lines and Pump Stations

During Phase 1, LTS visited the Commercial Pump Station off Tom Darlington Way, and the Carefree Inn Estates (CEI) lift station on Carefree Drive. LTS also visited a number of collection line locations that had been odor sources in the past including the Staghorn Drive area and the Boulder and Quartzite Drive area. Based on the initial review, fifteen locations were identified and evaluated for hydrogen sulfide and odor emissions, and one location was evaluated for ammonia emissions. Additionally, low-level hydrogen sulfide fenceline monitors were installed at the four sides of the wastewater treatment facility as well as one on the wall northeast of the CIE lift station. All of the locations were monitored in two five-day periods. During testing, four of the hydrogen sulfide monitors failed -- one at the headworks, one in the influent channel, and one at the southeast plant fenceline location during the first week of testing; and the second week of testing, one meter failed at the Century and Boulder Drive force main discharge location. Two of the meters were owned by BMSC and two were owned or rented by LTS. The graphs for the first two collection line locations can be seen with no hydrogen sulfide values and the meter constantly reading zero. One fenceline monitor did not record data on the southwest corner of the treatment facility.

During the second week of testing only one meter failed to operate properly, and no data were recorded at the Century and Boulder Drive location due to the failed meter. Repeat testing over the two-week period rendered the missing data irrelevant, as each location had at least five days of data collected at each location, which provided adequate information to determine what was needed for better odor control at the wastewater treatment plant and within the collection lines and pump stations.

Collection Lines and Pump Stations, Continued

The pump stations and the collection lines were found to have relatively high sulfides at all of the force main discharge locations, and at the influent of the treatment facility. This indicates that the sewage is quite septic due to the retention time in the force mains and the high wastewater temperatures.

Two of the smaller gravity line locations were found to be without flow in the summer: one test location was approximately ¼ mile upstream of the treatment plant on Quartz Drive, and the other was at the end of a Staghorn Drive. Without flow, these two locations had very low concentrations of hydrogen sulfide and no positive pressures. These two locations did not appear to be a significant source of odors during the summer. These conditions could be different with increased flow in the winter when more residents are in Arizona. This area should be evaluated again in the winter months to determine if the conditions within the gravity lines create an odor source that is not found in the summer months.

The gravity line test data on Staghorn Drive, and upstream on Boulder Drive determined that these locations were low-risk locations for odor emissions, and do not generally pose much of an odor emission problem in the summer. The hydrogen sulfide concentrations were always under 1 PPM and readings with the more accurate Jerome 631X were always under 0.15 PPM. Even though these locations are generally not a problem, unusual events such as blockages could make these locations vent odors into the ambient air, or additional flow in the winter could cause the same condition.

The main odor and sulfide producers are the wetwell/force main locations. This is typical in many wastewater systems and has been a problem for many locations across Arizona. Unfortunately, with the type of terrain found at the Boulders, force mains are required to move the sewage over the high points in the area. There are a number of treatment options to control hydrogen sulfide generation and odor releases in these types of systems, and most of them work with relatively good results. The product that BMSC is using is magnesium hydroxide, (brand name Thioguard). The product is designed to increase the pH of the wastewater, which keeps the sulfides in solution as long as the pH is above 8.5. It also provides some oxygen to the wastewater to oxidize the sulfides. The high pH that the product provides keeps the sulfides in solution and makes it difficult for them to be released into the headspace of the collection lines and at the wetwells. The two locations where the product provides the greatest benefit from chemical treatment are the CIE force main discharge location at Century and Boulder Drive, and at Boulder and Quartz Drive. Both of these locations are just before the sewer treatment facility and have had significant odor emissions in the past.

The use of the magnesium hydroxide at the Commercial lift station (that runs through the CIE lift station) is providing between 50% and 90% reduction in hydrogen sulfide emissions at the Commercial lift station wetwell and the force main discharge locations. The product is performing well at the feed rate BMSC is using, but the pH is relatively high at 9.0. The operators should continue to add the product to reduce the hydrogen sulfide emissions as much as possible for corrosion and odor control, but a chemical feed reduction is advisable to allow the system to operate at a pH between 8.4 and 8.6. This will have less of an impact on the wastewater treatment plant and still provide similar odor and hydrogen sulfide control.

Collection Lines and Pump Stations, Continued

Liquid wastewater analysis throughout the wastewater system indicated that the other parameters were typical, although sulfides in solutions were relatively high, peaking at 3.9 mg./lit at the wetwell of the Commercial lift station and up to 12.0 mg./lit at the discharge points. Normal ranges of sulfides in solution for wetwells are typically under 1.5 mg./liter, and a goal for force main discharge points would be under 5.0 mg./liter.

Even with these significant reductions in hydrogen sulfide concentrations due to the Thioguard, hydrogen sulfide levels remain very high in some locations. Additional measures probably will have to be taken to further control the odorous emissions, and are discussed in more detail later in the report.

Commercial Lift Station

Within the Commercial lift station wetwell, the hydrogen sulfide concentrations were relatively high, averaging 5-20 PPM with peaks of 32 PPM without the addition of magnesium hydroxide. The concentrations dropped to an average of under 2 PPM for the first week with chemical addition, but climbed as wastewater temperatures increased, with averages the second week ranging from 5 PPM to 20 PPM, with one unusual peak that was up to 102 PPM. This high peak most likely was due to a low pH cleaning product being discharged into the sewer and driving the hydrogen sulfide out of solution and into the headspace of the wetwell. Since the concentrations are up to 100 PPM in the wetwell, the hydrogen sulfide concentrations will need to be contained with a tightly sealed cover. The continued use of magnesium hydroxide to keep hydrogen sulfide levels and internal corrosion rates to a minimum is recommended. The location does not exhibit any positive pressures, but under the right ambient conditions, odors could be emitted from this location if not properly sealed. If odor complaints are received at this location, and sealing the wetwell is impractical, the installation of a small passive carbon filter could be utilized to collect and treat the odorous gas prior to being vented into the ambient air. If odor complaints continue after the installation of the passive carbon adsorber, a fan could be added to the carbon vessel to increase the negative pressure in the wetwell to keep odors from easily escaping into the ambient air. A packed tower odor scrubber or a biofilter can't be used at this location due to the space restraints at the lift station.

CIE Lift Station

At the CIE lift station, most of the past effort has been to seal all the possible venting locations to control the hydrogen sulfide and odor releases. Based on the data and the multiple site visits, this approach seems to be working quite well, although concentrations of 0.020 PPM were recorded at the fenceline on the Odalog monitors. These higher concentrations occurred at the hottest part of the day, each day during the first week of testing. After discussing the data with the manufacturer, the readings probably are not accurate as the instrument is unable to compensate for ambient temperatures above 110 degrees Fahrenheit. During the second week of testing a newer version analyzer was used at this location, and recorded only one short-term event. This one event is at the low detection level of the instrument and is also questionable. Handheld monitoring using a slightly more sensitive analyzer (Jerome 631X H2S Analyzer, accuracy of 0.003 PPM) did not record any elevated hydrogen sulfide concentrations anywhere around the CIE lift station.

CIE Lift Station, Continued

Although no odors were recorded around the lift station during any of the site visits, odors could be escaping from the pickholes upstream of the lift station.

Hydrogen sulfide concentrations within the collection lines and the CIE lift station wetwell were moderate to high. Four locations were monitored at the CIE lift station: one on the local gravity line, one at the force main discharge, and two on the wetwell structures within the lift station. The wetwell locations were relatively low in hydrogen sulfide concentrations, with levels up to 8 PPM. The incoming local gravity line, as mentioned earlier, had moderately high concentrations in the headspace, with peaks up to 21 PPM. The highest location around the CIE lift station was at the force main discharge. Peaks of 101 PPM were seen at this location without chemical addition, and 24 PPM with chemical addition. The magnesium hydroxide chemical feed site at the Commercial lift station is working well, and is providing a 75% reduction at the force main discharge at the CIE lift station with chemical addition. It should be noted that none of the concentrations recorded at either of these lift stations are unusual for a force main system.

Hydrogen sulfide concentrations were monitored in the local gravity line and recorded peaks of 21 PPM. Concentrations over 10 PPM are relatively high for an upstream gravity line. This area could be a candidate for chemical treatment to reduce the hydrogen sulfide concentrations going to the CIE lift station. If odors are still a problem in the area, Black Mountain Sewer Company (BMSC) may need to seal the manhole covers upstream of the lift station in the local gravity line to prevent any odors from escaping into the ambient air through the pickholes. A slight positive pressure (0.01 in./WC) was found around the CIE lift station collection lines. Under the right conditions, odors could be released through the pickholes with positive pressures of 0.01 in./WC. Sealing the pickholes on all of the manholes in the area is recommended first. If that proves inadequate, a small carbon adsorber with a fan could be used to provide a negative pressure on the upstream collection lines. As long as a chemical treatment program is in place, corrosion should not be a significant issue with sealed manholes.

Containing the odors within the sewer system as much as possible is the preferred approach for this area. If the odors cannot be contained adequately, an odor control approach similar to the Commercial lift station could be used at the CIE lift station. An odor control system is already on site and could be utilized if containment is not feasible; but carbon would probably be a better product at this location as the odor removal system (Peacemaker) does emit a slight chlorine odor and is not designed to treat amine odors that could be present at this location. LTS recommends that in the event that an odor control system is needed, the media to use would be carbon.

Force Main Discharge Locations

At the two locations that the force mains discharge into the gravity lines, just upstream of the wastewater facility, both locations have extremely high hydrogen sulfide concentrations. The force main discharge location at Quartz and Boulder Drive had concentrations up to 700 PPM, and the Century and Boulder location had concentrations over 100 PPM. Both locations also had positive pressures that tend to drive the odors and hydrogen sulfide concentrations out through the manhole cover pickholes.

The solution that BMSC has been using for the Century and Boulder location is installing a carbon insert for odor control. If the media is changed regularly, this insert will reduce the concentrations that are emitted out of the pickhole to under 1.0 PPM. Levels below 1.0 PPM would be considered low compared to most sewer systems in Arizona. This is probably the best solution for this location, although an insert that could hold a slightly deeper bed of carbon might be considered as a replacement to the unit that is now installed to give improved odor control and a longer life for the carbon.

At the Quartz and Boulder Drive location, the odor and hydrogen sulfide concentrations are being contained using a sealing manhole cover. This is preventing virtually all of the odors from being released into the ambient air, but the downside to this approach is that the location has significant positive pressures, up to 0.04 in./WC, and sealing the covers will force the air out to some other location, like resident vent stacks. Also, sealing the covers will create high corrosion rates due to the turbulence and high sulfide levels, and trying to contain all of the hydrogen sulfide releases. Even when Thioguard is added upstream, the turbulence can still strip the hydrogen sulfide out of solution. The Thioguard is working fairly well in reducing the releases at this location with approximately a 50% reduction, but with initial concentrations over 700 PPM, a 50% reduction is of little help in controlling the risk of odor emissions. With the significant positive pressures at this location, it is likely that these odors will be driven out of the surrounding homes' vent stacks. Due to this possibility, a meter was placed in a home vent stack just upstream of the Boulder and Quartz force main discharge location to determine if any odor was being emitted out of the local residences vent stacks. Concentrations of 5 PPM were recorded at the vent stack when no Thioguard was being added to the system. The levels dropped to under 1 PPM when the Thioguard was being added and no concentrations were recorded after the first day or two, but even with low concentrations of less than 1 PPM, they could still be an added odor source for the area. When the Thioguard feed pump was not operating, values up to 5 PPM were recorded out of the surrounding homes vent stacks. These concentrations could be a significant odor for the entire area.

A redesign at this structure is recommended if turbulence could be reduced. Reduced turbulence would keep the sulfides in solution to be treated by the waste treatment facility. Even with reduced concentrations due to less turbulence a fan generating negative pressures will still most likely be needed at the Quartz and Boulder Drive location to prevent odors from being forced out the local vent stacks.

Force Main Discharge Locations, Continued

There is also an additional pump station that was not evaluated called the Indian Rock Pump Station. This pump station discharges into the Quartz and Boulder location just upstream from the wastewater plant. Chemical feed could also be considered in this location if required.

Wastewater Treatment Facility

Six locations were tested at the wastewater treatment facility, the main influent line, the Parshall Flume structure, the headworks building, the splitter box, the old influent box, and the aeration basins influent. Most of the locations had relatively high hydrogen sulfide concentrations, over 10 PPM.

The influent locations, Parshall Flume, and headworks locations are seeing concentrations that are being carried downstream from the Boulder and Quartz Drive location. Slightly reduced concentrations were recorded within the treatment facility. The Thioguard is still helping at the plant, but the levels at the three in-plant locations were still significant. Additional hydrogen sulfide is being released at the splitter box and at the influent to the aeration basins and this is not related to the releases upstream at Boulder & Quartz Drive. The old splitter box was also evaluated and had low concentrations of hydrogen sulfide, and if sealed properly this location is really not a significant odor source.

Concentrations up to 120 PPM were seen at the influent location, but dropped to under 25 PPM within the plant. Still, with concentrations in the 10-25 PPM range, all of the locations will need to be treated. Currently the only locations that are receiving treatment are at the headworks, the splitter box and the influent to the aeration basins. Even though these locations are being treated with the existing odor control system (carbon adsorber), the influent to the aeration basins has significant gaps in the covers. This makes it difficult to contain the odors for treatment. LTS recommends that this area's covers be better sealed, and additional airflow is also recommended to increase the negative pressure on the basins to prevent any odors from escaping into the ambient air.

The Parshall flume and the influent line are currently not being treated. LTS recommends air treatment at these locations by extracting the odorous gas out of the structures with fiberglass ductwork and a fan, and treating the odors with an improved odor control system.

The headworks at the facility should be the focus of improved odor control. The concentrations in the room were up to 13 PPM and averaged over 4 PPM. This is not a significant amount of hydrogen sulfide, but other compounds that are odorous were recorded at this location. Concentrations of 1-5 PPM ammonia were recorded in the headworks in addition to the hydrogen sulfide. An improved odor control system would improve the negative pressure in the headworks and keep the odors from occasionally escaping into the ambient air

Wastewater Treatment Facility, Continued

The carbon adsorber odor control system was tested for removal efficiencies, and is performing well while treating the odors from the three locations it is extracting air from. Testing of the carbon adsorber indicated that the system is working to specifications with the new carbon that was installed earlier in the year. LTS never recorded any outlet results over 0.003 PPM out of the stack of the carbon adsorber during the two-hour test.

Even though the outlet values were very low, the negative pressure was almost zero at each of the locations from which the carbon adsorber is collecting odorous gas. Without the proper amount of negative pressure (> -0.02 in./WC) at the odorous locations in the plant, there is a risk that, under the right ambient conditions, significant odors could be released in to the ambient air.

The Odalog hydrogen sulfide monitors placed at the fenceline did not indicate that any significant amounts of hydrogen sulfide were being released into the ambient air; but testing with the Jerome 631X indicated that concentrations up to 0.024 PPM were occasionally being released at the fenceline. When the Porta-John was replaced at the facility, the spikes increased to over 0.030 PPM for the short duration they were on site. The County's limit is an average of 0.030 PPM for 30 minutes at the fenceline. This is a relatively loose specification, and it is recommended that BMSC have a goal of keeping the fenceline concentrations under 0.008 PPM in the future to prevent odor complaints. The reason LTS recommends that a target of 0.008 PPM be implemented is that based on a 1979 study performed by the California Air Resources Board, which found that 87% of people could detect a rotten egg odor from hydrogen sulfide at 0.008 PPM. It also stated that at 0.040 PPM, or five times the odor threshold, most people considered the odor a nuisance. This report is how the 0.030 PPM standard was derived in California and in Maricopa County.

Current fenceline odors at the facility are most likely from fugitive emissions due to a lack of negative pressures, mostly on the aeration basin influent areas. Other reduced sulfur odors are also typically found as part of the odor emissions and common in most wastewater treatment processes. Low level amines were also recorded at the headworks.

Other Odor Sources

Other odor sources were found during the study that could have occasional impacts on the locations, such as Porta-Johns located at the treatment facility and at the CIE lift stations. Southwest Gas was also replacing some of the gas mains in the area, presumably because of gas leaks. Natural gas is odorless, so the gas companies add an odorant at the distribution center, which is also a reduced sulfur compound called mercaptan. Mercaptans have a similar smell to hydrogen sulfide, and can often be interpreted as a sewer odor by some people. Other odors were also noted at the Commercial Lift Station that is clearly being emitted from the local restaurant grease traps. These emissions can often be very odorous, and also contain a large percentage of hydrogen sulfide. It is common for many people to interpret the grease traps odors as a sewer odor as they are very similar in nature and smell.

Recommendations

The short-term improvements that Black Mountain Sewer Company made as part of the Phase 1 review were correct, but to completely eliminate the odors 99% of the time at the wastewater treatment facility, a larger odor scrubber is recommended, in the range of 5,000 -10,000 CFM, with an additional stage for ammonia removal, and a final-stage carbon polisher. Airflows with a 5,000 -10,000 CFM system would increase the negative pressure in the headworks, splitter box and aeration basins, and to provide negative pressures at the Parshall Flume and in the influent line, which is not being addressed with the current carbon adsorber.

It is also recommended that the discharge location at Quartz and Boulder Drive be redesigned to reduce turbulence at this location. This could be part of the odor control improvement project at the plant, by creating a wetwell structure just to the North on the easement. The new odor control system would draw from this location along with the headworks, Parshall Flume, splitter box and aeration basins. The new collection structure would be designed to focus on a reduction in liquid turbulence and air extraction.

Black Mountain Sewer Company should continue to add Thioguard at the Commercial lift station for hydrogen sulfide control, and may consider adding an upstream chemical feed site for the gravity portion of the CIE lift station. At the Commercial lift station, the only improvement recommended at this location is to continue sealing the wetwell 100% to contain any odors that may be present in the wetwell.

LTS is recommending that a packed tower odor scrubber be installed with a 16" to 20" duct running out to a new junction structure to create a negative pressure at this location. The odors would be treated with a three-stage packed bed odor control system located at the treatment facility, and a carbon follower. The existing unit may be used as part of the polishing stage after the packed tower odor scrubber. An additional carbon unit would be required to handle the additional airflow.

Also, at the wastewater treatment facility, a continuous hydrogen sulfide monitor is also recommended to monitor the operation of the new odor control system and to alert the operators of any potential scrubber problems prior to receiving odor complaints. The only system on the market for this application that can read part-per-billion concentrations is the Sycamore Technologies system. This option should be evaluated to see if it would assist the facility in catching odor emission problems before they get to the surrounding community.

The Boulders in Carefr Liquid Sewage Data

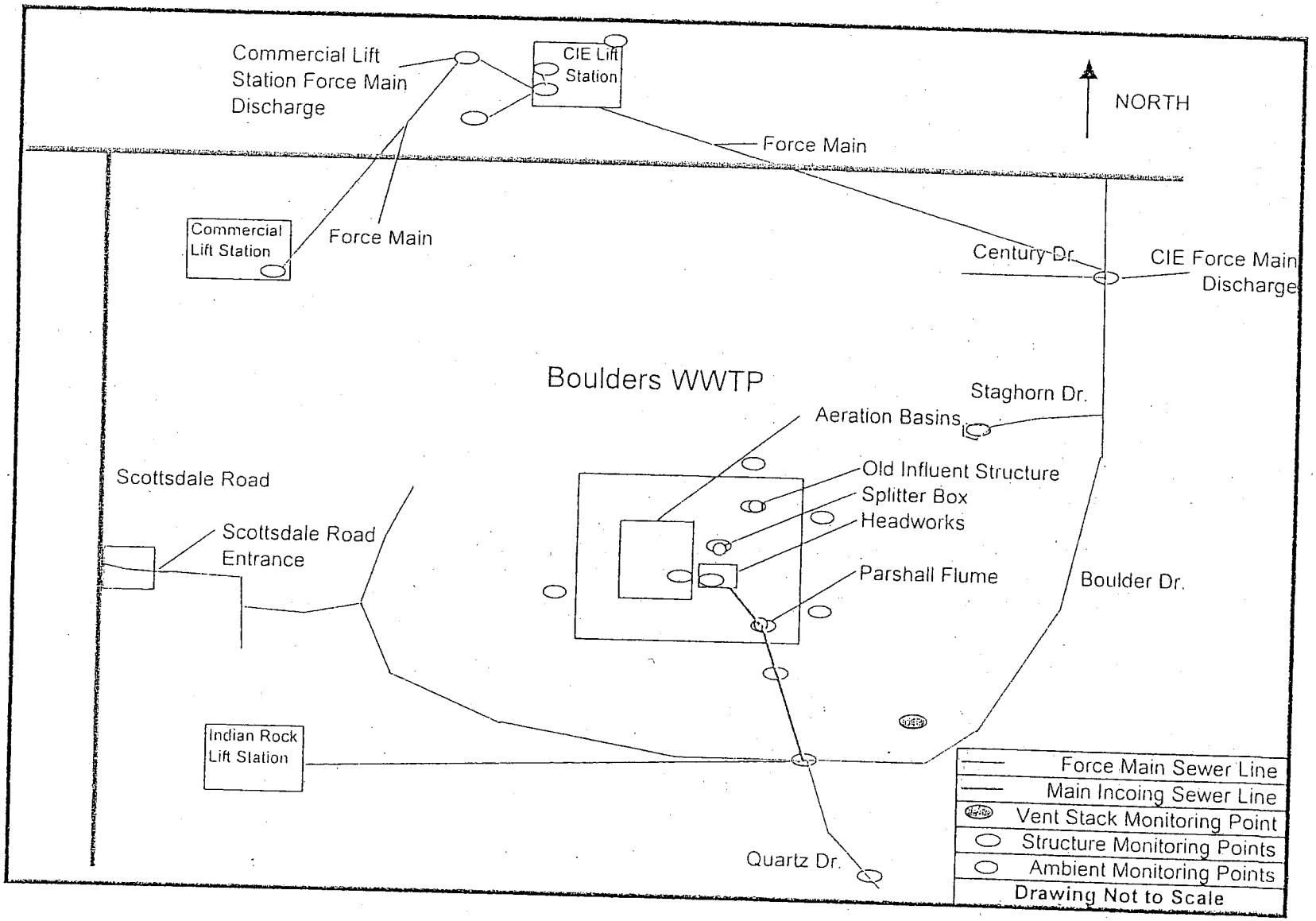
Test Sites

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/2/2004	9:30 AM	>50	8.17	-327	1.86	29.6	4.2	4.20	0.03	
Century & Boulder Dr.	6/2/2004	10:00 AM	26	8.41	-351	0.49	32.2	6.2	6.2	0.01	
Plant Influent	6/2/2004	10:30 AM	>50	7.65	-380	0.17	31.3	5.2	5.2	0.01	
Upstream Quartz Dr.	6/2/2004	11:00 AM	0.008	No Flow							
Staghorne Dr.	6/2/2004	11:30 AM	0.092								
Commercial Lift Station	6/2/2004	12:00 PM	14	7.87	-225	5.78	32.4	1.6	1.4	0.00	
Commercial Lift Station FM Discharge at CIE	6/2/2004	12:30 PM	8.0	7.43	-242	3.00	34.9	0.6	0.6	0.01	
CIE Incoming Gravity Line	6/2/2004	1:00 PM	0.089	7.87	-277	4.03	34.0	2.0	1.8	0.01	0 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/7/2004	8:00 AM	>50	8.84	-306	4.50	29.9	7.0	7.00	0.05	
Century & Boulder Dr.	6/7/2004	8:30 AM	23	9.24	-310	2.92	30.8	7.0	6.5	0.01	
Plant Influent	6/7/2004	9:00 AM	20	9.01	-310	5.60	29.1	9.0	9.0	0.00	
Upstream Quartz Dr.	6/7/2004	9:30 AM	0.012	No Flow							
Staghorne Dr.	6/7/2004	10:00 AM	0.031								
Commercial Lift Station	6/7/2004	10:30 AM	2.2	8.93	-279	4.20	30.7	2.2	2.1	0.00	
Commercial Lift Station FM Discharge at CIE	6/7/2004	11:00 AM	4.0	8.80	-284	2.62	32.0	2.0	1.4	0.01	
CIE Incoming Gravity Line	6/7/2004	11:30 AM	0.022	8.06	-182	2.61	31.8	0.2	0.1	0.01	90 GPD

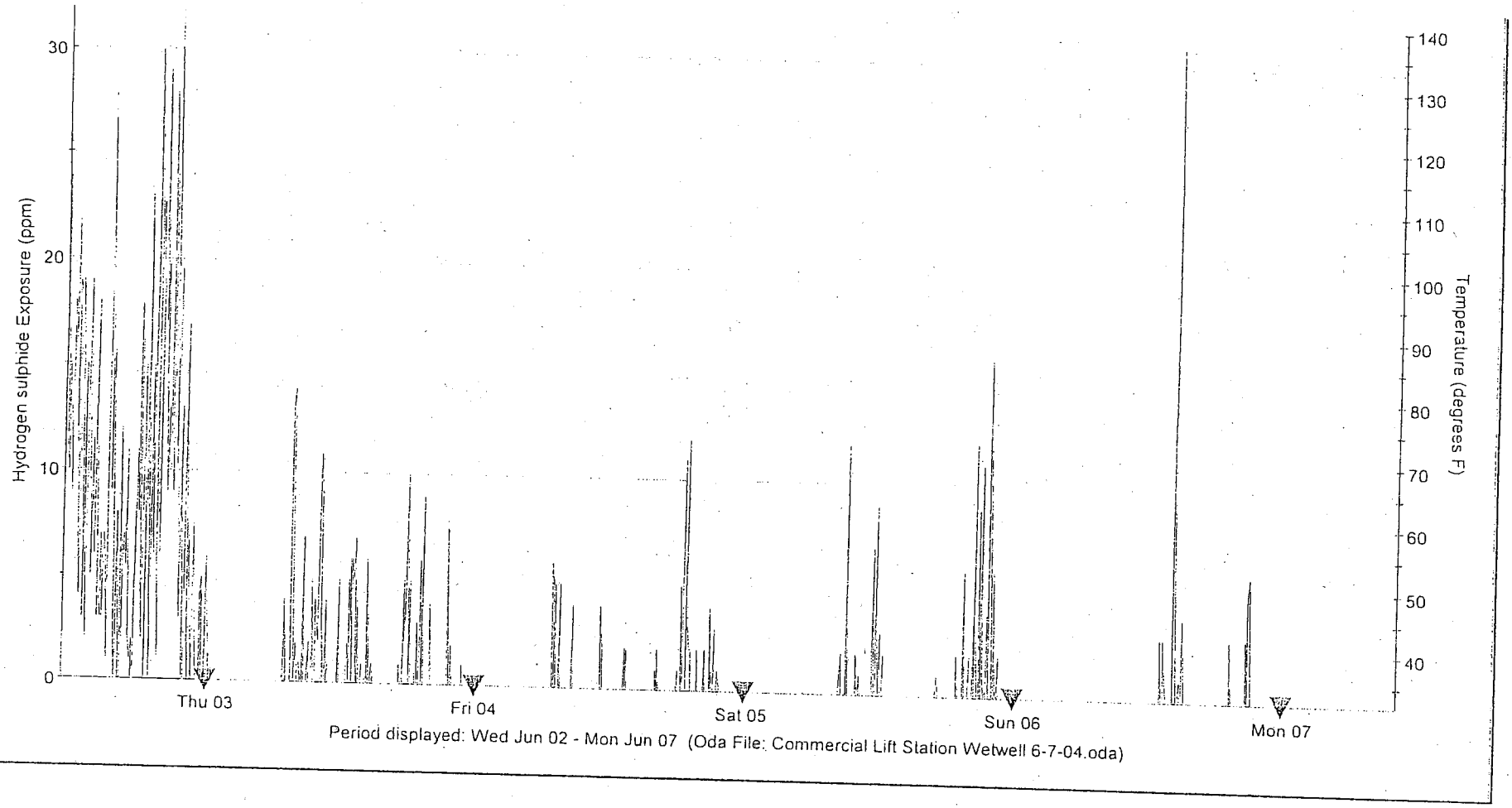
Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/9/2004	8:30 AM	>50	9.13	-307	5.72	28.3	12.0	12.0	0.03	
Century & Boulder Dr.	6/9/2004	9:00 AM	1.4	9.15	-246	4.80	29.2	7.0	6.5	0.00	
Plant Influent	6/9/2004	9:30 AM	>50	9.04	-309	4.32	28.7	12.0	12.0	0.005	
Upstream Quartz Dr.	6/9/2004	10:00 AM	0.004	No Flow							
Staghorne Dr.	6/9/2004	10:30 AM	0.004								
Commercial Lift Station	6/9/2004	11:00 AM	0.62	8.53	-300	2.40	29.0	3.6	3.2	0.00	
Commercial Lift Station FM Discharge at CIE	6/9/2004	11:30 AM	0.15	8.73	-299	5.40	30.3	2.7	2.5	0.00	
CIE Incoming Gravity Line	6/9/2004	12:00 PM	0.020	7.18	-257	2.52	31.0	1.1	1.1	0.00	90 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/14/2004	7:30 AM	40	9.10	-300	5.07	29.3	10.8	10.8	0.01	
Century & Boulder Dr.	6/14/2004	8:00 AM	48	9.11	-270	4.51	29.5	8.3	8.3	0.005	
Plant Influent	6/14/2004	8:30 AM	30	9.00	-315	4.01	29.1	10.5	10.5	0.005	
Upstream Quartz Dr.	6/14/2004	9:00 AM	0.037	No Flow							
Staghorne Dr.	6/14/2004	9:30 AM	0.019								
Commercial Lift Station	6/14/2004	10:00 AM	6.0	8.65	-299	2.07	30.0	3.9	3.7	0.00	
Commercial Lift Station FM Discharge at CIE	6/14/2004	10:30 AM	16	8.81	-291	5.11	30.7	3.0	2.9	0.01	
CIE Incoming Gravity Line	6/14/2004	11:00 AM	13	7.25	-231	2.01	31.2	1.3	1.3	0.01	90 GPD



The Boulders WWTP Site Map

- Session: 1 (OdaLog: OL0504069)



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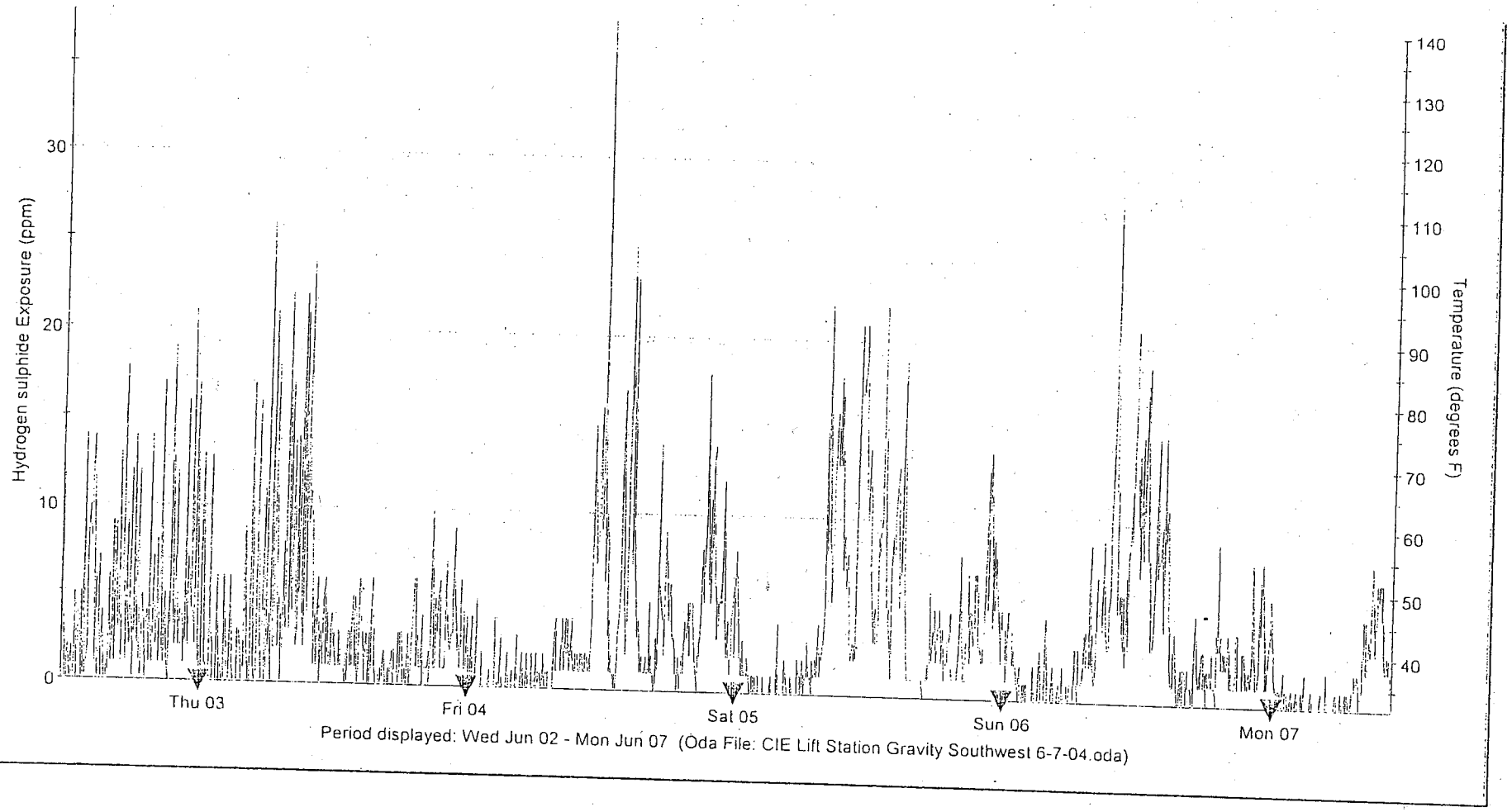

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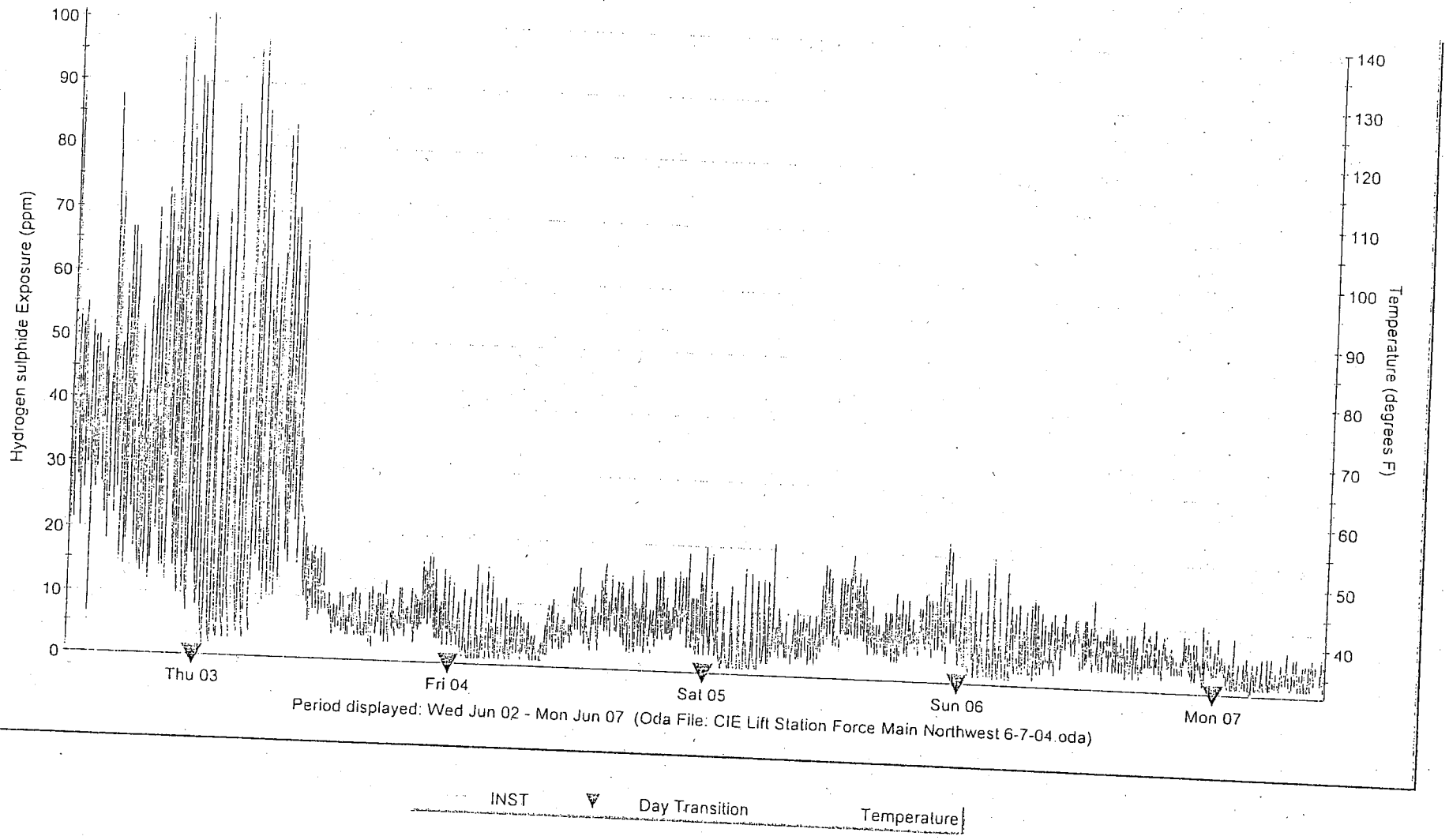

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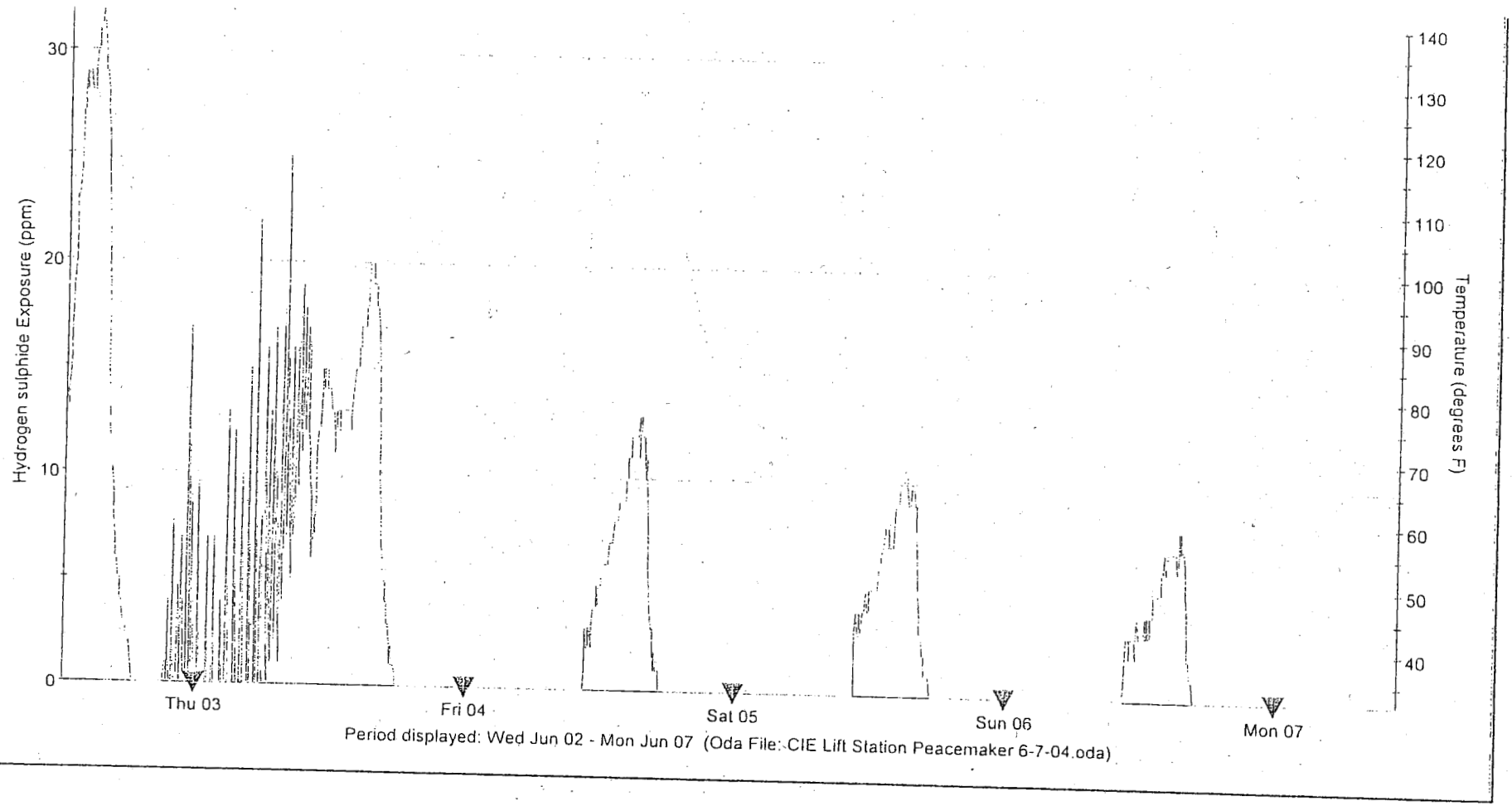

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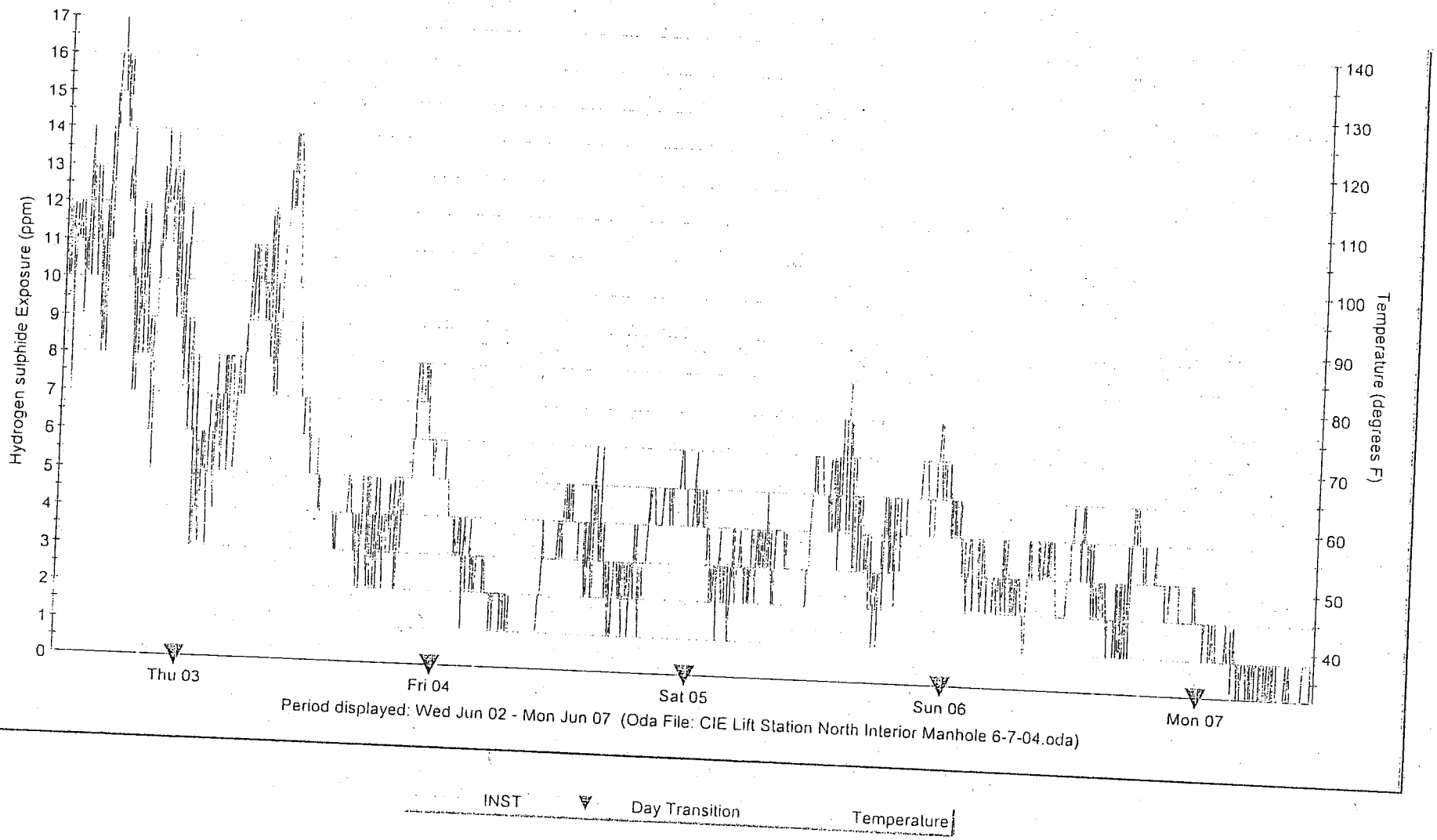

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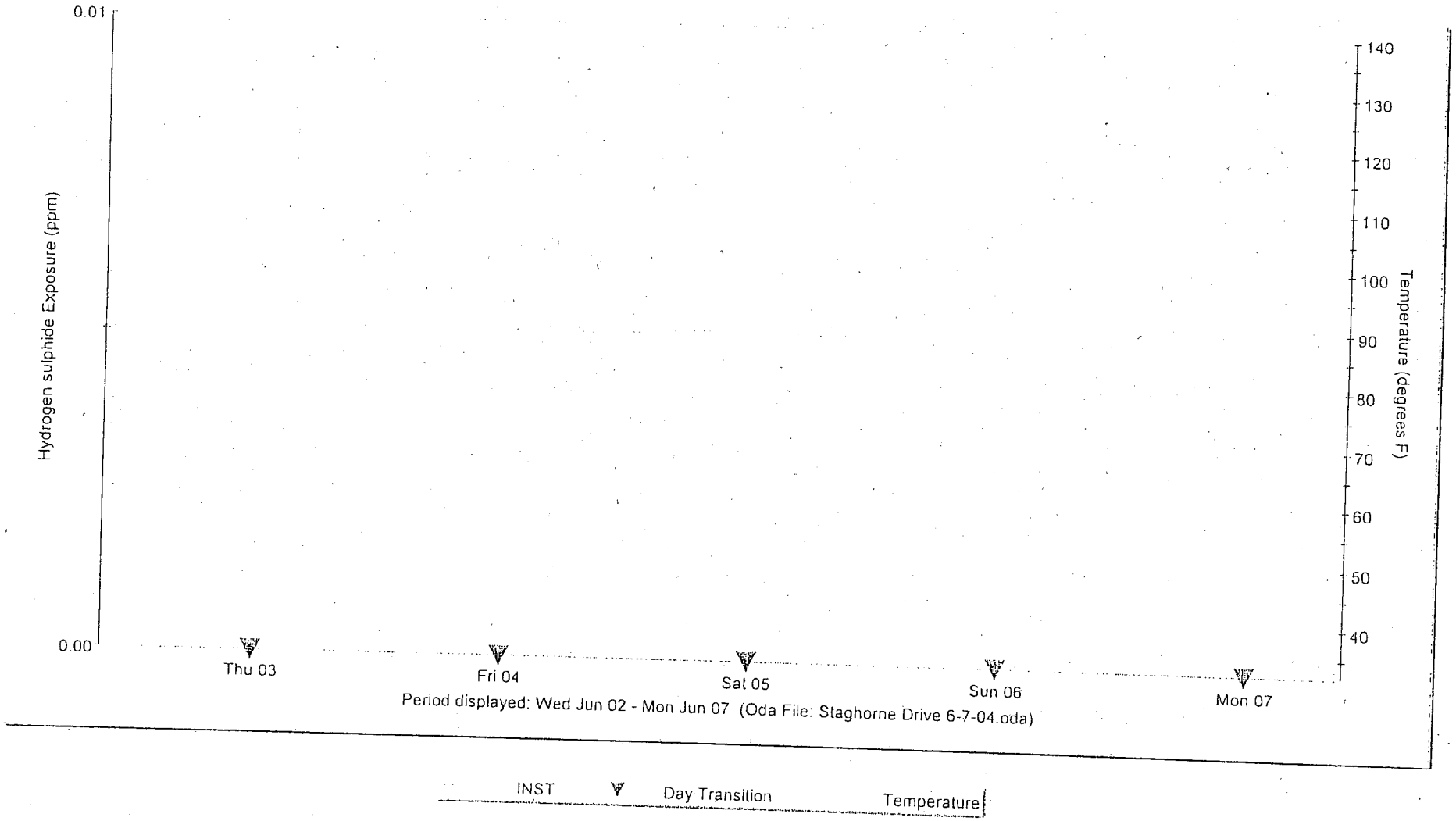

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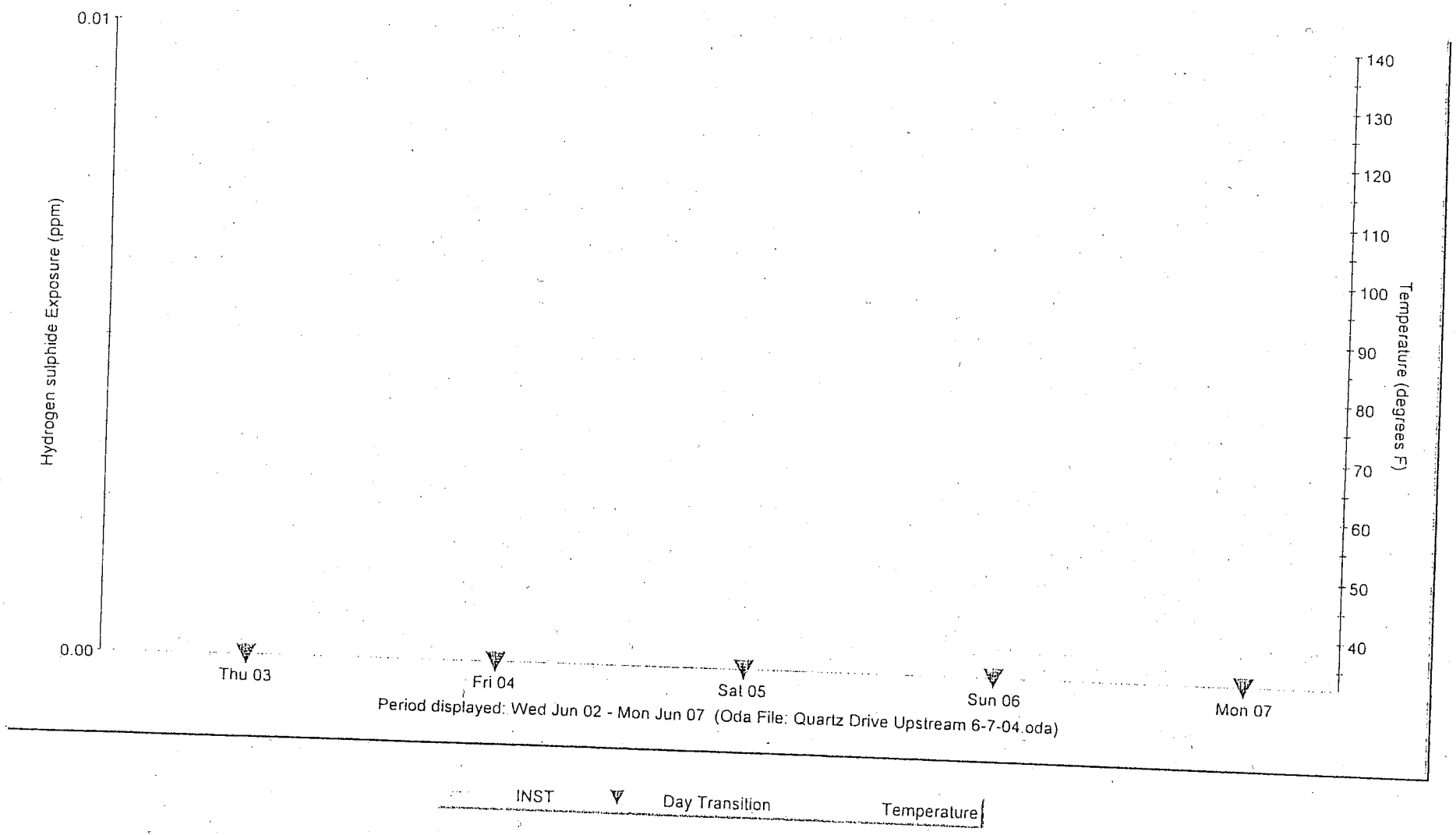

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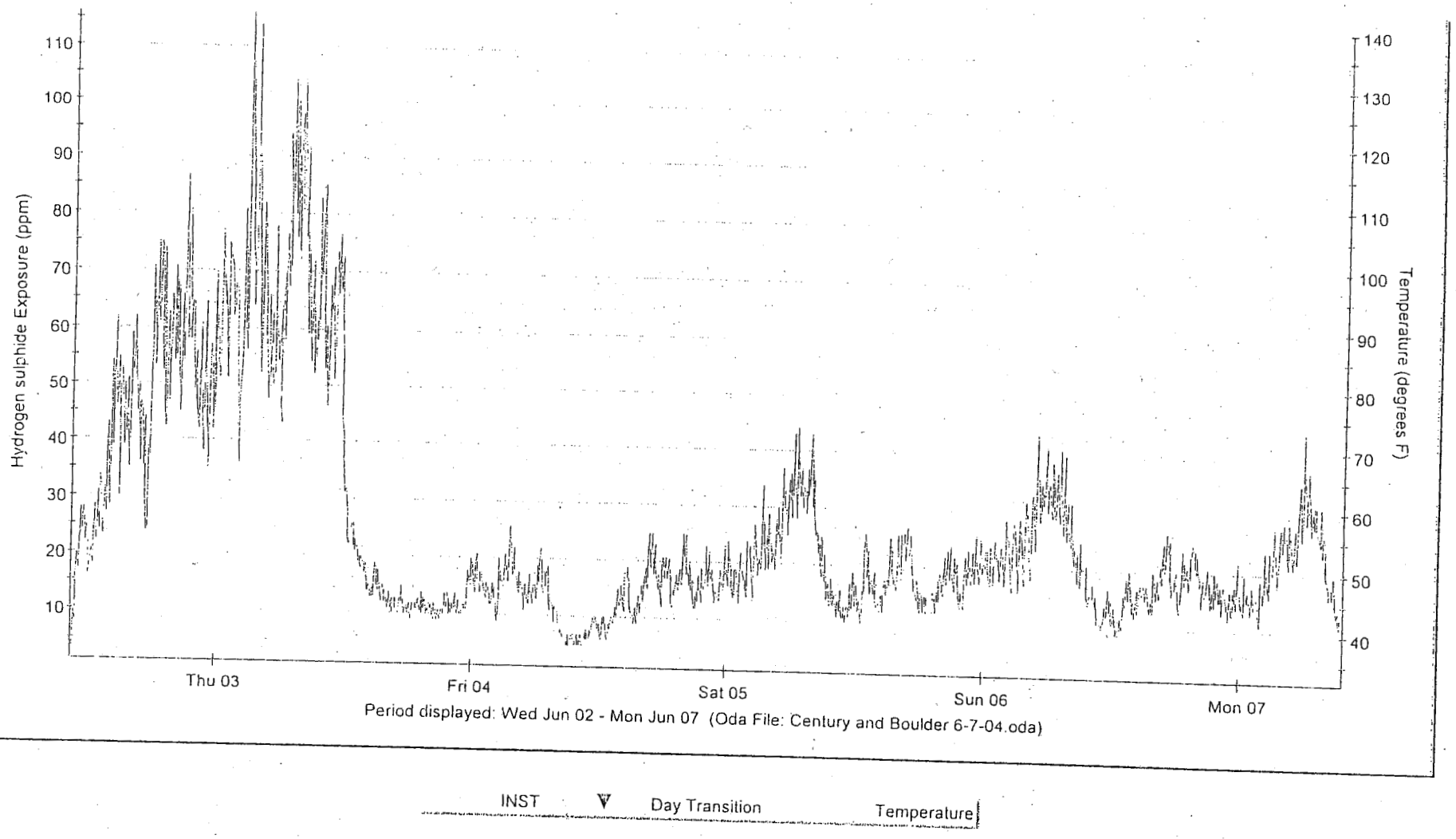

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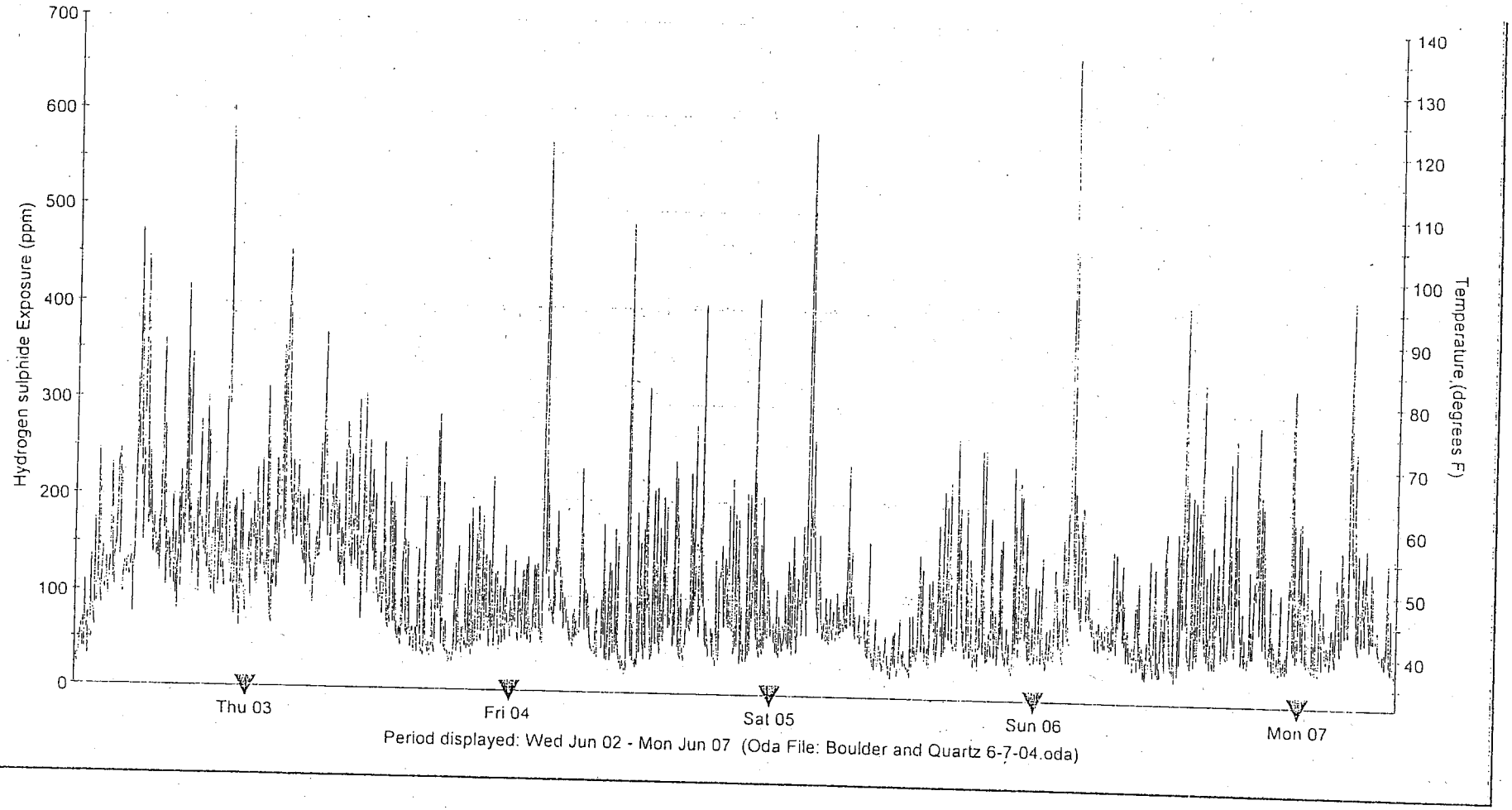

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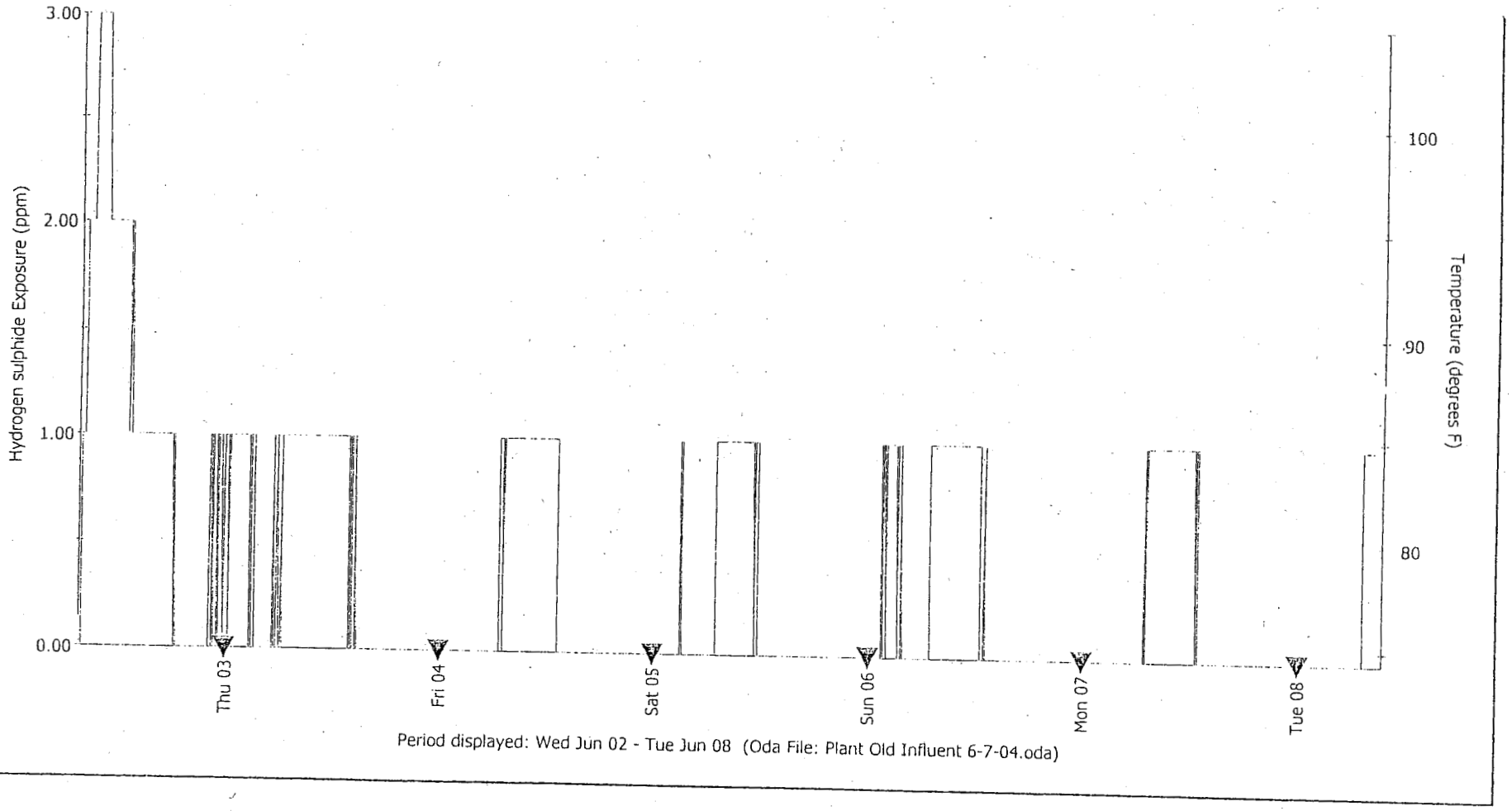

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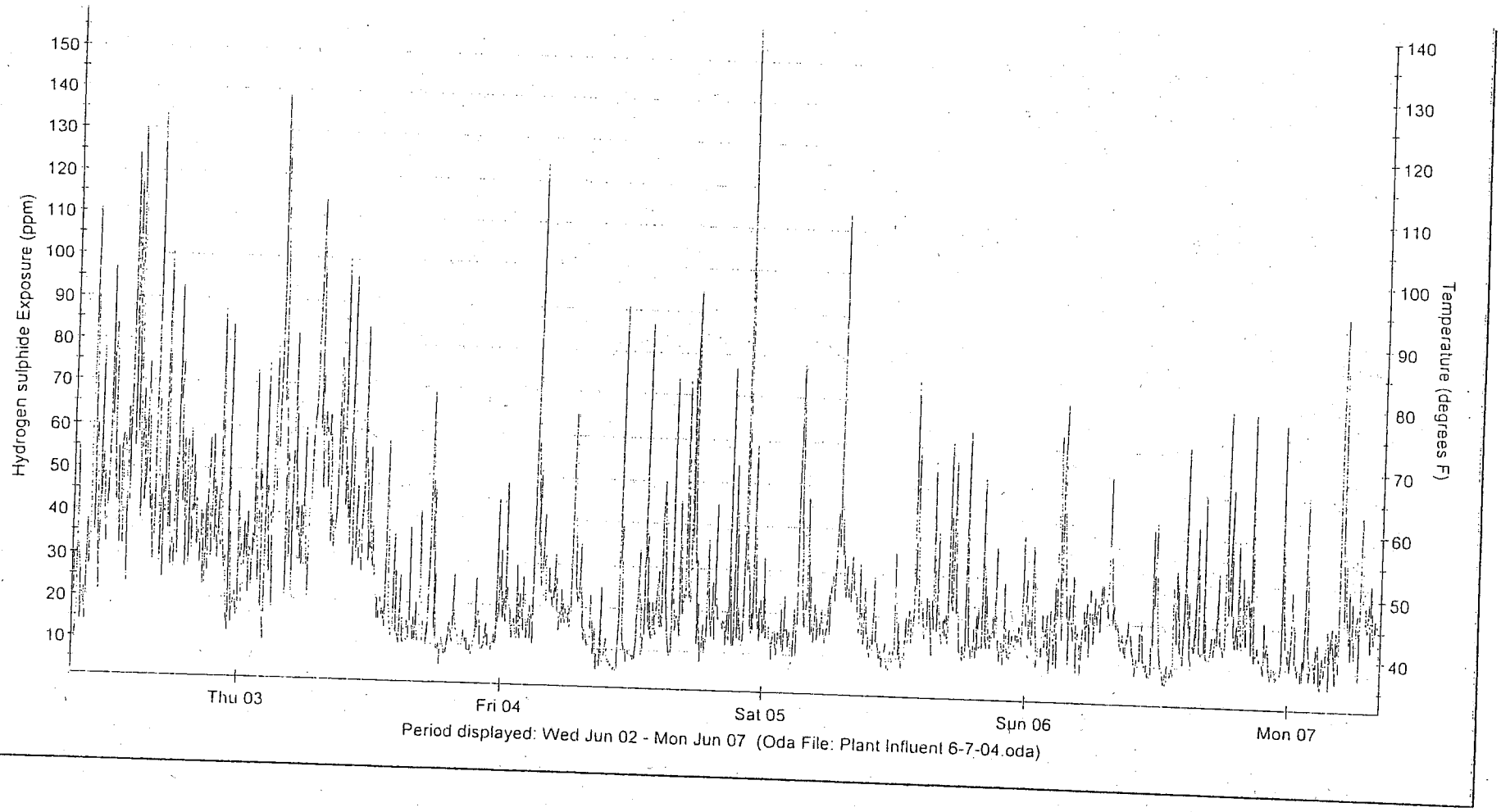
- Session: 1 (OdaLog: OL4505085)



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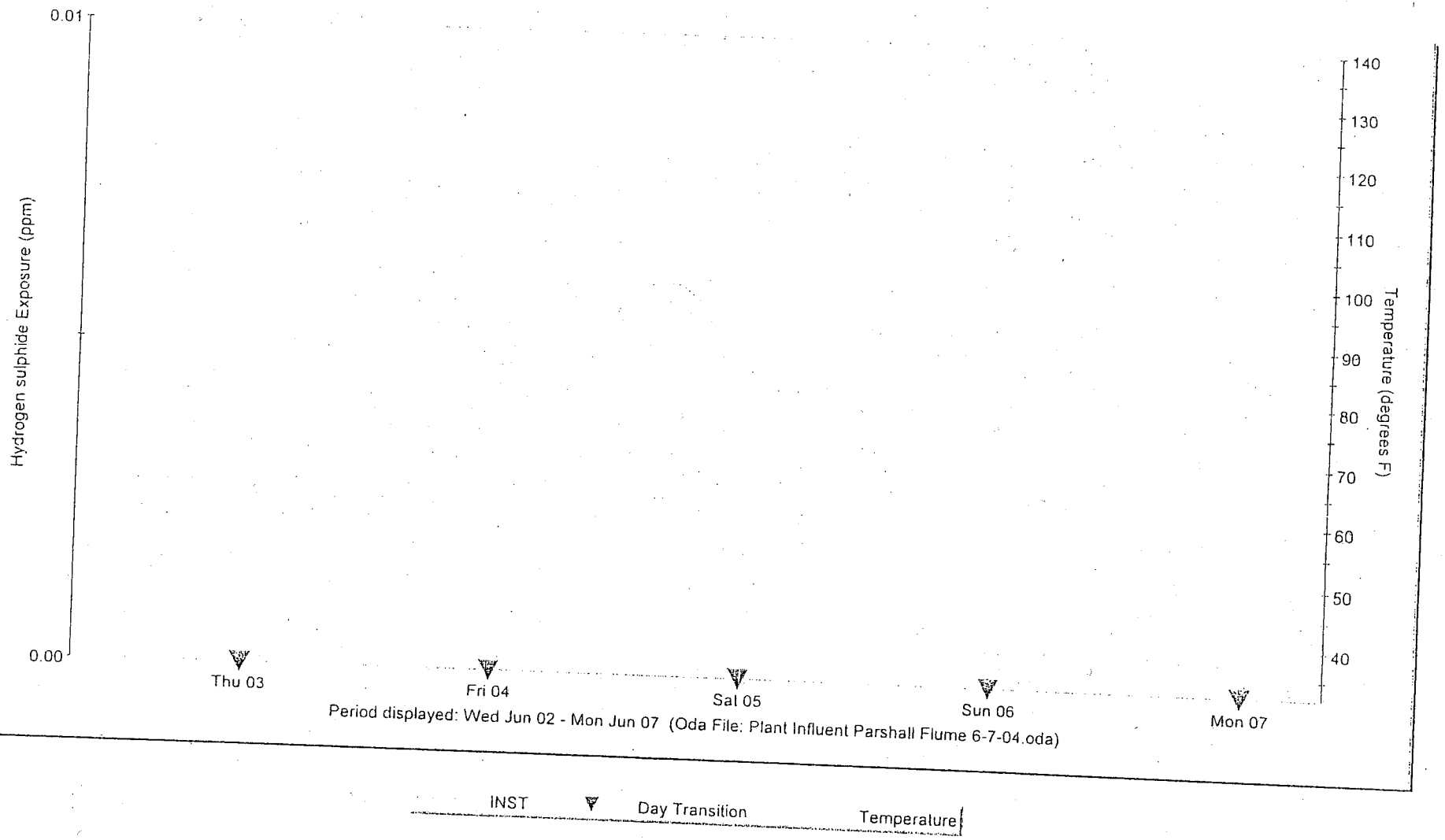

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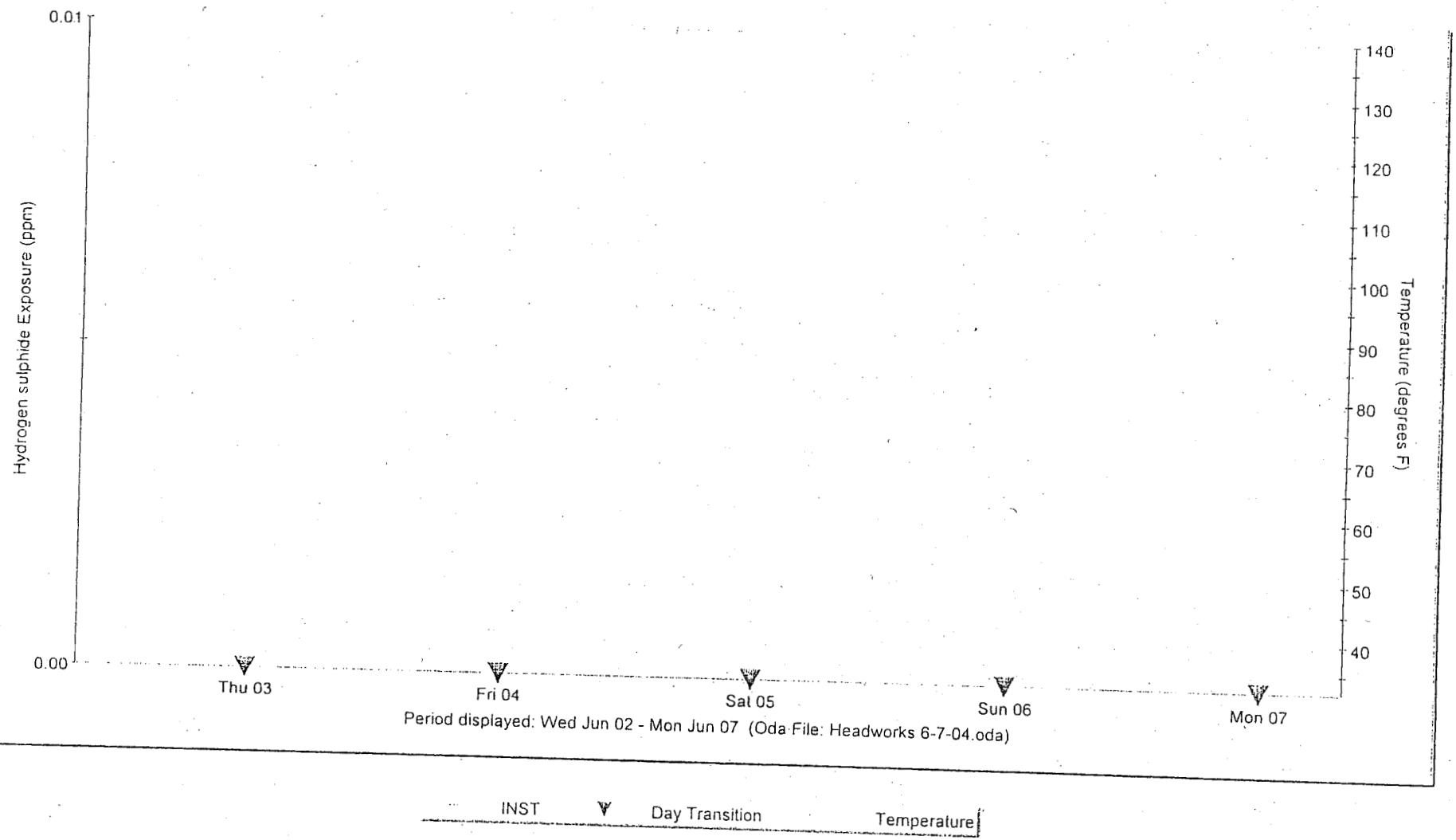

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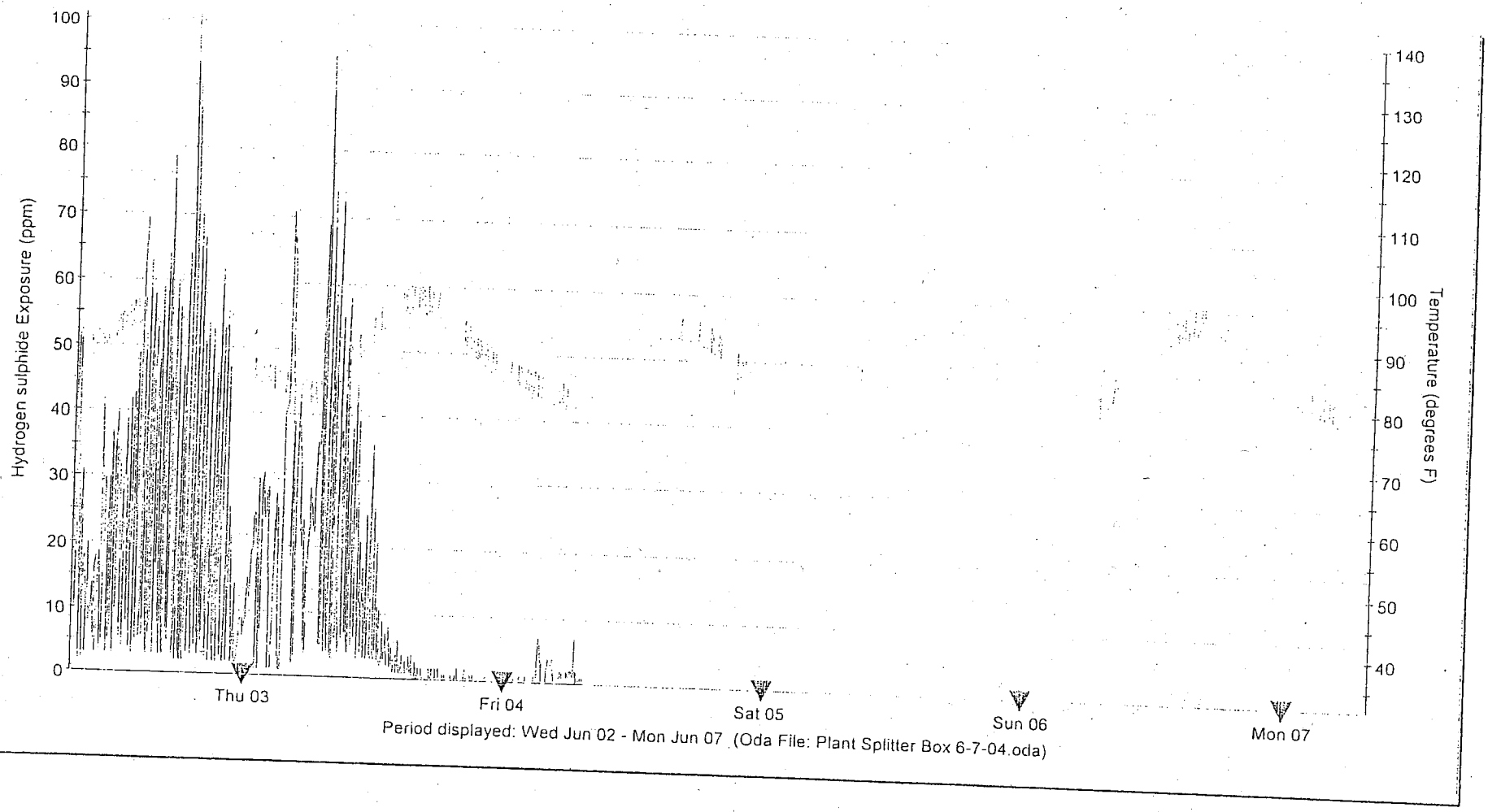

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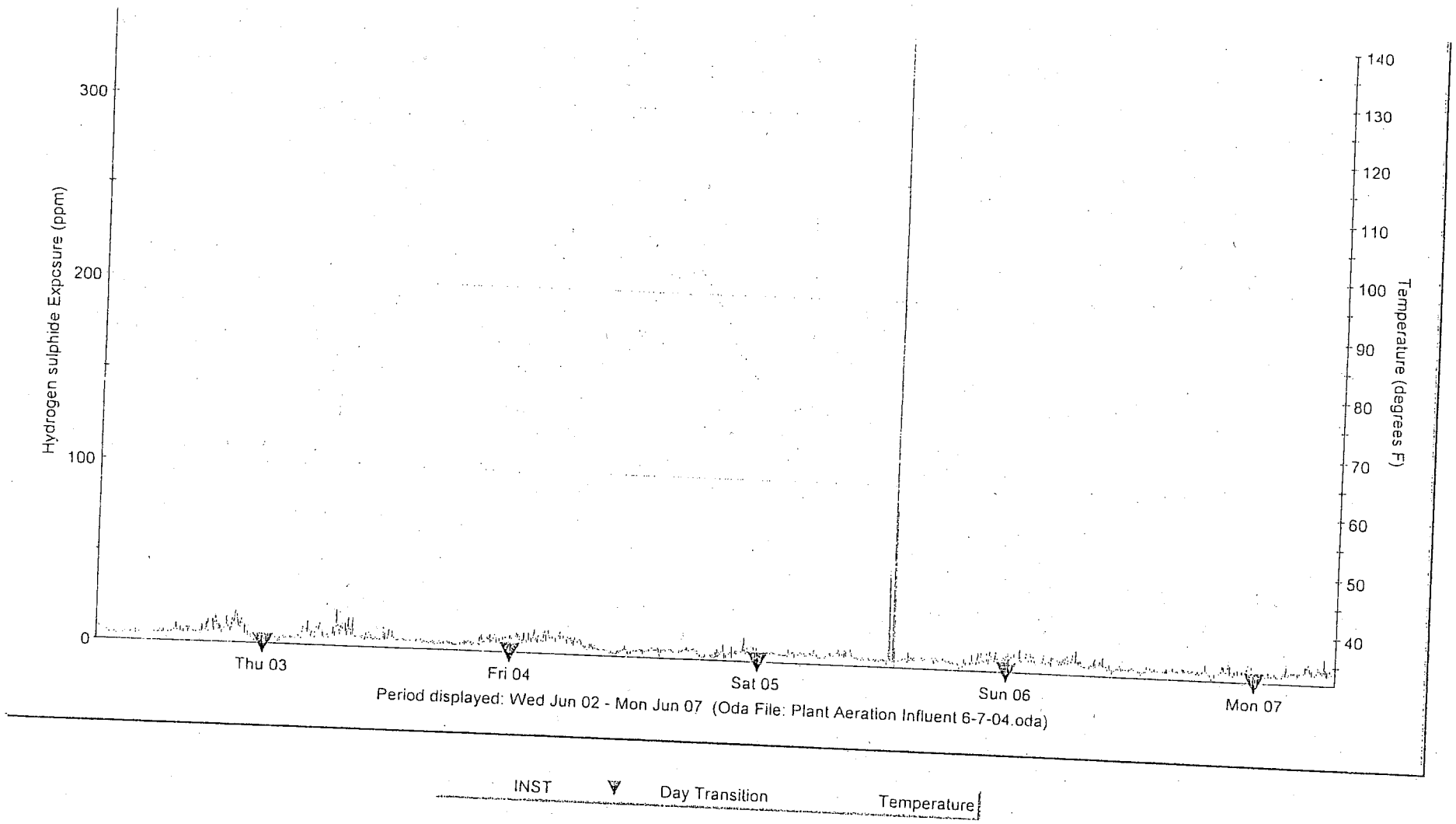

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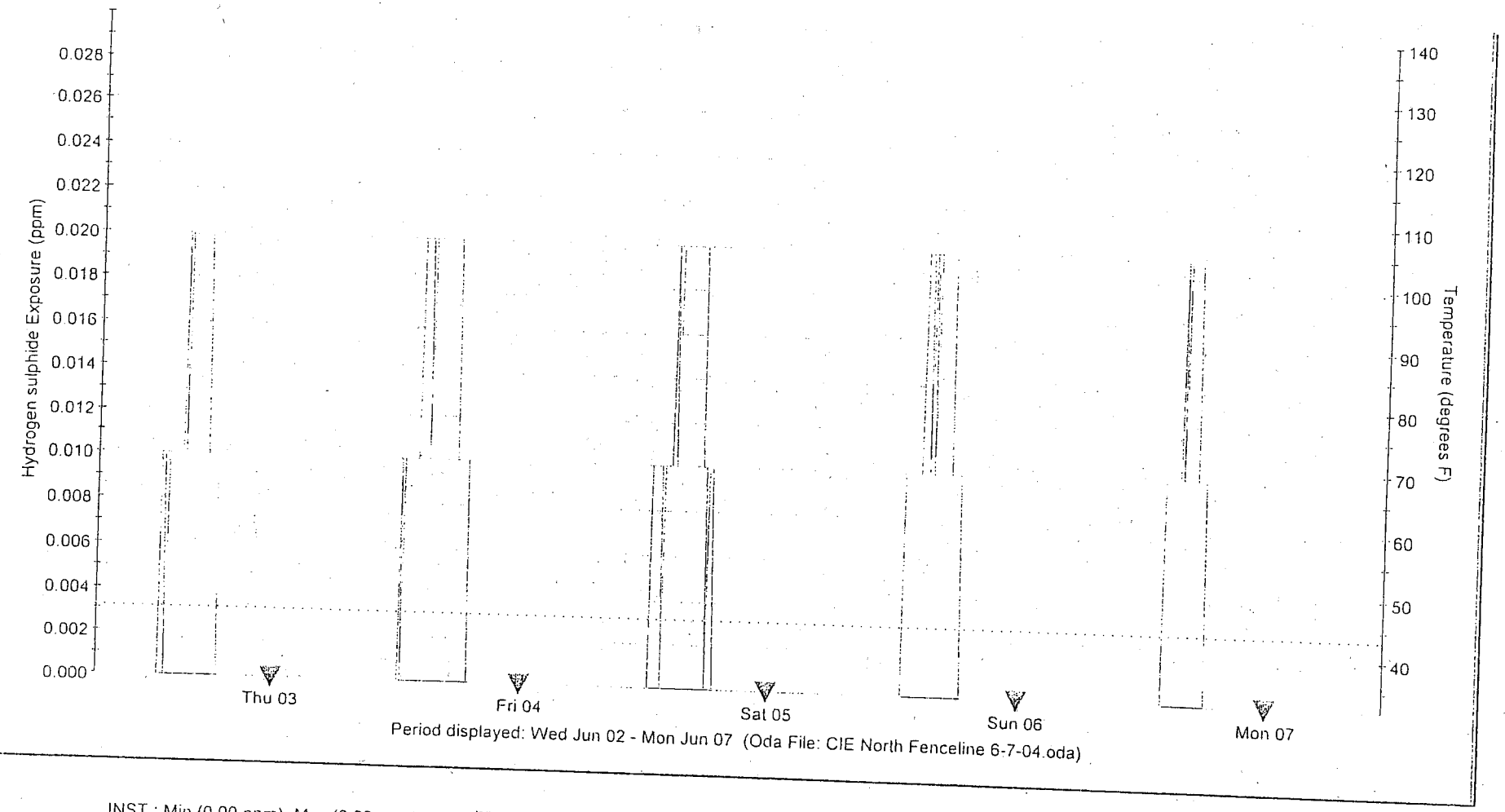
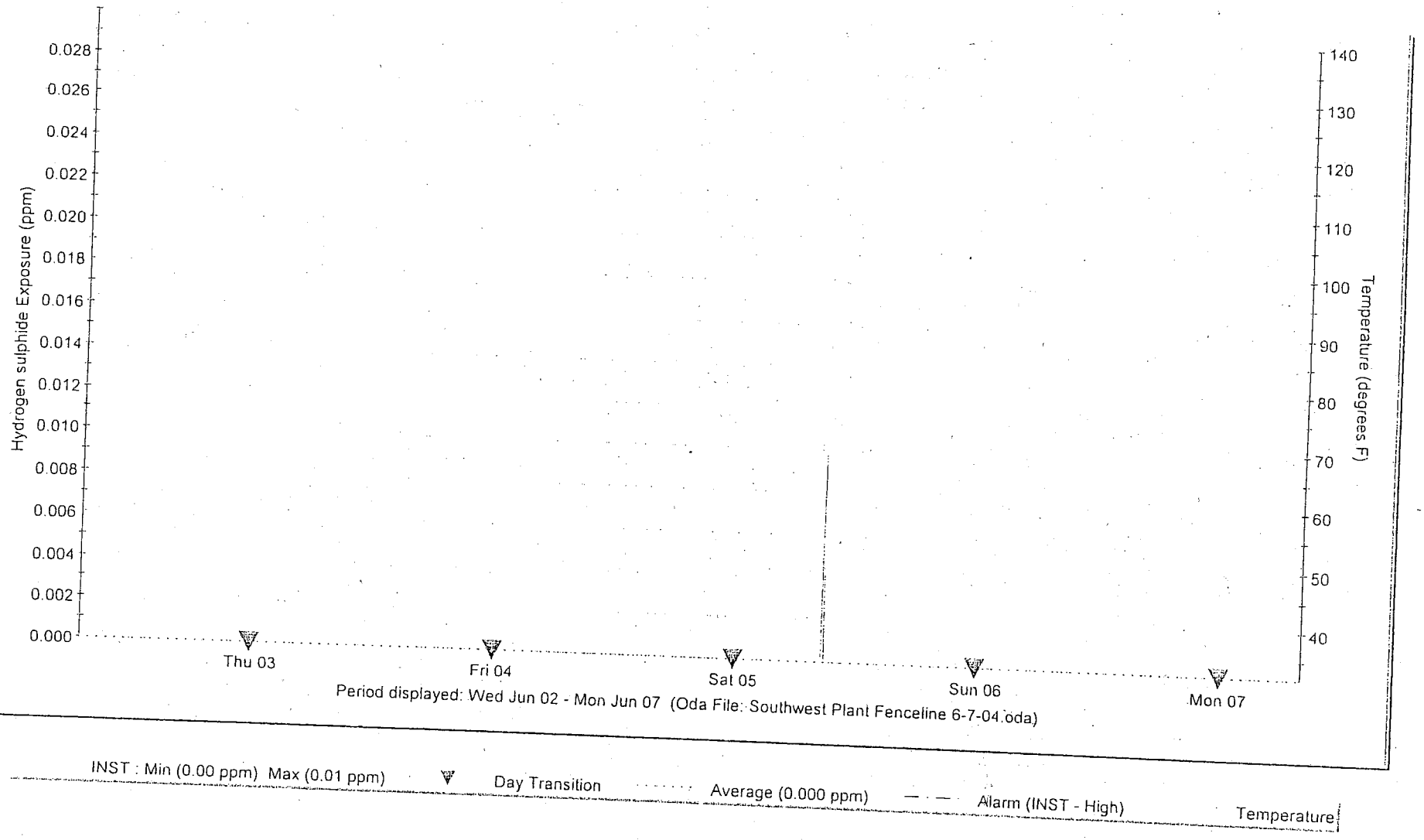


INST : Min (0.00 ppm) Max (0.02 ppm) Day Transition Average (0.003 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50073521)



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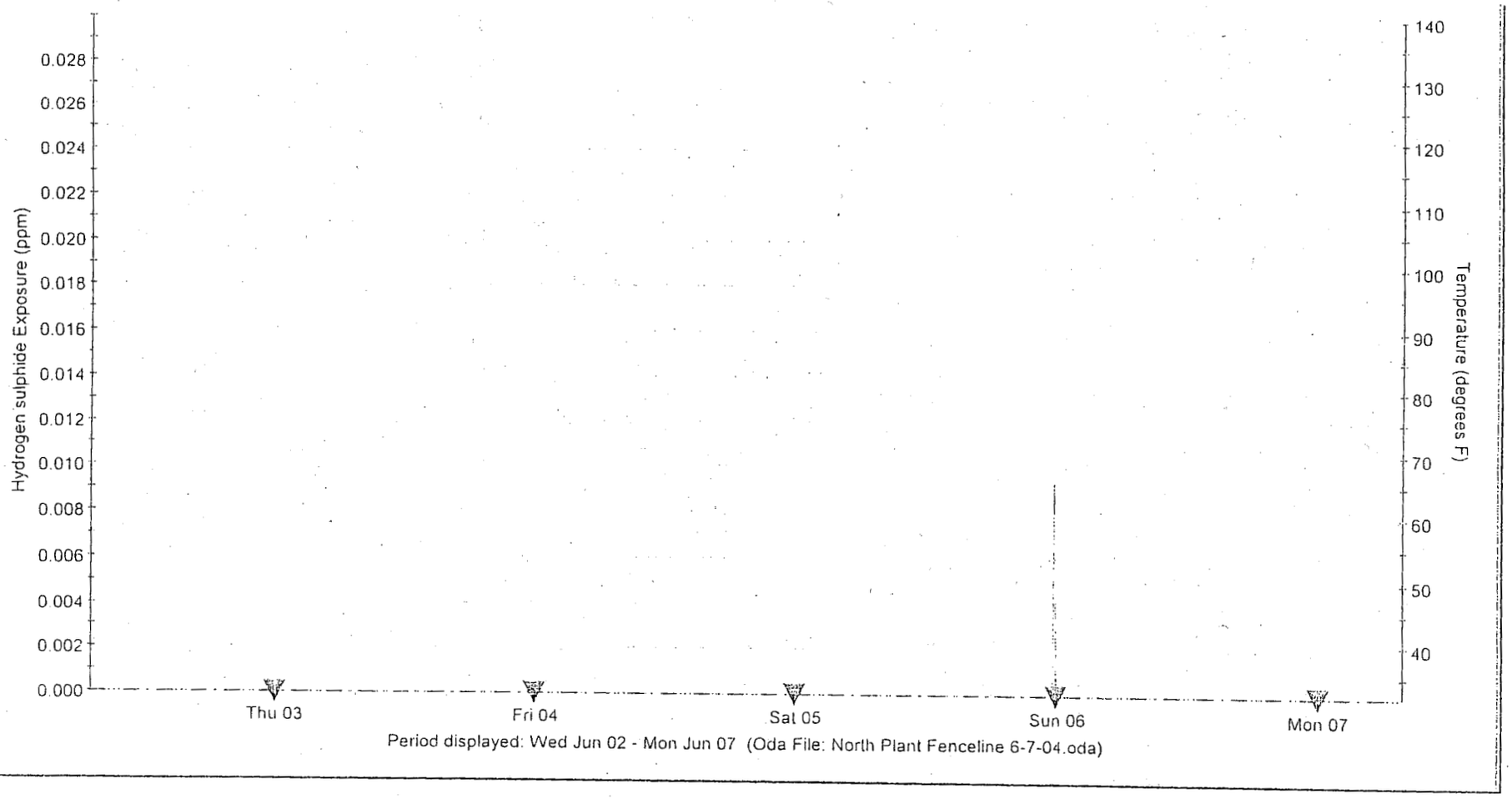

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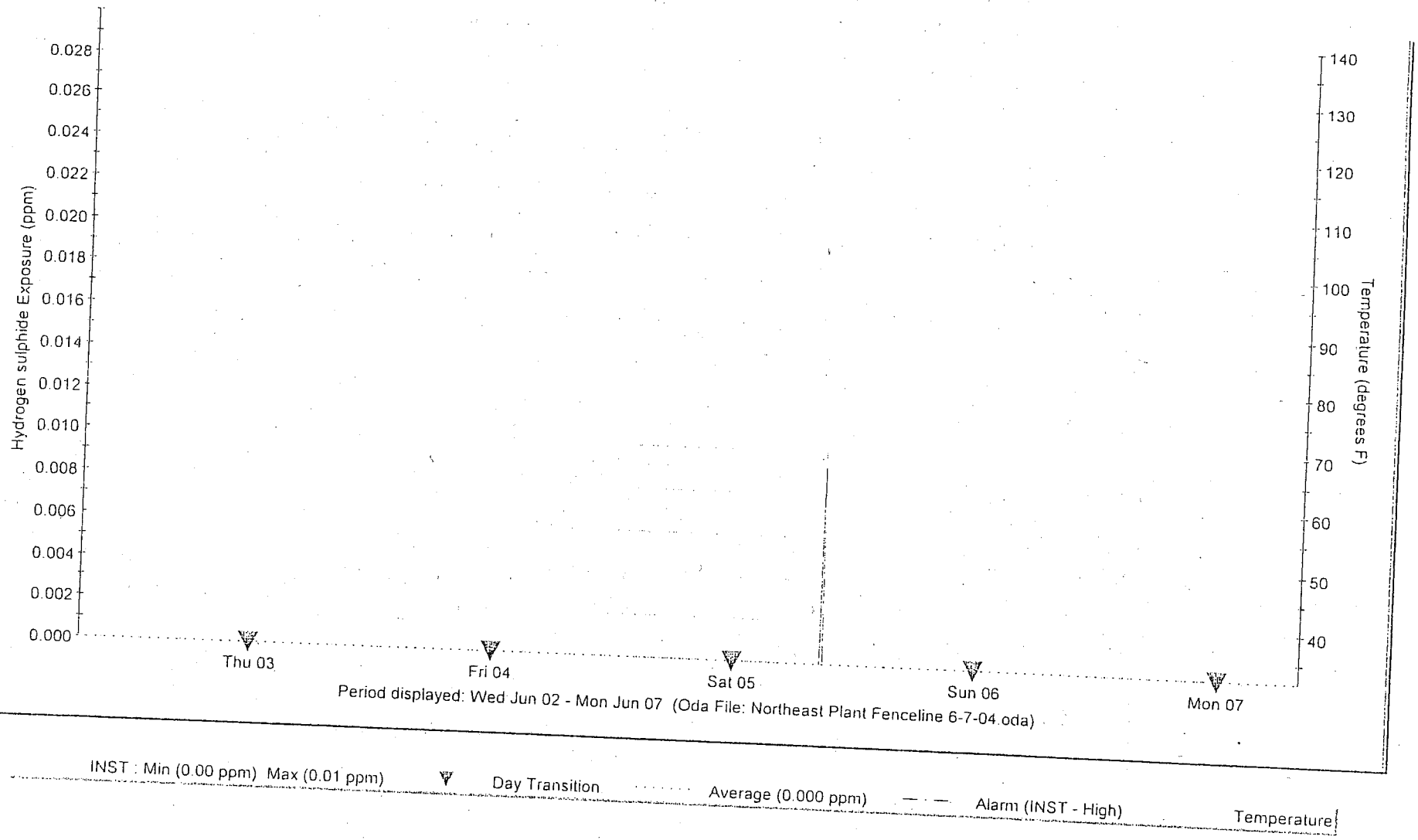

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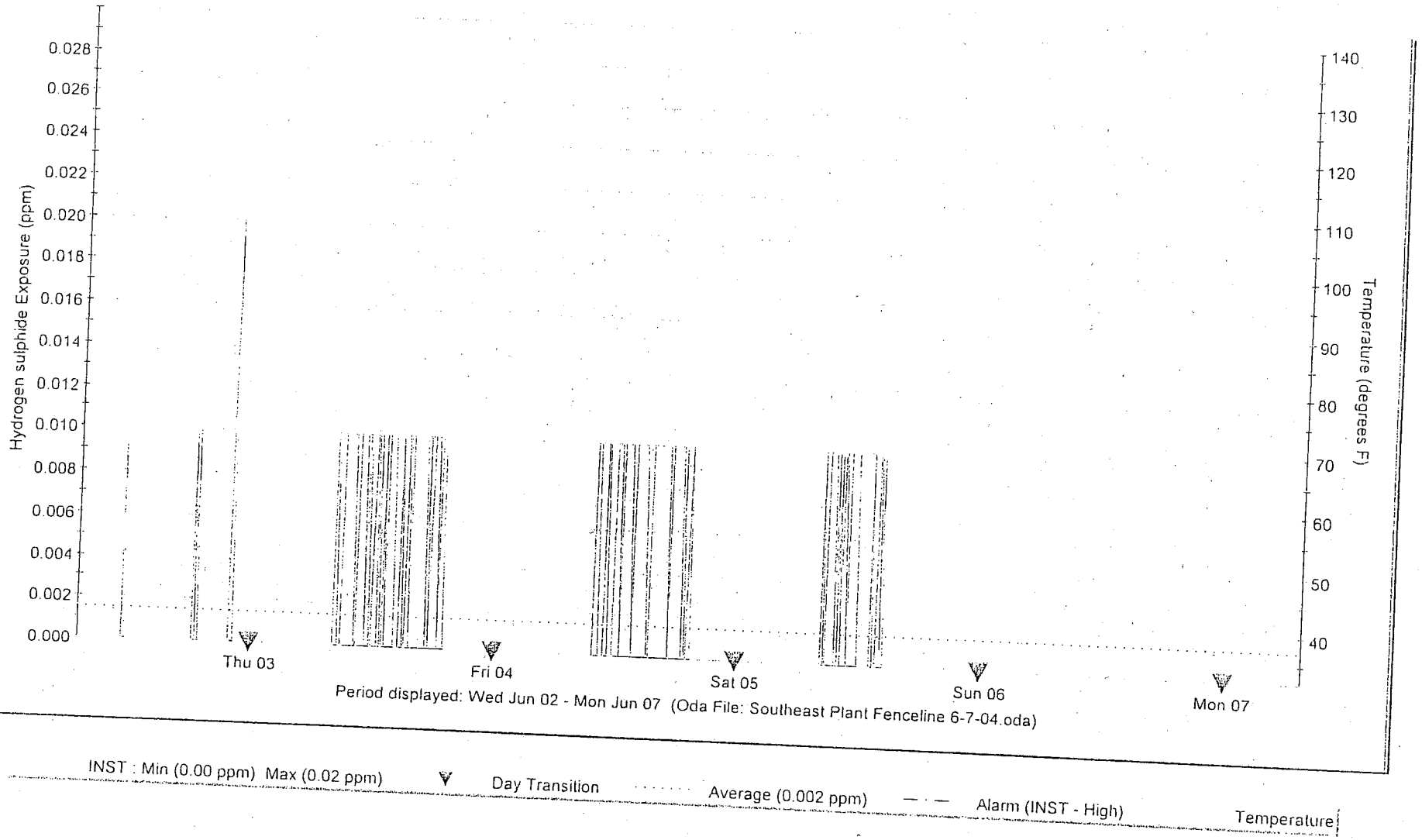

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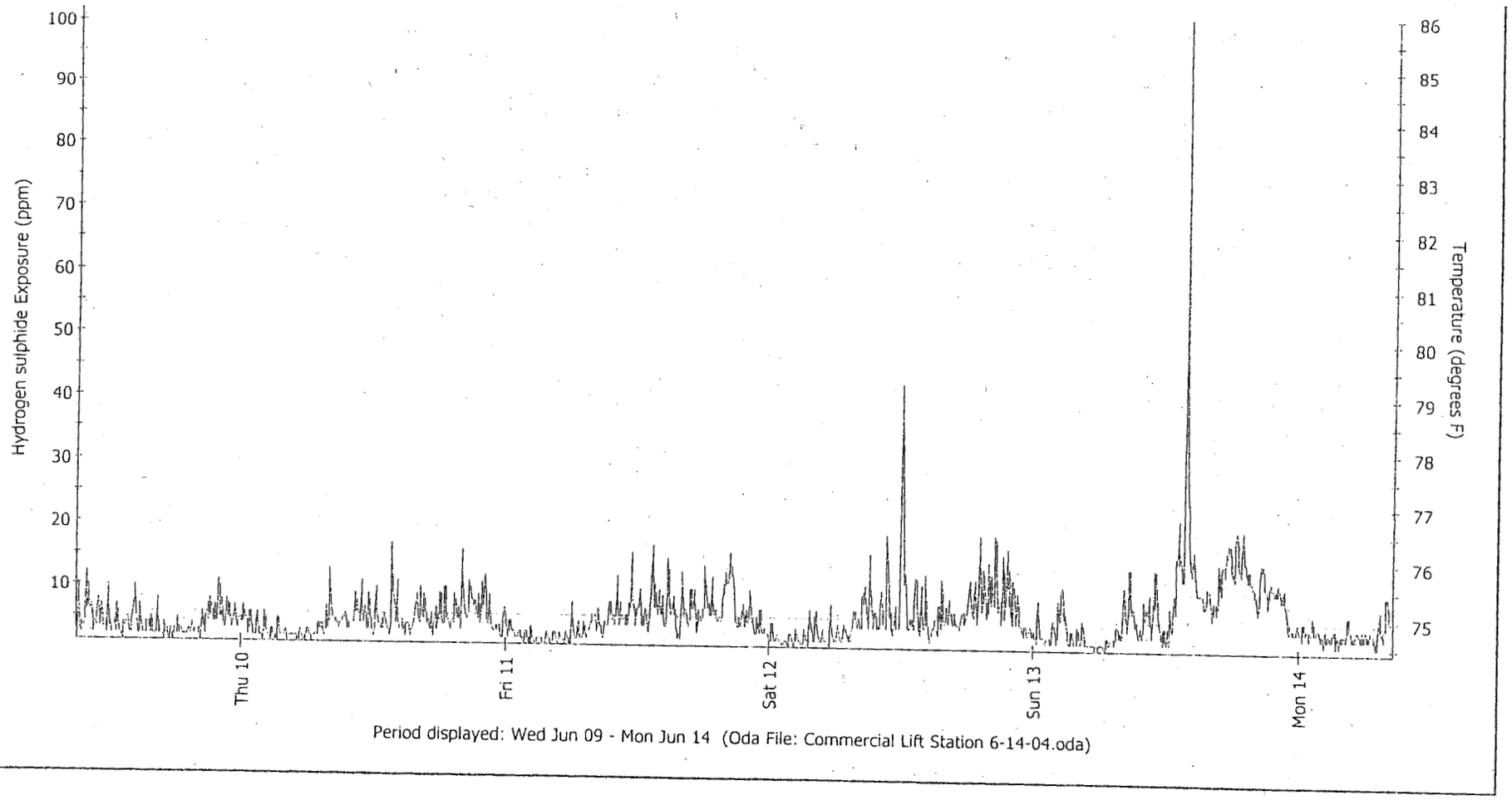

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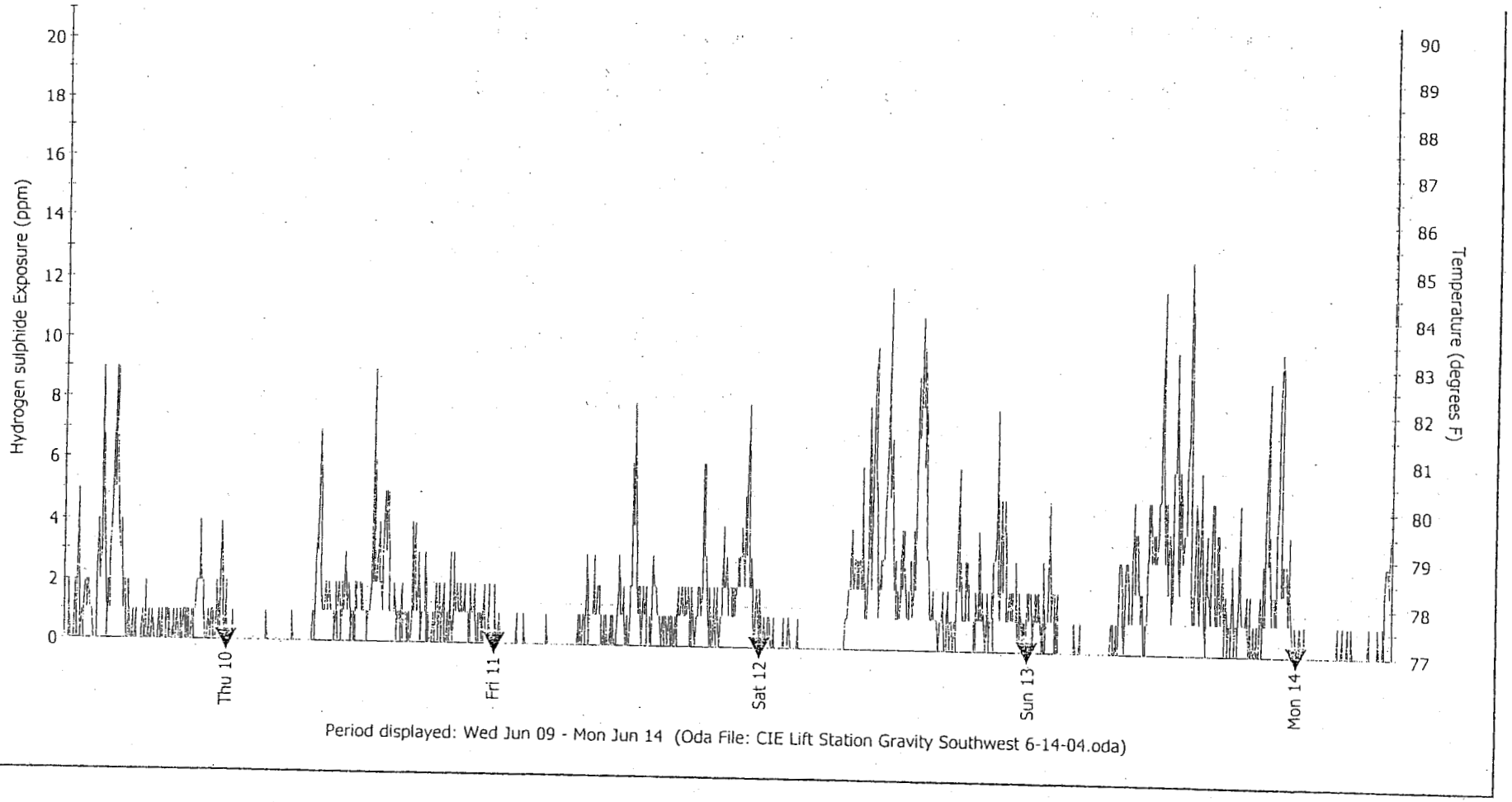
- Session: 1 (OdaLog: OL05123688)



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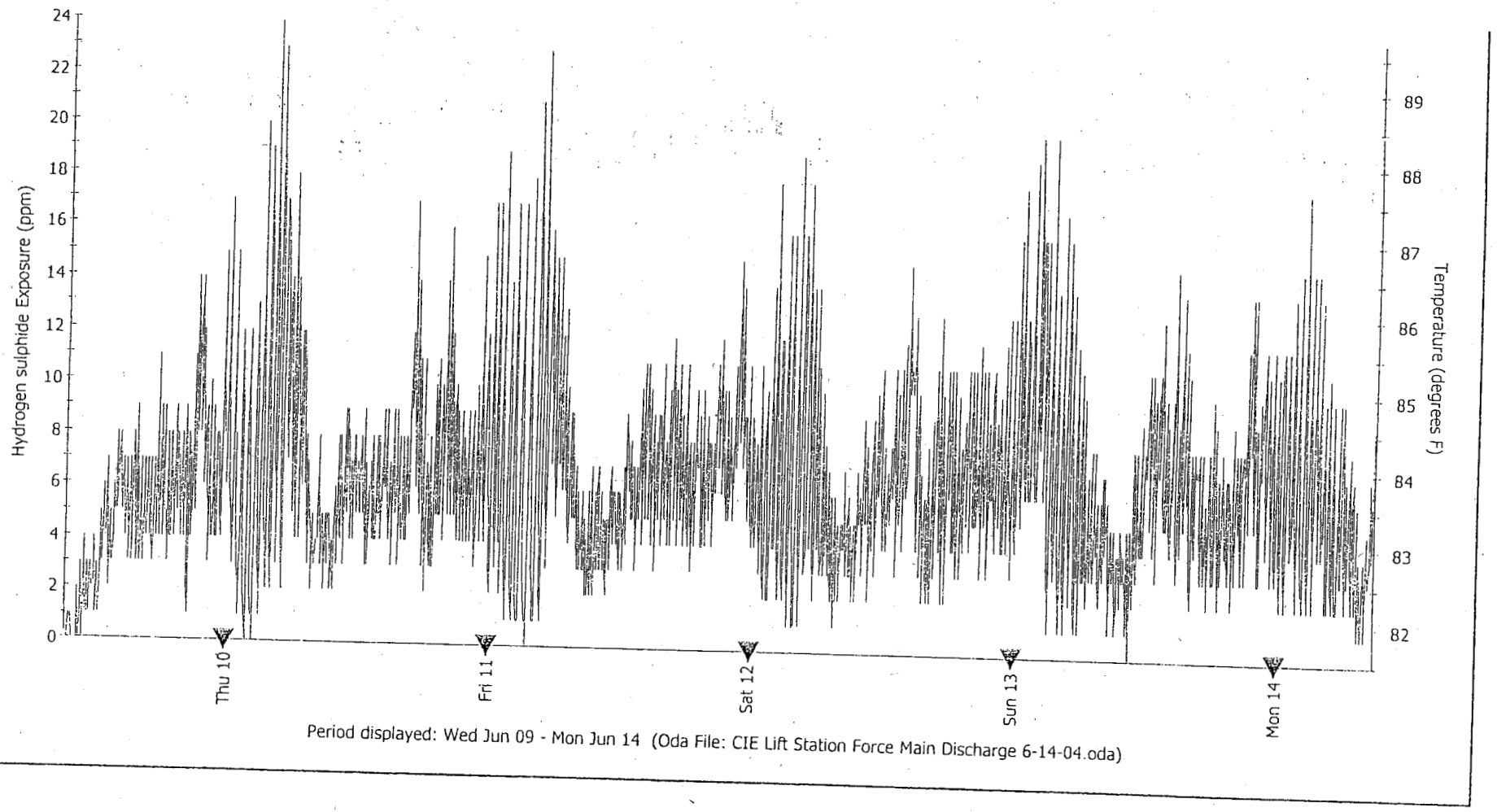

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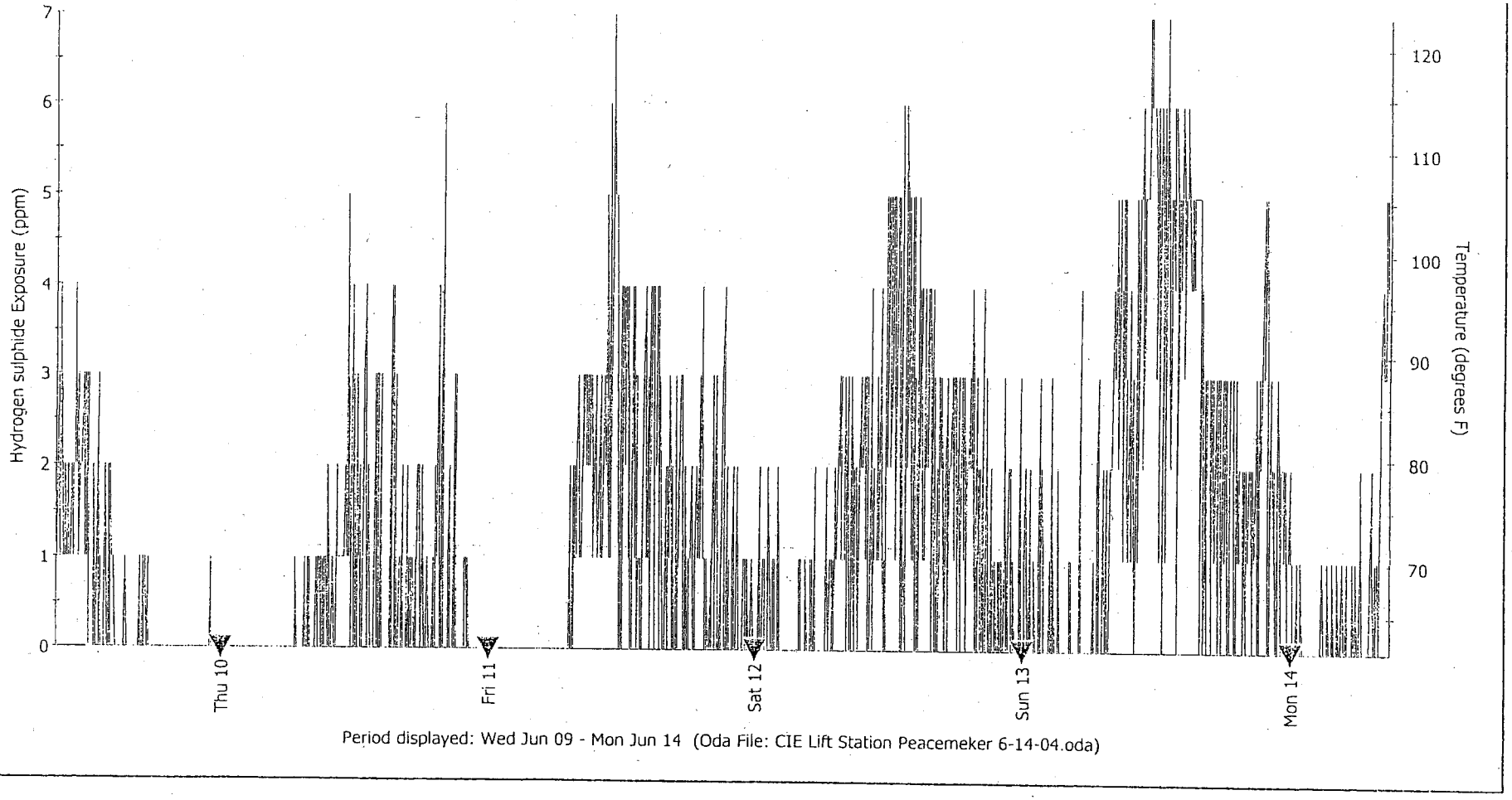

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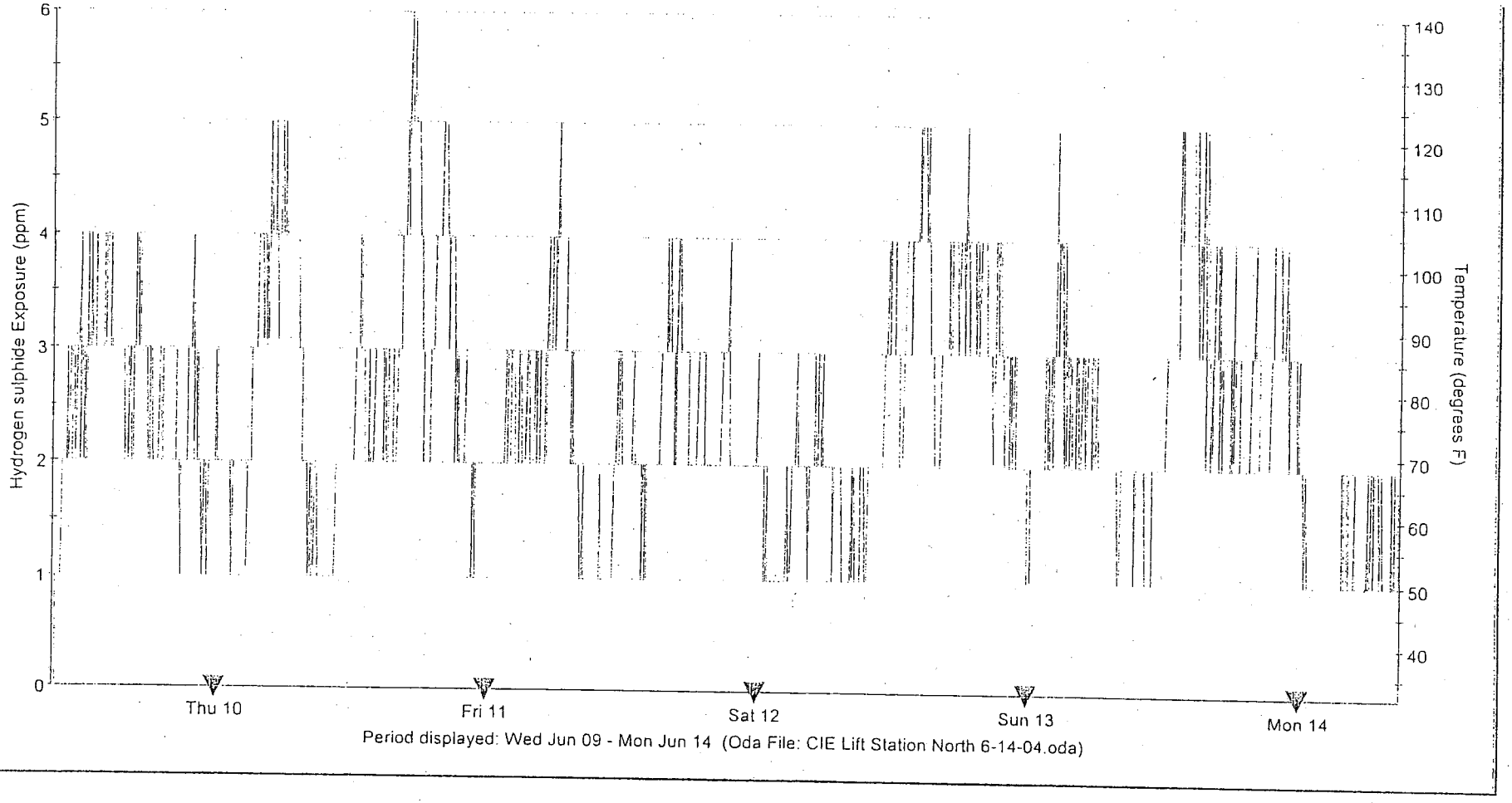
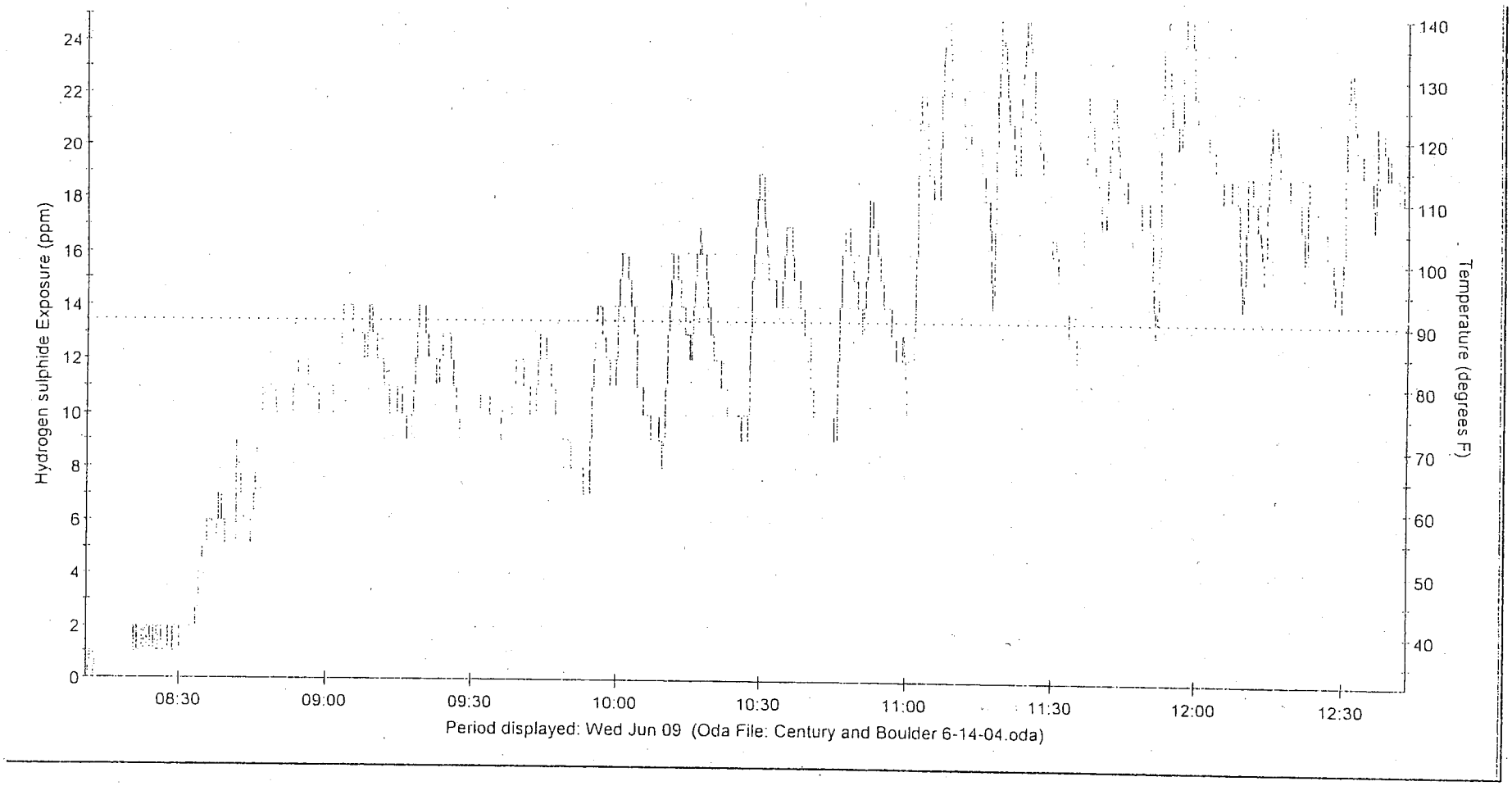
- Session: 1 (OdaLog: OL02011278)



INST ▼ Day Transition Temperature

- Session: 1 (OdaLog: OL45080161)



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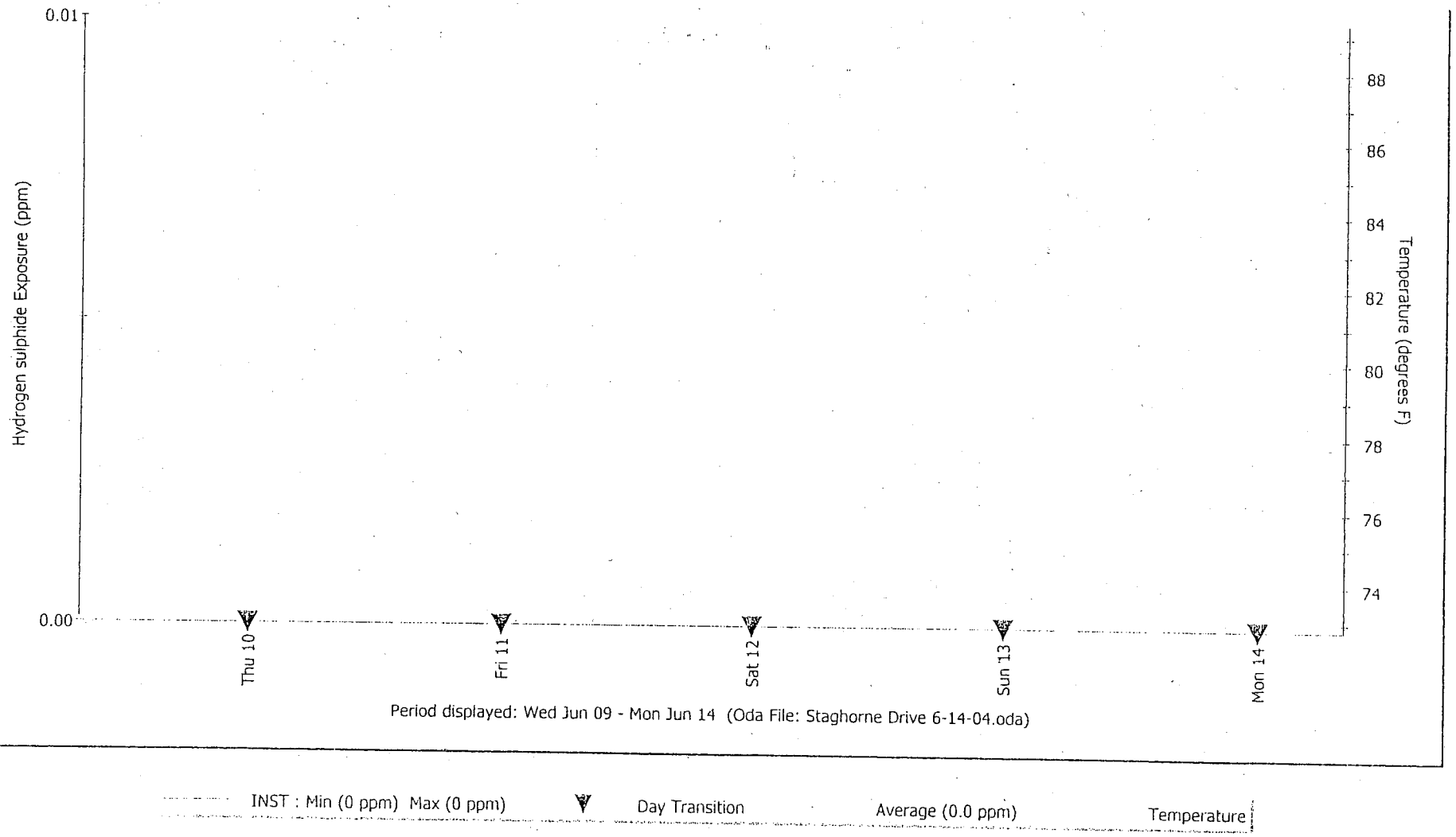

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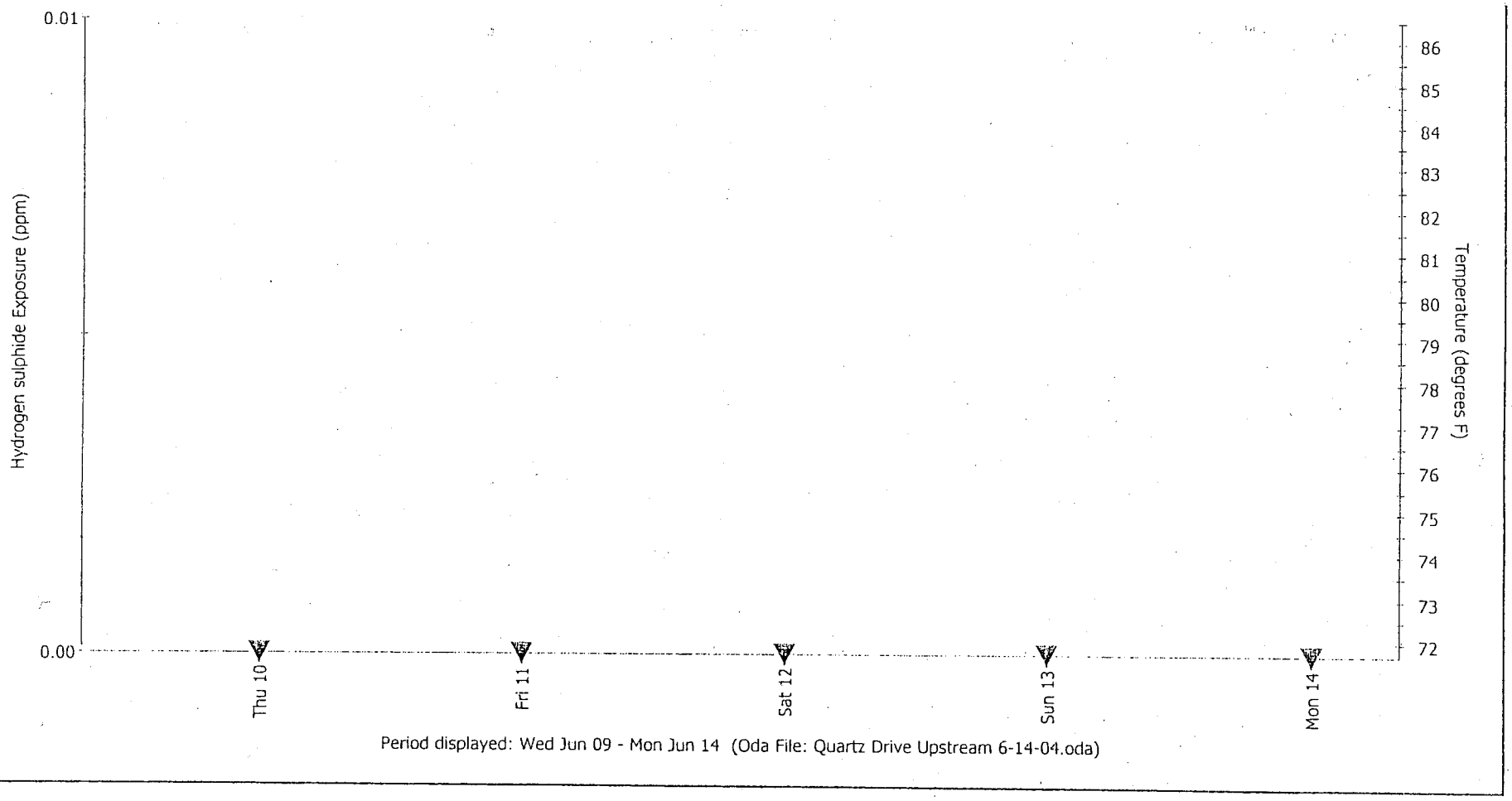

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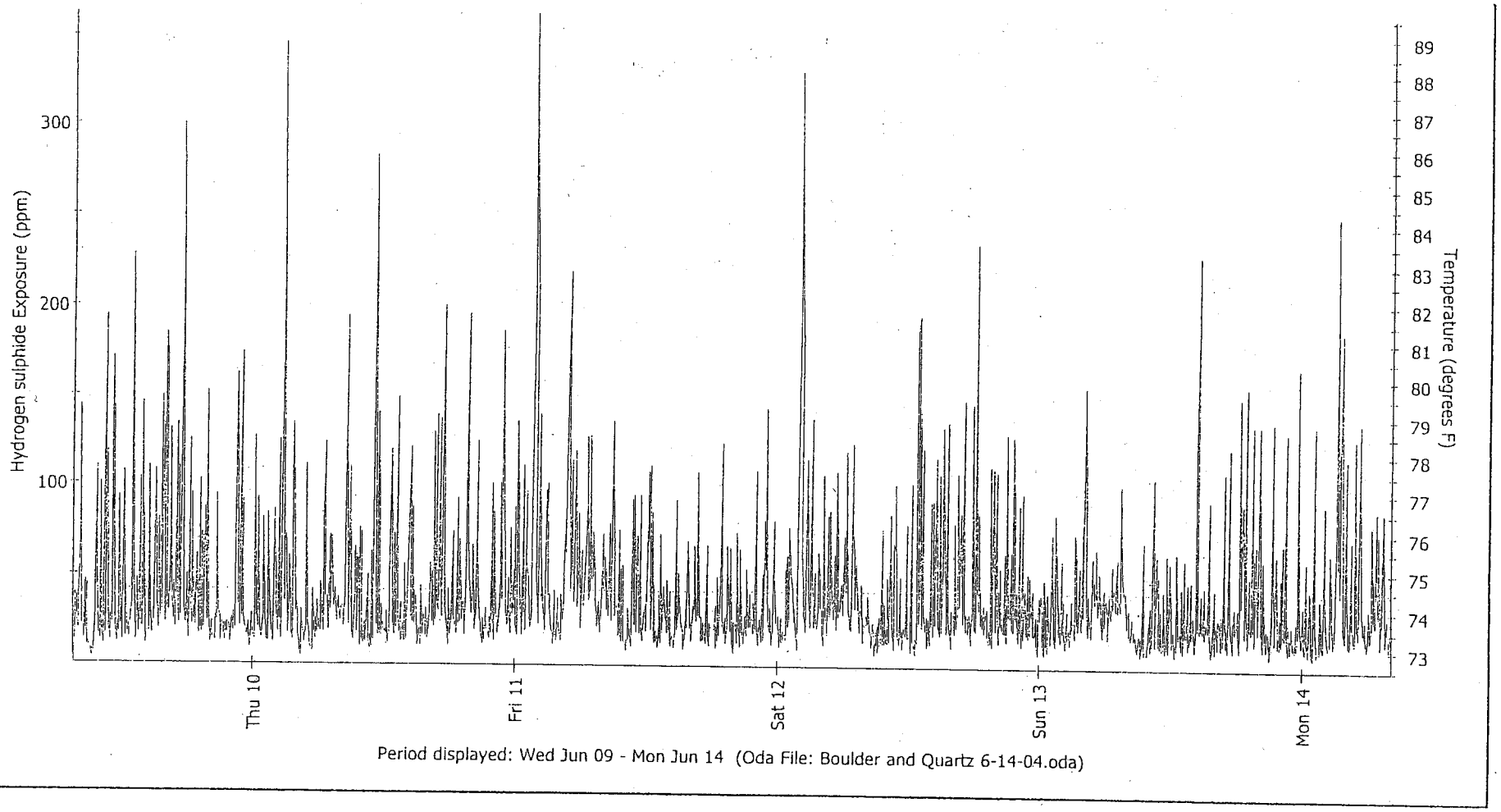
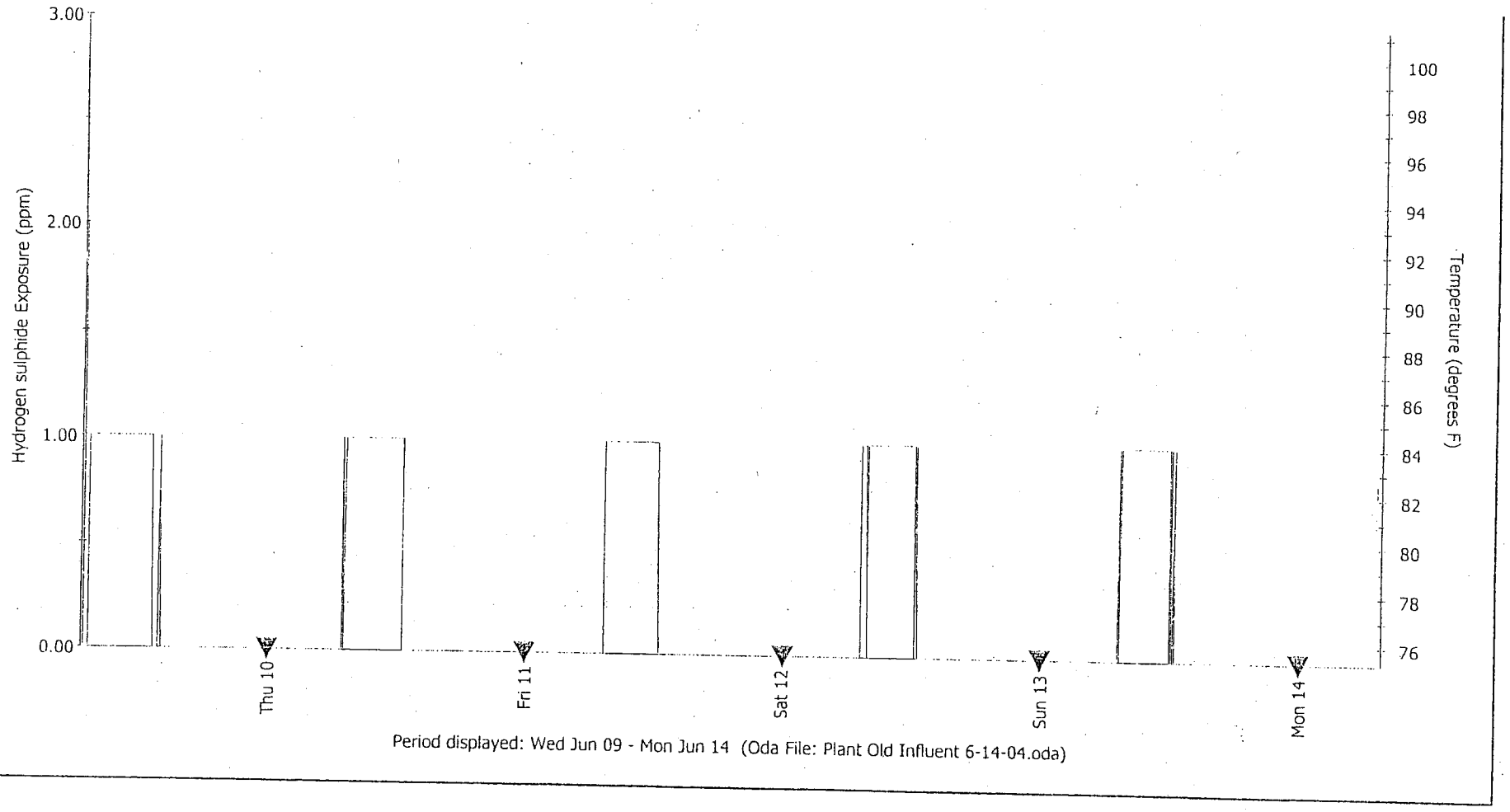
- Session: 1 (OdaLog: OL4505085)



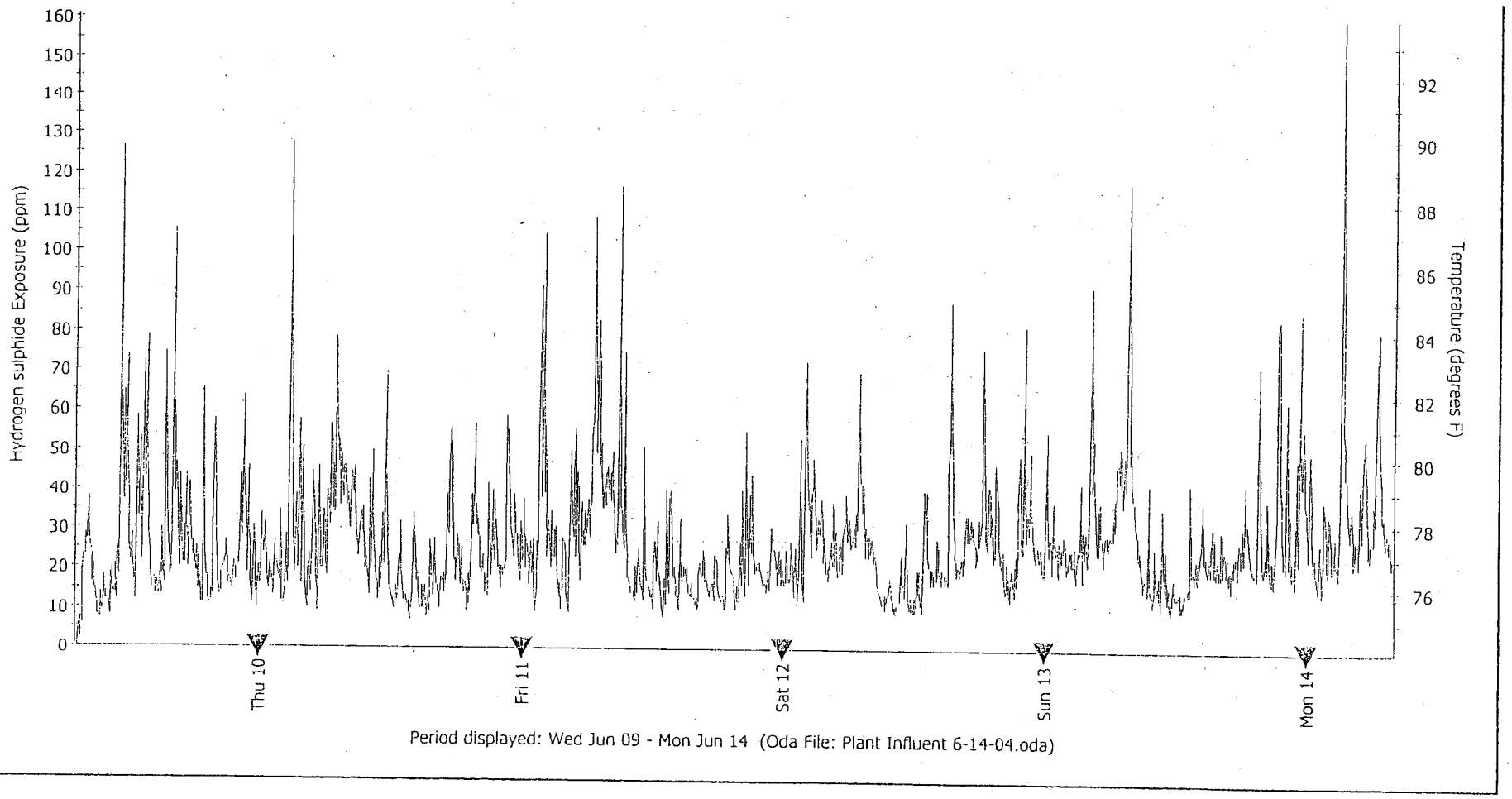
INST : Min (1 ppm) Max (364 ppm) ▼ Day Transition Average (42.1 ppm) Temperature

- Session: 3 (OdaLog: OL05011232)



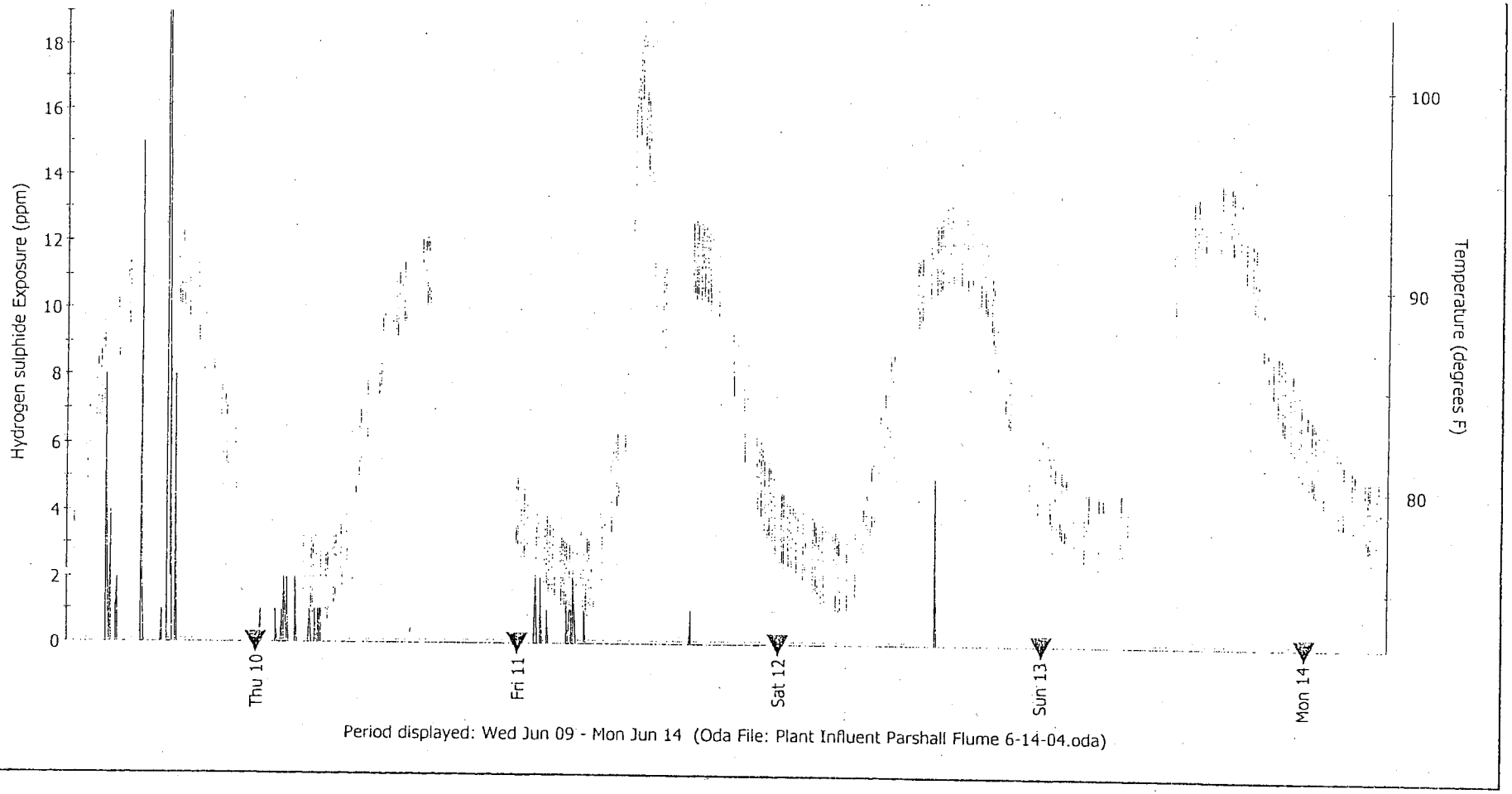
INST : Min (0 ppm) Max (3 ppm) | Day Transition | Average (0.2 ppm) | Temperature

- Session: 1 (OdaLog: OL45033819)



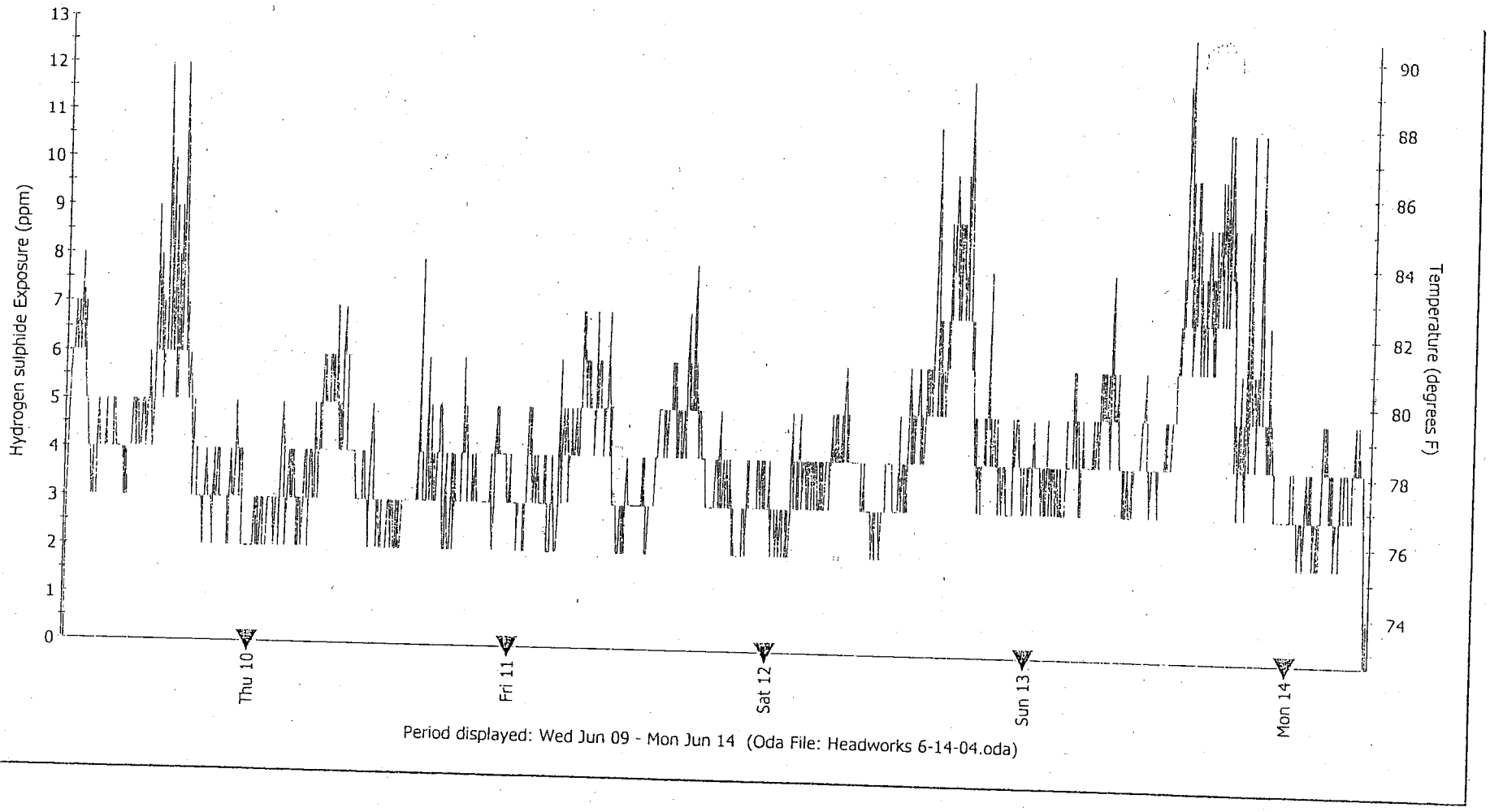
INST : Min (0 ppm) Max (161 ppm) Day Transition Average (27.0 ppm) Temperature

- Session: 1 (OdaLog: OL0504074)



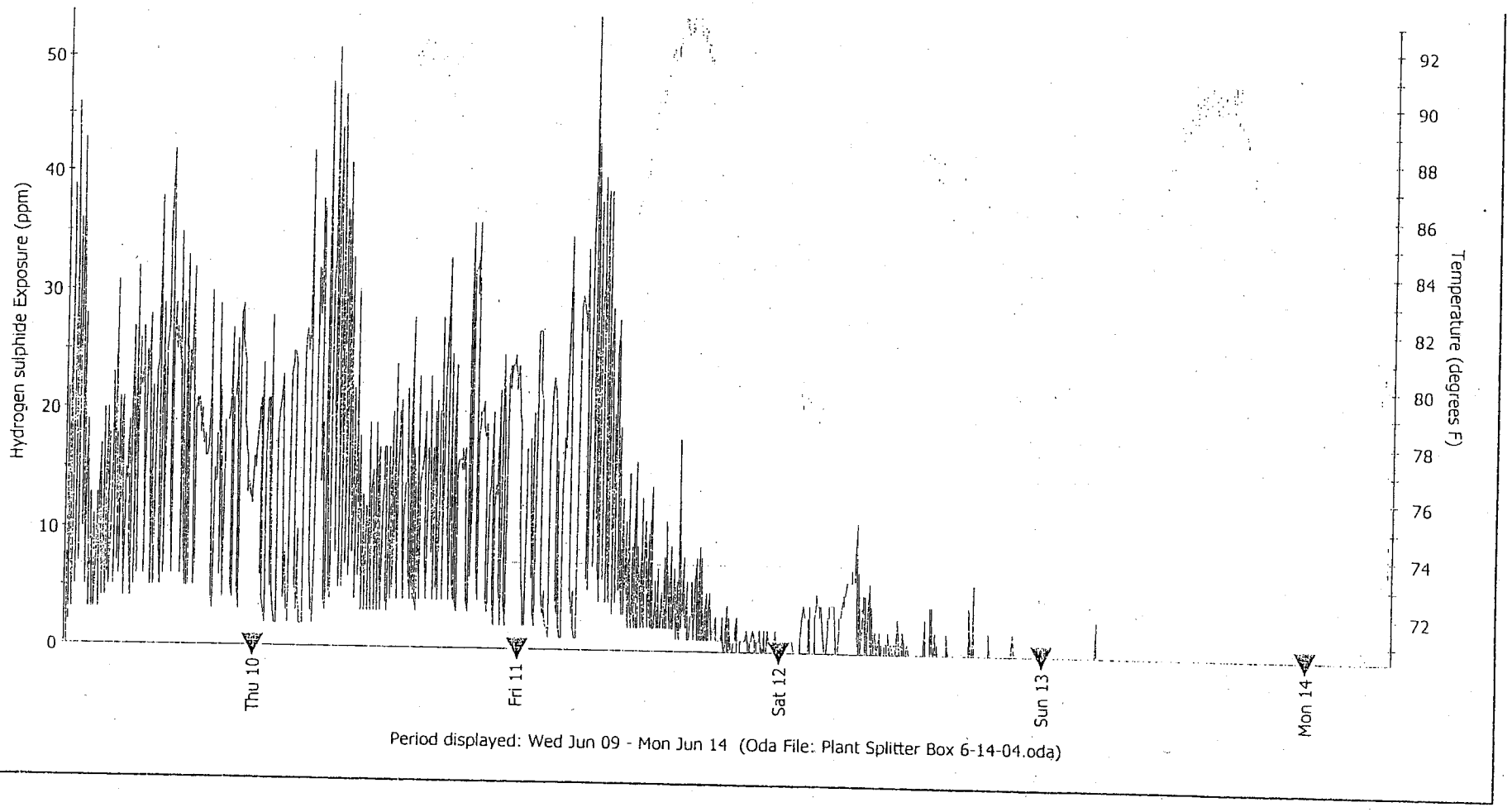
INST : Min (0 ppm) Max (19 ppm) Day Transition Average (0.1 ppm) Temperature

- Session: 1 (OdaLog: OL0504068)



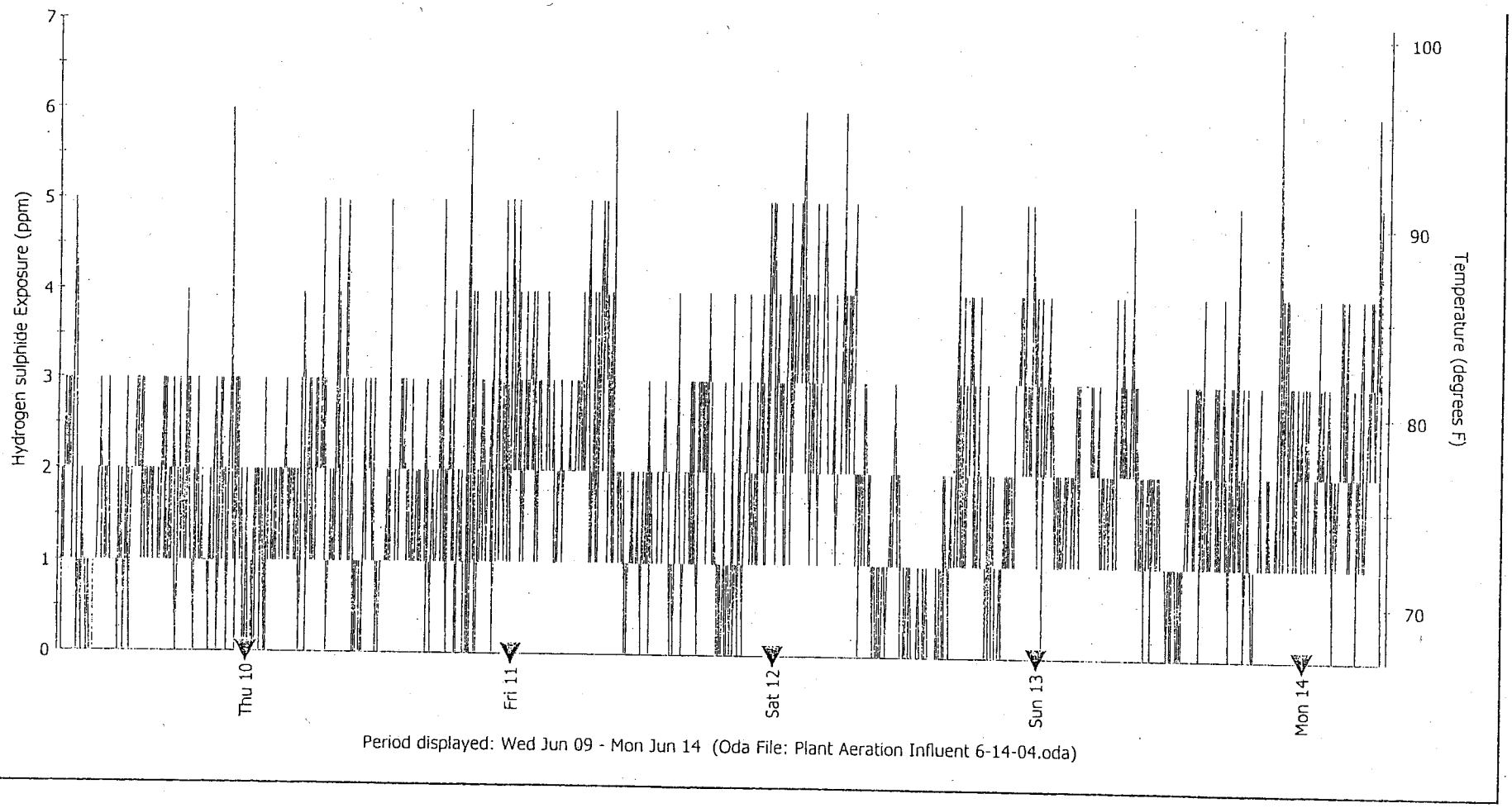
INST : Min (0 ppm) Max (13 ppm) Day Transition Average (4.2 ppm) Temperature

- Session: 1 (OdaLog: OL0504069)



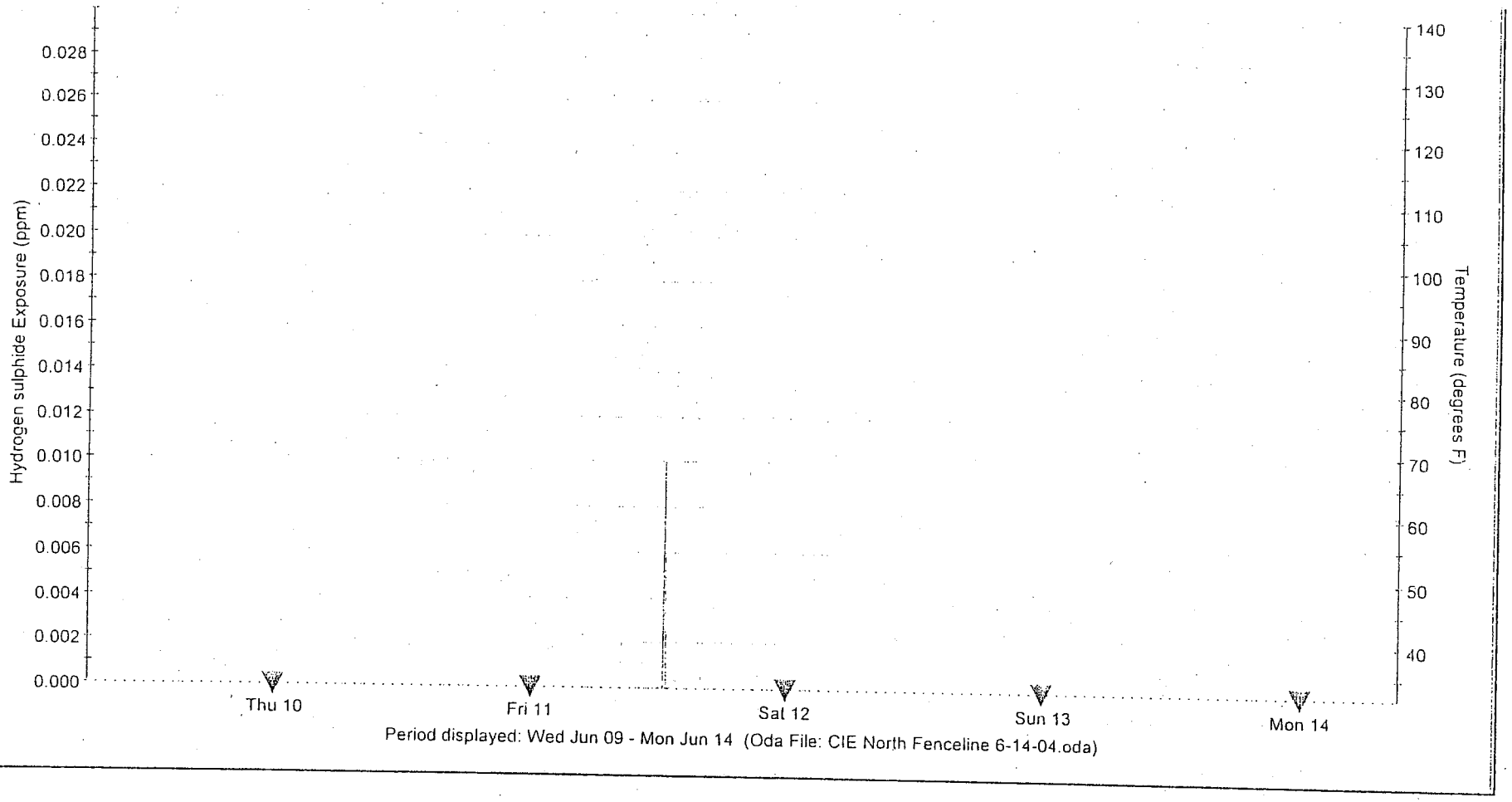
INST : Min (0 ppm) Max (54 ppm) Day Transition Average (7.3 ppm) Temperature

- Session: 1 (OdaLog: OL05113658)



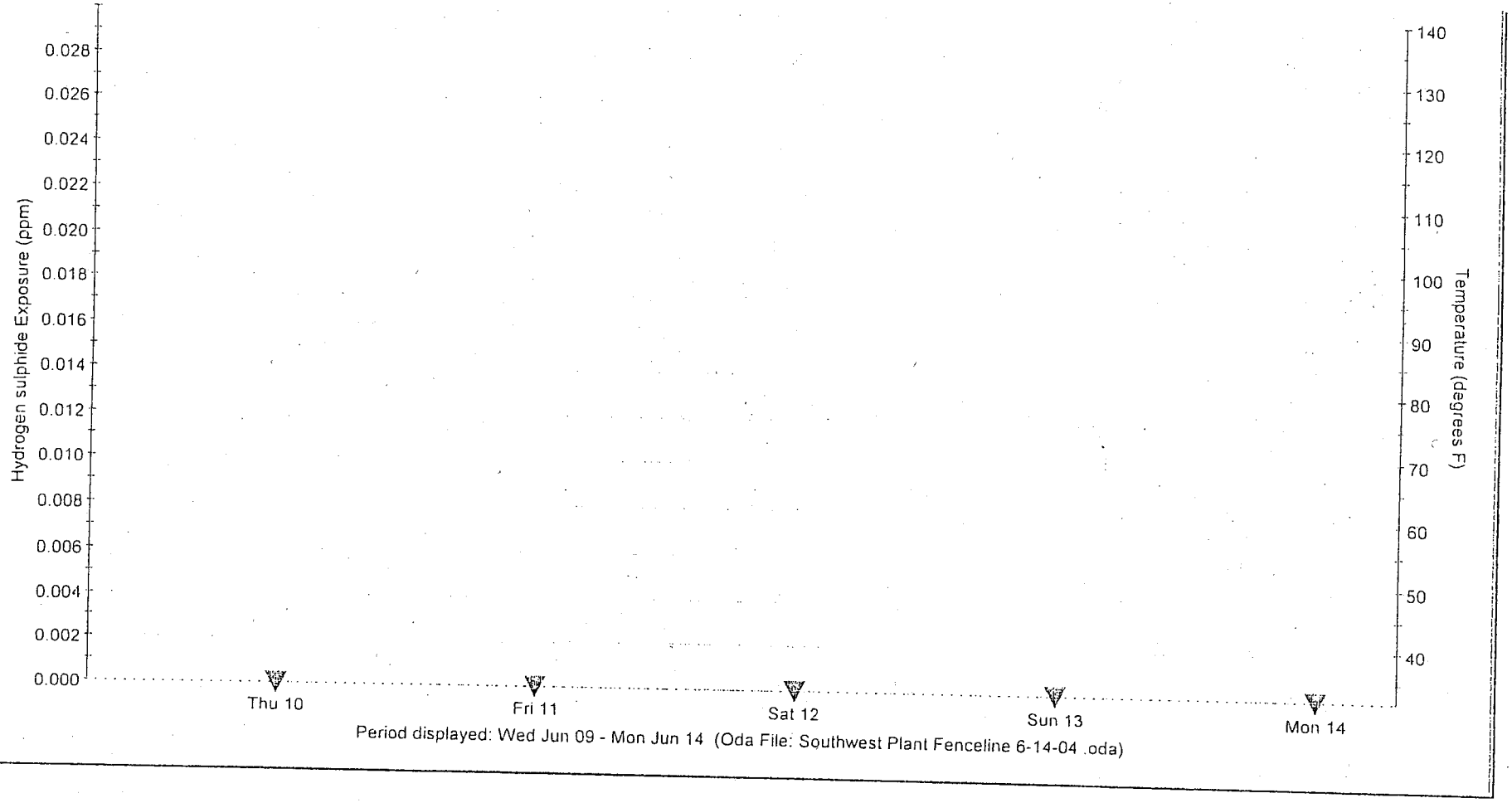
INST : Min (0 ppm) Max (7 ppm) Day Transition Average (1.8 ppm) Temperature

- Session: 1 (OdaLog: OL50044578)



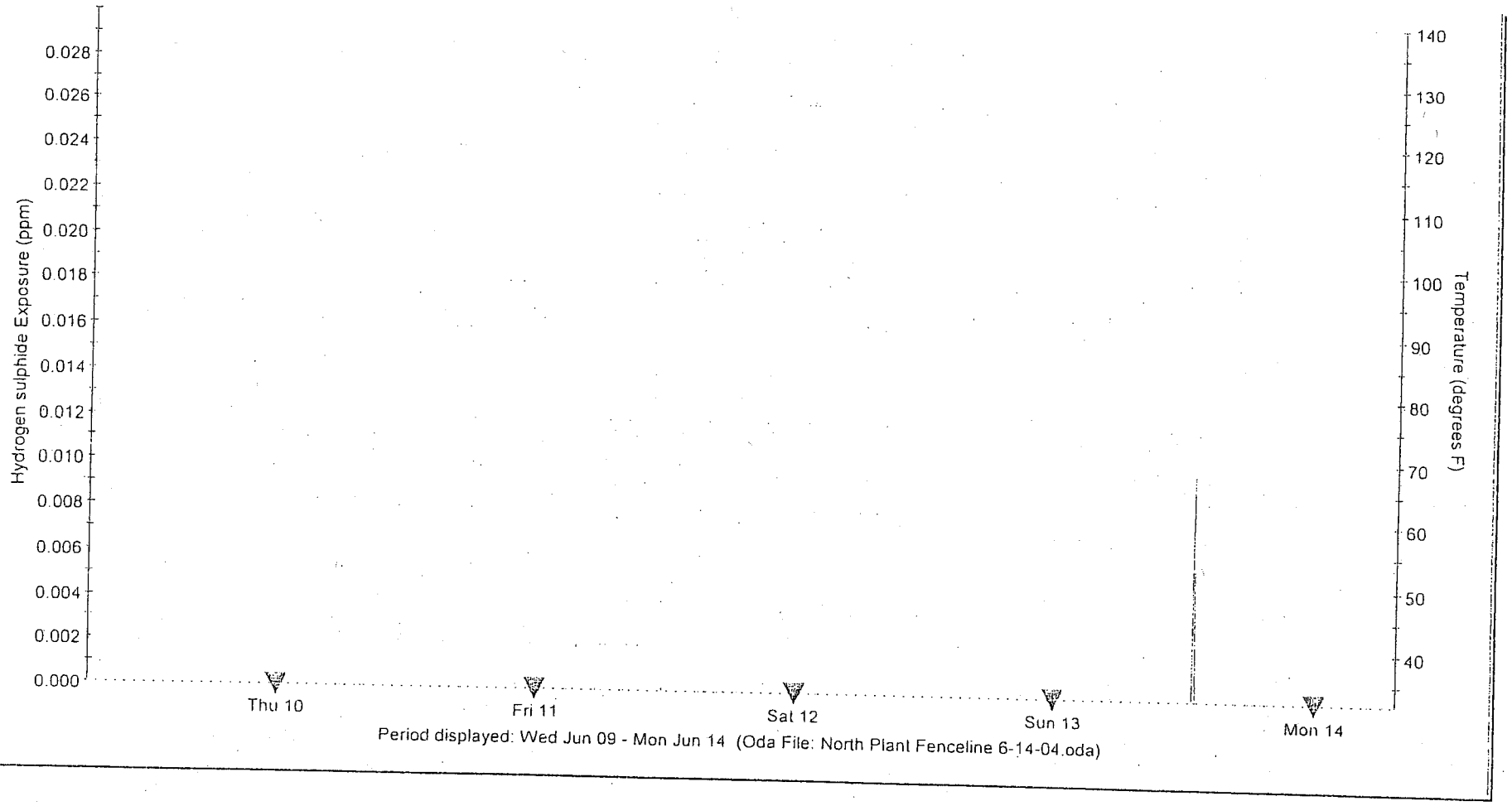
INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50063509)



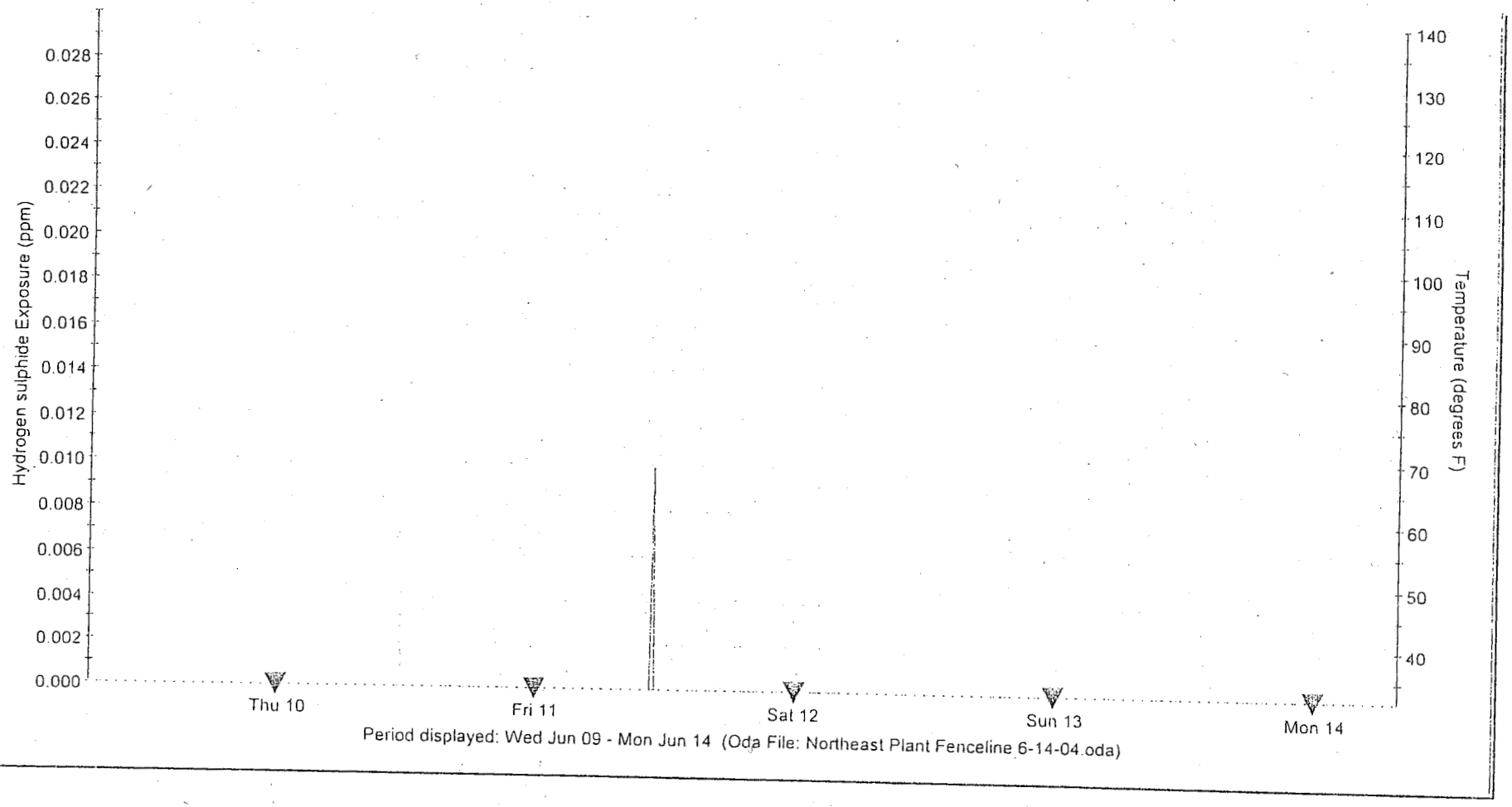
INST : Min (0.00 ppm) Max (0.00 ppm) ▼ Day Transition ····· Average (0.000 ppm) — · — Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50083533)



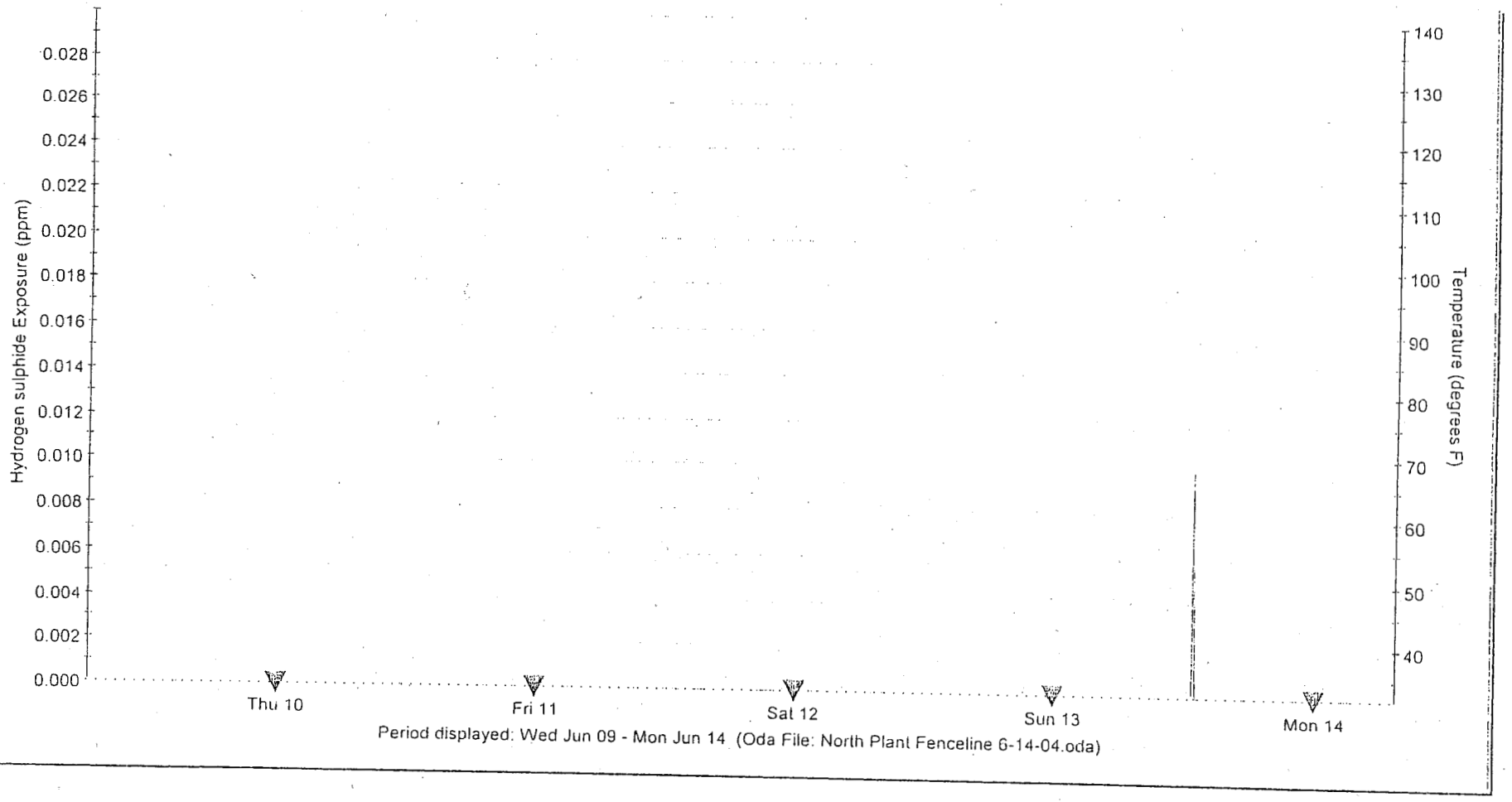
INST : Min (0.00 ppm) Max (0.01 ppm) Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50073521)

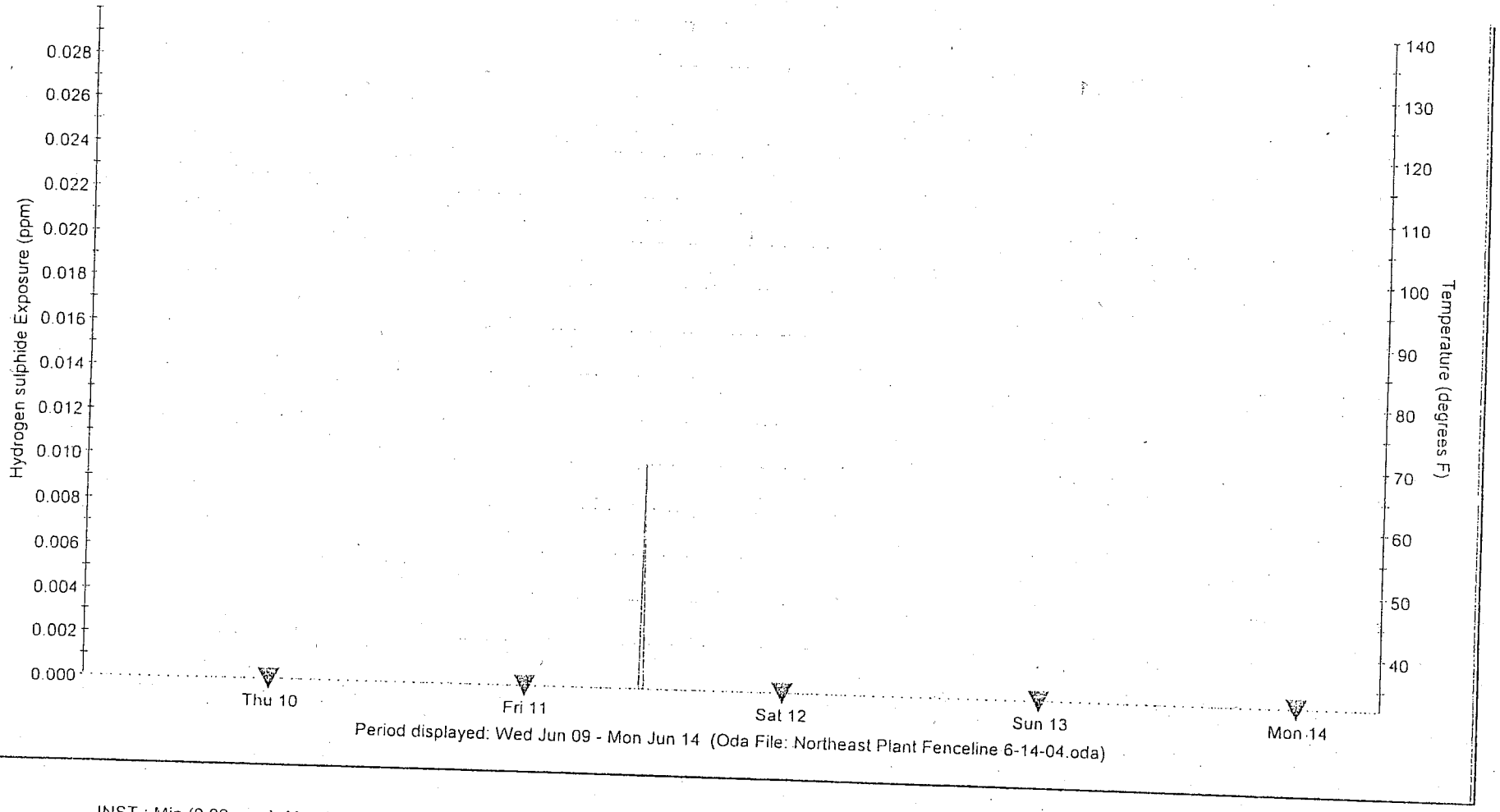


INST : Min (0.00 ppm) Max (0.01 ppm) Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50083533)



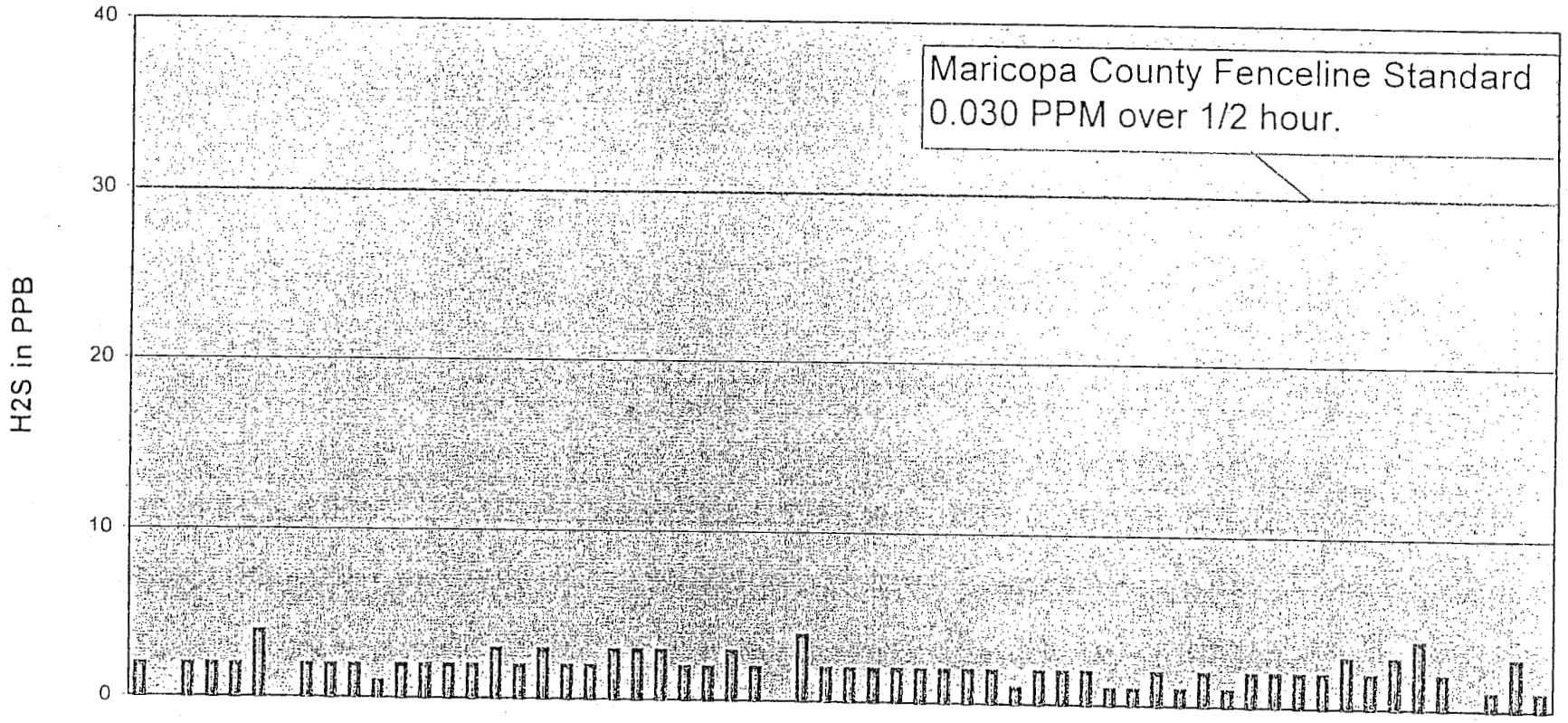
- Session: 1 (OdaLog: OL50073521)



INST : Min (0.00 ppm) Max (0.01 ppm) ▼ Day Transition ····· Average (0.000 ppm) — — Alarm (INST - High) Temperature

CIE Lift Station Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



North Fenceline

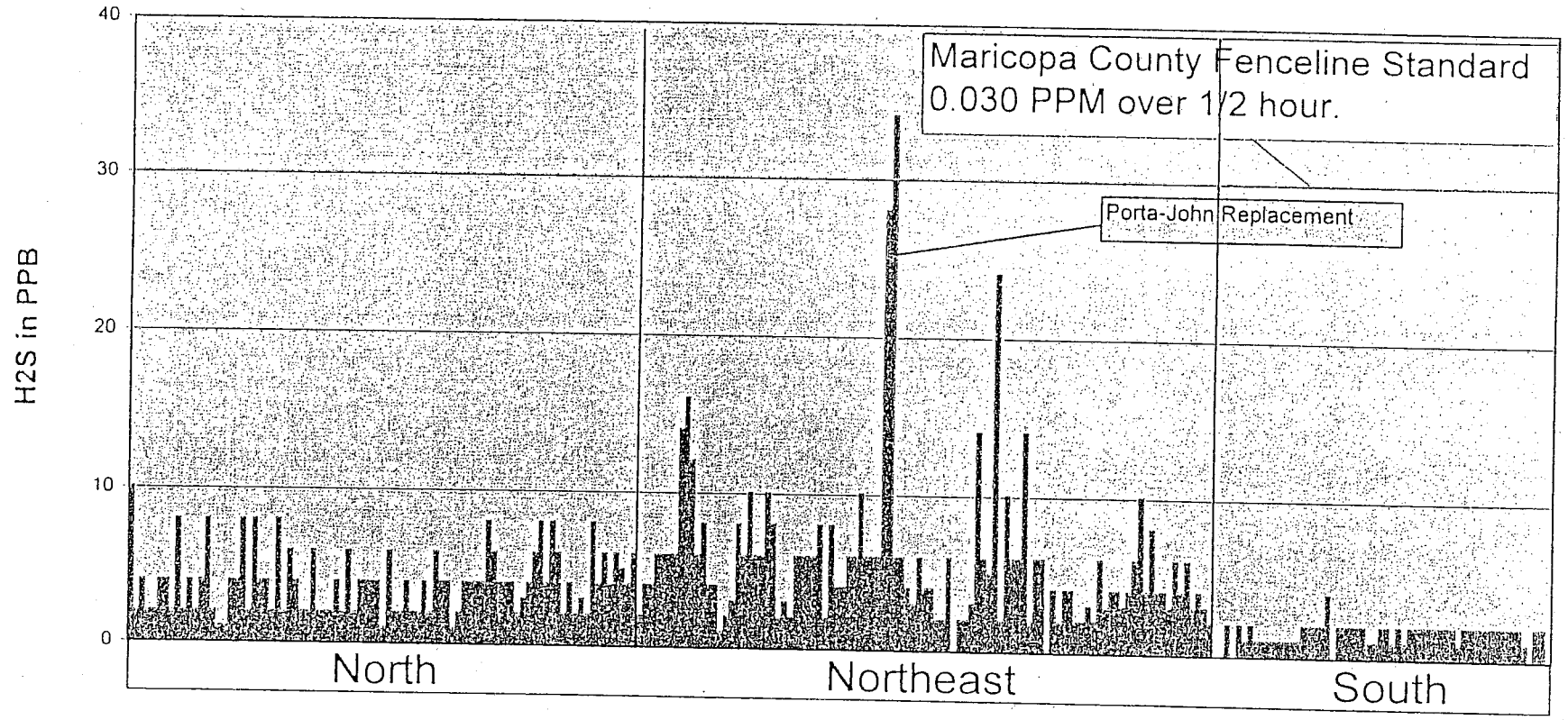
Wind -- Southwest to Northeast at 3-7 mph

Fence

June 8, 2004

The Boulders WRF Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



Fenceline

Wind -- Southwest to Northeast at 3-7 mph

Fence

June 8, 2004

APPENDIX B

CORRESPONDENCE BETWEEN TOWN OF CAREFREE AND BLACK MOUNTAIN SEWER CORPORATION

TOWN OF CAREFREE

100 EASY STREET
P.O. BOX 740
CAREFREE, ARIZONA 85377
(480) 488-3686 • FAX (480) 488-3845

OFFICE OF THE MAYOR

Mr. Bob Dodds
President
Algonquin Power Systems, Inc.
2845 Bristol Circle
Oakville, Ontario, Canada L6H 7H7

May 25, 2004

Re: Black Mountain Sewer Corporation Collection System
System I.D. #37-105

Dear Mr. Dodds:

Thank you for taking my call yesterday and discussing our mutual concerns regarding the collection system of the Black Mountain Sewer Corporation. I particularly admire an executive who takes calls on a National holiday. As a follow up to our discussion, I wish to provide you additional information relating to sewer odor problems at the Carefree Inn Lift Station and the north Boulders subdivisions. I have listed below some of the factors we discussed and agree need to be addressed by the Black Mountain Sewer Corporation in resolving the existing odor problems in the collection system and noise from the Boulders plant.

1. There are two 6" pressure lines approximately 5,500 feet in length that transport raw sewerage from the Carefree Inn Lift Station to the gravity manhole at the entrance to the Boulders gravity collection system (see attached map). The pump, that pressurizes the system, pumps 200 gpm. At 200 gpm through 2, 6" pipes, the velocity of the raw sewerage in the lines is below the 2 ft/sec required to scour the pipe and keep the solids from settling out. We believe solids have built up in the pressure pipes and are a main contributor to the septic conditions of the discharge. In addition, there are two wet wells and a septic tank at the lift station that are used to hold raw sewerage until it can be pumped. They hold approximately 1500 gallons of raw sewerage. Average pumping time that the pumps operate is about 2.5 minutes each cycle, which means that 66% of the raw sewerage remains in the wet wells all the time allowing time for the sewerage to become septic.
2. The same conditions exist at the Commercial Lift Station except that at this station Thio-guard is injected for odor control. The odor control works for a period of time, but after sitting in the downstream lift station and pressure piping as long as it does, it becomes ineffective.
3. There has been no control over maintenance of grease traps connected to the

collection system and limited cleaning of gravity lines. Buildup in the gravity lines, especially if grease enhanced, is known to contribute to the formation of odors.

4. There is no odor scrubber on the pressure line discharge manhole. The pressure line discharge at the discharge manhole causes surcharging in this and other down stream manholes, forcing odors into the atmosphere.

I offer the following specific suggestions in addressing some of the solutions to these problems.

1. Closing one of the 6" force mains to increase the velocity in the pipe.
2. Using ferric chloride as a odor elimination chemical in place of the Thio-guard.
3. Flushing the pressure line with enough water to vacate the entire line on a regular basis. (10,000 gallons per flushing).
4. Using an odor scrubber at the pressure line discharge manhole.
5. Establishing a program of inspecting the grease traps for proper maintenance.
6. Pressure cleaning gravity sewer lines on a regular basis often enough to eliminate buildup in the system.
7. Install pumps and lines sized to pump the daily flow on a continuing basis.
8. Elimination of the large amount of stored, raw sewerage at each lift station.
9. Find and install acoustical material to soften sound from the plant.

The residents around the lift stations and gravity flow line are extremely frustrated that these problems persist as evidenced by the continuing odor problem. I appreciate your consideration of the above listed issues and your willingness to be present at our June 1, 2004 Council Meeting. It is the Town's opinion that something must be done promptly in resolving the existing odor problems.

Sincerely,

Edward C. Morgan
Mayor

JP: jd

CC: Carefree Town Council
Michael Weber, General Manager, Black Mountain Sewer Corporation
Dale G. Bodiya, Maricopa County Environmental Services Department

June 23, 2004

RECEIVED
JUN 28 2004
Town of Carefree

BW

ALGONQUIN
WATER RESOURCES
OF AMERICA, INC.

Mayor Ed Morgan
Town of Carefree
100 Easy Street
P.O. Box 40
Carefree, Arizona 85377

RE: Nine-Point Odor Improvement Letter Response.

Dear Mayor Morgan,

As requested, please accept this letter as formal response from the Black Mountain Sewer Company (BMSC) in reference to your letter dated May 25, 2004 addressing nine (9) points of interest for consideration as improvements to the Carefree Inn Lift Station and the North Boulder Subdivision. Specifically, these points, as well as some of the preliminary discussion topics, are addressed as follows:

1. *Operating CIE force mains at less than 2 ft/sec* - The CIE Lift Station is currently constructed with one (1) six-inch and one (1) four- inch parallel pressure (force) mains. The two lift station pumps are rated at 255 gallons per minute (gpm) each at 90-feet of total discharge head (ft-tdh) and 320 gpm at 81 feet of total discharge head. The minimum flow rate to achieve the required 2.0 - feet per second (ft/sec) scour velocity in the six- inch main is 160 gpm. The minimum flow rate to achieve the minimum required 2.0 - feet per second (ft/sec) scour velocity in the four - inch main is 70 gpm. By operating both mains in parallel, the total discharge head on the pumps reduces from 90 ft-tdh to 81 ft-tdh. The lower discharge head allows the pumps to operate at an increase flow rate of 320 gpm, which increases the velocity in each of the force mains well above the 2.0 ft/sec requirement.

   The CIE wet-well has a capacity of 150 gallons per foot. The operating level of the wet-well manhole has been adjusted to operate between 6-inches and 4.5 feet or 600 gallons (plus the additional flow from the collection system). The lift station pumps are controlled by level and not by time. The pumps clear the entire contents of the chamber to within 6-inches of the floor each cycle regardless of the time. The time of each pump cycle varies depending on the volume of sewage in the chamber. Therefore the chamber is not 66% full after a pumping cycle as indicated in the letter.

2. *The effective use of Thioguard at the Commercial Lift Station* – Magnesium hydroxide (trade name Thioguard) is currently being used for odor control at the Commercial Lift Station. This chemical is injected into the wet-well and when

Algonquin Water Services, LLC
111 W. Wigwam Road
Suite B
Litchfield Park, AZ 85340

Ph: 623-935-9367
Fax: 623-935-1020

correctly applied, increases the pH of the sewage to a range that inhibits hydrogen sulfide from forming (pH above 8.2). Preliminary data obtained on the BMSC indicates hydrogen sulfide reduction as high as 66% in the collection system from this chemical application. Contrary to the assertion that the chemical becomes ineffective, this chemical actually becomes insoluble at a pH range of 9.0. Once insoluble, the chemical travels in solution with the sewage flow until the pH drops below 9.0, becoming soluble and depositing in the force main until the concentration raises the pH to an insoluble range once again. This process continues through out the collection system, eventually coating the entire piping system and reducing hydrogen sulfide generation throughout. Current data indicates pH readings as high as 9.0 reaching the manhole at Boulders Drive and Quartz drive before entering the plant, supporting the fact that this chemical is not becoming ineffective, but is treating the entire pipeline from Commercial lift station to the treatment plant. Data collection from the odor control study is expected to provide further evidence of this phenomenon.

BMSC has initiated a force main flushing program which utilizes the full wet well capacity which is pumped utilizing two pumps simultaneously, thereby increasing the scour velocity well above the normal operating velocity of the main. The increased scour velocity is more than adequate to remove any existing material deposition in the force main. The increased flow also improves scouring velocity of the receiving gravity sewer main in the North Boulder subdivision. The main flushing is performed on each of the fifteen pumping stations on a semi-monthly basis.

3. *Industrial Pretreatment Program and Sewer Cleaning* – As BMSC has conveyed at previous meetings with the Town Council, BMSC's current tariff issued through the jurisdiction of the Arizona Corporation Commission (ACC) limits the provisions to address industrial pretreatment offenders by refusal to serve those commercial accounts not equipped with pretreatment equipment. As you may be aware, the grease trap apparatus is actually owned and operated by the commercial sewer customer and is not part of the BMSC sewer system. Maintaining these facilities is the sole responsibility of the commercial sewer customer. However, there are responsibilities under more recent Fats Oil and Grease (FOG) regulations that require a minimal effort for the reduction of discharges that lead to excessive material build-up or sewer back-up. By the Town Council adapting an ordinance addressing industrial pretreatment standards, maintenance of these facilities can be mandated and enforced. However, without a Town Ordinance, BMSC can merely suggest methods for controlling and maintaining grease traps in an appropriate manner paralleling the best available practices and industry standards. At this time, whether the methods of control are enacted is the sole discretion of the sewer customer. Attached are materials developed by BMSC for commercial customer distribution to help remind customers of these practices.
As of March of this year BMSC has developed a gravity and force main flushing program. As discussed in item 2 above this program concentrates on flushing and cleaning of two separate areas of the collection system. First, the lift station

and wet-wells of each lift station are allowed to surcharge to its maximum capacity. The wet-wells are flushed by utilizing the maximum pumping capacity of each station. This method allows industry recommended standard scouring velocity to be achieved. Each force main is flushed twice per month as a minimum, or more frequently, on an "as-needed" basis.

The gravity main program includes flushing and cleaning of gravity mains on a repeating basis. Currently, this program is limited to the most problematic areas of the collections system. Once completed, the program will expand to maintain sewer mains of a less problematic nature. The recently completed odor control study will help identify problematic areas by monitoring hydrogen sulfide formations which are an indicator of debris deposition in the mains. The goal of the program is to maintain each gravity sewer main according to best available practices and industry standards.

4. *In Response to item No. 4 of the May 25 letter*, it is unclear what portion of the collection system that is being referred to. However BMSC has commissioned a comprehensive odor control study which will identify any odor emitting situations of the most notable areas of the collection system. Once identified, these areas will be addressed, including physical modifications and improvements that may warrant odor scrubbing technology as suggested.

In reference to the four points above, BMSC offers the following comments to the nine specific suggestions noted as solutions to the noted problems as foreseen by the Town of Carefree.

1. *Closing one 6-inch main to increase the velocity in the pipe.* As noted in the first point above, it appears that closing off the 6-inch force main may actually change the operating performance of the pumps, increasing the total discharge head and reducing the pumping rate leading to a decrease in the velocity in the force main. Once the odor control study is complete, BMSC will analyze the data to determine if there are indicators of debris deposition in the force main. If so, BMSC will look at opportunities to increase velocity to industry standard levels which discourage deposition of material in the force main.
2. *Using ferric chloride as an odor elimination chemical in place of the Thio-guard.* To date the decision to use Thio-guard (magnesium hydroxide) in the collection system has proven to be very effective at managing hydrogen sulfide in the collection system. As is the situation at the Commercial Lift Station, magnesium hydroxide is an effective odor deterrent to odor formation in situations that offer a method of treatment before hydrogen sulfide is ever formed. When properly applied, this chemical can eliminate the formation of hydrogen sulfide at its point of application as well as at he receiving collection system. Ferric Chloride on the other hand, can only treat hydrogen sulfide after formation. Therefore the addition of magnesium hydroxide at the commercial lift station is a proactive measure that maintains an environment in the collection system that discourages hydrogen sulfide from ever forming, whereas ferric chloride must be added at a point after

hydrogen sulfide is formed. In addition, this chemical is much more dangerous to handle, is hazardous, is corrosive to the collection system infrastructure and is detrimental to the receiving biological treatment process. The use of this chemical as a final point of application at the treatment plant may be evaluated as part of the odor control study. BMSC is confident with its selection of odor control chemical at this time.

3. *Flushing the pressure line with enough water to vacate the entire line on a regular basis (10,000 gallons per flushing)*. As noted in item 2 above, the BMSC has adapted line flushing programs for both force main as well gravity mains. However, the odor control study should present evidence that material deposition indicators are present. If warranted, BMSC will make appropriate measures to improve scouring velocities in this force main which may include increasing the volume of media pumped into the force main to clear debris deposition.
4. *Using an odor scrubber at the pressure line discharge manhole*. Although the exact location point of application referenced in the letter is unclear, BMSC will not rule out any warranted improvement as deemed necessary through the odor control study, which may include physical improvements such as the application of odor scrubbing technologies.
5. *Establishing a program of inspecting the grease traps for proper maintenances*. BMSC favors the proactive measure of grease trap inspection. However it is BMSC position that for this program to be effective, the Town of Carefree needs to pass an industrial pretreatment ordinance that gives BMSC the authority for inspection as well as enforcement actions for non compliance. BMSC has prepared the attached informational documents to be mailed to each customer in support of informing commercial sewer customers of the standard practices for control and maintenance of their grease traps.
6. *Pressure cleaning gravity sewer lines on a regular basis often enough to eliminate buildup in the system*. As mentioned in point No. 3 above, the gravity main flushing program incorporated in March of this year, includes flushing and cleaning of gravity mains on a repeating basis. Currently, this program is limited to the most problematic areas of the collections system. Once completed, the program will expand to maintain sewer mains of a less problematic nature. The recently completed odor control study will help identify problematic areas by monitoring hydrogen sulfide formations which are an indicator of debris deposition in the mains. The goal of the program is to maintain each gravity sewer main in accordance with the best available practices and industry standards.
7. *Install pumps and line sized to pump the daily flow on a continuous basis*. The implementation of continuous pumping systems (Variable Frequency Drive or VFDs), are only applicable to higher flows, which are not experienced in the BMSC collection system. Current flows in to the BMSC wastewater treatment plant average 79,000 gallons during the summer months and nearly 140,000 gallons during the winter months. If all of this flow ran through a single pump station equipped with VFDs a continuous pumping rate of 100 gallons per minute (gpm) for winter months and 55 gallons per minute during summer months would be required. These flow rates are well below the recommended scour velocity for a standard 6-inch main (160 gpm). Since this is not the case and the majority of the

flow is pumped during a 12-hour period, the application of continuous flow pumps would lead to the same operating scenario as the intermittent pumping system currently used and the pumps would still shut off during low flow periods.

Moreover, continuous pumping systems can increase odor problems due to long detention times in the wet-well, since the pumps operate by maintaining a minimum wet-well level at all times. Also continuous pumping systems can reduce scour velocity in the mains as flow rates are reduced to maintain the minimum wet-well levels. Conversely, intermittent pumping systems such as those employed in the BMSC collection system, actually help reduce odors by reducing detention time in the wet well (as the pump systems are operated to pump to nearly empty wet-well level each pumping cycle), and maximizing the velocity introduced to the collection system by maintaining maximum flow rates at all times during the pumping cycle. For the minimal flows involved, BMSC maintains that the intermittent pumping systems are the most appropriate for optimal odor control.

8. *Elimination of large amounts of stored, raw sewage at each lift station*. As previously communicated to the Town, this evaluation was completed nearly six months ago and operational changes have been employed at most of the lift stations. For example, the CIE lift station has a wet well that can operate between 0 and 10 feet. This operating level has been changed to 0.5 to 4 feet. BMSC has incorporated these operation changes to significantly reduce the detention time of the raw sewage in the wet-wells even though the changes have increased the operating cost and the amount of energy used as the number of pumping cycles have increased significantly.
9. *Find and install acoustical material to soften sound from the plant*. As discussed at the public council meeting on June 1st, BMSC has been proactively investigating the sound issues at the BMSC WWTP. A Phase I report was issued in draft form outlining the decibel levels at various points around the plant, as well as proposed improvement to various sound emitting equipment. Currently specifications and installation details are being developed by the third party engineering firm of Damon S. Williams and Associates (DSWA). As noted in the attached project timeline, specifications should be received in the next thirty days and construction will begin shortly thereafter.

As presented in the December 12, 2003 meeting between BMSC staff and Town Council Members, BMSC's resolution of the odor issue will require a balanced approach of treating each of the aesthetic issues in combination with sustaining complete odor control in all problem areas. BMSC continues to address aesthetic issues by a combination of physical; chemical and mechanical improvements required to eliminate sewer conditions which promote odor formation and eliminate fugitive emissions from odor collection and treatment systems. The goal of this effort is to modify operating conditions to reduce odor causing compounds to minimal levels, record these levels and modify the existing odor control equipment to mitigate these levels with efficiency. As noted in the attached odor improvement timeline, to date, we have completed operating adjustments and

modifications to the system that represents normal operating conditions. The odor control study initiated June 3, 2004 will record these conditions. From this information, adjustments and modifications to the odor control systems will be made which will achieve and maintain odor control within regulatory guidelines.

As discussed in our December 12, 2003 meeting with Town staff, the aesthetic improvement schedule will take some time to complete. I have attached a project time line which references our proactive agenda along with noted projections to our on-going efforts.

As is evidenced by the numerous improvements previously completed and recognized by the Town, BMSC is committed to being a good neighbor in the Carefree community. BMSC is committed to continuing to operate and maintain the plant and appurtenant facilities in compliance with all regulatory requirements. We will continue to work diligently with environmental regulatory agencies, Town officials and community representatives to achieve an operation which is performing within all laws and regulation and is aesthetically acceptable to the surrounding community. If you have any questions, please contact our office at 480-575-7303.

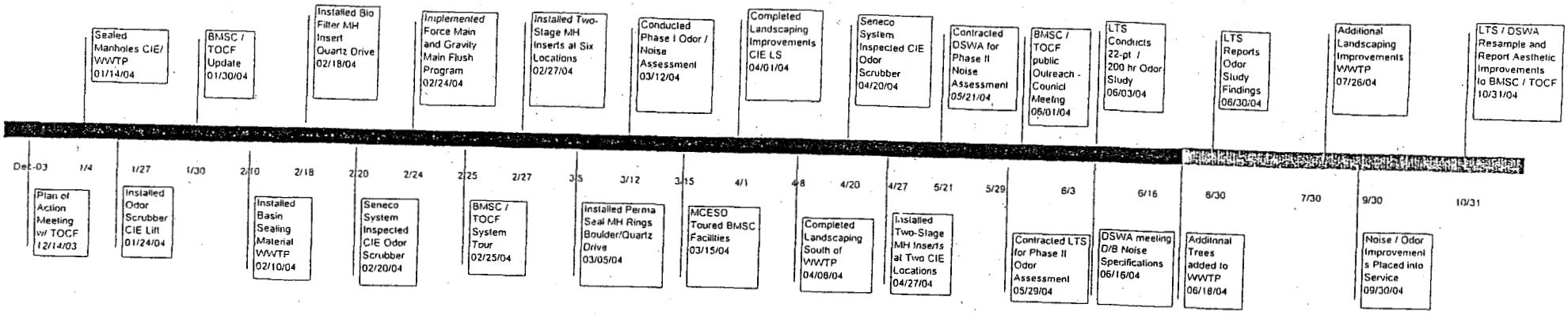
Sincerely,
Black Mountain Sewer Company

Joel L. Wade
Manager of Engineering and Construction
Algonquin Water Services, L.L.C.

JLW/jlw : BMSC omprovements

cc:
Michael D. Weber P.E., General Manager Algonquin Water Services, L.L.C.
Bob Dodds P.E., President, Operations Algonquin Power Services, L.L.C.
Charlie Hernandez – Operations Manager Algonquin Water Services, L.L.C.

Aesthetic Improvement Timeline
Black Mountain Sewer Company
12/03 - 10/04



June 30, 2004

Spanish Village
Acct No. 1000872
5050 N. 40th St. Suite 260
Phoenix AZ, 85018

ALGONQUIN
WATER RESOURCES
OF AMERICA, INC.

Attn: Commercial Account Sewer Discharger

RE: BMSC – FATS OIL AND GREASE (FOG) REDUCTION PROGRAM

The discharge of fats, oils, and grease (FOG) is a leading cause of sewer spills. This letter is being sent to you to inform you of Black Mountain Sewer Company's (BMSC's) on-going efforts to reduce the risk of outfall or sewer spills from grease accumulation in the sewer mains. To prevent this material from entering the sewer system, BMSC requires commercial customers discharging high levels of FOG to install grease removal equipment. To ensure that this equipment functions effectively, restaurants and FOG discharges must periodically remove accumulated FOG and food solids from these devices. Restaurants and other high FOG dischargers, frequently utilize commercial pumping contractors to clean their grease removal equipment and properly dispose of the removed material. It is the sole responsibility of the commercial sewer account to properly document the proper maintenance of these devices.

The material pumped from the grease removal equipment is comprised of grease, fats, oils, trash, food solids, and water. Because of the high levels of grease, fats, and oils in this waste stream, the pumped material cannot, under any circumstances, be discharged to the environment or into the sewer system. A licensed commercial waste hauler may be used to properly maintain and dispose of industrial strength waste from sewer grease trap/interceptors.

Furthermore, the practice of discharging treated or untreated wastewater from a pumping vehicle into the sewer without permission of the BMSC is strictly prohibited. **The practice of decanting or discharging wastewater from any device back into grease traps or interceptors constitutes an unauthorized discharge.** Furthermore, discharges of pumped grease trap or interceptor wastewater to other un-permitted locations, such as carwash interceptors or manholes, is also prohibited. Unauthorized trucked waste discharges and the failure to obtain the required permit are prohibited under local and federal laws; violations may result in enforcement procedures up to and including civil or criminal penalties.

The attached flyer illustrates guidelines associated with the on-going FOG reduction program. Please help us protect the environment by properly operating and maintaining your grease collection system. For more information on the community-wide FOG reduction program, please contact the BMSC customer service line at 480-575-7303.

Thank you for your support.

Black Mountain Sewer Company

Algonquin Water Services, LLC
111 W. Wigwam Road
Suite B
Litchfield Park, AZ 85340

Ph: 623-935-9367
Fax: 623-935-1020

Black Mountain Sewer Company

Fats Oils and Grease (FOG)

Fats, Oil and Grease (FOG) discharged into the sanitary sewer by commercial or industrial users can cause a number of problems in the sewer system. Grease & oil have poor solubility and tend to separate from the aqueous phase. Although this characteristic is advantageous in facilitating the separation of oil & grease in pretreatment devices such as grease traps and interceptors, it complicates the transportation of wastes in the sewer and can complicate treatment and disposal at the wastewater treatment plant.

FOG in wastewater from food service facilities can result in decreased carrying capacity of sewers due to congealed, cooled grease which coats the inside of the pipes. Once a pipe becomes constricted, the potential for a stoppage increases. Stoppages can and will eventually cause sanitary sewer overflows. In order to ensure efficient sewage treatment, protect the sewer system and protect public health, the Black Mountain Sewer Company (BMSC) has established the following requirements for all commercial business accounts:

General Requirement

Any type of business where oil and grease may be discharged into a public sewer shall have an interceptor/trap. The interceptor or trap shall be of a type and capacity approved by BMSC.

a. Each interceptor or trap shall be accessible at all times for inspection, cleaning and removal of grease and other material. Interceptors or traps installed outside of the building shall be constructed in such a manner so as to exclude the entrance of surface water and storm water.
b. The interceptor or trap shall be situated on the User's premises. Operation and maintenance of the trap is the sole reasonability of the commercial sewer account.
c. Building repair or remodels permitted for use requiring interceptors/traps shall be subject to these regulations.
d. Waste discharges from fixtures, including but not limited to, scullery sinks, pot and pan sinks, mop sinks, soup kettles and floor drains, shall be drained into the sanitary sewer through an interceptor/trap. Toilets, urinals and other similar fixtures shall not drain through the interceptor/trap.
e. Interceptors and traps shall be maintained in efficient operating condition. At minimum, grease traps must be **cleaned monthly** or as deemed necessary by the Industrial Waste Inspector. The use of chemicals, bacteria or other agents to dissolve grease or otherwise clean grease interceptors/traps is specifically prohibited. No such grease shall be introduced into any drainage piping leaving the premises, or public or private sewer.
f. Large capacity concrete type interceptors (500-gallon capacity or greater) shall have a suitable sample box to provide access for collection of wastewater samples. Large interceptors must be serviced every three-months or as deemed necessary by the industrial waste inspector.
g. Each appliance connected to a pre-cast under sink type grease trap shall have a flow device installed. No dishwashers may be connected to these types of grease traps.
h. A record of grease trap cleaning or copies of grease interceptor servicing must be maintained for the previous twelve-month period and made available for inspection by the BMSC's representative (sample form attached).

Additional Information

For additional information on limiting FOG into the sewer system, please contact the BMSC Customer Service line at (480)-575-7303.

Frequently Asked Questions (FAQ)

About

Fats Oil and Grease - (FOG)

Is FOG a problem in Our Area?

For sewage collection and treatment of commercial business, the answer is an emphatic YES! FOG is singled out for special attention because of its poor solubility in water and its tendency to separate from the liquid solution.

Large amounts of fats oil and grease in the wastewater cause trouble in the collection system pipes. FOG decreases pipe capacity and, therefore requires piping systems to be cleaned more often and in some cases, replaced sooner than otherwise expected. FOG can also hamper effective treatment and odor control at the wastewater treatment facilities.

FOG in a warm liquid may not appear harmful. But, as the liquid cools, the grease or fat congeals and causes nauseous mats on the surface of settling tanks, digesters, in the wet wells of pumping stations, and the interior of pipes and other surfaces which may cause a shutdown of wastewater treatment units.

Problems caused by wastes from restaurants and other FOG-producing establishments have served as the basis for ordinances and regulations governing the discharge of grease materials to the sanitary sewer system. This type of waste has forced the requirement of the installation of preliminary treatment facilities, commonly known as grease traps or interceptors.

What is a grease trap and how does it work?

A trap is a small reservoir built into the wastewater piping a short distance from the grease producing area. Baffles in the reservoir retain the wastewater long enough for the grease to congeal and rise to the surface. The grease can then be removed and disposed properly.

What is a grease interceptor?

An interceptor is a vault with a minimum capacity of between 500 and 750 gallons that is located on the exterior of the building. The vault includes a minimum of two compartments, and flow between each compartment is through a 90° fitting designed for grease retention. The capacity of the interceptor provides adequate residence time so that the wastewater has time to cool, allowing any remaining grease not collected by the traps time to congeal and rise to the surface where it accumulates until the interceptor is cleaned.

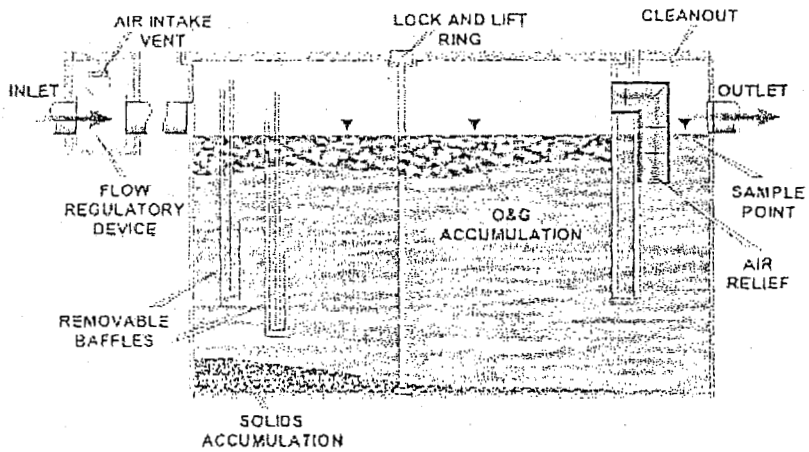
How do I clean my grease trap?

Grease trap maintenance is usually performed by maintenance staff, or other employees of the establishment. Grease interceptor (GI) maintenance, which is usually performed by permitted haulers or recyclers, consists of removing the entire volume (liquids and solids) from the GI and properly disposing of the material in accordance with all Federal, State, and/or local laws. When performed properly and at the appropriate frequency, grease interceptor and trap maintenance can greatly reduce the discharge of fats, oil, and grease (FOG) into the wastewater collection system.

The required maintenance frequency for grease interceptors and traps depends greatly on the amount of FOG a facility generates as well as any best management practices (BMPs) that the establishment implements to reduce the FOG discharged into its sanitary sewer system. In many cases, an establishment that implements BMPs will realize financial benefit through a reduction in their required grease interceptor and trap maintenance frequency. WARNING! Do not use hot water, acids, caustics, solvents, or emulsifying agents when cleaning grease traps and interceptors.

Grease Trap Maintenance

A proper maintenance procedure for a grease trap is outlined below:



Step	Action
1.	Bail out any water in the trap or interceptor to facilitate cleaning. The water should be contained and should not be discharged into the sanitary sewer if the Oil and Grease concentration is greater than 50 parts per million (ppm). Any discharges into the sanitary above 50 ppm is not allowed and should be disposed of by a professional waste handler.
2.	Remove baffles if possible.
3.	Dip the accumulated grease out of the interceptor and deposit in a watertight container.
4.	Scrape the sides, the lid, and the baffles with a putty knife to remove as much of the grease as possible,

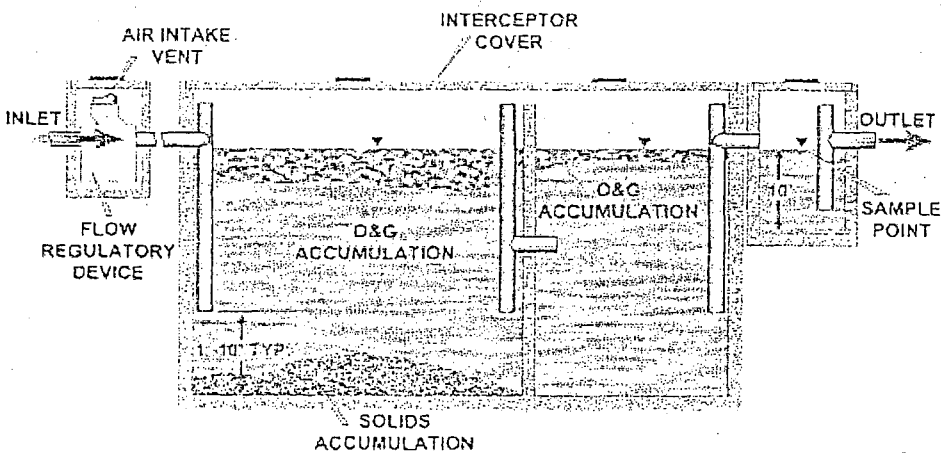
	and deposit the grease into a watertight container.
5.	Contact a hauler or recycler for grease pick-up.
6.	Replace the baffle and the lid.
7.	Record the volume of grease removed on the maintenance log.

Grease Interceptor Maintenance

Grease interceptors, due to their size, will usually be cleaned by grease haulers or recyclers. Licensed septage haulers can also pump out grease interceptors and haul the waste to the treatment plant. There are a number of companies who are permitted to haul and dispose of FOG.

A proper maintenance procedure for a grease interceptor is outlined below:

NOTE: Since the establishment is liable for the condition of their pretreatment devices, the establishment owners/representatives should witness all cleaning/maintenance activities to verify that the interceptor is being fully cleaned and properly maintained.



Step	Action
1.	Contact a grease hauler or recycler for cleaning.
2.	Ensure that all flow is stopped to the interceptor by shutting the isolation valve in the inlet piping to the interceptor.
3.	Remove the lid and bail out any water in the trap or interceptor to facilitate cleaning. The water should be discharged to the sanitary sewer system.

4.	Remove baffles if possible.
5.	Dip the accumulated grease out of the interceptor and deposit in a watertight container.
6.	Pump out the settled solids and then the remaining liquids.
7.	Scrape the sides, the lid, and the baffles with a putty knife to remove as much of the grease as possible, and deposit the grease into a watertight container.
8.	Replace the baffle and the lid.
9.	Record the volume of grease removed on the maintenance log.

Can you recommend a maintenance schedule?

All grease interceptors should be cleaned ***at least once each month***. Some establishments will find it necessary to clean their traps *more often than twice per month*. If the establishment is cleaning too often, the owner should consider installing a larger trap or interceptor.

Do I have a grease trap?

If the establishment is uncertain whether it has a grease trap, the owner should contact the Black Mountain Sewer Company (480)-575-7303 for a scheduled inspection.

Do I need a grease trap?

Any establishment that introduces grease or oil into the drainage and sewage system in quantities large enough to cause line blockages or hinder sewage treatment is required to install a grease trap or interceptor.

Interceptors are usually required for high volume restaurants (full menu establishments operating 16 hrs/day and/or serving 500+ meals per day) and large commercial establishments such as hotels, hospitals, factories, or school kitchens. Grease traps are required for small volume (fast food or take-out restaurants with limited menus, minimum dishwashing, and/or minimal seating capacity) and medium volume (full menu establishments operating 8-16 hrs/day and/or serving 100-400 meals/day) establishments. Medium volume establishments may be required to install an interceptor depending upon the size of the establishment.

Is the grease trap I have adequate?

The Uniform Plumbing Code requires that no grease trap have a capacity less than 20 gallons per minute (gpm) or more than 55 gpm. The size of the trap depends upon the number of fixtures connected to it. The following table provides criteria for sizing grease traps:

Total number of fixtures connected	Required rate of flow, gpm	Grease retention capacity, lbs
1	20	40
2	25	50
3	35	70
4	50	100

The size will also depend largely upon the maintenance schedule. If a grease trap or interceptor is not maintained regularly it will not provide the necessary grease removal. The establishment should work out a specific cleaning schedule that is right for the establishment. All grease traps need to have the grease cleaned out periodically and no one likes to do the job. It is a dirty job. Running extremely hot water down the drain only moves the problem down stream. It does not go away. Catch the grease at the source! This is the most economical means to reduce *all* costs.

What if I don't install a grease trap?

If the establishment uses grease and oil in food preparation, it will eventually encounter a maintenance problem with a plugged building sewer line. The blockage can create a sewer backup situation and ultimately a potential health problem in the establishment. Someone will have to pay for removing the blockage. If the problem is in the building sewer line, then the establishment has direct responsibility for paying for the maintenance. If the blockage or restriction is in the public sewer main and it can be proven that the establishment is the cause of the blockage, then the establishment may have to pay for the public sewer to be maintained. Blocking a sanitary sewer line is also a violation of the federal Clean Water Act.

Who determines if I need a grease trap or interceptor?

An approved grease trap or interceptor shall be installed according to the Uniform Plumbing Code, Maricopa County Environmental Services Department (MCESC) or the Arizona Department of Environmental Quality
The rules of the Health Department will also assist the establishment in determining if a grease trap or interceptor is required. The BMSC prohibits the

discharge of materials that can solidify and create blockages in the wastewater collection system or treatment plants. The BMSC, MCESD or ADEQ may make periodic inspections to see that no health problems exist due to improperly maintained grease interceptors. These agencies may enforce if a problem exists.

How can I get in compliance?

The establishment should contact the BMSC (480)-488-2987. This will enable the proper jurisdiction to assist the developer with design standards, establishment of cleaning schedules or advise of any problems showing up in the wastewater collection system. Along with sewer tap inspections, a grease interceptor inspection is required regardless of whether the establishment has an existing trap or is installing a new one.

What are the criteria for inspecting grease traps?

All food service establishments suspected of causing problems to the collection system or treatment facilities will be inspected. The inspector will use the following criteria to inspect grease traps:

Percent of Trap Filled	Trap Condition
25	Good
25 – 50	Fair
>50	Poor

If the trap is in FAIR condition, the establishment should be advised to keep an eye on the maintenance schedule. The cleaning frequency may need to be increased. If the trap is in POOR condition, the establishment should be issued a compliance order to have it cleaned immediately. The establishment should then be required to contact the issuing authority within 30 days to verify that the grease interceptor has been properly cleaned.

Commercial Accounts

Spanish Village
5050 N 40th Street Suite #260
Phoenix 85018

El Pedregal
34505 Scottsdale Road
Scottsdale, AZ 85262

Bakery Cantina
2515 N. Scottsdale Suite #1
Scottsdale AZ 85257

Pia's
PO Box 5443
Carefree, AZ 85377

Bad Donkey
PO Box 5292,
Carefree, AZ 85377

Basha's
PO Box 488
Chandler AZ 85244

Pizzafarro's
2800 N. Central Suite #1500
Phoenix AZ 85004

Flap Jacks
2800 N. Central Suite #1500
Phoenix AZ 85004

China Joy
2800 N. Central Suite #1500
Phoenix AZ 85004

English Rose Tea Room
PO Box 5865
Carefree, AZ 85377

Boulders
PO Box 2090
Carefree, AZ 85377

Carefree Inn

37220 N. Mule Train
Carefree, AZ 85377
Trattoria Romania / Carefree Plaza
PO Box 921
Carefree AZ, 85377

Carefree Water Company

Memo

RECEIVED
JUN 29
Town of Carefree

To: E. Morgan

From: S. Francom

CC: G. Gardner, J. Pearson

Date: June 29, 2004

Re: Black Mountain Sewer – Letter of June 23, 2004

Assuming that everything in the above referenced letter is true there are some obvious information that has been excluded that I believe needs response and indicates that Black Mountain still has not fully addressed their system problems.

There is approximately 6,200 feet of 4" and 6" sewer pressure line between the CIE lift station and the first manhole inside the Boulders. That much line would hold approximately 8,620 gallons of sewerage. If the CIE lift station pumps 30,000 to 40,000 gallons average per day and pumps approximately 600 gallons each time it pumps at a rate of 320 gallons per minute that equates to the line being evacuated 3.5 to 4.6 times every 24 hours. At 320 gallons per minute it would take about 27 minutes of constant pumping to vacate the line . Under the conditions as described in the letter, the pumps would run each time they turned on less than two minutes. It is evident that there is sewerage sitting in the line for an extended period of time. They indicated that the pH as tested in the manhole at Quartz Valley and Boulder Drive is as high as 9.0 which indicates that the sewerage could not smell because of the residual capability of the Thioguard, However the sewerage stream still stinks and as a result they have sealed all the manholes. Either the pH reading is incorrect, Thioguard does not work as they believe or the Thioguard is not in the sewerage stream in the quantities they have indicated.

As to the flushing of the CIE and other lift stations, unless additional water is introduced at the time of the flushing I cannot see that normal sewerage flow would be sufficient to flush the 8,520 gallons of setting sewerage from the pressure line. They indicated that the CIE lift station containment capacity was 150, gallons /ft that would mean that they would have to have approximately an equivalent of 57 feet of wet well to have sufficient water to empty the pressure line. I do not believe that the pressure line has ever really been totally flushed out. It would be so easy just to do it instead of arguing about what they have done or not done.

I know that there was in place in the Boulder Sewer Company's filing with the Arizona Corporation Commission a far reaching Requirement of Service document. That document contained strong limitations as to the type of sewerage the sewer company would take. Included in that document were limitations as to the temperature, BOD strength, fat and oil content and specific prohibitions on chemicals and other products. That document was used by the Boulders Sewer to regulate private and commercial discharges into the collection system and was used to cause the cleaning of grease traps by restaurants and public cooking and baking facilities. It was used to eliminate discharge of photo developing

chemicals and chlorine discharges to the collection system. That document must still be in place and is a matter of public record I would presume.

Finally, I believe at the Commercial Lift Station there is still in place a large septic tank between the manhole on Ho Street and the new wet well manhole at the lift station which might be affecting the septic condition of the sewerage.

BLACK MOUNTAIN SEWER CORPORATION

Mayor Edward C. Morgan
Town of Carefree
PO Box 740
100 Easy Street
Carefree, Arizona 85377

August 10, 2004

TC
JP
BW

RECEIVED
AUG 12 2004
Town of Carefree

Re: Black Mountain Sewer Company - Action Plan

Dear Mayor Morgan,

As agreed upon during the August 3, 2004 Town of Carefree council meeting, I am pleased to provide you the action plan presented as **Figure 1**, below. This plan is based on the recommendations of the recently completed odor study conducted by Lamb Technical Services. Black Mountain Sewer Company (BMSC) remains committed to continuing the numerous improvements the Town has already recognized as having significantly improved the situation which we inherited from the prior owners and believes these projects will further eliminate the minor odors that might exist at the plant site and within the collection system.

This action plan provides for the installation of additional sealing material at the plant site, sound attenuation material at the plant site, and an additional chemical feed station in the collection system.

ID	Task Name	Duration	Start
1	**Sound / Odor Improvements**	**35 days**	**Mon 8/9/04**
2	Delivery of fan cover	10 days	Mon 8/9/04
3	Install fan cover	1 day	Mon 8/23/04
4	Delivery of Louvers	30 days	Mon 8/9/04
5	Install Louvers	5 days	Mon 9/20/04
6	Delivery of New Grating	15 days	Mon 8/9/04
7	Install New Grating	2 days	Mon 8/30/04
8	Delivery of Sound Material	10 days	Mon 8/9/04
9	Install Sound Meterial	10 days	Mon 8/23/04
10	**Sage Brush Chem Feed**	**22 days**	**Mon 8/9/04**
11	Site Prep	2 days	Mon 8/9/04
12	Equipement Install	3 days	Wed 8/11/04
13	Electrical Improvments	10 days	Mon 8/16/04
14	Start-up and Testing	7 days	Mon 8/30/04

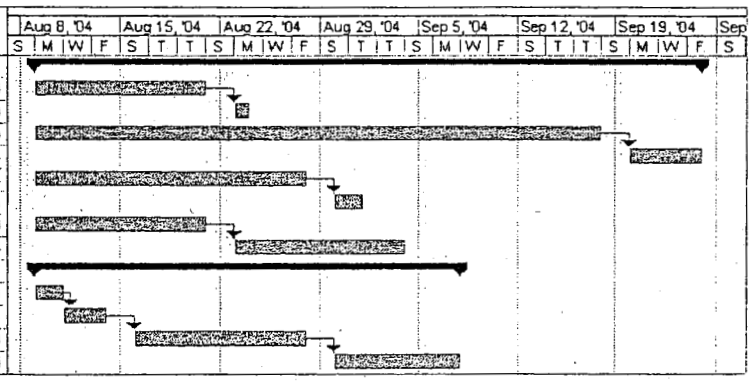


Figure 1 - Timeline for Odor Improvements

Black Mountain Sewer Co.
PO Box 459
Litchfield Park, AZ, 85340

Telephone: (623) 935-9367 Facsimile: (623) 935-1020

As we had discussed, BMSC believes that its long standing record of complete regulatory compliance and its past commitment to resolving this situation as evidenced by the numerous improvements implemented to date, demonstrate our good faith efforts in this matter. Unfortunately, the Town has chosen to condition the signing of the operating agreement upon resolution of the perceived odor situation and indicated in the most recent council meeting that resolution would be deemed achieved only when the Town received a letter from the Boulders Home Owners Association indicating complete satisfaction with the situation. BMSC believes this to be an unrealistic, unachievable goal and further believes that the Town is unduly and unreasonably withholding the operating agreement. Consequently, before any future improvements will be considered, BMSC and the Town must enter into an operating agreement.

Should you need to discuss this matter further, please do not hesitate to call. Thank you for your time and consideration.

Very truly yours,

Michael D. Weber

Michael D. Weber, P.E.
General Manager

Carefree Water Company

Memo

To: E. Morgan

From: S. Francom

CC: J. Pearson

Date: August 17, 2004

Re: My response to Black Mountain Sewer's letter re the "Action Plan" as a result of Lamb's odor study

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First I want to say that Lamb's study was quite complete however he has one glaring mistake that could and will effect odors in the Boulder. He states that the pressure line discharge form the CIE lift station into the gravity line occurs at the manhole located at Century and Boulders Drive and at that location he encountered concentrations of 700 PPM. The actual discharge point is the manhole located at Boulders Drive and Ironwood and if the concentration of odors remains equal or higher at that location there will be a problem at that intersection. I do not know why he was told that Century Way was the discharge point unless there were odor complaints and he investigated that location only.

As to the action plan, I look at the things that BMS has indicated they are going to do as a result of the study and I believe that the actions they have indicated to do were all in place prior to the study and none are a result of the study The study indicated that the main problems were the turbulence at the manhole at Boulder Drive and Quartz Valley near the treatment facility, undersized suction blowers on the filtration system, ineffectiveness of the current filtering system because the treatment train covers allow too much infiltration of air into the system thus destroying the negative pressure under the covers which then does not draw odors from the treatment trains into the filter, the wrong type and size of filter.

The study had nothing to do with Sage Brush nor sound attenuation. It recommends redesign of the Quartz Valley manhole to eliminate the turbulence and add a connection to the filtration system to cause a negative pressure in the manhole and installation of a multi-stage wet filtration system sufficient in size to cause negative pressures in all the treatment train vessels including the metering house, aeration basins, sludge wasting basins and the manhole at Quartz Valley.

It is still my belief that one of the pressure lines from the CIE to the gravity system should be eliminated or thoroughly flushed on a regular basis mitigate odors up stream from the treatment facility. I also know that when the CIE pumps run the gravity flow line in the boulders is super charged causing a higher pressure in the manholes that force air from the manholes. (Supercharge of a gravity line is when the inflow into the manholes exceed the capacity of the out flow pipe and the outflow pipe fills completely and partially fills the manhole displacing the air in the manhole.0

APPENDIX C

ODOR CONTROL
MANUFACTURER INFORMATION

USFilter

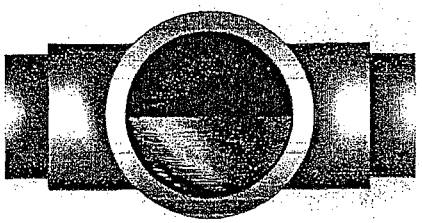
BIOXIDE®

...THE NATURAL SOLUTION

BIOXIDE ... THE NATURAL SOLUTION

To meet the needs of the industry, USFilter's Davis Process Products has developed BIOXIDE® as a means to eliminate the odor, corrosion and safety problems associated with hydrogen sulfide in sewage. In addition, BIOXIDE® combats most other odors commonly found in wastewater treatment systems. BIOXIDE® is a unique, proven product because it achieves sewage odor control naturally, rather than chemically. As a result, BIOXIDE® both *removes* dissolved hydrogen sulfide and prevents its formation. This fact makes the BIOXIDE® process ideally suited to provide effective and affordable odor control throughout the entire collection system.

BIOXIDE® is a patented process which controls hydrogen sulfide odors and corrosion biologically. Introduction of nitrate oxygen via addition of BIOXIDE® solution into a waste stream creates an environment in which certain naturally occurring bacteria thrive. These bacteria utilize the dissolved hydrogen sulfide which is present as a part of their metabolism, thereby cost-effectively removing any dissolved hydrogen sulfide from the wastewater. This process eliminates the odor, corrosion and safety problems associated with atmospheric hydrogen sulfide. This removal mechanism, patented by USFilter's Davis Process Products in 1990, allows economical elimination of dissolved hydrogen sulfide for a far broader range of wastewater collection system odor problems than previously considered possible with nitrate addition to prevent anaerobic biological activity. The BIOXIDE® process has a proven track record for controlling hydrogen sulfide in a variety of collection system applications, with over 1,000 installations throughout the U.S. and Canada. Dissolved hydrogen sulfide concentrations of over 50 ppm are reduced to <0.1 ppm in the most severe applications.



CONTAINS NO HAZARDOUS SUBSTANCES

Many options to control or eliminate odor compromise safety by reaction and flammability. Their storage and handling is often hazardous and costs are high, making them economically impracticable. Based upon the requirements of a particular odor problem, USFilter's Davis Process Products will design and administer a BIOXIDE® solution dosage strategy to stimulate and sustain the biological process. BIOXIDE® is an aqueous solution of non-hazardous nitrate salt (as defined by the EPA CERCLA list). Therefore, the use of BIOXIDE® releases no hazardous substances to the environment, nor does it expose workers or the public to potentially dangerous situations.

REDUCES BOD

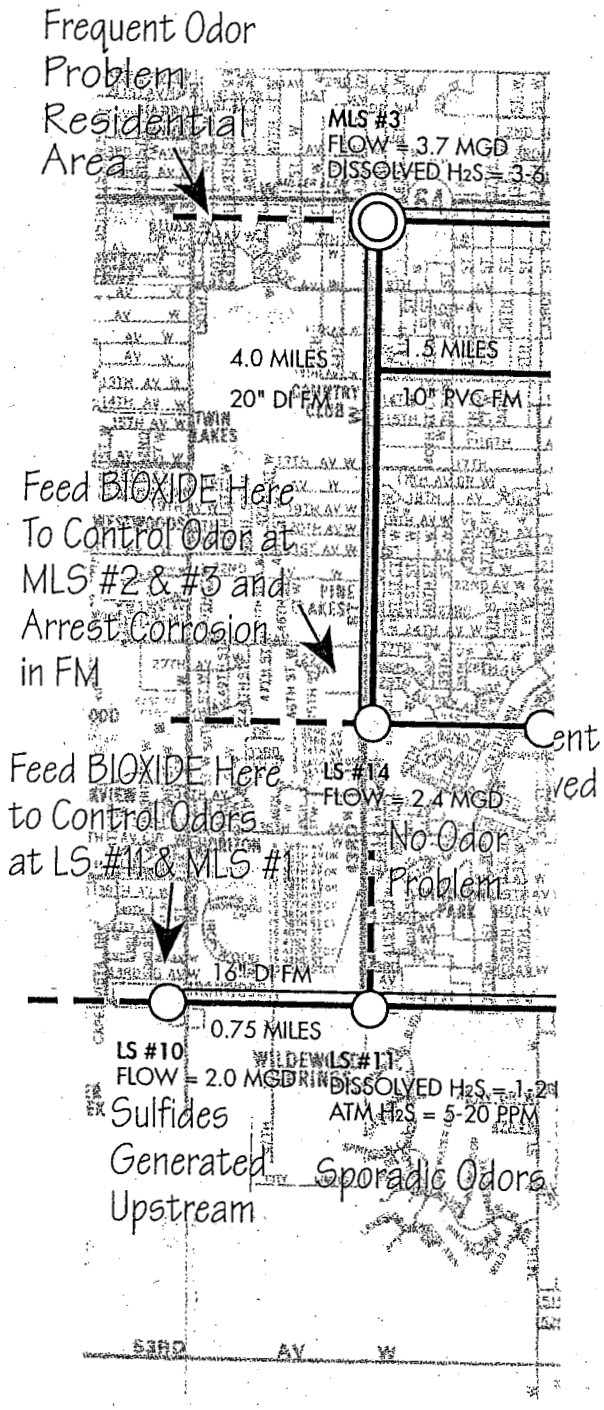
Because BIOXIDE® achieves odor control biologically, an additional benefit of its use is sewage BOD reduction. Therefore, a potential secondary benefit of BIOXIDE® is reduced BOD loading and increased treatment plant capacity where BOD loading is limiting.

TREATS OTHER COMMON SEWAGE ODORS

Hydrogen sulfide is normally the predominant sewage odor problem. However, other odorous sulfur compounds such as mercaptans and organic sulfides can also contribute to odor problems. The biological environment created by BIOXIDE® will effectively remove these problem compounds as well.

ARRESTS CORROSION

Collection system and treatment plant equipment and structures of concrete or metal are severely corroded by atmospheric hydrogen sulfide. While no product can reverse the damage already caused by existing corrosion, BIOXIDE® reduces further corrosion by effectively eliminating dissolved hydrogen sulfide, the source of atmospheric hydrogen sulfide.



The system it
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system. This a
Process Produ

The BIOXIDE® System for odor control is a complete program which is guaranteed to solve specific odor problems within wastewater collection and treatment systems. USFilter's Davis Process Products guarantees your 100% satisfaction with the ability of BIOXIDE® to deliver the results which it has been employed to attain. In order to provide such a guarantee, USFilter's Davis Process Products thoroughly analyzes each odor control problem using our experienced technical personnel to survey your system characteristics. The survey results are then analyzed by our staff to determine the optimum application. Once this analysis is complete, a proposal is then submitted identifying the particular odor problems in the system and the effectiveness of BIOXIDE® as a corrective measure.

Upon completion of the survey, a field test is arranged to demonstrate the effectiveness of BIOXIDE®. USFilter's Davis Process Products designs a custom BIOXIDE® solution feed program with the optimum application locations for cost effective sulfide removal, based on our survey. Our trained technicians then install and start up the system. This installation is supported by thorough operator training, follow-up evaluation and troubleshooting services.

WHEN COMPARED TO ALTERNATIVE METHODS, BIOXIDE® EXCELS IN EFFICIENCY, SAFETY AND COST EFFECTIVENESS

BIOXIDE® VS. OXIDIZERS

Chemical oxidizers such as Chlorine, Hydrogen Peroxide and Potassium Permanganate are commonly used to control hydrogen sulfide odors. In comparison to BIOXIDE®, these materials have several negatives. There are high reactivity and flammability risks involved in the use of such oxidizers. These safety hazards make expensive storage and handling techniques and equipment a necessity. While these costly steps reduce the risks involved with using these oxidizers, the liability associated with their use remains.

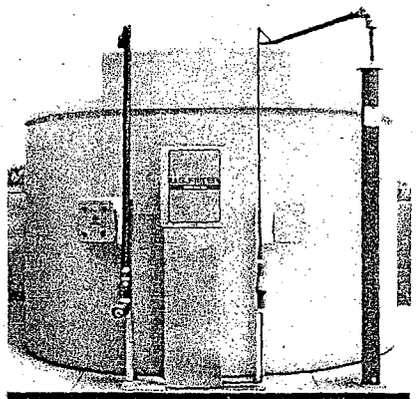
In addition, oxidizers trigger a chemical, rather than a biological reaction within the system. The oxidizing mechanism of these products is not specific to hydrogen sulfide and therefore excess dosage (compared to theoretical) is the norm. This contributes to the relatively high cost. However, BIOXIDE® is a biological process specific to odor compounds and, unlike oxidizers, it is also effective in preventing the formation of dissolved hydrogen sulfide.

BIOXIDE® VS. PH ADJUSTMENTS

Another alternative method to controlling Hydrogen Sulfide odors is the use of Sodium Hydroxide to adjust the pH. This method kills many helpful organisms which are present in the sewage, making it detrimental to plant operations. BIOXIDE® enhances biological organism growth thereby complementing the natural operation of the plant. Furthermore, caustic treatment such as pH adjustment cannot be sustained on a continuous basis. In contrast, BIOXIDE® is suited for continuous treatment making it a much more effective, and consistent method of odor control.

BIOXIDE® VS. BACTERIA ADDITION

The addition of volumes of "new" bacteria is not effective in controlling hydrogen sulfide because the sewage is not conducive to their growth. The difficulty in achieving consistent dosage and lack of stability contribute to the ineffectiveness and high cost of bacteria addition. In contrast, the BIOXIDE® process provides the nutrients via a stable, easily metered aqueous solution, which promotes the growth of naturally occurring bacteria within the sewage collection system.



Typical BIOXIDE® Above-Ground Storage and Metered Delivery System

BIOXIDE® VS. METAL SALTS

Metal salts are normally the most economical means of dissolved hydrogen sulfide control. However, metal salts are specific to the removal of hydrogen sulfide, therefore they commonly leave other odor compounds untreated. BIOXIDE® can provide equivalent effectiveness and economy in a natural manner rather than via a chemical process while treating a broader range of odor causing compounds. In addition, BIOXIDE® provides extra benefits in the form of BOD reduction.

BIOXIDE® VS. VAPOR PHASE TREATMENT

Vapor phase technologies such as adsorption systems or air scrubbers control odors by ventilating and treating the atmosphere in one geographic area. BIOXIDE® controls odor compounds within the sewage preventing their release to the atmosphere. In short, BIOXIDE® prevents an odor problem from its source, while vapor phase technologies treat the problem after it exists. Similarly, BIOXIDE® eliminates the severe corrosion caused by atmospheric hydrogen sulfide making it a significantly more effective means of reducing corrosion than vapor phase treatment. These differences make BIOXIDE® a better value for odor and corrosion control in most cases.

BIOXIDE® IS A SAFE, EASY-TO-HANDLE METHOD OF ODOR CONTROL

One of the primary factors which should be taken into consideration when selecting any process for use in wastewater treatment systems, is the safety of those who will be handling the materials. The safety of BIOXIDE® is documented by the fact that it is the only leading method of treatment for dissolved hydrogen sulfide which is not on the EPA CERCLA list of hazardous substances. This fact clears BIOXIDE® for convenient underground storage.

USFILTER'S DAVIS PROCESS PRODUCTS - THE INDUSTRY LEADER IN THE DEVELOPMENT OF ODOR CONTROL SYSTEMS

USFilter's Davis Process Products is a recognized leader in the development of innovative products for the control of odors in wastewater collection and treatment systems. USFilter's Davis Process Products established a revolutionary hydrogen sulfide control product in 1978 with the development of ODOPHOS®. With the introduction of BIOXIDE®, AQuit™, Bioxide-AQ™, POLY-STAGE™ Air Scrubbing Systems, and various other products and services, USFilter's Davis Process Products has developed the only complete selection of odor control systems for sewer systems and industry. These products offer alternative approaches to the total odor control problem, making USFilter's Davis Process Products the company with a solution for every odor control problem. Regional distribution and service locations are in Temecula, CA; Wilmington, DE; Sarasota, FL; Canton, GA; Granite City, IL; Florence, SC and Seguin, TX.

OUTSTANDING SERVICE SINCE 1938 IS YOUR ASSURANCE OF SATISFACTION

Davis Water & Waste Industries, Inc. was founded in 1938 and has been an industry leader in the design, manufacture and distribution of products that help to meet the world demand for clean water. USFilter acquired Davis and all its divisions in 1996. In 1999 USFilter was acquired by Vivendi, creating the world's largest and most comprehensive supplier of water and wastewater equipment and services. The size, strength and stellar reputation of Davis, USFilter and Vivendi represent your guarantee that USFilter's Davis Process Products will continue to provide thorough service, ethical business practice, effective products and service after the sale.

USFilter
2650 Tallevast Road
Sarasota, FL 34243
(941) 355-2971 *phone*
1-800-345-3982 *toll free*
(941) 351-4756 *fax*
www.usfilter.com
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DP-D401-BX-BR-1103

Carbon Filters and Accessories (CF, CFR, CFB)

Carbon Filters (CF)

Orenco carbon filters are used to reduce the odor of sewer gases. Containing granulated activated impregnated carbon, the UV resistant PVC housing slips onto standard Schedule 40-size pipe. Carbon recharge packages and adapter bushings are available. Custom sizes available.

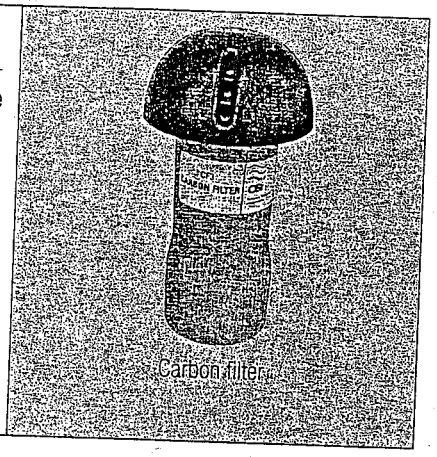
For carbon filter lids refer to *Lids (FL)* on page 4.

NOMENCLATURE

CF □

Filter diameter:
3 = 3"
4 = 4"

Carbon filter



Carbon filter

Carbon Filter Recharge Packages (CFR)

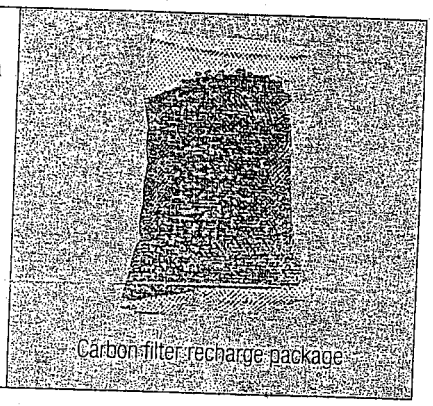
Orenco carbon filter recharge packs are used as a simple, clean method of refilling carbon filters. Offered in a ready-to-drop-in pouch for all standard carbon filter sizes.

NOMENCLATURE

CFR □

Carbon filter diameter (inches):
3 = 3"
4 = 4"
12 = 12" (for lids)

Carbon filter recharge package


Carbon filter recharge package

Carbon Filter Bushings (CFB)

Orenco carbon filter bushings are used to adapt the mounting flange of the carbon filter to an existing vent outlet of different diameter. Molded of PVC.

NOMENCLATURE

CFB □□

Bushing size (inches):
32 = 3" to 2" reducer
42 = 4" to 2" reducer
43 = 4" to 3" reducer

Carbon filter bushing

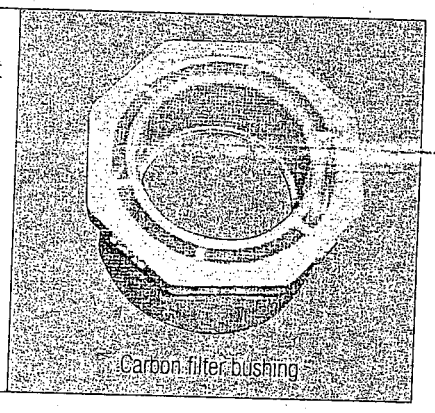
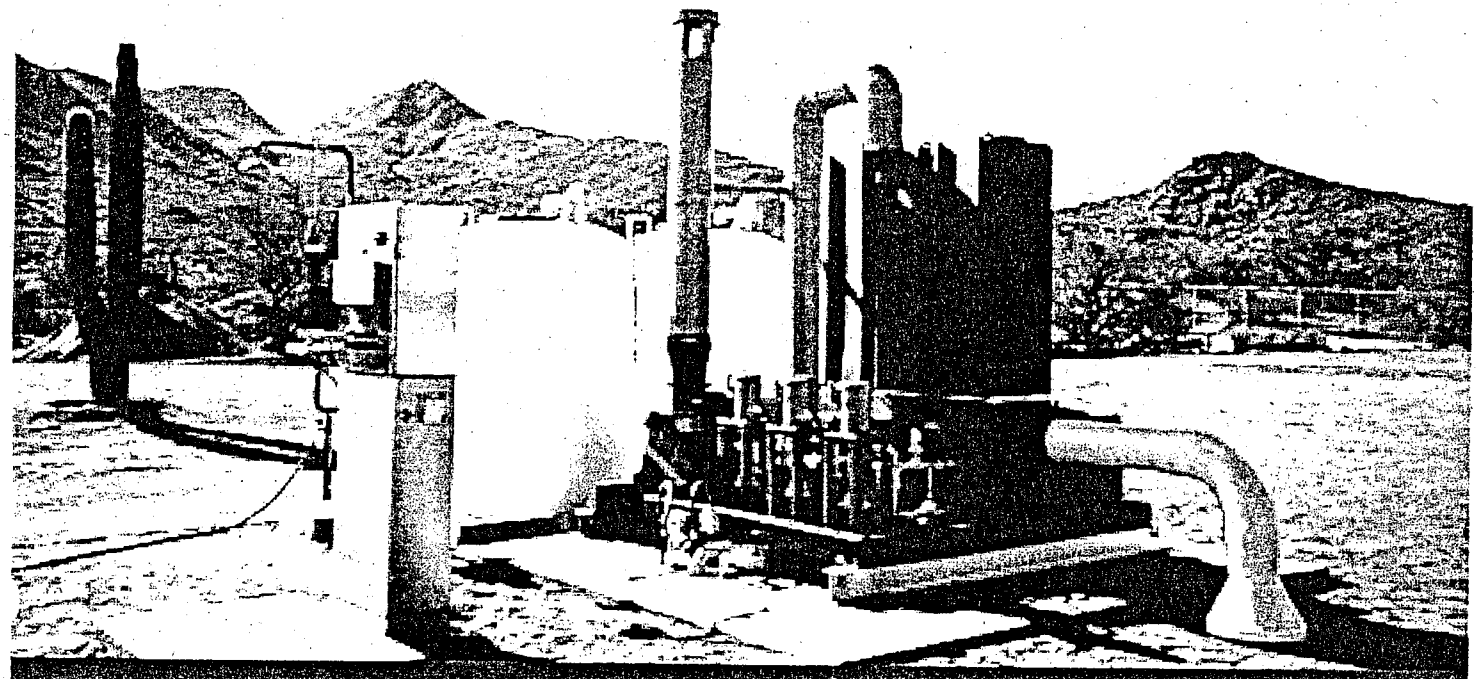

Carbon filter bushing

TABLE 52. CARBON FILTER, RECHARGE PACKAGE, AND BUSHING EXAMPLES

Model code	Description
CF3	Carbon filter with weather cap, 3" diameter
CFR3	Activated carbon refill package, for 3" diameter filter
CFB32	Bushing for carbon filter, mounts CF3 to 2" diameter outlet

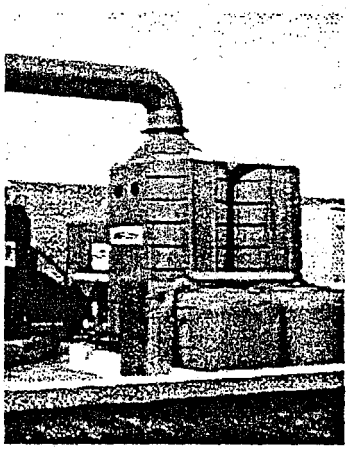


POLY-STAGE™

ODOR CONTROL

SYSTEMS

USFILTER'S POLY-STAGE™ ODOR CONTROL SYSTEMS



KEY ADVANTAGES

- ⅓ THE CHEMICAL COST OF CONVENTIONAL SCRUBBERS
- 99.5% H_2S REMOVAL
- EFFICIENT REMOVAL OF AMMONIA AND ORGANIC ODORS
- LOW PROFILE AND COMPACT SIZE
- FACTORY ASSEMBLED FOR EASE OF INSTALLATION
- USFILTER GUARANTEE

Municipal and industrial water and wastewater treatment plants supply our growing communities with a vital resource: clean water. In the process of treating our water, some processes generate odorous gases. As a good neighbor, often in close proximity to the general public, these facilities must contain and neutralize any odors created. USFilter offers a complete line of odor treatment solutions.

A preferred solution is wet chemical scrubbing. USFilter's Poly-Stage™ Odor Control System is a patented[1], multi-stage, multi-chemistry wet scrubber system that can be configured to remove hydrogen sulfide (H_2S), ammonia (NH_3) and organic odors from municipal and industrial processes. Each installation is custom designed to maximize removal efficiency of the odorous compounds and to minimize chemical consumption. Performance is guaranteed.

The compact design of the Poly-Stage scrubbers occupies a fraction of the space required by conventional packed tower systems, with better chemical utilization and lower installation and maintenance costs. Each system is completely factory pre-assembled and mechanically tested prior to shipment.

USFilter offers L-Series and DD-71 Series Poly-Stage systems. The L-Series scrubbers are designed to handle air flow rates of up to 1,000 cfm and the DD-71 Series systems are designed to handle air flow rates from 1,000 cfm to 6,000 cfm.

Within each of the two series, three models are offered: the Simplex, the Duplex and the Triplex scrubbers. The Simplex scrubber is a single-stage scrubber suitable for lower air flow rates and odor loads, and up to 95% H_2S removal. The Duplex scrubber is a two-stage scrubber suitable for moderate air flow rates and odor loads, and up to 99% H_2S removal. The Triplex scrubber is a three-stage scrubber suitable for higher air flow rates and odor loads, and for 99.5%+ H_2S removal.

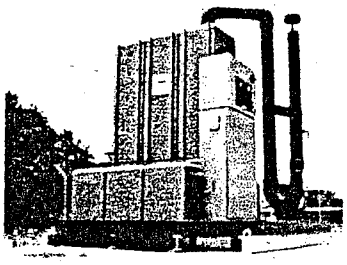
The Duplex and Triplex models are designed to minimize chemical costs by using relatively inexpensive sodium hydroxide (caustic) to remove 70-80% of the odors in the first stage(s), and then treating the remaining odors with a combination of sodium hypochlorite (bleach) and caustic in the last stage. Four-stage Quadriplex systems have also been built to treat NH_3, H_2S and organics in a single system.

HDXLPE CONSTRUCTION

USFilter's Poly-Stage scrubbers use rotationally molded vessels of High Density Crosslinked Polyethylene (HDXLPE). The unique rotational molding technique creates a vessel without seams or joints which mitigates leaks.

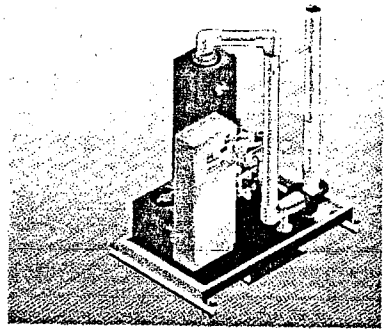
The vessels are chemically resistant to concentrated acids, alkalis and oxidizers and are designed to operate in very harsh environments, with constant exposure to weather and UV attack.

(1) Poly-Stage systems are covered under U.S. Patent Number 4,948,402, Re. 35, 234

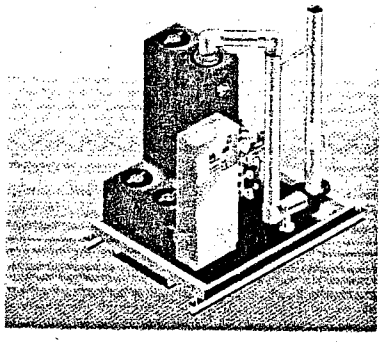


USFilter's L-Series Scrubber is a skid-mounted, modular design, once-through, packaged odor control system. Each system includes one to three stages of gas absorption, an individual integral sump for each stage, mist eliminator, induced draft exhaust fan, exhaust stack, recirculation and metering pumps, piping, valves, fittings, instrumentation and controls to make a complete and functional system. Each system is completely factory assembled and tested prior to shipment. The L-Series scrubbers are sized to handle air flow rates up to 1,000 cfm.

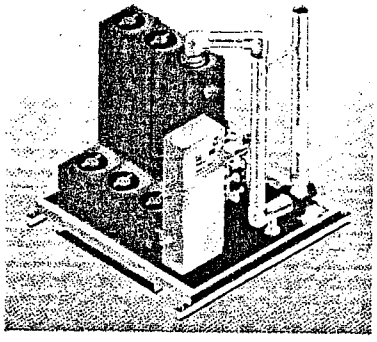
L-Series Simplex System
Skid Dimensions: 5'-0"L x 8'-0"W
Footprint Required*: 13'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 300 lbs.
Operating Weight: 1,000 lbs.
Fan HP: 0.5 to 2.0
Pump HP: 0.33



L-Series Duplex System
Skid Dimensions: 6'-3"L x 8'-6"W
Footprint Required*: 15'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 750 lbs.
Operating Weight: 1,500 lbs.
Fan HP: 1.0 to 3.0
Pump HP (Total): 0.67



L-Series Triplex System
Skid Dimensions: 7'-3"L x 8'-6"W
Footprint Required*: 16'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 1,500 lbs.
Operating Weight: 2,500 lbs.
Fan HP: 1.0 to 3.0
Pump HP (Total): 1.0

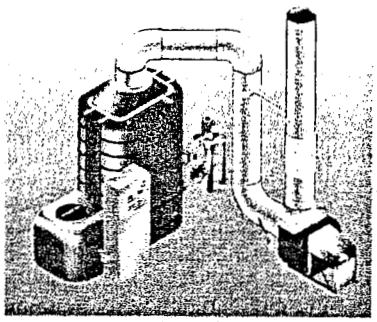


* Includes chemical storage tanks

USFilter's DD-71 Series Scrubber is a modular design, once-through, packaged odor control system. Each system includes one to three stages of gas absorption, an individual integral sump for each stage, mist eliminator, induced draft exhaust fan, exhaust stack, recirculation and metering pumps, piping, valves, fittings, instrumentation and controls to make a complete and functional system. Each system is completely factory assembled and tested prior to shipment. The DD-71 series scrubbers are sized to handle air flow rates up to 6,000 cfm.

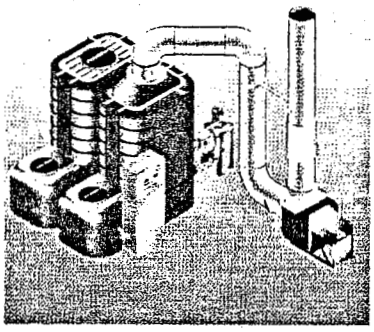
DD-71 Simplex System

Vessel Dimension: 3'-8"L x 8'-0"W x 7'-6"H
Footprint Required*: 18'-6"L x 20'-0"W
Shipping Weight: 1,800 lbs.
Operating Weight: 5,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP: 3.0



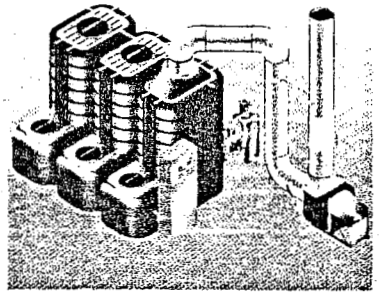
DD-71 Duplex System

Vessel Dimension: 7'-4"L x 8'-0"W x 7'-6"H
Footprint Required*: 22'-0"L x 20'-0"W
Shipping Weight: 2,800 lbs.
Operating Weight: 10,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP (Total): 6.0



DD-71 Triplex System

Vessel Dimension: 11'-0"L x 8'-0"W x 7'-6"H
Footprint Required*: 25'-6"L x 20'-0"W
Shipping Weight: 4,000 lbs.
Operating Weight: 15,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP (Total): 9.0

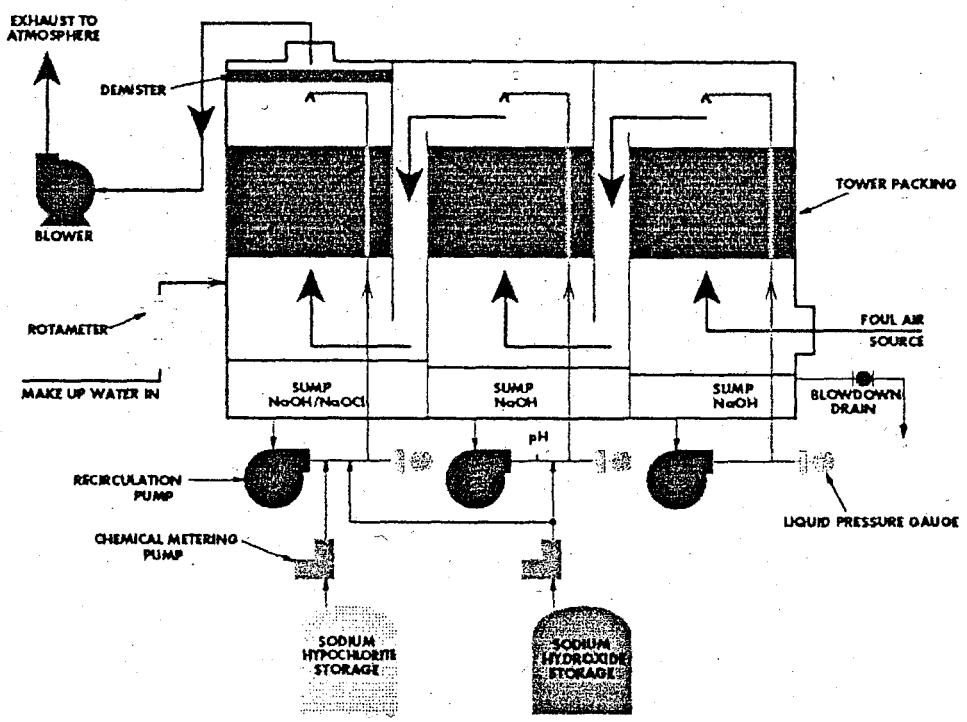


* Includes chemical storage tanks

PROCESS DESCRIPTION

The schematic diagram below illustrates a typical Triplex configuration for hydrogen sulfide removal. The system utilizes sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl) to react with and remove the odorous compounds present in the air stream.

In Stage 1, the process gas is pre-treated with the blowdown from Stage 2 to remove 70-80% of the incoming H_2S. The gas then passes through Stage 2, which is fed with blowdown from Stage 3 as well as with fresh NaOH solution to provide removal of an additional 70-80% of the remaining H_2S. The gas then passes through Stage 3, which is fed with fresh NaOCl and NaOH solutions, to provide a strong oxidation reaction to remove the remaining H_2S and other odors.



CUSTOM DESIGNS

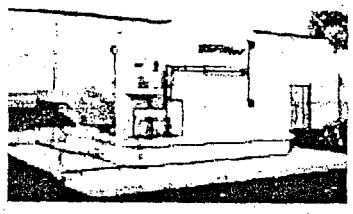
The Poly-Stage scrubber system can be configured to remove ammonia and hydrogen sulfide in the same scrubber. The system chemistry can also be configured to remove odorous organic compounds that cannot be controlled effectively with a conventional caustic and bleach scrubber.

OTHER VAPOR PHASE ODOR CONTROL PRODUCTS BY USFILTER

LO/PRO ODOR CONTROL SYSTEM

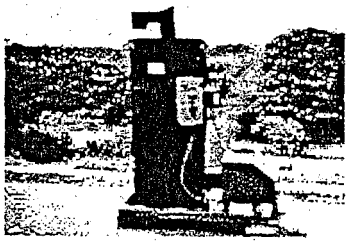
The patented LO/PRO® Multi-Stage Packaged Scrubber System is one of the most technically advanced and cost-effective scrubber systems available. The LO/PRO is a factory pre-assembled system of unitary construction which can do the work of conventional packed towers in less than half the space and at a fraction of the cost. Each installation is custom designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Pe rformance is guaranteed with removal efficiencies in excess of 99.0% and air flow rates up to 25,000 cfm.

ZABOCS BIOLOGICAL SYSTEM



The ZABOCS™ Biological Odor Control System is an advanced multi-media system which combines gas absorption, adsorption and biological treatment to capture and then eliminate organic and inorganic odors from wastewater process air streams. The unique combination of proprietary Biodagene™ and Biocarb™ media enables the ZABOCS system to treat three times the air volume compared to similarly sized conventional biofilter systems, while immediately treating odors with zero acclimation time.

CARBON ADSORPTION SYSTEMS



Carbon adsorption is an effective solution to many odor control problems. It is particularly useful for small air flows, remote locations, and control of specific volatile organic compounds that are difficult to remove by wet scrubbing.

We offer a complete line of carbon adsorption systems, ranging from small modular systems (100 cfm and up) to larger, dual-bed systems up to 20,000 cfm.

To find out more about how to put USFilter to work for you, contact us at

USFilter

RJ Environmental Products
13100 Gregg St. Suite B
Poway, CA 92064
858.486.8500 phone
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RJ-POLY-BR-0903

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USFilter

LO/PRO®

PACKAGED

ODOR CONTROL

SYSTEM

Municipal and industrial water and wastewater treatment plants supply our growing communities with a vital resource: clean water. During the water treatment process, odorous gases such as hydrogen sulfide, ammonia and organic compounds can be generated. As a good neighbor, often in close proximity to the general public, and to meet the ever increasing requirements for air quality permits, these facilities must contain and neutralize any odors created.

A preferred solution is wet chemical scrubbing. A wet scrubber mixes odorous gases with a stream of liquid chemicals that react with and neutralize the offensive compounds. RJ Environmental Products offers a complete line of wet scrubber odor control systems. By far our most popular, versatile and effective product is the LO/PRO® Packaged Odor Control System.

Since its introduction in 1994, the LO/PRO has become the industry leader. It is the result of more than 25 years of experience developing, designing, building and testing wet scrubber systems. To date there are more than 250 LO/PRO scrubber systems in operation worldwide.

USFilter sets the standard for odor control technology. Our experience, reputation and product line are unequalled in the industry.

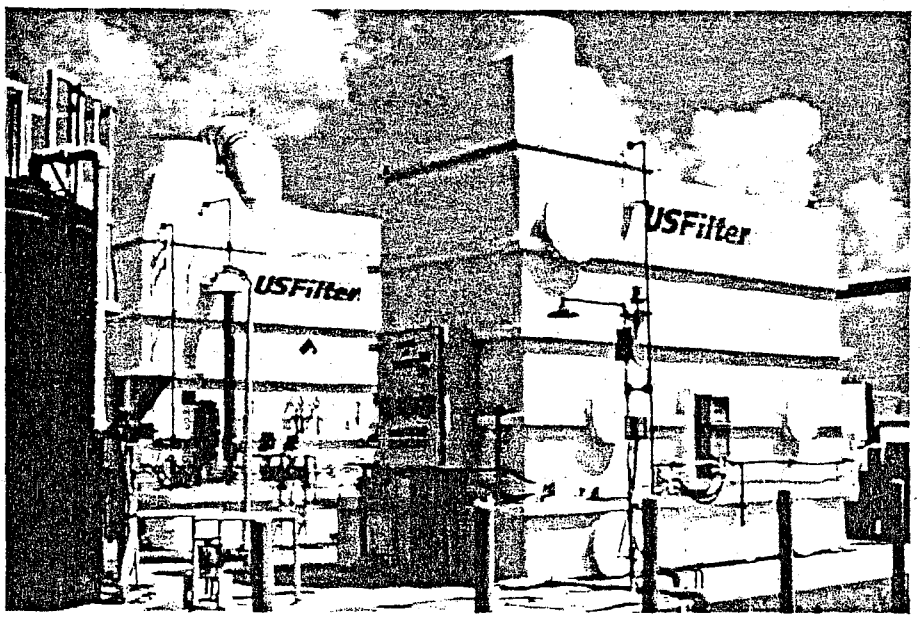
SUPERIOR TECHNOLOGY

The LO/PRO® Odor Control System is the most technologically advanced and cost effective scrubber system available. The LO/PRO is a patented[1], multi-stage, multi-chemistry wet scrubber system which can be configured to remove hydrogen sulfide, ammonia, or organic odors from municipal and industrial process gases.

Each installation is custom-designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Performance is guaranteed, with removal efficiencies in excess of 99.0% and airflow rates up to 24,500 cfm.

Each system is completely factory pre-assembled and mechanically tested prior to shipment. Premium vinylester fiberglass reinforced plastic (FRP) construction provides superior strength and corrosion resistance. The compact design occupies a fraction of the space required by conventional packed tower systems, with better chemical utilization and lower installation and maintenance costs.

- PATENTED PROCESS
- VERSATILE DESIGN
- LOW PROFILE/ COMPACT SIZE
- SINGLE SOURCE RESPONSIBILITY
- GUARANTEED PERFORMANCE
- FACTORY ASSEMBLED
- EASY INSTALLATION



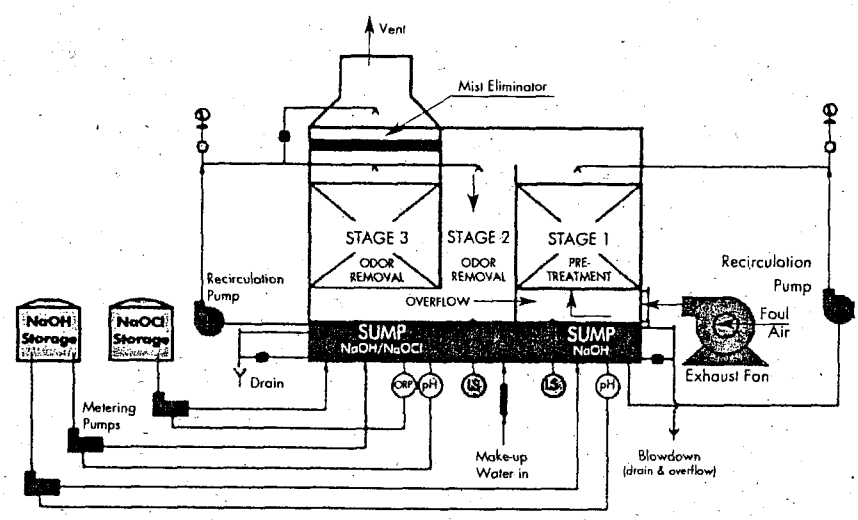
[1]The United States Patent and Trademark Office has recognized the novelty of the design of the LO/PRO with the award of two patents (U.S. Patent Nos. 5,876,662 and 6,174,498). An additional patent application is now pending. USFilter is the only company able to offer the innovative odor control systems covered by these patents.

H_2S REMOVAL

PROCESS CONFIGURATION

The schematic diagram below illustrates a typical LO/PRO configuration for hydrogen sulfide (H_2S) removal. In Stage 1, the process gas is pre-treated with blowdown from Stage 2/3 as well as with fresh caustic solution to remove 70-80% of the incoming H_2S.

The gas then passes through Stages 2 and 3, where a strong oxidation reaction removes all remaining H_2S. Chemical utilization is optimized through precise control of pH and ORP levels in the scrubber liquid.



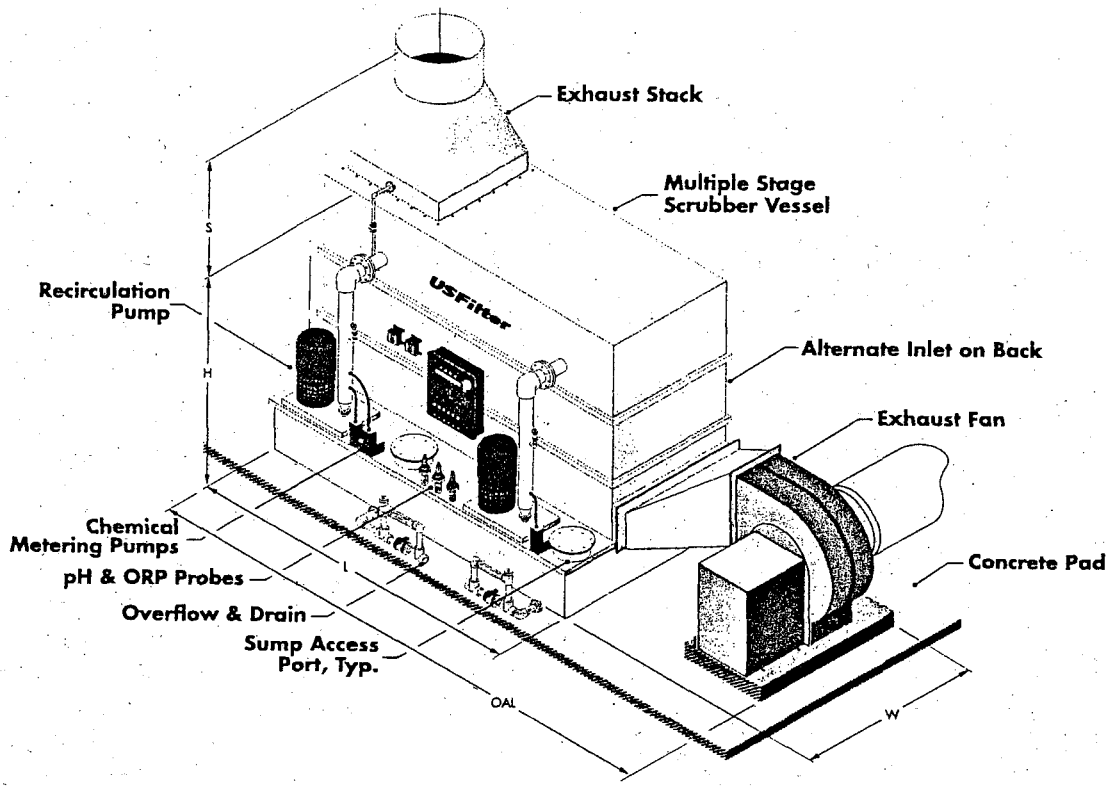
COMBINED H_2S AND NH_3 REMOVAL

LO/PRO systems have been designed for removal of hydrogen chloride, hydrogen fluoride, and other acid gases. Systems can also be configured to remove ammonia (NH_3) and hydrogen sulfide in the same scrubber. In this process, the first stage is maintained at a low pH, and a strongly acidic solution removes more than 99% of the ammonia. In the second and third stages, sodium hydroxide (caustic) and sodium hypochlorite (bleach) in the solution remove more than 99% of the hydrogen sulfide.

CUSTOM DESIGNS

The chemistry can be configured to remove mercaptans and other odorous organic compounds that cannot be controlled effectively with a conventional caustic and bleach scrubber. We have also designed unique odor control systems that operate at high pressure or high vacuum, systems that treat gases containing up to 50% carbon dioxide and/or methane, and systems that treat concentrations in excess of 60,000 ppm H_2S.

LO/PRO® DESIGN INFORMATION

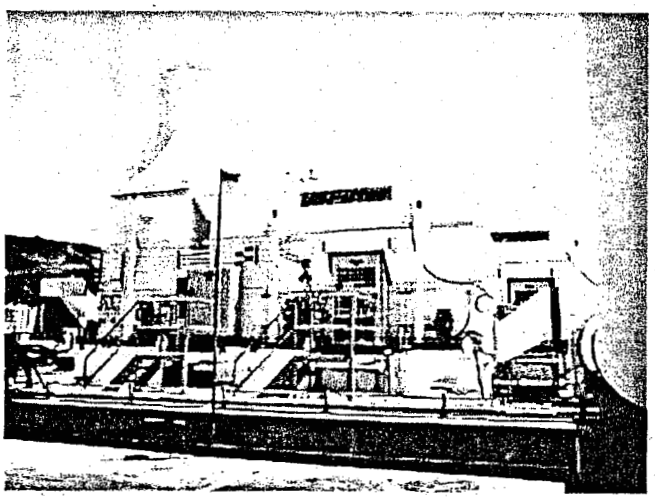


LO/PRO DESIGN INFORMATION

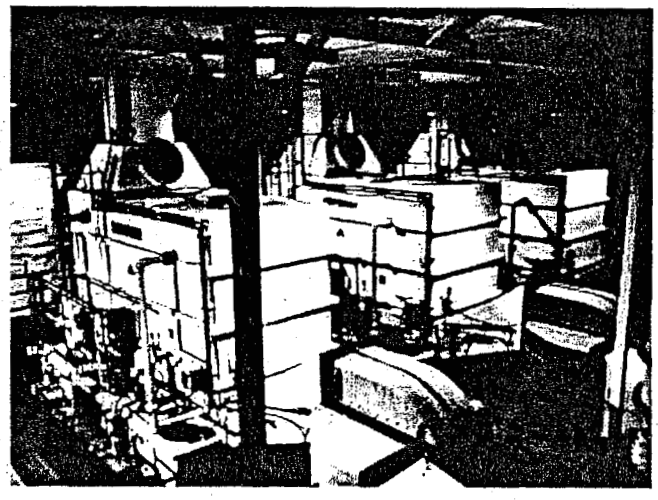
Model	Airflow Rate	Scrubber Dimensions LxWxH	Overall Length [OAL]	Shipping Wt	Operating Wt	Fan Motor[1]	Recirc Pump 1 Motor	Recirc Pump 2 Motor
Unit	cfm *m³/hr*	ft *mm*	ft *mm*	lb *kg*	lb *kg*	HP *kW*	HP *kW*	HP *kW*
LP-1500	1,000 *1,700*	4.50 x 4.00 x 8.50 *1,370 x 1,220 x 2,590*	9.00 *2,740*	1,000 *450*	3,500 *1,600*	5.0 *3.7*	1.5 *1.1*	2.0 *1.5*
LP-1750	1,300 *2,200*	5.25 x 4.25 x 9.25 *1,600 x 1,300 x 2,820*	10.00 *3,050*	1,600 *700*	4,500 *2,000*	5.0 *3.7*	2.0 *1.5*	3.0 *2.2*
LP-2000	1,700 *2,900*	6.00 x 4.50 x 9.25 *1,830 x 1,370 x 2,820*	11.00 *3,350*	2,200 *1,000*	6,000 *2,700*	7.5 *5.6*	2.0 *1.5*	5.0 *3.7*
LP-2250	2,200 *3,700*	6.75 x 4.75 x 9.25 *2,060 x 1,450 x 2,820*	12.50 *3,810*	2,500 *1,100*	7,000 *3,200*	7.5 *5.6*	3.0 *2.2*	5.0 *3.7*
LP-2500	2,700 *4,600*	7.50 x 5.00 x 9.50 *2,290 x 1,520 x 2,900*	13.00 *3,960*	3,100 *1,400*	8,000 *3,600*	7.5 *5.6*	3.0 *2.2*	5.0 *3.7*
LP-2750	3,300 *5,600*	8.25 x 5.25 x 9.50 *2,520 x 1,600 x 2,900*	15.00 *4,570*	3,700 *1,700*	9,500 *4,300*	7.5 *5.6*	5.0 *3.7*	5.0 *3.7*
LP-3000	4,000 *6,800*	9.00 x 5.50 x 10.50 *2,740 x 1,680 x 3,200*	15.50 *4,720*	4,400 *2,000*	11,000 *5,000*	10.0 *7.5*	5.0 *3.7*	5.0 *3.7*
LP-3500	5,500 *9,300*	8.75 x 6.00 x 11.00 *2,670 x 1,830 x 3,350*	16.00 *4,880*	5,000 *2,300*	12,000 *5,500*	15.0 *11.2*	5.0 *3.7*	5.0 *3.7*
LP-4000	7,100 *12,100*	10.00 x 6.50 x 11.00 *3,050 x 1,980 x 3,350*	17.50 *5,330*	5,600 *2,500*	14,500 *6,600*	15.0 *11.2*	5.0 *3.7*	7.5 *5.6*
LP-4500	9,100 *15,500*	11.25 x 7.00 x 11.25 *3,430 x 2,130 x 3,430*	19.50 *5,940*	6,200 *2,800*	17,000 *7,700*	20.0 *14.9*	5.0 *3.7*	7.5 *5.6*
LP-5000	11,200 *19,000*	12.50 x 7.50 x 11.50 *3,810 x 2,290 x 3,500*	20.50 *6,250*	6,800 *3,100*	19,500 *8,900*	25.0 *18.6*	7.5 *5.6*	7.5 *5.6*
LP-5500	13,600 *23,100*	13.75 x 8.00 x 11.75 *4,190 x 2,440 x 3,580*	22.00 *6,710*	7,500 *3,400*	22,000 *10,000*	30.0 *22.4*	7.5 *5.6*	10.0 *7.5*
LP-6000	16,200 *27,500*	15.00 x 8.50 x 12.00 *4,570 x 2,590 x 3,660*	24.00 *7,320*	8,300 *3,800*	25,500 *11,600*	40.0 *29.8*	7.5 *5.6*	10.0 *7.5*
LP-6500	20,000 *34,000*	16.25 x 9.00 x 12.25 *4,950 x 2,740 x 3,730*	26.00 *7,930*	9,100 *4,100*	28,500 *13,000*	50.0 *37.3*	10.0 *7.5*	15.0 *11.2*
LP-7000	24,500 *41,600*	17.50 x 9.50 x 12.50 *5,330 x 2,900 x 3,810*	27.00 *8,230*	10,000 *4,500*	32,000 *14,500*	60.0 *44.7*	10.0 *7.5*	25.0 *18.6*

S – Stack Height (minimum 5 ft.)
1 – Fan HP based on 2 in. water column inlet duct loss

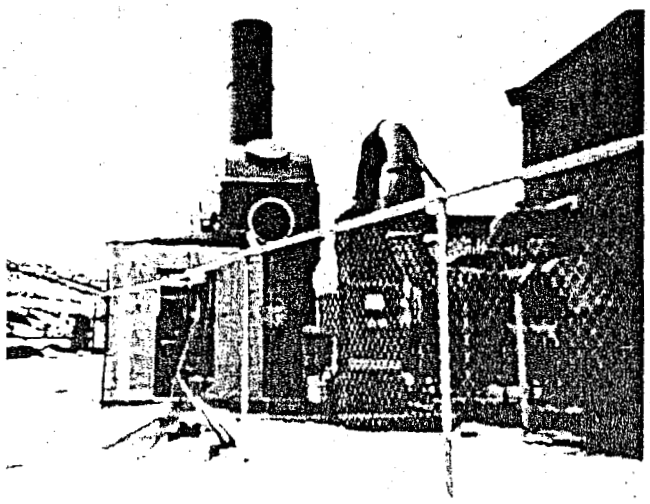
Los Angeles, CA				
Application	Hyperion WWTP Influent Pump Station			
Air Flow Rate (CFM)	2 systems, 20,000 cfm each			
Chemicals	NaOH and NaOCl			
Design Efficiency	99.0%			
Dimensions L x W x H (ft)	16.25 x 9.0 x 12.25			
Performance	**Average**		**Peak**	
	North	**South**	**North**	**South**
Inlet H_2S (ppm)	46.0	43.2	200	200
Outlet H_2S (ppm)	0.024	0.016	0.058	0.024
Removal Efficiency	99.95%	99.96%	99.97%	99.99%

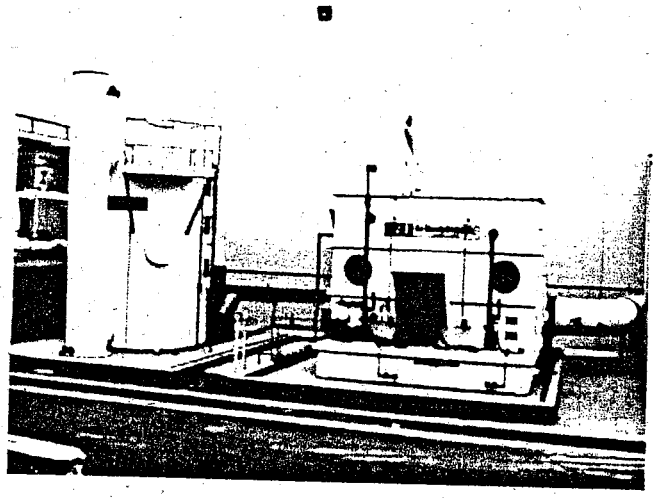


Las Vegas, NV						
Application	Las Vegas WRF, Primary Clarifiers					
Air Flow Rate (CFM)	7 systems, 24,500 cfm each					
Chemicals	NaOH and NaOCl					
Design Efficiency	99.5% at peak					
Dimensions L x W x H (ft)	17.5 x 9.5 x 12.5					
Performance	**Average**			**Peak**		
	#2	**#3**	**#4**	**#2**	**#3**	**#4**
Inlet H_2S (ppm)	11.2	10.6	11.0	22.6	22.3	20.8
Outlet H_2S (ppm)	0.01	0.00	0.03	0.01	0.01	0.02
Removal Efficiency	99.92%	99.97%	99.75%	99.96%	99.96%	99.89%

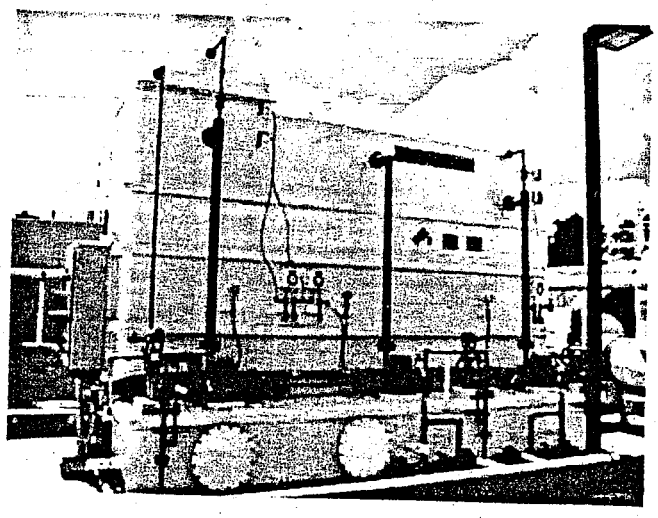


Avon, CO		
Application	Avon WWTP, ATAD Process	
Air Flow Rate (CFM)	3,000	
Chemicals	NaOH, NaOCl and H_2SO_4	
Design Efficiency	99.0%	
Dimensions L x W x H (ft)	11.0 x 5.5 x 10.0	
Performance	**H_2S**	**Mercaptans**
Inlet H_2S (ppm)	8.0	6.0
Outlet H_2S (ppm)	0.02	ND
Removal Efficiency	99.75%	>99.0%

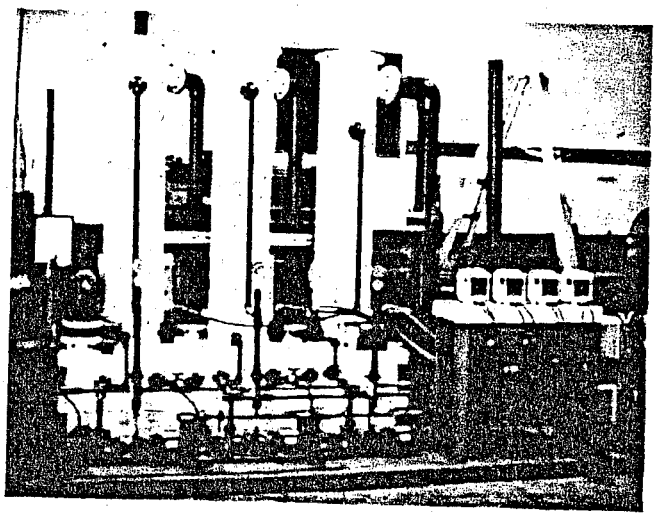




Samsung Corp., Tijuana, Mexico		
Application	Acid Gas Scrubbers (3)	
Air Flow Rate (CFM)	10,600 to 21,200	
Chemicals	NaOH	
Design Efficiency	99.9%	
Dimensions L x W x H (ft)	13.5 x 8.0 x 13.0	
Performance	**HCl**	**HF**
Inlet H_2S (ppm)	350	350
Outlet H_2S (ppm)	<0.35	<0.35
Removal Efficiency	99.9%	99.9%



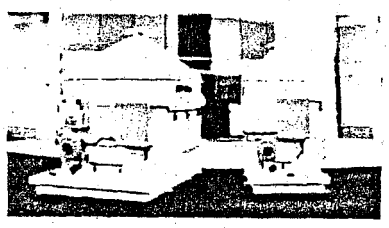
Bonita Springs, FL		
Application	Hydrogen Sulfide and Ammonia Scrubber	
Air Flow Rate (CFM)	8,035	
Chemicals	NaOH, NaOCl and H_2SO_4	
Design Efficiency	99.5%	
Dimensions L x W x H (ft)	11.25 x 7.0 x 11.25	
Performance	**H_2S**	**NH_3 (design)**
Inlet (ppm)	100	200
Outlet (ppm)	0.022	<1.0
Removal Efficiency	99.98%	99.5%



Continental Grain Co., Capiata, Paraguay		
Application	Bio Gas Scrubber	
Air Flow Rate (CFM)	250	
Chemicals	NaOH and NaOCl	
Design Efficiency	95.0%	
Dimensions L x W x H (ft)	12.5 x 5.5 x 9.1	
Performance	**Average**	**Peak**
Inlet H_2S (ppm)	18,000	26,000
Outlet H_2S (ppm)	0.7	0.7
Removal Efficiency	99.99%	99.99%

OTHER ODOR CONTROL PRODUCTS

BIOLOGICAL ODOR CONTROL SYSTEMS

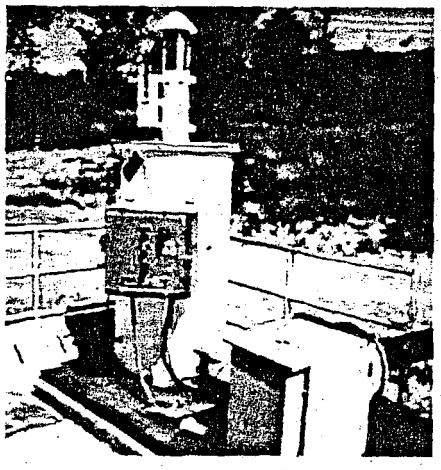


USFilter offers several biological odor control systems. The ZABOCS™ biofilter system is designed for flow rates from 100 to 5,000 cfm, and is ideal for unattended, remote pump stations. Better than 99% H_2S removal is achieved reliably, with minimal maintenance. The USFilter Bioscrubber system is designed for flow rates from 2,000 to 20,000 cfm and higher. The Bioscrubber system uses unique light weight, high surface area media to allow high air volumes in a compact space. All USFilter biological odor control systems are supported by custom bio-nutrients which enhance and accelerate the biological degradation of odorous compounds.

CARBON ADSORPTION SYSTEMS

Carbon adsorption is an effective solution to many odor control problems. It is particularly useful for small air flows, remote locations, and control of specific volatile organic compounds that are difficult to remove by wet scrubbing.

We offer a complete line of carbon adsorption systems, ranging from small modular systems (100 cfm and up) to larger, dual-bed systems (up to 15,000 cfm).



ADDITIONAL ODOR CONTROL TECHNOLOGIES

USFilter offers the most comprehensive selection of odor control technologies available. Please contact us for information on additional vapor-phase technologies such as biofiltration or liquid-phase technologies including the patented Bioxide® Process, AQuit,® Odophos,® and hydrogen peroxide.

RJ Environmental Products sets the standard for reliable, economical, and effective odor control systems.

USFilter

A Siemens Business

RJ Environmental Products
13100 Gregg Street, Suite B
Poway, CA 92064
858-486-8500 *phone*
858-486-8501 *fax*

www.usfilter.com

USFilter reserves the right to change the specifications referred to in this literature at any time, without prior notice. AQuit, Bioxide, LO/PRO, Odophos and ZABOCS are trademarks of USFilter Corporation or its affiliates.

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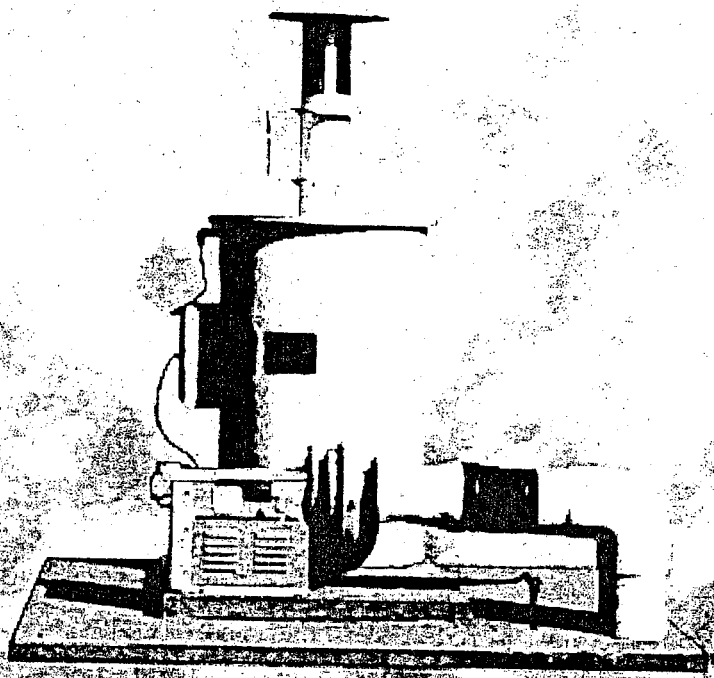
RJ-LP-BR-0804



USFilter

CARBON ADSORBER ODOR CONTROL SYSTEMS

RJC SERIES

MODULAR CARBON ADSORBER SYSTEMS

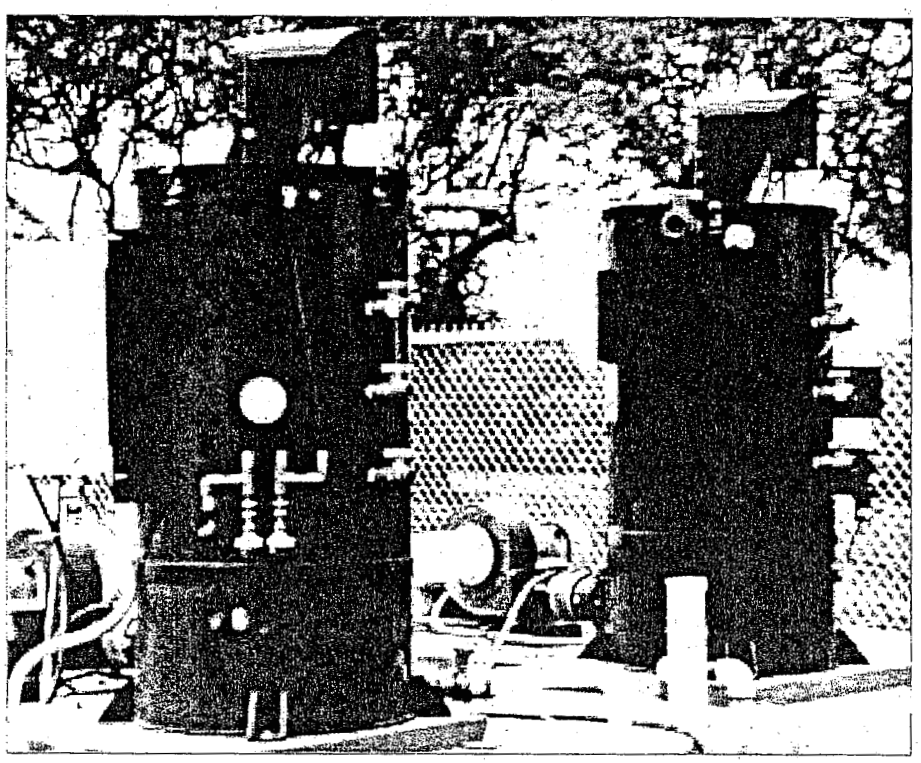
USFilter's RJC™ Series Modular Carbon Adsorbers are skid-mounted, pre-assembled systems ranging in flow capacity from 100 cfm to 1,400 cfm. Vessels are offered in either polypropylene or fiberglass reinforced plastic (FRP) and fans are available in epoxy coated stainless steel or FRP. Passive systems are also available which use natural process ventilation in place of the fan. The carbon media type is selected based on the specific application.

USFilter's Modular Carbon Adsorbers are often used to remove hydrogen sulfide (H_2S) from municipal wastewater. The RJC series adsorbers remove in excess of 99% of the inlet hydrogen sulfide and are designed to provide one or more years of bed life.[1]

The RJC Series Adsorbers only require inlet ducting, drain piping and power to the control panel to be completely operational.

FEATURES

- Pre-assembled and skid-mounted for simple installation
- Models for air flow rates from 100 to 1,400 cfm
- Passive flow systems available
- High performance carbon media
- Vessel constructed of polypropylene or premium vinylester fiberglass reinforced plastic
- Fan manufactured of stainless steel or fiberglass reinforced plastic
- Includes control panel, drain and grounding rod
- Available with volume control damper, carbon sample ports, differential pressure gauge



Two carbon adsorption systems in Makena, HI.

[1] Based on inlet H_2S concentrations below 7 ppm, at the maximum listed flow rate, and based on the adsorption capacity of Westates UOCH-KP carbon.

TYPICAL APPLICATIONS

- Hydrogen Sulfide
- Municipal Sewage Odors
- Industrial VOC Control

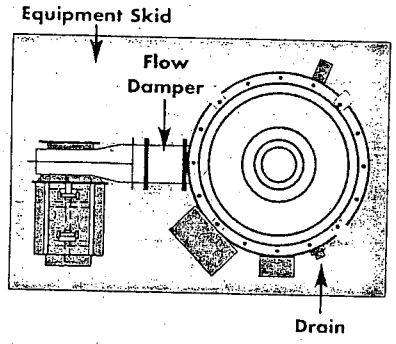
Carbon adsorption is an effective means of odor control for many applications. Carbon adsorbers can efficiently remove a variety of inorganic and organic compounds from municipal and industrial process air. Typical compounds adsorbed include hydrogen sulfide, aldehydes, ketones, and a wide range of industrial solvents and volatile organic compounds.

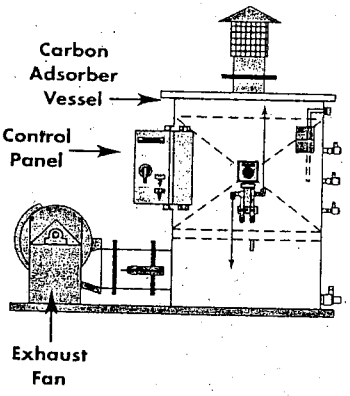
Carbon adsorbers are particularly useful for low air flows, low odor loads, remote locations, and for the control of specific volatile organic compounds. We offer a complete line of carbon adsorption systems, ranging from skid-mounted modular systems to custom designed, single and dual-bed systems capable of handling air flows in excess of 20,000 cfm.

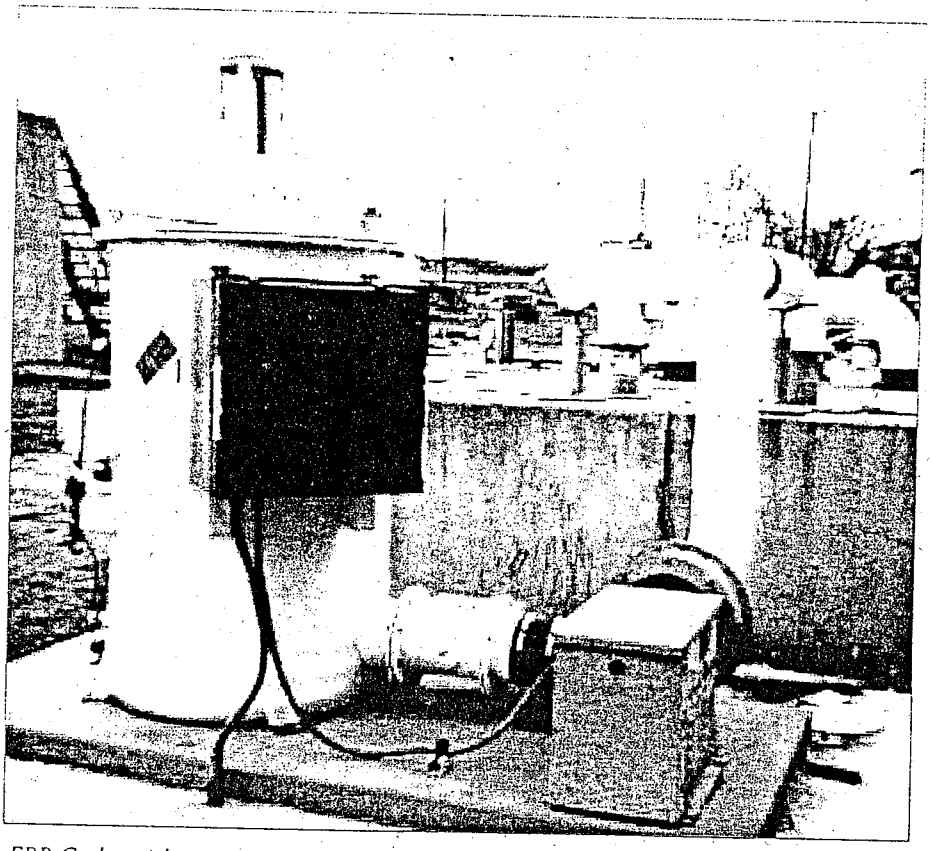
PROCESS DESCRIPTION

USFilter's Carbon Adsorber is a once-through, chemical adsorption process. Odorous compounds (H_2S and malodorous organics) are removed from the air stream by adsorption onto the activated carbon porous surface. Foul air from various sources is collected and passed through the adsorber. After entering the vessel, the foul air flows through a densely packed bed of activated carbon media. The cleaned air continues through the vessel and is exhausted through the stack.

The carbon media is selected based on the expected inlet contaminants and their concentrations. For hydrogen sulfide, we recommend USFilter's UOCH-KP caustic impregnated media. The caustic impregnant (KOH) catalyzes the oxidation of hydrogen sulfide to product elemental sulfur and water and greatly increases the H_2S capacity of the carbon media. The sulfur produced is adsorbed on the internal surface of the activated carbon while the water is mainly lost to the flowing air gas stream. The flowing air stream dissipates the heat. For VOC's, we recommend pelletized anthracite media that offers high adsorption capacity with minimal pressure drop. Other carbon media types are available for specific applications.







FRP Carbon Adsorption System in Hagerstown, MD.

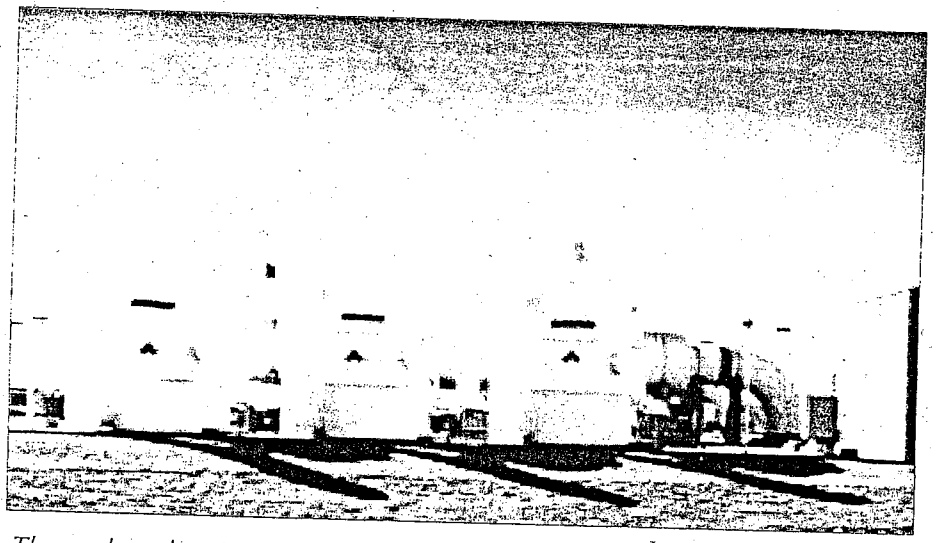
SIZING INFORMATION

Model #	Air Flow Rate (cfm)	Carbon Quantity (lbs)	Vessel Dia. x Height (ft)	Approximate Skid Length x Width (ft.)	Operating Weight (lbs)	Inlet & Outlet Dia. (in.)	Fan Motor (HP)
RJC-100	Up to 100	200	1.5 x 5.0	4.3 x 3.2	700	4	1.0
RJC-200	100–200	360	2.0 x 5.0	5.3 x 3.5	1,000	6	1.0
RJC-300	200–300	570	2.5 x 5.0	5.8 x 3.8	1,300	6	1.5
RJC-400	300–450	820	3.0 x 5.0	6.3 x 4.1	1,700	8	1.5
RJC-600	450–600	1,120	3.5 x 5.5	7.7 x 4.9	2,500	8	2.0
RJC-800	600–800	1,450	4.0 x 5.5	8.3 x 4.9	3,200	10	2.0
RJC-1000	800–1,000	1,850	4.5 x 5.5	8.8 x 5.2	4,000	10	3.0
RJC-1200	1,000–1,400	2,300	5.0 x 5.5	9.1 x 5.6	4,700	12	5.0

CONVENTIONAL CARBON ADSORBER SYSTEMS

For larger air flow rates, USFilter offers custom designed single and dual bed carbon adsorbers, often used as a polishing stage following a wet scrubber system. Carbon adsorber units can be designed to handle in excess of 20,000 cfm.

As with the modular carbon adsorber systems, the carbon media type is selected based on the specific application.



Three carbon adsorption units in Glendale, AZ (dual bed).

SIZING INFORMATION*

Air Flow Rate (cfm)	Vessel Dia. (ft.)	Bed Type	Vessel Height (ft.)	Footprint Required (ft.)	Fan Motor (HP)
1,700	6.0	Single	8.0	11.0 x 8.0	5.0
3,000	8.0	Single	8.0	15.0 x 10.0	7.5
4,700	10.0	Single	8.0	17.0 x 12.0	10.0
6,800	12.0	Single	8.0	20.0 x 14.0	15.0
9,400	10.0	Dual	13.0	19.0 x 12.0	20.0
11,400	11.0	Dual	13.0	20.0 x 13.0	20.0
13,600	12.0	Dual	13.0	21.0 x 14.0	25.0
20,000	14.0	Dual	13.0	23.0 x 16.0	40.0

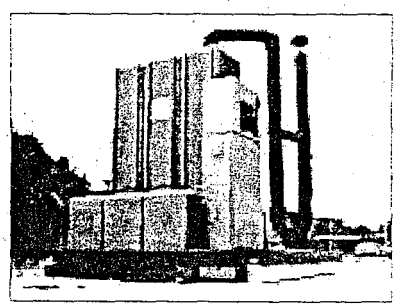
*These are examples only, based on a superficial velocity of approximately 60 feet per minute.

OTHER VAPOR PHASE ODOR CONTROL PRODUCTS BY USFILTER

LO/PRO® ODOR CONTROL SYSTEM

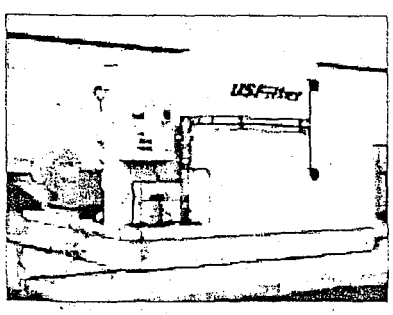
The patented LO/PRO® Multi-Stage Packaged Scrubber System is one of the most technically advanced and cost-effective scrubber systems available. The LO/PRO is a factory pre-assembled system of unitary construction which can do the work of conventional packed towers in less than half the space and at a fraction of the cost. Each installation is custom designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Performance is guaranteed with removal efficiencies in excess of 99.0% and air flow rates up to 24,500 cfm.

POLY-STAGE™ SCRUBBING TECHNOLOGY



The "L" Series and "DD71" Series Air Scrubbers provide a cost-effective, trouble free and flexible method to eliminate contaminants for all types of odor and fume control in air streams up to 6,000 cfm. The modular Poly-Stage™ scrubbing technology, using the packed-bed wet scrubbing process with a variety of chemical treatments, has proven effective for a wide range of airborne contaminants. With this patented technology, each module contains an integral packed bed, sump and re-circulation system. All vessels are seamless, maintenance free and guaranteed against failure for five years when used according to specifications.

ZABOCS™ BIOLOGICAL ODOR CONTROL SYSTEMS



The ZABOCS™ Biological Odor Control System is an advanced multi-media system which combines gas absorption, adsorption and biological treatment to capture and then eliminate organic and inorganic odors from wastewater process air streams. The unique combination of proprietary Biodagene™ and Biocarb™ media enables the ZABOCS system to treat three times the air volume compared to similar sized conventional biofilter systems, while immediately treating odors with zero acclimation time.

To find out more about how to put USFilter to work for you, contact us at

USFilter

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Poway, CA 92064
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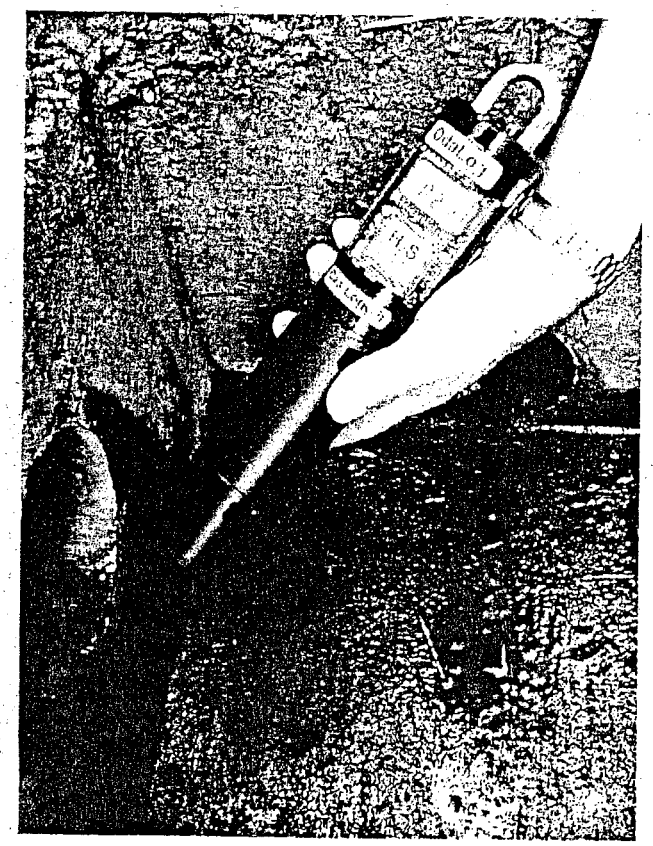
CS-ODOR-BR-0302

NEW !

OdaLog® Low Range Hydrogen Sulfide Gas Logger

For odor and corrosion studies

The OdaLog® Low Range Gas Logger was developed for locating and monitoring low-level hydrogen sulfide gas emissions (0.01 to 2.00 ppm).

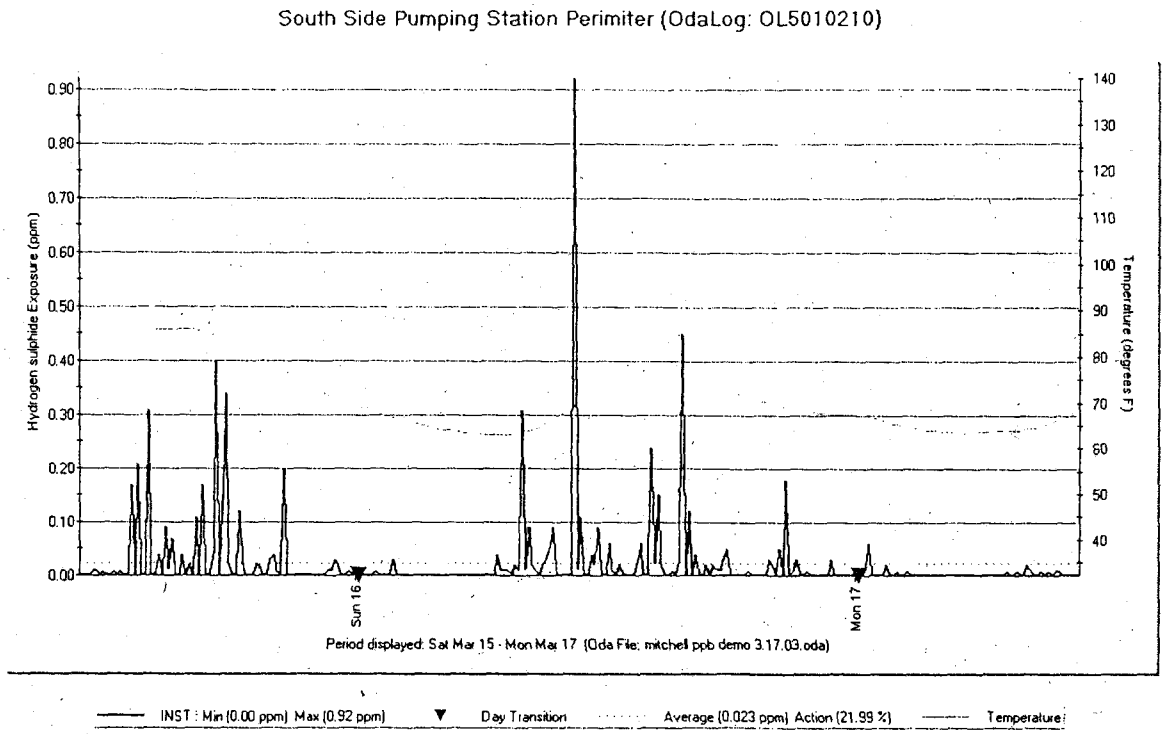


Typical applications include:

- Odor monitoring
- Control room monitoring
- Scrubber performance testing
- Ambient air analysis
- H_2S source detection
- Research projects

Detection Instruments Corporation
5815 N Black Canyon Highway • Suite 103 • Phoenix, AZ 85015 • Phone: 602-797-0630
www.detectioninstruments.com

An internal data logger records H_2S gas concentrations for later downloading of data in tabular or graphical form, using the standard OdaLog® Software.



- Infra-red data transmission
- Customize for specific applications
- Zooming capabilities
- Export to other spreadsheets

SPECIFICATIONS

Measurement range:	0.00 to 2.00 ppm
Logging/Sampling Interval	10 minutes to 1 hour
Memory capacity	30000 data points
Relative humidity range:	15 – 90% (non-condensing)
Pressure range:	Atmospheric, +/- 10%
External dimensions:	62mm (2.44") diameter X 345mm (13.6") long
Instrument weight:	Approximately 900 grams (2.0 lbs.)
Instrument Temperature Range	0° C to 40° C and 6° C change/Hr maximum (32° F to 104° F and 11° F change/Hr maximum)
Environmental protection	IP54 (dust and splash protected)
Zero drift (NTP)	+/- 0.01 ppm
Conditions: NTP, fresh air, taken over 10 consecutive sample cycles	
Precision	5% Relative Standard Deviation
Conditions: NTP, 0.20 ppm H2S applied, taken over 10 consecutive sample cycles.	
Accuracy	+/- 10% of reading 0.10 to 2.00 ppm
Conditions: NTP, 0.20 ppm applied, taken over 10 consecutive sample cycles.	

POWER SUPPLY

CPU Battery Type and Life	3.6V, 2/3 AA size Lithium cell, 2 months
Pump Battery and Life	1.5V "C" Size Alkaline, 7 days

WARRANTY

12 month warranty on electronics and sensors, 3 months on pumps and mechanical parts, when used in accordance with operation manual (excluding calibration and freight costs).

NTP defined as: Temperature = 20° C, Pressure = 1 Atmosphere

In the interest of continued improvements, we reserve the right to change design features without prior notice.

DETECTION INSTRUMENTS Corporation

OdaLog Low Range Hydrogen Sulfide Gas Logger

Part #	Description	Price
OL50	**OdaLog Low Range Hydrogen Sulfide Gas Logger** Range: 0.01 - 2.00 parts per million H_2S. Includes: Operation manual, magnetic allen tool, 2 - 3.6v lithium ion batteries, 4 "C" batteries, calibration fitting and hanging kit consisting of 3 feet of coated cable and 2 carabiners. Software sold separately.	$ 2,995.00
OLES	**OdaLog Environmental Shelter** Shields OdaLog from direct sunlight/temperature fluctuations.	$ 195.00
OLS	**OdaLog Software Kit (used with OL50, OL04, OL05, OL45)** Includes: Software (CD disc), infra red communications link, pushing tool/IR link stand.	$ 275.00
OLLRMK	**OdaLog Low Range Maintenance Kit** Includes: (2) 3.6 volt lithium ion battery, (4) "C" batteries, (4) filters, (2) absorbent packs, (1) allen tool, (1) switch cover, (1) O-ring, (1) calibration cup.	$ 75.00
OLLRCASE	**OdaLog Low Range Carrying Case** Holds three Low Range OdaLogs. Dimensions: 19 1/8" L x 15 7/16" W x 7 9/16" D	$ 195.00
OLLRGAS	**OdaLog Low Range Hydrogen Sulfide Gas Calibration Kit** Includes: 5 ppm Hydrogen Sulfide gas, carrying case, 0.25 lpm gas regulator, and dilution module.	$ 645.00
OLCYL5	**Gas Cylinder** - 5 ppm H_2S gas cylinder	$ 145.00
OLLRCAL	**OdaLog Low Range Calibration** Includes: Replacement of filter, batteries, a complete inspection and calibration of unit.	$ 145.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

All prices are FOB, Phoenix, AZ All prices in U.S. Dollars Updated July 21, 2004

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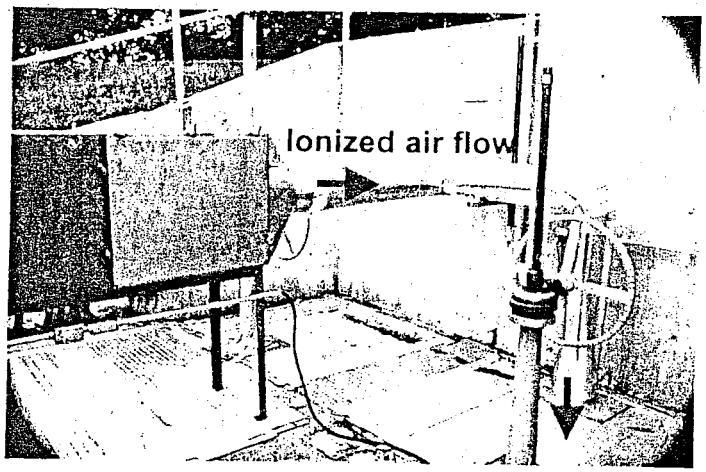
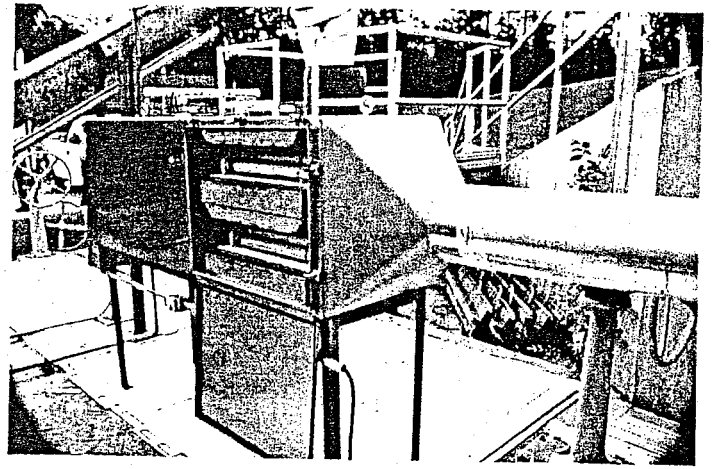
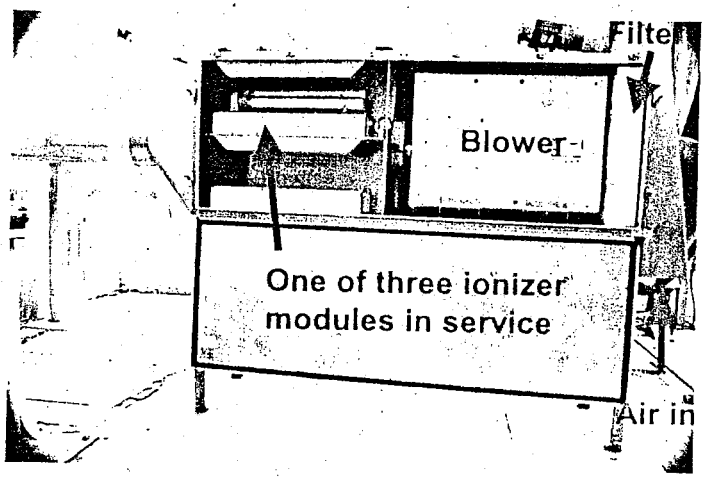
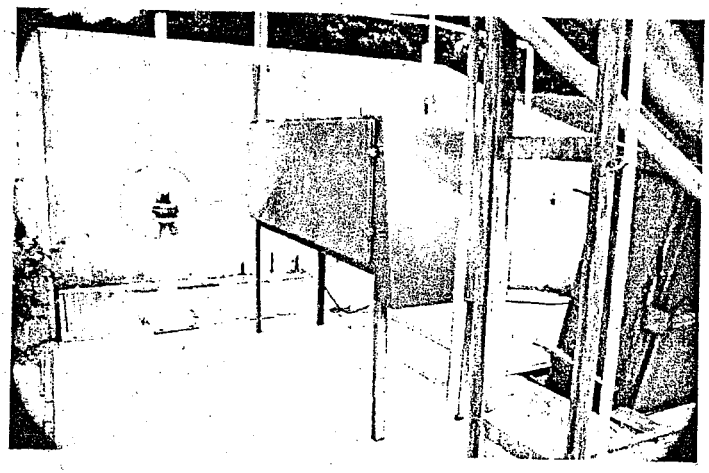
www.detectioninstruments.com

Pre-Engineered Standard System - San Jacinto River Authority, The Woodlands, Texas – Air Ionized Odor Control Plant #1 Mechanical Bar Screen at Plant Influent









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9212 Highland Road
Pittsburgh, PA 15237
Phone: 412-366-1977
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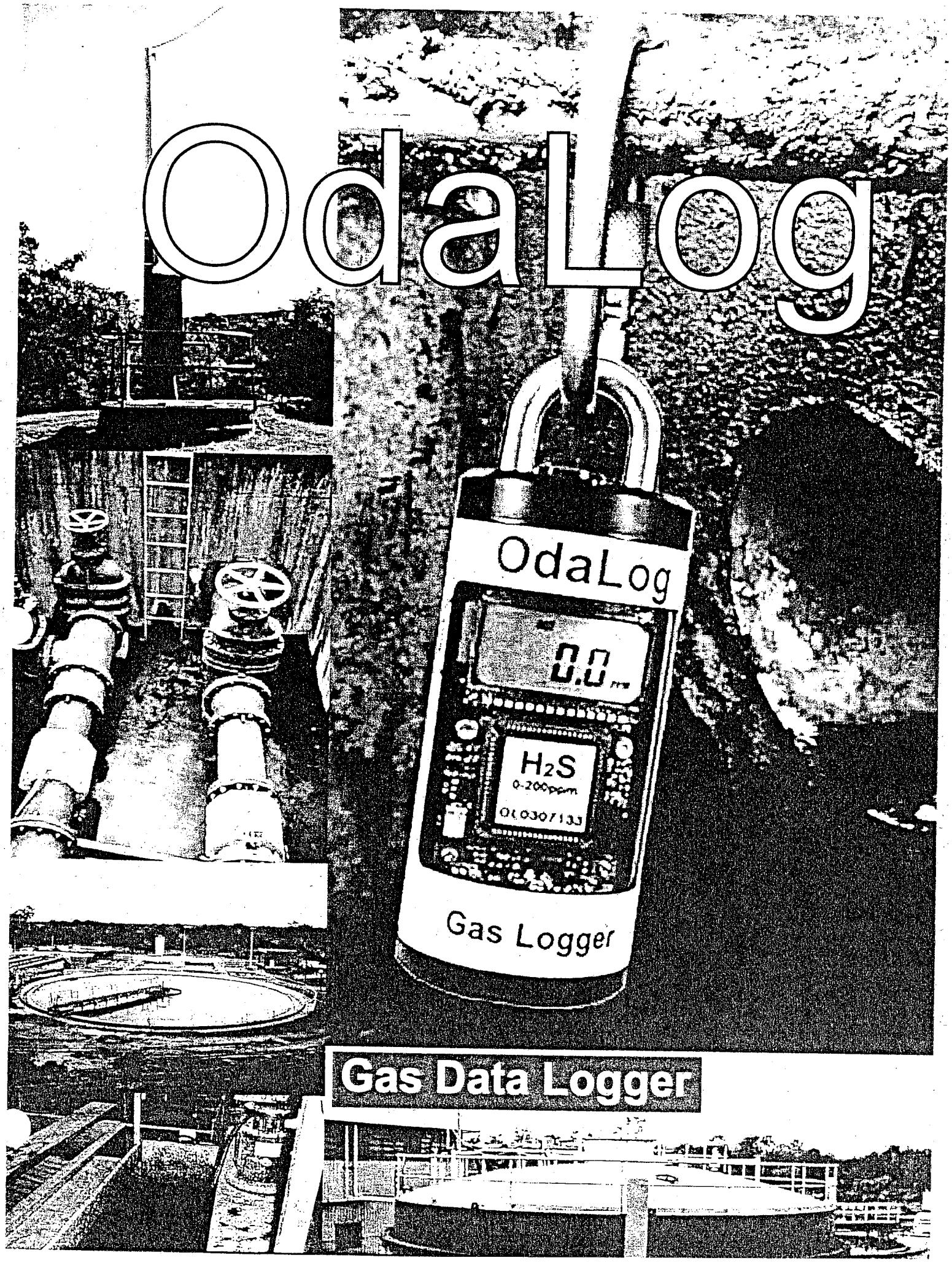
www.trans-tech.org

OdaLog



Gas Data Logger

PURPOSE DESIGNED

The OdaLog has been specifically designed for the Wastewater Industry, primarily for locating at or close to the source of Hydrogen Sulphide emissions such as within sewerage pumping stations and receiving manholes.

Its purpose is to log levels of H_2S in the range 0-200 ppm for later downloading of data in tabular or graphical form to highlight significant variations in H_2S levels over time.

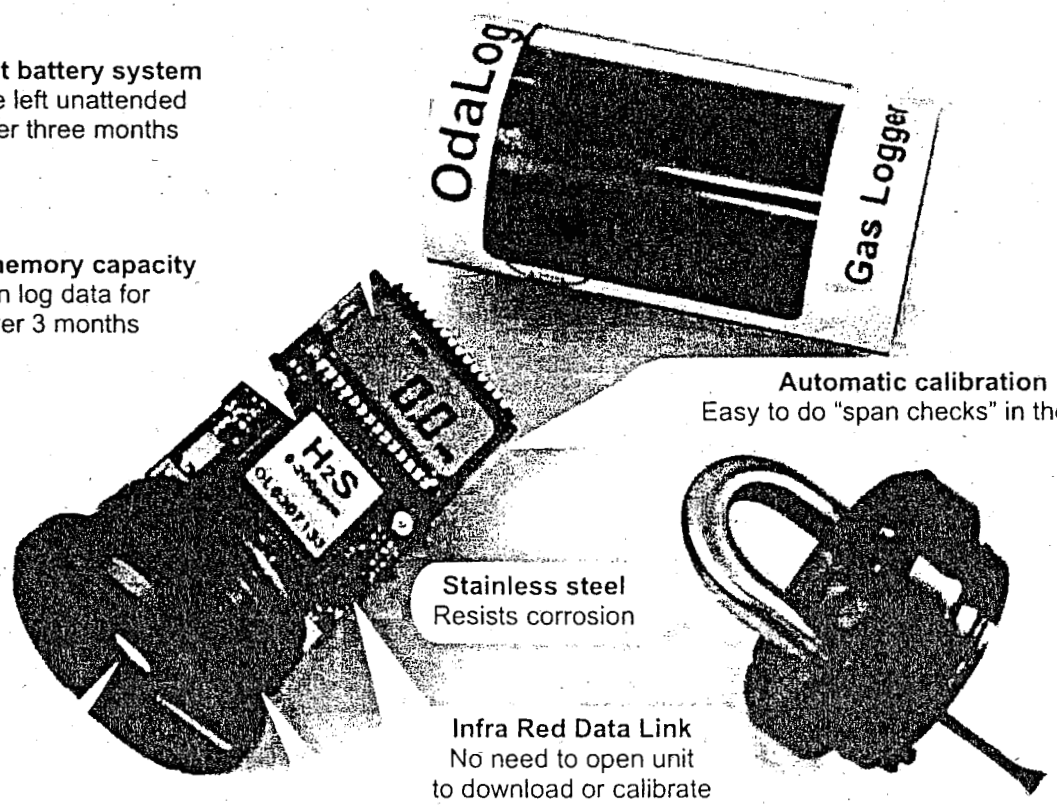
Due to the nature of the environment in which the instrument has to operate, it has been designed to be splash resistant, robust, small, and able to log data for extended periods of time.

Clear LCD display
Shows gas reading, time of day, Temperature, battery volts, % Log used, logging interval.

Durable non-corrosive plastic body
Survives in harsh Wastewater environment

Efficient battery system
Can be left unattended for over three months

High memory capacity
Can log data for over 3 months



Automatic calibration
Easy to do "span checks" in the field

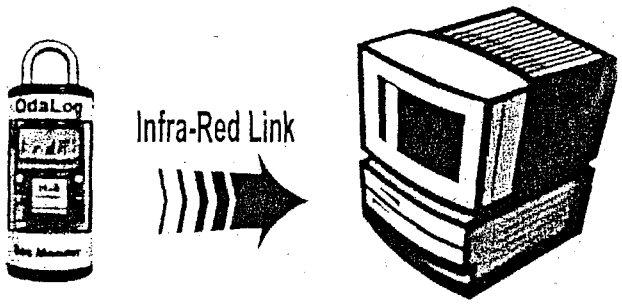
Stainless steel
Resists corrosion

Infra Red Data Link
No need to open unit to download or calibrate

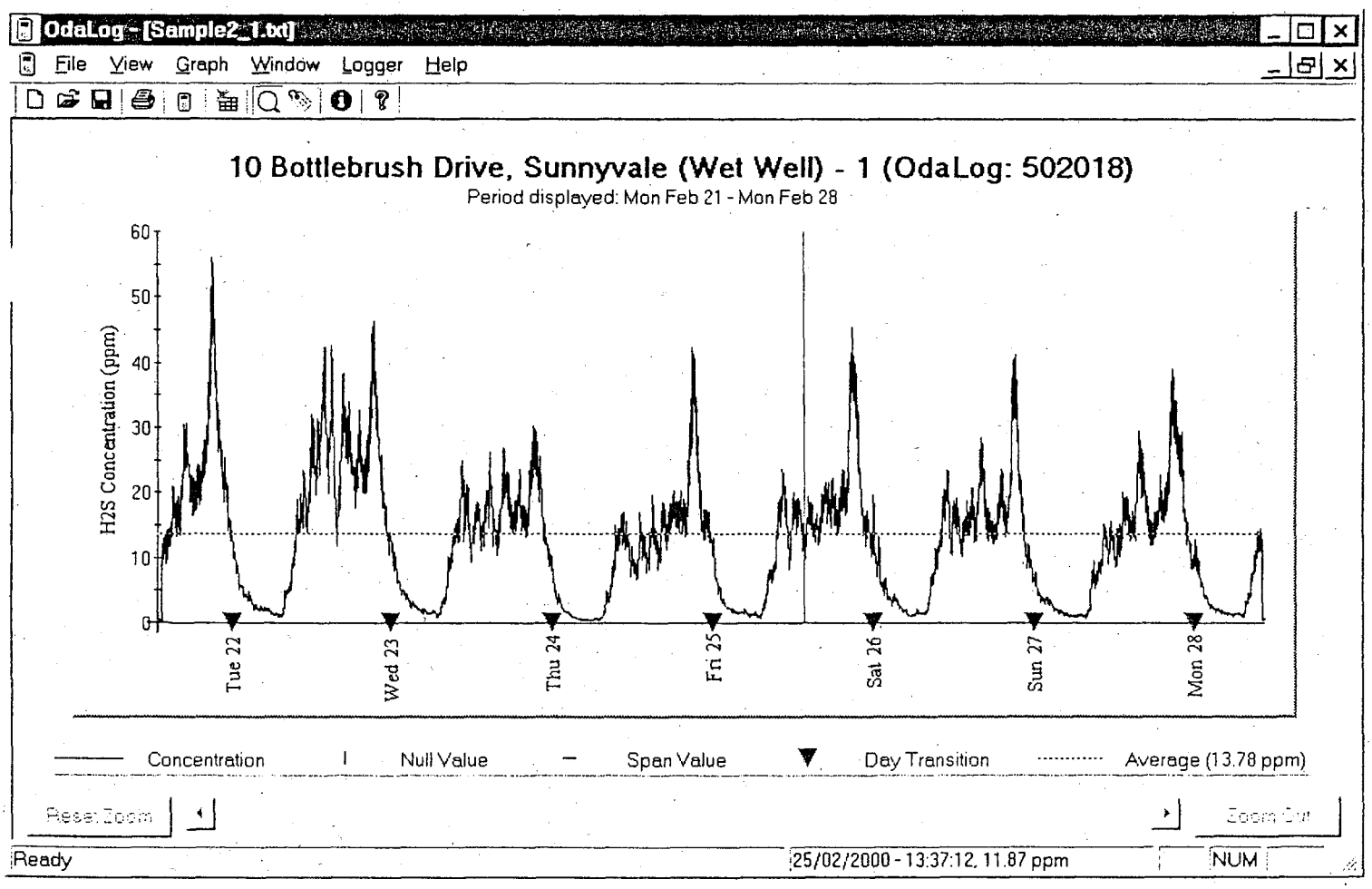
Filter over sensor
Repels splashes

Double O-Ring seals
Prevent water ingress

LONG TERM RECORDING



- Displays Line Graphs
- Ability to zoom in on selected time periods
- Ability to export data to spreadsheets
- Ability to customise graphical scale and mark time intervals on X-axis
- Records Odalog serial number on printout and allows graphs to be labelled
- Uses Infra Red Communication for downloading and configuring



32,000 logging intervals allow very detailed or very long studies e.g.

Over 3 months at 5 minute intervals

- Over 3 weeks at 1 minute intervals
- Over 3 days at 10 second intervals

SPECIFICATIONS

SENSOR TYPE:	Electrochemical Hydrogen Sulphide
X RANGE:	0 to 999.9 ppm
D RANGE:	0 to 200.0 ppm
ACCURACY AT STP:	+/- 1.0 ppm
RESOLUTION:	0.1 ppm
RESPONSE TIME:	T90 < 60 seconds
PRESSURE RANGE:	Atmospheric +/- 10%
RELATIVE HUMIDITY RANGE:	15 to 90% (non-condensing)
LCD DISPLAY:	00.0 to 999.9
INSTRUMENT TEMP RANGE:	-10 C to +40 C
EXTERNAL DIMENSIONS:	165mm x 62mm Dia
INSTRUMENT WEIGHT:	450 grams

POWER SUPPLY

BATTERY :	3 x 1.5V AA Alkaline Batteries or 1 x 3.6V Lithium Battery (1-136 or 1-137)
BATTERY LIFE:	Alkaline Batteries Over 3 Months or Lithium Battery Over 6 Months

DATA LOGGER

MEMORY CAPACITY:	32,000 Readings
LOGGING INTERVAL:	Selectable from 1 second to 1 hour (e.g.) 1 min interval logs for 22 days, 5 min interval logs for over 3 mths

Approvals

RINSIC SAFETY:	Standards Australia AUS Ex 2478X, certified to: Ex ia I/IIC T4 IP66/67 NEMKO 03 ATEX134, certified to: I M2 / II 2 GD, EEx ia I/IIC T4 IP66/67
ELECTROMAGNETIC COMPATIBILITY:	The OdaLog Type I and accessories have been tested and conform to the requirements of C-Tick, CE & FCC.

SERVICING

We recommend that the OdaLog is returned to an authorized App-Tek service centre at least once every six months for a full inspection, software upgrade as developed, calibration, test for linearity and to have new batteries fitted.

WARRANTY

12 month warranty when used in accordance with operation manual (excluding calibration & freight costs).

Authorized Distributor

Detection Instruments Corp.
5815 N. Black Canyon Highway, Suite 103, Phoenix, AZ 85015
Free: 866.632.5647
Fax: 602.797.0631

Manufactured By

App-Tek INTERNATIONAL PTY LTD

ABN 28 089 678 339

Address:
Unit 13/6 Pinacle Street Brendale Queensland Australia 4500
P.O.Box 5523 Brendale Queensland Australia 4500

Web Page:
http://www.odalog.com

In the interest of continued improvement, we reserve the right to change design features without prior notice.

DETECTION INSTRUMENTS Corporation

OdaLog Hydrogen Sulfide Gas Data Logger

PART #	DESCRIPTION	PRICE
OL04	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-50 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OL05	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-200 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OL45	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-1000 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OLS	**OdaLog Software Kit,** (used with OL04, OL05, OL45) Includes: Software (CD disc), Infra Red Communications Link, Pushing Tool/IR Link Stand, O-Ring grease.	$ 275.00
OLS-USB	**OdaLog Software Kit with USB adapter** (used with OL04, OL05, OL45) Includes: Sofware (CD disc), Infra Red Communications Link with USB Adapter, Pushing Tool/IR Link Stand.	$ 305.00
OLGAS	**OdaLog Hydrogen Sulfide Gas Calibration Kit** Includes Test Gas, Gas regulator, Plastic Carrying Case.	$ 395.00
OLCASE	**OdaLog Carrying Case**: Rugged, corrosion & dust proof case. Dimensions: 10 5/8" L x 9 3/4" W x 4 15/16" D, Holds three loggers.	$ 125.00
MOSS-2	**Multiple OdaLog Sampling System-2** Includes: Operation Manual, ¼" OD tubing (20ft.), power adapter and connectors. OdaLogs and software sold separately.	$ 995.00

OdaLog Hydrogen Sulfide Gas Data Logger Spare Parts

PART #	DESCRIPTION	PRICE
12-002kit	**OdaLog** Infra Red Communications Link with Stand	$ 135.00
12-002USBKit	OdaLog Infra Red Communications Link with USB adapter and Stand	$ 65.00
OLSEN	**OdaLog** Replacement Sensor (please specify gas type and range).	$ 250.00
OLMK	**OdaLog** Maintenance Kit Includes: Filters (4), Absorbent pack (2) AA Batteries (6), Switch Cover (1), Calibration Cup (1), O-Ring (1) Desiccant Packs (2), Allen Tool (1)	$ 50.00
OLCAL	**OdaLog** Calibration Includes: Calibration, battery & filter replacement & complete inspection.	$ 65.00
OLCYL	**OdaLog** Replacement Gas Cylinder: Hydrogen Sulfide gas. Available in 25 / 50 / 100 ppm gas concentration, 58 liter cylinder.	$ 145.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

All prices are FOB, Phoenix, AZ All prices in U.S. Dollars Updated March 5, 2004

Exhibit B

LTS, INC.
5102 SOUTH FERN COURT
CHANDLER, AZ 85248

Odor and Hydrogen Sulfide Monitoring Specialists Since 1991

FEB 2 3 2006

TOWN OF CAREFREE

SEWAGE COLLECTION AND CONVEYANCE SYSTEM

AND BOULDERS WATER RECLAMATION FACILITY

ODOR AND HYDROGEN SULFIDE

PHASE 2 STUDY

Performed for Black Mountain Sewer Company

Final Draft Report

July 28, 2004

Lamb Technical Services, Inc. 5102 South Fern Court, Chandler, AZ 85248 Phone 800-609-2635 / 480-802-2789 Fax 480-802-2790 elamblts@aol.com

EXECUTIVE SUMMARY

Background

On March 12, 2004, Black Mountain Sewer Company (BMSC) requested that Lamb Technical Services, Inc. (LTS) review the current condition, relevant to odor control of the sewage collection and conveyance system and the associated treatment plant located in The Boulders development in Carefree, AZ. The odor situation that BMSC inherited eighteen months ago has been an ongoing problem for the community for some period of time.

LTS and Joel Wade, Engineering Manager for BMSC, spent the morning reviewing the condition of each area, and a detailed explanation of past odor problems was presented to LTS. BMSC also discussed some of the short-term solutions that had been implemented to reduce or eliminate past odor emission problems, which the residents had been experiencing in many areas of Carefree. The Phase Two study is designed to perform a thorough odor evaluation by providing hydrogen sulfide (H_2S) data at multiple sewer line, fenceline and in-plant locations and the associated risks of odor emissions from each location. LTS was also asked to recommend any further action that Black Mountain Sewer Company may implement to further reduce the odor emissions from the treatment facility and its associated collection lines.

Phase 2 Data Review

Collection Lines and Pump Stations

During Phase 1, LTS visited the Commercial Pump Station off Tom Darlington Way, and the Carefree Inn Estates (CEI) lift station on Carefree Drive. LTS also visited a number of collection line locations that had been odor sources in the past including the Staghorn Drive area and the Boulder and Quartzite Drive area. Based on the initial review, fifteen locations were identified and evaluated for hydrogen sulfide and odor emissions, and one location was evaluated for ammonia emissions. Additionally, low-level hydrogen sulfide fenceline monitors were installed at the four sides of the wastewater treatment facility as well as one on the wall northeast of the CIE lift station. All of the locations were monitored in two five-day periods. During testing, four of the hydrogen sulfide monitors failed -- one at the headworks, one in the influent channel, and one at the southeast plant fenceline location during the first week of testing; and the second week of testing, one meter failed at the Century and Boulder Drive force main discharge location. Two of the meters were owned by BMSC and two were owned or rented by LTS. The graphs for the first two collection line locations can be seen with no hydrogen sulfide values and the meter constantly reading zero. One fenceline monitor did not record data on the southwest corner of the treatment facility.

During the second week of testing only one meter failed to operate properly, and no data were recorded at the Century and Boulder Drive location due to the failed meter. Repeat testing over the two-week period rendered the missing data irrelevant, as each location had at least five days of data collected at each location, which provided adequate information to determine what was needed for better odor control at the wastewater treatment plant and within the collection lines and pump stations.

Collection Lines and Pump Stations, Continued

The pump stations and the collection lines were found to have relatively high sulfides at all of the force main discharge locations, and at the influent of the treatment facility. This indicates that the sewage is quite septic due to the retention time in the force mains and the high wastewater temperatures.

Two of the smaller gravity line locations were found to be without flow in the summer: one test location was approximately ¼ mile upstream of the treatment plant on Quartz Drive, and the other was at the end of a Staghorn Drive. Without flow, these two locations had very low concentrations of hydrogen sulfide and no positive pressures. These two locations did not appear to be a significant source of odors during the summer. These conditions could be different with increased flow in the winter when more residents are in Arizona. This area should be evaluated again in the winter months to determine if the conditions within the gravity lines create an odor source that is not found in the summer months.

The gravity line test data on Staghorn Drive, and upstream on Boulder Drive determined that these locations were low-risk locations for odor emissions, and do not generally pose much of an odor emission problem in the summer. The hydrogen sulfide concentrations were always under 1 PPM and readings with the more accurate Jerome 631X were always under 0.15 PPM. Even though these locations are generally not a problem, unusual events such as blockages could make these locations vent odors into the ambient air, or additional flow in the winter could cause the same condition.

The main odor and sulfide producers are the wetwell/force main locations. This is typical in many wastewater systems and has been a problem for many locations across Arizona. Unfortunately, with the type of terrain found at the Boulders, force mains are required to move the sewage over the high points in the area. There are a number of treatment options to control hydrogen sulfide generation and odor releases in these types of systems, and most of them work with relatively good results. The product that BMSC is using is magnesium hydroxide, (brand name Thioguard). The product is designed to increase the pH of the wastewater, which keeps the sulfides in solution as long as the pH is above 8.5. It also provides some oxygen to the wastewater to oxidize the sulfides. The high pH that the product provides keeps the sulfides in solution and makes it difficult for them to be released into the headspace of the collection lines and at the wetwells. The two locations where the product provides the greatest benefit from chemical treatment are the CIE force main discharge location at Century and Boulder Drive, and at Boulder and Quartz Drive. Both of these locations are just before the sewer treatment facility and have had significant odor emissions in the past.

The use of the magnesium hydroxide at the Commercial lift station (that runs through the CIE lift station) is providing between 50% and 90% reduction in hydrogen sulfide emissions at the Commercial lift station wetwell and the force main discharge locations. The product is performing well at the feed rate BMSC is using, but the pH is relatively high at 9.0. The operators should continue to add the product to reduce the hydrogen sulfide emissions as much as possible for corrosion and odor control, but a chemical feed reduction is advisable to allow the system to operate at a pH between 8.4 and 8.6. This will have less of an impact on the wastewater treatment plant and still provide similar odor and hydrogen sulfide control.

Collection Lines and Pump Stations, Continued

Liquid wastewater analysis throughout the wastewater system indicated that the other parameters were typical, although sulfides in solutions were relatively high, peaking at 3.9 mg./lit at the wetwell of the Commercial lift station and up to 12.0 mg./lit at the discharge points. Normal ranges of sulfides in solution for wetwells are typically under 1.5 mg./liter, and a goal for force main discharge points would be under 5.0 mg./liter.

Even with these significant reductions in hydrogen sulfide concentrations due to the Thioguard, hydrogen sulfide levels remain very high in some locations. Additional measures probably will have to be taken to further control the odorous emissions, and are discussed in more detail later in the report.

Commercial Lift Station

Within the Commercial lift station wetwell, the hydrogen sulfide concentrations were relatively high, averaging 5-20 PPM with peaks of 32 PPM without the addition of magnesium hydroxide. The concentrations dropped to an average of under 2 PPM for the first week with chemical addition, but climbed as wastewater temperatures increased, with averages the second week ranging from 5 PPM to 20 PPM, with one unusual peak that was up to 102 PPM. This high peak most likely was due to a low pH cleaning product being discharged into the sewer and driving the hydrogen sulfide out of solution and into the headspace of the wetwell. Since the concentrations are up to 100 PPM in the wetwell, the hydrogen sulfide concentrations will need to be contained with a tightly sealed cover. The continued use of magnesium hydroxide to keep hydrogen sulfide levels and internal corrosion rates to a minimum is recommended. The location does not exhibit any positive pressures, but under the right ambient conditions, odors could be emitted from this location if not properly sealed. If odor complaints are received at this location, and sealing the wetwell is impractical, the installation of a small passive carbon filter could be utilized to collect and treat the odorous gas prior to being vented into the ambient air. If odor complaints continue after the installation of the passive carbon adsorber, a fan could be added to the carbon vessel to increase the negative pressure in the wetwell to keep odors from easily escaping into the ambient air. A packed tower odor scrubber or a biofilter can't be used at this location due to the space restraints at the lift station.

CIE Lift Station

At the CIE lift station, most of the past effort has been to seal all the possible venting locations to control the hydrogen sulfide and odor releases. Based on the data and the multiple site visits, this approach seems to be working quite well, although concentrations of 0.020 PPM were recorded at the fenceline on the Odalog monitors. These higher concentrations occurred at the hottest part of the day, each day during the first week of testing. After discussing the data with the manufacturer, the readings probably are not accurate as the instrument is unable to compensate for ambient temperatures above 110 degrees Fahrenheit. During the second week of testing a newer version analyzer was used at this location, and recorded only one short-term event. This one event is at the low detection level of the instrument and is also questionable. Handheld monitoring using a slightly more sensitive analyzer (Jerome 631X H2S Analyzer, accuracy of 0.003 PPM) did not record any elevated hydrogen sulfide concentrations anywhere around the CIE lift station.

CIE Lift Station, Continued

Although no odors were recorded around the lift station during any of the site visits, odors could be escaping from the pickholes upstream of the lift station.

Hydrogen sulfide concentrations within the collection lines and the CIE lift station wetwell were moderate to high. Four locations were monitored at the CIE lift station: one on the local gravity line, one at the force main discharge, and two on the wetwell structures within the lift station. The wetwell locations were relatively low in hydrogen sulfide concentrations, with levels up to 8 PPM. The incoming local gravity line, as mentioned earlier, had moderately high concentrations in the headspace, with peaks up to 21 PPM. The highest location around the CIE lift station was at the force main discharge. Peaks of 101 PPM were seen at this location without chemical addition, and 24 PPM with chemical addition. The magnesium hydroxide chemical feed site at the Commercial lift station is working well, and is providing a 75% reduction at the force main discharge at the CIE lift station with chemical addition. It should be noted that none of the concentrations recorded at either of these lift stations are unusual for a force main system.

Hydrogen sulfide concentrations were monitored in the local gravity line and recorded peaks of 21 PPM. Concentrations over 10 PPM are relatively high for an upstream gravity line. This area could be a candidate for chemical treatment to reduce the hydrogen sulfide concentrations going to the CIE lift station. If odors are still a problem in the area, Black Mountain Sewer Company (BMSC) may need to seal the manhole covers upstream of the lift station in the local gravity line to prevent any odors from escaping into the ambient air through the pickholes. A slight positive pressure (0.01 in./WC) was found around the CIE lift station collection lines. Under the right conditions, odors could be released through the pickholes with positive pressures of 0.01 in./WC. Sealing the pickholes on all of the manholes in the area is recommended first. If that proves inadequate, a small carbon adsorber with a fan could be used to provide a negative pressure on the upstream collection lines. As long as a chemical treatment program is in place, corrosion should not be a significant issue with sealed manholes.

Containing the odors within the sewer system as much as possible is the preferred approach for this area. If the odors cannot be contained adequately, an odor control approach similar to the Commercial lift station could be used at the CIE lift station. An odor control system is already on site and could be utilized if containment is not feasible; but carbon would probably be a better product at this location as the odor removal system (Peacemaker) does emit a slight chlorine odor and is not designed to treat amine odors that could be present at this location. LTS recommends that in the event that an odor control system is needed, the media to use would be carbon.

Force Main Discharge Locations

At the two locations that the force mains discharge into the gravity lines, just upstream of the wastewater facility, both locations have extremely high hydrogen sulfide concentrations. The force main discharge location at Quartz and Boulder Drive had concentrations up to 700 PPM, and the Century and Boulder location had concentrations over 100 PPM. Both locations also had positive pressures that tend to drive the odors and hydrogen sulfide concentrations out through the manhole cover pickholes.

The solution that BMSC has been using for the Century and Boulder location is installing a carbon insert for odor control. If the media is changed regularly, this insert will reduce the concentrations that are emitted out of the pickhole to under 1.0 PPM. Levels below 1.0 PPM would be considered low compared to most sewer systems in Arizona. This is probably the best solution for this location, although an insert that could hold a slightly deeper bed of carbon might be considered as a replacement to the unit that is now installed to give improved odor control and a longer life for the carbon.

At the Quartz and Boulder Drive location, the odor and hydrogen sulfide concentrations are being contained using a sealing manhole cover. This is preventing virtually all of the odors from being released into the ambient air, but the downside to this approach is that the location has significant positive pressures, up to 0.04 in./WC, and sealing the covers will force the air out to some other location, like resident vent stacks. Also, sealing the covers will create high corrosion rates due to the turbulence and high sulfide levels, and trying to contain all of the hydrogen sulfide releases. Even when Thioguard is added upstream, the turbulence can still strip the hydrogen sulfide out of solution. The Thioguard is working fairly well in reducing the releases at this location with approximately a 50% reduction, but with initial concentrations over 700 PPM, a 50% reduction is of little help in controlling the risk of odor emissions. With the significant positive pressures at this location, it is likely that these odors will be driven out of the surrounding homes' vent stacks. Due to this possibility, a meter was placed in a home vent stack just upstream of the Boulder and Quartz force main discharge location to determine if any odor was being emitted out of the local residences vent stacks. Concentrations of 5 PPM were recorded at the vent stack when no Thioguard was being added to the system. The levels dropped to under 1 PPM when the Thioguard was being added and no concentrations were recorded after the first day or two, but even with low concentrations of less than 1 PPM, they could still be an added odor source for the area. When the Thioguard feed pump was not operating, values up to 5 PPM were recorded out of the surrounding homes vent stacks. These concentrations could be a significant odor for the entire area.

A redesign at this structure is recommended if turbulence could be reduced. Reduced turbulence would keep the sulfides in solution to be treated by the waste treatment facility. Even with reduced concentrations due to less turbulence a fan generating negative pressures will still most likely be needed at the Quartz and Boulder Drive location to prevent odors from being forced out the local vent stacks.

Force Main Discharge Locations, Continued

There is also an additional pump station that was not evaluated called the Indian Rock Pump Station. This pump station discharges into the Quartz and Boulder location just upstream from the wastewater plant. Chemical feed could also be considered in this location if required.

Wastewater Treatment Facility

Six locations were tested at the wastewater treatment facility, the main influent line, the Parshall Flume structure, the headworks building, the splitter box, the old influent box, and the aeration basins influent. Most of the locations had relatively high hydrogen sulfide concentrations, over 10 PPM.

The influent locations, Parshall Flume, and headworks locations are seeing concentrations that are being carried downstream from the Boulder and Quartz Drive location. Slightly reduced concentrations were recorded within the treatment facility. The Thioguard is still helping at the plant, but the levels at the three in-plant locations were still significant. Additional hydrogen sulfide is being released at the splitter box and at the influent to the aeration basins and this is not related to the releases upstream at Boulder & Quartz Drive. The old splitter box was also evaluated and had low concentrations of hydrogen sulfide, and if sealed properly this location is really not a significant odor source.

Concentrations up to 120 PPM were seen at the influent location, but dropped to under 25 PPM within the plant. Still, with concentrations in the 10-25 PPM range, all of the locations will need to be treated. Currently the only locations that are receiving treatment are at the headworks, the splitter box and the influent to the aeration basins. Even though these locations are being treated with the existing odor control system (carbon adsorber), the influent to the aeration basins has significant gaps in the covers. This makes it difficult to contain the odors for treatment. LTS recommends that this area's covers be better sealed, and additional airflow is also recommended to increase the negative pressure on the basins to prevent any odors from escaping into the ambient air.

The Parshall flume and the influent line are currently not being treated. LTS recommends air treatment at these locations by extracting the odorous gas out of the structures with fiberglass ductwork and a fan, and treating the odors with an improved odor control system.

The headworks at the facility should be the focus of improved odor control. The concentrations in the room were up to 13 PPM and averaged over 4 PPM. This is not a significant amount of hydrogen sulfide, but other compounds that are odorous were recorded at this location. Concentrations of 1-5 PPM ammonia were recorded in the headworks in addition to the hydrogen sulfide. An improved odor control system would improve the negative pressure in the headworks and keep the odors from occasionally escaping into the ambient air

Wastewater Treatment Facility, Continued

The carbon adsorber odor control system was tested for removal efficiencies, and is performing well while treating the odors from the three locations it is extracting air from. Testing of the carbon adsorber indicated that the system is working to specifications with the new carbon that was installed earlier in the year. LTS never recorded any outlet results over 0.003 PPM out of the stack of the carbon adsorber during the two-hour test.

Even though the outlet values were very low, the negative pressure was almost zero at each of the locations from which the carbon adsorber is collecting odorous gas. Without the proper amount of negative pressure (> -0.02 in./WC) at the odorous locations in the plant, there is a risk that, under the right ambient conditions, significant odors could be released in to the ambient air.

The Odalog hydrogen sulfide monitors placed at the fenceline did not indicate that any significant amounts of hydrogen sulfide were being released into the ambient air; but testing with the Jerome 631X indicated that concentrations up to 0.024 PPM were occasionally being released at the fenceline. When the Porta-John was replaced at the facility, the spikes increased to over 0.030 PPM for the short duration they were on site. The County's limit is an average of 0.030 PPM for 30 minutes at the fenceline. This is a relatively loose specification, and it is recommended that BMSC have a goal of keeping the fenceline concentrations under 0.008 PPM in the future to prevent odor complaints. The reason LTS recommends that a target of 0.008 PPM be implemented is that based on a 1979 study performed by the California Air Resources Board, which found that 87% of people could detect a rotten egg odor from hydrogen sulfide at 0.008 PPM. It also stated that at 0.040 PPM, or five times the odor threshold, most people considered the odor a nuisance. This report is how the 0.030 PPM standard was derived in California and in Maricopa County.

Current fenceline odors at the facility are most likely from fugitive emissions due to a lack of negative pressures, mostly on the aeration basin influent areas. Other reduced sulfur odors are also typically found as part of the odor emissions and common in most wastewater treatment processes. Low level amines were also recorded at the headworks.

Other Odor Sources

Other odor sources were found during the study that could have occasional impacts on the locations, such as Porta-Johns located at the treatment facility and at the CIE lift stations. Southwest Gas was also replacing some of the gas mains in the area, presumably because of gas leaks. Natural gas is odorless, so the gas companies add an odorant at the distribution center, which is also a reduced sulfur compound called mercaptan. Mercaptans have a similar smell to hydrogen sulfide, and can often be interpreted as a sewer odor by some people. Other odors were also noted at the Commercial Lift Station that is clearly being emitted from the local restaurant grease traps. These emissions can often be very odorous, and also contain a large percentage of hydrogen sulfide. It is common for many people to interpret the grease traps odors as a sewer odor as they are very similar in nature and smell.

Recommendations

The short-term improvements that Black Mountain Sewer Company made as part of the Phase 1 review were correct, but to completely eliminate the odors 99% of the time at the wastewater treatment facility, a larger odor scrubber is recommended, in the range of 5,000 -10,000 CFM, with an additional stage for ammonia removal, and a final-stage carbon polisher. Airflows with a 5,000 -10,000 CFM system would increase the negative pressure in the headworks, splitter box and aeration basins, and to provide negative pressures at the Parshall Flume and in the influent line, which is not being addressed with the current carbon adsorber.

It is also recommended that the discharge location at Quartz and Boulder Drive be redesigned to reduce turbulence at this location. This could be part of the odor control improvement project at the plant, by creating a wetwell structure just to the North on the easement. The new odor control system would draw from this location along with the headworks, Parshall Flume, splitter box and aeration basins. The new collection structure would be designed to focus on a reduction in liquid turbulence and air extraction.

Black Mountain Sewer Company should continue to add Thioguard at the Commercial lift station for hydrogen sulfide control, and may consider adding an upstream chemical feed site for the gravity portion of the CIE lift station. At the Commercial lift station, the only improvement recommended at this location is to continue sealing the wetwell 100% to contain any odors that may be present in the wetwell.

LTS is recommending that a packed tower odor scrubber be installed with a 16" to 20" duct running out to a new junction structure to create a negative pressure at this location. The odors would be treated with a three-stage packed bed odor control system located at the treatment facility, and a carbon follower. The existing unit may be used as part of the polishing stage after the packed tower odor scrubber. An additional carbon unit would be required to handle the additional airflow.

Also, at the wastewater treatment facility, a continuous hydrogen sulfide monitor is also recommended to monitor the operation of the new odor control system and to alert the operators of any potential scrubber problems prior to receiving odor complaints. The only system on the market for this application that can read part-per-billion concentrations is the Sycamore Technologies system. This option should be evaluated to see if it would assist the facility in catching odor emission problems before they get to the surrounding community.

The Boulders in Carefree Liquid Sewage Data

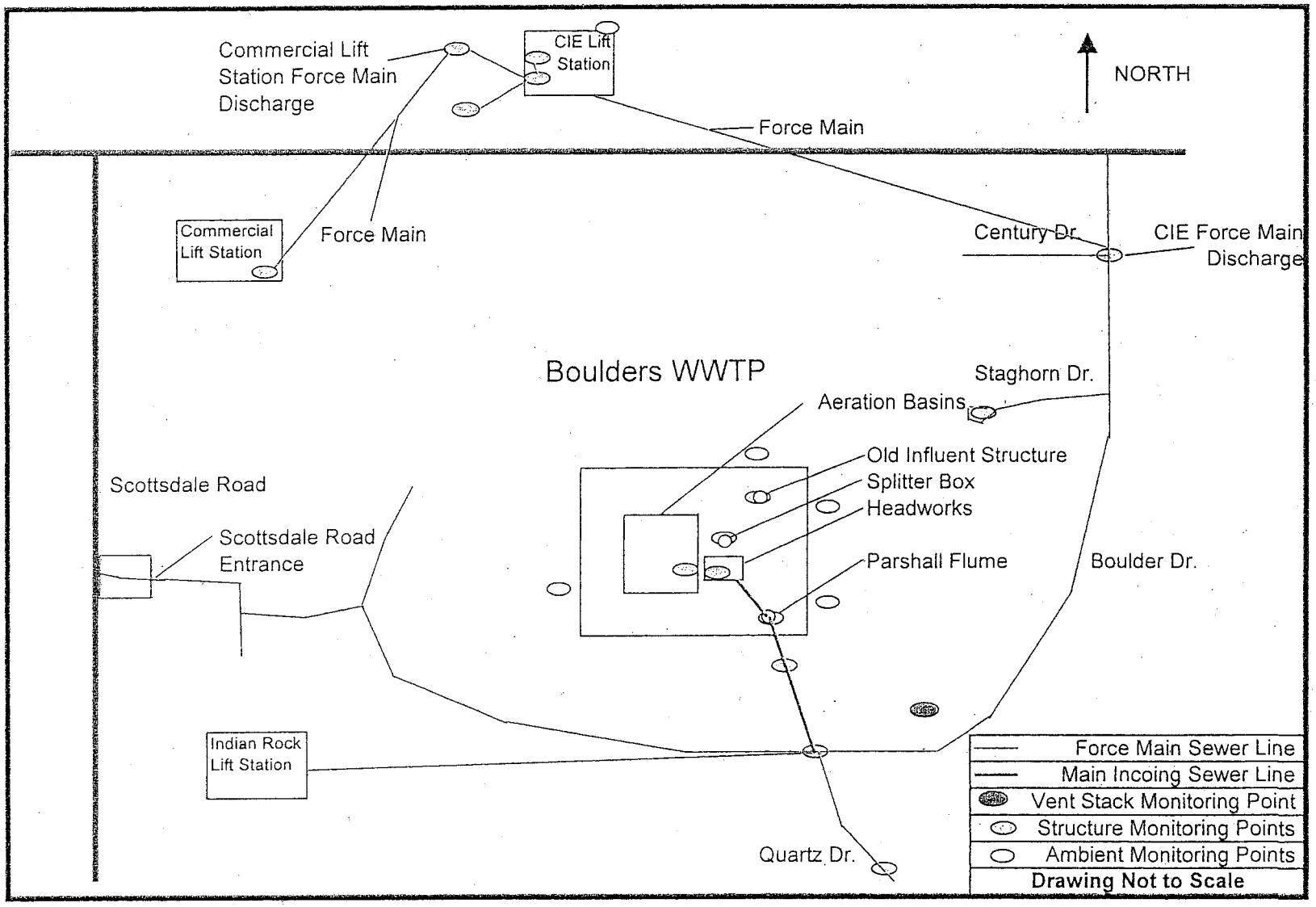
Test Sites

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/2/2004	9:30 AM	>50	8.17	-327	1.86	29.6	4.2	4.20	0.03	
Century & Boulder Dr.	6/2/2004	10:00 AM	26	8.41	-351	0.49	32.2	6.2	6.2	0.01	
Plant Influent	6/2/2004	10:30 AM	>50	7.65	-380	0.17	31.3	5.2	5.2	0.01	
Upstream Quartz Dr.	6/2/2004	11:00 AM	0.008	No Flow							
Staghorne Dr.	6/2/2004	11:30 AM	0.092								
Commercial Lift Station	6/2/2004	12:00 PM	14	7.87	-225	5.78	32.4	1.6	1.4	0.00	
Commercial Lift Station FM Discharge at CIE	6/2/2004	12:30 PM	8.0	7.43	-242	3.00	34.9	0.6	0.6	0.01	
CIE Incoming Gravity Line	6/2/2004	1:00 PM	0.089	7.87	-277	4.03	34.0	2.0	1.8	0.01	
											0 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/7/2004	8:00 AM	>50	8.84	-306	4.50	29.9	7.0	7.00	0.05	
Century & Boulder Dr.	6/7/2004	8:30 AM	23	9.24	-310	2.92	30.8	7.0	6.5	0.01	
Plant Influent	6/7/2004	9:00 AM	20	9.01	-310	5.60	29.1	9.0	9.0	0.00	
Upstream Quartz Dr.	6/7/2004	9:30 AM	0.012	No Flow							
Staghorne Dr.	6/7/2004	10:00 AM	0.031								
Commercial Lift Station	6/7/2004	10:30 AM	2.2	8.93	-279	4.20	30.7	2.2	2.1	0.00	
Commercial Lift Station FM Discharge at CIE	6/7/2004	11:00 AM	4.0	8.80	-284	2.62	32.0	2.0	1.4	0.01	
CIE Incoming Gravity Line	6/7/2004	11:30 AM	0.022	8.06	-182	2.61	31.8	0.2	0.1	0.01	
											90 GPD

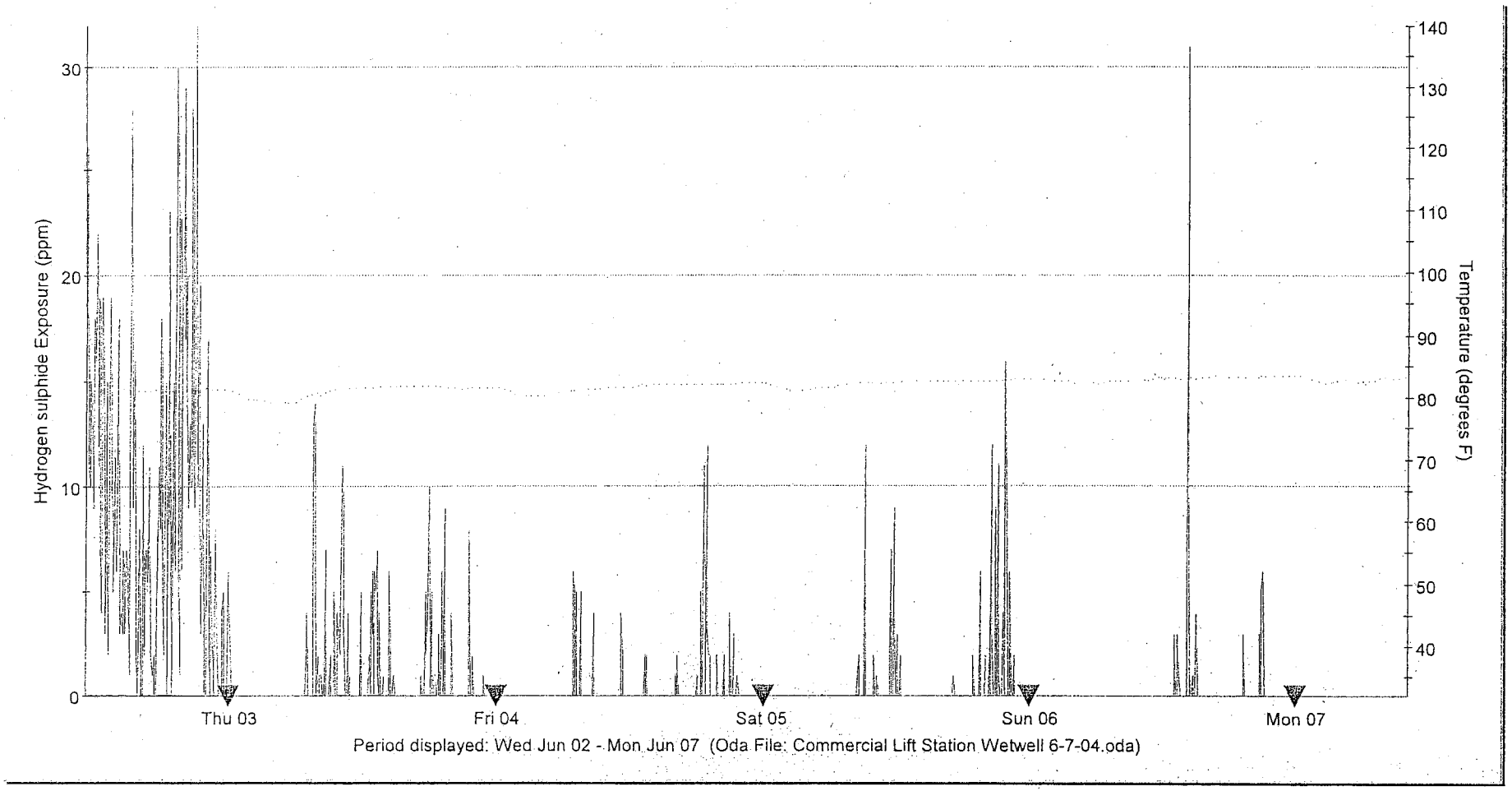
Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/9/2004	8:30 AM	>50	9.13	-307	5.72	28.3	12.0	12.0	0.03	
Century & Boulder Dr.	6/9/2004	9:00 AM	1.4	9.15	-246	4.80	29.2	7.0	6.5	0.00	
Plant Influent	6/9/2004	9:30 AM	>50	9.04	-309	4.32	28.7	12.0	12.0	0.005	
Upstream Quartz Dr.	6/9/2004	10:00 AM	0.004	No Flow							
Staghorne Dr.	6/9/2004	10:30 AM	0.004								
Commercial Lift Station	6/9/2004	11:00 AM	0.62	8.53	-300	2.40	29.0	3.6	3.2	0.00	
Commercial Lift Station FM Discharge at CIE	6/9/2004	11:30 AM	0.15	8.73	-299	5.40	30.3	2.7	2.5	0.00	
CIE Incoming Gravity Line	6/9/2004	12:00 PM	0.020	7.18	-257	2.52	31.0	1.1	1.1	0.00	
											90 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/14/2004	7:30 AM	40	9.10	-300	5.07	29.3	10.8	10.8	0.01	
Century & Boulder Dr.	6/14/2004	8:00 AM	48	9.11	-270	4.51	29.5	8.3	8.3	0.005	
Plant Influent	6/14/2004	8:30 AM	30	9.00	-315	4.01	29.1	10.5	10.5	0.005	
Upstream Quartz Dr.	6/14/2004	9:00 AM	0.037	No Flow							
Staghorne Dr.	6/14/2004	9:30 AM	0.019								
Commercial Lift Station	6/14/2004	10:00 AM	6.0	8.65	-299	2.07	30.0	3.9	3.7	0.00	
Commercial Lift Station FM Discharge at CIE	6/14/2004	10:30 AM	16	8.81	-291	5.11	30.7	3.0	2.9	0.01	
CIE Incoming Gravity Line	6/14/2004	11:00 AM	13	7.25	-231	2.01	31.2	1.3	1.3	0.01	
											90 GPD

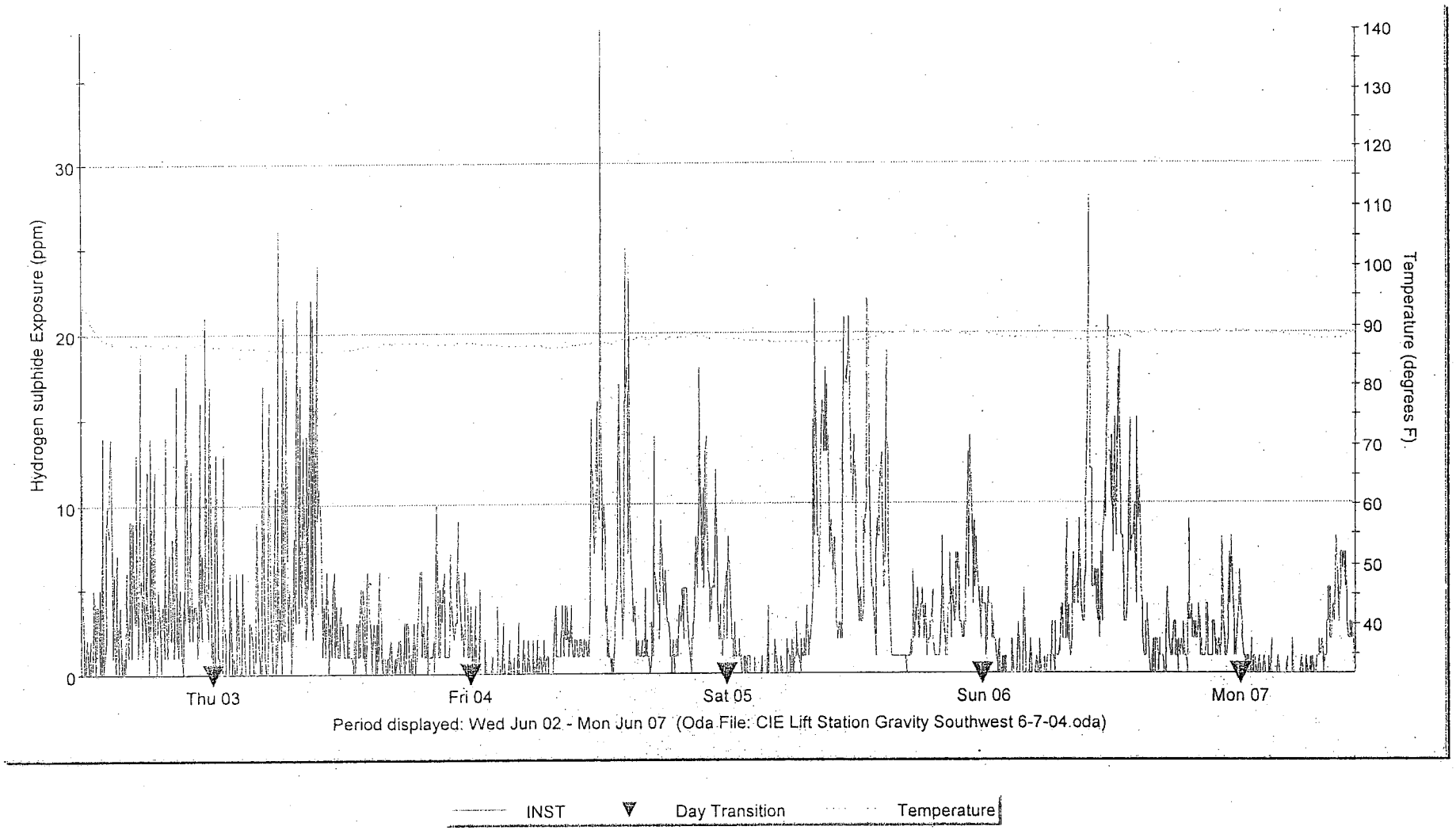


The Boulders WWTP Site Map

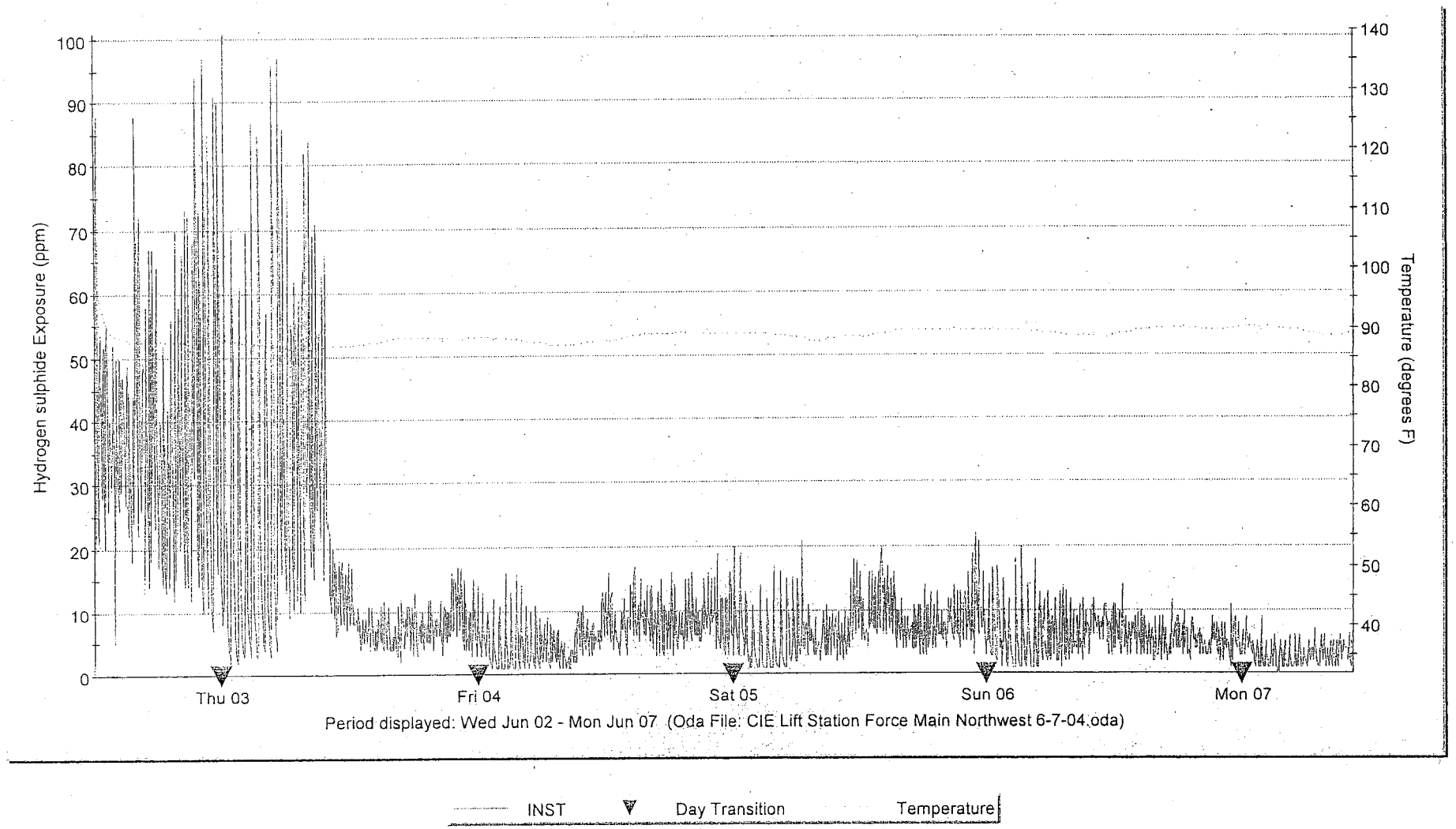
- Session: 1 (OdaLog: OL0504069)



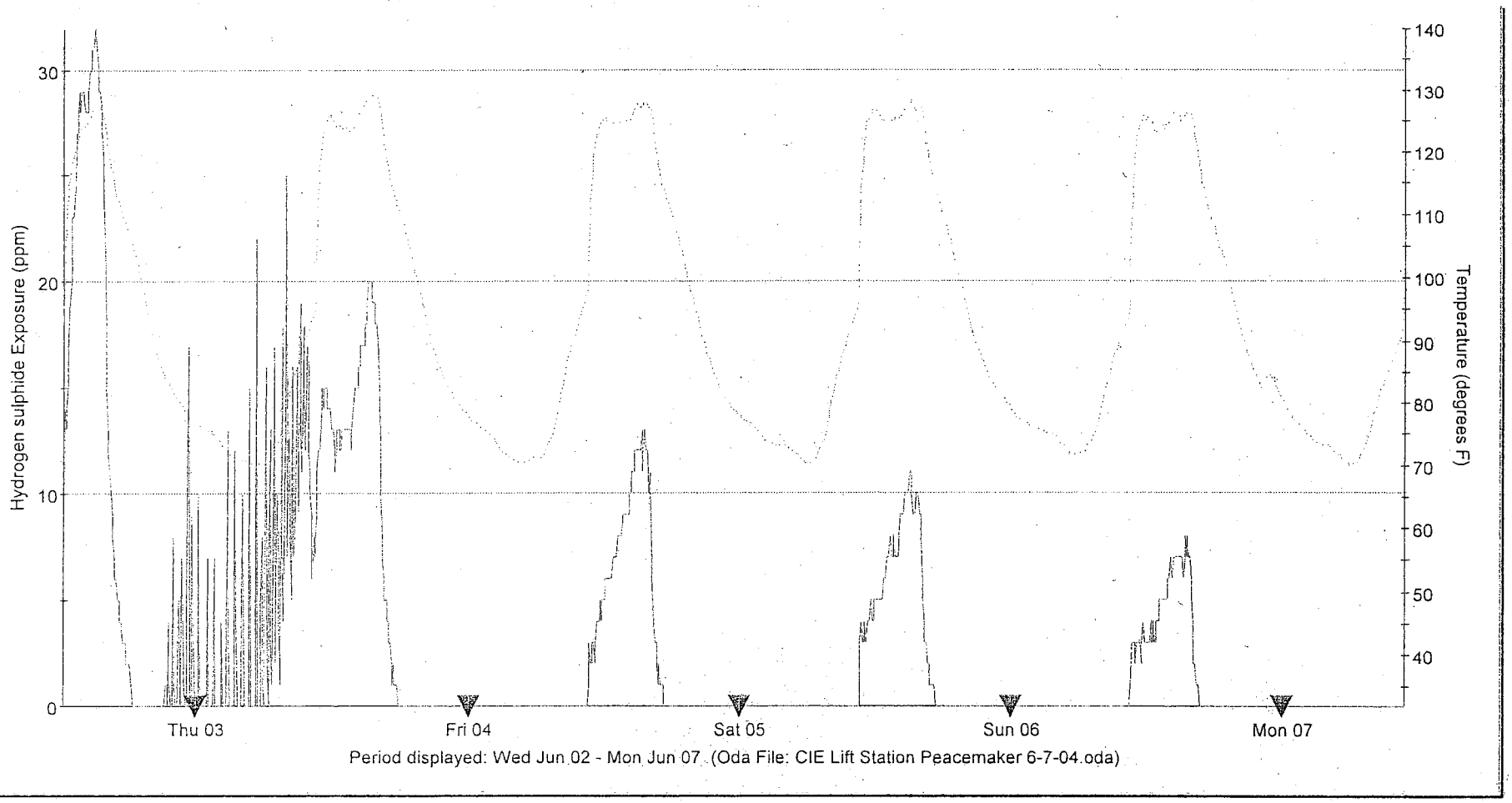
- Session: 1 (OdaLog: OL05123688)



- Session: 1 (OdaLog: OL05113658)

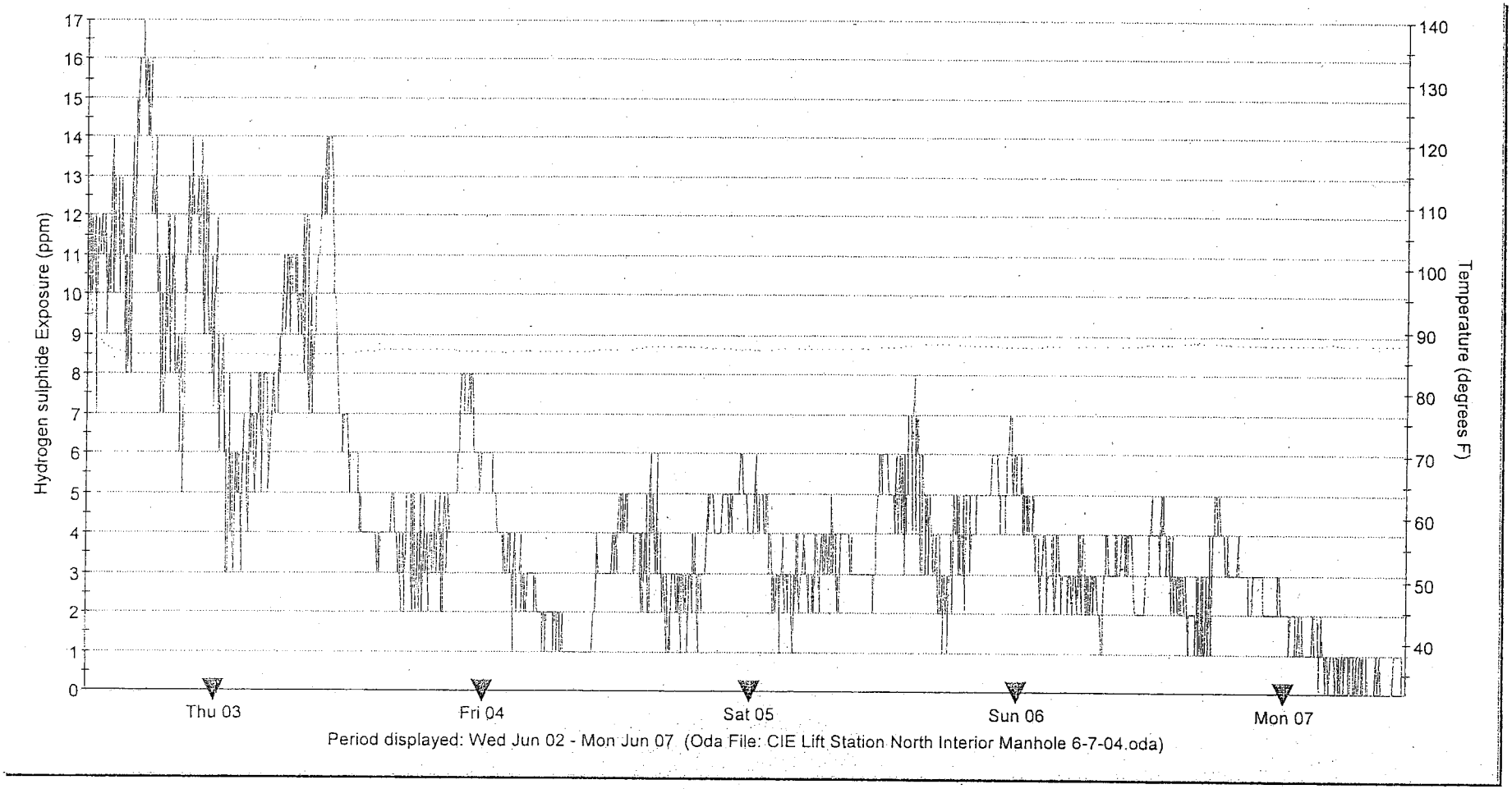


- Session: 1 (OdaLog: OL0504068)



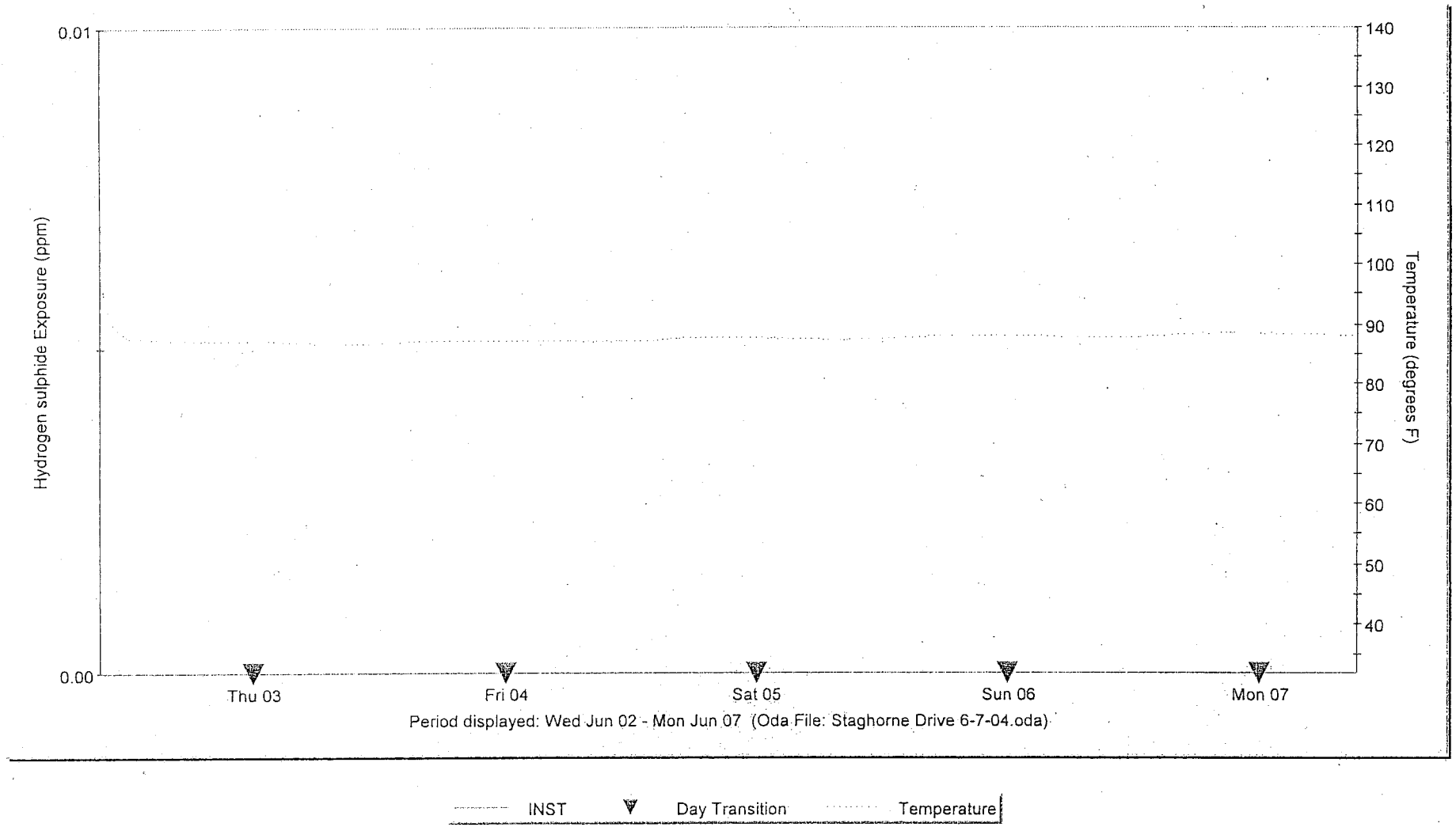
INST ▼ Day Transition Temperature

- Session: 1 (OdaLog: OL0504071)

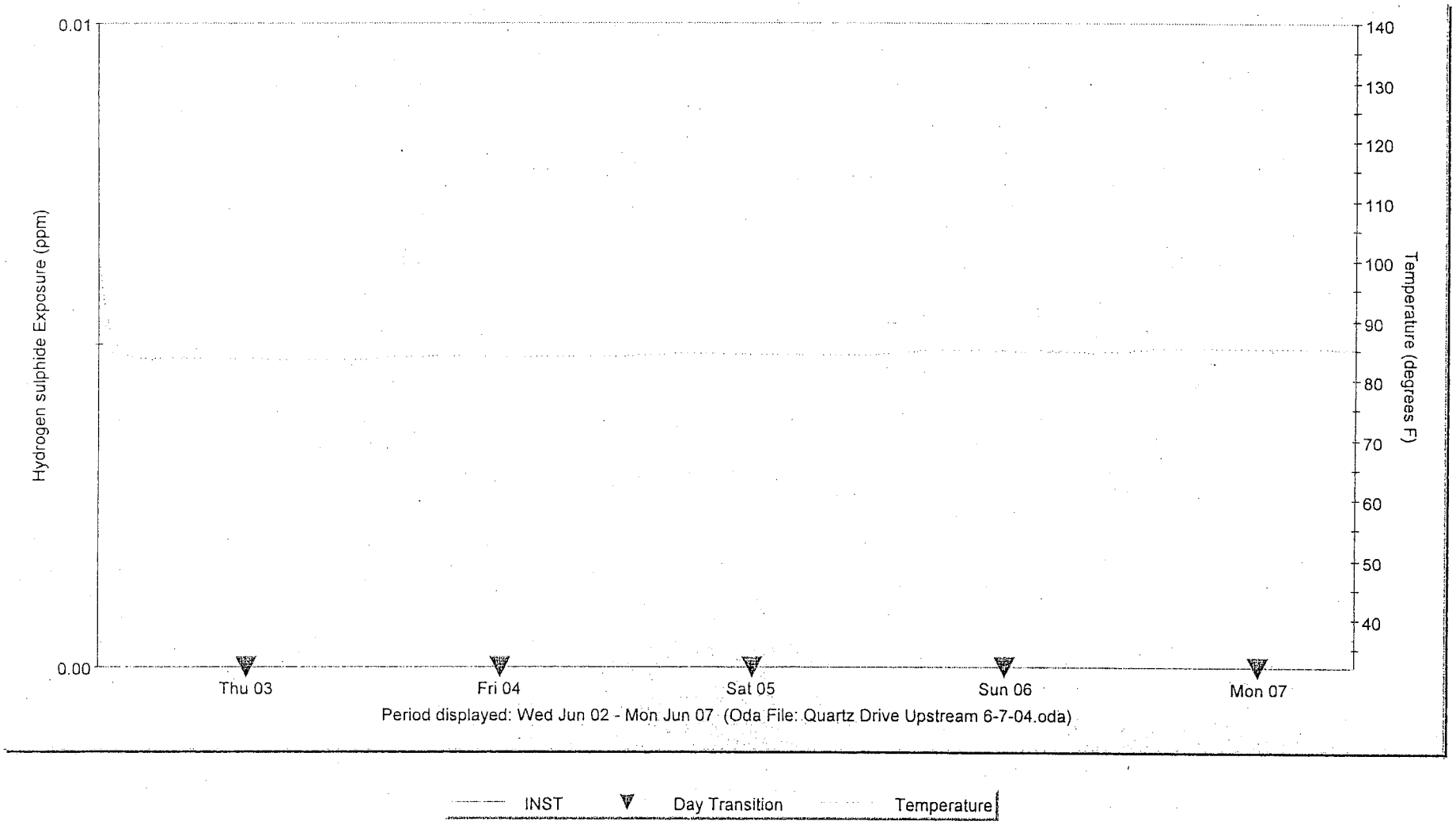


INST ▼ Day Transition Temperature

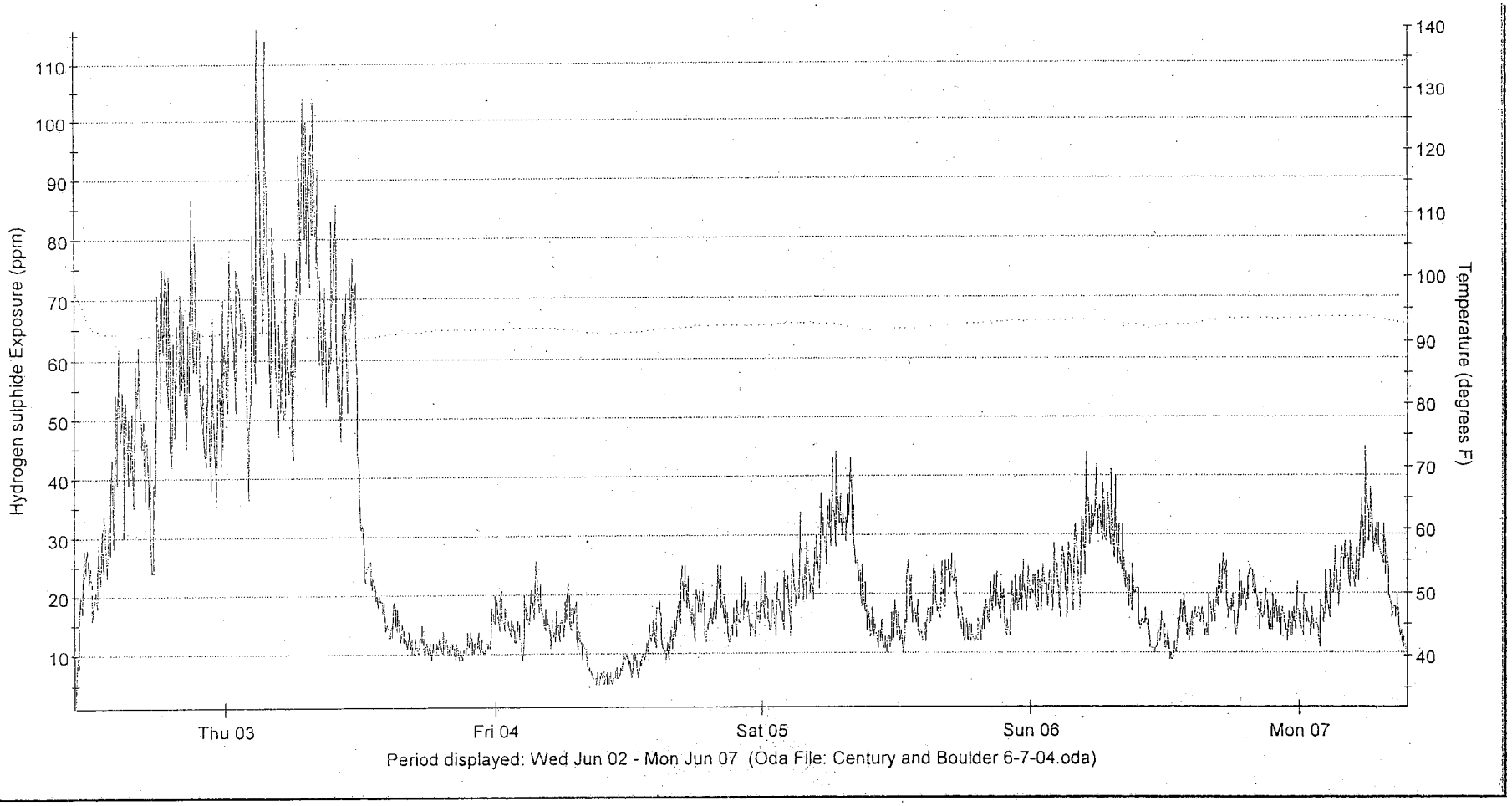
- Session: 1 (OdaLog: OL05011231)



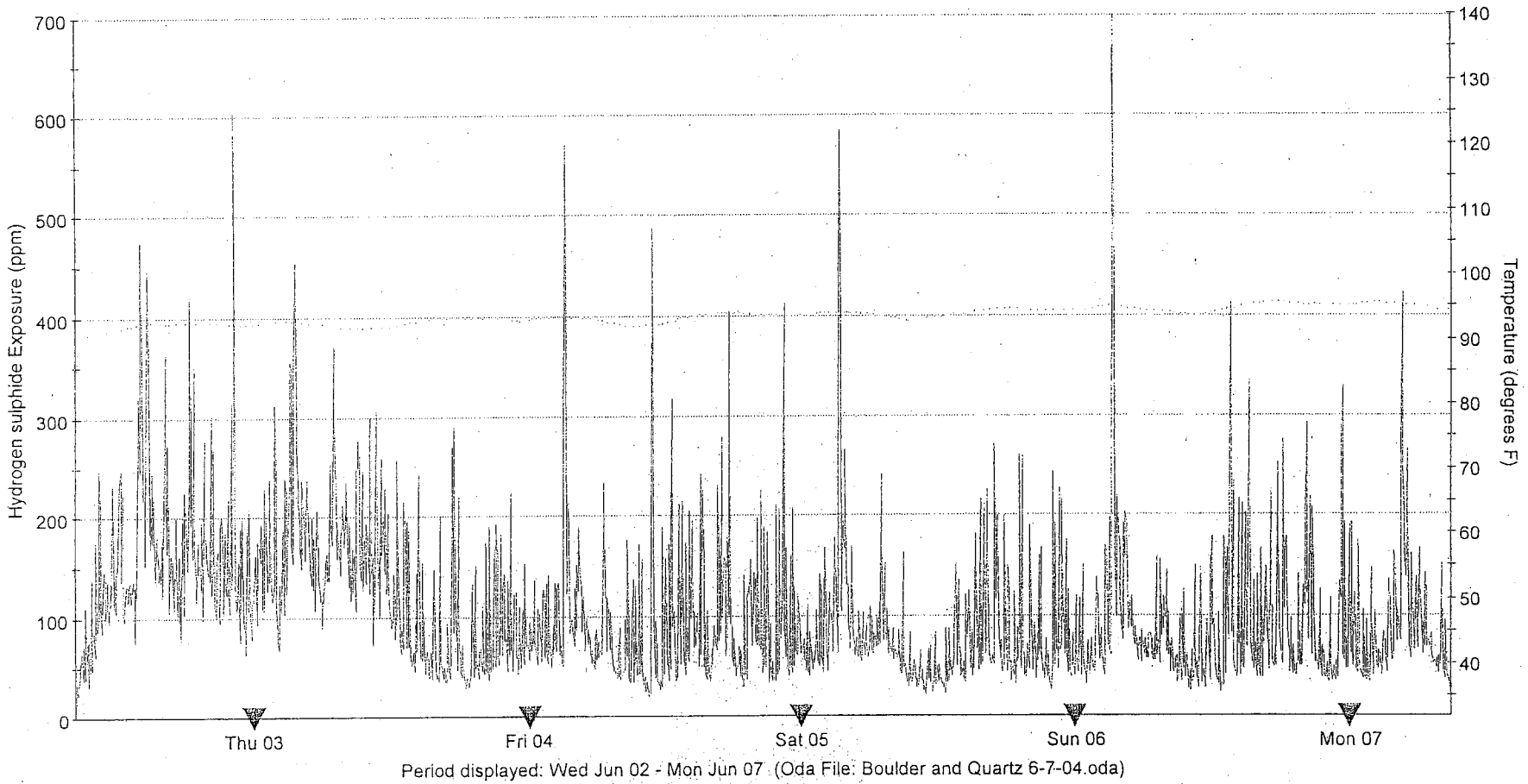
- Session: 1 (OdaLog: OL05110204)



- Session: 1 (OdaLog: OL45033818)

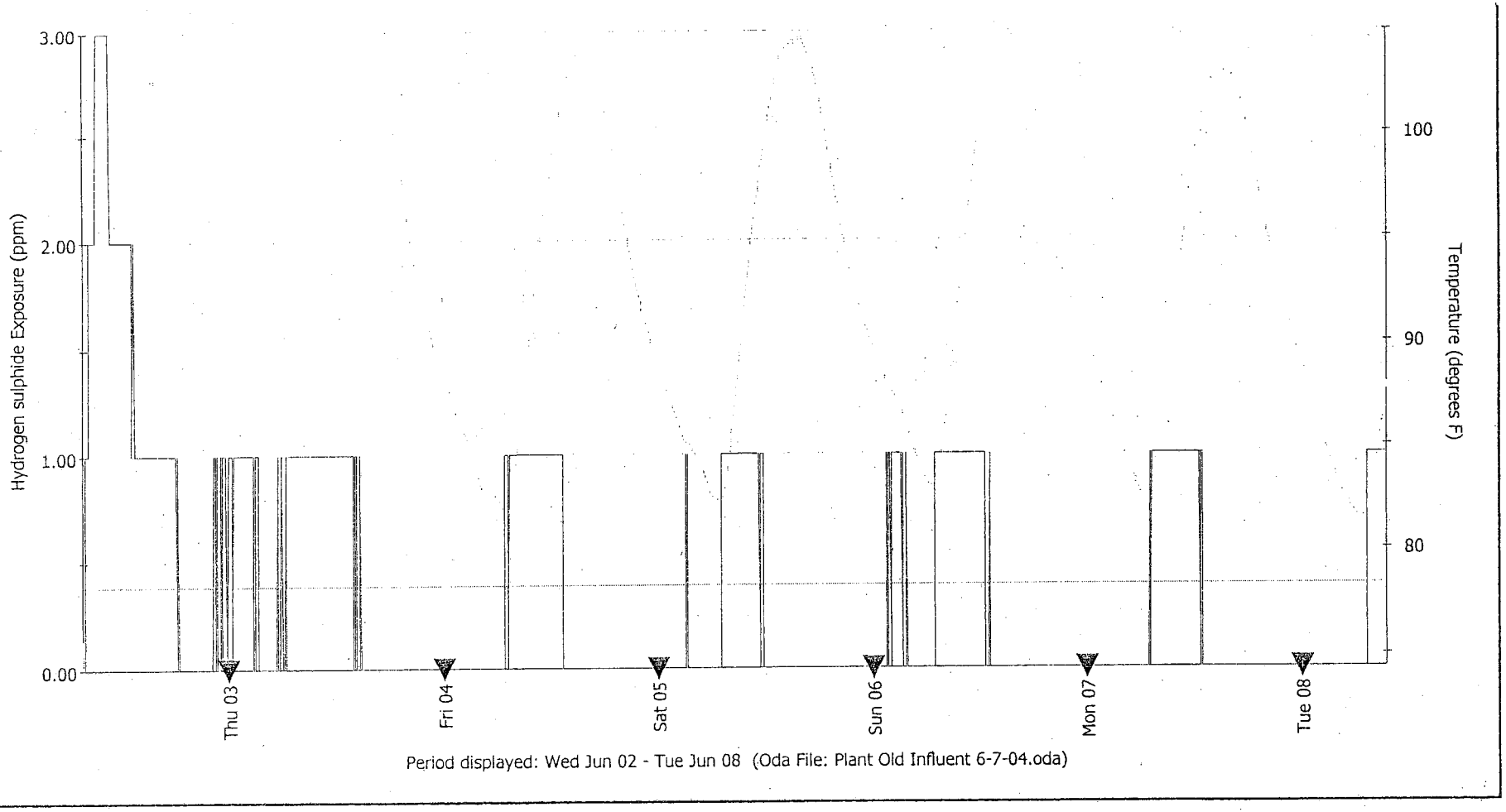


- Session: 1 (OdaLog: OL45033819)



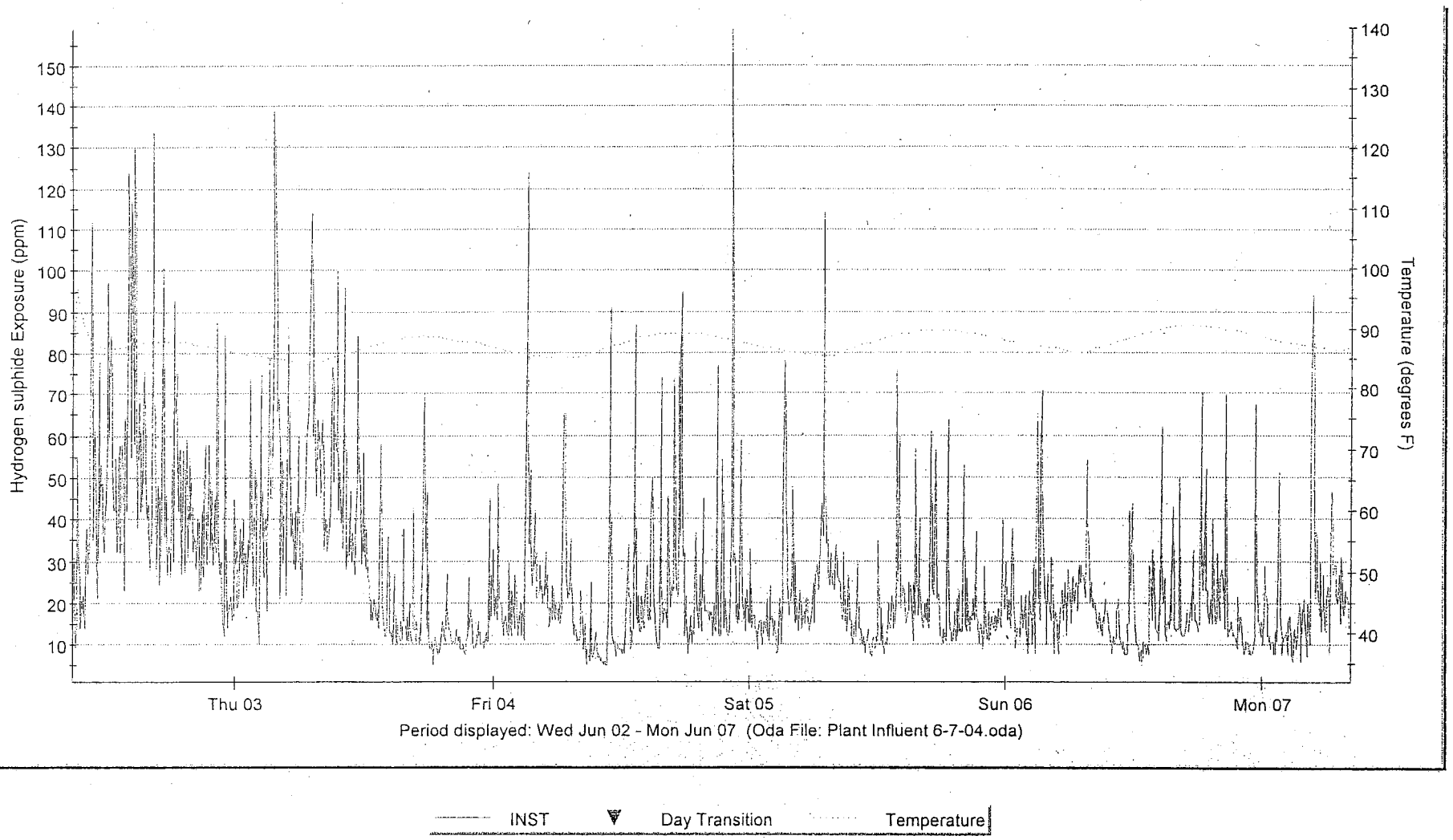
INST Day Transition Temperature

- Session: 1 (OdaLog: OL05011232)

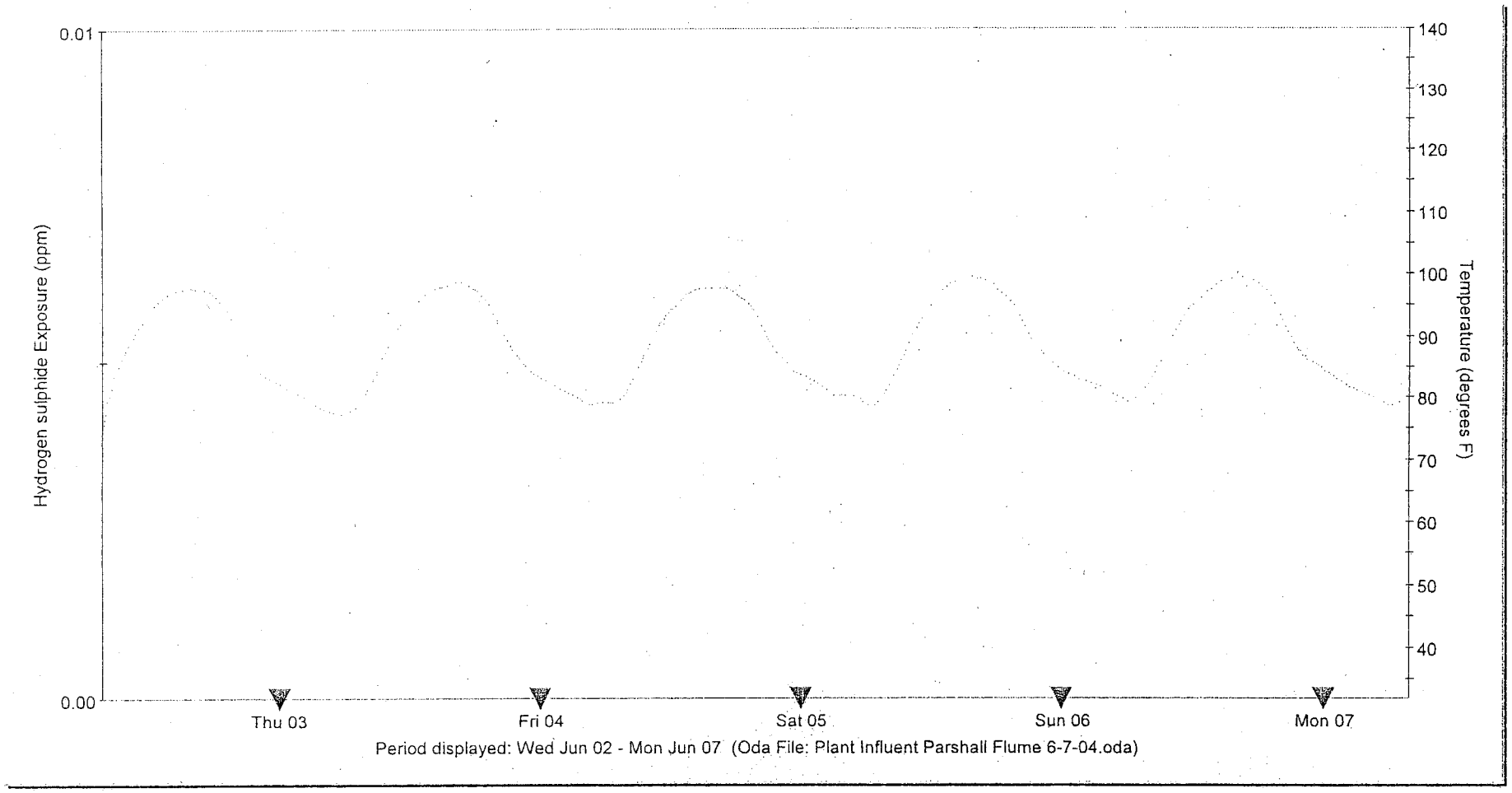


INST : Min (0 ppm) Max (3 ppm) | Day Transition | Average (0.4 ppm) | Temperature

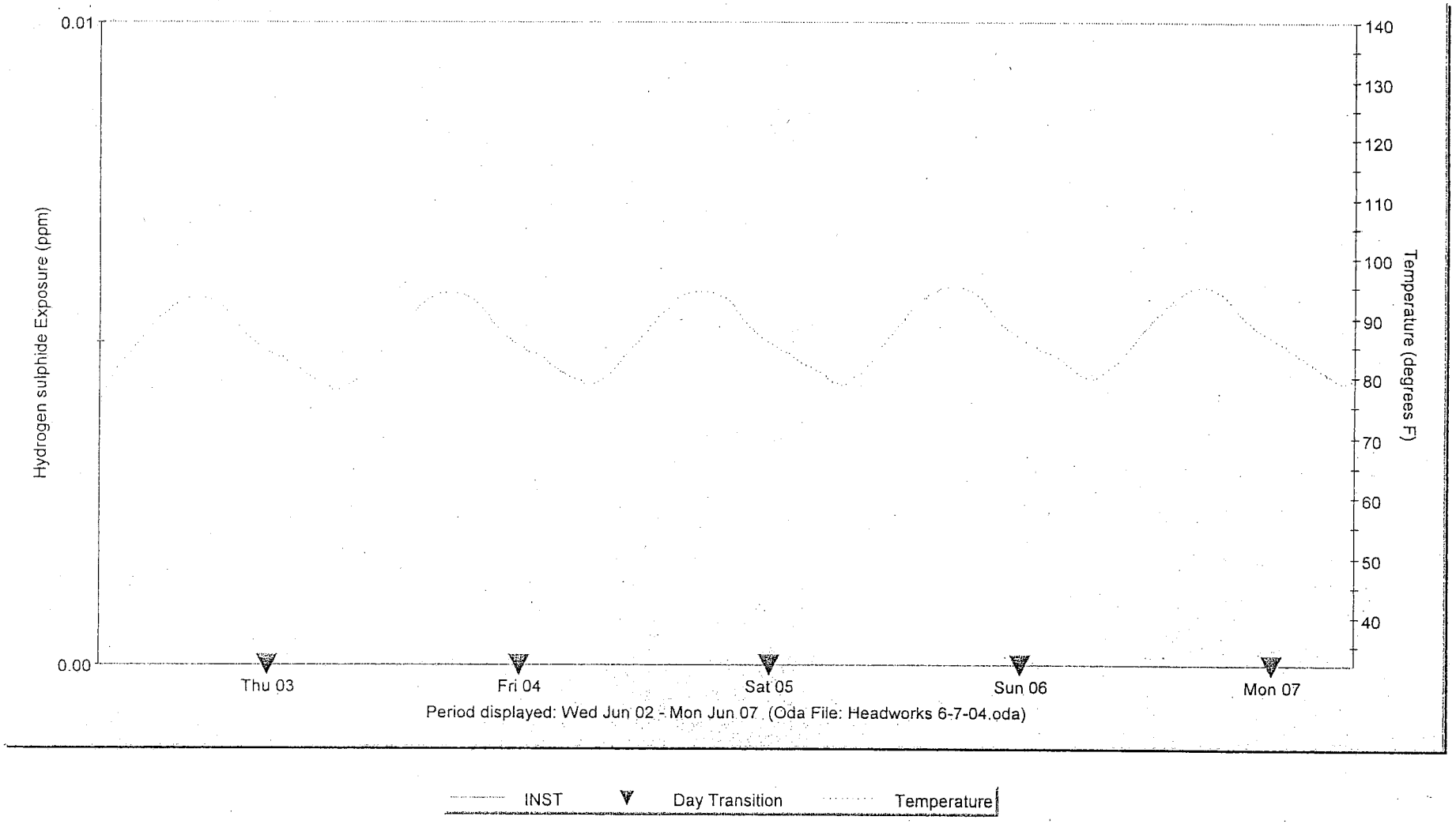
- Session: 1 (OdaLog: OL4505085)



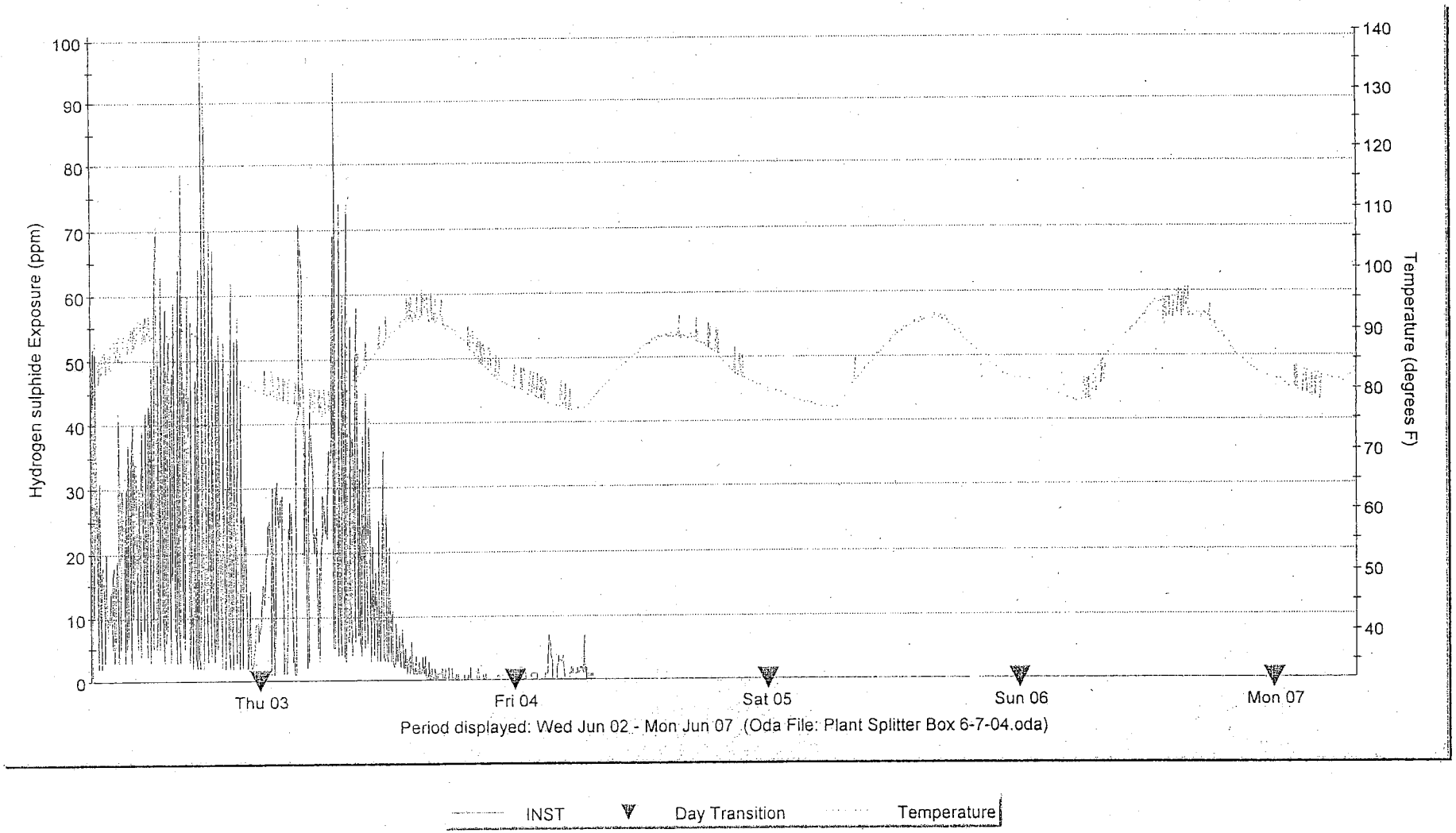
- Session: 1 (OdaLog: OL45093434)



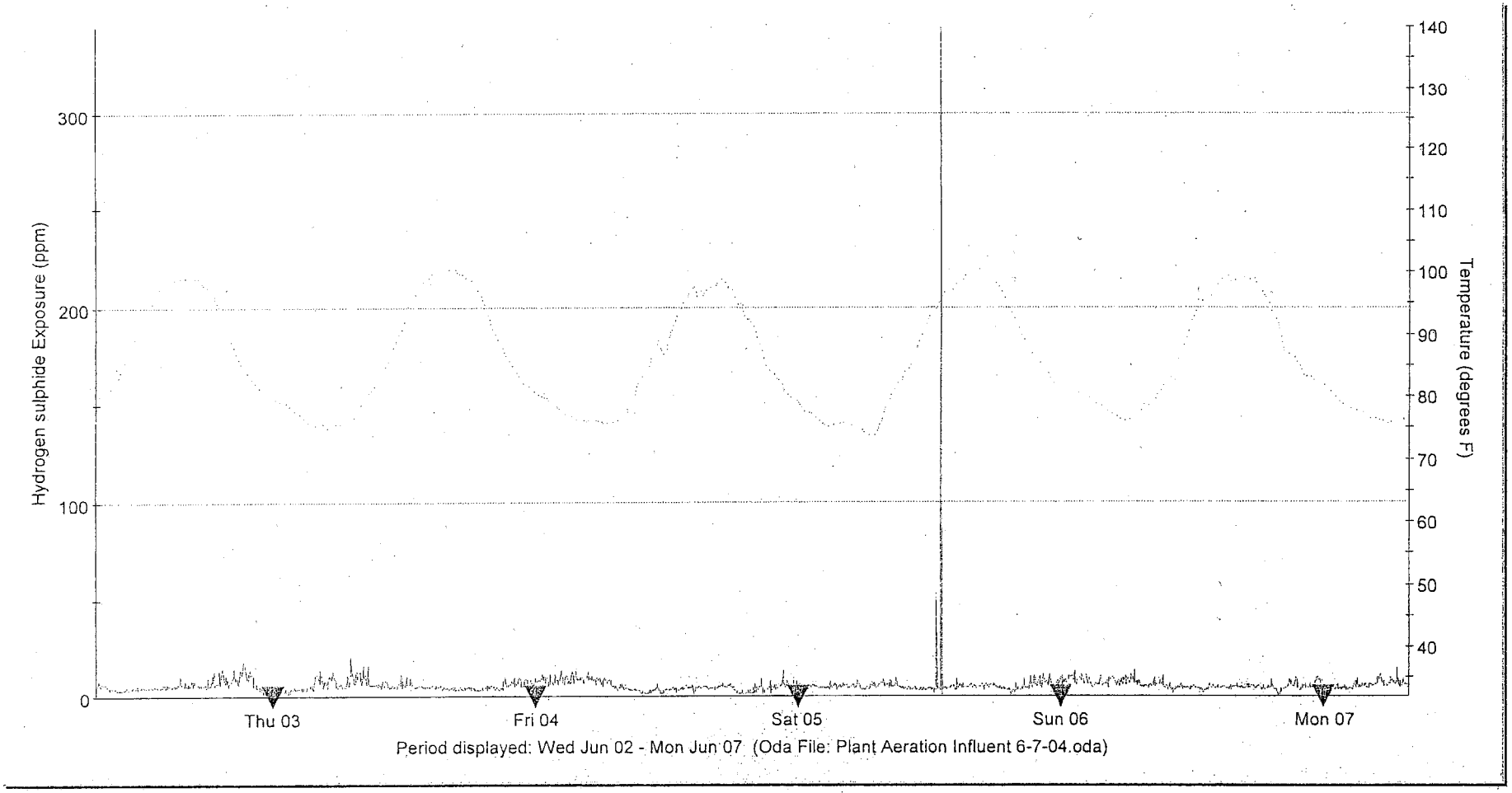
- Session: 1 (OdaLog: OL45103527)



- Session: 1 (OdaLog: OL0504074)

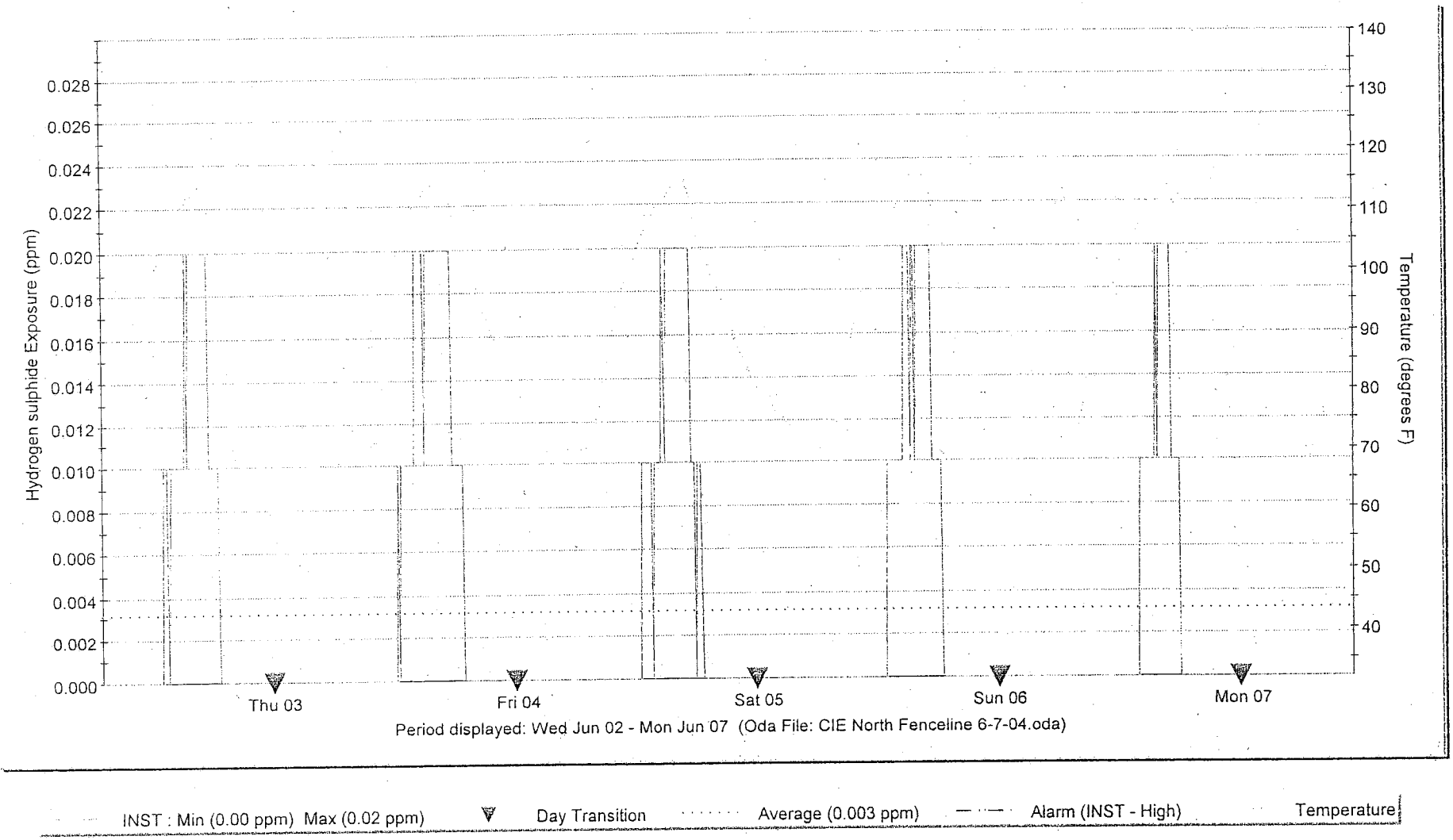


- Session: 1 (OdaLog: OL03110203)



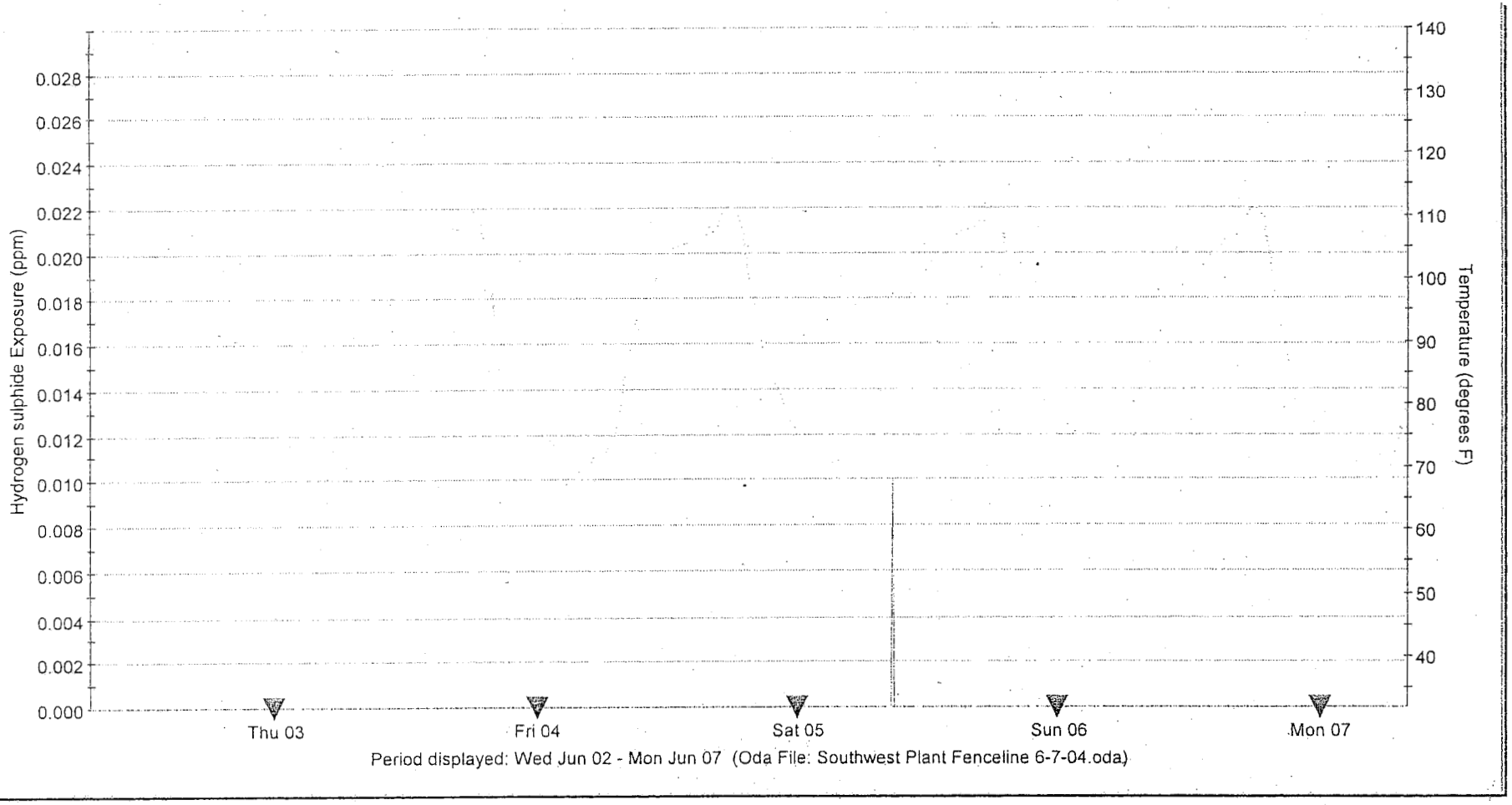
INST ▼ Day Transition Temperature

- Session: 1 (OdaLog: OL50083533)



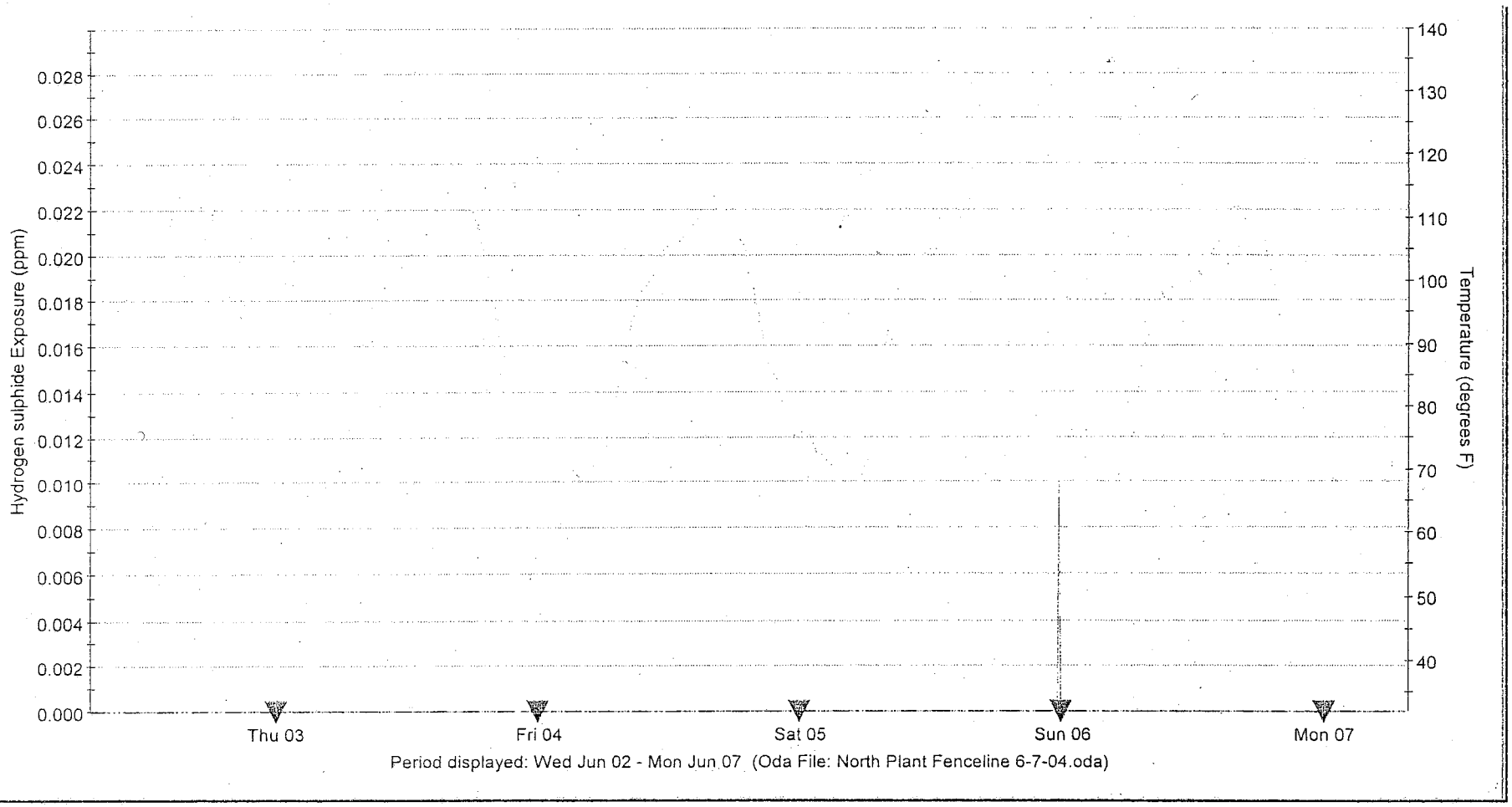
INST : Min (0.00 ppm) Max (0.02 ppm) | Day Transition | Average (0.003 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50073521)



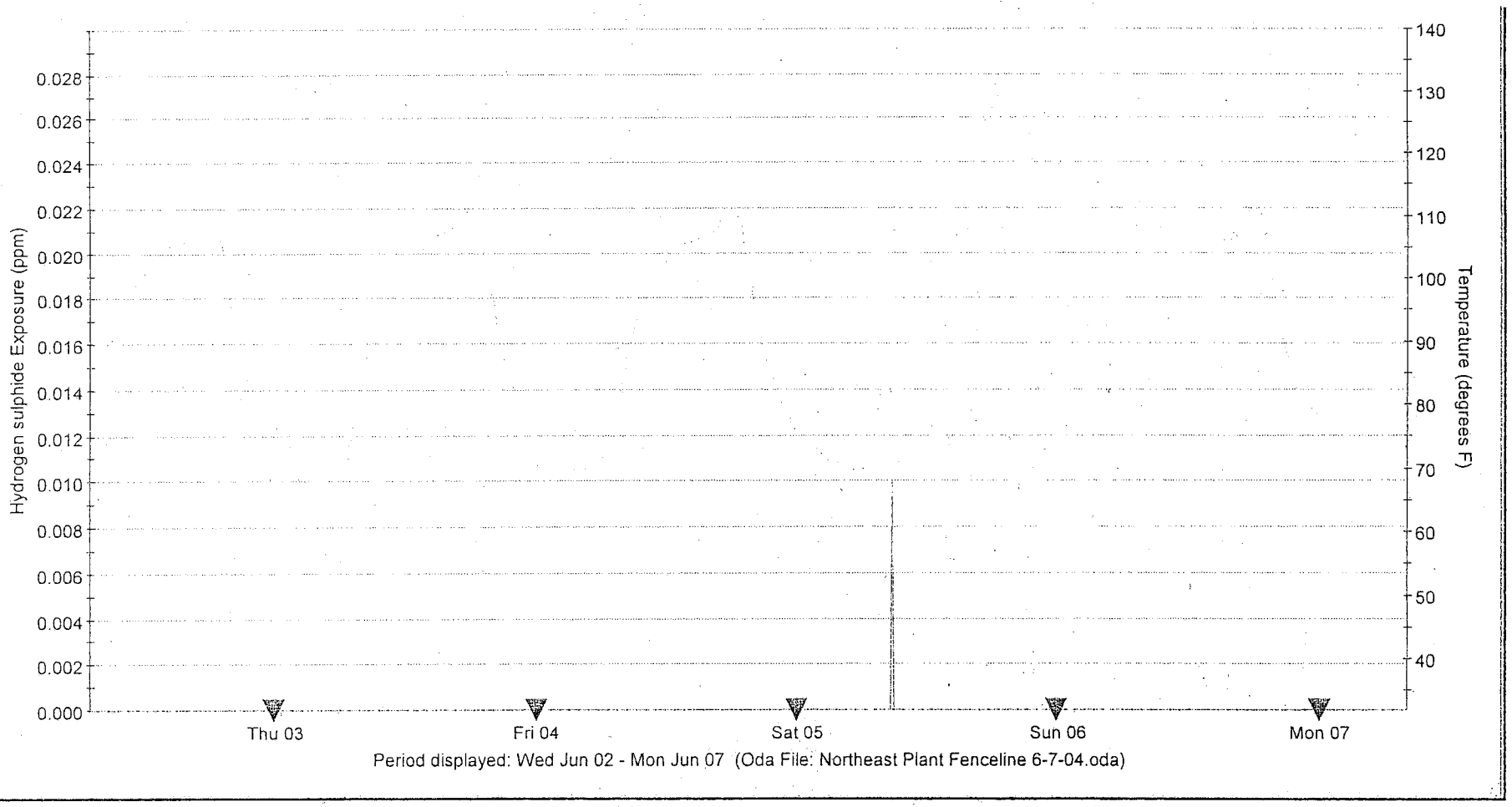
INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50103539)



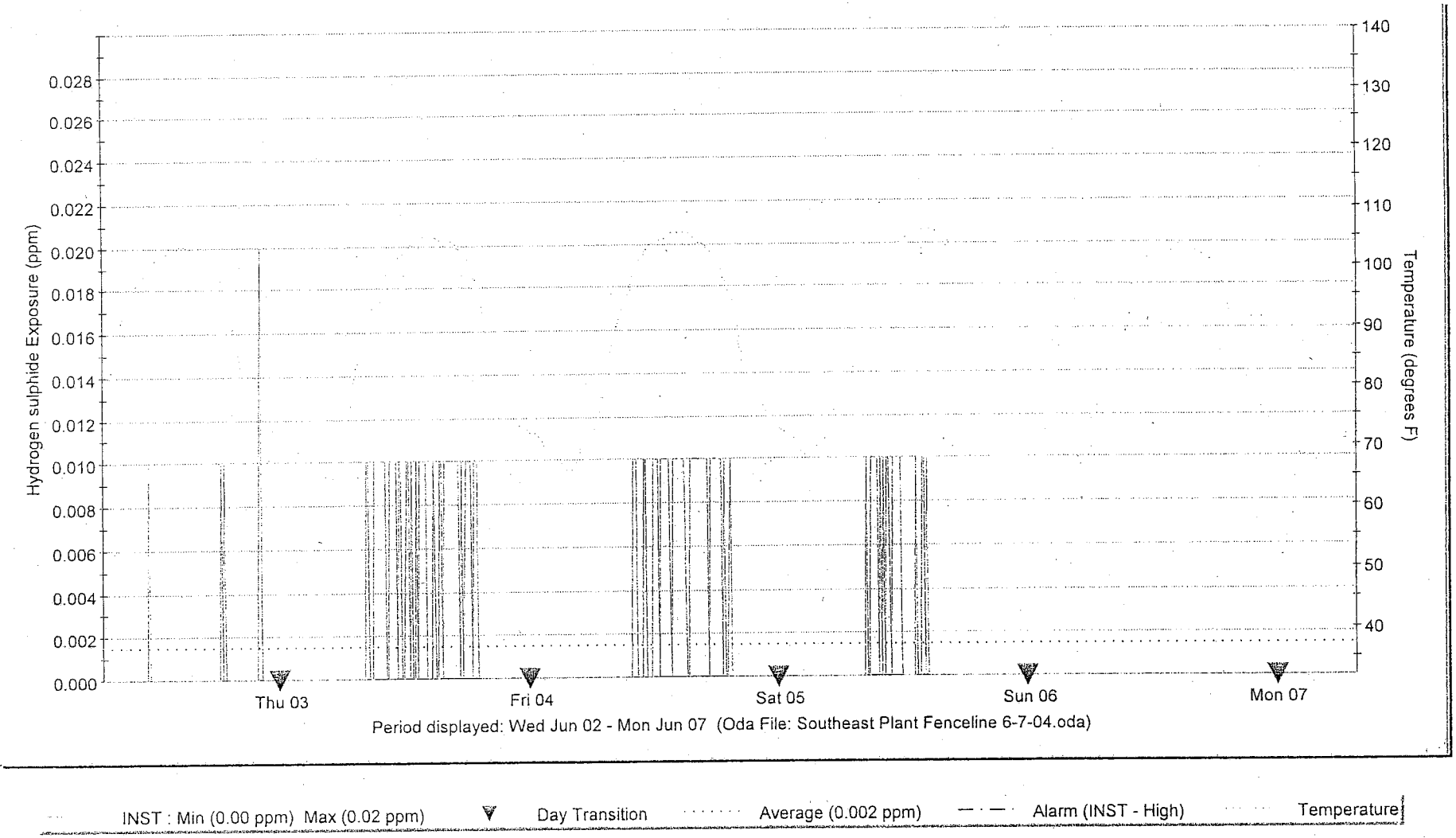
INST : Min (0.00 ppm) Max (0.01 ppm) ▼ Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50073521)



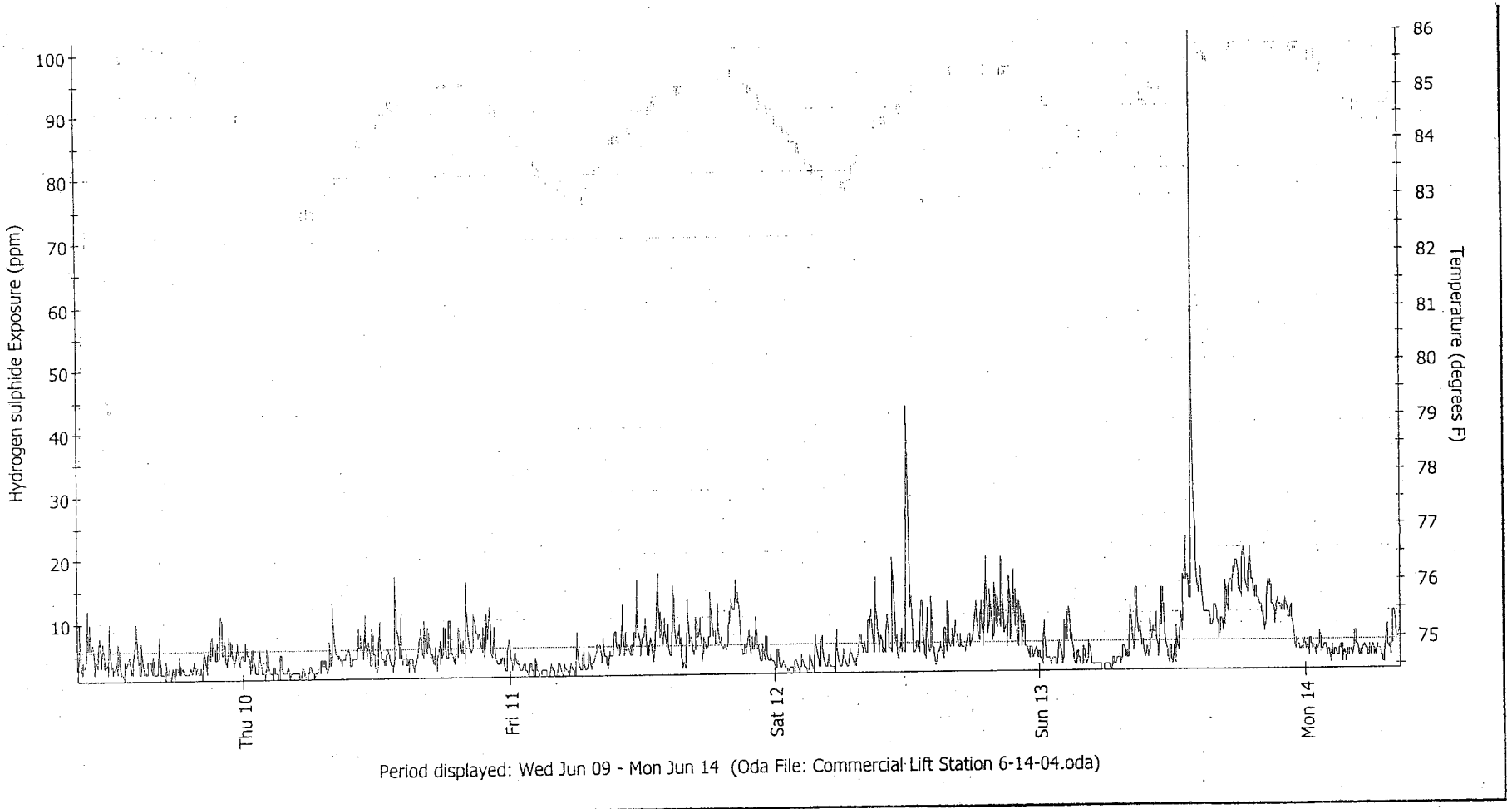
INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50044578)



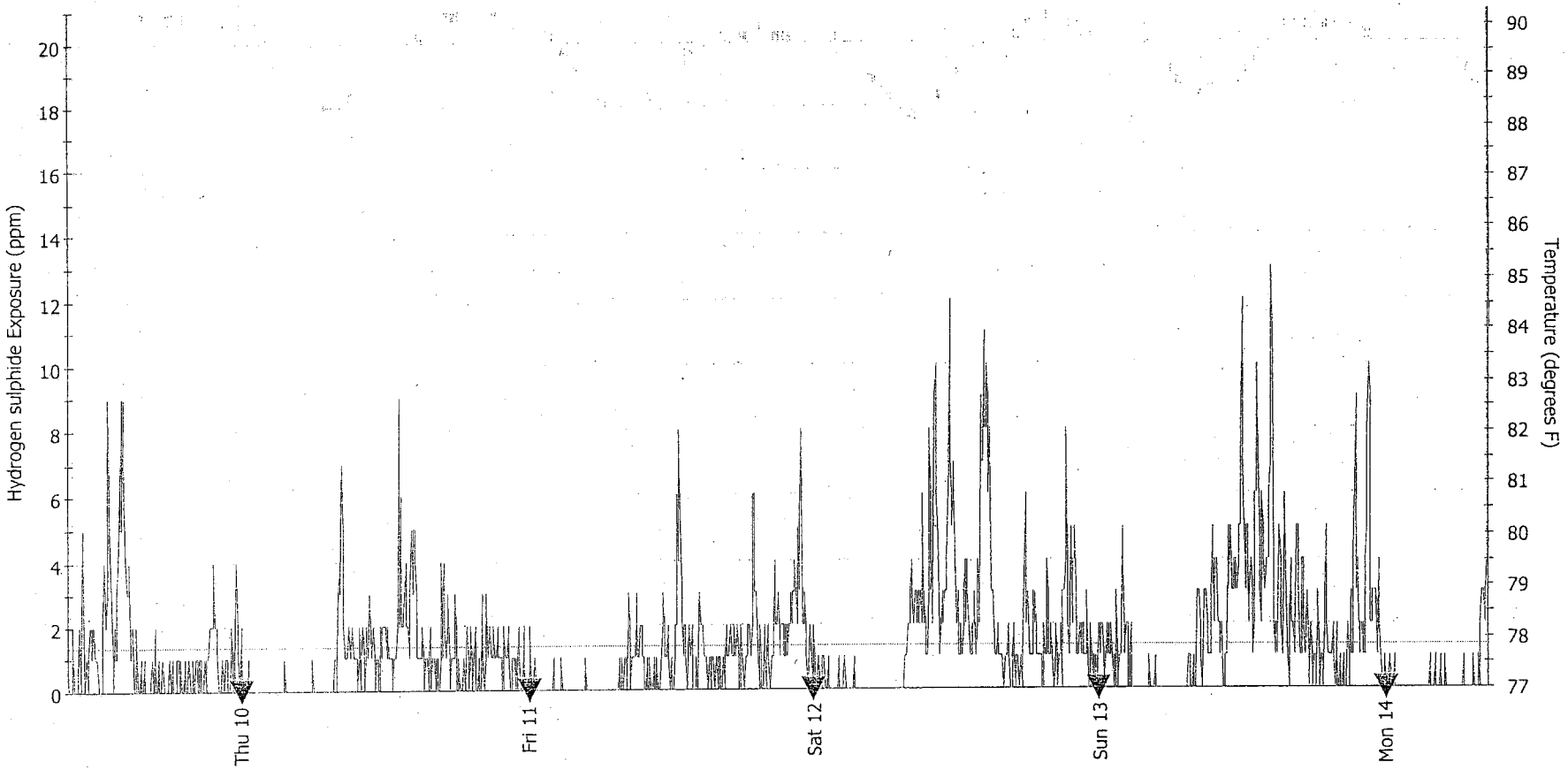
INST : Min (0.00 ppm) Max (0.02 ppm) ▼ Day Transition ····· Average (0.002 ppm) — · — Alarm (INST - High) ····· Temperature

- Session: 1 (OdaLog: OL03110203)



INST : Min (1 ppm) Max (102 ppm) | Day Transition | Average (5.7 ppm) | Temperature

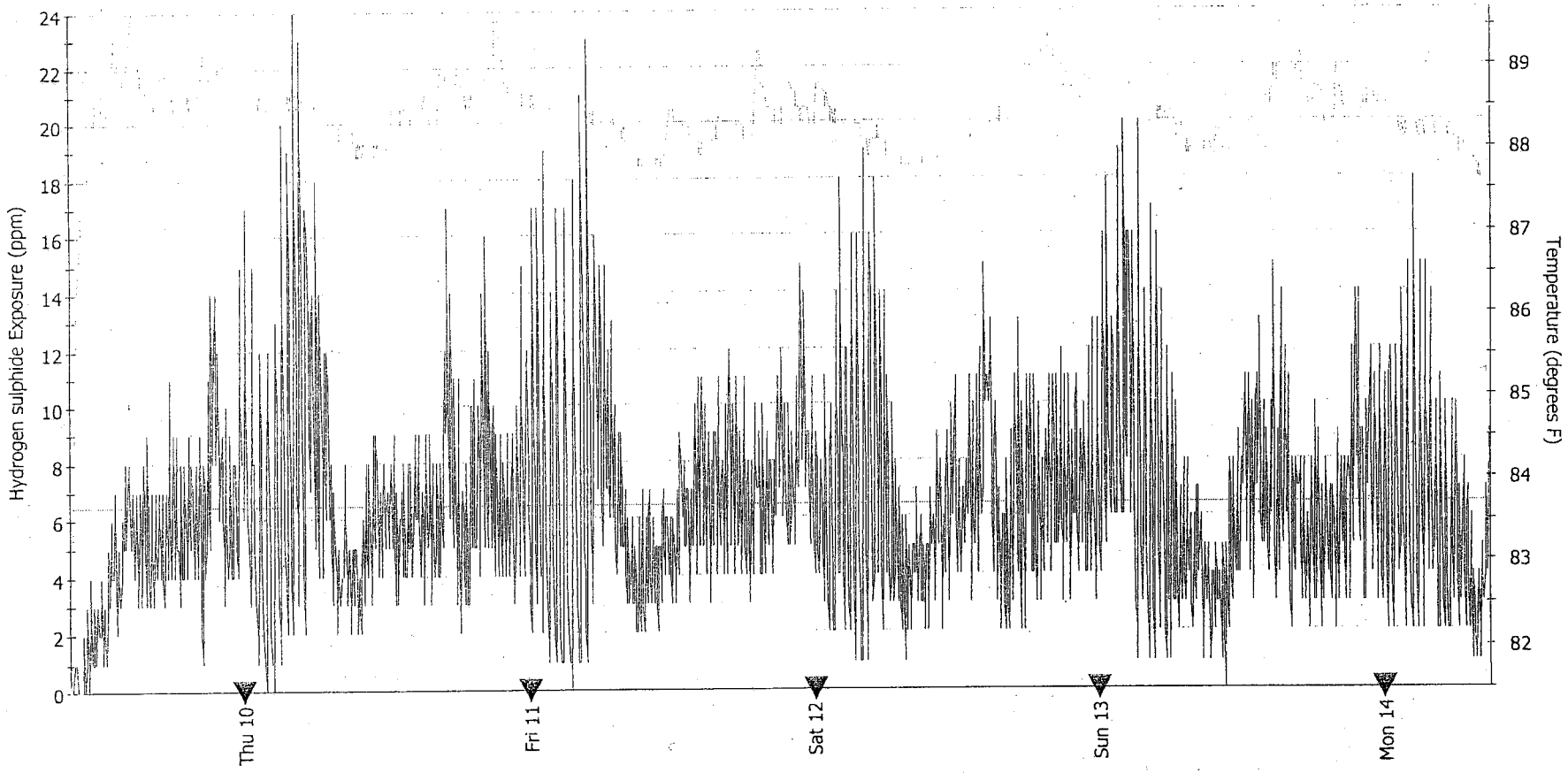
- Session: 1 (OdaLog: OL05123688)



Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: CIE Lift Station Gravity Southwest 6-14-04.oda)

INST : Min (0 ppm) Max (21 ppm) | Day Transition | Average (1.3 ppm) | Temperature

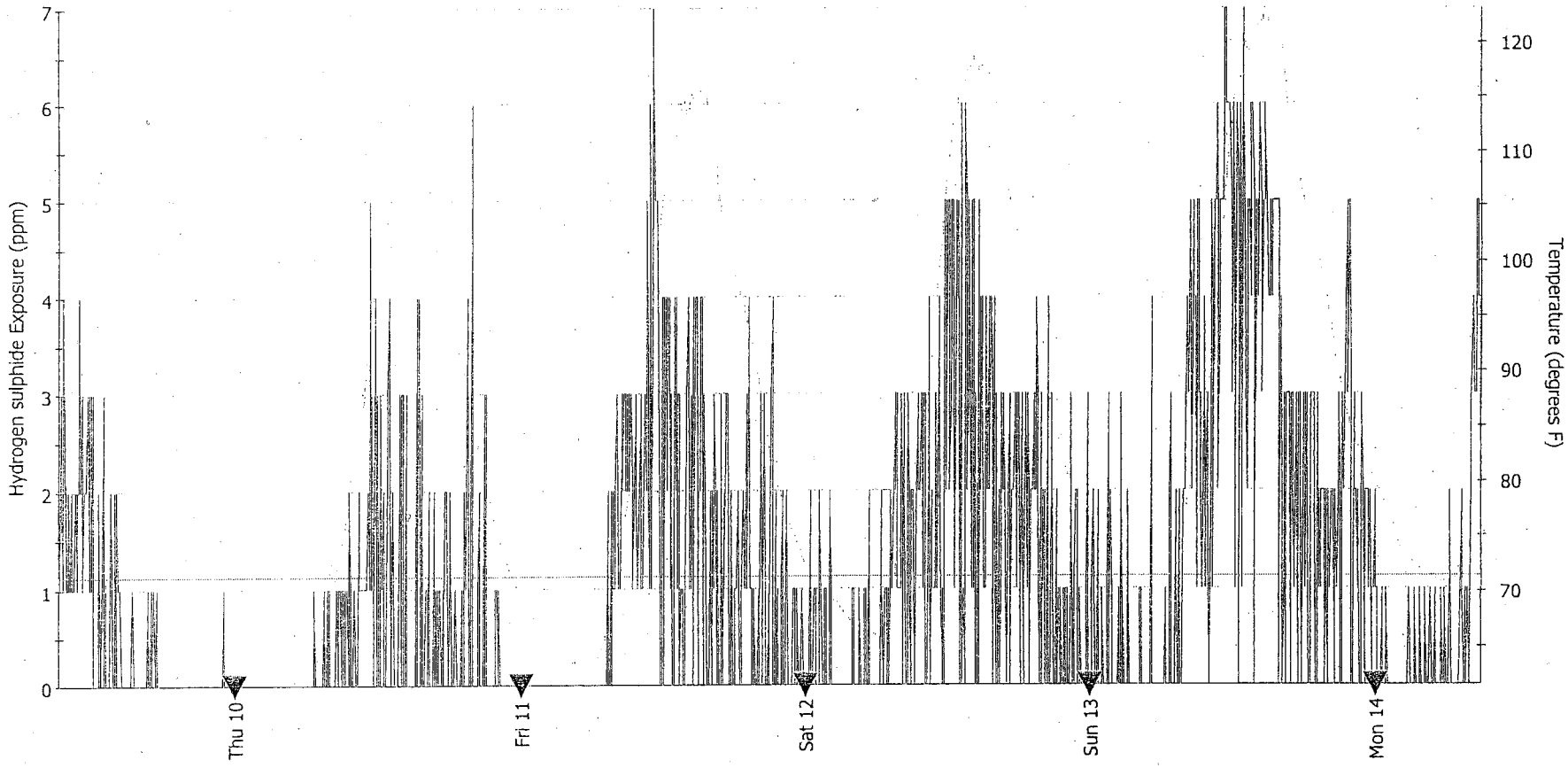
- Session: 1 (OdaLog: OL45033818)



Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: CIE Lift Station Force Main Discharge 6-14-04.oda)

INST : Min (0 ppm) Max (24 ppm) | Day Transition | Average (6.4 ppm) | Temperature

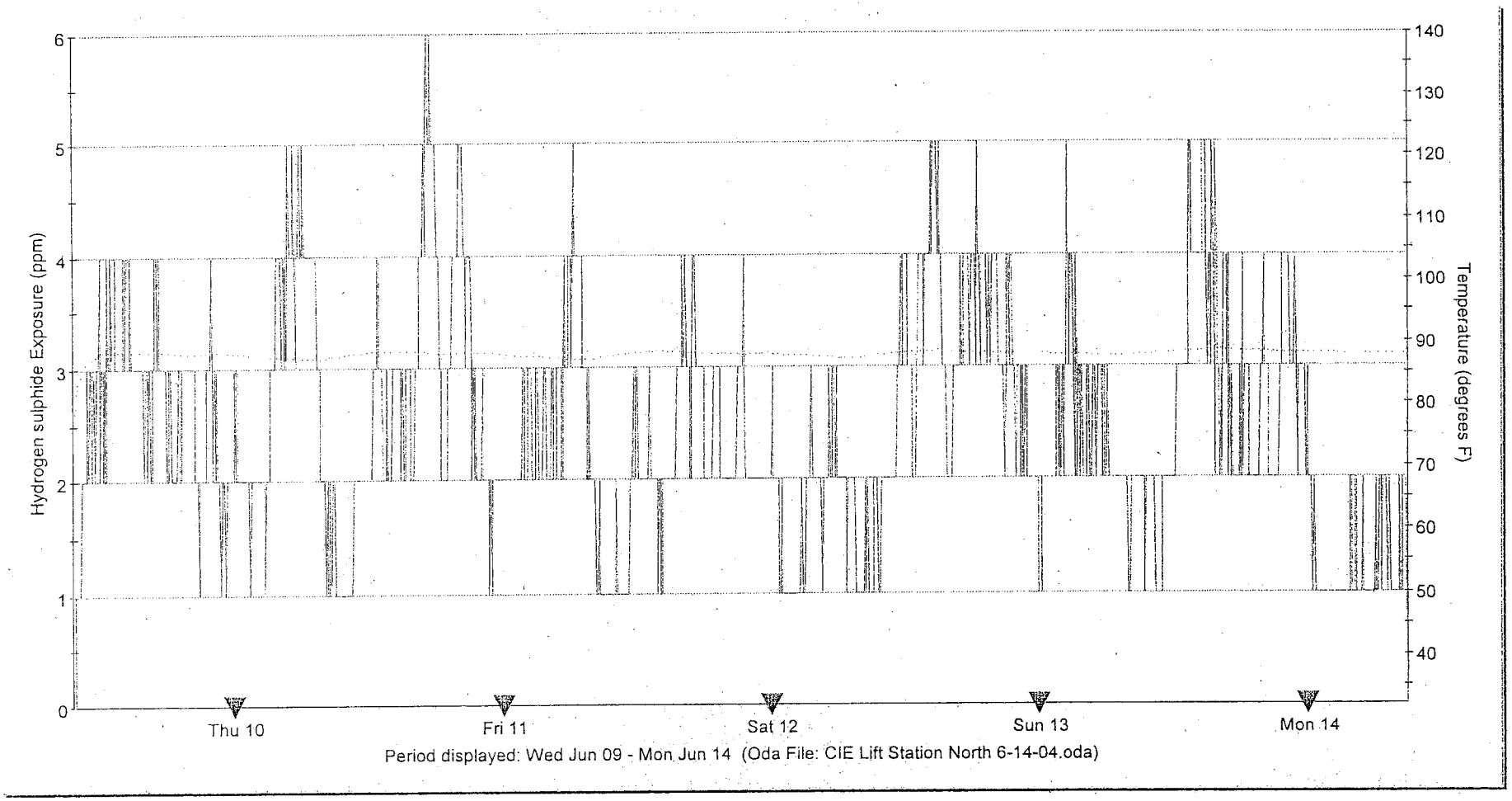
- Session: 1 (OdaLog: OL05011231)



Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: CIE Lift Station Peacemeker 6-14-04.oda)

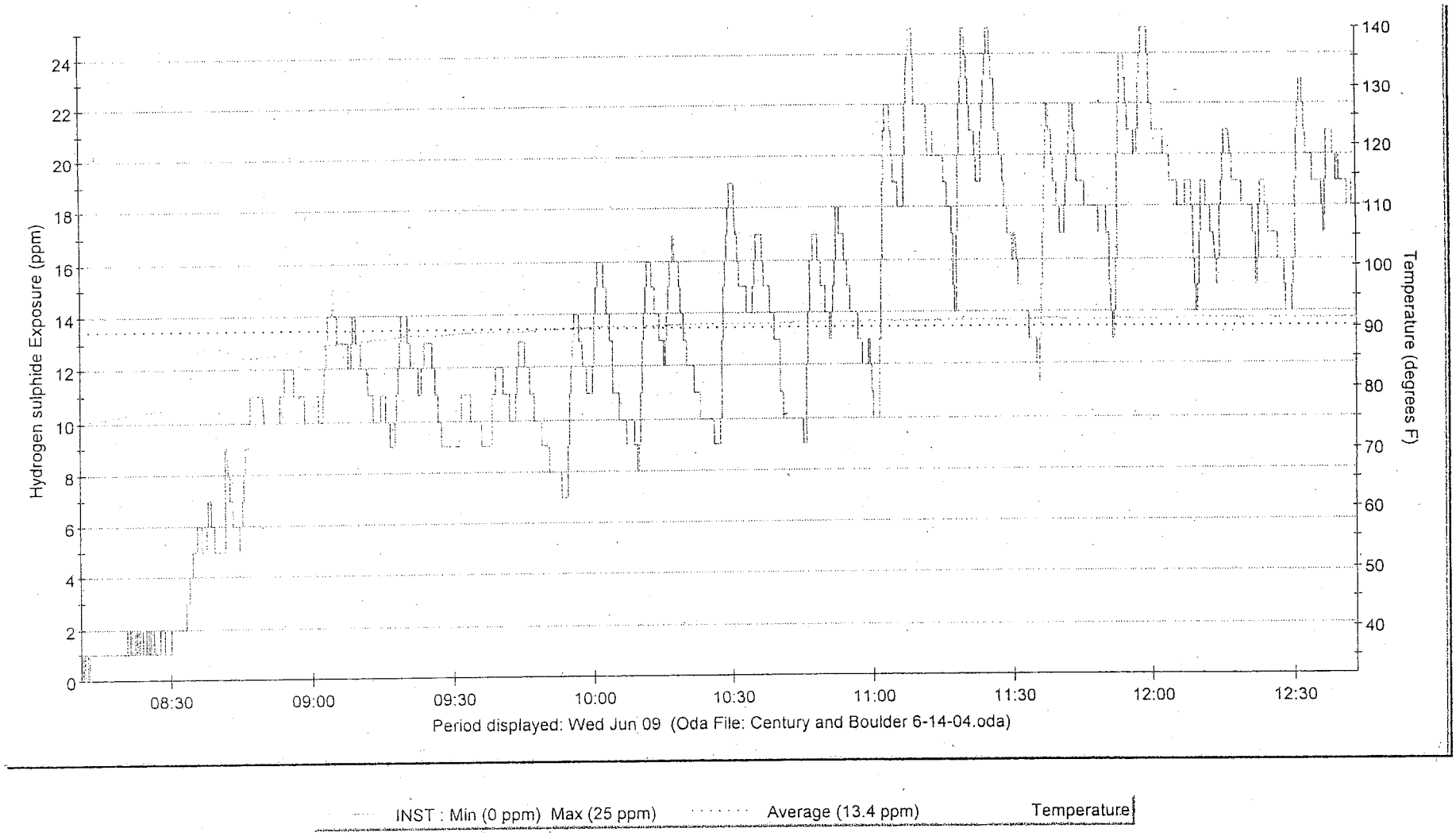
INST : Min (0 ppm) Max (7 ppm) | Day Transition | Average (1.1 ppm) | Temperature

- Session: 1 (OdaLog: OL02011278)

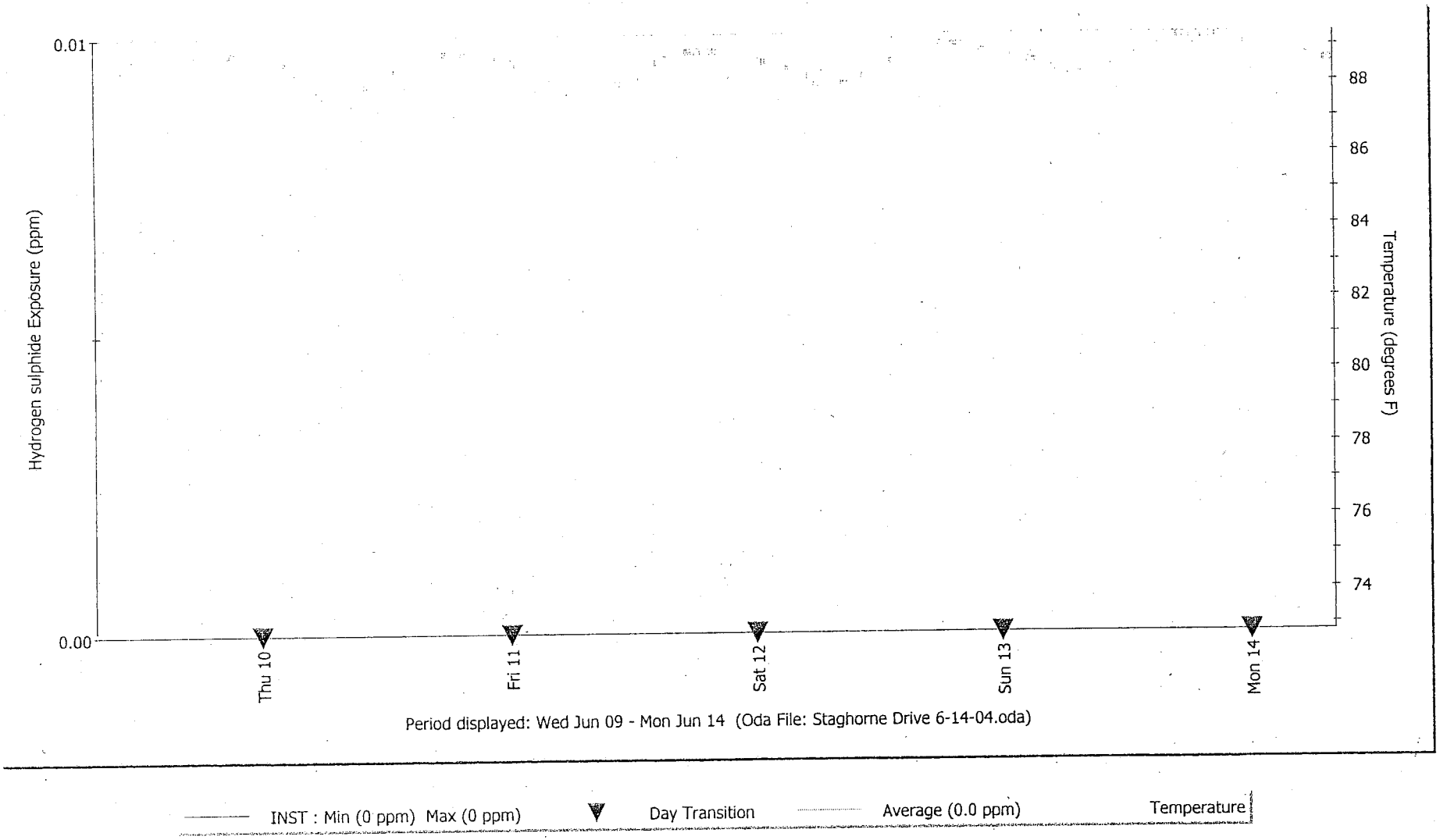


INST | Day Transition | Temperature

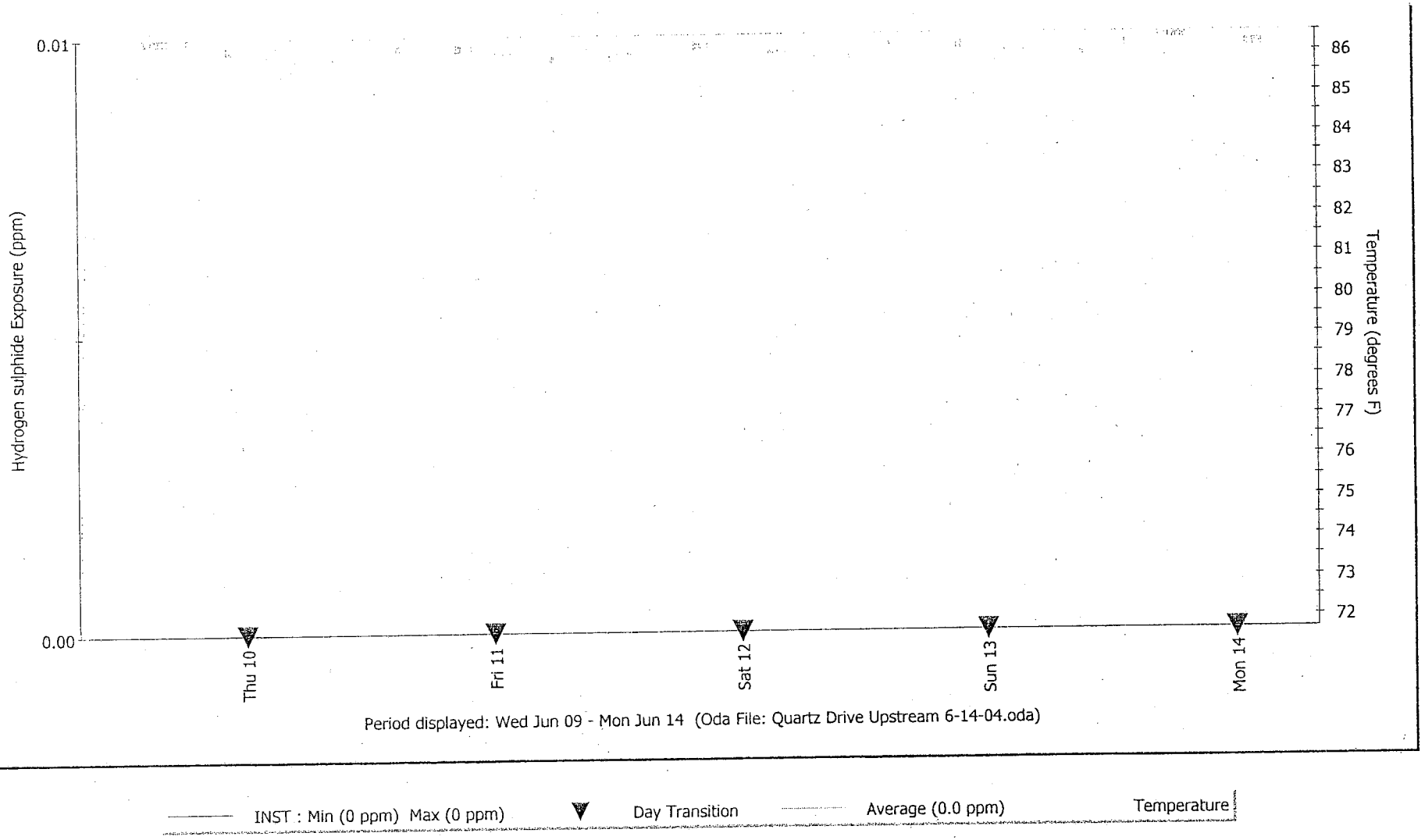
- Session: 1 (OdaLog: OL45080161)



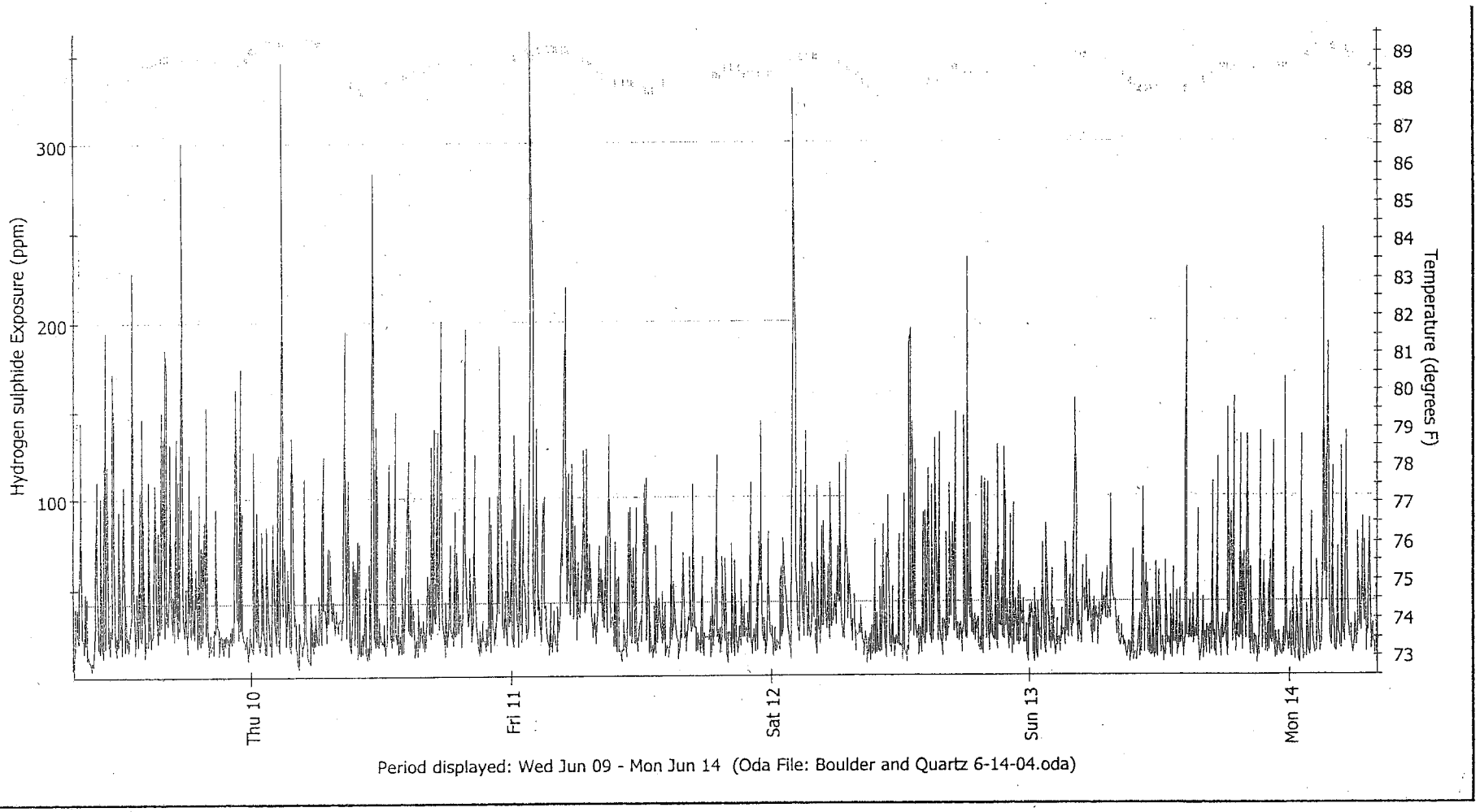
- Session: 1 (OdaLog: OL0504071)



- Session: 1 (OdaLog: OL05110204)

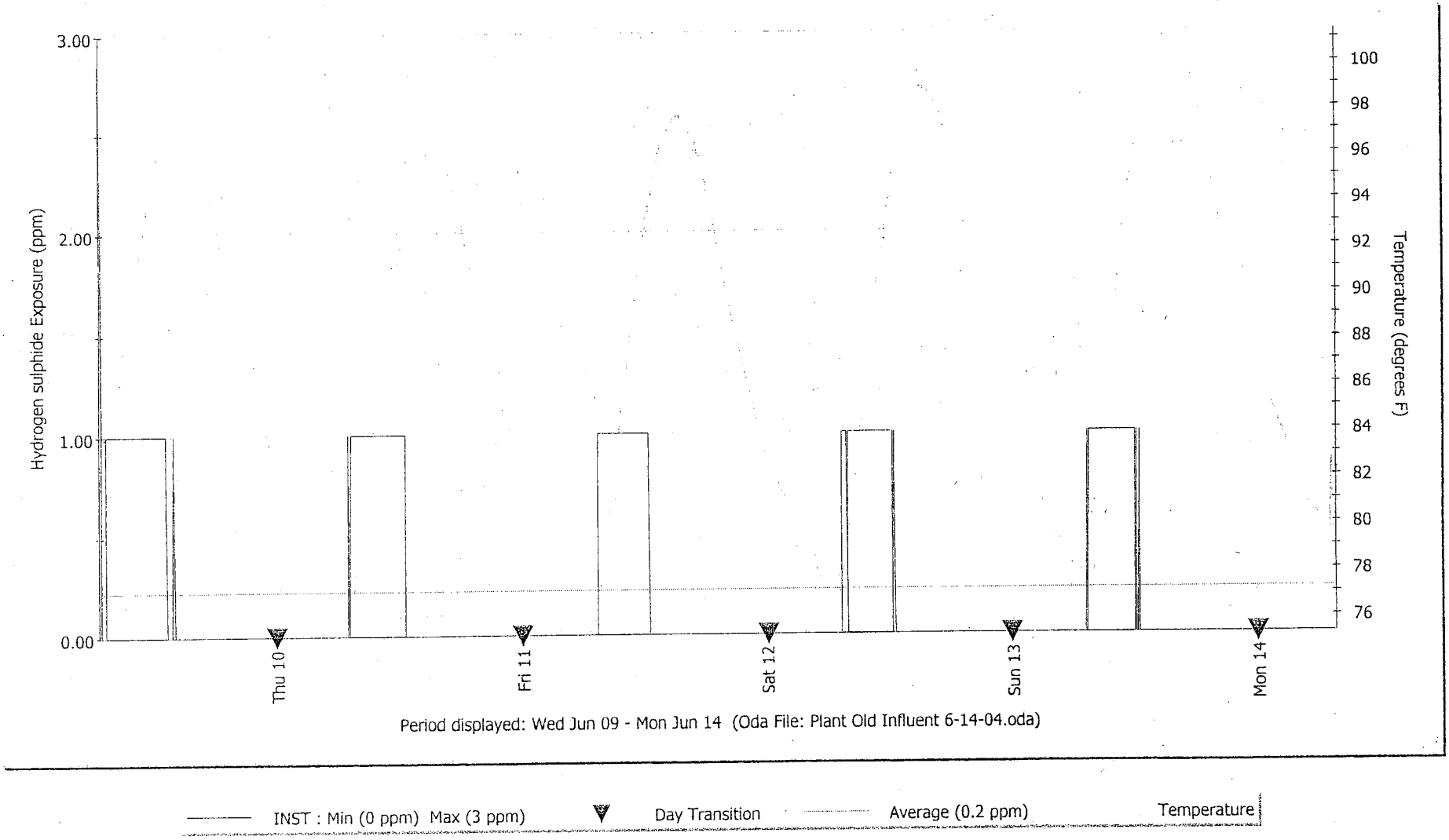


- Session: 1 (OdaLog: OL4505085)

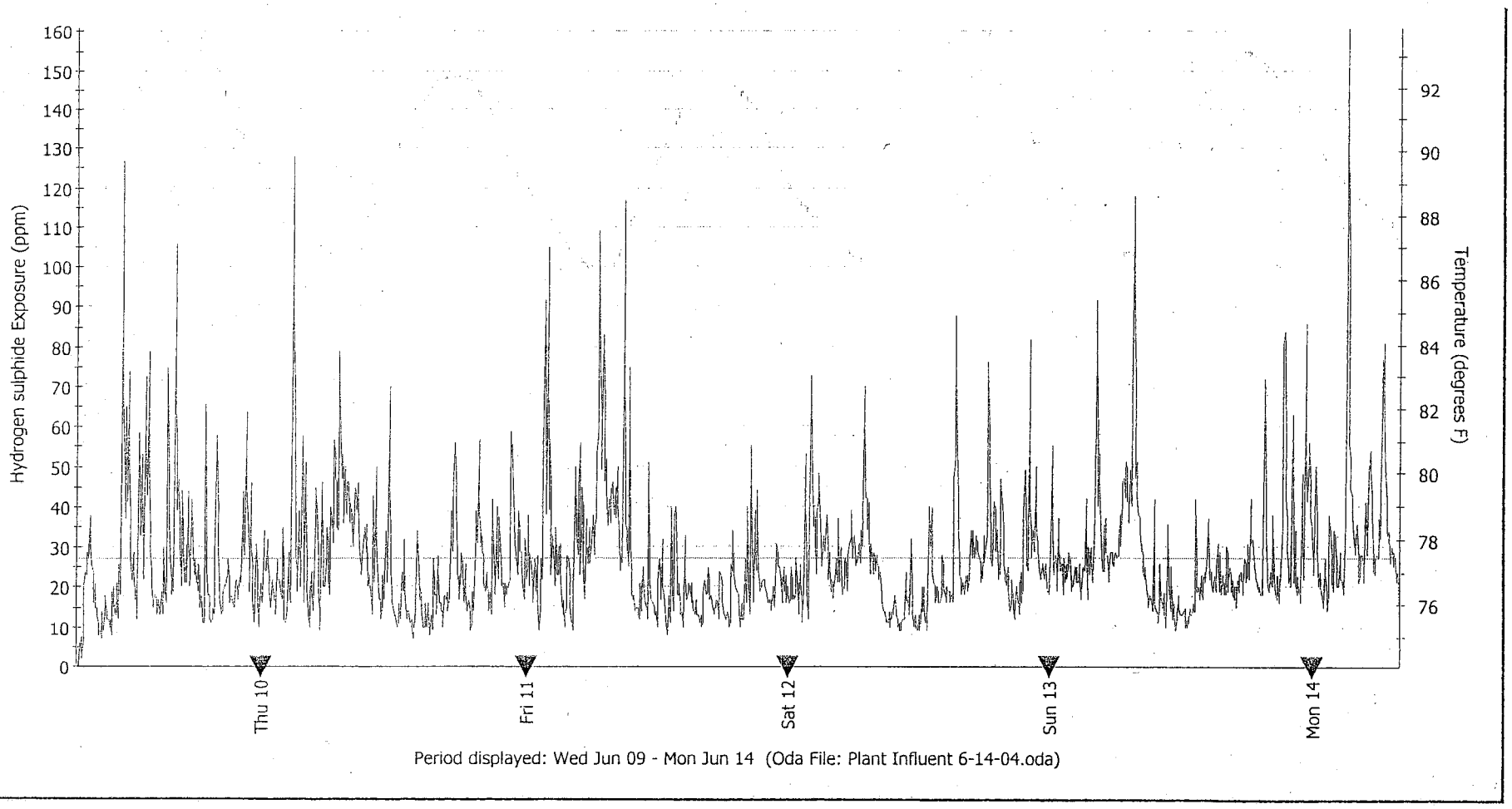


INST : Min (1 ppm) Max (364 ppm) ▼ Day Transition Average (42.1 ppm) Temperature

- Session: 3 (OdaLog: OL05011232)

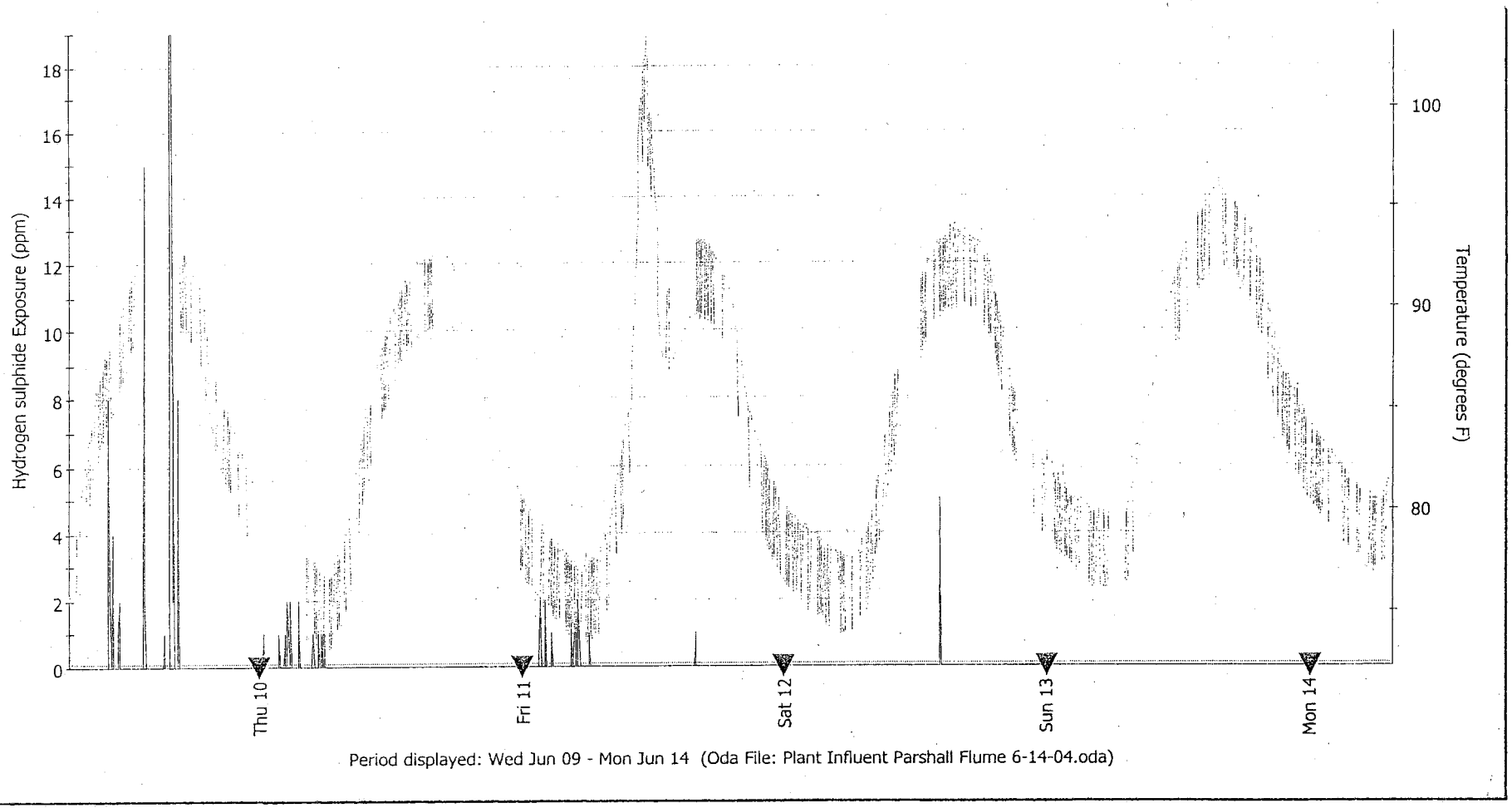


- Session: 1 (OdaLog: OL45033819)



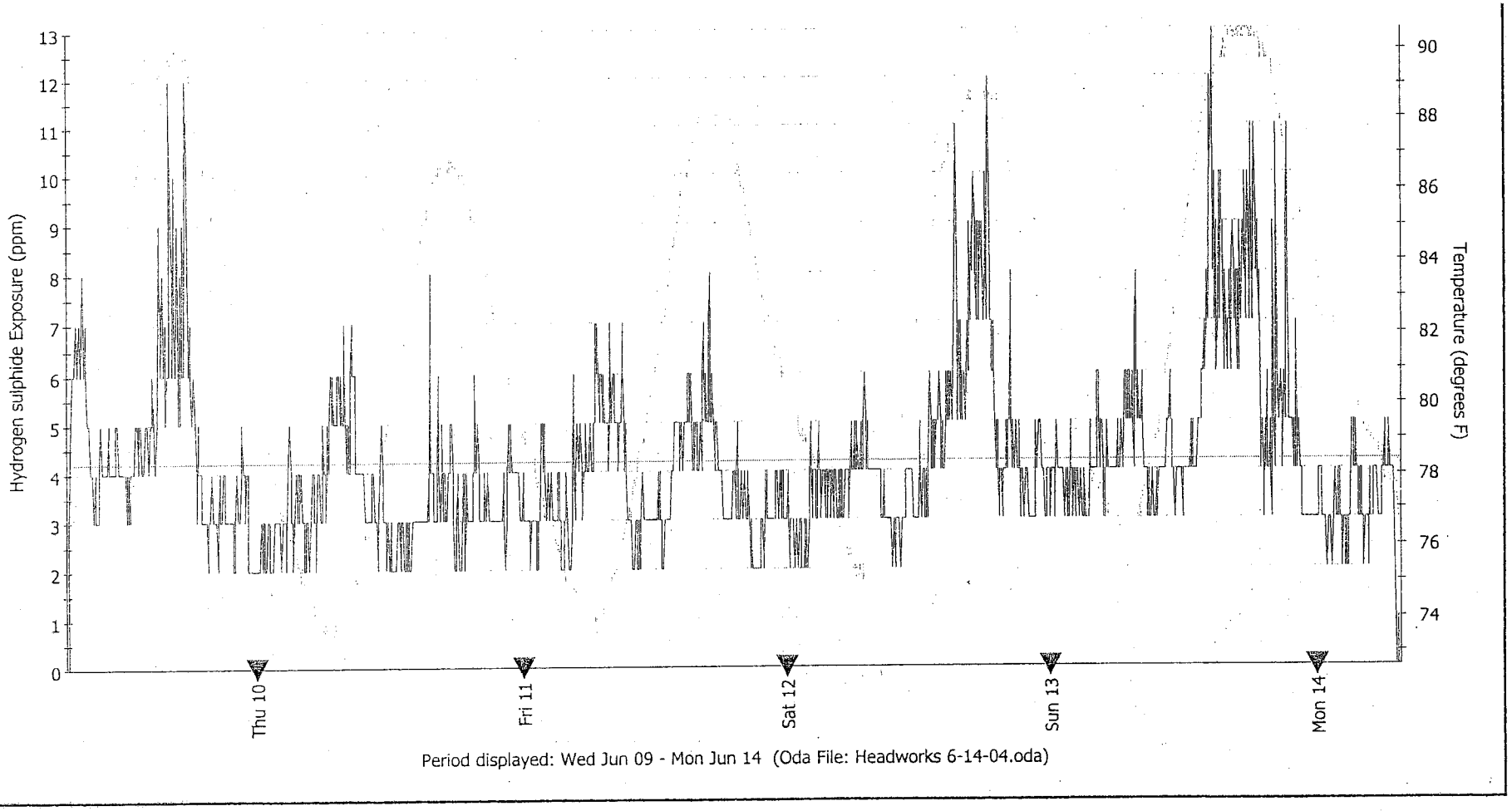
INST : Min (0 ppm) Max (161 ppm) ▼ Day Transition Average (27.0 ppm) Temperature

- Session: 1 (OdaLog: OL0504074)



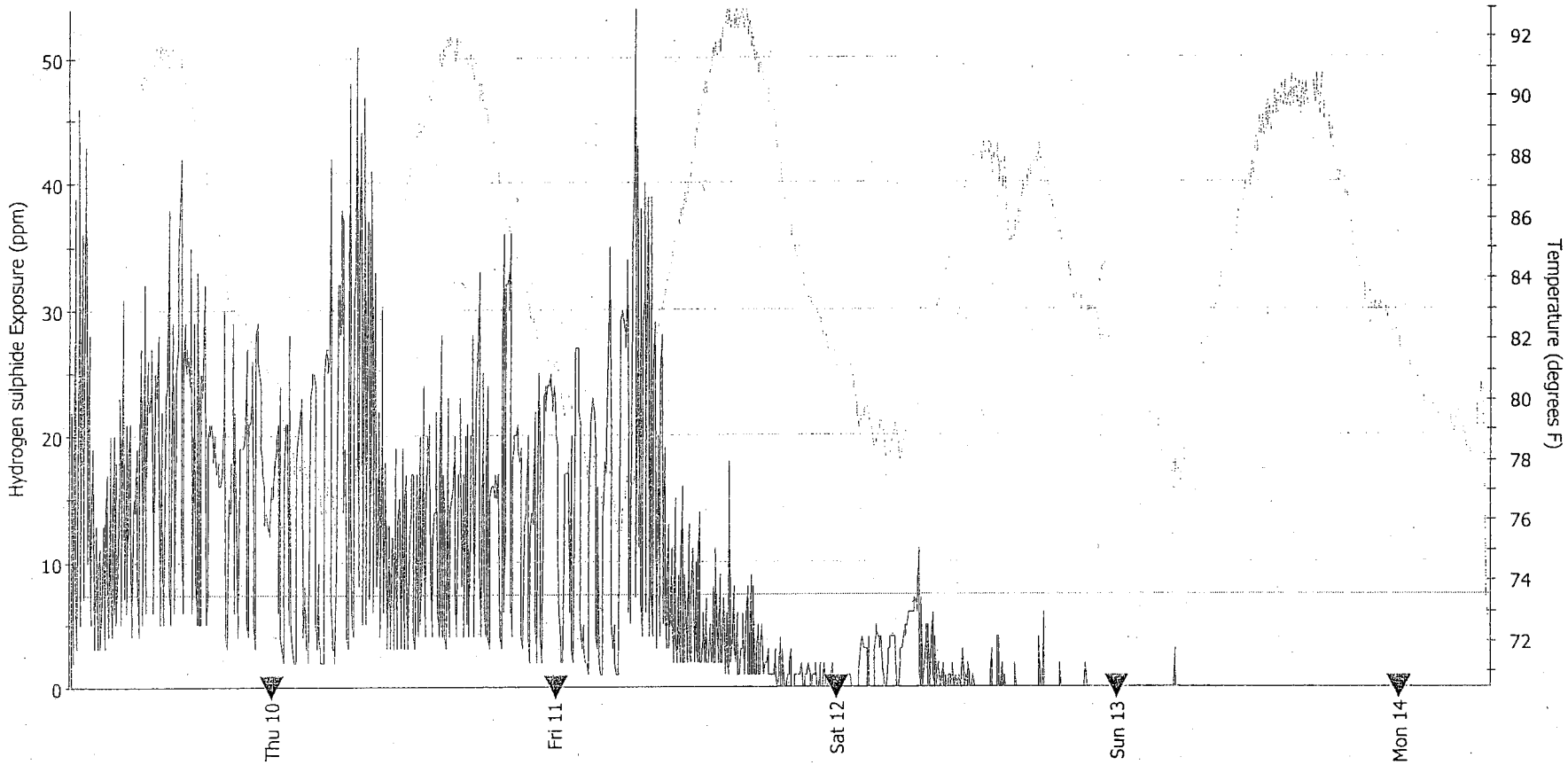
INST : Min (0 ppm) Max (19 ppm) | Day Transition | Average (0.1 ppm) | Temperature

- Session: 1 (OdaLog: OL0504068)



INST : Min (0 ppm) Max (13 ppm) | Day Transition | Average (4.2 ppm) | Temperature

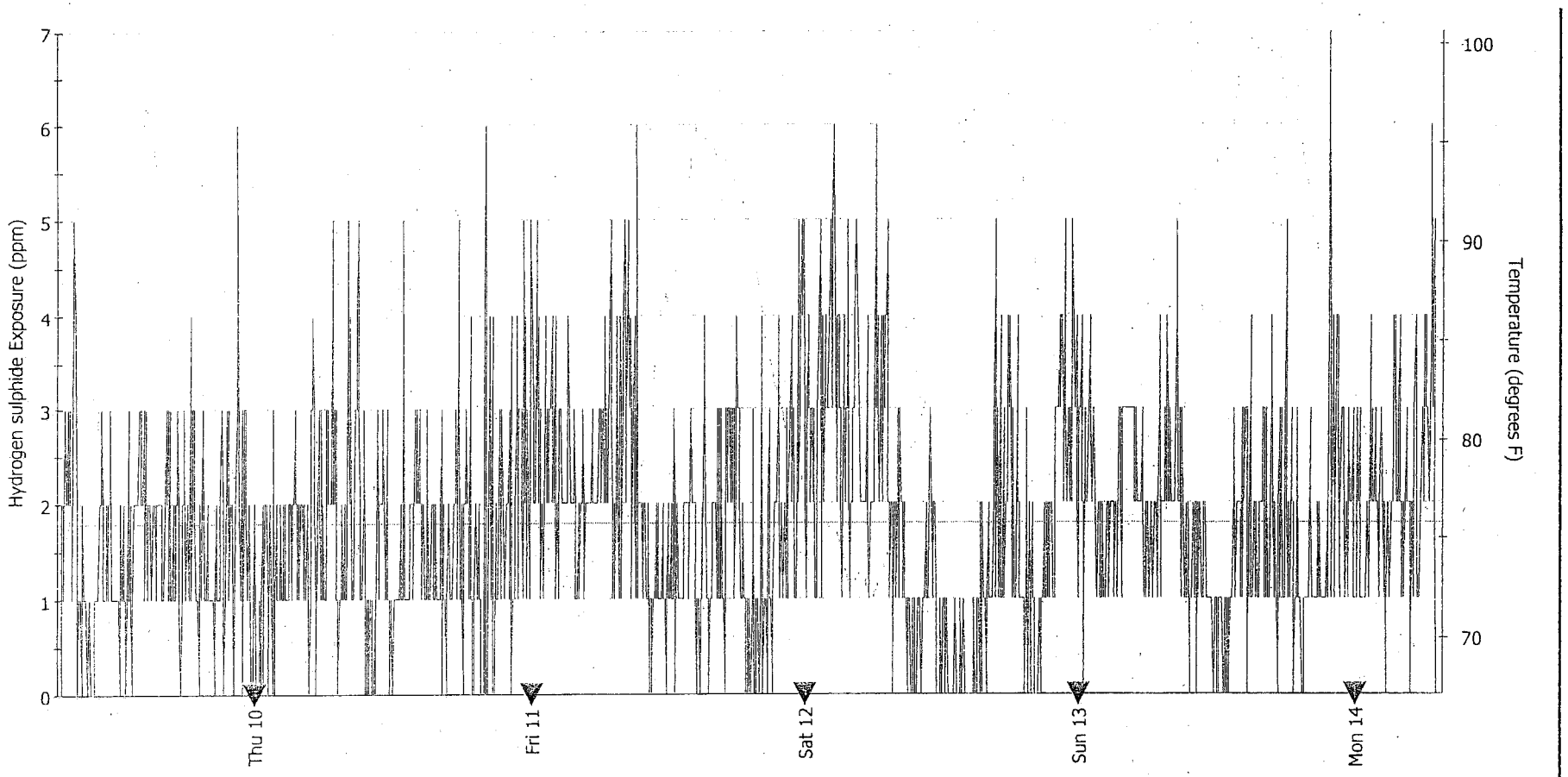
- Session: 1 (OdaLog: OL0504069)



Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: Plant Splitter Box 6-14-04.oda)

INST : Min (0 ppm) Max (54 ppm) | Day Transition | Average (7.3 ppm) | Temperature

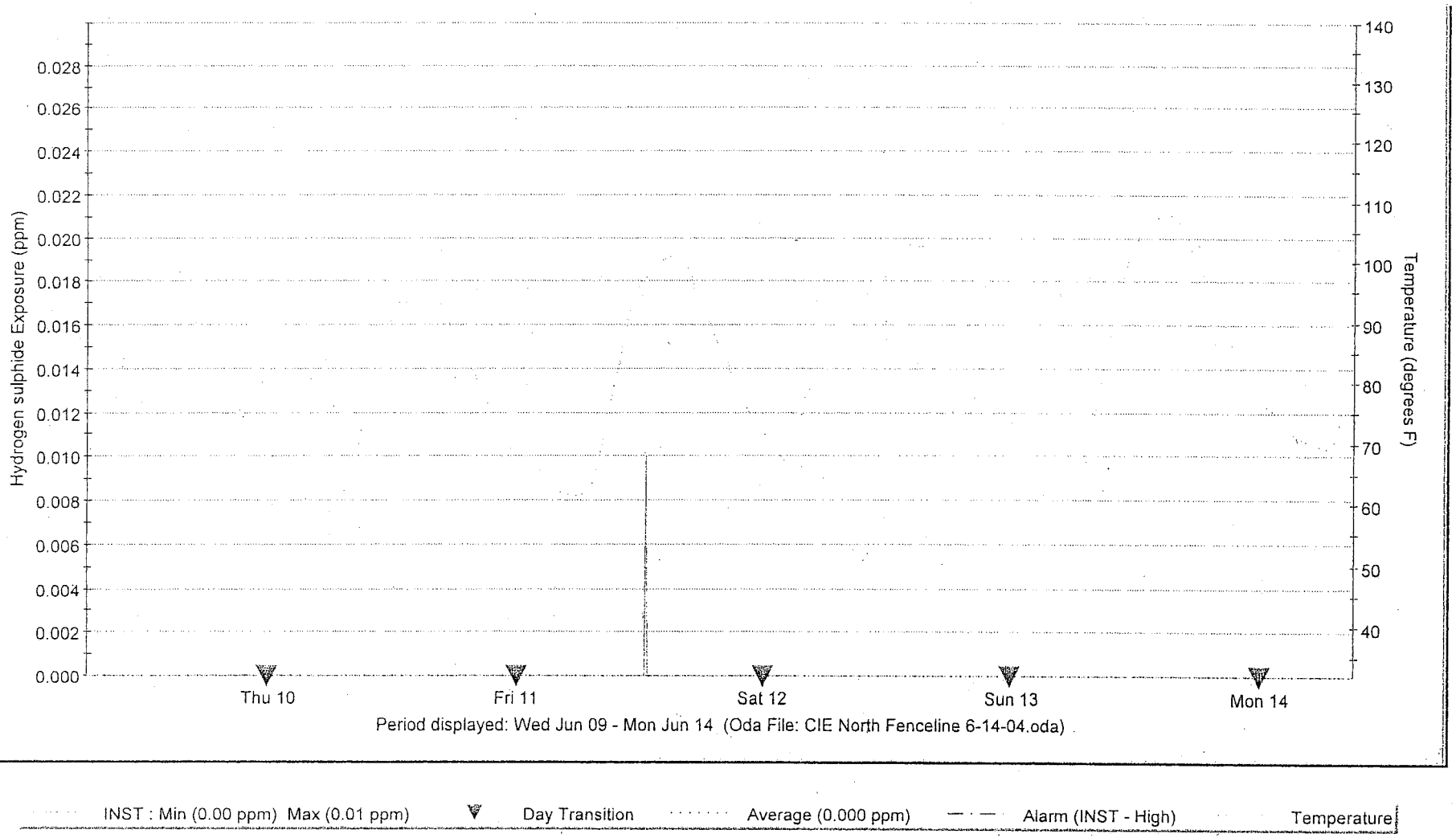
- Session: 1 (OdaLog: OL05113658)



Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: Plant Aeration Influent 6-14-04.oda)

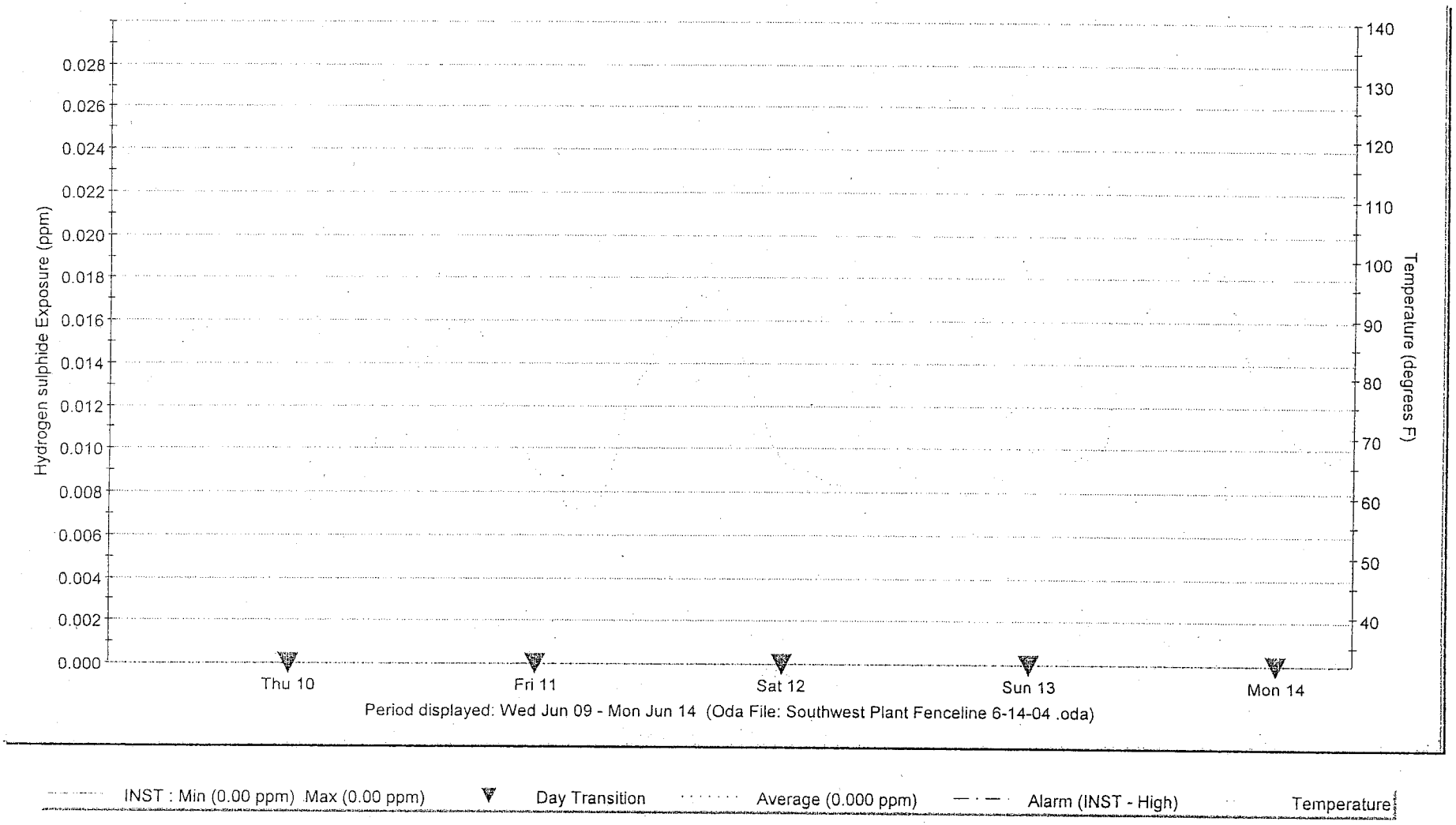
INST : Min (0 ppm) Max (7 ppm) | Day Transition | Average (1.8 ppm) | Temperature

- Session: 1 (OdaLog: OL50044578)



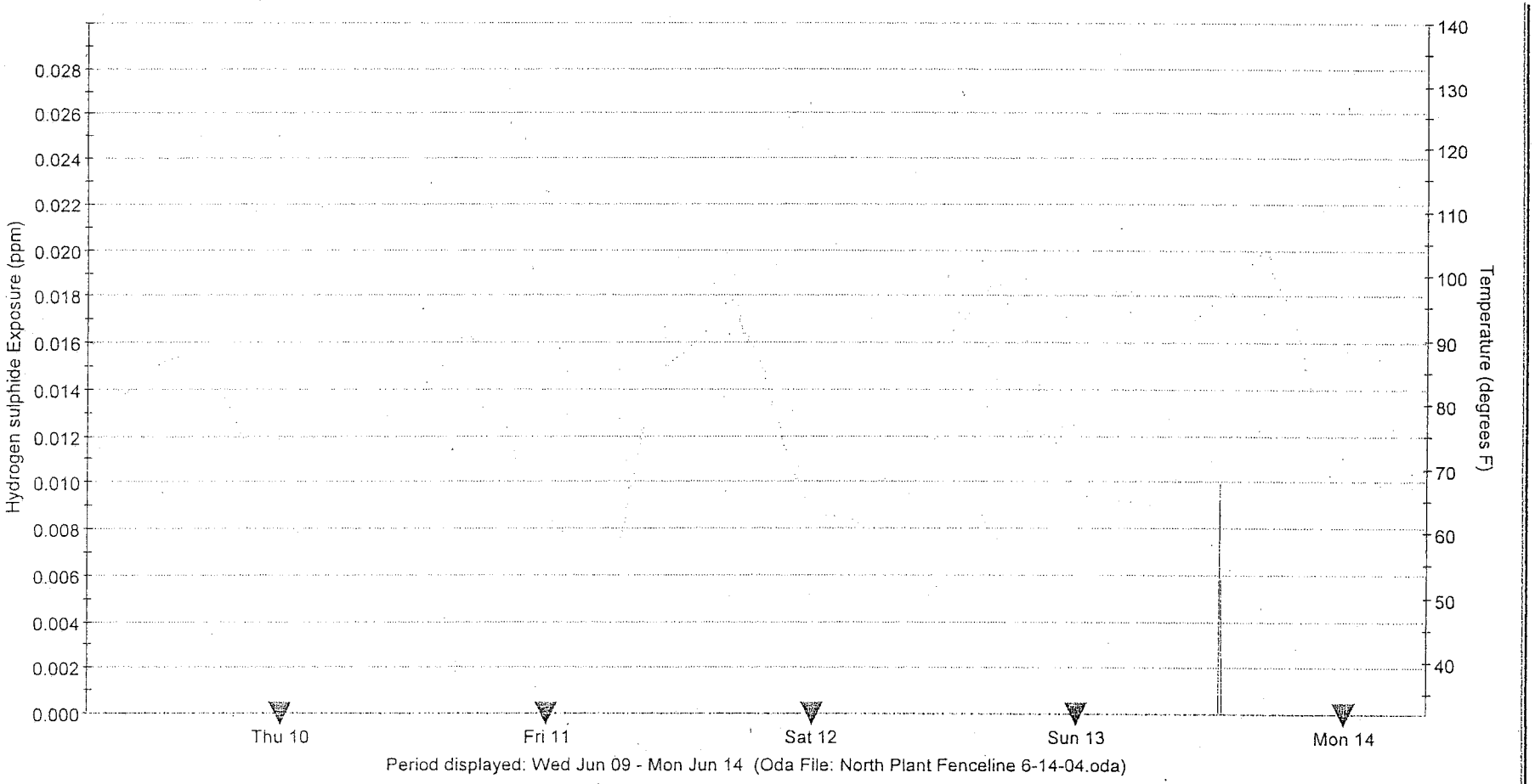
INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50063509)



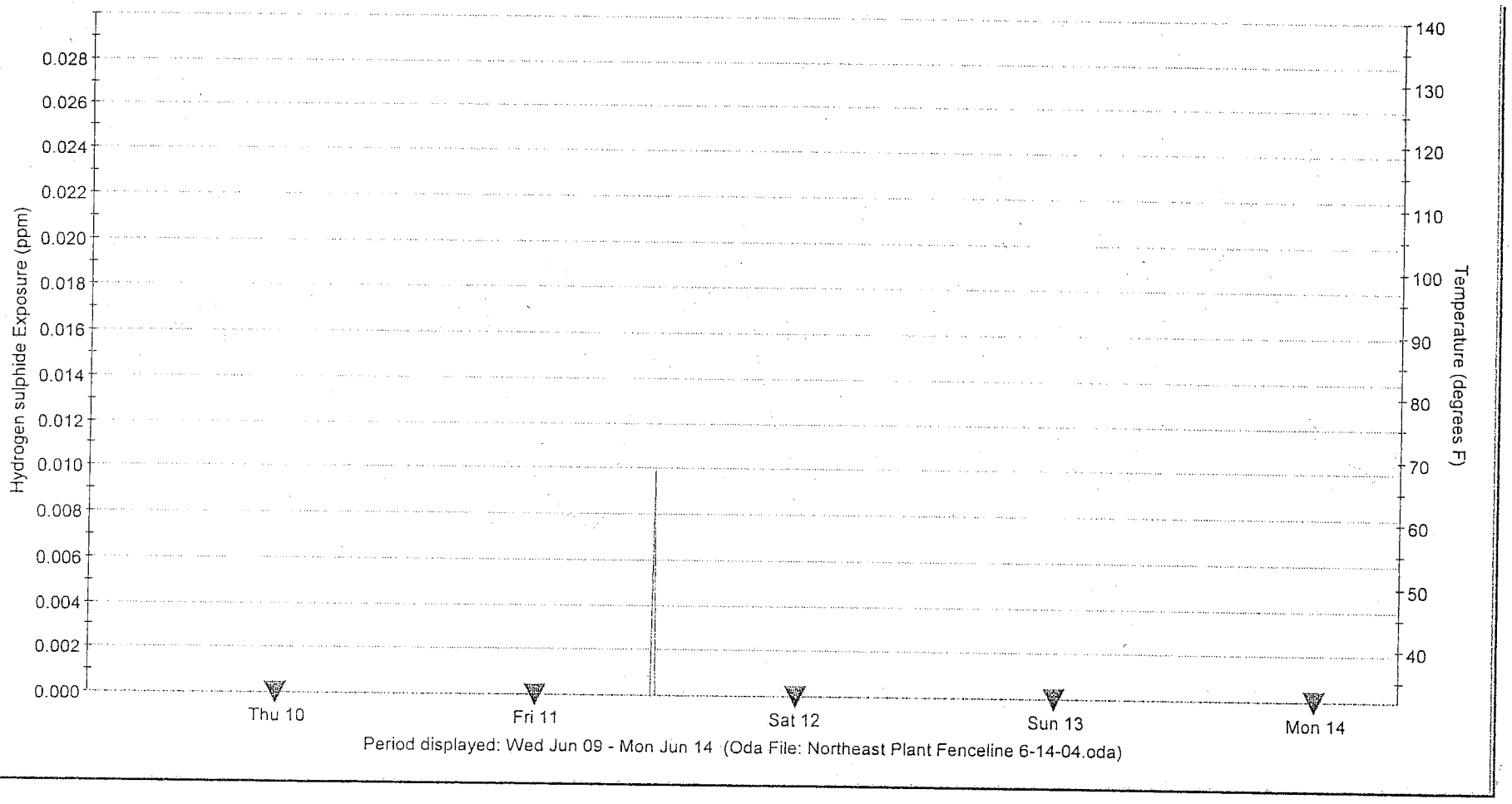
INST : Min (0.00 ppm) Max (0.00 ppm) ▼ Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50083533)



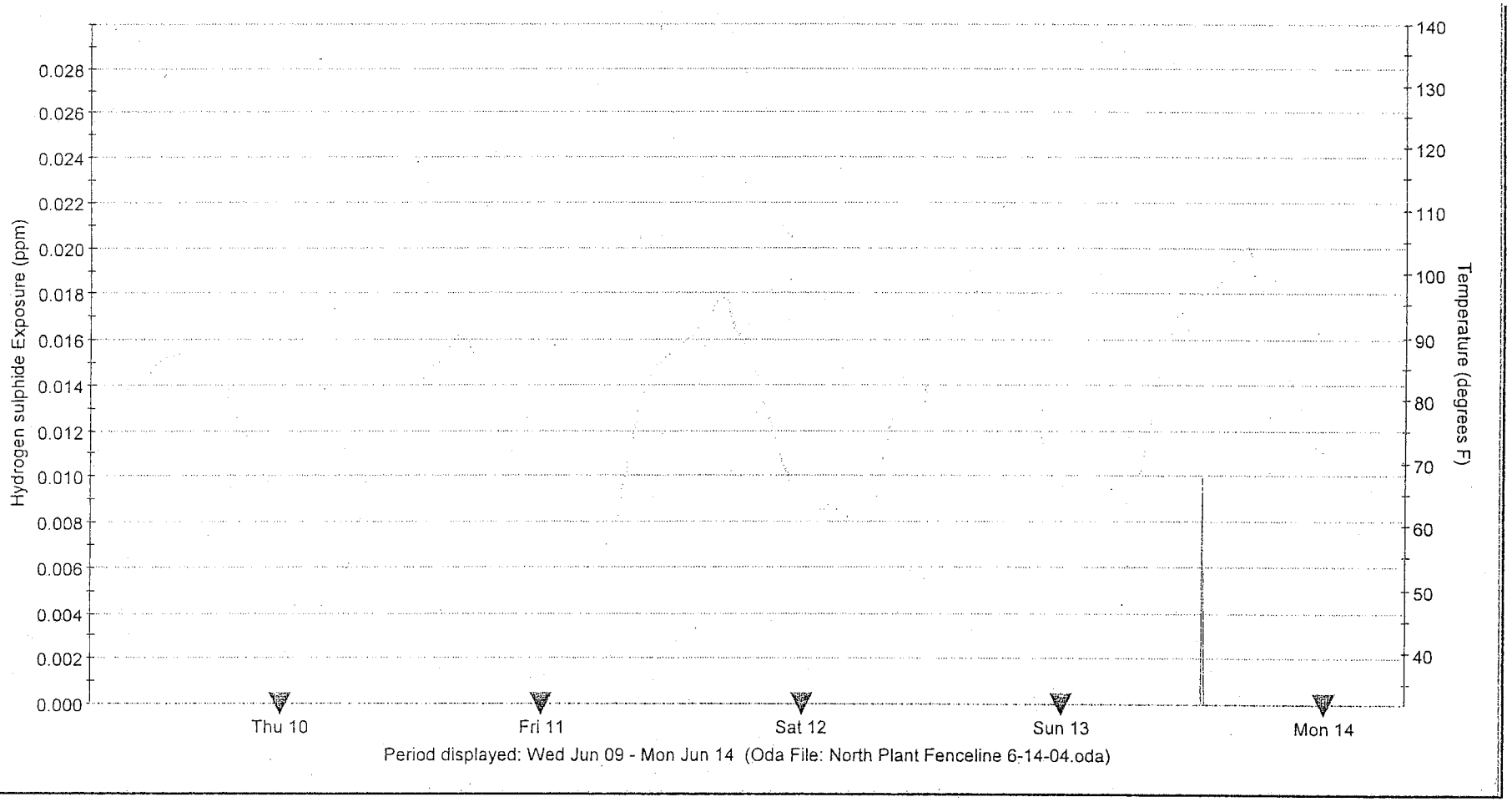
INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50073521)



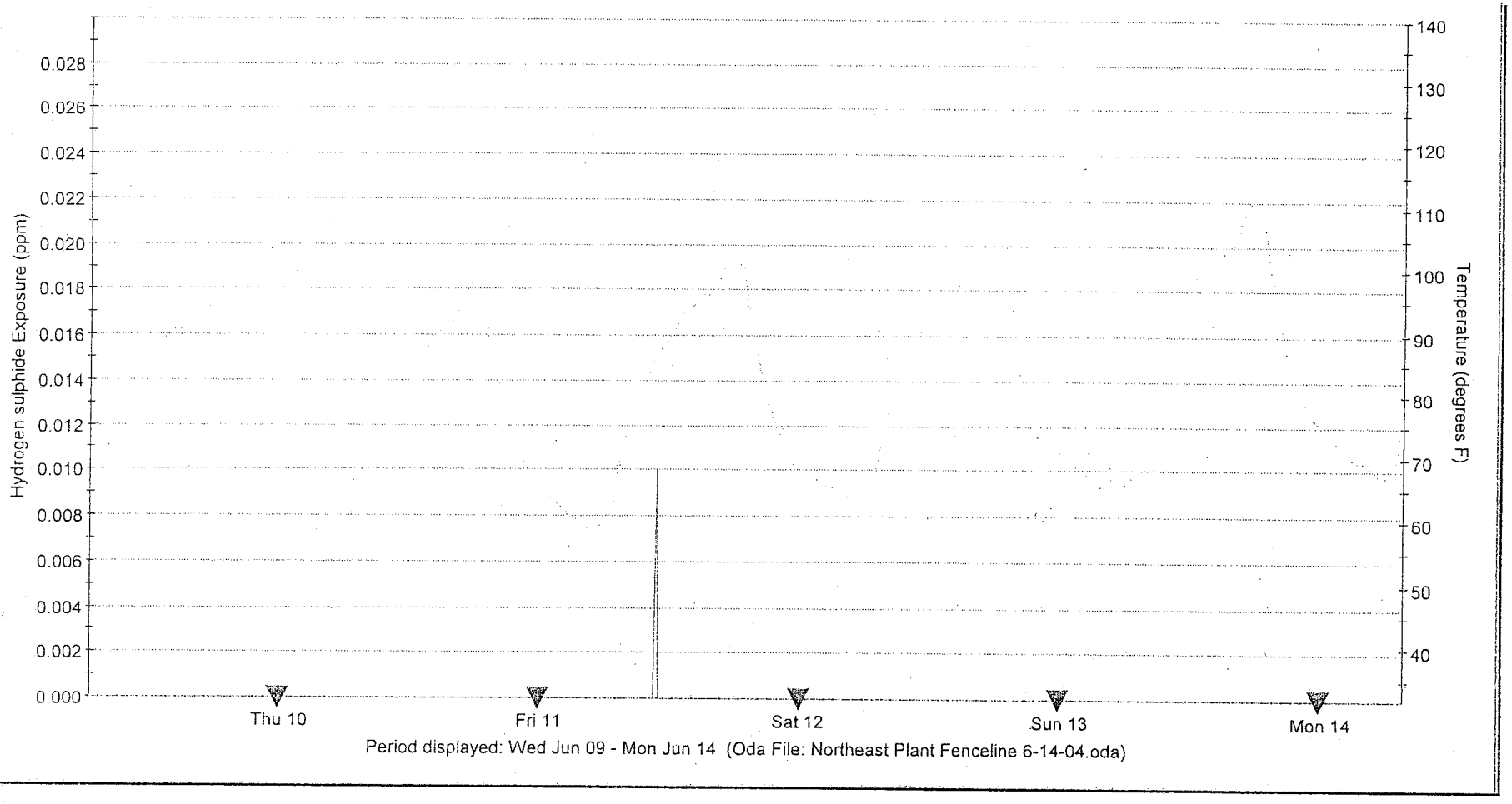
INST : Min (0.00 ppm) Max (0.01 ppm) ▼ Day Transition ····· Average (0.000 ppm) — · — Alarm (INST - High) · · · Temperature

- Session: 1 (OdaLog: OL50083533)



INST : Min (0.00 ppm) Max (0.01 ppm) ▼ Day Transition Average (0.000 ppm) — · — Alarm (INST - High) Temperature

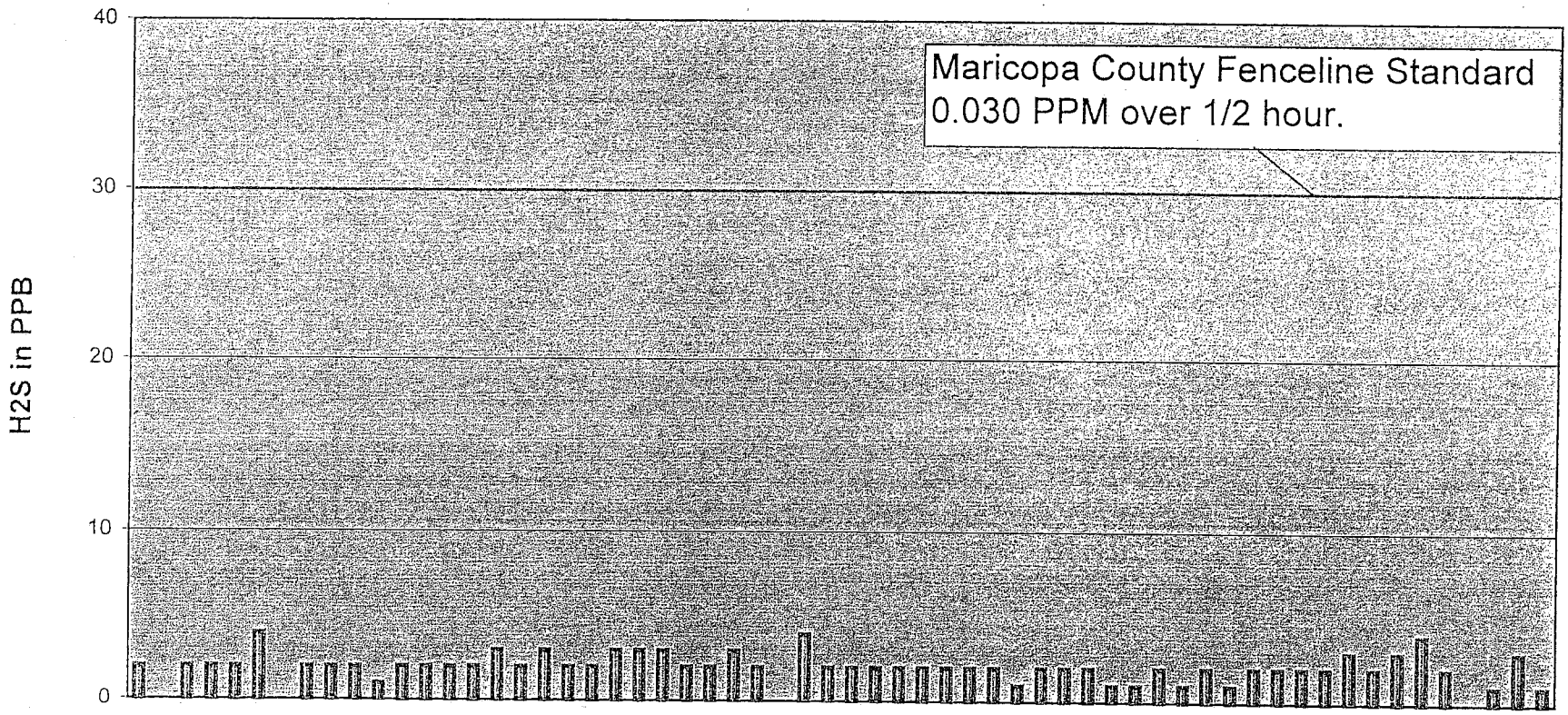
- Session: 1 (OdaLog: OL50073521)



INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

CIE Lift Station Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



North Fenceline

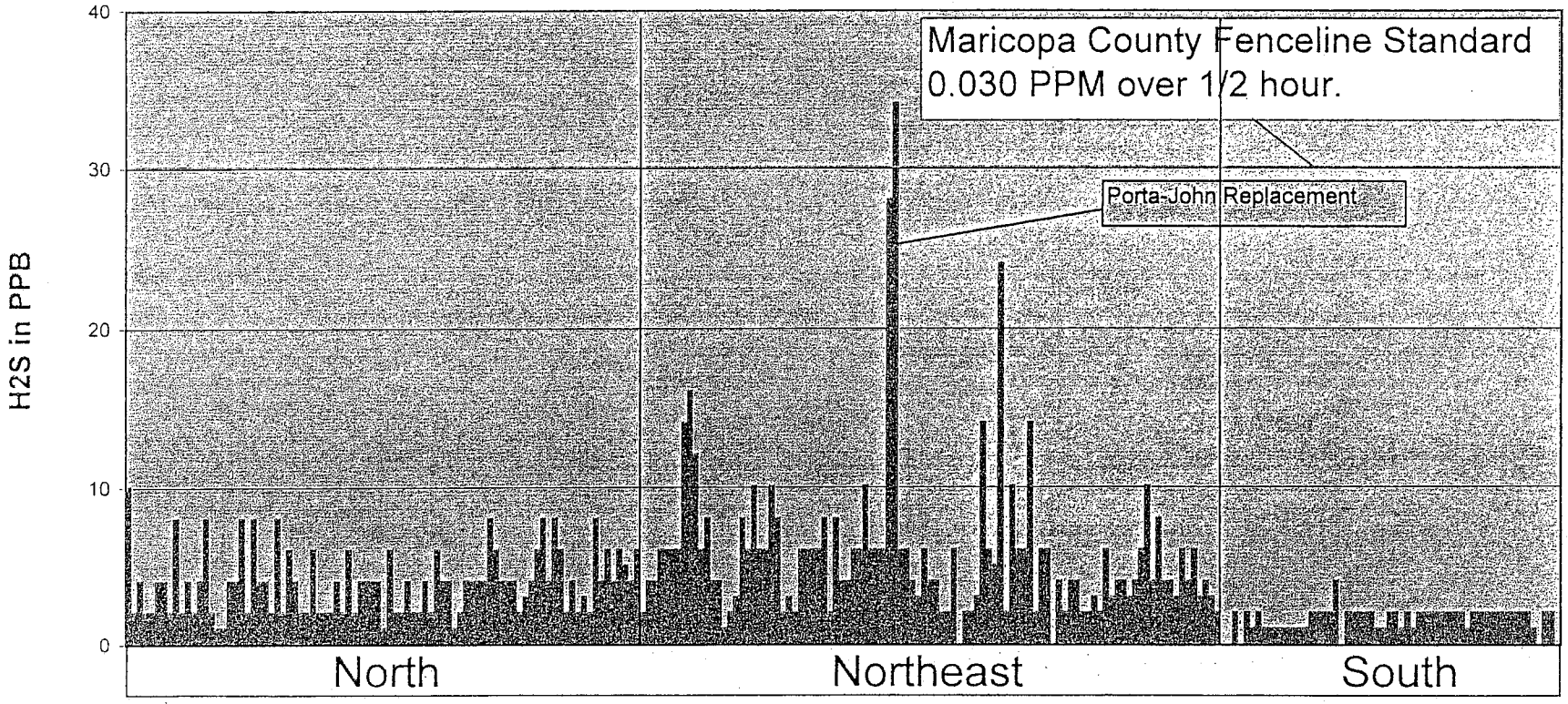
Wind -- Southwest to Northeast at 3-7 mph

Fence

June 8, 2004

The Boulders WRF Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



Fence

Fenceline

Wind -- Southwest to Northeast at 3-7 mph

June 8, 2004

Exhibit 2

AFFIDAVIT OF JONATHAN PEARSON

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Jonathan Pearson, being first duly sworn upon his oath, deposes and says:

1. I am the Town Administrator for the Town of Carefree (the "Town"). I have held this position since 1987. My official duties include coordination and administration of day-to-day activities of the employees of the Town.

2. As Town Administrator, I actively participate in the Town's decision making process and dealings with Black Mountain Sewer Company ("Black Mountain Sewer").

3. I am aware that residents of the Town from the Carefree Inn Estates and Boulders Development subdivisions have complained of odors coming from the Black Mountain Sewer system.

4. I have read the Affidavit of Stan Francom submitted herewith and agree with the descriptions and conclusions contained therein.

5. The Town has offered to fund and install equipment on a test basis to reduce the odors experienced by residents of the Boulders Development subdivision as suggested in reports prepared by Carter Burgess and Lamb Technical Services, Inc. ("LTS") addressing the odor problems encountered in these areas. The Carter Burgess and LTS reports are included as exhibits to the Affidavit of Stan Francom.

6. Black Mountain Sewer rejected any and all such offers from the Town to fund and install equipment on a test basis to reduce the odors experienced by residents of the Boulders Development subdivision.

7. The Town understands and appreciates that Black Mountain Sewer Company has made an effort to reduce the odor problems encountered by the residents of the Carefree Inn Estates and Boulders Development subdivisions, but residents in these subdivisions continue to complain about odor problems. The Carter Burgess and LTS reports suggest a number of potential capital projects that may reduce the odor problems. The Town's position is that a rate increase for Black Mountain Sewer is only appropriate if Black Mountain Sewer devises a plan to implement at least the most critical capital improvements as suggested by Carter Burgess and LTS to eliminate the odor problems and such capital improvement costs are considered as a component of any rate increase sought by Black Mountain Sewer.

I declare under penalty of perjury that the foregoing is true and correct

Dated this 9th day of March, 2006.

OFFICIAL SEAL
BEV PETERSON
Notary Public – State Of Arizona
MARICOPA COUNTY
My Comm. Expires Oct. 7, 2006

Jonathan Pearson

SUBSCRIBED AND SWORN to before me
this 9th day of March, 2006.

Notary Public

My Commission Expires:

10-7-06

Exhibit 3

AFFIDAVIT OF JASON C. BETHKE

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Jason C. Bethke, being first duly sworn upon his oath, deposes and says:

1. I am a Registered Professional Engineer. My certificate number is 33976.

2. Under my direction and review, a report was prepared for the Town of Carefree entitled Odor Control Review and Recommendations dated October 2004 (the "Report"), attached hereto as Exhibit A. The report was prepared while I was employed by Carter Burgess as a civil engineer.

3. I am prepared to testify before the Arizona Corporation Commission regarding the contents, analysis, conclusions, and recommendations contained in the Report.

4. My C.V. is available upon request.

I declare under penalty of perjury that the foregoing is true and correct

Dated this 9th day of March, 2006.

Jason C Bethke
Jason C. Bethke

SUBSCRIBED AND SWORN to before me
this 9th day of March, 2006.

Notary Public

My Commission Expires:

July 2, 2007

REBECCA LOUISE LAMMEY
Notary Public - Arizona
MARICOPA COUNTY
My Commission Expires
JULY 2, 2007

Exhibit A

RECEIVED
OCT - 5 2004
Town of Carefree

TOWN OF CAREFREE

FEB 2 3 2006

ODOR CONTROL REVIEW AND RECOMMENDATIONS

OCTOBER 2004

Carter::Burgess
3003 N. CENTRAL AVENUE, SUITE 1700
PHOENIX, ARIZONA 85012

Registered Professional Engineer (Civil)
CERTIFICATE NO.
33976
JASON C.
BETHKE
Date Signed 10/5/04
ARIZONA, U.S.A.

The Town of Carefree has held discussions with Black Mountain Sewer Company (BMSC) regarding sewer odors in their community. In response to numerous resident complaints, BMSC contracted LTS, Inc. to provide an odor study of their collection and treatment system. The LTS study focused on levels of hydrogen sulfide at known problem spots within the BMSC system. Based on the study, BMSC submitted an action plan to the Town of Carefree for approval. The report briefly addresses methods of controlling odors, but does not recommend permanent solutions to stop the creation of odors at the source.

The Town of Carefree is concerned that the LTS recommendations and subsequent BMSC action plan do not represent a definite solution to the Town's odor problem. This study is meant to supplement the LTS report by providing a comprehensive analysis of the available means for preventing, treating and controlling sewer odors in the BMSC system. The main areas of concern, shown in Figure 1, include:

- The Commercial Lift Station and surrounding area;
- The Carefree Inn Estates (CIE) Lift Station and surrounding area;
- The Discharge Manhole near the Intersection of Boulder Drive and Ironwood Road; and
- The BMSC Water Reclamation Facility (WRF) in the Boulders Community.

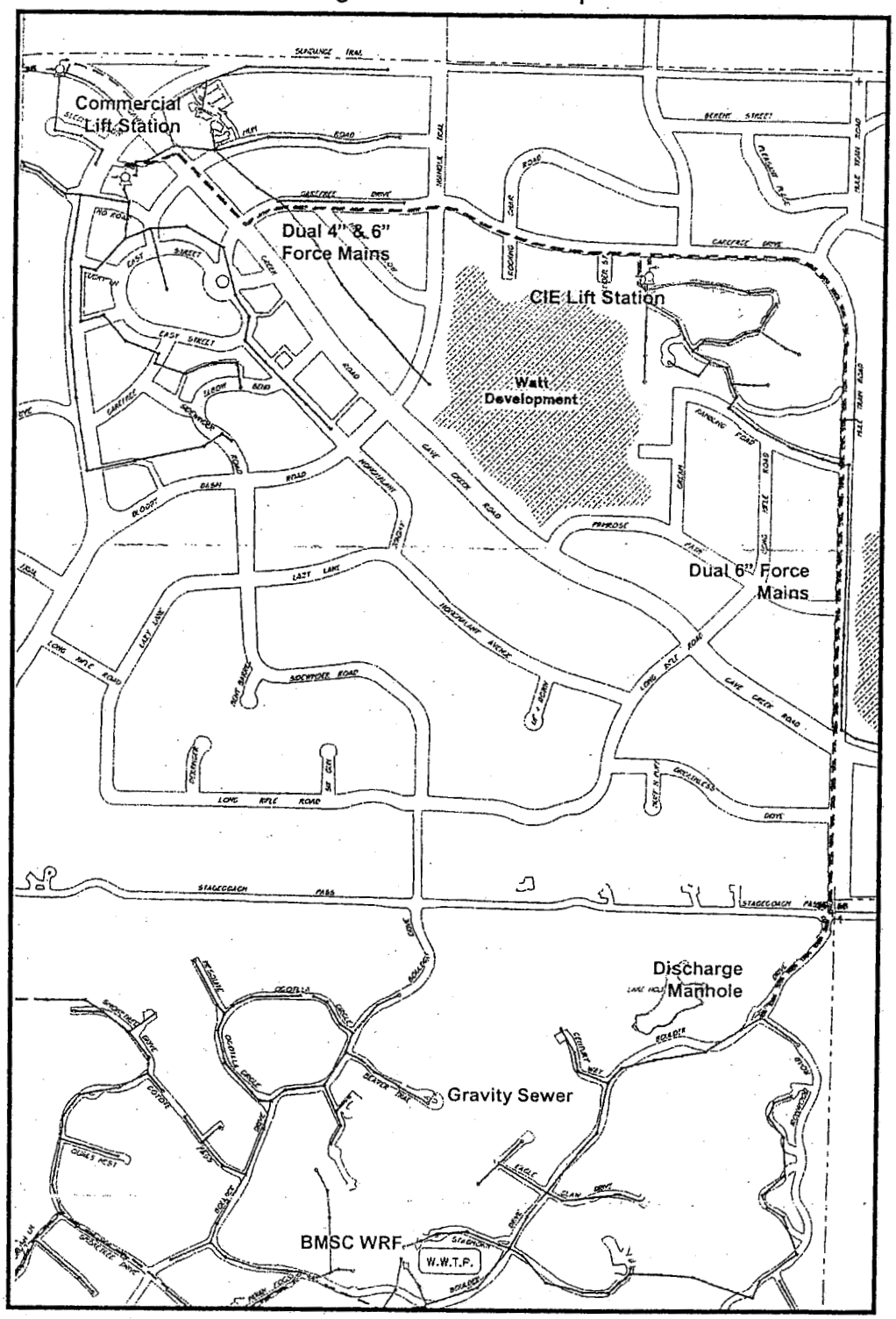
The Commercial lift station receives sewage from downtown area residences and businesses. The sewage flows through a septic tank and two manholes upstream of the lift station, causing an increased retention time in the system. The sewage is then pumped through two force mains (one 4-inch and one 6-inch) to the CIE lift station. The design flow rate of this pump station is 200 gallons per minute (gpm) as shown on the map provided by BMSC. As noted in the LTS study and shown in the photograph to the right, numerous additional odor sources surround the lift station, including a grease trap and dumpster.

Additional Odor Sources at Commercial Lift Station

As with the Commercial lift station, the wet well at CIE is preceded by a 1000-gallon septic tank and an 8-ft diameter x 12-ft deep manhole directly upstream. In addition to receiving flow from the dual force mains, the CIE lift station collects sewage from the Carefree Inn Estates and the Carefree Airport. The combined sewage is then pumped through dual 6-inch force mains to a manhole near the intersection of Ironwood Road and Boulder Drive in the Boulders Community. Flow exiting this manhole travels by gravity to the BMSC WRF located off Boulder Drive, west of Staghorn Lane. The

design flow rate of the CIE lift station is 250 gpm with one force main open, and 440 gpm with two as shown on the map provided by BMSC. Currently, both force mains are operational.

Figure 1: Location Map



Scale: 1" = 1000'

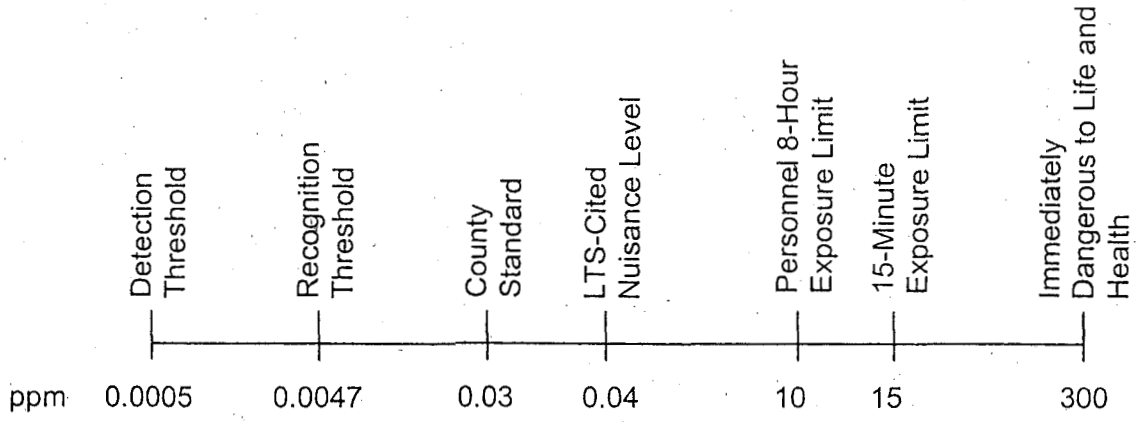
II. Sewer Odors: Types and Causes

All wastewater collection, conveyance and treatment facilities have the potential to emit bothersome odors. The anaerobic conditions associated with collection systems and primary treatment makes these portions of the system particularly problematic. Sulfate-reducing bacteria thrive in anaerobic environments, where no dissolved oxygen is available for respiration. These bacteria use the sulfate ion, which is naturally abundant in most waters, as an oxygen source for respiration. The byproduct of this activity, highly corrosive hydrogen sulfide gas (H_2S), has a strong rotten-egg odor. The gas is released to the atmosphere in areas such as wet wells, manholes and headworks facilities.

In collection systems, most sulfide generation occurs in the slime layer on the pipe wall or in sludge deposits on the pipe invert. The contribution of sulfide from the bulk liquid is relatively small. If the wastewater contains dissolved oxygen (DO), an aerobic slime layer exists closest to the bulk wastewater. Therefore, even if sulfide is generated in the anaerobic layer closer to the pipe wall, it is biologically oxidized as it passes through the aerobic layer. However, if this aerobic layer does not exist, as in the case where wastewater contains little or no DO, sulfide can diffuse into the bulk wastewater.

Odor is measurable using objective, scientific methods. Four objective parameters of perceived odor include concentration, intensity, persistence and character descriptors. Additional measurable but subjective parameters of odor perception include hedonic tone (pleasantness vs. unpleasantness), annoyance and strength. These parameters are subjective because they are reported by individuals who must rely on their interpretation of word scales and their personal feelings, beliefs, memories, experiences and prejudices. Guidelines and legal definitions of subjective odor parameter scales can often assist individuals in reporting observed odor; however, the nature of these parameters remains subjective. The values presented in Figure 3 are commonly used to describe levels of human exposure to H_2S.

Figure 3: Hydrogen Sulfide Concentration Scale



As shown in Figure 3, the LTS study cited the H_2S nuisance level as 0.04 ppm; however, the recognition level is an order of magnitude lower. Due to the subjective nature of individual response to odor stimuli, it is difficult to determine what level of prevention and control will be sufficient to satisfy the community. It is possible that an emission that meets county standards could result in an odor complaint. The goal of the Town of Carefree is not to reach a predetermined H_2S level, but to maintain a sewer system that results in no resident complaints. Therefore, this study will present odor control measures in order of cost and ease of implementation, under the premise that if BMSC succeeds in eliminating further complaints after instituting one or more of the recommended measures, more costly methods may not be required.

In addition to H_2S, several other odor-producing compounds exist in typical wastewater. These include organic sulfides; mercaptans; nitrogen compounds including ammonia and amines; acids such as acetic and butyric; and acetaldehyde. Not all odor control technologies are efficient at removing the full array of odor-producing compounds. This study will focus primarily on odor control technologies for H_2S removal, since this was determined to be the main problem in the LTS study. Where available, information regarding removal efficiencies of other compounds will be cited for specific odor control technologies.

Retention Time

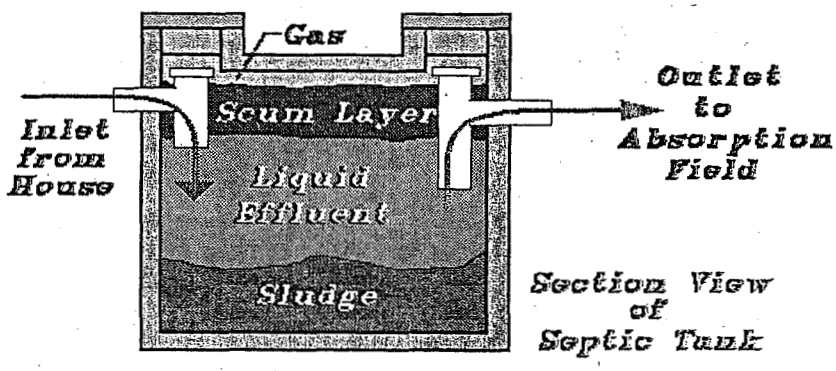
H_2S production requires an anaerobic environment, typically resulting from long retention times in the collection system. The length and design of the BMSC collection system make it particularly susceptible to these anaerobic conditions. Identified main contributors to the creation of H_2S in the BMSC system are:

- The existence of upstream septic tanks at the two largest lift stations;
- The existence of one or more manholes upstream of these lift stations;

- The long pump cycle times; and
- The dual force mains leaving both pump stations.

Septic tanks are anaerobic digesters by design. As shown in Figure 2, in a typical domestic application, the tank would accept raw sewage from the house; over time the sludge settles out and the scum floats to the top, leaving a clarified effluent. The sludge and scum are retained for further treatment. The issue that arises from the presence of a septic tank in the collection system is that it yields anaerobic sewage. Furthermore, it is likely that the septic tanks upstream of the pump stations are full of sludge, so that anaerobic sludge is flowing into the pump station, rather than clarified liquid.

Figure 2: Typical Septic Tank Installation



From Septic Information Website (http://www.inspect-ny.com/septbook.htm)

In addition to the retention time provided by a septic tank, the Commercial lift station combines the wet well and two upstream manholes, resulting in increased retention time between pump cycles. A manhole is also located upstream of the CIE lift station. The long residence time created by the additional manholes and septic tanks results in an anaerobic environment and sewage high in H_2S concentration. The manholes also provide additional areas for the hydrogen sulfide gas that is generated to escape to the atmosphere.

Lift station pumps are designed based on peak flow, wet well capacity and allowable pump cycle time. The pump cycle time is the time between pump starts, or the time it takes the wet well to fill plus the time it takes the pump to empty it. Typical pump cycle times are 4 to 6 minutes, or 10 to 15 cycles per hour. Longer pump cycle times are desirable because they result in longer pump life and lower electrical costs. However, in wastewater applications, it is ideal to use the shortest pump cycle time recommended by the pump manufacturer to cut down on the wet well residence time and the potential for anaerobic conditions. While observing the CIE lift station, a pump run time of 3 minutes, 40 seconds was noted. Based on a design pumping rate of 440 gpm, over 1600 gallons

of sewage must accumulate in the wet well and upstream manhole between pump cycles. During periods of low flow, this provides more than sufficient time for the sewage to turn septic.

All force mains in a sewer collection system should be designed to provide velocities between 2 and 5 feet per second (fps). Velocities below 2 fps allow solids in the pumped fluid to settle out. Based on the design pumping rates at the Commercial and CIE lift stations, the velocity from Commercial to CIE is 1.1 to 2.5 fps, and from CIE to the effluent manhole is 2.5 fps. As shown in Figure 1, each of the force mains from the Commercial to the CIE lift station is approximately 3,500 feet long. From CIE to the effluent manhole, the force mains are approximately 6,000 feet long. Based on capacity of the force mains[1], the Commercial lift station must pump 7,420 gallons before the lines discharge into the CIE station. The pumps must cycle over 10 times[2] for the flow to reach the CIE station, therefore, the retention time in the force main is well over two hours.[3] At least 17,640 gallons (or 11 pump cycles) must be pumped from the CIE lift station prior to exiting the force mains, resulting in a mean residence time in excess of two hours.[3]

As verified by the LTS study, the long residence times observed in the BMSC collection system, which are exacerbated by the four items discussed above, result in exceptionally high H_2S levels. At the Commercial lift station, H_2S levels reach 102 parts per million (ppm); the CIE lift station reaches 101 ppm H_2S with no chemical addition at the Commercial lift station, or 24 ppm with the addition of Thioguard. Hydrogen Sulfide levels at the force main discharge location were found to be 700 ppm.

Reducing retention time in a collection system is not always feasible; therefore several odor control technologies exist.

III. Primary Types of Odor Control Technologies

The many technologies available to control odors from wastewater collection and treatment systems can be divided into two categories: vapor-phase and liquid-phase. Vapor-phase technologies are used to control odors in air or gas, and are typically used in point source applications including wastewater treatment plants and pump stations. Liquid-phase technologies are used to control odors in wastewater and typically are used in collection systems where controlling odors and corrosion over a widespread area is necessary and multiple-point odor control may be required.

[1] A 4-in force main has a capacity of 0.65 gallons per linear ft; a 6-in main has a capacity of 1.47 gallons per linear ft.
[2] Assumes a pump run time equal to CIE Lift Station (3.67 minutes)
[3] Assumes pump cycle time of 11 minutes

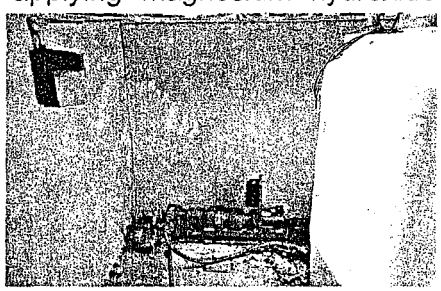
A. Liquid Phase Odor Control Technologies

Liquid-phase odor control technologies include pH adjustment, air and oxygen injection, chemical oxidation, nitrate additions, iron salts and biological controls. A discussion of each of the methods follows, including maintenance and performance issues.

1. pH Adjustment

The pH of wastewater has an important role in determining the amount of H_2S gas available for release to the atmosphere. At pH 6.0, over 90% of dissolved sulfide is present as dissolved gas; at pH 8.0, less than 10% is available as gas. Therefore, a decrease of one pH unit can significantly increase the release of H_2S gas, causing odor and corrosion problems. There are two approaches to controlling pH in sewer collection systems. One approach involves continuous pH adjustment to hold H_2S in solution; the second involves using intermittent slug doses of caustic to inactivate the slime layer and minimize sulfide generation.

Several base chemicals can be used to provide continuous pH adjustment, including calcium hydroxide or lime ($Ca(OH)_2$), magnesium hydroxide ($Mg(OH)_2$), and sodium hydroxide or caustic (NaOH). Studies have shown that the less soluble characteristics of magnesium hydroxide result in a timed-release effect that is particularly valuable in collection system applications. BMSC is currently applying magnesium hydroxide (Thioguard) at the Commercial Lift Station. The product is effective as long as the increased pH in the wastewater is maintained. As additional flows are encountered, including the CIE lift station where gravity mains from the airport and Carefree Inn Estates also feed the wet well, the pH is reduced, thereby decreasing the effectiveness of the chemical addition.



Chemical Addition Equipment at the Commercial Lift Station

Periodic slug dosing with caustic can effectively remove all sulfide forms. It is not added to shift the equilibrium, but to kill the biological slime layer that reduces sulfate to sulfide. Exposure to high pH levels will destroy the slime layer and cause it to slough. The slime layer will immediately begin to reform, but it may take days or weeks to reach full sulfide production again. The time required for slime layer regeneration after slug dosing is a function of pH, temperature and time of contact.

Lime and sodium hydroxide are the typical chemicals of choice for slug dosing due to their quick solution time, which maximizes contact time. Caustic slugging can adversely

affect pH-sensitive treatment processes and effluent discharge limits, necessitating equalization basins to receive the caustic slug for slow release to the treatment facility. Because of this added maintenance requirement, caustic slugging is not used as often as continuous dosing, and is not recommended for the BMSC system.

2. Air and Oxygen Injection

Most odor production in wastewater can be prevented if a minimum DO concentration of 0.5 to 1.0 mg/L is maintained. As previously discussed, because it is difficult to maintain oxygen concentrations naturally, supplemental sources of oxygen may be used. Wastewater oxygen levels may be increased through the addition of air, oxygen or chemicals containing bound oxygen, such as nitrate (NO_3) or hydrogen peroxide (H_2O_2) (see Chemical Oxidation and Nitrate Addition, below).

Air is a readily available source of oxygen that has been used to successfully control odors in gravity sewers and force mains. Air will not completely dissolve in water at normal pressures, resulting in the release of some residual gases. If odorous compounds are present in the wastewater at the point of air injection, odors will diffuse into undissolved air and escape to the atmosphere, sometimes causing increased odor. Depending on the method of air injection, turbulence can also release odors, thereby worsening the problem. Due to this potential to intensify odor production, the addition of air for odor control is not recommended for use in the BMSC system.

The addition of pure oxygen to improve DO levels and reduce odors has been in use for over 20 years. Oxygen has a major advantage over air when added to wastewater because it is five times more soluble in water, resulting in a smaller volume of gas required to achieve equal oxygen transfer. Reductions in biochemical oxygen demand (a measure of oxygen being consumed by microorganisms breaking down organic matter) have also been reported following installation of oxygen injection equipment. Oxygen can either be generated on-site for requirements greater than 2,000 pounds per day (lb/d) or purchased commercially and delivered by truck for lesser quantities.

3. Chemical Oxidation

Chemical oxidants attack and destroy odor-causing compounds through chemical reactions. Although some of the chemicals in this category contain oxygen as part of their molecular structure, their primary action is to chemically react with the odorous compound in the dissolved form rather than release oxygen for use by bacteria. Chlorine, hypochlorite and hydrogen peroxide are examples of chemical oxidants.

Chlorine is relatively inexpensive and powerful, and the necessary equipment to administer it is widely available. It is obtainable as pure gas, hypochlorite solution, or hypochlorite granules or tablets. Chlorine gas is commonly used at wastewater treatment facilities for disinfection, but storage and handling requirements make it less desirable for collection system odor control. Hypochlorite solutions are much safer to use for collection system applications and the equipment is relatively simple to operate and maintain. Negative aspects of chlorine addition include its indiscriminate oxidation of any reduced compound in wastewater, necessitating overfeeding to ensure complete sulfide oxidation (typically 5 to 15 parts chlorine to each part sulfide). Depending on point of application and dosage, chlorine can kill organisms beneficial to wastewater treatment processes, resulting in process upset. Also, the reaction between chlorine and wastewater can produce potentially toxic and carcinogenic compounds, which may impart their own objectionable odors.

Hydrogen peroxide is commonly used to oxidize H_2S to sulfur or sulfate depending on the pH of the wastewater. Most wastewater applications theoretically require 1 part peroxide per part hydrogen sulfide; however, like other oxidants, peroxide reacts with other organics in the wastewater, so higher dosages (typically 2 to 4 parts peroxide to 1 part sulfide) are required. Peroxide is fast-acting, making it suitable for injection immediately upstream of problem locations. However, it is also quickly consumed, requiring multiple injection sites for treatment in collection systems. The maintenance and repair of H_2O_2 systems require special training; therefore, feed systems are often contract-operated by suppliers.

4. Nitrate Addition

Nitrate addition controls sulfide through two reaction mechanisms: prevention and removal. Nitrate is added to fresh wastewater as a substitute source of oxygen, preventing the reduction of sulfate to sulfide. Anaerobic bacteria responsible for odor and sulfide generation use dissolved oxygen, nitrate and sulfate as oxygen sources, in that order of preference. Dissolved Oxygen and nitrate, available in minimal quantities in typical wastewater, are quickly depleted, allowing bacteria to consuming oxygen from sulfate and causing odor and corrosion problems. When nitrate is added to wastewater, the bacteria consume it instead of sulfate, resulting in the production of nitrogen gas rather than sulfide.

Nitrate can also be added to wastewater to remove dissolved $H_2S$by a biochemical process, which converts the sulfide to sulfate. The nitrate supplies oxygen to bacteria present in wastewater to metabolize H_2S. The removal reaction is a biochemical process, and as such, may require a reaction time of one to two hours for optimum

performance. However, the removal mechanism requires one-third the amount of nitrate as the prevention mechanism. Due to its long reaction time, nitrate addition for sulfide removal may be ideally suited for BMSC collection system application.

Nitrate is typically available as an aqueous solution of calcium nitrate containing varying concentrations of nitrate-oxygen. Nitrate is one of the safest sulfide control chemicals to handle, with most nitrate salt solutions considered to be nonhazardous substances. Nitrate can be injected into force main discharges or directly to pump station wet wells.

5. Iron Salts

Iron salts combine with dissolved sulfide to form relatively insoluble precipitates. The precipitates are black or reddish-brown floc particles that do not deposit in the collection system, but readily settle with other solids at the treatment plant. Four types of iron salt solutions are commercially available: ferrous sulfate, ferrous chloride, ferric sulfate and ferric chloride. The addition of sulfate-based salts is typically not a concern in wastewater systems because sulfate is present in excess and sulfide generation is not increased significantly. The amount of ferric (Fe^{+++}) salts required for reaction with sulfide is typically slightly less than the amount of ferrous (Fe^{++}) salts required to precipitate an equal amount.

Iron salts are fast-acting and may be injected just upstream of a treatment plant to remove sulfide before the headworks facility, or added upstream in the collection system to realize greater odor and corrosion control. Unlike oxidants, iron salts do not react with organic materials in the wastewater; therefore, they can be overdosed at one upstream location to treat long stretches in a collection system. Regardless of the amount added, iron precipitates will remain suspended in the collection system, and will not form deposits. The iron precipitate adds to the overall solids production at the treatment facility, with the volume dependent on the amount of sulfide treated. The increase in solids generation typically does not exceed 5% of the plant's overall solids production.

Ferrous sulfides have been shown to only allow control of H_2S to 0.05 to 1 mg/L. In most cases, this level of treatment is satisfactory to prevent odors and corrosion; however, in areas of turbulence, H_2S release may still be a problem. Furthermore, in areas of pH depression, such as anaerobic waste streams in which the pH drops below 6.5, ferrous sulfide partially dissociates and may release sulfide to the wastewater. Since areas of turbulence (such as drop manholes and force main discharges, and dilution of high-pH flows from the Commercial lift station with low-pH anaerobic flows) are believed to be occurring at the CIE lift station, the addition of iron salts is not recommended without further testing to verify satisfactory pH values.

6. Biological Controls

Numerous biological controls on the market are purported to control sulfide and odor in collection systems. One available product alters the metabolism of the existing bacteria in the slime layer, so they no longer reduce sulfate. The product is only effective as a preventive measure, and has therefore been applied in conjunction with nitrates to perform removal. Other products composed of specially developed bacteria that are intended to replace the existing bacterial slime layer have not been shown to provide effective treatment in full-scale applications. Due to the experimental nature of biological controls, they are not recommended for use in the BMSC system, without full-scale testing prior to implementation.

B. Vapor-Phase Odor Control Technologies

Liquid-phase treatment can significantly reduce sulfide formation and release in collection systems; however, in highly turbulent locations, even trace amounts of sulfide can yield H_2S concentrations high enough to cause odor and corrosion issues. Treatment units include packed tower scrubbers, activated carbon units, biofilters and ionization. Considerations for residential areas include noise reduction for fans and pumps and shorter stacks to maintain visual aesthetics.

1. Packed Tower Scrubber

Packed tower scrubbers have been used for numerous applications and have demonstrated good performance. They offer high-efficiency removal in a compact footprint, and several manufacturers provide low-profile systems ideal for residential applications. Disadvantages for wet scrubbers include the use of chemicals and potable water, which require additional space and maintenance considerations such as chemical storage tanks, pumps and drive space for delivery trucks. Due to the increased maintenance requirements associated with this type of vapor-phase treatment, packed tower scrubbers will be considered mainly for use at the BMSC WRF.

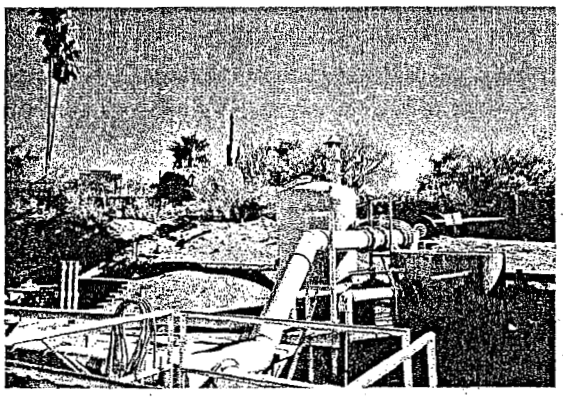
2. Activated Carbon Units

Activated carbon units are well-suited for many treatment and collection system applications. Although larger than wet scrubbers, they do not require chemicals, resulting in a similar overall footprint. Because no chemicals are involved, fewer security concerns arise from outdoor installation of carbon units. Carbon inserts are available for manholes, but are only suitable for low strength odors due to the small amount of carbon. A major maintenance concern associated with carbon units is the rapid media

depletion that results at high H_2S levels. An available water washable media is projected to last over two years at H_2S levels of 10 ppm; however, regeneration is required every six months. The vendor has developed a replaceable canister system that allows for sequential washing, while the remaining units are still in service. The low pH discharge of the canister unit is a concern for collection system applications, requiring neutralization to avoid damage to pipelines during low flow periods. A low cost neutralization system has been developed to address this concern.

3. Biofilters

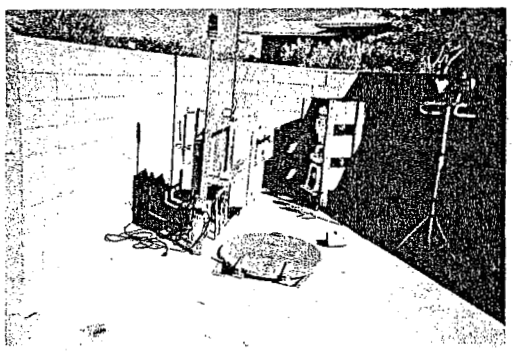
Traditional biofilters require considerably lower velocities than wet scrubbers and carbon units, and therefore occupy a larger footprint. Where adequate space is available, biofilters offer simple operation with no chemical addition, low operation costs and no hazardous materials to dispose. However, biofilters carry an intrinsic earthy odor, which may be detected by nearby residents. Several vendors have developed enclosed systems that may be better suited for collection system applications and treatment works located in residential areas, such as the BMSC WRF. The units have a high-velocity stack discharge, so any residual odor is well dispersed.



View of nearby residence from BMSC WRF Aeration Basins

4. Ionization

Ionization technology involves the use of ion tubes with an alternating current to produce negative and positive ions and form clusters of oxygen molecules. While other vapor-phase technologies treat the exhaust air prior to discharge, ionization treats the supply air. The ionized air disassociates a variety of gaseous compounds and has been shown to effectively treat H_2S, ammonia and a wide range of other odorous compounds. Benign end products such as carbon dioxide, nitrogen and water vapor are formed. Typical treatment involves injecting enough treated air to form a layer above the foul air in wet wells and manholes. Ionization tubes require cleaning once



CIE Lift Station with Residence in Background

every two to three months. Reported case studies include installation of an ionization system at a pump station within 50 ft of a residence, which produced consistent odor complaints prior to installation. No odor incidents have occurred since system startup, indicating this technology might be helpful for the BMSC system.

IV. Proposed Odor Control Projects

Following completion of the LTS study, BMSC submitted an action plan to correct the sewer odor issue to the Town of Carefree. The action items include the following:

- Water Reclamation Facility
  - Install Fan Cover
  - Install Louvers
  - Install New Grating
  - Install Sound Material
- Sage Brush Lift Station
  - Install Chemical Feed

Although these actions will help to reduce the odors emitted from the collection and treatment system, they do not represent all items covered by the LTS study. Based on the findings of this report and the LTS study, Carter & Burgess has prepared a list of proposed odor control projects. The projects are categorized as general, preventive measures, liquid phase treatment and vapor phase treatment. Approximate implementation costs are provided with each project description.

• General

- **G1 – Community Feedback Website**

  Create and maintain a website at which Town of Carefree residents can view information about causes of sewer odor; current odor control projects in the community; and measures accomplished to date. The website should include a form that residents can complete and send electronically to issue a complaint. The form should contain the date, time, nature and location of the odor, and the complainant's name, at a minimum, and should be routed to BMSC and the Town Council. Keeping the community informed of improvement measures and providing a constructive means of informing BMSC of problem spots will facilitate better relations between BMSC and the community.

  Implementation Cost: $20,000

- ## Preventive Measures

  - **P1 – Grease Trap Policy and Enforcement**
    Institute a policy under which all restaurants are required to maintain a grease trap. This will reduce the amount of grease dumped into the sewers, thereby reducing secondary odors and pipe cleaning costs.
    Implementation Cost: $4,000

  - **P2 – Sewer Cleaning Program**
    Institute a regular sewer cleaning program in which all pipes in the collection system are jetted. This will reduce sewer odors by eliminating the slime buildup on the pipe wall.
    Implementation Cost: $6 per linear foot of pipe

  - **P3 – Demolish Septic Tanks and Manholes at Lift Stations**
    Replace the septic tank and manholes upstream of the Commercial and CIE lift stations with pipe. Demolition of the septic tanks will remove a major contributor to anaerobic conditions in the collection system. Removal of the manhole(s) will reduce the effective size of the lift station wet well, reducing hydraulic residence times. Both actions will result in less potential for the sewage to turn septic and produce H_2S odors.
    Implementation Cost: $200,000

  - **P4 – Redesign Lift Stations**
    Redesign the Commercial and CIE lift stations, including cleaning and plugging one of the force mains exiting each pump station (4-in leaving Commercial and 6-inch leaving CIE); modifying the wet well size and/or level controls to reduce residence time; and replacing the pumps to decrease pump cycle time. These actions will reduce retention time in the wet wells and force mains, thereby decreasing the likelihood of sulfide generation.
    Implementation Cost: $500,000

- **P5 – Collection System Capacity Evaluation**

  Prior to performing any additional reconstruction within the collection system, a system-wide capacity evaluation should be performed to resolve conflicting capacity information cited in correspondence between the Town of Carefree and BMSC (see Appendix B). The capacity evaluation will verify any locations experiencing siphons or surcharging of gravity mains, and confirm which portions of the system are producing odors due to turbulence and other rectifiable design features. This evaluation will validate the necessity of the following proposed action items:

  - Redesign influent manhole at Quartz Drive and Boulder Drive to eliminate turbulence causing the escape of H_2S;
  - Redesign gravity line and discharge manhole at Ironwood Road and Boulder Drive to prevent surcharging lines and positive pressures; and
  - Extend CIE force main to plant to eliminate odor issues at discharge manhole at Ironwood Road and Boulder Drive.

  Implementation Cost: $150,000

• Liquid Phase Treatment

- **L1 – pH Control**

  Add Thioguard (Magnesium Hydroxide) to CIE and discharge manhole at Ironwood Road and Boulder Drive intersection. Maintaining a pH of 8.3 to 9.0 in the sewer will keep over 90% of present sulfide in suspension, reducing H_2S odors.

  Implementation Cost: $50,000 capital cost + $45,000 annual cost

- **L2 – Preventive Nitrate Addition**

  Add calcium nitrate feed at the Commercial lift station, causing anaerobic bacteria to consume the nitrate-oxygen instead of sulfate-oxygen and thereby decreasing sulfide production.

  Implementation Cost: $45,000 + $60,000 annual cost

- **L3 – Nitrate Addition for Removal**

  Add calcium nitrate feed at the CIE lift station, allowing hydrogen sulfide to be reincorporated into the bulk wastewater as sulfate. The one to two hour reaction time is provided in the force main, reducing odors at the downstream discharge manhole.

  Implementation Cost: $45,000 capital cost + $45,000 annual cost

- **L4 – Pilot Study**

  Due to the potential for process upset and/or additional odor generation, the following technologies are proposed, but are not recommended for implementation without a pilot study to verify their odor removal efficiencies.

  - Oxygen Addition
  - Hydrogen Peroxide
  - Iron Salts

  Implementation Cost: $150,000

• Vapor Phase Treatment

- **V1 – Seal Manholes**

  Seal manholes to prevent positive pressures in the system from causing odors to escape through manhole covers. However, it should be noted that if H_2S forms, it will escape; therefore, if all manholes are sealed, odors will back up into residents' vents.

  Implementation Cost: $250 per manhole

- **V2 – Residential Vent Carbon Filters**

  Install carbon filters on residential vents to intercept and treat odorous emissions. Replacement carbon packs are required when carbon is spent; replacement frequency is dependent on quantity and concentration of odors.

  Implementation Cost: $60 per vent + $30 per replacement

- **V3 – H_2S Monitor**

  Install a low-level monitor at the fence line of the wastewater treatment plant to track concentration and frequency of odors escaping from the facility. Provide additional monitors as needed to adequately record odors at problem spots in the collection system. Monitors are portable, so monitoring locations can be moved as odor issues are resolved. Sycamore Technologies' low-level indicator is accurate from 10 ppb to 2 ppm and should be used at the plant fence line; their traditional model displays H_2S levels from 0 to 200 ppm and may be required at problem spots with high concentrations.

  Implementation Cost: $4,000 per monitor, including weatherproof housing and computer software

- **V4 – Seal Aeration Basins**

  Seal the cutouts in the aeration basins with aluminum checker plate tohelp prevent odor emissions and create a negative pressure beneath the covers.

  Implementation Cost: $50,000

- **V5 – Wet Scrubber at WRF**

  Add a dual-stage scrubber to known odor producing areas to sufficiently reduce odor production and ensure negative pressures in problem areas such as the headworks facility, aeration basins and influent manhole.

  Implementation Cost: $300,000 + $150,000 annual cost

- **V6 – Carbon Units at Lift Station or Manhole**

  Carbon units ensure that any escaping odors will be treated before reaching residents. Where carbon units exist, add a fan to increase negative pressures in manhole and flow through carbon.

  Implementation Cost: $50,000 + $4,000 annual cost

- **V7 – Wet Scrubber at Lift Station or Manhole**

  Add a dual-stage scrubber to known odor producing lift stations and wet wells to reduce odor production and ensure negative pressures.

  Implementation Cost: $110,000 + $18,000 annual cost

- **V8 – Ionization**

  Ionization will help to reduce odors escaping from sewers by treating all air in the headspace, or by adding a layer of treated air over the existing H_2S. Larger systems are also available for treatment facilities, if required.

  Implementation Cost: $85,000 + $3,000 annual cost

V. Recommended Short Term Projects

Carter & Burgess has arranged the proposed projects in the recommended order of implementation. It is recommended that the projects shown in Table 1 be implemented within three months. It should be noted that projects have been ordered in consideration of ease of implementation, likelihood of solving or helping to resolve odor issues, capital costs, operation and maintenance costs and ease of maintenance. Estimated capital cost associated with implementing each project is shown. These are in addition to the BMSC proposed projects, and those recommended in the LTS study are noted in the table.

Table 1: Recommended Short Term Odor Control Projects

Project Designation	Project Description	Estimated Implementation Cost
G1	Community Feedback Website	$20,000
P1	Grease Trap Policy and Enforcement	$4,000
V1	Seal Manholes (LTS)	$250 per manhole
V2	Residential Vent Carbon Filter	$60 per vent
V3	H_2S Monitor (LTS)	$4,000
V4	Seal Aeration Basins (LTS)	$50,000
P2	Regular Sewer Cleaning Program	$6 per linear foot of pipe
L1	pH Control	$50,000

VI. Recommended Long Term Projects

Projects that will take more than three months to implement are shown in Table 2. Proposed projects are arranged in the recommended order of implementation. BMSC should proceed with project implementation until odor complaints cease.

Table 2: Recommended Long Term Odor Control Projects

Project Designation	Project Description	Estimated Implementation Cost
P3	Demolish Septic Tanks and Manholes at Lift Stations	$200,000
P4	Redesign Lift Stations	$500,000
P5	Collection System Capacity Evaluation	$150,000
V5	Wet Scrubber at WRF (LTS)	$300,000
L2	Preventive Nitrate Addition	$45,000
L3	Nitrate Addition for Removal	$45,000
V6	Carbon Units at Lift Station or Manhole (LTS)	$50,000
L4	Pilot Study	$150,000
V7	Wet Scrubber at Lift Station or Manhole	$110,000
V8	Ionization	$85,000

VII. Recommended Projects by Ascending Capital Cost

Table 3 lists recommended projects in order of ascending capital cost. It should be noted that projects with the lowest capital cost might have associated operational/maintenance costs.

Table 3: Recommended Projects by Ascending Capital Cost

Project Designation	Project Description	Estimated Implementation Cost
P2	Regular Sewer Cleaning Program	$6 /LF
V1	Seal Manholes	$250/manhole
V2	Residential Vent Carbon Filter	$60/vent
P1	Grease Trap Policy and Enforcement	$4,000
V3	H_2S Monitor	$4,000
G1	Community Feedback Website	$20,000
L2	Preventive Nitrate Addition	$45,000
L3	Nitrate Addition for Removal	$45,000
V6	Carbon Units at Lift Station or Manhole	$50,000
L1	pH Control	$50,000
V4	Seal Aeration Basins	$50,000
V8	Ionization	$85,000
V7	Wet Scrubber at Lift Station or Manhole	$110,000
L4	Pilot Study	$150,000
P5	Collection System Capacity Evaluation	$150,000
P3	Demolish Septic Tanks and Manholes at Lift Stations	$200,000
V5	Wet Scrubber at WRF	$300,000
P4	Redesign Lift Stations	$500,000

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APPENDIX A

LTS, INC. ODOR CONTROL STUDY

LTS, INC.
5102 SOUTH FERN COURT
CHANDLER, AZ 85248

Odor and Hydrogen Sulfide Monitoring Specialists Since 1991

TOWN OF CAREFREE

SEWAGE COLLECTION AND CONVEYANCE SYSTEM AND BOULDERS WATER RECLAMATION FACILITY

ODOR AND HYDROGEN SULFIDE

PHASE 2 STUDY

Performed for Black Mountain Sewer Company

Final Draft Report

July 28, 2004

Lamb Technical Services, Inc. 5102 South Fern Court, Chandler, AZ 85248 Phone 800-609-2635 / 480-802-2789 Fax 480-802-2790 elamblts@aol.com

EXECUTIVE SUMMARY

Background

On March 12, 2004, Black Mountain Sewer Company (BMSC) requested that Lamb Technical Services, Inc. (LTS) review the current condition, relevant to odor control of the sewage collection and conveyance system and the associated treatment plant located in The Boulders development in Carefree, AZ. The odor situation that BMSC inherited eighteen months ago has been an ongoing problem for the community for some period of time.

LTS and Joel Wade, Engineering Manager for BMSC, spent the morning reviewing the condition of each area, and a detailed explanation of past odor problems was presented to LTS. BMSC also discussed some of the short-term solutions that had been implemented to reduce or eliminate past odor emission problems, which the residents had been experiencing in many areas of Carefree. The Phase Two study is designed to perform a thorough odor evaluation by providing hydrogen sulfide (H_2S) data at multiple sewer line, fenceline and in-plant locations and the associated risks of odor emissions from each location. LTS was also asked to recommend any further action that Black Mountain Sewer Company may implement to further reduce the odor emissions from the treatment facility and its associated collection lines.

Phase 2 Data Review

Collection Lines and Pump Stations

During Phase 1, LTS visited the Commercial Pump Station off Tom Darlington Way, and the Carefree Inn Estates (CEI) lift station on Carefree Drive. LTS also visited a number of collection line locations that had been odor sources in the past including the Staghorn Drive area and the Boulder and Quartzite Drive area. Based on the initial review, fifteen locations were identified and evaluated for hydrogen sulfide and odor emissions, and one location was evaluated for ammonia emissions. Additionally, low-level hydrogen sulfide fenceline monitors were installed at the four sides of the wastewater treatment facility as well as one on the wall northeast of the CIE lift station. All of the locations were monitored in two five-day periods. During testing, four of the hydrogen sulfide monitors failed -- one at the headworks, one in the influent channel, and one at the southeast plant fenceline location during the first week of testing; and the second week of testing, one meter failed at the Century and Boulder Drive force main discharge location. Two of the meters were owned by BMSC and two were owned or rented by LTS. The graphs for the first two collection line locations can be seen with no hydrogen sulfide values and the meter constantly reading zero. One fenceline monitor did not record data on the southwest corner of the treatment facility.

During the second week of testing only one meter failed to operate properly, and no data were recorded at the Century and Boulder Drive location due to the failed meter. Repeat testing over the two-week period rendered the missing data irrelevant, as each location had at least five days of data collected at each location, which provided adequate information to determine what was needed for better odor control at the wastewater treatment plant and within the collection lines and pump stations.

Collection Lines and Pump Stations, Continued

The pump stations and the collection lines were found to have relatively high sulfides at all of the force main discharge locations, and at the influent of the treatment facility. This indicates that the sewage is quite septic due to the retention time in the force mains and the high wastewater temperatures.

Two of the smaller gravity line locations were found to be without flow in the summer: one test location was approximately ¼ mile upstream of the treatment plant on Quartz Drive, and the other was at the end of a Staghorn Drive. Without flow, these two locations had very low concentrations of hydrogen sulfide and no positive pressures. These two locations did not appear to be a significant source of odors during the summer. These conditions could be different with increased flow in the winter when more residents are in Arizona. This area should be evaluated again in the winter months to determine if the conditions within the gravity lines create an odor source that is not found in the summer months.

The gravity line test data on Staghorn Drive, and upstream on Boulder Drive determined that these locations were low-risk locations for odor emissions, and do not generally pose much of an odor emission problem in the summer. The hydrogen sulfide concentrations were always under 1 PPM and readings with the more accurate Jerome 631X were always under 0.15 PPM. Even though these locations are generally not a problem, unusual events such as blockages could make these locations vent odors into the ambient air, or additional flow in the winter could cause the same condition.

The main odor and sulfide producers are the wetwell/force main locations. This is typical in many wastewater systems and has been a problem for many locations across Arizona. Unfortunately, with the type of terrain found at the Boulders, force mains are required to move the sewage over the high points in the area. There are a number of treatment options to control hydrogen sulfide generation and odor releases in these types of systems, and most of them work with relatively good results. The product that BMSC is using is magnesium hydroxide, (brand name Thioguard). The product is designed to increase the pH of the wastewater, which keeps the sulfides in solution as long as the pH is above 8.5. It also provides some oxygen to the wastewater to oxidize the sulfides. The high pH that the product provides keeps the sulfides in solution and makes it difficult for them to be released into the headspace of the collection lines and at the wetwells. The two locations where the product provides the greatest benefit from chemical treatment are the CIE force main discharge location at Century and Boulder Drive, and at Boulder and Quartz Drive. Both of these locations are just before the sewer treatment facility and have had significant odor emissions in the past.

The use of the magnesium hydroxide at the Commercial lift station (that runs through the CIE lift station) is providing between 50% and 90% reduction in hydrogen sulfide emissions at the Commercial lift station wetwell and the force main discharge locations. The product is performing well at the feed rate BMSC is using, but the pH is relatively high at 9.0. The operators should continue to add the product to reduce the hydrogen sulfide emissions as much as possible for corrosion and odor control, but a chemical feed reduction is advisable to allow the system to operate at a pH between 8.4 and 8.6. This will have less of an impact on the wastewater treatment plant and still provide similar odor and hydrogen sulfide control.

Collection Lines and Pump Stations, Continued

Liquid wastewater analysis throughout the wastewater system indicated that the other parameters were typical, although sulfides in solutions were relatively high, peaking at 3.9 mg./lit at the wetwell of the Commercial lift station and up to 12.0 mg./lit at the discharge points. Normal ranges of sulfides in solution for wetwells are typically under 1.5 mg./liter, and a goal for force main discharge points would be under 5.0 mg./liter.

Even with these significant reductions in hydrogen sulfide concentrations due to the Thioguard, hydrogen sulfide levels remain very high in some locations. Additional measures probably will have to be taken to further control the odorous emissions, and are discussed in more detail later in the report.

Commercial Lift Station

Within the Commercial lift station wetwell, the hydrogen sulfide concentrations were relatively high, averaging 5-20 PPM with peaks of 32 PPM without the addition of magnesium hydroxide. The concentrations dropped to an average of under 2 PPM for the first week with chemical addition, but climbed as wastewater temperatures increased, with averages the second week ranging from 5 PPM to 20 PPM, with one unusual peak that was up to 102 PPM. This high peak most likely was due to a low pH cleaning product being discharged into the sewer and driving the hydrogen sulfide out of solution and into the headspace of the wetwell. Since the concentrations are up to 100 PPM in the wetwell, the hydrogen sulfide concentrations will need to be contained with a tightly sealed cover. The continued use of magnesium hydroxide to keep hydrogen sulfide levels and internal corrosion rates to a minimum is recommended. The location does not exhibit any positive pressures, but under the right ambient conditions, odors could be emitted from this location if not properly sealed. If odor complaints are received at this location, and sealing the wetwell is impractical, the installation of a small passive carbon filter could be utilized to collect and treat the odorous gas prior to being vented into the ambient air. If odor complaints continue after the installation of the passive carbon adsorber, a fan could be added to the carbon vessel to increase the negative pressure in the wetwell to keep odors from easily escaping into the ambient air. A packed tower odor scrubber or a biofilter can't be used at this location due to the space restraints at the lift station.

CIE Lift Station

At the CIE lift station, most of the past effort has been to seal all the possible venting locations to control the hydrogen sulfide and odor releases. Based on the data and the multiple site visits, this approach seems to be working quite well, although concentrations of 0.020 PPM were recorded at the fenceline on the Odalog monitors. These higher concentrations occurred at the hottest part of the day, each day during the first week of testing. After discussing the data with the manufacturer, the readings probably are not accurate as the instrument is unable to compensate for ambient temperatures above 110 degrees Fahrenheit. During the second week of testing a newer version analyzer was used at this location, and recorded only one short-term event. This one event is at the low detection level of the instrument and is also questionable. Handheld monitoring using a slightly more sensitive analyzer (Jerome 631X H2S Analyzer, accuracy of 0.003 PPM) did not record any elevated hydrogen sulfide concentrations anywhere around the CIE lift station.

CIE Lift Station, Continued

Although no odors were recorded around the lift station during any of the site visits, odors could be escaping from the pickholes upstream of the lift station.

Hydrogen sulfide concentrations within the collection lines and the CIE lift station wetwell were moderate to high. Four locations were monitored at the CIE lift station: one on the local gravity line, one at the force main discharge, and two on the wetwell structures within the lift station. The wetwell locations were relatively low in hydrogen sulfide concentrations, with levels up to 8 PPM. The incoming local gravity line, as mentioned earlier, had moderately high concentrations in the headspace, with peaks up to 21 PPM. The highest location around the CIE lift station was at the force main discharge. Peaks of 101 PPM were seen at this location without chemical addition, and 24 PPM with chemical addition. The magnesium hydroxide chemical feed site at the Commercial lift station is working well, and is providing a 75% reduction at the force main discharge at the CIE lift station with chemical addition. It should be noted that none of the concentrations recorded at either of these lift stations are unusual for a force main system.

Hydrogen sulfide concentrations were monitored in the local gravity line and recorded peaks of 21 PPM. Concentrations over 10 PPM are relatively high for an upstream gravity line. This area could be a candidate for chemical treatment to reduce the hydrogen sulfide concentrations going to the CIE lift station. If odors are still a problem in the area, Black Mountain Sewer Company (BMSC) may need to seal the manhole covers upstream of the lift station in the local gravity line to prevent any odors from escaping into the ambient air through the pickholes. A slight positive pressure (0.01 in./WC) was found around the CIE lift station collection lines. Under the right conditions, odors could be released through the pickholes with positive pressures of 0.01 in./WC. Sealing the pickholes on all of the manholes in the area is recommended first. If that proves inadequate, a small carbon adsorber with a fan could be used to provide a negative pressure on the upstream collection lines. As long as a chemical treatment program is in place, corrosion should not be a significant issue with sealed manholes.

Containing the odors within the sewer system as much as possible is the preferred approach for this area. If the odors cannot be contained adequately, an odor control approach similar to the Commercial lift station could be used at the CIE lift station. An odor control system is already on site and could be utilized if containment is not feasible; but carbon would probably be a better product at this location as the odor removal system (Peacemaker) does emit a slight chlorine odor and is not designed to treat amine odors that could be present at this location. LTS recommends that in the event that an odor control system is needed, the media to use would be carbon.

Force Main Discharge Locations

At the two locations that the force mains discharge into the gravity lines, just upstream of the wastewater facility, both locations have extremely high hydrogen sulfide concentrations. The force main discharge location at Quartz and Boulder Drive had concentrations up to 700 PPM, and the Century and Boulder location had concentrations over 100 PPM. Both locations also had positive pressures that tend to drive the odors and hydrogen sulfide concentrations out through the manhole cover pickholes.

The solution that BMSC has been using for the Century and Boulder location is installing a carbon insert for odor control. If the media is changed regularly, this insert will reduce the concentrations that are emitted out of the pickhole to under 1.0 PPM. Levels below 1.0 PPM would be considered low compared to most sewer systems in Arizona. This is probably the best solution for this location, although an insert that could hold a slightly deeper bed of carbon might be considered as a replacement to the unit that is now installed to give improved odor control and a longer life for the carbon.

At the Quartz and Boulder Drive location, the odor and hydrogen sulfide concentrations are being contained using a sealing manhole cover. This is preventing virtually all of the odors from being released into the ambient air, but the downside to this approach is that the location has significant positive pressures, up to 0.04 in./WC, and sealing the covers will force the air out to some other location, like resident vent stacks. Also, sealing the covers will create high corrosion rates due to the turbulence and high sulfide levels, and trying to contain all of the hydrogen sulfide releases. Even when Thioguard is added upstream, the turbulence can still strip the hydrogen sulfide out of solution. The Thioguard is working fairly well in reducing the releases at this location with approximately a 50% reduction, but with initial concentrations over 700 PPM, a 50% reduction is of little help in controlling the risk of odor emissions. With the significant positive pressures at this location, it is likely that these odors will be driven out of the surrounding homes' vent stacks. Due to this possibility, a meter was placed in a home vent stack just upstream of the Boulder and Quartz force main discharge location to determine if any odor was being emitted out of the local residences vent stacks. Concentrations of 5 PPM were recorded at the vent stack when no Thioguard was being added to the system. The levels dropped to under 1 PPM when the Thioguard was being added and no concentrations were recorded after the first day or two, but even with low concentrations of less than 1 PPM, they could still be an added odor source for the area. When the Thioguard feed pump was not operating, values up to 5 PPM were recorded out of the surrounding homes vent stacks. These concentrations could be a significant odor for the entire area.

A redesign at this structure is recommended if turbulence could be reduced. Reduced turbulence would keep the sulfides in solution to be treated by the waste treatment facility. Even with reduced concentrations due to less turbulence a fan generating negative pressures will still most likely be needed at the Quartz and Boulder Drive location to prevent odors from being forced out the local vent stacks.

Force Main Discharge Locations, Continued

There is also an additional pump station that was not evaluated called the Indian Rock Pump Station. This pump station discharges into the Quartz and Boulder location just upstream from the wastewater plant. Chemical feed could also be considered in this location if required.

Wastewater Treatment Facility

Six locations were tested at the wastewater treatment facility, the main influent line, the Parshall Flume structure, the headworks building, the splitter box, the old influent box, and the aeration basins influent. Most of the locations had relatively high hydrogen sulfide concentrations, over 10 PPM.

The influent locations, Parshall Flume, and headworks locations are seeing concentrations that are being carried downstream from the Boulder and Quartz Drive location. Slightly reduced concentrations were recorded within the treatment facility. The Thioguard is still helping at the plant, but the levels at the three in-plant locations were still significant. Additional hydrogen sulfide is being released at the splitter box and at the influent to the aeration basins and this is not related to the releases upstream at Boulder & Quartz Drive. The old splitter box was also evaluated and had low concentrations of hydrogen sulfide, and if sealed properly this location is really not a significant odor source.

Concentrations up to 120 PPM were seen at the influent location, but dropped to under 25 PPM within the plant. Still, with concentrations in the 10-25 PPM range, all of the locations will need to be treated. Currently the only locations that are receiving treatment are at the headworks, the splitter box and the influent to the aeration basins. Even though these locations are being treated with the existing odor control system (carbon adsorber), the influent to the aeration basins has significant gaps in the covers. This makes it difficult to contain the odors for treatment. LTS recommends that this area's covers be better sealed, and additional airflow is also recommended to increase the negative pressure on the basins to prevent any odors from escaping into the ambient air.

The Parshall flume and the influent line are currently not being treated. LTS recommends air treatment at these locations by extracting the odorous gas out of the structures with fiberglass ductwork and a fan, and treating the odors with an improved odor control system.

The headworks at the facility should be the focus of improved odor control. The concentrations in the room were up to 13 PPM and averaged over 4 PPM. This is not a significant amount of hydrogen sulfide, but other compounds that are odorous were recorded at this location.. Concentrations of 1-5 PPM ammonia were recorded in the headworks in addition to the hydrogen sulfide. An improved odor control system would improve the negative pressure in the headworks and keep the odors from occasionally escaping into the ambient air

Wastewater Treatment Facility, Continued

The carbon adsorber odor control system was tested for removal efficiencies, and is performing well while treating the odors from the three locations it is extracting air from. Testing of the carbon adsorber indicated that the system is working to specifications with the new carbon that was installed earlier in the year. LTS never recorded any outlet results over 0.003 PPM out of the stack of the carbon adsorber during the two-hour test.

Even though the outlet values were very low, the negative pressure was almost zero at each of the locations from which the carbon adsorber is collecting odorous gas. Without the proper amount of negative pressure (> -0.02 in./WC) at the odorous locations in the plant, there is a risk that, under the right ambient conditions, significant odors could be released in to the ambient air.

The Odalog hydrogen sulfide monitors placed at the fenceline did not indicate that any significant amounts of hydrogen sulfide were being released into the ambient air; but testing with the Jerome 631X indicated that concentrations up to 0.024 PPM were occasionally being released at the fenceline. When the Porta-John was replaced at the facility, the spikes increased to over 0.030 PPM for the short duration they were on site. The County's limit is an average of 0.030 PPM for 30 minutes at the fenceline. This is a relatively loose specification, and it is recommended that BMSC have a goal of keeping the fenceline concentrations under 0.008 PPM in the future to prevent odor complaints. The reason LTS recommends that a target of 0.008 PPM be implemented is that based on a 1979 study performed by the California Air Resources Board, which found that 87% of people could detect a rotten egg odor from hydrogen sulfide at 0.008 PPM. It also stated that at 0.040 PPM, or five times the odor threshold, most people considered the odor a nuisance. This report is how the 0.030 PPM standard was derived in California and in Maricopa County.

Current fenceline odors at the facility are most likely from fugitive emissions due to a lack of negative pressures, mostly on the aeration basin influent areas. Other reduced sulfur odors are also typically found as part of the odor emissions and common in most wastewater treatment processes. Low level amines were also recorded at the headworks.

Other Odor Sources

Other odor sources were found during the study that could have occasional impacts on the locations, such as Porta-Johns located at the treatment facility and at the CIE lift stations. Southwest Gas was also replacing some of the gas mains in the area, presumably because of gas leaks. Natural gas is odorless, so the gas companies add an odorant at the distribution center, which is also a reduced sulfur compound called mercaptan. Mercaptans have a similar smell to hydrogen sulfide, and can often be interpreted as a sewer odor by some people. Other odors were also noted at the Commercial Lift Station that is clearly being emitted from the local restaurant grease traps. These emissions can often be very odorous, and also contain a large percentage of hydrogen sulfide. It is common for many people to interpret the grease traps odors as a sewer odor as they are very similar in nature and smell.

Recommendations

The short-term improvements that Black Mountain Sewer Company made as part of the Phase 1 review were correct, but to completely eliminate the odors 99% of the time at the wastewater treatment facility, a larger odor scrubber is recommended, in the range of 5,000 -10,000 CFM, with an additional stage for ammonia removal, and a final-stage carbon polisher. Airflows with a 5,000 -10,000 CFM system would increase the negative pressure in the headworks, splitter box and aeration basins, and to provide negative pressures at the Parshall Flume and in the influent line, which is not being addressed with the current carbon adsorber.

It is also recommended that the discharge location at Quartz and Boulder Drive be redesigned to reduce turbulence at this location. This could be part of the odor control improvement project at the plant, by creating a wetwell structure just to the North on the easement. The new odor control system would draw from this location along with the headworks, Parshall Flume, splitter box and aeration basins. The new collection structure would be designed to focus on a reduction in liquid turbulence and air extraction.

Black Mountain Sewer Company should continue to add Thioguard at the Commercial lift station for hydrogen sulfide control, and may consider adding an upstream chemical feed site for the gravity portion of the CIE lift station. At the Commercial lift station, the only improvement recommended at this location is to continue sealing the wetwell 100% to contain any odors that may be present in the wetwell.

LTS is recommending that a packed tower odor scrubber be installed with a 16" to 20" duct running out to a new junction structure to create a negative pressure at this location. The odors would be treated with a three-stage packed bed odor control system located at the treatment facility, and a carbon follower. The existing unit may be used as part of the polishing stage after the packed tower odor scrubber. An additional carbon unit would be required to handle the additional airflow.

Also, at the wastewater treatment facility, a continuous hydrogen sulfide monitor is also recommended to monitor the operation of the new odor control system and to alert the operators of any potential scrubber problems prior to receiving odor complaints. The only system on the market for this application that can read part-per-billion concentrations is the Sycamore Technologies system. This option should be evaluated to see if it would assist the facility in catching odor emission problems before they get to the surrounding community.

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The Boulders in Carefr Liquid Sewage Data

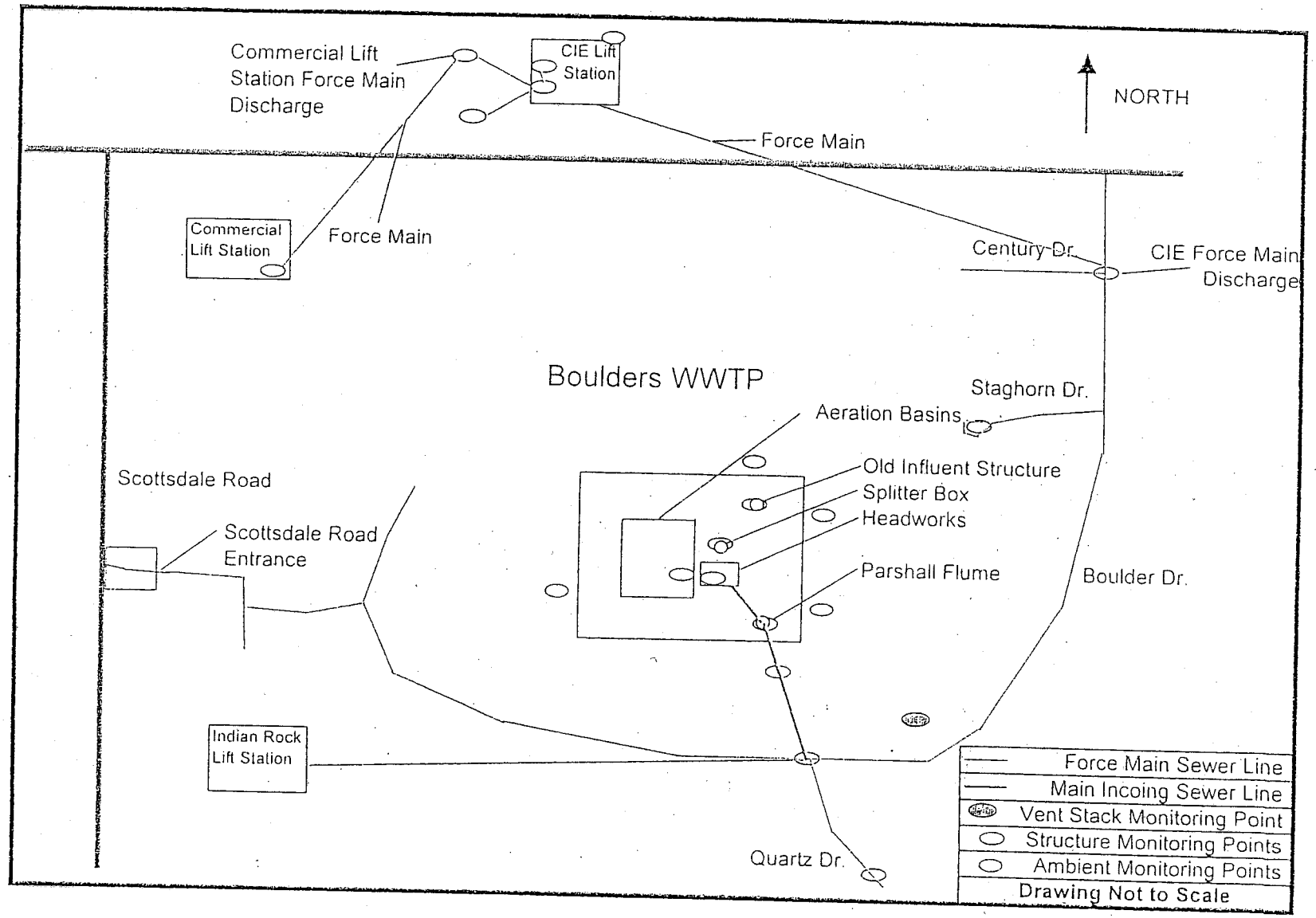
Test Sites

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/2/2004	9:30 AM	>50	8.17	-327	1.86	29.6	4.2	4.20	0.03	
Century & Boulder Dr.	6/2/2004	10:00 AM	26	8.41	-351	0.49	32.2	6.2	6.2	0.01	
Plant Influent	6/2/2004	10:30 AM	>50	7.65	-380	0.17	31.3	5.2	5.2	0.01	
Upstream Quartz Dr.	6/2/2004	11:00 AM	0.008	No Flow							
Staghorne Dr.	6/2/2004	11:30 AM	0.092								
Commercial Lift Station	6/2/2004	12:00 PM	14	7.87	-225	5.78	32.4	1.6	1.4	0.00	
Commercial Lift Station FM Discharge at CIE	6/2/2004	12:30 PM	8.0	7.43	-242	3.00	34.9	0.6	0.6	0.01	
CIE Incoming Gravity Line	6/2/2004	1:00 PM	0.089	7.87	-277	4.03	34.0	2.0	1.8	0.01	0 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/7/2004	8:00 AM	>50	8.84	-306	4.50	29.9	7.0	7.00	0.05	
Century & Boulder Dr.	6/7/2004	8:30 AM	23	9.24	-310	2.92	30.8	7.0	6.5	0.01	
Plant Influent	6/7/2004	9:00 AM	20	9.01	-310	5.60	29.1	9.0	9.0	0.00	
Upstream Quartz Dr.	6/7/2004	9:30 AM	0.012	No Flow							
Staghorne Dr.	6/7/2004	10:00 AM	0.031								
Commercial Lift Station	6/7/2004	10:30 AM	2.2	8.93	-279	4.20	30.7	2.2	2.1	0.00	
Commercial Lift Station FM Discharge at CIE	6/7/2004	11:00 AM	4.0	8.80	-284	2.62	32.0	2.0	1.4	0.01	
CIE Incoming Gravity Line	6/7/2004	11:30 AM	0.022	8.06	-182	2.61	31.8	0.2	0.1	0.01	90 GPD

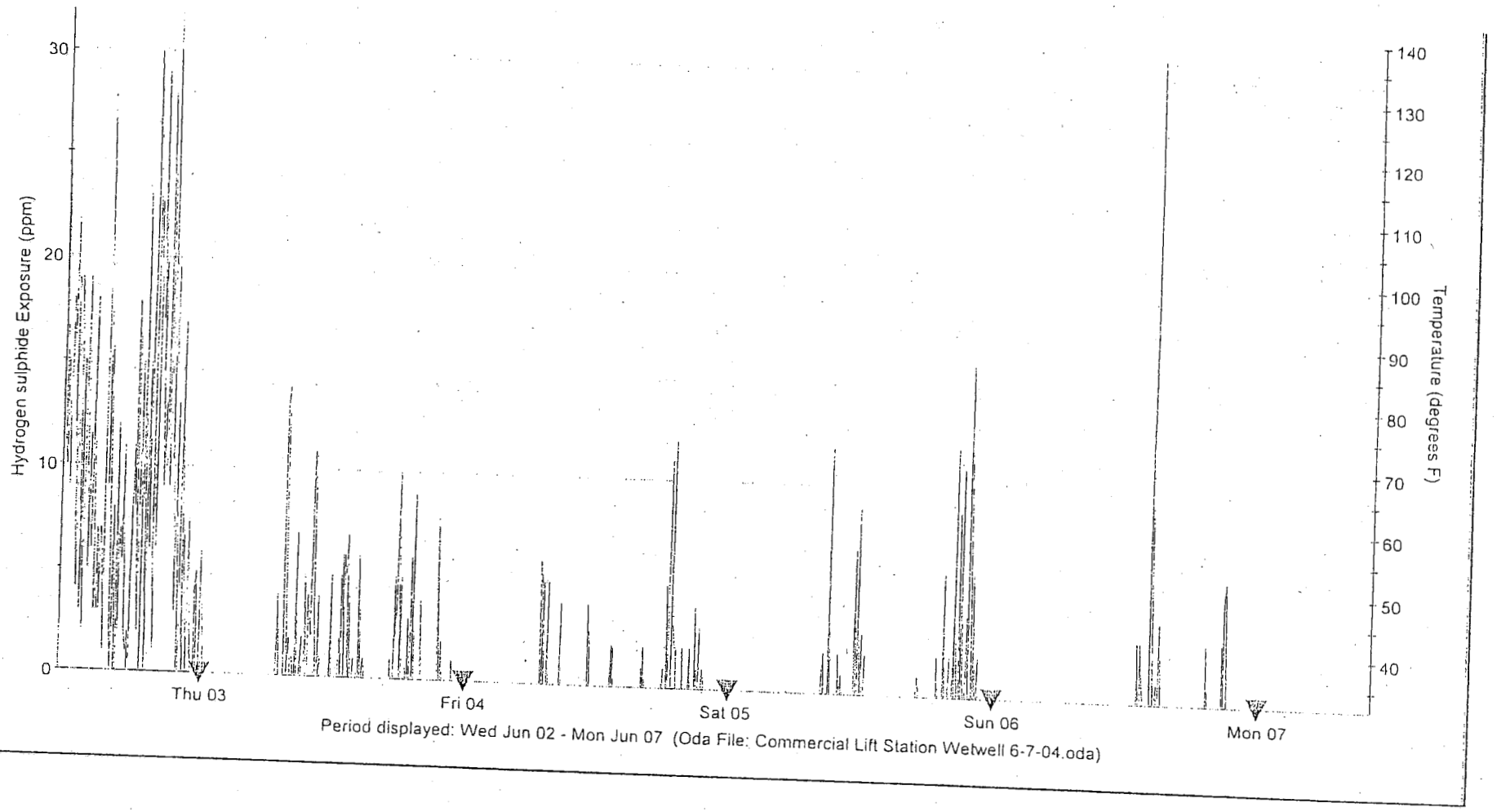
Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/9/2004	8:30 AM	>50	9.13	-307	5.72	28.3	12.0	12.0	0.03	
Century & Boulder Dr.	6/9/2004	9:00 AM	1.4	9.15	-246	4.80	29.2	7.0	6.5	0.00	
Plant Influent	6/9/2004	9:30 AM	>50	9.04	-309	4.32	28.7	12.0	12.0	0.005	
Upstream Quartz Dr.	6/9/2004	10:00 AM	0.004	No Flow							
Staghorne Dr.	6/9/2004	10:30 AM	0.004								
Commercial Lift Station	6/9/2004	11:00 AM	0.62	8.53	-300	2.40	29.0	3.6	3.2	0.00	
Commercial Lift Station FM Discharge at CIE	6/9/2004	11:30 AM	0.15	8.73	-299	5.40	30.3	2.7	2.5	0.00	
CIE Incoming Gravity Line	6/9/2004	12:00 PM	0.020	7.18	-257	2.52	31.0	1.1	1.1	0.00	90 GPD

Location Description	Date	Time	Airborne H2S in PPM	pH	ORP in mV	DO in PPM	Temperature in Deg. C	Total Sulfides in mg./lit.	Dissolved Sulfides in mg./lit.	Pressure in in./WC	Feed Rate in GPD
Boulder & Quartz Dr.	6/14/2004	7:30 AM	40	9.10	-300	5.07	29.3	10.8	10.8	0.01	
Century & Boulder Dr.	6/14/2004	8:00 AM	48	9.11	-270	4.51	29.5	8.3	8.3	0.005	
Plant Influent	6/14/2004	8:30 AM	30	9.00	-315	4.01	29.1	10.5	10.5	0.005	
Upstream Quartz Dr.	6/14/2004	9:00 AM	0.037	No Flow							
Staghorne Dr.	6/14/2004	9:30 AM	0.019								
Commercial Lift Station	6/14/2004	10:00 AM	6.0	8.65	-299	2.07	30.0	3.9	3.7	0.00	
Commercial Lift Station FM Discharge at CIE	6/14/2004	10:30 AM	16	8.81	-291	5.11	30.7	3.0	2.9	0.01	
CIE Incoming Gravity Line	6/14/2004	11:00 AM	13	7.25	-231	2.01	31.2	1.3	1.3	0.01	90 GPD

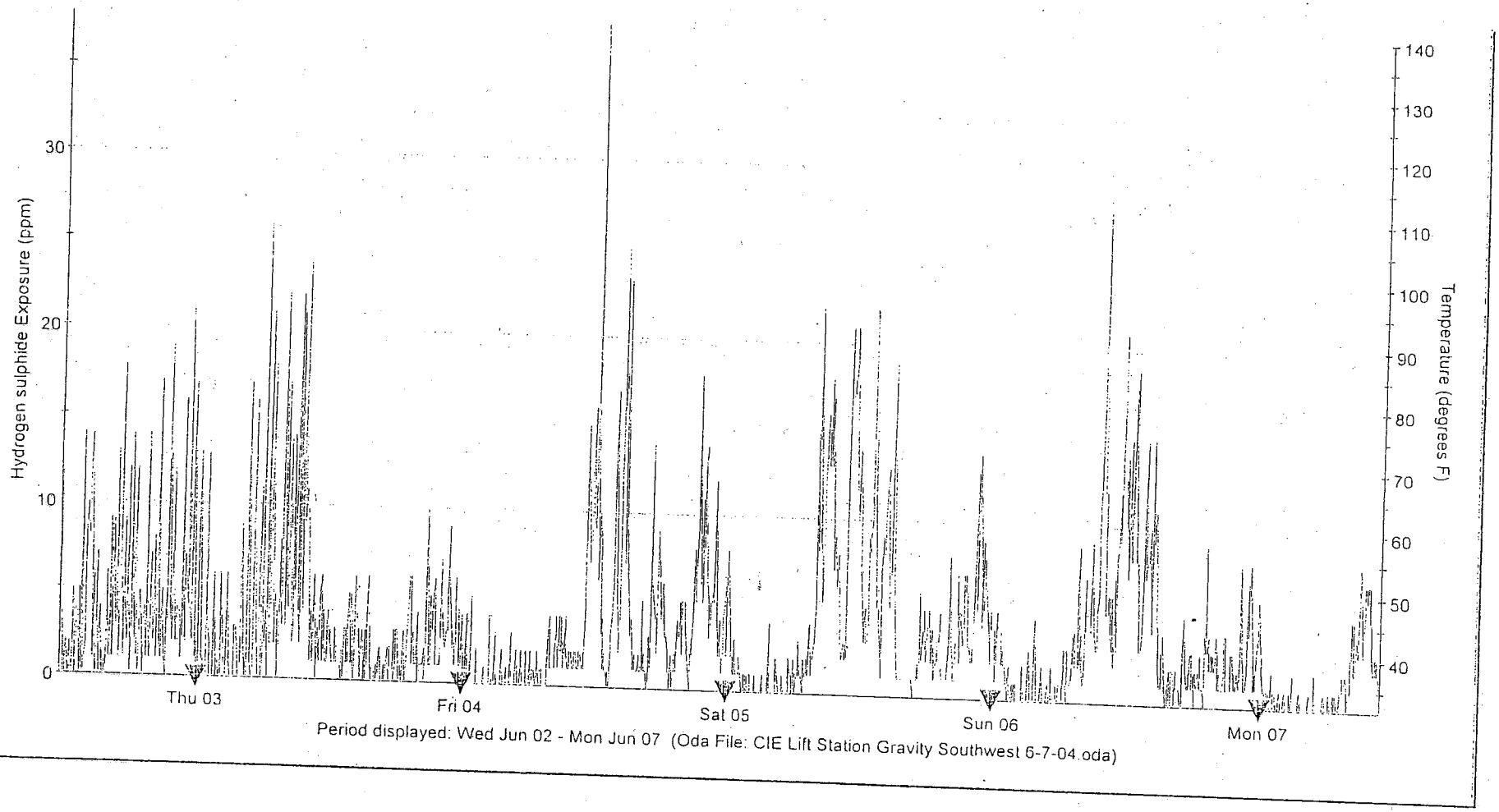


The Boulders WWTP Site Map

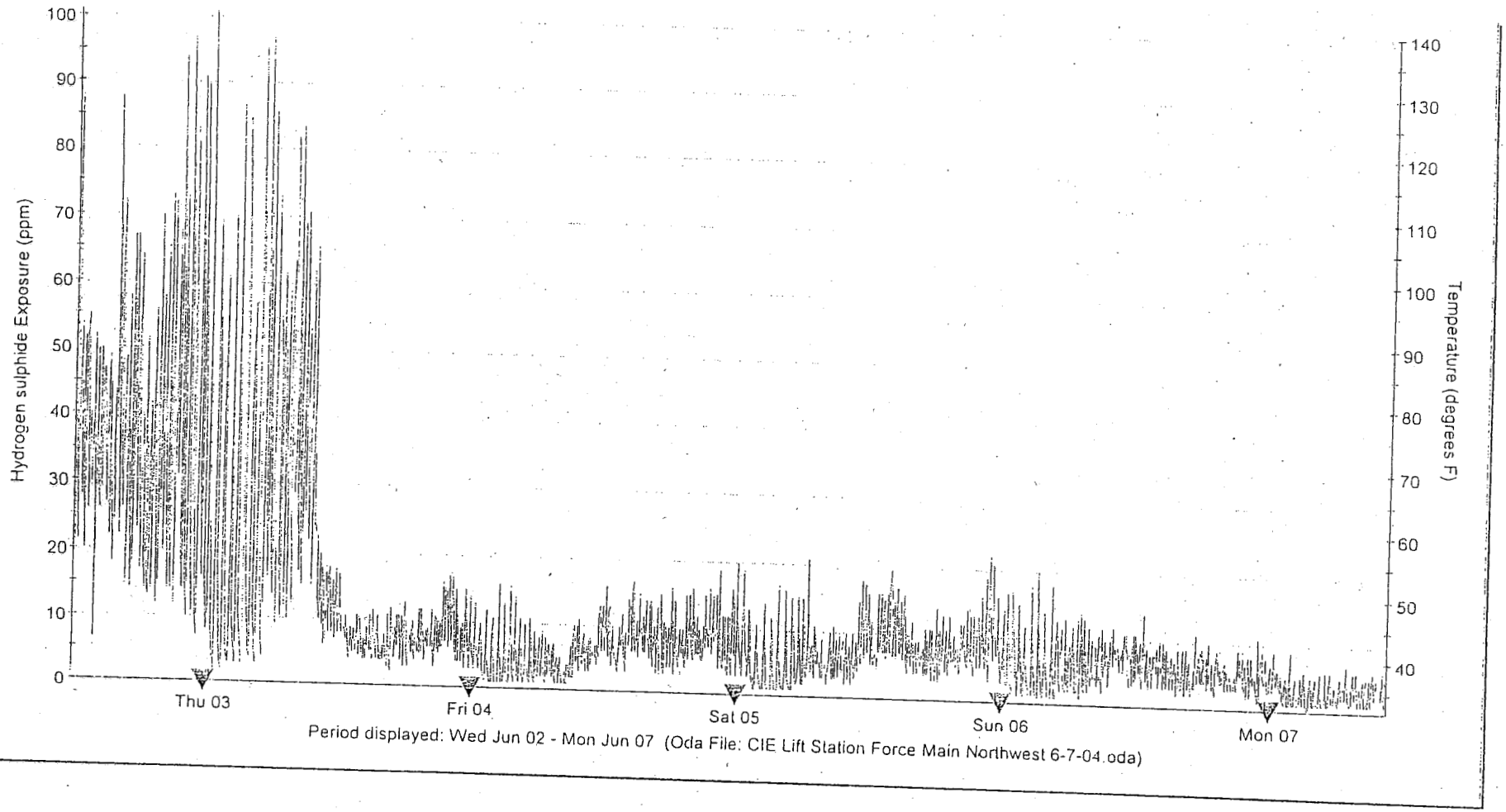
- Session: 1 (OdaLog: OL0504069)



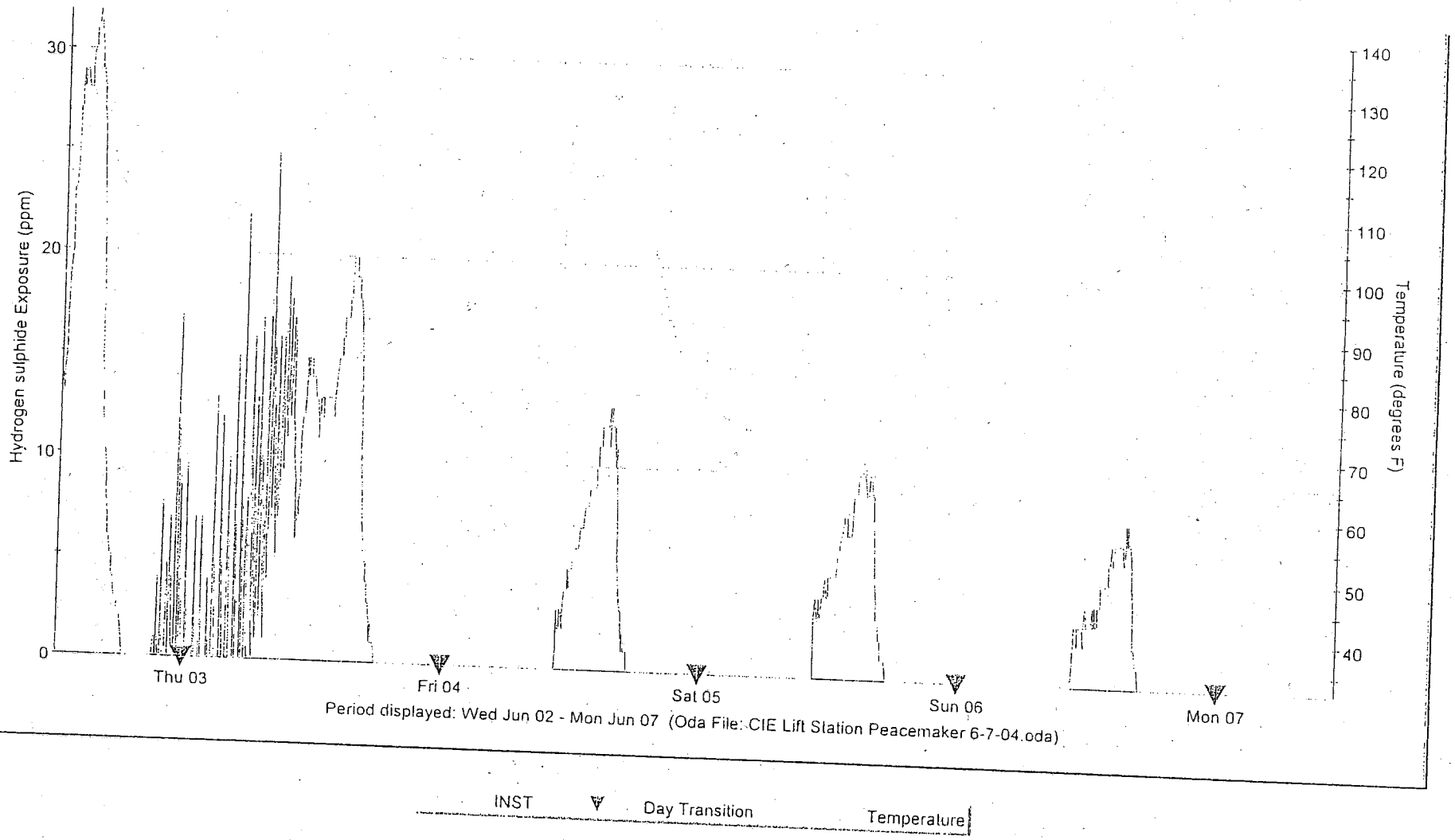
- Session: 1 (OdaLog: OL05123688)



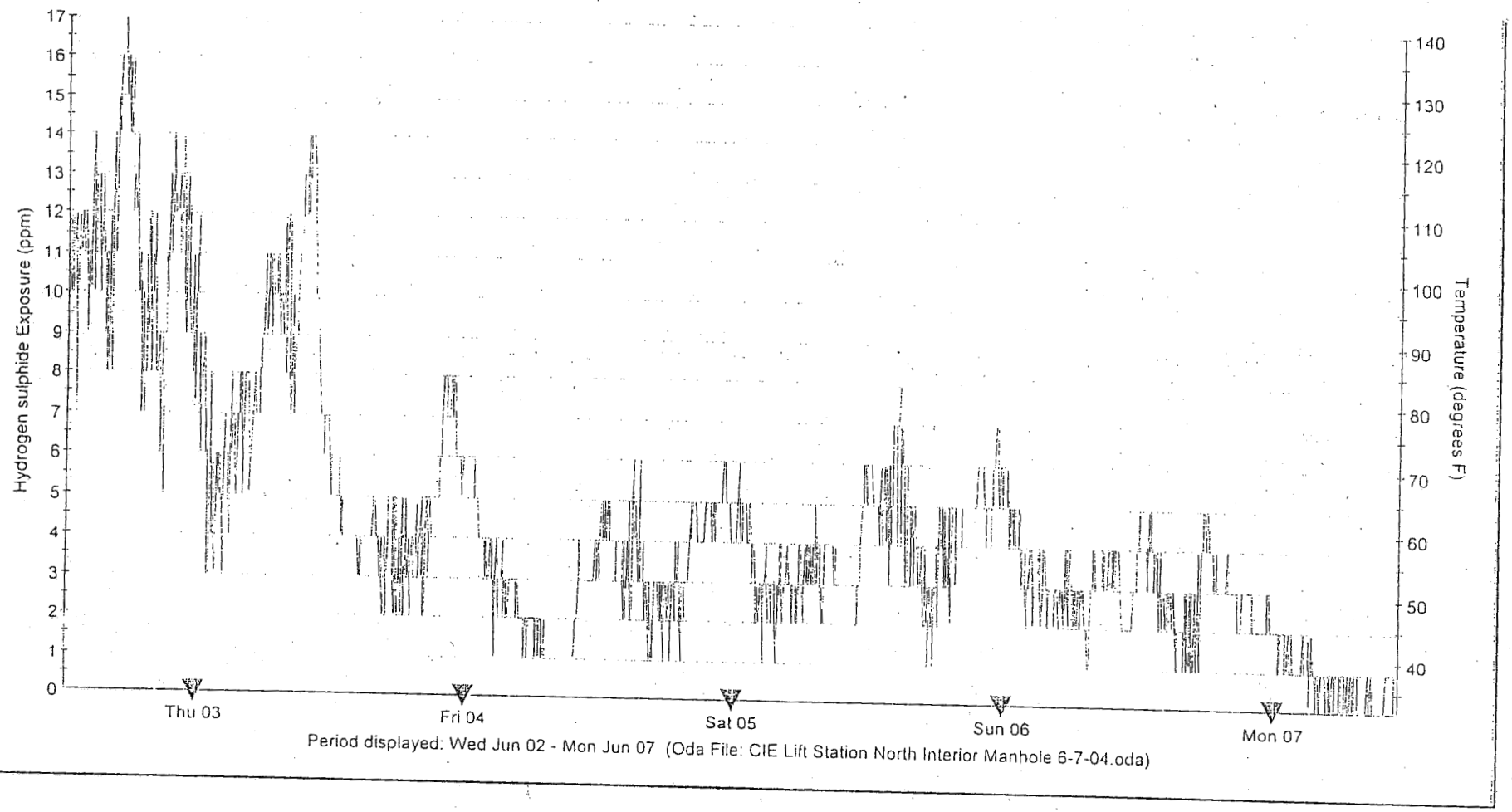
- Session: 1 (OdaLog: OL05113658)



- Session: 1 (OdaLog: OL0504068)

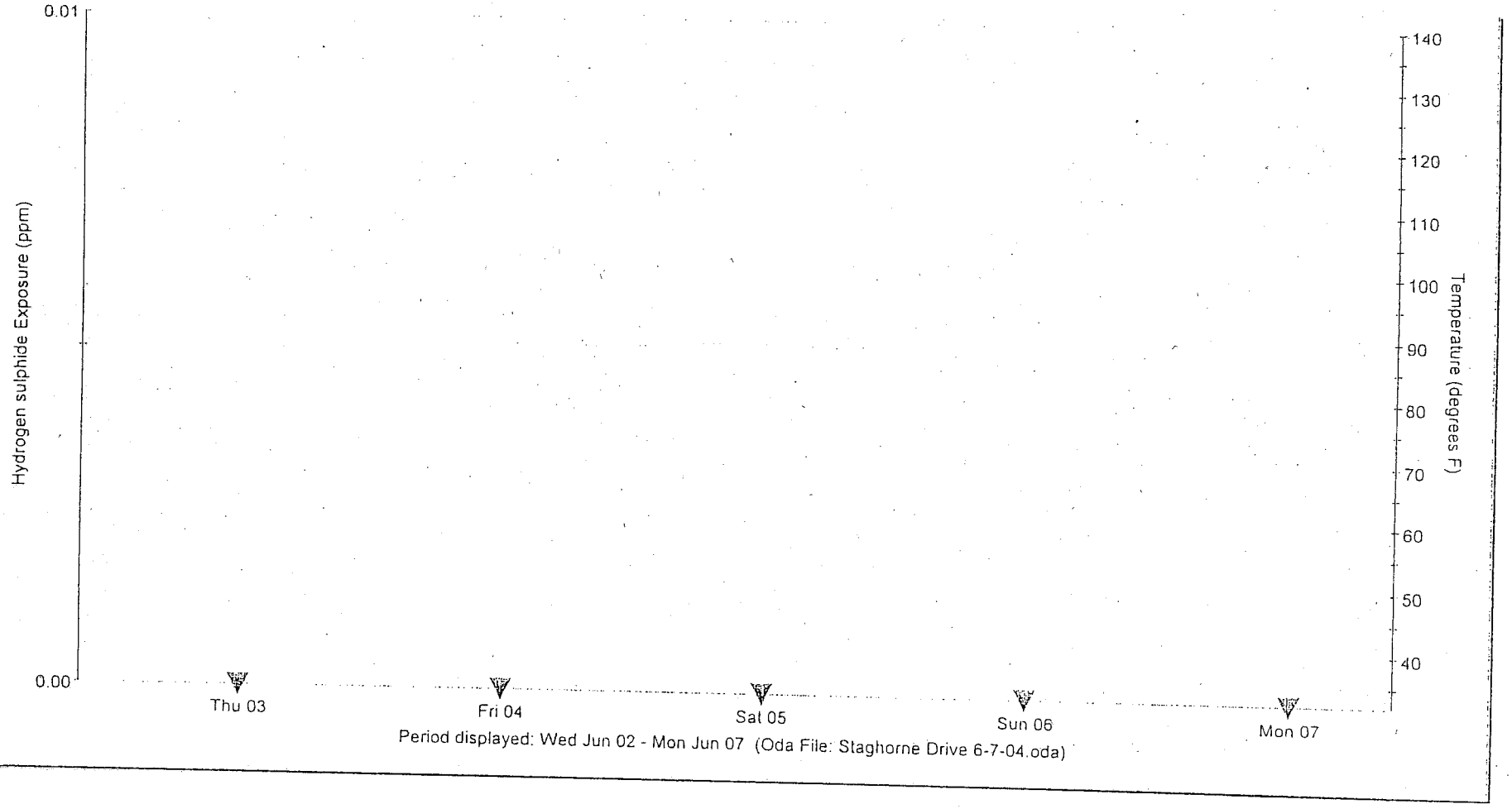


- Session: 1 (OdaLog: OL0504071)

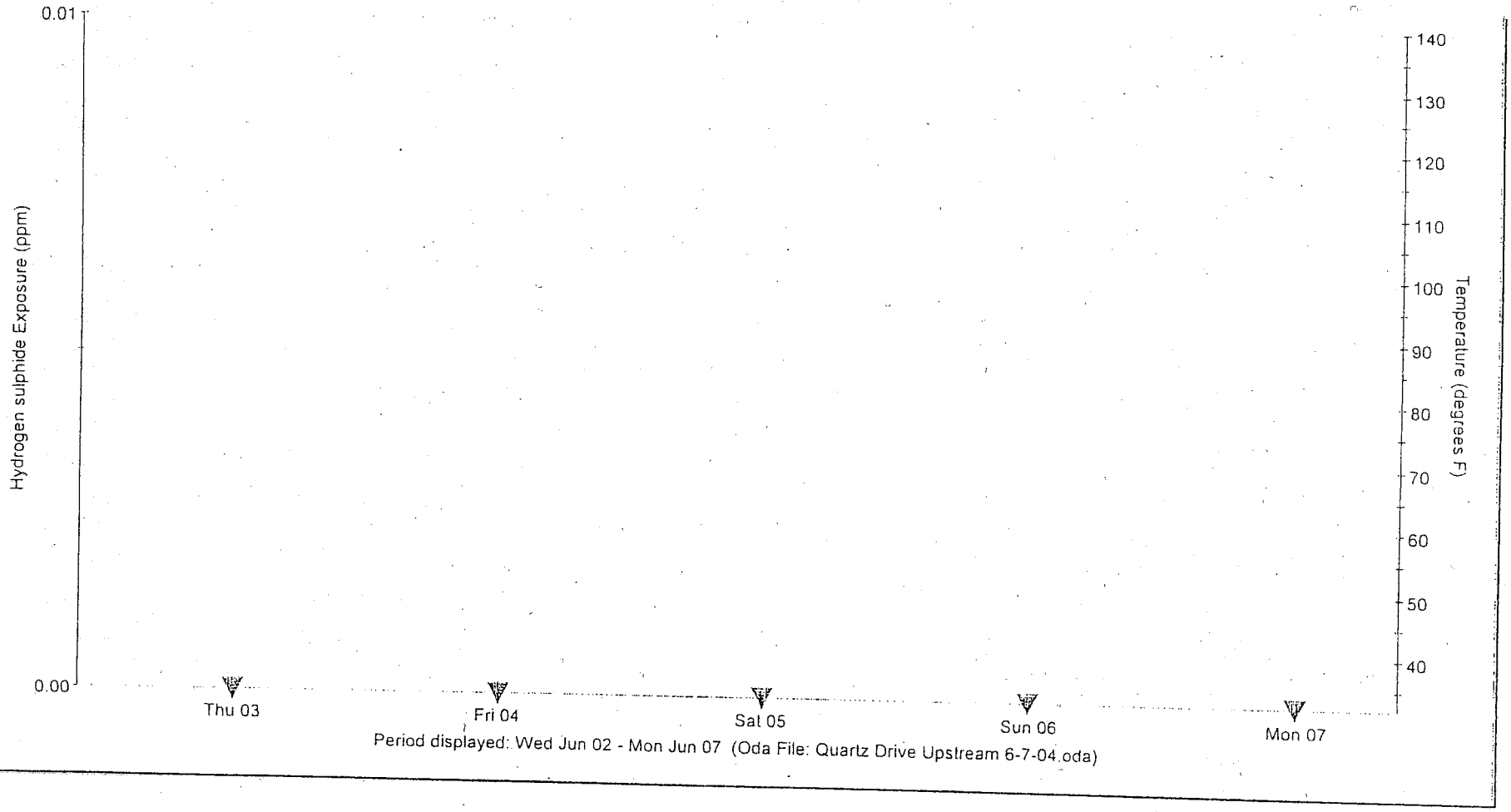


INST Day Transition Temperature

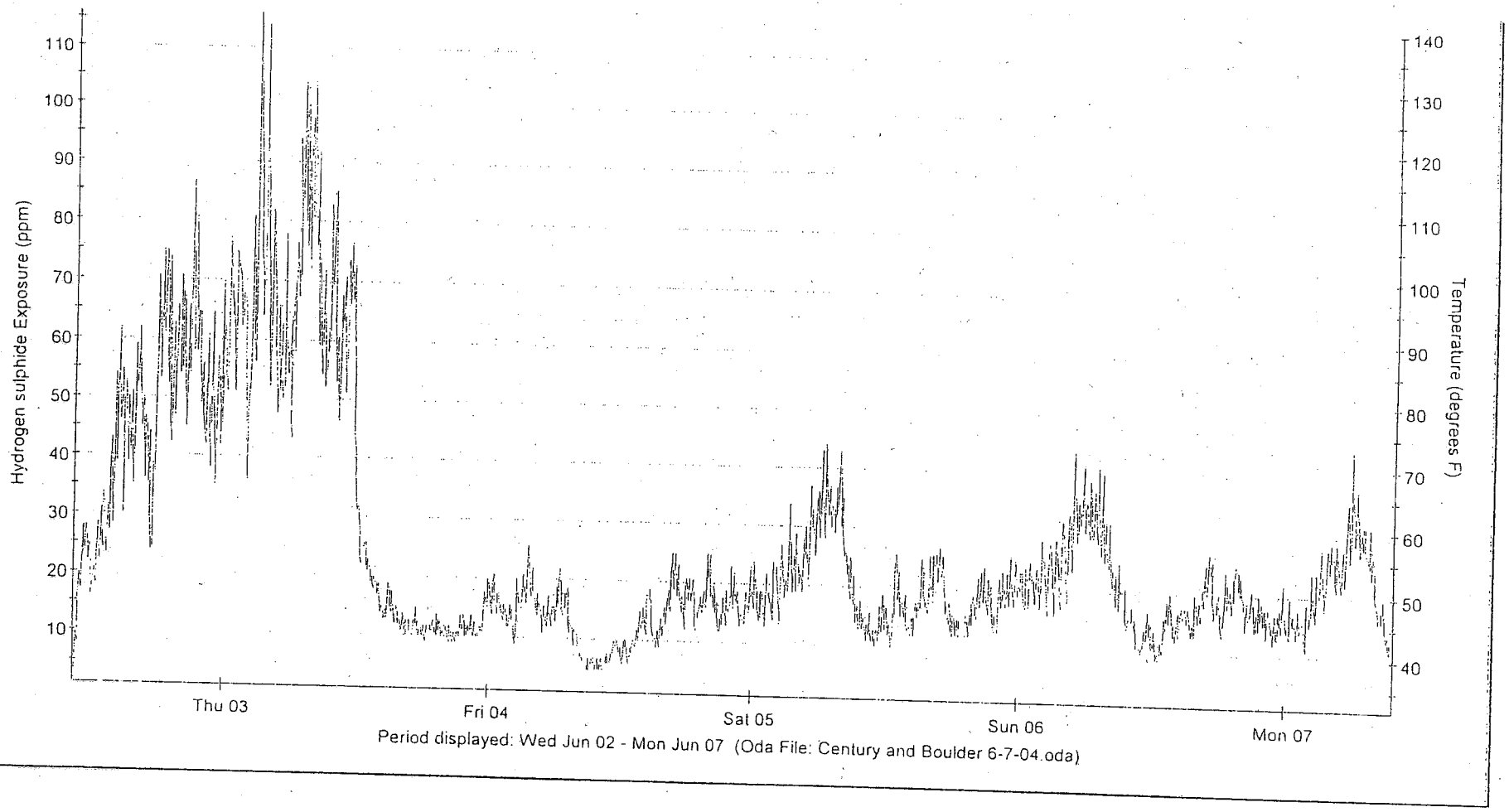
- Session: 1 (OdaLog: OL05011231)



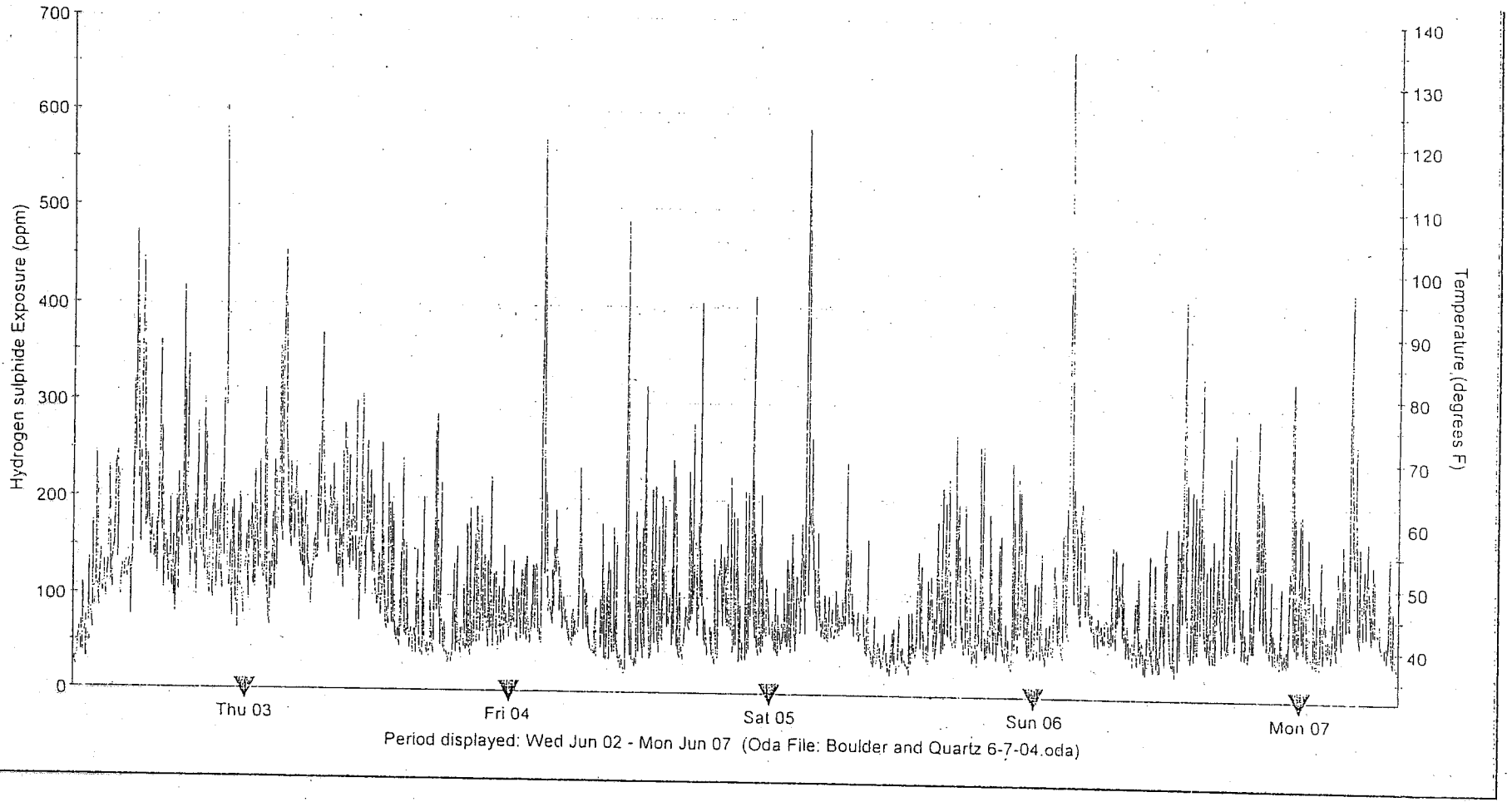
- Session: 1 (OdaLog: OL05110204)



- Session: 1 (OdaLog: OL45033818)

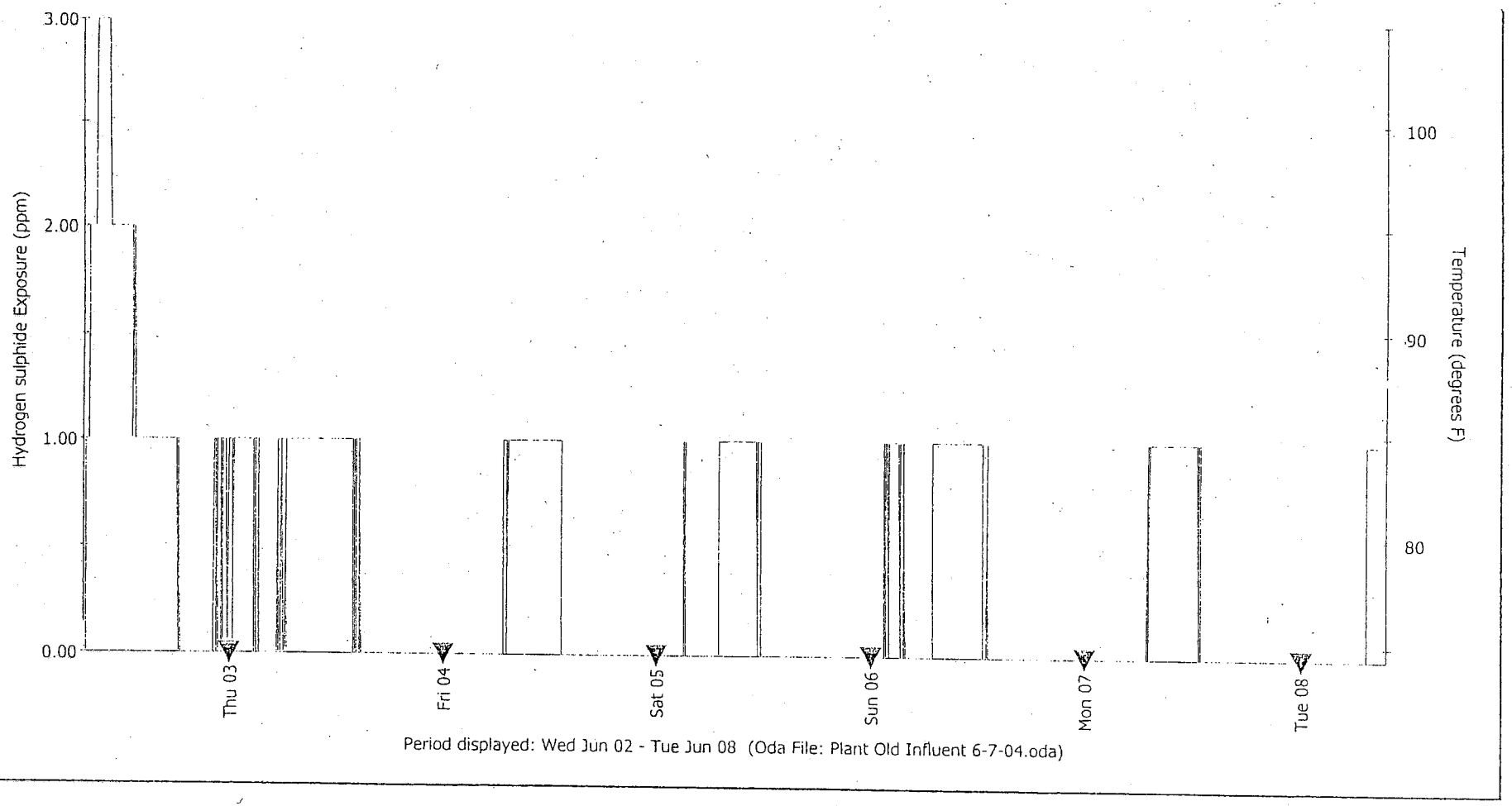


- Session: 1 (OdaLog: OL45033819)



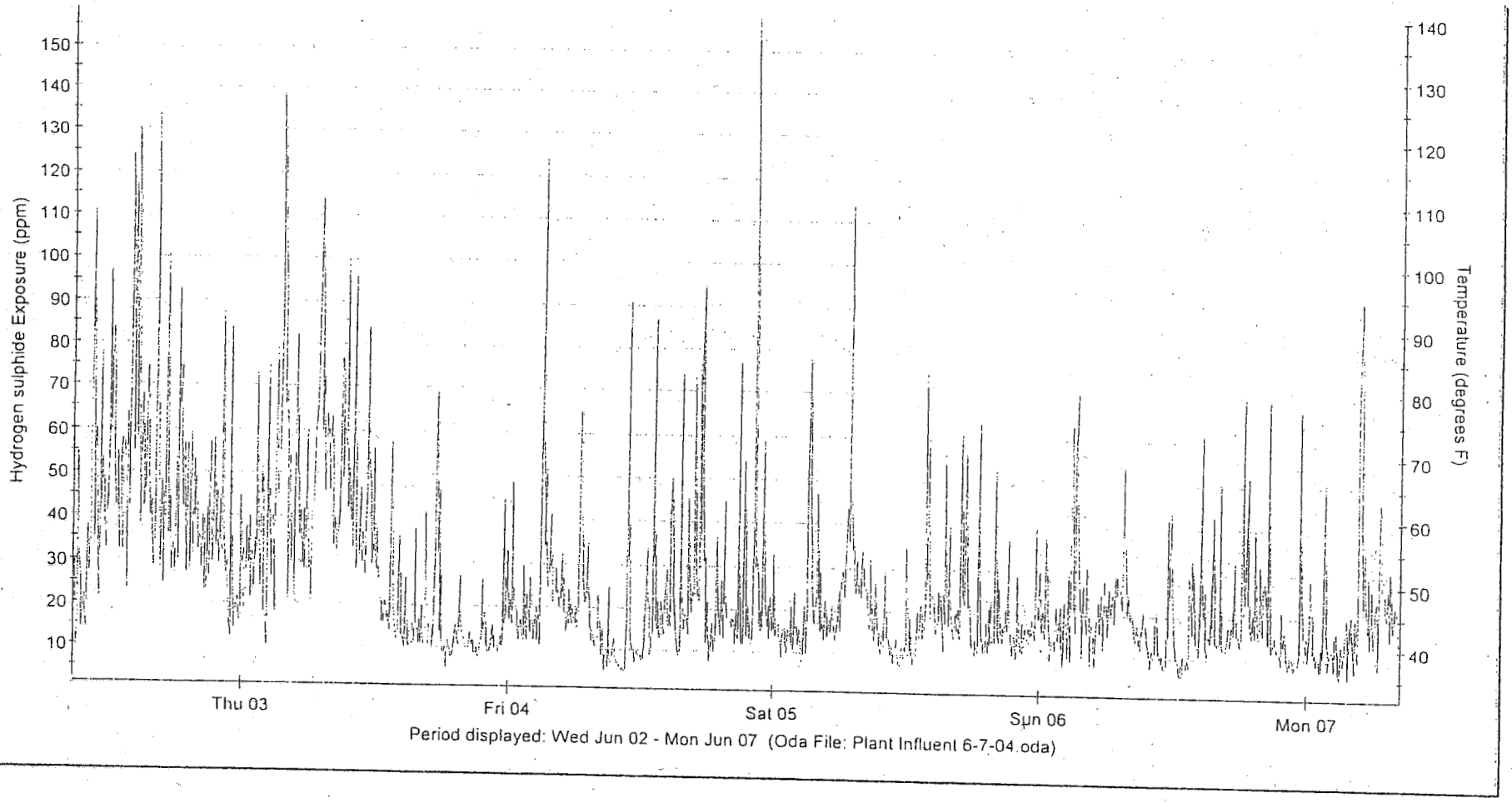
INST Day Transition Temperature

- Session: 1 (OdaLog: OL05011232)



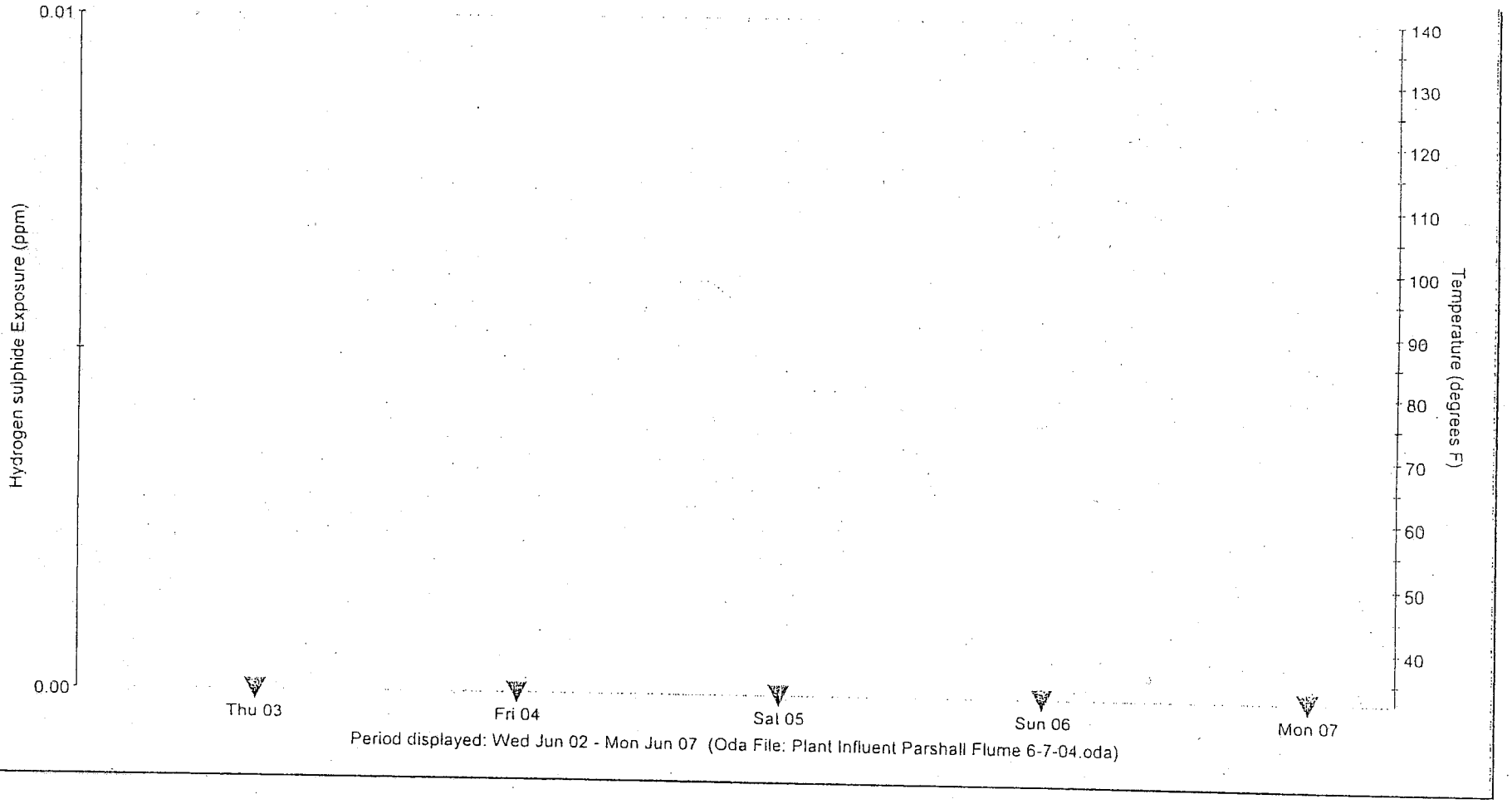
INST : Min (0 ppm) Max (3 ppm) | Day Transition | Average (0.4 ppm) | Temperature

- Session: 1 (OdaLog: OL4505085)



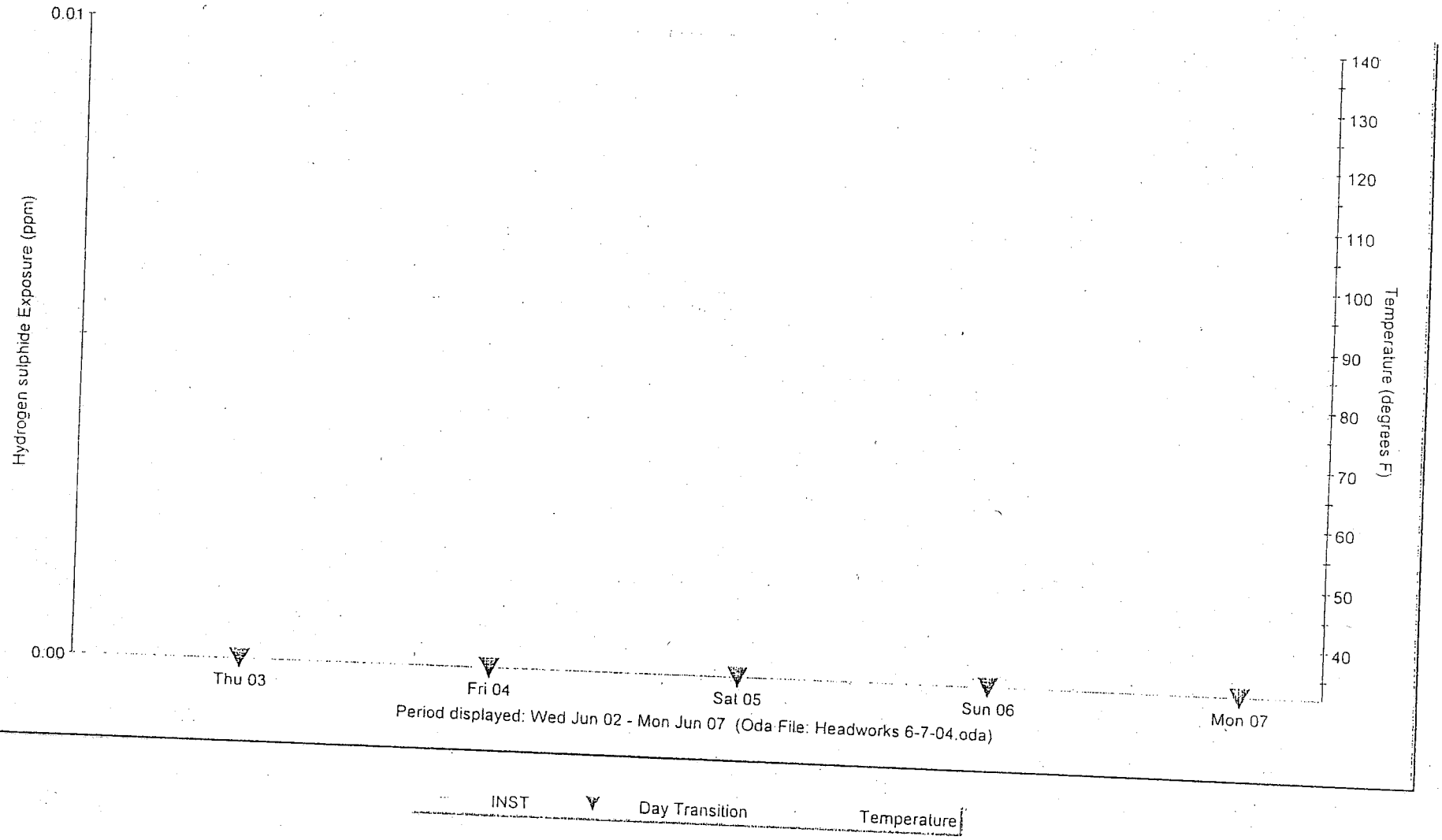
INST ▼ Day Transition Temperature

- Session: 1 (OdaLog: OL45093434)

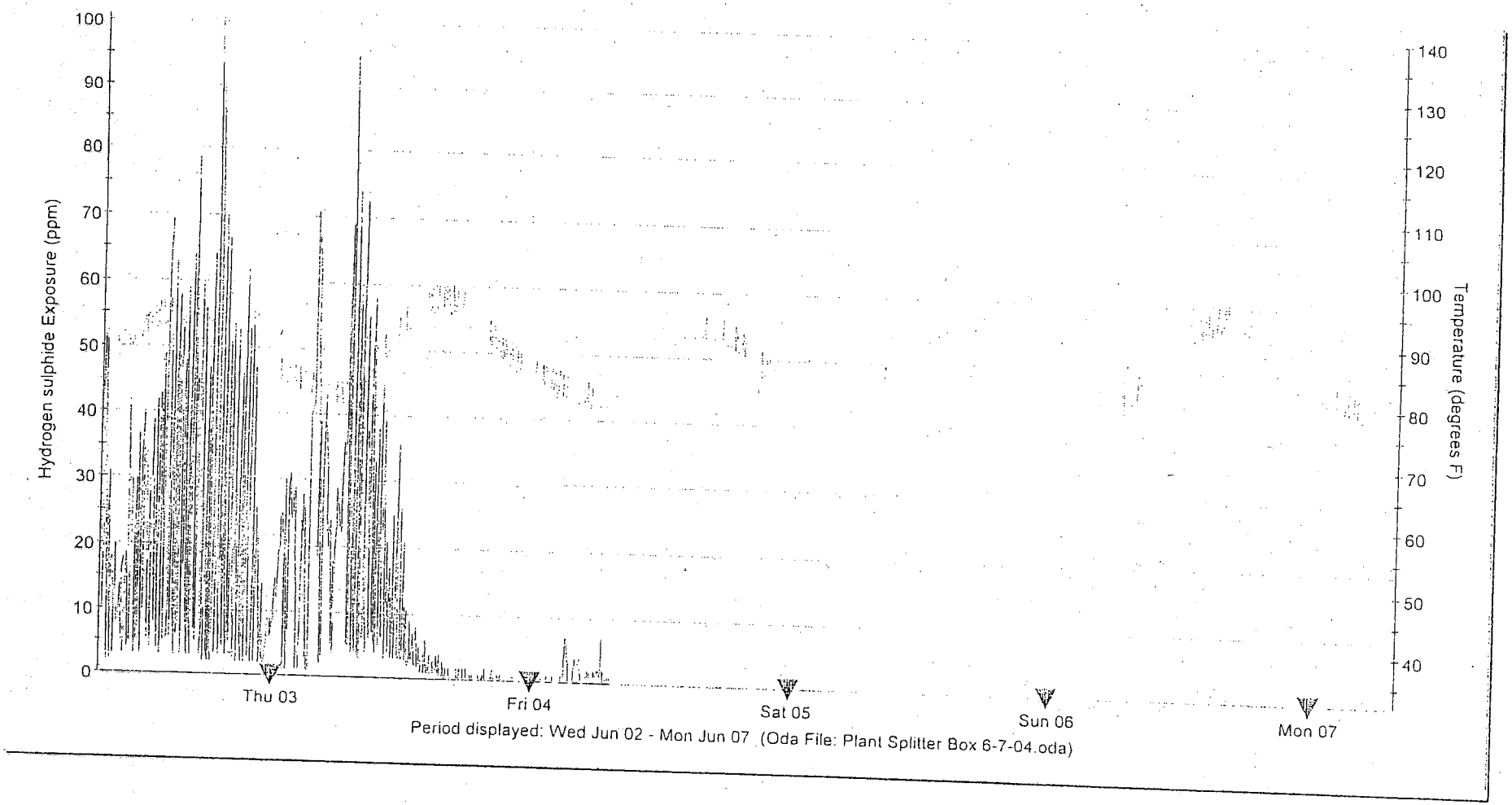


INST Day Transition Temperature

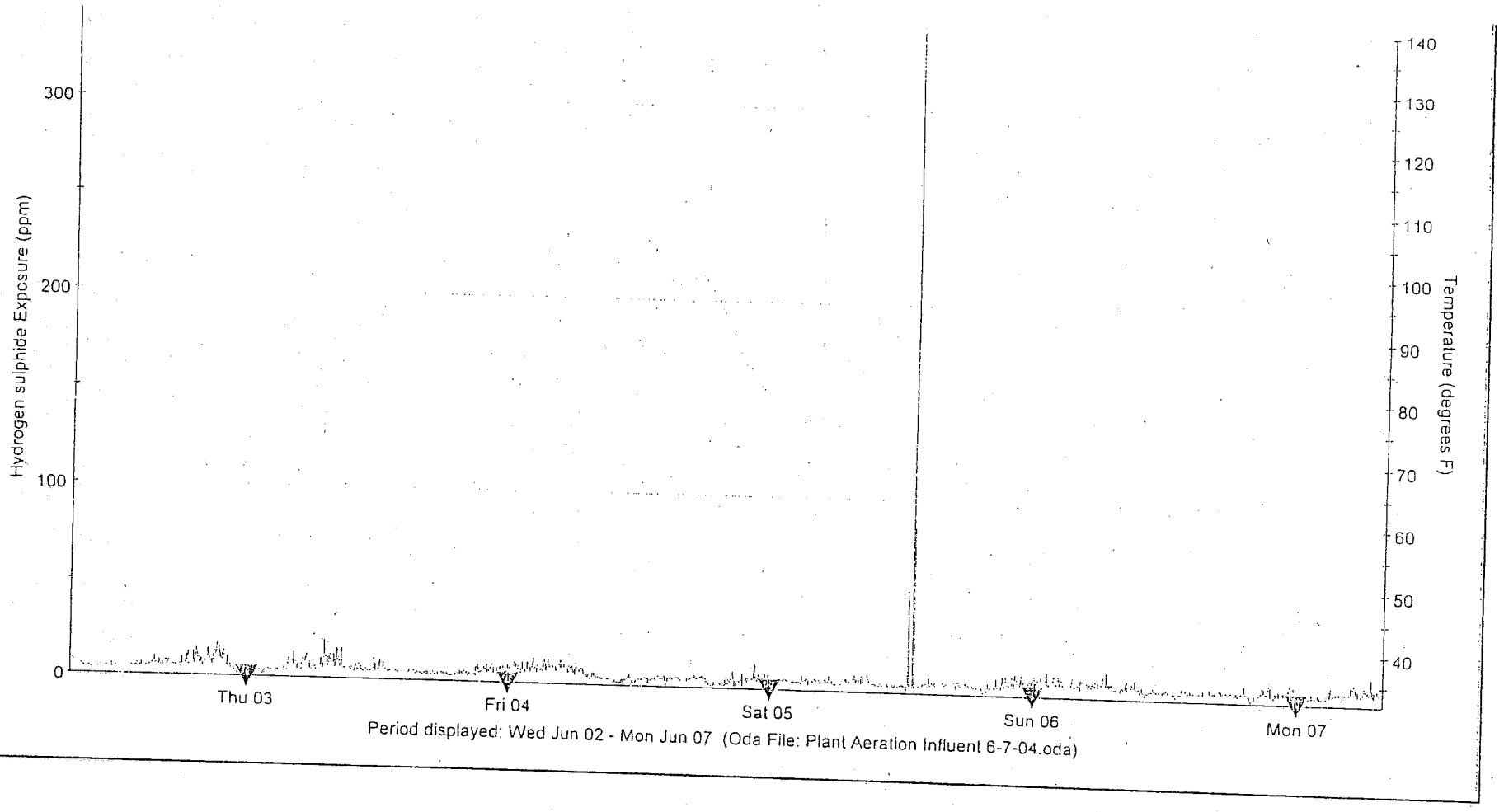
- Session: 1 (OdaLog: OL45103527)



- Session: 1 (OdaLog: OL0504074)

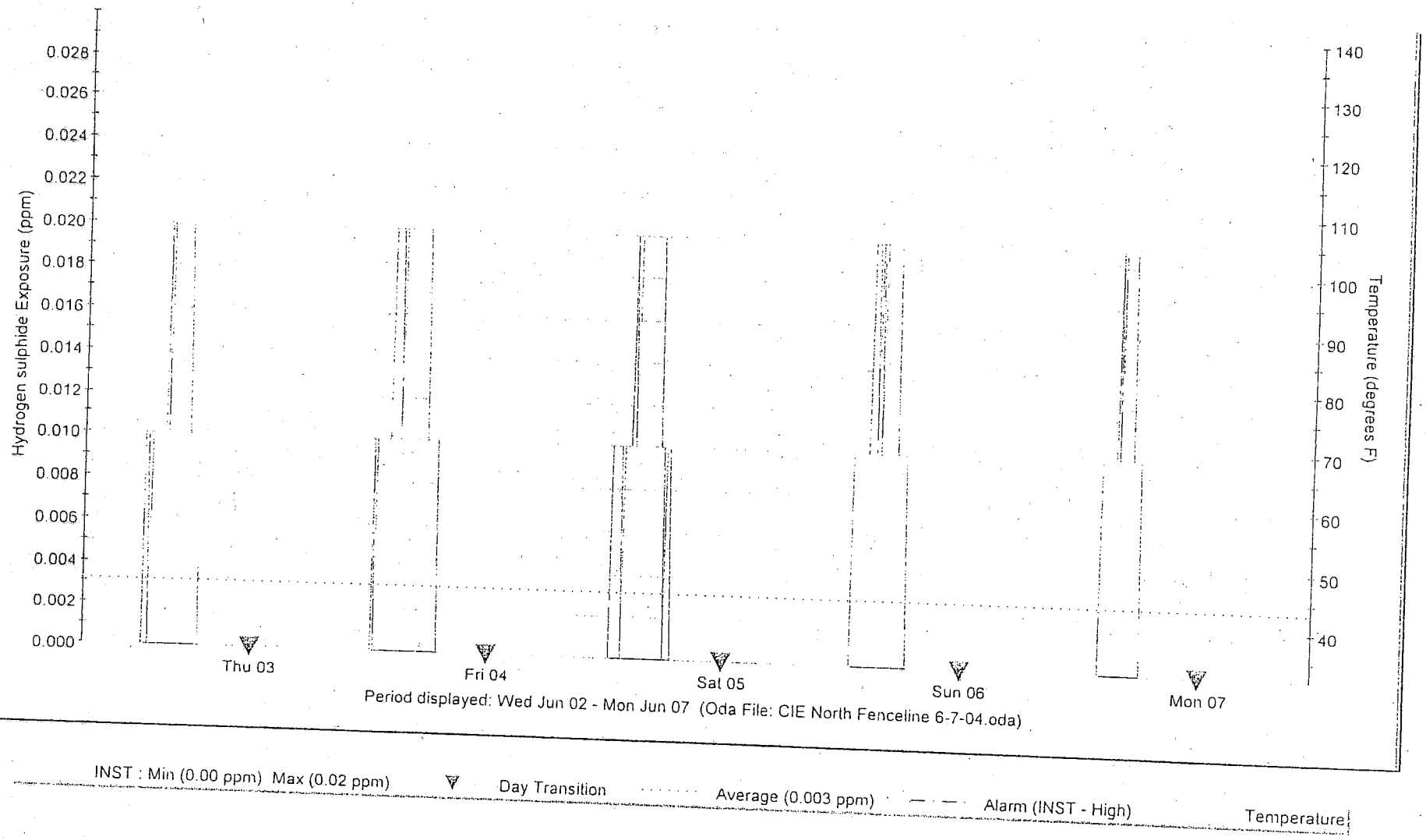


- Session: 1 (OdaLog: OL03110203)

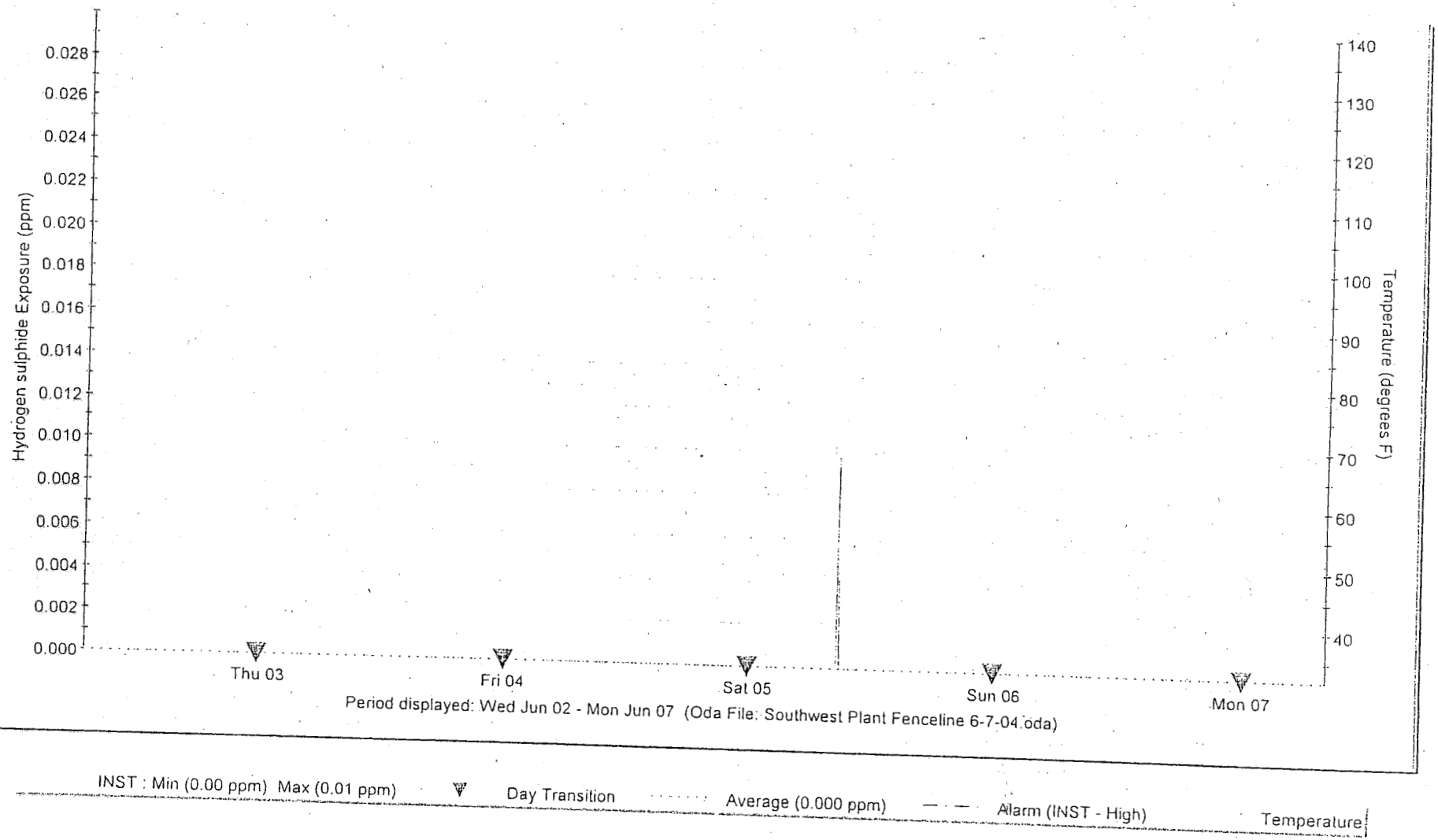


INST ▼ Day Transition Temperature

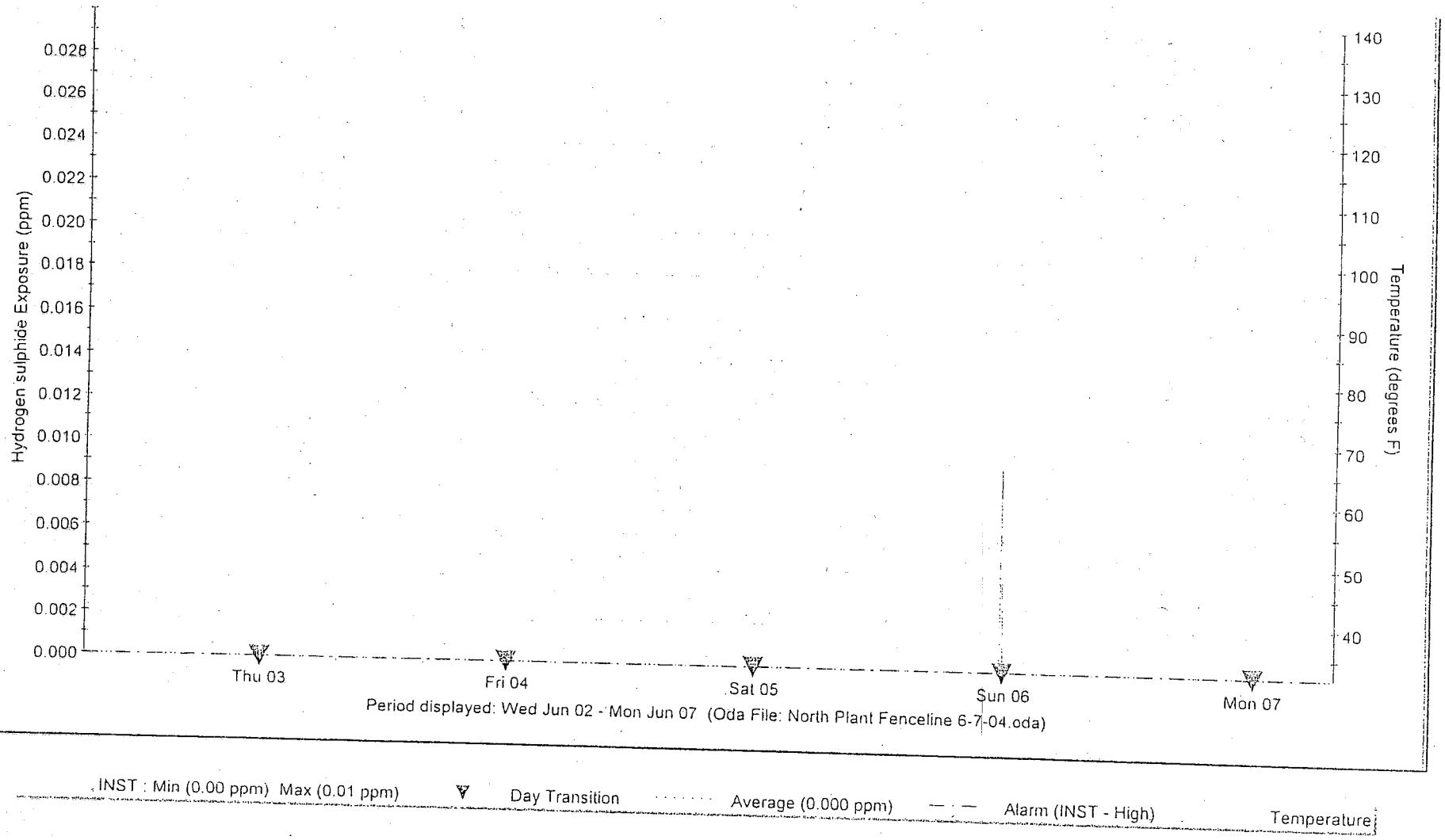
- Session: 1 (OdaLog: OL50083533)



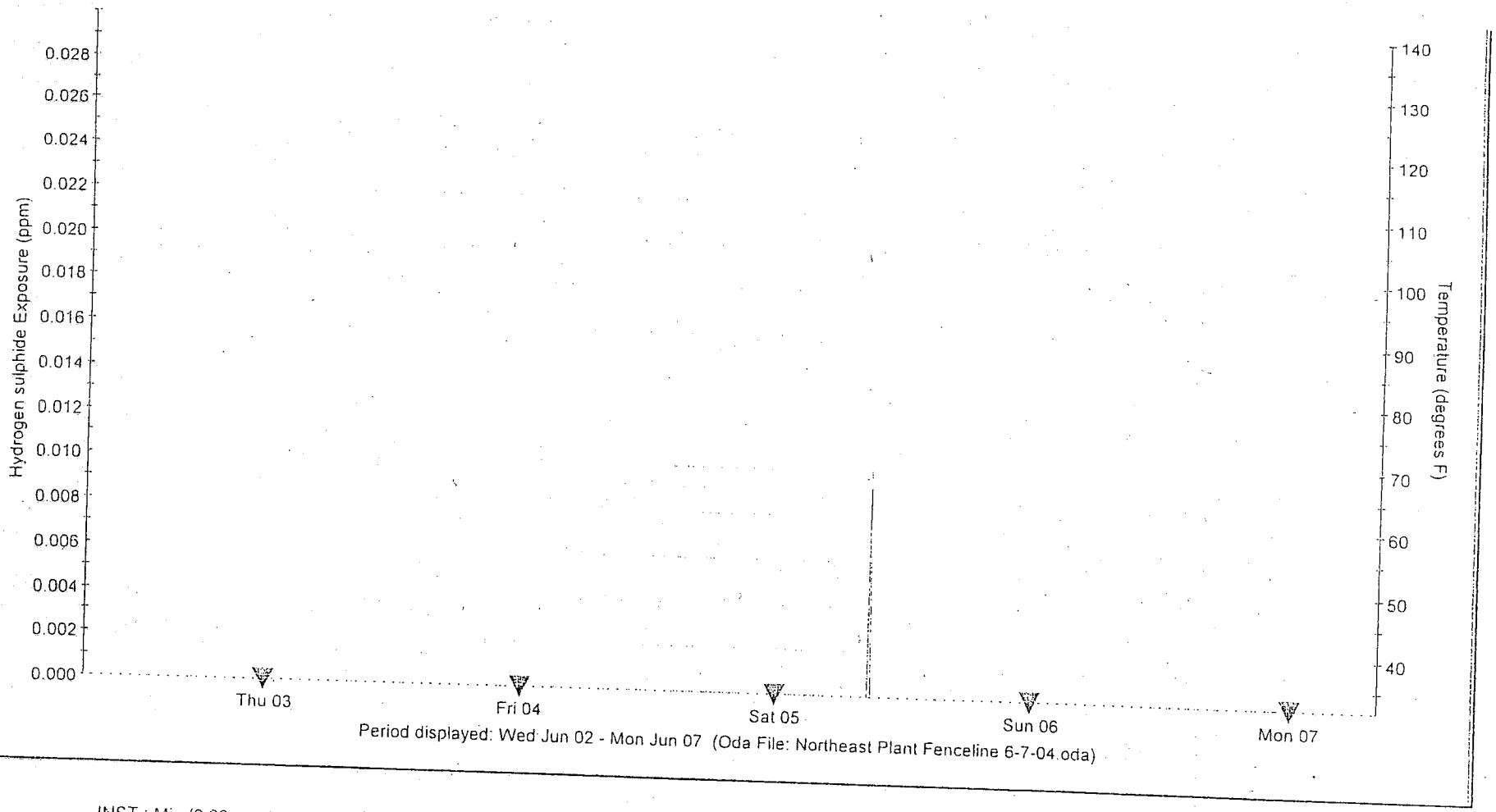
- Session: 1 (OdaLog: OL50073521)



- Session: 1 (OdaLog: OL50103539)

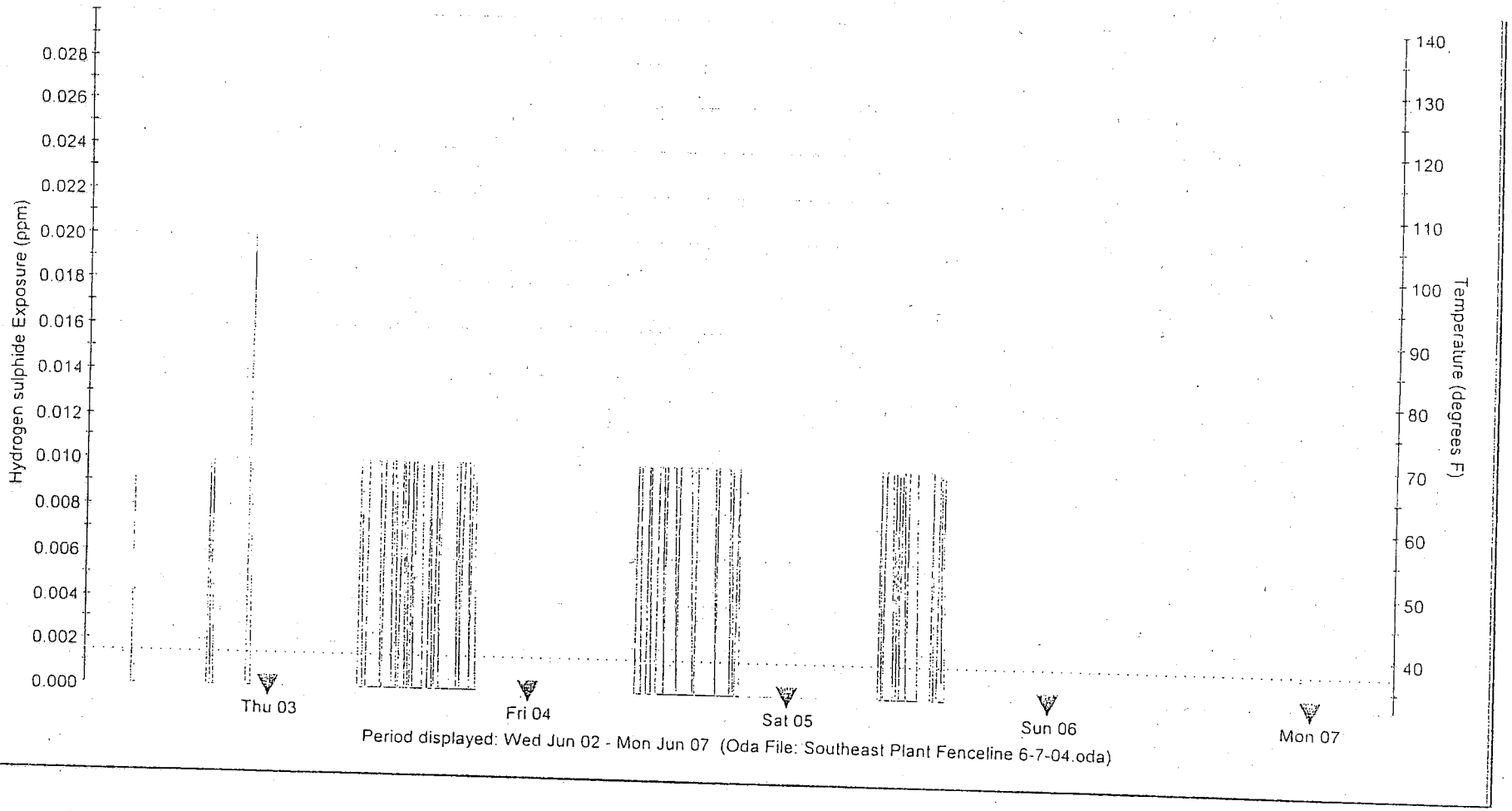


- Session: 1 (OdaLog: OL50073521)



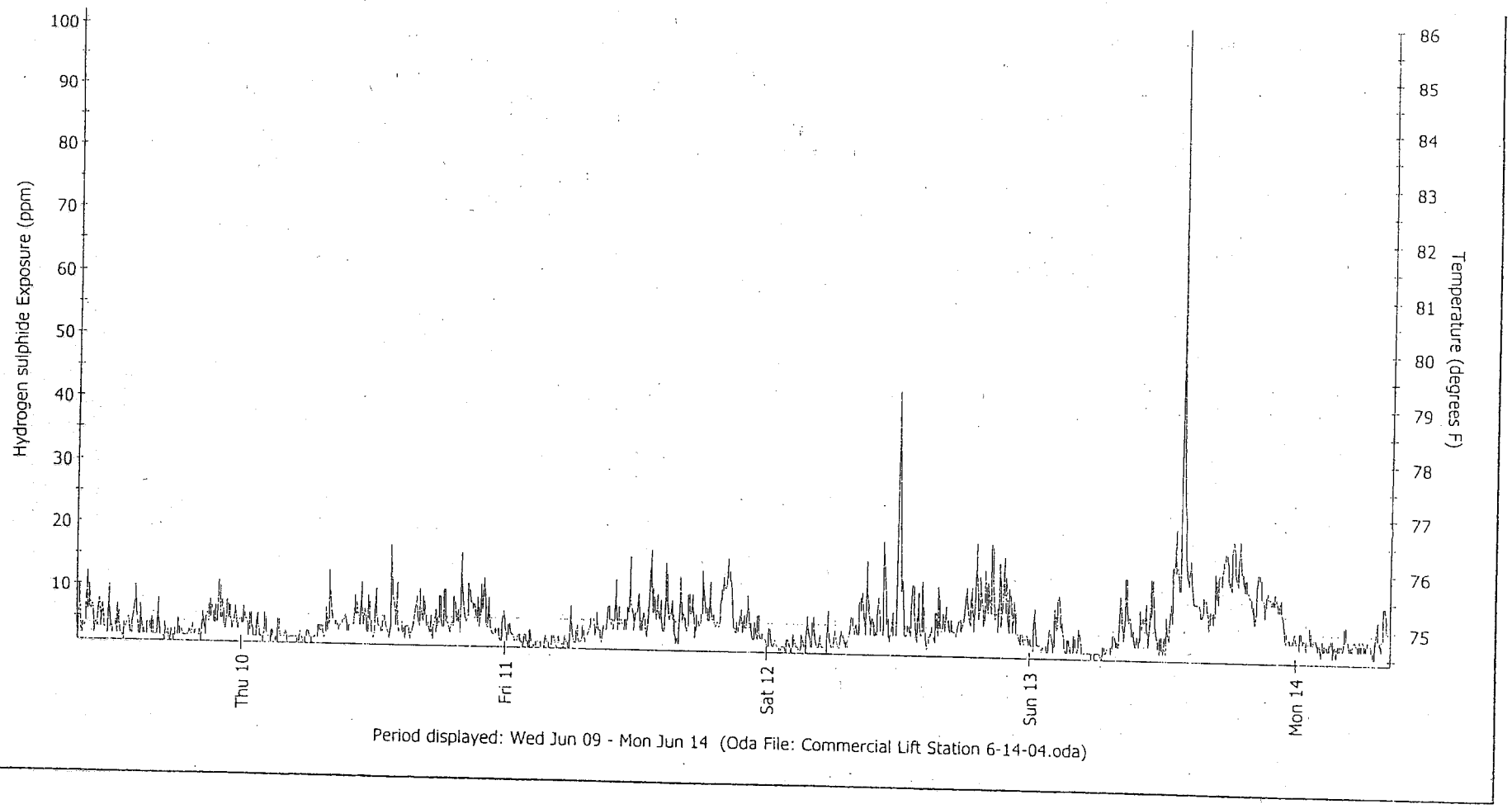
INST : Min (0.00 ppm) Max (0.01 ppm) Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL50044578)



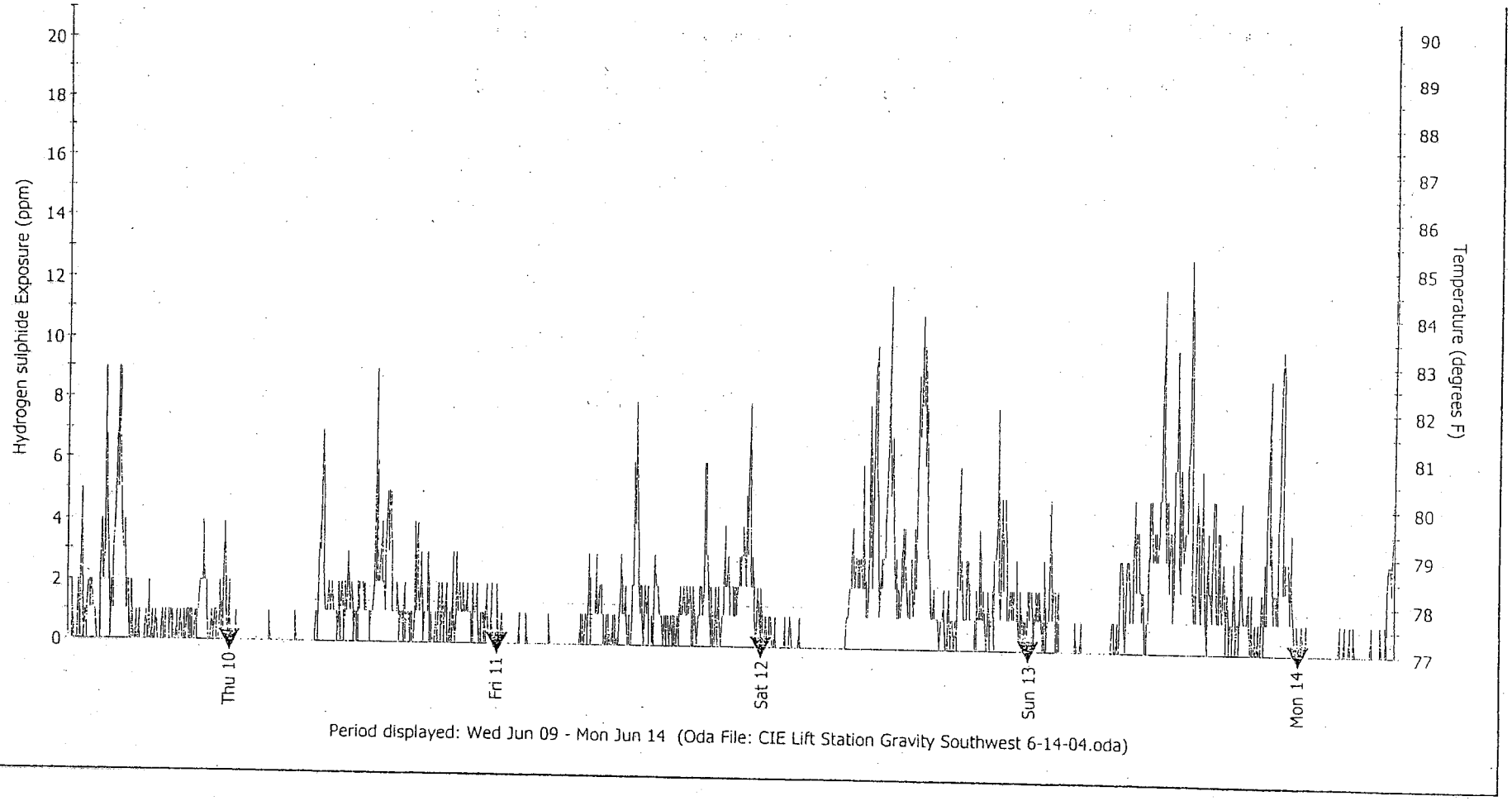
INST : Min (0.00 ppm) Max (0.02 ppm) Day Transition Average (0.002 ppm) Alarm (INST - High) Temperature

- Session: 1 (OdaLog: OL03110203)



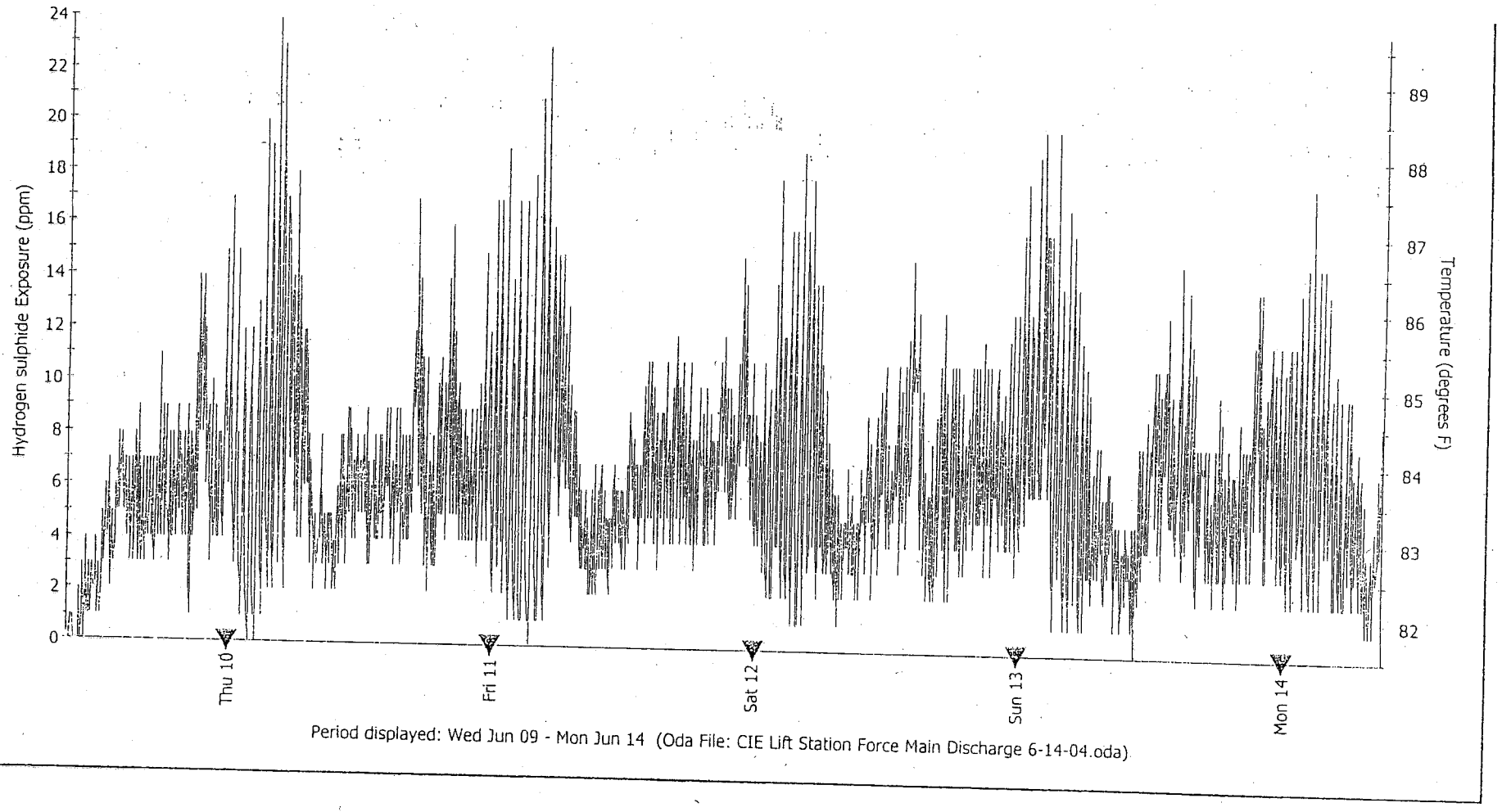
INST : Min (1 ppm) Max (102 ppm) Day Transition Average (5.7 ppm) Temperature

- Session: 1 (OdaLog: OL05123688)



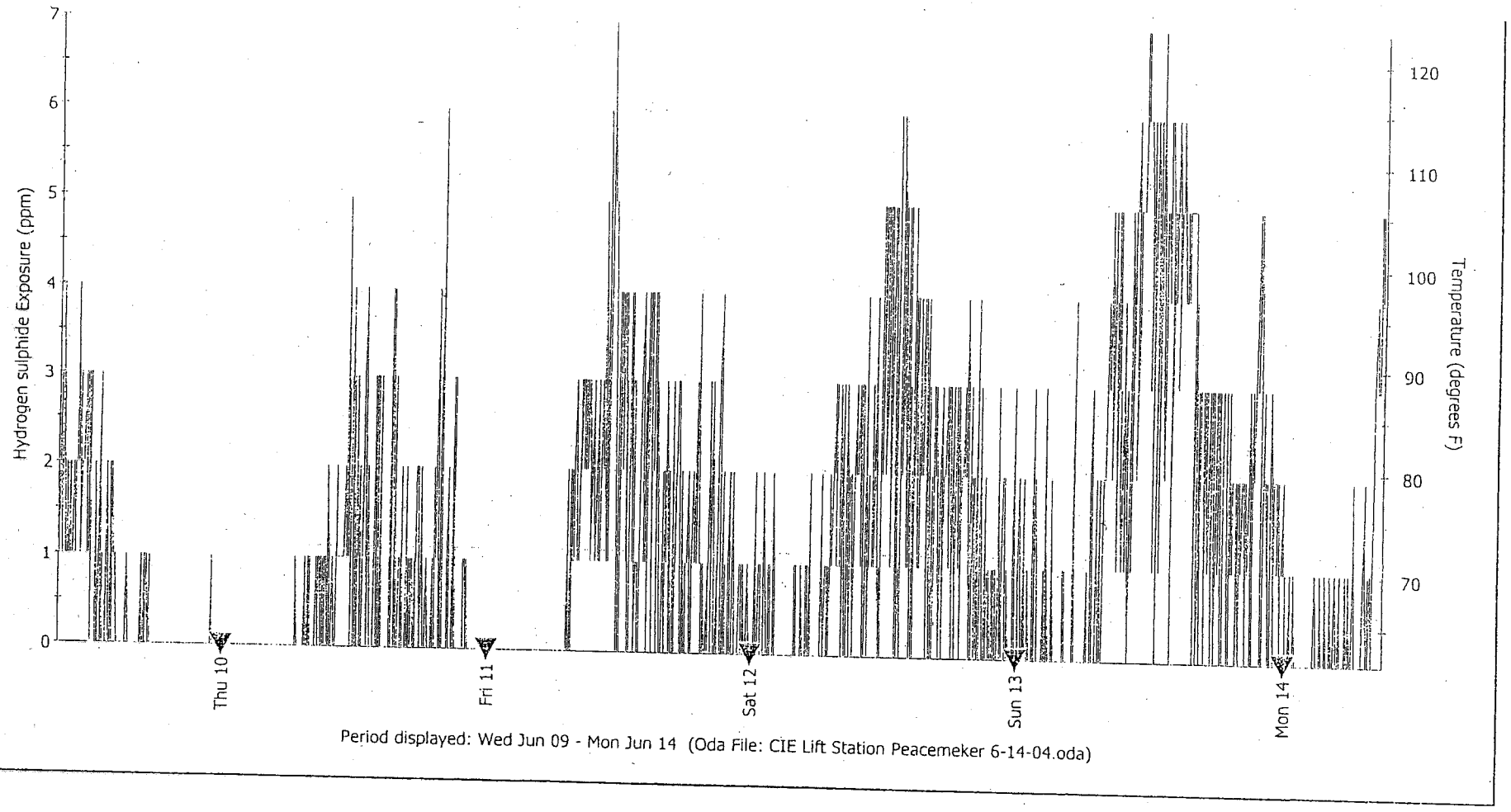
INST : Min (0 ppm) Max (21 ppm) Day Transition Average (1.3 ppm) Temperature

- Session: 1 (OdaLog: OL45033818)



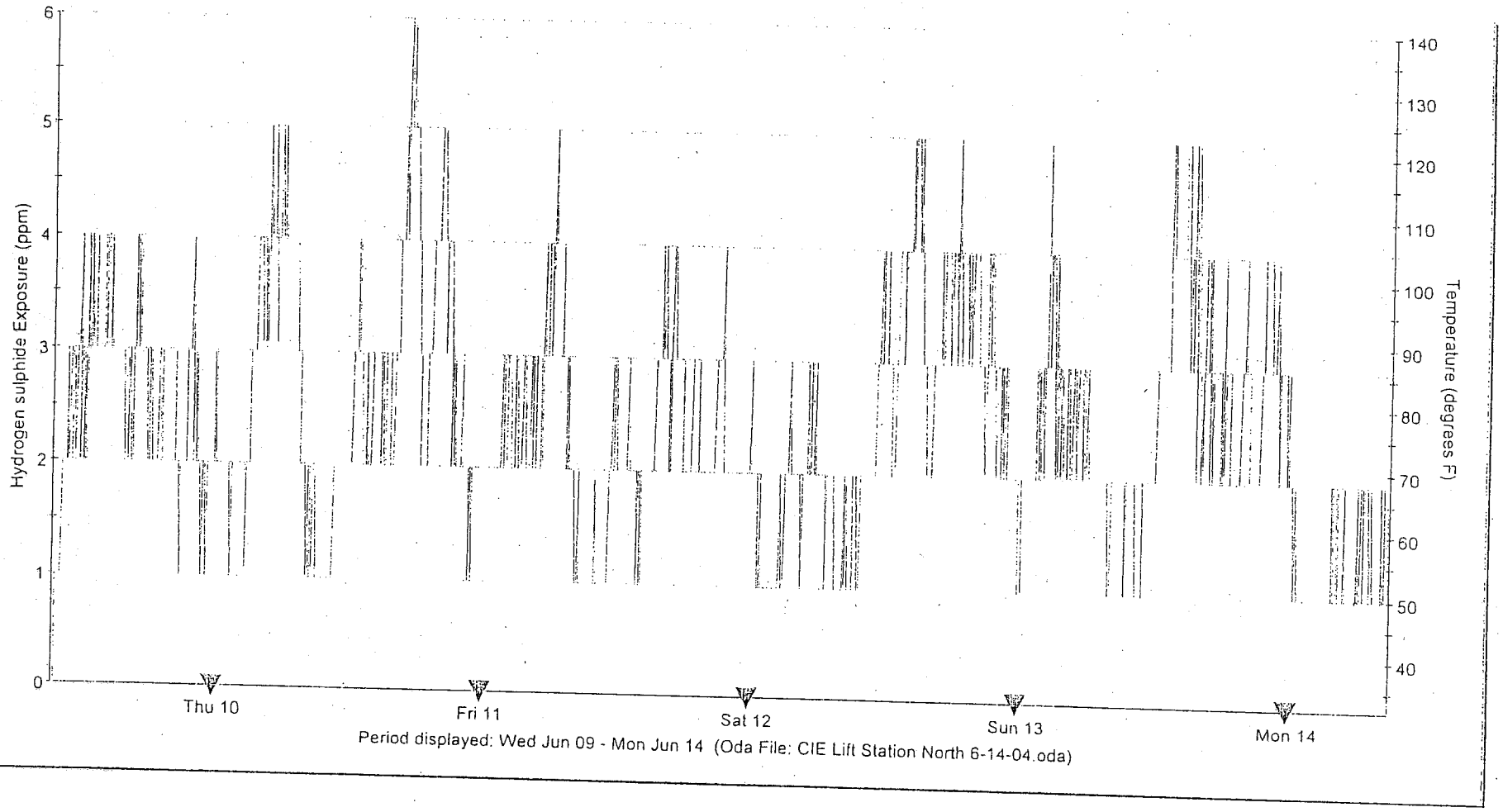
INST : Min (0 ppm) Max (24 ppm) ▼ Day Transition Average (6.4 ppm) Temperature

- Session: 1 (OdaLog: OL05011231)

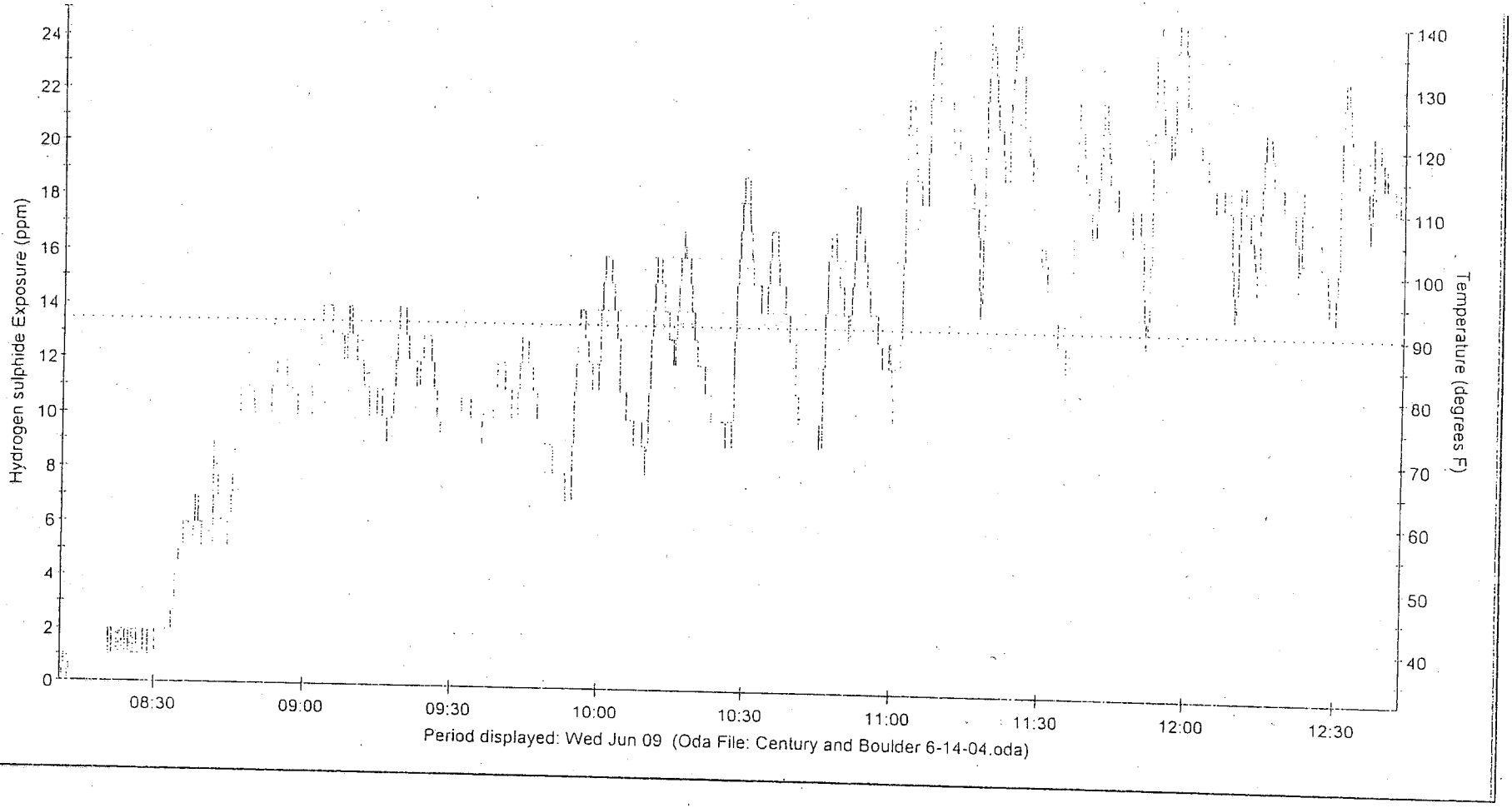


INST : Min (0 ppm) Max (7 ppm) Day Transition Average (1.1 ppm) Temperature

- Session: 1 (OdaLog: OL02011278)

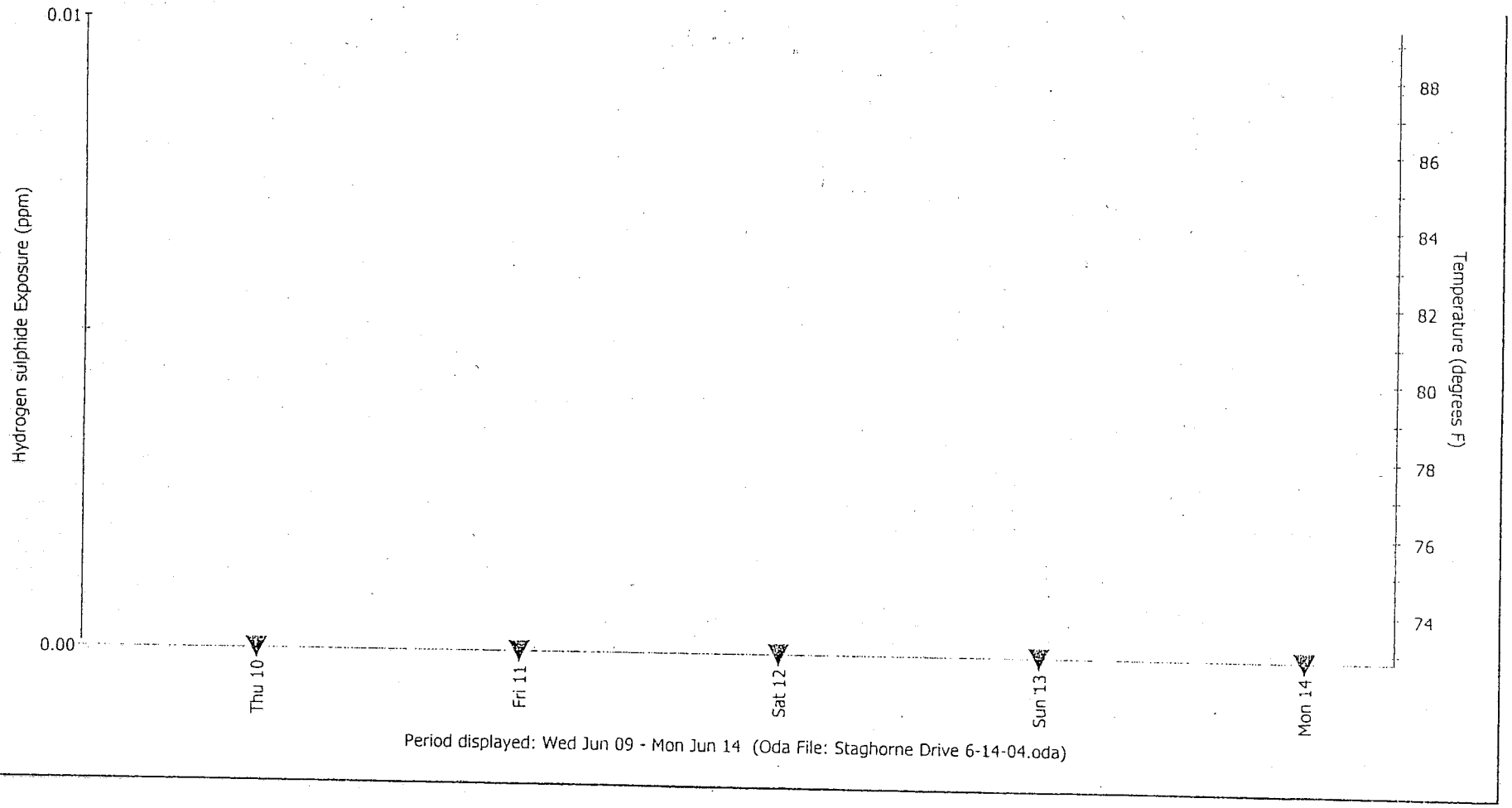


- Session: 1 (OdaLog: OL45080161)



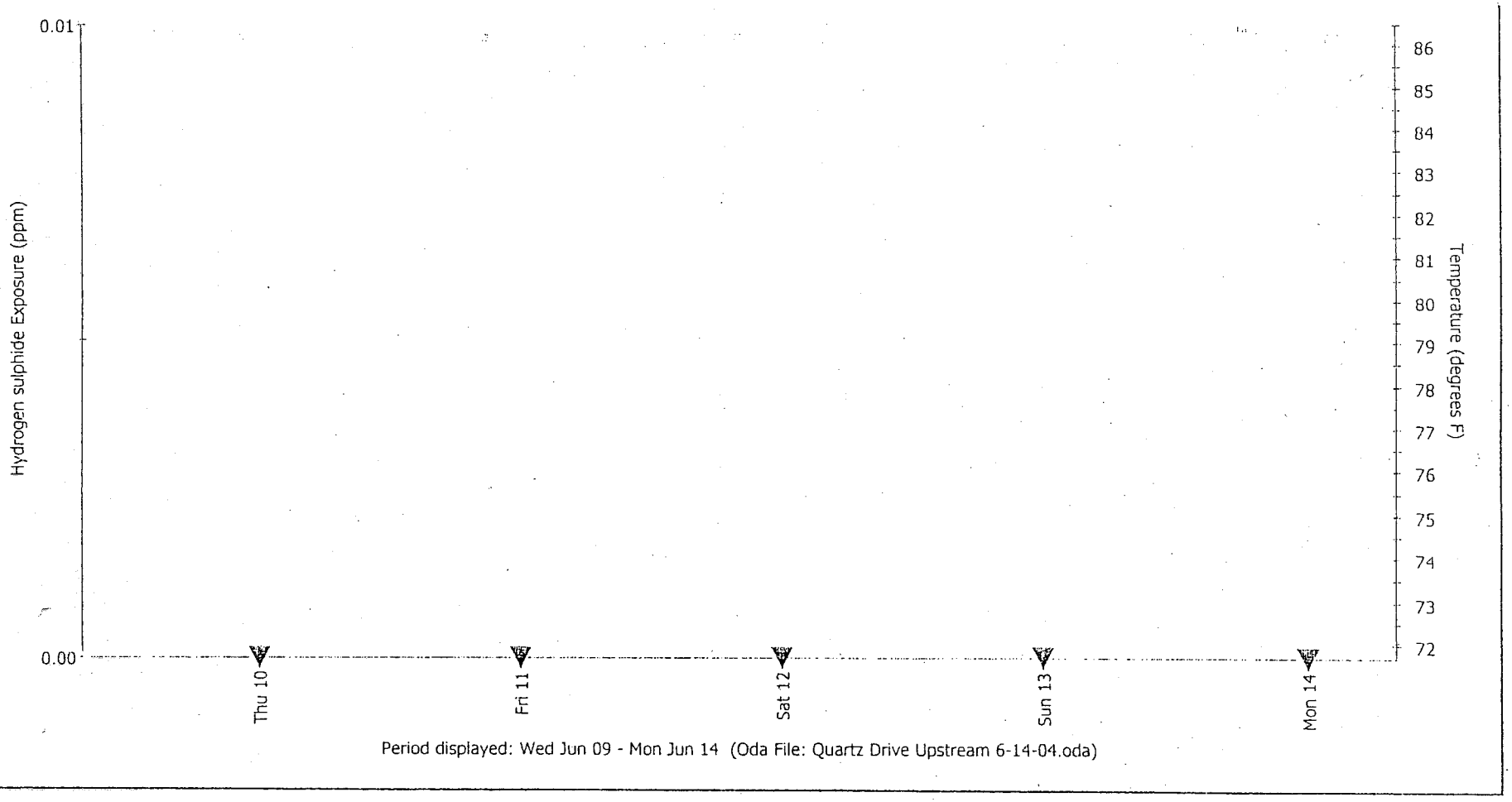
INST : Min (0 ppm) Max (25 ppm) Average (13.4 ppm) Temperature

- Session: 1 (OdaLog: OL0504071)



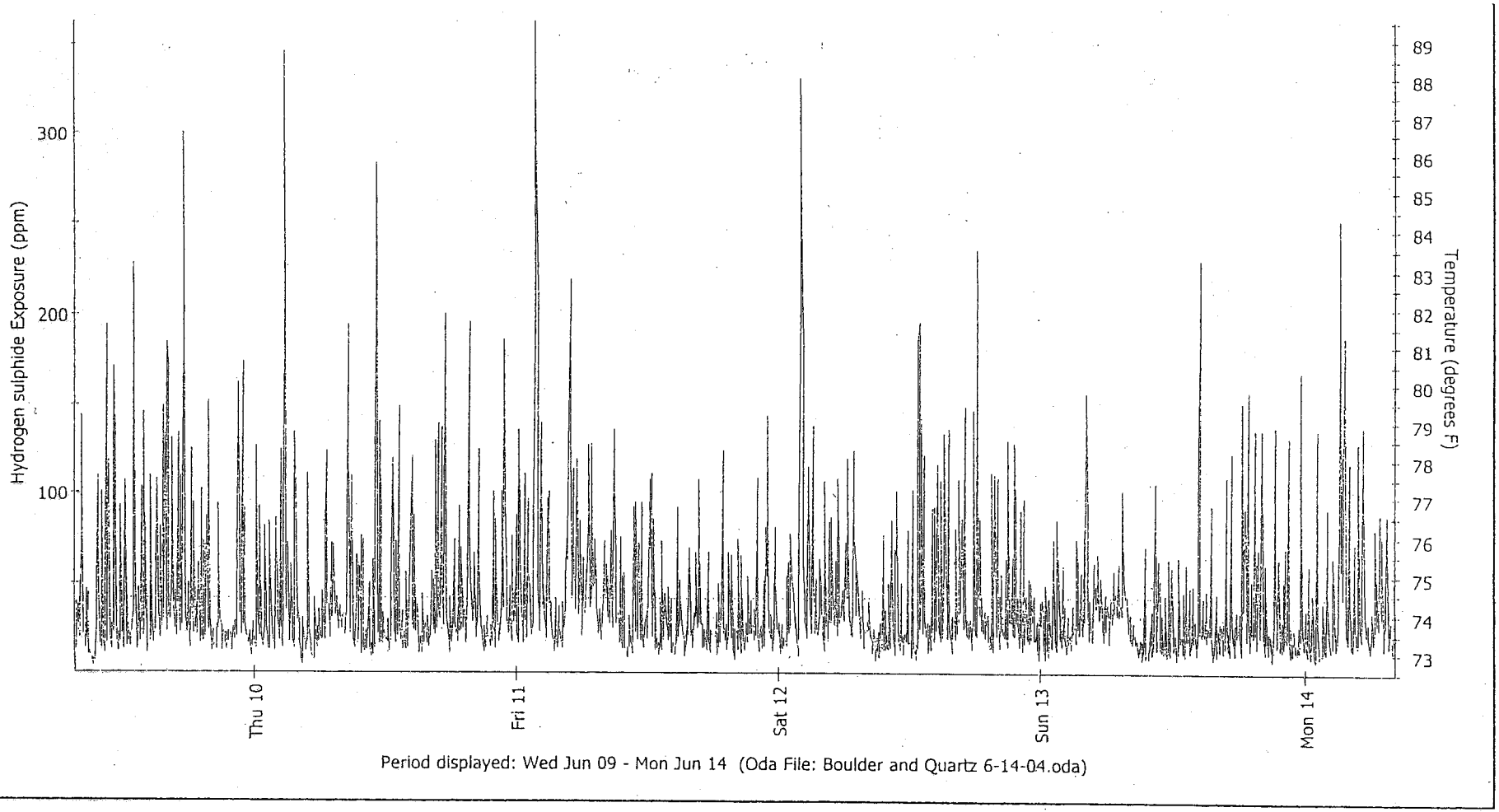
INST : Min (0 ppm) Max (0 ppm) Day Transition Average (0.0 ppm) Temperature

- Session: 1 (OdaLog: OL05110204)



INST : Min (0 ppm) Max (0 ppm) Day Transition Average (0.0 ppm) Temperature

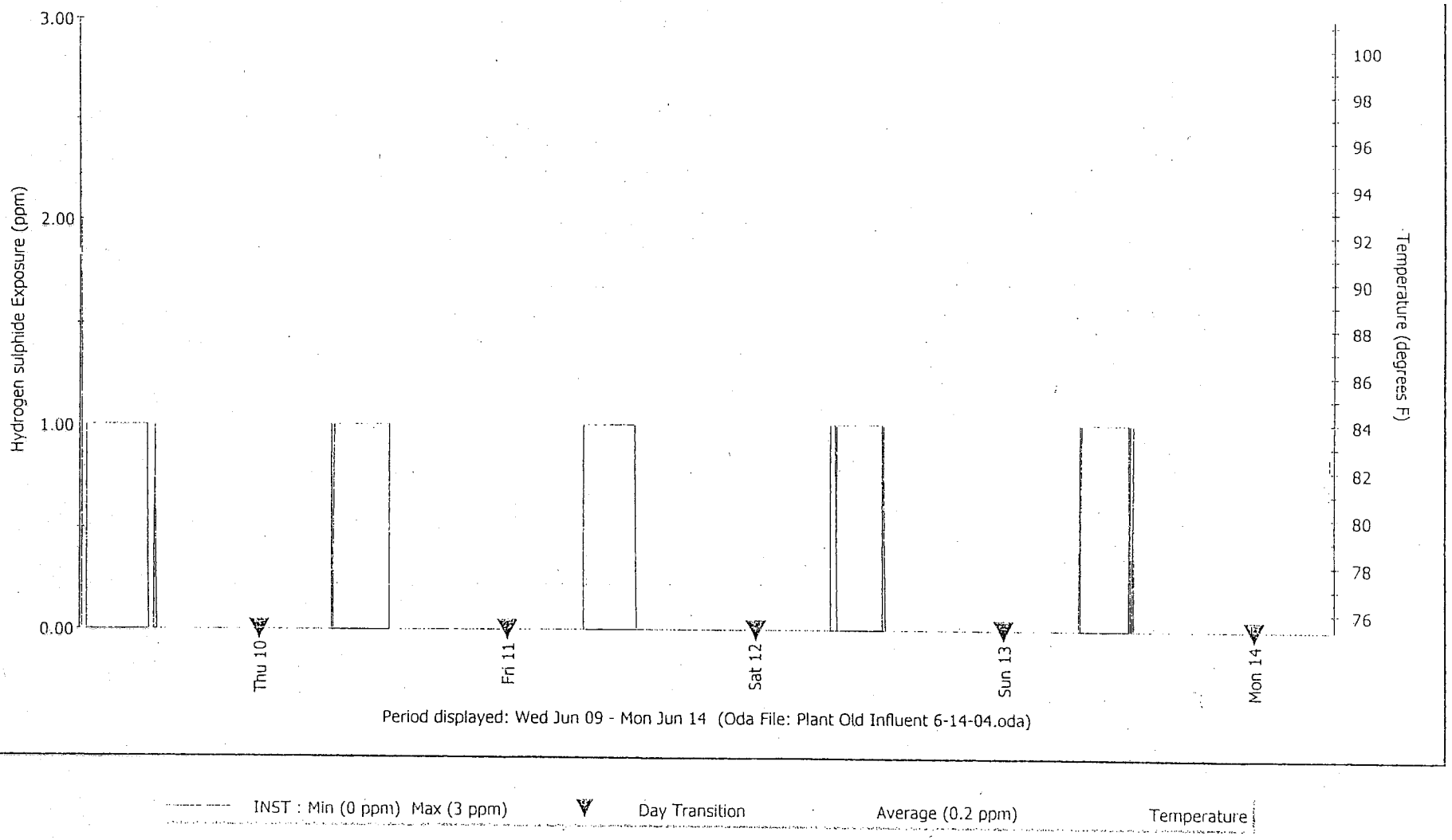
- Session: 1 (OdaLog: OL4505085)



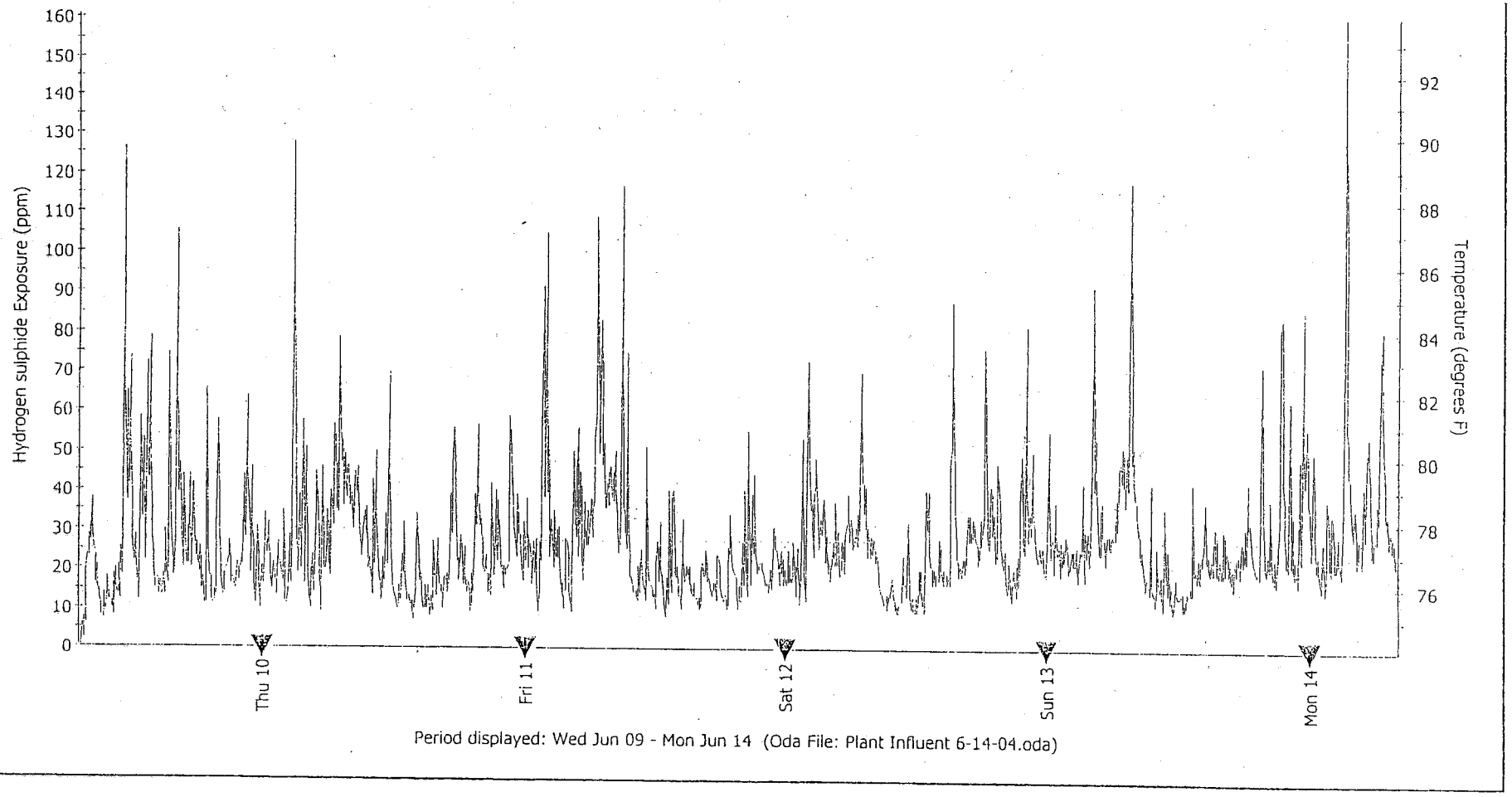
Period displayed: Wed Jun 09 - Mon Jun 14 (Oda File: Boulder and Quartz 6-14-04.oda)

INST : Min (1 ppm) Max (364 ppm) | Day Transition | Average (42.1 ppm) | Temperature

- Session: 3 (OdaLog: OL05011232)

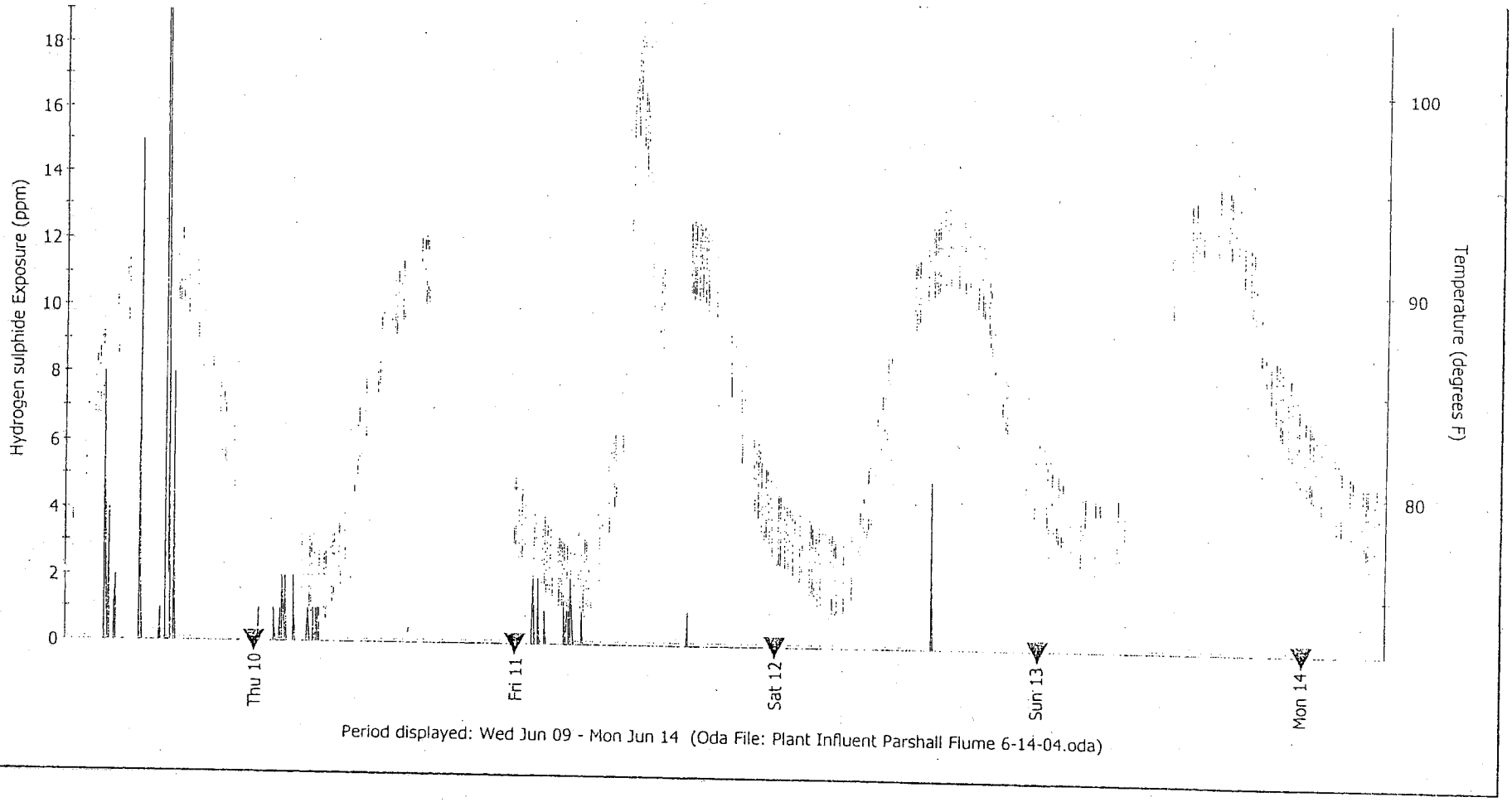


- Session: 1 (OdaLog: OL45033819)



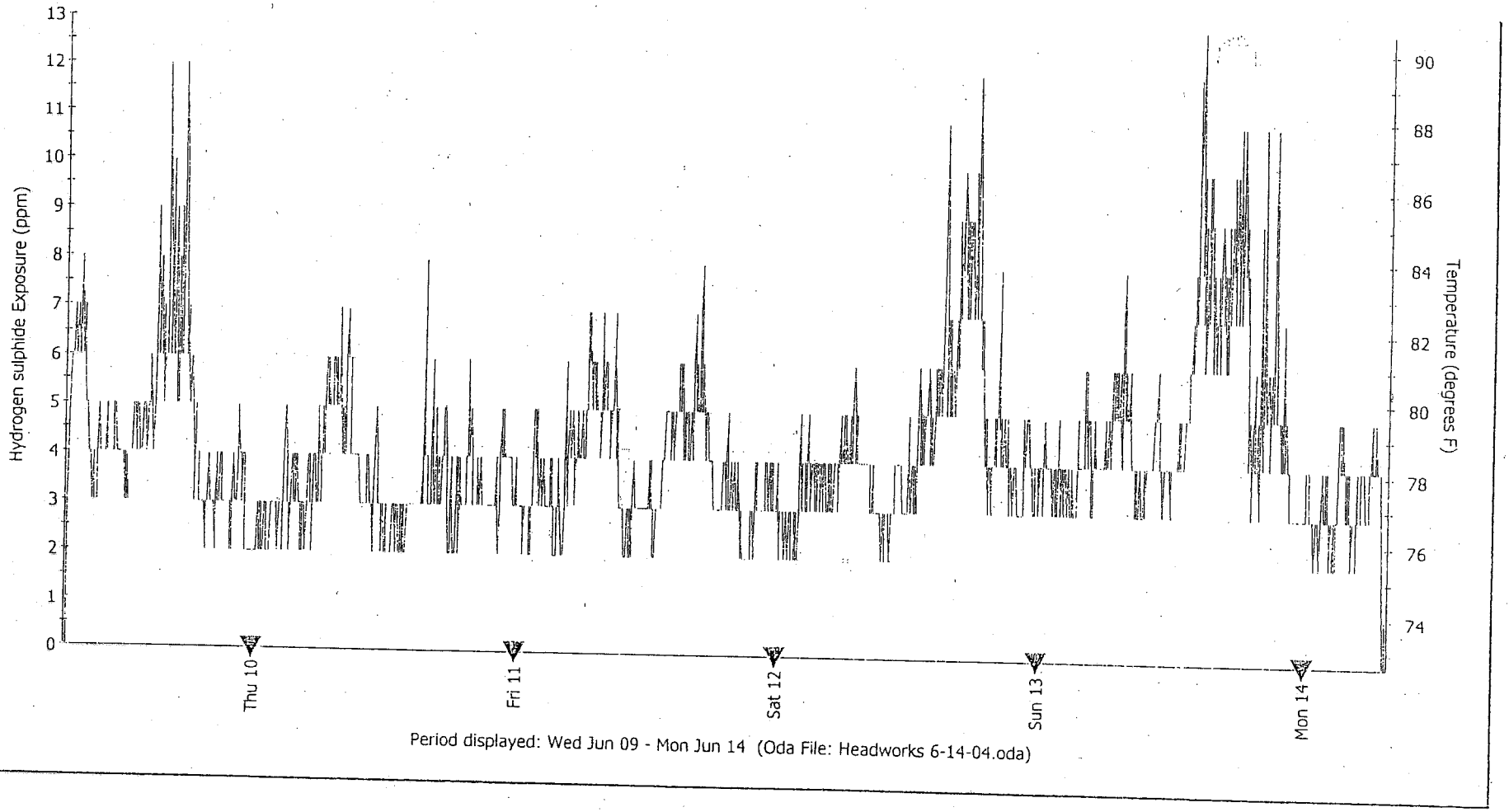
INST : Min (0 ppm) Max (161 ppm) Day Transition Average (27.0 ppm) Temperature

- Session: 1 (OdaLog: OL0504074)



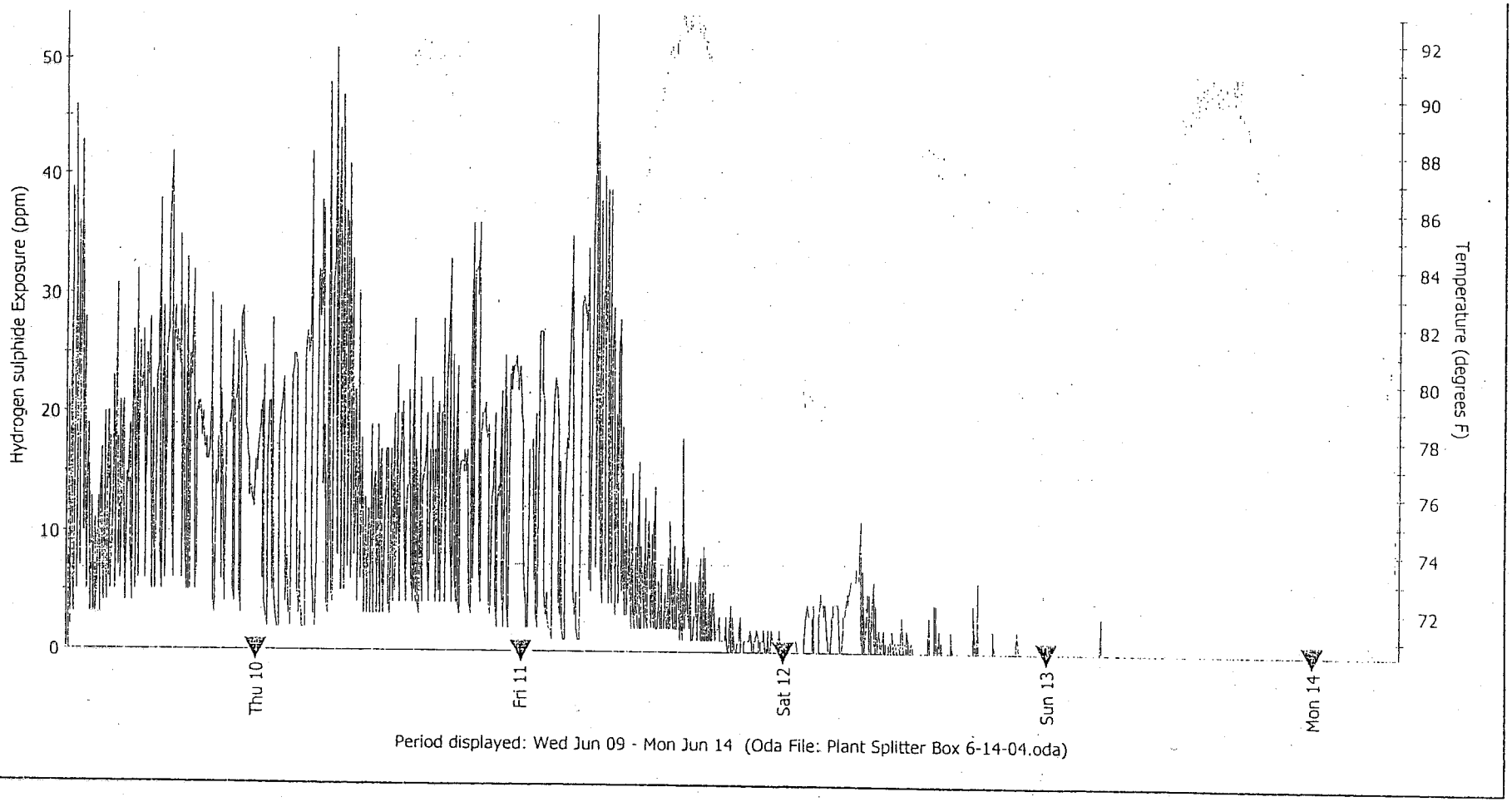
INST : Min (0 ppm) Max (19 ppm) Day Transition Average (0.1 ppm) Temperature

- Session: 1 (OdaLog: OL0504068)



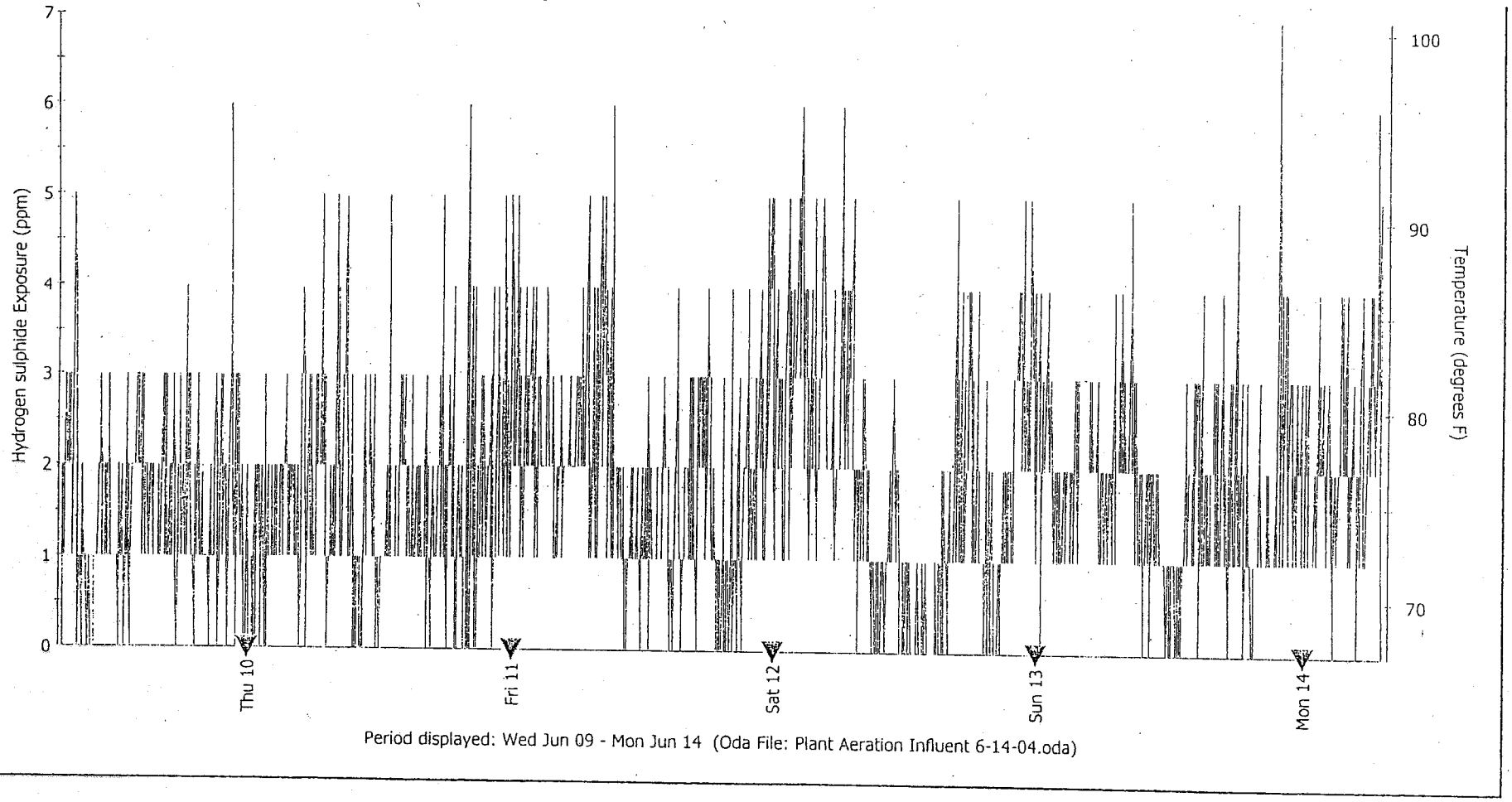
INST : Min (0 ppm) Max (13 ppm) | Day Transition | Average (4.2 ppm) | Temperature

- Session: 1 (OdaLog: OL0504069)



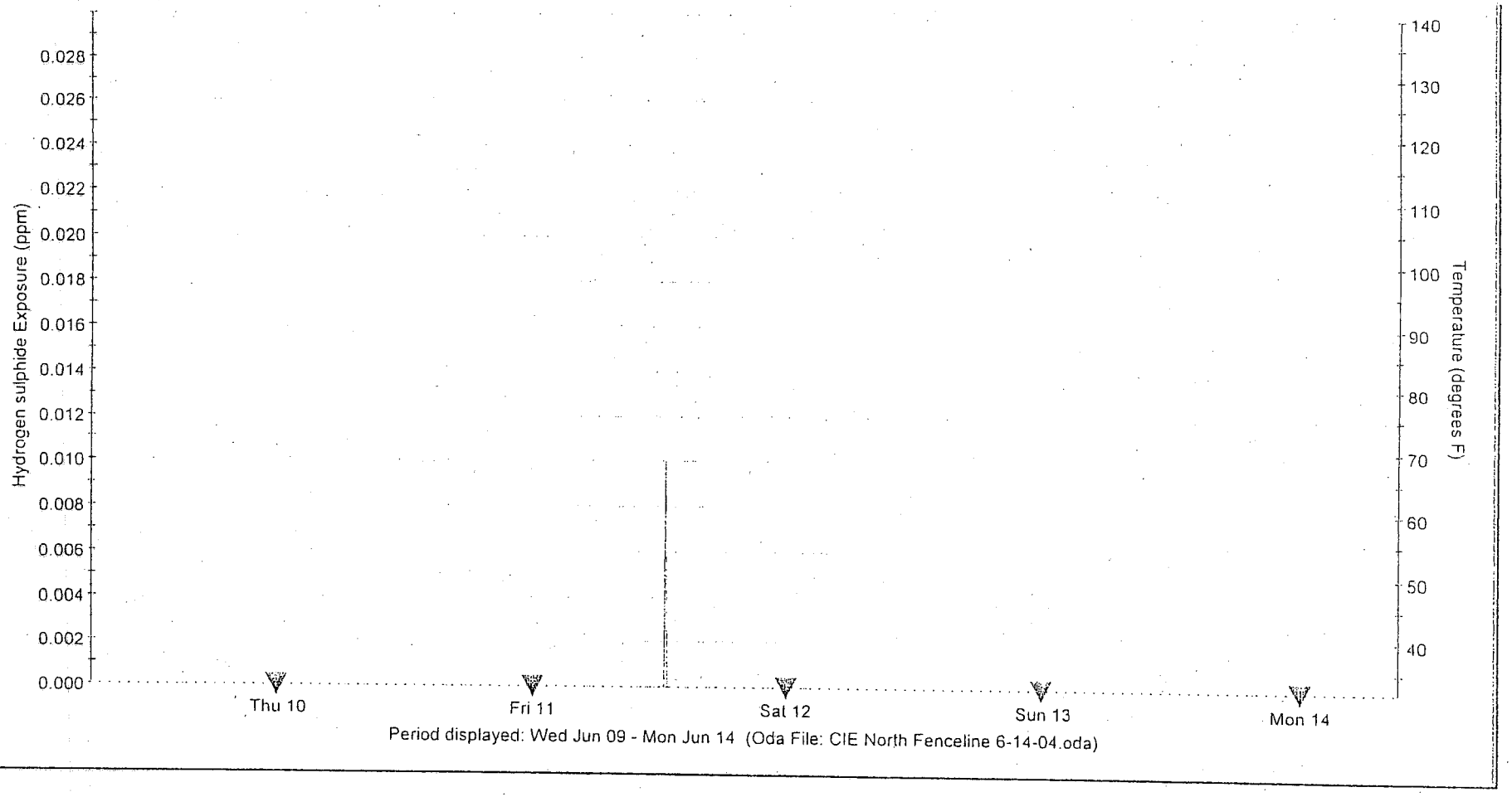
INST : Min (0 ppm) Max (54 ppm) | Day Transition | Average (7.3 ppm) | Temperature

- Session: 1 (OdaLog: OL05113658)



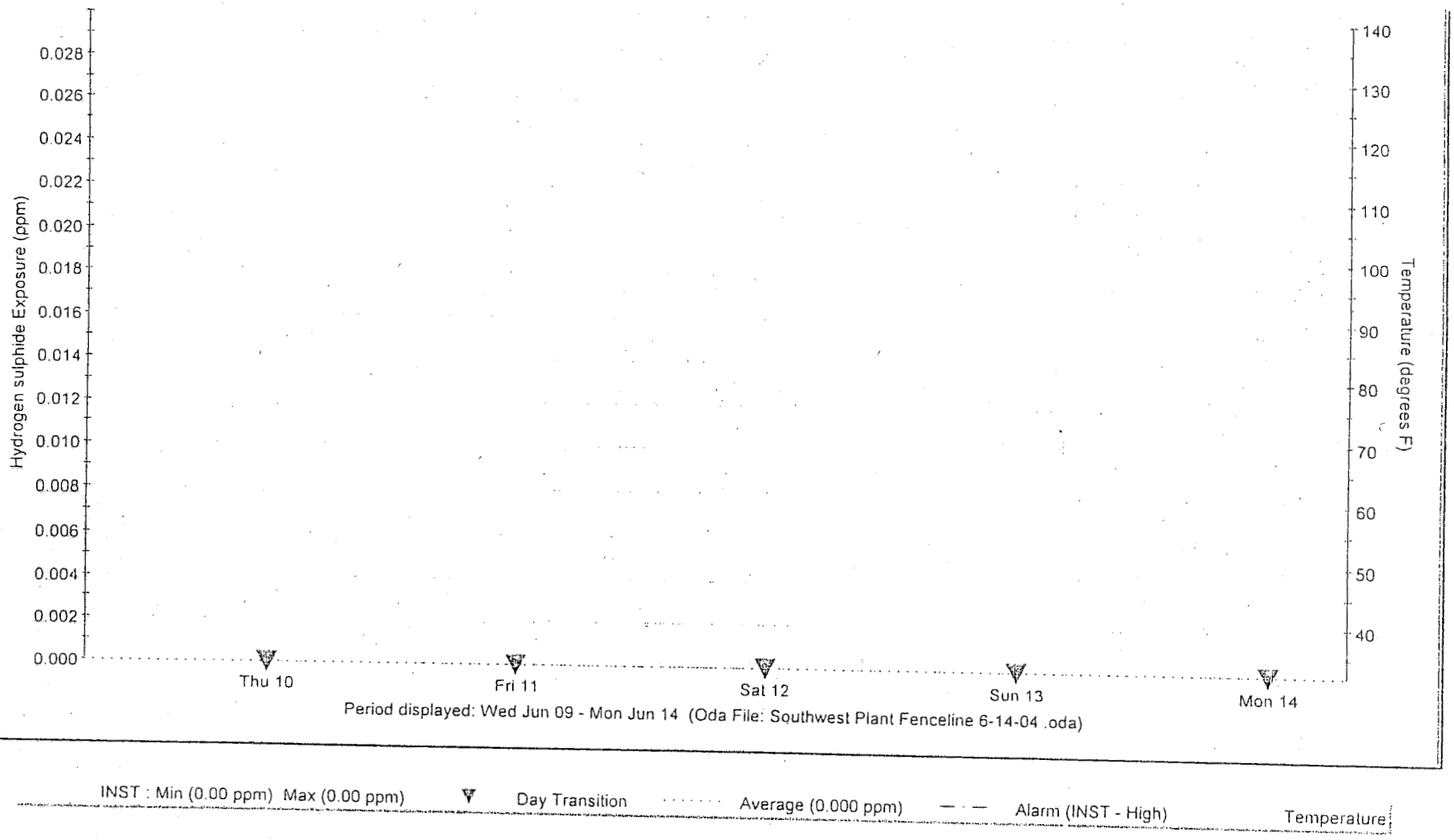
INST : Min (0 ppm) Max (7 ppm) Day Transition Average (1.8 ppm) Temperature

- Session: 1 (OdaLog: OL50044578)

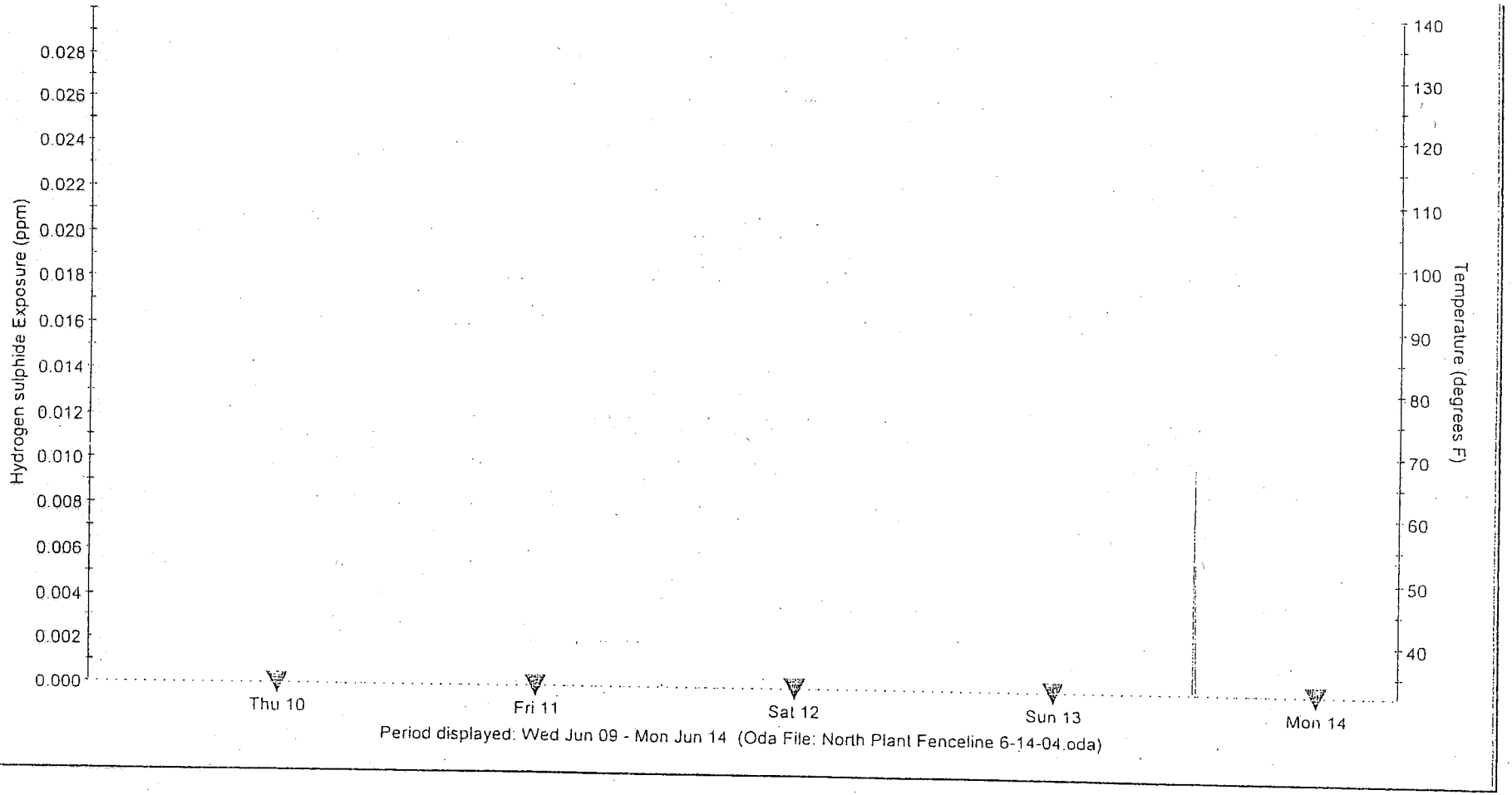


INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50063509)

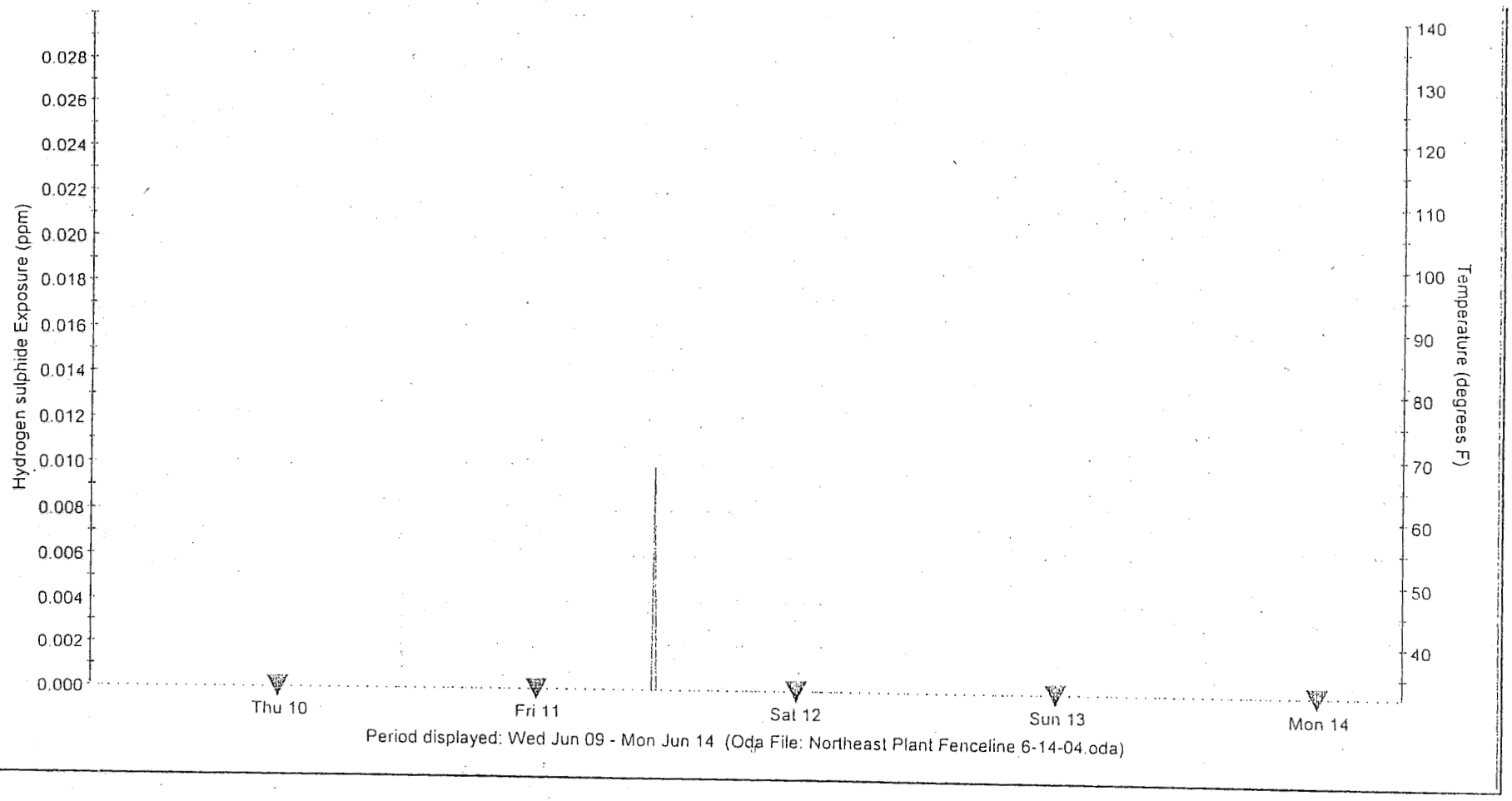


- Session: 1 (OdaLog: OL50083533)



INST : Min (0.00 ppm) Max (0.01 ppm) | Day Transition | Average (0.000 ppm) | Alarm (INST - High) | Temperature

- Session: 1 (OdaLog: OL50073521)



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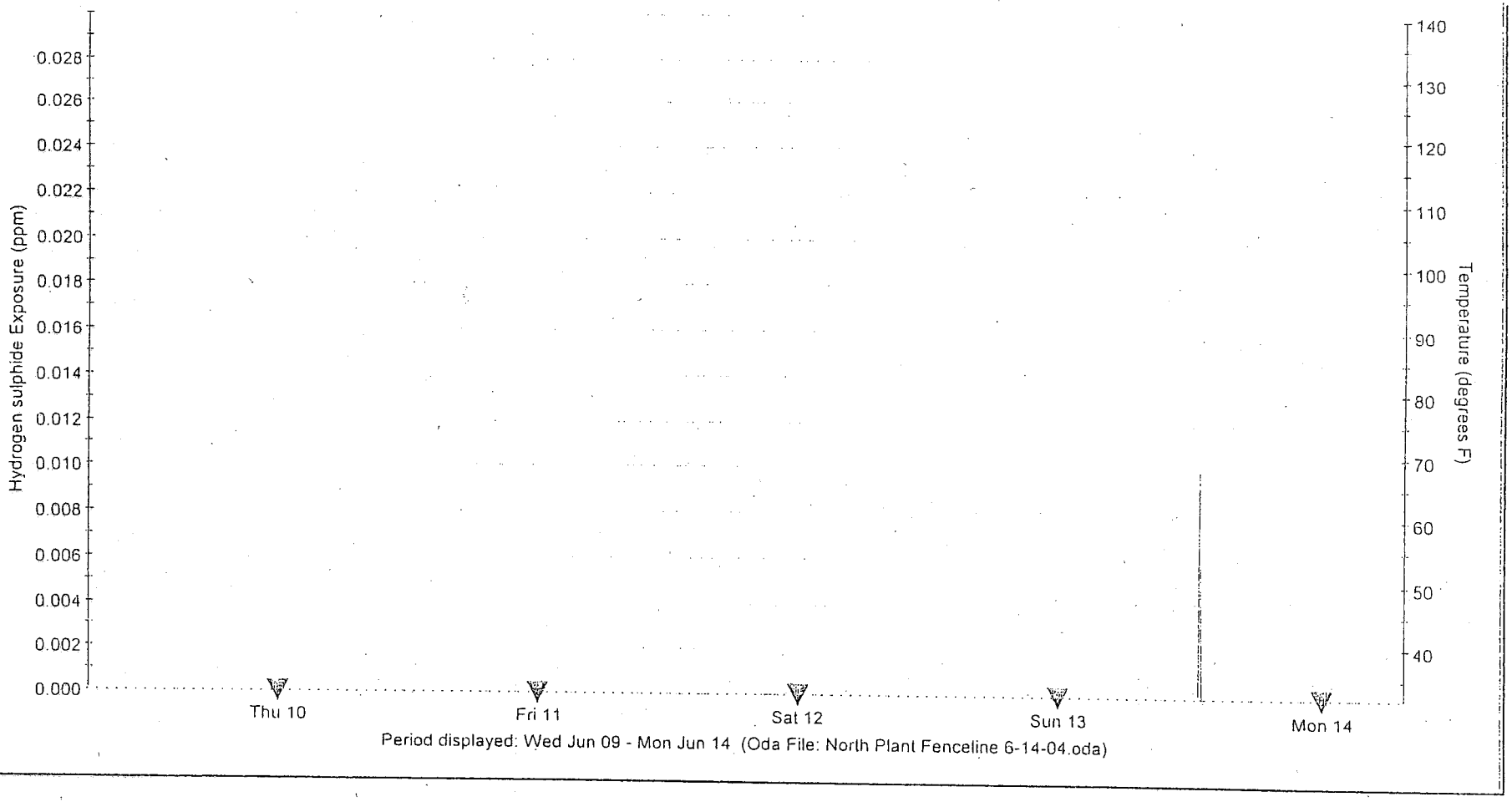
- Session: 1 (OdaLog: OL50083533)



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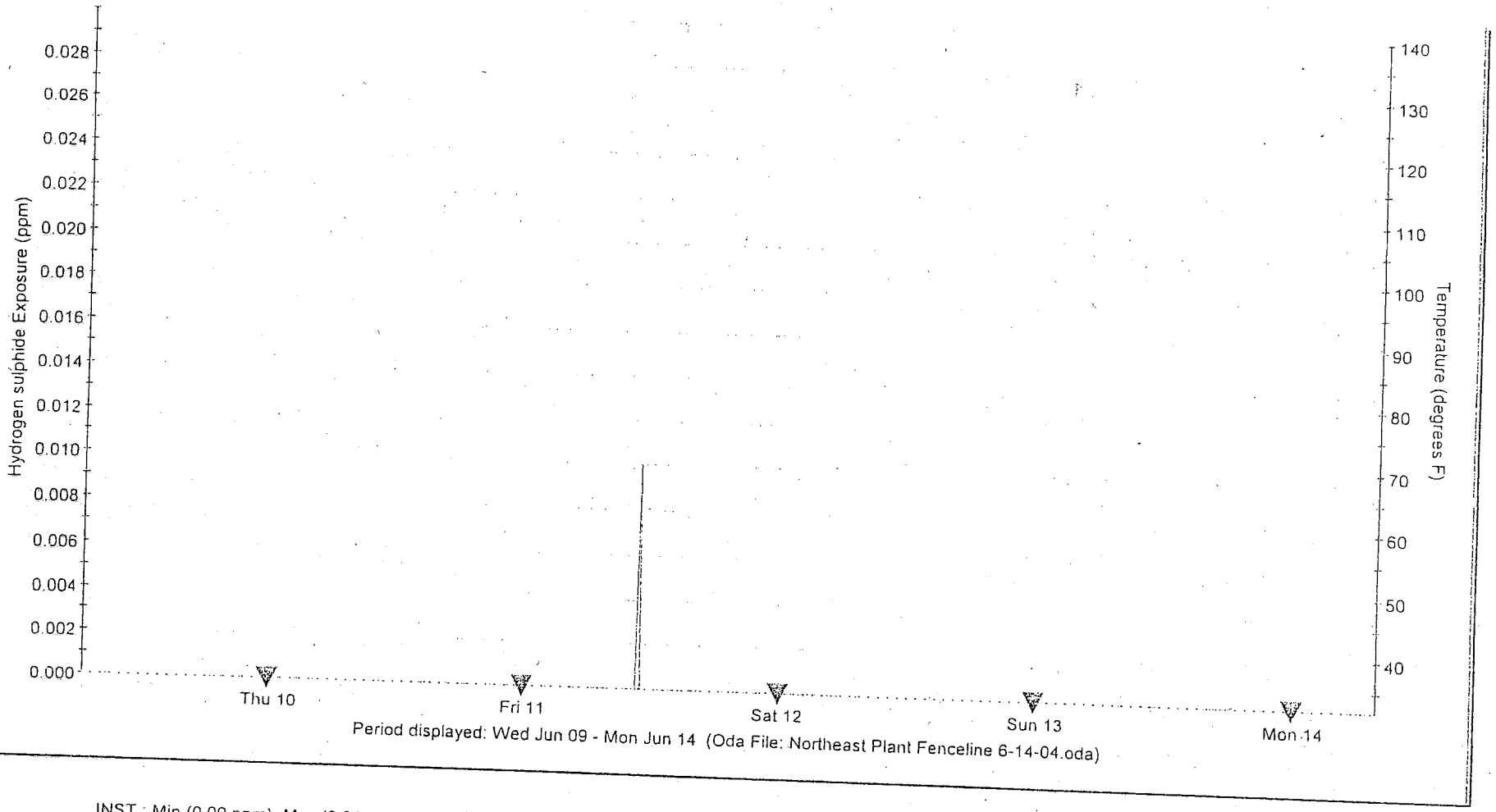
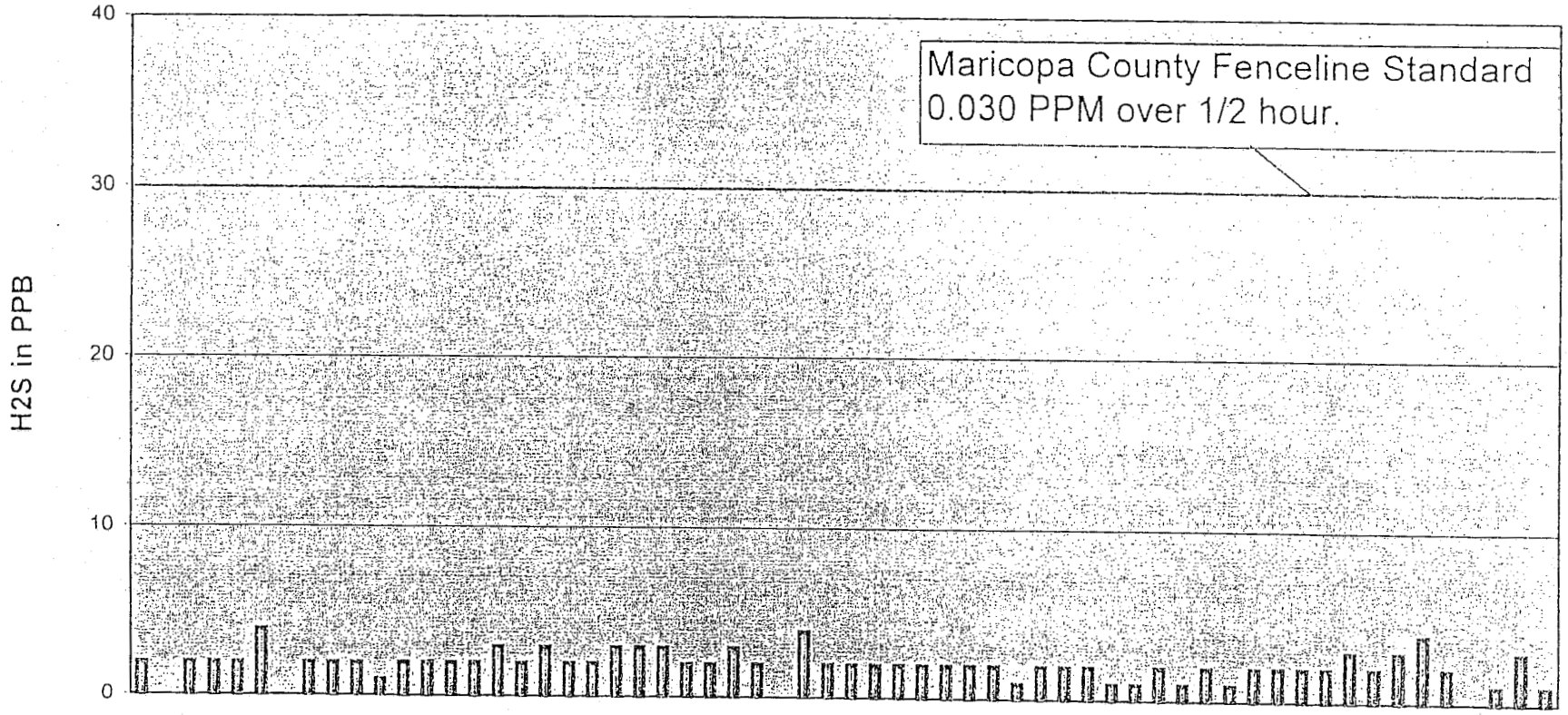
- Session: 1 (OdaLog: OL50073521)



INST : Min (0.00 ppm) Max (0.01 ppm) Day Transition Average (0.000 ppm) Alarm (INST - High) Temperature

CIE Lift Station Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



North Fenceline

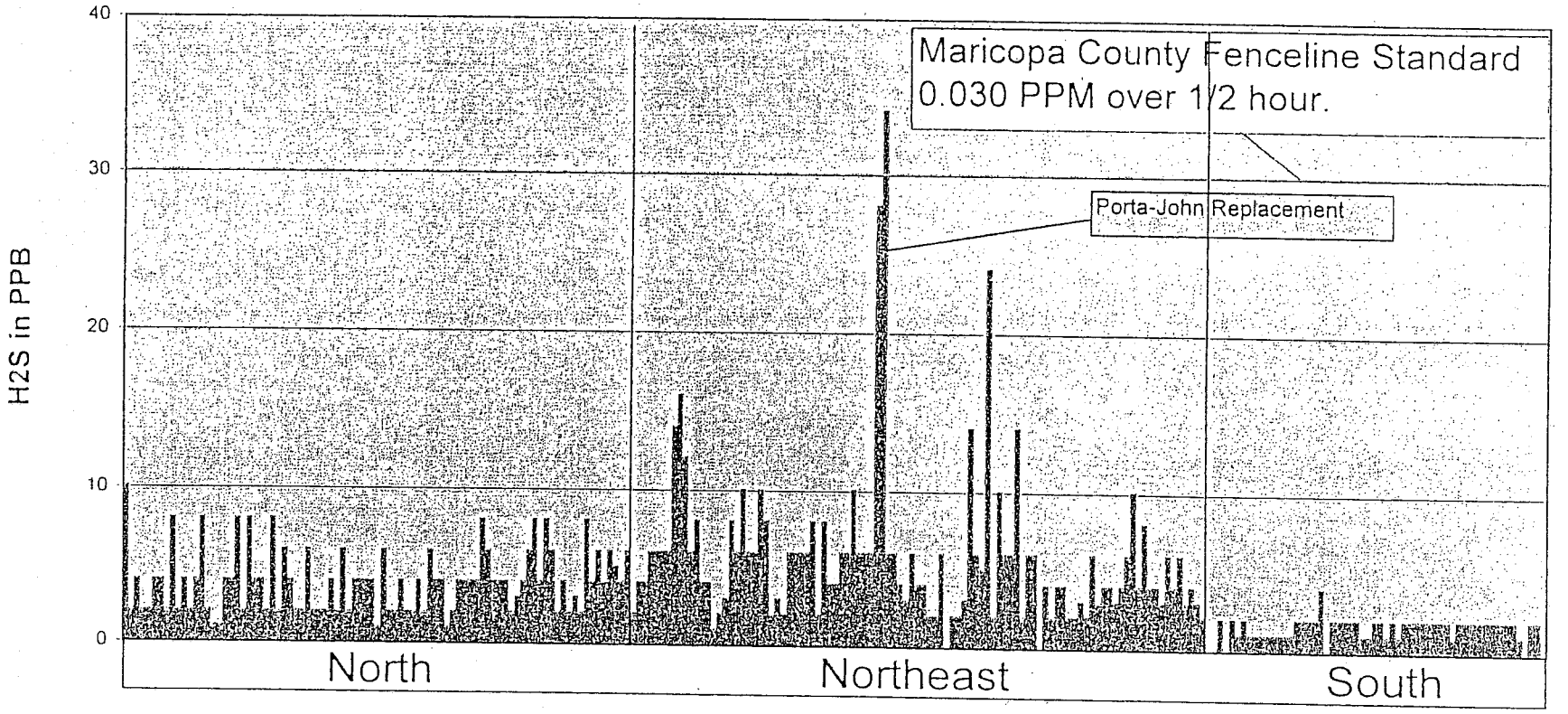
Wind -- Southwest to Northeast at 3-7 mph

Fence

June 8, 2004

The Boulders WRF Fenceline Hydrogen Sulfide Concentrations

PPM H2S Versus Fenceline



Fenceline

Wind -- Southwest to Northeast at 3-7 mph

Fence

June 8, 2004

APPENDIX B

CORRESPONDENCE BETWEEN TOWN OF CAREFREE AND BLACK MOUNTAIN SEWER CORPORATION

TOWN OF CAREFREE

100 EASY STREET
P.O. BOX 740
CAREFREE, ARIZONA 85377
(480) 488-3686 • FAX (480) 488-3845

OFFICE OF THE MAYOR

Mr. Bob Dodds
President
Algonquin Power Systems, Inc.
2845 Bristol Circle
Oakville, Ontario, Canada L6H 7H7

May 25, 2004

Re: Black Mountain Sewer Corporation Collection System
System I.D. #37-105

Dear Mr. Dodds:

Thank you for taking my call yesterday and discussing our mutual concerns regarding the collection system of the Black Mountain Sewer Corporation. I particularly admire an executive who takes calls on a National holiday. As a follow up to our discussion, I wish to provide you additional information relating to sewer odor problems at the Carefree Inn Lift Station and the north Boulders subdivisions. I have listed below some of the factors we discussed and agree need to be addressed by the Black Mountain Sewer Corporation in resolving the existing odor problems in the collection system and noise from the Boulders plant.

1. There are two 6" pressure lines approximately 5,500 feet in length that transport raw sewerage from the Carefree Inn Lift Station to the gravity manhole at the entrance to the Boulders gravity collection system (see attached map). The pump, that pressurizes the system, pumps 200 gpm. At 200 gpm through 2, 6" pipes, the velocity of the raw sewerage in the lines is below the 2 ft/sec required to scour the pipe and keep the solids from settling out. We believe solids have built up in the pressure pipes and are a main contributor to the septic conditions of the discharge. In addition, there are two wet wells and a septic tank at the lift station that are used to hold raw sewerage until it can be pumped. They hold approximately 1500 gallons of raw sewerage. Average pumping time that the pumps operate is about 2.5 minutes each cycle, which means that 66% of the raw sewerage remains in the wet wells all the time allowing time for the sewerage to become septic.
2. The same conditions exist at the Commercial Lift Station except that at this station Thio-guard is injected for odor control. The odor control works for a period of time, but after sitting in the downstream lift station and pressure piping as long as it does, it becomes ineffective.
3. There has been no control over maintenance of grease traps connected to the

collection system and limited cleaning of gravity lines. Buildup in the gravity lines, especially if grease enhanced, is known to contribute to the formation of odors.

4. There is no odor scrubber on the pressure line discharge manhole. The pressure line discharge at the discharge manhole causes surcharging in this and other down stream manholes, forcing odors into the atmosphere.

I offer the following specific suggestions in addressing some of the solutions to these problems.

1. Closing one of the 6" force mains to increase the velocity in the pipe.
2. Using ferric chloride as a odor elimination chemical in place of the Thio-guard.
3. Flushing the pressure line with enough water to vacate the entire line on a regular basis. (10,000 gallons per flushing).
4. Using an odor scrubber at the pressure line discharge manhole.
5. Establishing a program of inspecting the grease traps for proper maintenance.
6. Pressure cleaning gravity sewer lines on a regular basis often enough to eliminate buildup in the system.
7. Install pumps and lines sized to pump the daily flow on a continuing basis.
8. Elimination of the large amount of stored, raw sewerage at each lift station.
9. Find and install acoustical material to soften sound from the plant.

The residents around the lift stations and gravity flow line are extremely frustrated that these problems persist as evidenced by the continuing odor problem. I appreciate your consideration of the above listed issues and your willingness to be present at our June 1, 2004 Council Meeting. It is the Town's opinion that something must be done promptly in resolving the existing odor problems.

Sincerely,

Edward C. Morgan
Mayor

JP: jd

CC: Carefree Town Council
Michael Weber, General Manager, Black Mountain Sewer Corporation
Dale G. Bodiya, Maricopa County Environmental Services Department

June 23, 2004

RECEIVED
JUN 28 2004
Town of Carefree

BW

Mayor Ed Morgan
Town of Carefree
100 Easy Street
P.O. Box 40
Carefree, Arizona 85377

ALGONQUIN
WATER RESOURCES
OF AMERICA, INC.

RE: Nine-Point Odor Improvement Letter Response.

Dear Mayor Morgan,

As requested, please accept this letter as formal response from the Black Mountain Sewer Company (BMSC) in reference to your letter dated May 25, 2004 addressing nine (9) points of interest for consideration as improvements to the Carefree Inn Lift Station and the North Boulder Subdivision. Specifically, these points, as well as some of the preliminary discussion topics, are addressed as follows:

1. *Operating CIE force mains at less than 2 ft/sec* - The CIE Lift Station is currently constructed with one (1) six-inch and one (1) four- inch parallel pressure (force) mains. The two lift station pumps are rated at 255 gallons per minute (gpm) each at 90-feet of total discharge head (ft-tdh) and 320 gpm at 81 feet of total discharge head. The minimum flow rate to achieve the required 2.0 - feet per second (ft/sec) scour velocity in the six- inch main is 160 gpm. The minimum flow rate to achieve the minimum required 2.0 - feet per second (ft/sec) scour velocity in the four - inch main is 70 gpm. By operating both mains in parallel, the total discharge head on the pumps reduces from 90 ft-tdh to 81 ft-tdh. The lower discharge head allows the pumps to operate at an increase flow rate of 320 gpm, which increases the velocity in each of the force mains well above the 2.0 ft/sec requirement.

   The CIE wet-well has a capacity of 150 gallons per foot. The operating level of the wet-well manhole has been adjusted to operate between 6-inches and 4.5 feet or 600 gallons (plus the additional flow from the collection system). The lift station pumps are controlled by level and not by time. The pumps clear the entire contents of the chamber to within 6-inches of the floor each cycle regardless of the time. The time of each pump cycle varies depending on the volume of sewage in the chamber. Therefore the chamber is not 66% full after a pumping cycle as indicated in the letter.

2. *The effective use of Thioguard at the Commercial Lift Station* – Magnesium hydroxide (trade name Thioguard) is currently being used for odor control at the Commercial Lift Station. This chemical is injected into the wet-well and when

Algonquin Water Services, LLC
111 W. Wigwam Road
Suite B
Litchfield Park, AZ 85340

Ph: 623-935-9367
Fax: 623-935-1020

correctly applied, increases the pH of the sewage to a range that inhibits hydrogen sulfide from forming (pH above 8.2). Preliminary data obtained on the BMSC indicates hydrogen sulfide reduction as high as 66% in the collection system from this chemical application. Contrary to the assertion that the chemical becomes ineffective, this chemical actually becomes insoluble at a pH range of 9.0. Once insoluble, the chemical travels in solution with the sewage flow until the pH drops below 9.0, becoming soluble and depositing in the force main until the concentration raises the pH to an insoluble range once again. This process continues through out the collection system, eventually coating the entire piping system and reducing hydrogen sulfide generation throughout. Current data indicates pH readings as high as 9.0 reaching the manhole at Boulders Drive and Quartz drive before entering the plant, supporting the fact that this chemical is not becoming ineffective, but is treating the entire pipeline from Commercial lift station to the treatment plant. Data collection from the odor control study is expected to provide further evidence of this phenomenon.

BMSC has initiated a force main flushing program which utilizes the full wet well capacity which is pumped utilizing two pumps simultaneously, thereby increasing the scour velocity well above the normal operating velocity of the main. The increased scour velocity is more than adequate to remove any existing material deposition in the force main. The increased flow also improves scouring velocity of the receiving gravity sewer main in the North Boulder subdivision. The main flushing is performed on each of the fifteen pumping stations on a semi-monthly basis.

3. *Industrial Pretreatment Program and Sewer Cleaning* – As BMSC has conveyed at previous meetings with the Town Council, BMSC's current tariff issued through the jurisdiction of the Arizona Corporation Commission (ACC) limits the provisions to address industrial pretreatment offenders by refusal to serve those commercial accounts not equipped with pretreatment equipment. As you may be aware, the grease trap apparatus is actually owned and operated by the commercial sewer customer and is not part of the BMSC sewer system. Maintaining these facilities is the sole responsibility of the commercial sewer customer. However, there are responsibilities under more recent Fats Oil and Grease (FOG) regulations that require a minimal effort for the reduction of discharges that lead to excessive material build-up or sewer back-up. By the Town Council adapting an ordinance addressing industrial pretreatment standards, maintenance of these facilities can be mandated and enforced. However, without a Town Ordinance, BMSC can merely suggest methods for controlling and maintaining grease traps in an appropriate manner paralleling the best available practices and industry standards. At this time, whether the methods of control are enacted is the sole discretion of the sewer customer. Attached are materials developed by BMSC for commercial customer distribution to help remind customers of these practices.
As of March of this year BMSC has developed a gravity and force main flushing program. As discussed in item 2 above this program concentrates on flushing and cleaning of two separate areas of the collection system. First, the lift station

and wet-wells of each lift station are allowed to surcharge to its maximum capacity. The wet-wells are flushed by utilizing the maximum pumping capacity of each station. This method allows industry recommended standard scouring velocity to be achieved. Each force main is flushed twice per month as a minimum, or more frequently, on an "as-needed" basis.

The gravity main program includes flushing and cleaning of gravity mains on a repeating basis. Currently, this program is limited to the most problematic areas of the collections system. Once completed, the program will expand to maintain sewer mains of a less problematic nature. The recently completed odor control study will help identify problematic areas by monitoring hydrogen sulfide formations which are an indicator of debris deposition in the mains. The goal of the program is to maintain each gravity sewer main according to best available practices and industry standards.

4. *In Response to item No. 4 of the May 25 letter*, it is unclear what portion of the collection system that is being referred to. However BMSC has commissioned a comprehensive odor control study which will identify any odor emitting situations of the most notable areas of the collection system. Once identified, these areas will be addressed, including physical modifications and improvements that may warrant odor scrubbing technology as suggested.

In reference to the four points above, BMSC offers the following comments to the nine specific suggestions noted as solutions to the noted problems as foreseen by the Town of Carefree.

1. *Closing one 6-inch main to increase the velocity in the pipe.* As noted in the first point above, it appears that closing off the 6-inch force main may actually change the operating performance of the pumps, increasing the total discharge head and reducing the pumping rate leading to a decrease in the velocity in the force main. Once the odor control study is complete, BMSC will analyze the data to determine if there are indicators of debris deposition in the force main. If so, BMSC will look at opportunities to increase velocity to industry standard levels which discourage deposition of material in the force main.
2. *Using ferric chloride as an odor elimination chemical in place of the Thio-guard.* To date the decision to use Thio-guard (magnesium hydroxide) in the collection system has proven to be very effective at managing hydrogen sulfide in the collection system. As is the situation at the Commercial Lift Station, magnesium hydroxide is an effective odor deterrent to odor formation in situations that offer a method of treatment before hydrogen sulfide is ever formed. When properly applied, this chemical can eliminate the formation of hydrogen sulfide at its point of application as well as at he receiving collection system. Ferric Chloride on the other hand, can only treat hydrogen sulfide after formation. Therefore the addition of magnesium hydroxide at the commercial lift station is a proactive measure that maintains an environment in the collection system that discourages hydrogen sulfide from ever forming, whereas ferric chloride must be added at a point after

hydrogen sulfide is formed. In addition, this chemical is much more dangerous to handle, is hazardous, is corrosive to the collection system infrastructure and is detrimental to the receiving biological treatment process. The use of this chemical as a final point of application at the treatment plant may be evaluated as part of the odor control study. BMSC is confident with its selection of odor control chemical at this time.

3. *Flushing the pressure line with enough water to vacate the entire line on a regular basis (10,000 gallons per flushing)*. As noted in item 2 above, the BMSC has adapted line flushing programs for both force main as well gravity mains. However, the odor control study should present evidence that material deposition indicators are present. If warranted, BMSC will make appropriate measures to improve scouring velocities in this force main which may include increasing the volume of media pumped into the force main to clear debris deposition.
4. *Using an odor scrubber at the pressure line discharge manhole*. Although the exact location point of application referenced in the letter is unclear, BMSC will not rule out any warranted improvement as deemed necessary through the odor control study, which may include physical improvements such as the application of odor scrubbing technologies.
5. *Establishing a program of inspecting the grease traps for proper maintenances*. BMSC favors the proactive measure of grease trap inspection. However it is BMSC position that for this program to be effective, the Town of Carefree needs to pass an industrial pretreatment ordinance that gives BMSC the authority for inspection as well as enforcement actions for non compliance. BMSC has prepared the attached informational documents to be mailed to each customer in support of informing commercial sewer customers of the standard practices for control and maintenance of their grease traps.
6. *Pressure cleaning gravity sewer lines on a regular basis often enough to eliminate buildup in the system*. As mentioned in point No. 3 above, the gravity main flushing program incorporated in March of this year, includes flushing and cleaning of gravity mains on a repeating basis. Currently, this program is limited to the most problematic areas of the collections system. Once completed, the program will expand to maintain sewer mains of a less problematic nature. The recently completed odor control study will help identify problematic areas by monitoring hydrogen sulfide formations which are an indicator of debris deposition in the mains. The goal of the program is to maintain each gravity sewer main in accordance with the best available practices and industry standards.
7. *Install pumps and line sized to pump the daily flow on a continuous basis*. The implementation of continuous pumping systems (Variable Frequency Drive or VFDs), are only applicable to higher flows, which are not experienced in the BMSC collection system. Current flows in to the BMSC wastewater treatment plant average 79,000 gallons during the summer months and nearly 140,000 gallons during the winter months. If all of this flow ran through a single pump station equipped with VFDs a continuous pumping rate of 100 gallons per minute (gpm) for winter months and 55 gallons per minute during summer months would be required. These flow rates are well below the recommended scour velocity for a standard 6-inch main (160 gpm). Since this is not the case and the majority of the

flow is pumped during a 12-hour period, the application of continuous flow pumps would lead to the same operating scenario as the intermittent pumping system currently used and the pumps would still shut off during low flow periods.

Moreover, continuous pumping systems can increase odor problems due to long detention times in the wet-well, since the pumps operate by maintaining a minimum wet-well level at all times. Also continuous pumping systems can reduce scour velocity in the mains as flow rates are reduced to maintain the minimum wet-well levels. Conversely, intermittent pumping systems such as those employed in the BMSC collection system, actually help reduce odors by reducing detention time in the wet well (as the pump systems are operated to pump to nearly empty wet-well level each pumping cycle), and maximizing the velocity introduced to the collection system by maintaining maximum flow rates at all times during the pumping cycle. For the minimal flows involved, BMSC maintains that the intermittent pumping systems are the most appropriate for optimal odor control.

8. *Elimination of large amounts of stored, raw sewage at each lift station*. As previously communicated to the Town, this evaluation was completed nearly six months ago and operational changes have been employed at most of the lift stations. For example, the CIE lift station has a wet well that can operate between 0 and 10 feet. This operating level has been changed to 0.5 to 4 feet. BMSC has incorporated these operation changes to significantly reduce the detention time of the raw sewage in the wet-wells even though the changes have increased the operating cost and the amount of energy used as the number of pumping cycles have increased significantly.
9. *Find and install acoustical material to soften sound from the plant*. As discussed at the public council meeting on June 1st, BMSC has been proactively investigating the sound issues at the BMSC WWTP. A Phase I report was issued in draft form outlining the decibel levels at various points around the plant, as well as proposed improvement to various sound emitting equipment. Currently specifications and installation details are being developed by the third party engineering firm of Damon S. Williams and Associates (DSWA). As noted in the attached project timeline, specifications should be received in the next thirty days and construction will begin shortly thereafter.

As presented in the December 12, 2003 meeting between BMSC staff and Town Council Members, BMSC's resolution of the odor issue will require a balanced approach of treating each of the aesthetic issues in combination with sustaining complete odor control in all problem areas. BMSC continues to address aesthetic issues by a combination of physical; chemical and mechanical improvements required to eliminate sewer conditions which promote odor formation and eliminate fugitive emissions from odor collection and treatment systems. The goal of this effort is to modify operating conditions to reduce odor causing compounds to minimal levels, record these levels and modify the existing odor control equipment to mitigate these levels with efficiency. As noted in the attached odor improvement timeline, to date, we have completed operating adjustments and

modifications to the system that represents normal operating conditions. The odor control study initiated June 3, 2004 will record these conditions. From this information, adjustments and modifications to the odor control systems will be made which will achieve and maintain odor control within regulatory guidelines.

As discussed in our December 12, 2003 meeting with Town staff, the aesthetic improvement schedule will take some time to complete. I have attached a project time line which references our proactive agenda along with noted projections to our on-going efforts.

As is evidenced by the numerous improvements previously completed and recognized by the Town, BMSC is committed to being a good neighbor in the Carefree community. BMSC is committed to continuing to operate and maintain the plant and appurtenant facilities in compliance with all regulatory requirements. We will continue to work diligently with environmental regulatory agencies, Town officials and community representatives to achieve an operation which is performing within all laws and regulation and is aesthetically acceptable to the surrounding community. If you have any questions, please contact our office at 480-575-7303.

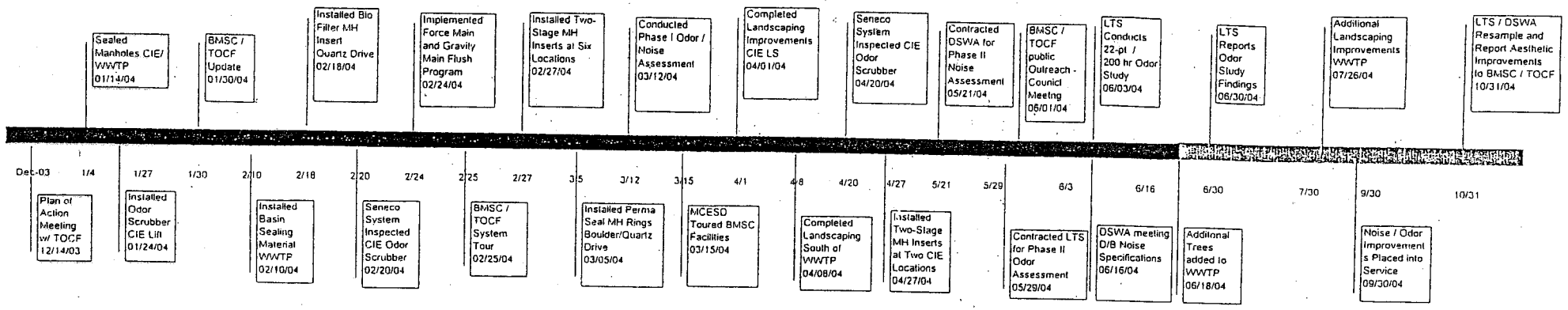
Sincerely,
Black Mountain Sewer Company

Joel L. Wade
Manager of Engineering and Construction
Algonquin Water Services, L.L.C.

JLW/jlw : BMSC omprovements

cc:
Michael D. Weber P.E., General Manager Algonquin Water Services, L.L.C.
Bob Dodds P.E., President, Operations Algonquin Power Services, L.L.C.
Charlie Hernandez – Operations Manager Algonquin Water Services, L.L.C.

Aesthetic Improvement Timeline
Black Mountain Sewer Company
12/03 - 10/04



June 30, 2004

Spanish Village
Acct No. 1000872
5050 N. 40th St. Suite 260
Phoenix AZ, 85018

ALGONQUIN
WATER RESOURCES
OF AMERICA, INC.

Attn: Commercial Account Sewer Discharger

RE: BMSC – FATS OIL AND GREASE (FOG) REDUCTION PROGRAM

The discharge of fats, oils, and grease (FOG) is a leading cause of sewer spills. This letter is being sent to you to inform you of Black Mountain Sewer Company's (BMSC's) on-going efforts to reduce the risk of outfall or sewer spills from grease accumulation in the sewer mains. To prevent this material from entering the sewer system, BMSC requires commercial customers discharging high levels of FOG to install grease removal equipment. To ensure that this equipment functions effectively, restaurants and FOG discharges must periodically remove accumulated FOG and food solids from these devices. Restaurants and other high FOG dischargers, frequently utilize commercial pumping contractors to clean their grease removal equipment and properly dispose of the removed material. It is the sole responsibility of the commercial sewer account to properly document the proper maintenance of these devices.

The material pumped from the grease removal equipment is comprised of grease, fats, oils, trash, food solids, and water. Because of the high levels of grease, fats, and oils in this waste stream, the pumped material cannot, under any circumstances, be discharged to the environment or into the sewer system. A licensed commercial waste hauler may be used to properly maintain and dispose of industrial strength waste from sewer grease trap/interceptors.

Furthermore, the practice of discharging treated or untreated wastewater from a pumping vehicle into the sewer without permission of the BMSC is strictly prohibited. **The practice of decanting or discharging wastewater from any device back into grease traps or interceptors constitutes an unauthorized discharge.** Furthermore, discharges of pumped grease trap or interceptor wastewater to other un-permitted locations, such as carwash interceptors or manholes, is also prohibited. Unauthorized trucked waste discharges and the failure to obtain the required permit are prohibited under local and federal laws; violations may result in enforcement procedures up to and including civil or criminal penalties.

The attached flyer illustrates guidelines associated with the on-going FOG reduction program. Please help us protect the environment by properly operating and maintaining your grease collection system. For more information on the community-wide FOG reduction program, please contact the BMSC customer service line at 480-575-7303.

Thank you for your support.

Black Mountain Sewer Company

Algonquin Water Services, LLC
111 W. Wigwam Road
Suite B
Litchfield Park, AZ 85340

Ph: 623-935-9367
Fax: 623-935-1020

Black Mountain Sewer Company

Fats Oils and Grease (FOG)

Fats, Oil and Grease (FOG) discharged into the sanitary sewer by commercial or industrial users can cause a number of problems in the sewer system. Grease & oil have poor solubility and tend to separate from the aqueous phase. Although this characteristic is advantageous in facilitating the separation of oil & grease in pretreatment devices such as grease traps and interceptors, it complicates the transportation of wastes in the sewer and can complicate treatment and disposal at the wastewater treatment plant.

FOG in wastewater from food service facilities can result in decreased carrying capacity of sewers due to congealed, cooled grease which coats the inside of the pipes. Once a pipe becomes constricted, the potential for a stoppage increases. Stoppages can and will eventually cause sanitary sewer overflows. In order to ensure efficient sewage treatment, protect the sewer system and protect public health, the Black Mountain Sewer Company (BMSC) has established the following requirements for all commercial business accounts:

General Requirement

Any type of business where oil and grease may be discharged into a public sewer shall have an interceptor/trap. The interceptor or trap shall be of a type and capacity approved by BMSC.

a. Each interceptor or trap shall be accessible at all times for inspection, cleaning and removal of grease and other material. Interceptors or traps installed outside of the building shall be constructed in such a manner so as to exclude the entrance of surface water and storm water.
b. The interceptor or trap shall be situated on the User's premises. Operation and maintenance of the trap is the sole reasonability of the commercial sewer account.
c. Building repair or remodels permitted for use requiring interceptors/traps shall be subject to these regulations.
d. Waste discharges from fixtures, including but not limited to, scullery sinks, pot and pan sinks, mop sinks, soup kettles and floor drains, shall be drained into the sanitary sewer through an interceptor/trap. Toilets, urinals and other similar fixtures shall not drain through the interceptor/trap.
e. Interceptors and traps shall be maintained in efficient operating condition. At minimum, grease traps must be **cleaned monthly** or as deemed necessary by the Industrial Waste Inspector. The use of chemicals, bacteria or other agents to dissolve grease or otherwise clean grease interceptors/traps is specifically prohibited. No such grease shall be introduced into any drainage piping leaving the premises, or public or private sewer.
f. Large capacity concrete type interceptors (500-gallon capacity or greater) shall have a suitable sample box to provide access for collection of wastewater samples. Large interceptors must be serviced every three-months or as deemed necessary by the industrial waste inspector.
g. Each appliance connected to a pre-cast under sink type grease trap shall have a flow device installed. No dishwashers may be connected to these types of grease traps.
h. A record of grease trap cleaning or copies of grease interceptor servicing must be maintained for the previous twelve-month period and made available for inspection by the BMSC's representative (sample form attached).

Additional Information

For additional information on limiting FOG into the sewer system, please contact the BMSC Customer Service line at (480)-575-7303.

Frequently Asked Questions (FAQ)

About

Fats Oil and Grease - (FOG)

Is FOG a problem in Our Area?

For sewage collection and treatment of commercial business, the answer is an emphatic YES! FOG is singled out for special attention because of its poor solubility in water and its tendency to separate from the liquid solution.

Large amounts of fats oil and grease in the wastewater cause trouble in the collection system pipes. FOG decreases pipe capacity and, therefore requires piping systems to be cleaned more often and in some cases, replaced sooner than otherwise expected. FOG can also hamper effective treatment and odor control at the wastewater treatment facilities.

FOG in a warm liquid may not appear harmful. But, as the liquid cools, the grease or fat congeals and causes nauseous mats on the surface of settling tanks, digesters, in the wet wells of pumping stations, and the interior of pipes and other surfaces which may cause a shutdown of wastewater treatment units.

Problems caused by wastes from restaurants and other FOG-producing establishments have served as the basis for ordinances and regulations governing the discharge of grease materials to the sanitary sewer system. This type of waste has forced the requirement of the installation of preliminary treatment facilities, commonly known as grease traps or interceptors.

What is a grease trap and how does it work?

A trap is a small reservoir built into the wastewater piping a short distance from the grease producing area. Baffles in the reservoir retain the wastewater long enough for the grease to congeal and rise to the surface. The grease can then be removed and disposed properly.

What is a grease interceptor?

An interceptor is a vault with a minimum capacity of between 500 and 750 gallons that is located on the exterior of the building. The vault includes a minimum of two compartments, and flow between each compartment is through a 90° fitting designed for grease retention. The capacity of the interceptor provides adequate residence time so that the wastewater has time to cool, allowing any remaining grease not collected by the traps time to congeal and rise to the surface where it accumulates until the interceptor is cleaned.

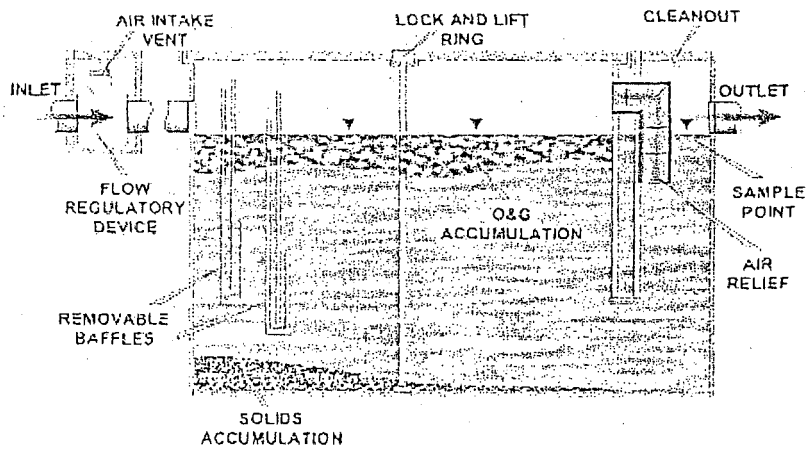
How do I clean my grease trap?

Grease trap maintenance is usually performed by maintenance staff, or other employees of the establishment. Grease interceptor (GI) maintenance, which is usually performed by permitted haulers or recyclers, consists of removing the entire volume (liquids and solids) from the GI and properly disposing of the material in accordance with all Federal, State, and/or local laws. When performed properly and at the appropriate frequency, grease interceptor and trap maintenance can greatly reduce the discharge of fats, oil, and grease (FOG) into the wastewater collection system.

The required maintenance frequency for grease interceptors and traps depends greatly on the amount of FOG a facility generates as well as any best management practices (BMPs) that the establishment implements to reduce the FOG discharged into its sanitary sewer system. In many cases, an establishment that implements BMPs will realize financial benefit through a reduction in their required grease interceptor and trap maintenance frequency. WARNING! Do not use hot water, acids, caustics, solvents, or emulsifying agents when cleaning grease traps and interceptors.

Grease Trap Maintenance

A proper maintenance procedure for a grease trap is outlined below:



Step	Action
1.	Bail out any water in the trap or interceptor to facilitate cleaning. The water should be contained and should not be discharged into the sanitary sewer if the Oil and Grease concentration is greater than 50 parts per million (ppm). Any discharges into the sanitary above 50 ppm is not allowed and should be disposed of by a professional waste handler.
2.	Remove baffles if possible.
3.	Dip the accumulated grease out of the interceptor and deposit in a watertight container.
4.	Scrape the sides, the lid, and the baffles with a putty knife to remove as much of the grease as possible,

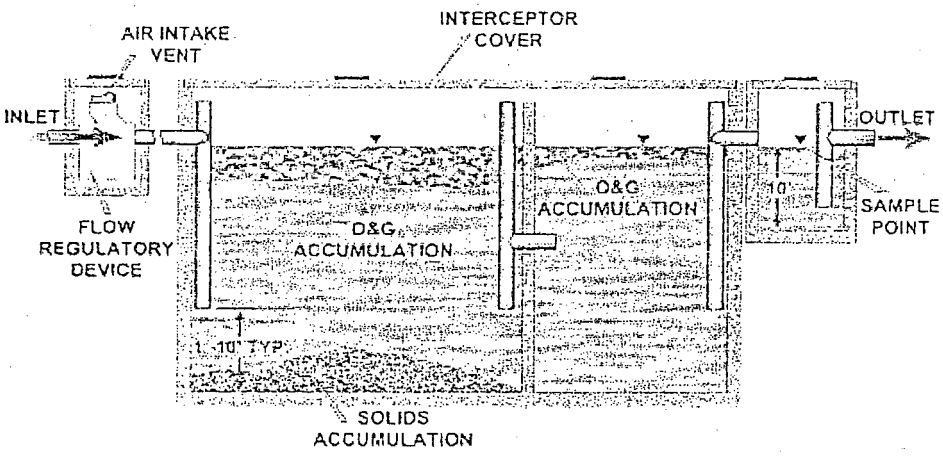
	and deposit the grease into a watertight container.
5.	Contact a hauler or recycler for grease pick-up.
6.	Replace the baffle and the lid.
7.	Record the volume of grease removed on the maintenance log.

Grease Interceptor Maintenance

Grease interceptors, due to their size, will usually be cleaned by grease haulers or recyclers. Licensed septage haulers can also pump out grease interceptors and haul the waste to the treatment plant. There are a number of companies who are permitted to haul and dispose of FOG.

A proper maintenance procedure for a grease interceptor is outlined below:

NOTE: Since the establishment is liable for the condition of their pretreatment devices, the establishment owners/representatives should witness all cleaning/maintenance activities to verify that the interceptor is being fully cleaned and properly maintained.



Step	Action
1.	Contact a grease hauler or recycler for cleaning.
2.	Ensure that all flow is stopped to the interceptor by shutting the isolation valve in the inlet piping to the interceptor.
3.	Remove the lid and bail out any water in the trap or interceptor to facilitate cleaning. The water should be discharged to the sanitary sewer system.

4.	Remove baffles if possible.
5.	Dip the accumulated grease out of the interceptor and deposit in a watertight container.
6.	Pump out the settled solids and then the remaining liquids.
7.	Scrape the sides, the lid, and the baffles with a putty knife to remove as much of the grease as possible, and deposit the grease into a watertight container.
8.	Replace the baffle and the lid.
9.	Record the volume of grease removed on the maintenance log.

Can you recommend a maintenance schedule?

All grease interceptors should be cleaned ***at least once each month***. Some establishments will find it necessary to clean their traps *more often than twice per month*. If the establishment is cleaning too often, the owner should consider installing a larger trap or interceptor.

Do I have a grease trap?

If the establishment is uncertain whether it has a grease trap, the owner should contact the Black Mountain Sewer Company (480)-575-7303 for a scheduled inspection.

Do I need a grease trap?

Any establishment that introduces grease or oil into the drainage and sewage system in quantities large enough to cause line blockages or hinder sewage treatment is required to install a grease trap or interceptor.

Interceptors are usually required for high volume restaurants (full menu establishments operating 16 hrs/day and/or serving 500+ meals per day) and large commercial establishments such as hotels, hospitals, factories, or school kitchens. Grease traps are required for small volume (fast food or take-out restaurants with limited menus, minimum dishwashing, and/or minimal seating capacity) and medium volume (full menu establishments operating 8-16 hrs/day and/or serving 100-400 meals/day) establishments. Medium volume establishments may be required to install an interceptor depending upon the size of the establishment.

Is the grease trap I have adequate?

The Uniform Plumbing Code requires that no grease trap have a capacity less than 20 gallons per minute (gpm) or more than 55 gpm. The size of the trap depends upon the number of fixtures connected to it. The following table provides criteria for sizing grease traps:

Total number of fixtures connected	Required rate of flow, gpm	Grease retention capacity, lbs
1	20	40
2	25	50
3	35	70
4	50	100

The size will also depend largely upon the maintenance schedule. If a grease trap or interceptor is not maintained regularly it will not provide the necessary grease removal. The establishment should work out a specific cleaning schedule that is right for the establishment. All grease traps need to have the grease cleaned out periodically and no one likes to do the job. It is a dirty job. Running extremely hot water down the drain only moves the problem down stream. It does not go away. Catch the grease at the source! This is the most economical means to reduce *all* costs.

What if I don't install a grease trap?

If the establishment uses grease and oil in food preparation, it will eventually encounter a maintenance problem with a plugged building sewer line. The blockage can create a sewer backup situation and ultimately a potential health problem in the establishment. Someone will have to pay for removing the blockage. If the problem is in the building sewer line, then the establishment has direct responsibility for paying for the maintenance. If the blockage or restriction is in the public sewer main and it can be proven that the establishment is the cause of the blockage, then the establishment may have to pay for the public sewer to be maintained. Blocking a sanitary sewer line is also a violation of the federal Clean Water Act.

Who determines if I need a grease trap or interceptor?

An approved grease trap or interceptor shall be installed according to the Uniform Plumbing Code, Maricopa County Environmental Services Department (MCESC) or the Arizona Department of Environmental Quality
The rules of the Health Department will also assist the establishment in determining if a grease trap or interceptor is required. The BMSC prohibits the

discharge of materials that can solidify and create blockages in the wastewater collection system or treatment plants. The BMSC, MCESD or ADEQ may make periodic inspections to see that no health problems exist due to improperly maintained grease interceptors. These agencies may enforce if a problem exists.

How can I get in compliance?

The establishment should contact the BMSC (480)-488-2987. This will enable the proper jurisdiction to assist the developer with design standards, establishment of cleaning schedules or advise of any problems showing up in the wastewater collection system. Along with sewer tap inspections, a grease interceptor inspection is required regardless of whether the establishment has an existing trap or is installing a new one.

What are the criteria for inspecting grease traps?

All food service establishments suspected of causing problems to the collection system or treatment facilities will be inspected. The inspector will use the following criteria to inspect grease traps:

Percent of Trap Filled	Trap Condition
25	Good
25 – 50	Fair
>50	Poor

If the trap is in FAIR condition, the establishment should be advised to keep an eye on the maintenance schedule. The cleaning frequency may need to be increased. If the trap is in POOR condition, the establishment should be issued a compliance order to have it cleaned immediately. The establishment should then be required to contact the issuing authority within 30 days to verify that the grease interceptor has been properly cleaned.

Commercial Accounts

Spanish Village
5050 N 40th Street Suite #260
Phoenix 85018

El Pedregal
34505 Scottsdale Road
Scottsdale, AZ 85262

Bakery Cantina
2515 N. Scottsdale Suite #1
Scottsdale AZ 85257

Pia's
PO Box 5443
Carefree, AZ 85377

Bad Donkey
PO Box 5292,
Carefree, AZ 85377

Basha's
PO Box 488
Chandler AZ 85244

Pizzafarro's
2800 N. Central Suite #1500
Phoenix AZ 85004

Flap Jacks
2800 N. Central Suite #1500
Phoenix AZ 85004

China Joy
2800 N. Central Suite #1500
Phoenix AZ 85004

English Rose Tea Room
PO Box 5865
Carefree, AZ 85377

Boulders
PO Box 2090
Carefree, AZ 85377

Carefree Inn

37220 N. Mule Train
Carefree, AZ 85377
Trattoria Romania / Carefree Plaza
PO Box 921
Carefree AZ, 85377

Carefree water Company

Memo

RECEIVED
JUN 29
Town of Carefree

To: E. Morgan

From: S. Francom

CC: G. Gardner, J. Pearson

Date: June 29, 2004

Re: Black Mountain Sewer – Letter of June 23, 2004

Assuming that everything in the above referenced letter is true there are some obvious information that has been excluded that I believe needs response and indicates that Black Mountain still has not fully addressed their system problems.

There is approximately 6,200 feet of 4" and 6" sewer pressure line between the CIE lift station and the first manhole inside the Boulders. That much line would hold approximately 8,620 gallons of sewerage. If the CIE lift station pumps 30,000 to 40,000 gallons average per day and pumps approximately 600 gallons each time it pumps at a rate of 320 gallons per minute that equates to the line being evacuated 3.5 to 4.6 times every 24 hours. At 320 gallons per minute it would take about 27 minutes of constant pumping to vacate the line . Under the conditions as described in the letter, the pumps would run each time they turned on less than two minutes. It is evident that there is sewerage sitting in the line for an extended period of time. They indicated that the pH as tested in the manhole at Quartz Valley and Boulder Drive is as high as 9.0 which indicates that the sewerage could not smell because of the residual capability of the Thioguard, However the sewerage stream still stinks and as a result they have sealed all the manholes. Either the pH reading is incorrect, Thioguard does not work as they believe or the Thioguard is not in the sewerage stream in the quantities they have indicated.

As to the flushing of the CIE and other lift stations, unless additional water is introduced at the time of the flushing I cannot see that normal sewerage flow would be sufficient to flush the 8,520 gallons of setting sewerage from the pressure line. They indicated that the CIE lift station containment capacity was 150, gallons /ft that would mean that they would have to have approximately an equivalent of 57 feet of wet well to have sufficient water to empty the pressure line. I do not believe that the pressure line has ever really been totally flushed out. It would be so easy just to do it instead of arguing about what they have done or not done.

I know that there was in place in the Boulder Sewer Company's filing with the Arizona Corporation Commission a far reaching Requirement of Service document. That document contained strong limitations as to the type of sewerage the sewer company would take. Included in that document were limitations as to the temperature, BOD strength, fat and oil content and specific prohibitions on chemicals and other products. That document was used by the Boulders Sewer to regulate private and commercial discharges into the collection system and was used to cause the cleaning of grease traps by restaurants and public cooking and baking facilities. It was used to eliminate discharge of photo developing

chemicals and chlorine discharges to the collection system. That document must still be in place and is a matter of public record I would presume.

Finally, I believe at the Commercial Lift Station there is still in place a large septic tank between the manhole on Ho Street and the new wet well manhole at the lift station which might be affecting the septic condition of the sewerage.

BLACK MOUNTAIN SEWER CORPORATION

Mayor Edward C. Morgan
Town of Carefree
PO Box 740
100 Easy Street
Carefree, Arizona 85377

August 10, 2004

TC
JP
BW

RECEIVED
AUG 12 2004
Town of Carefree

Re: Black Mountain Sewer Company - Action Plan

Dear Mayor Morgan,

As agreed upon during the August 3, 2004 Town of Carefree council meeting, I am pleased to provide you the action plan presented as **Figure 1**, below. This plan is based on the recommendations of the recently completed odor study conducted by Lamb Technical Services. Black Mountain Sewer Company (BMSC) remains committed to continuing the numerous improvements the Town has already recognized as having significantly improved the situation which we inherited from the prior owners and believes these projects will further eliminate the minor odors that might exist at the plant site and within the collection system.

This action plan provides for the installation of additional sealing material at the plant site, sound attenuation material at the plant site, and an additional chemical feed station in the collection system.

ID	Task Name	Duration	Start
1	**Sound / Odor Improvements**	**35 days**	**Mon 8/9/04**
2	Delivery of fan cover	10 days	Mon 8/9/04
3	Install fan cover	1 day	Mon 8/23/04
4	Delivery of Louvers	30 days	Mon 8/9/04
5	Install Louvers	5 days	Mon 9/20/04
6	Delivery of New Grating	15 days	Mon 8/9/04
7	Install New Grating	2 days	Mon 8/30/04
8	Delivery of Sound Material	10 days	Mon 8/9/04
9	Install Sound Material	10 days	Mon 8/23/04
10	**Sage Brush Chem Feed**	**22 days**	**Mon 8/9/04**
11	Site Prep	2 days	Mon 8/9/04
12	Equipement Install	3 days	Wed 8/11/04
13	Electrical Improvments	10 days	Mon 8/16/04
14	Start-up and Testing	7 days	Mon 8/30/04

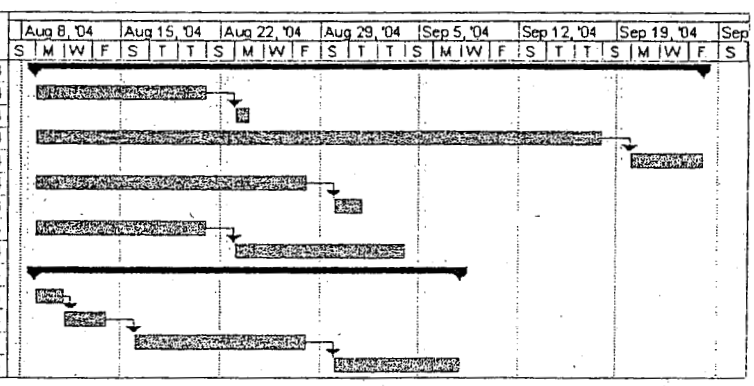


Figure 1 - Timeline for Odor Improvements

Black Mountain Sewer Co.
PO Box 459
Litchfield Park, AZ, 85340

Telephone: (623) 935-9367 Facsimile: (623) 935-1020

As we had discussed, BMSC believes that its long standing record of complete regulatory compliance and its past commitment to resolving this situation as evidenced by the numerous improvements implemented to date, demonstrate our good faith efforts in this matter. Unfortunately, the Town has chosen to condition the signing of the operating agreement upon resolution of the perceived odor situation and indicated in the most recent council meeting that resolution would be deemed achieved only when the Town received a letter from the Boulders Home Owners Association indicating complete satisfaction with the situation. BMSC believes this to be an unrealistic, unachievable goal and further believes that the Town is unduly and unreasonably withholding the operating agreement. Consequently, before any future improvements will be considered, BMSC and the Town must enter into an operating agreement.

Should you need to discuss this matter further, please do not hesitate to call. Thank you for your time and consideration.

Very truly yours,

Michael D. Weber

Michael D. Weber, P.E.
General Manager

Carefree Water Company

Memo

To: E. Morgan

From: S. Francom

CC: J. Pearson

Date: August 17, 2004

Re: My response to Black Mountain Sewer's letter re the "Action Plan" as a result of Lamb's odor study

---

First I want to say that Lamb's study was quite complete however he has one glaring mistake that could and will effect odors in the Boulder. He states that the pressure line discharge form the CIE lift station into the gravity line occurs at the manhole located at Century and Boulders Drive and at that location he encountered concentrations of 700 PPM. The actual discharge point is the manhole located at Boulders Drive and Ironwood and if the concentration of odors remains equal or higher at that location there will be a problem at that intersection. I do not know why he was told that Century Way was the discharge point unless there were odor complaints and he investigated that location only.

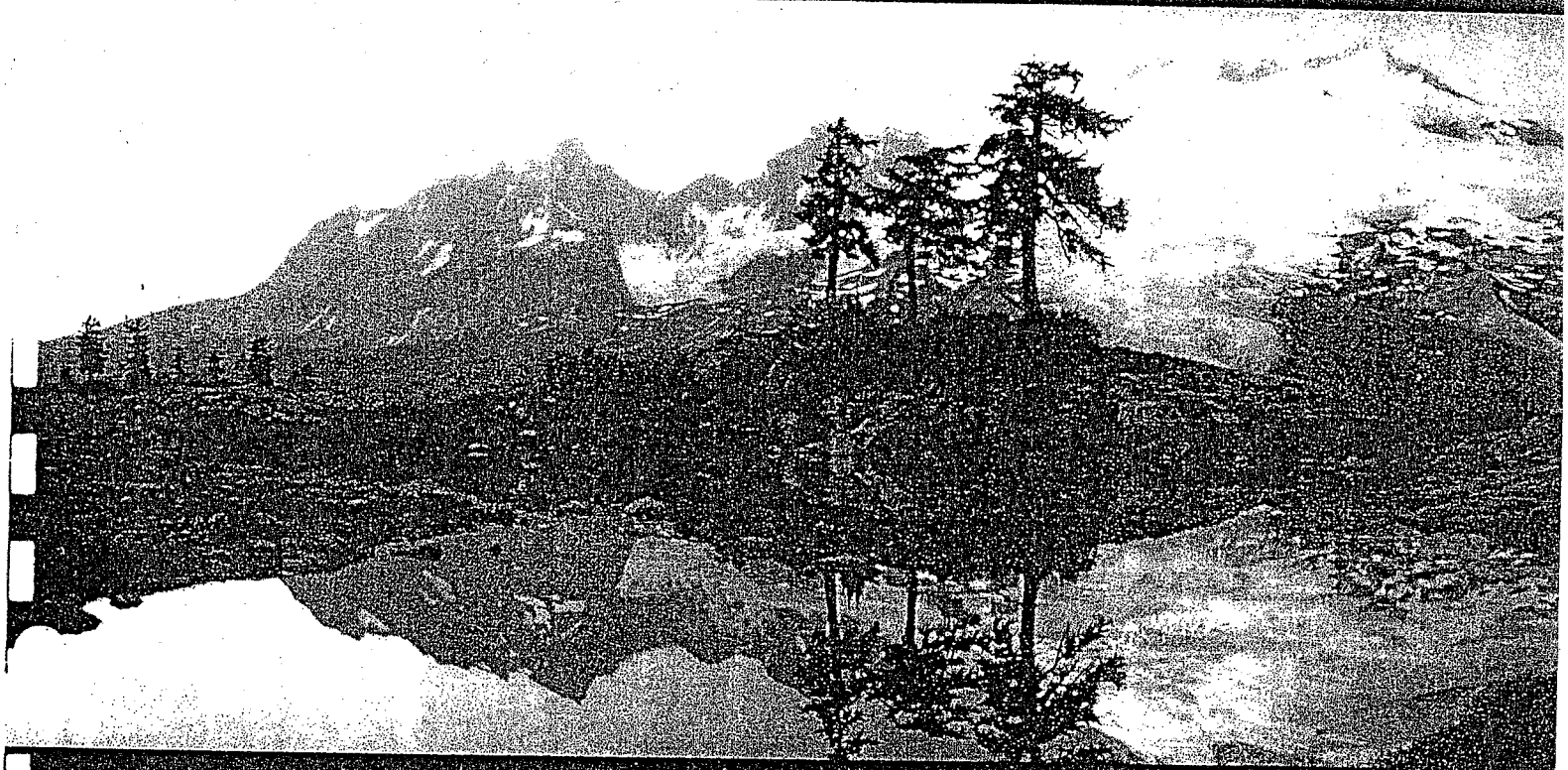
As to the action plan, I look at the things that BMS has indicated they are going to do as a result of the study and I believe that the actions they have indicated to do were all in place prior to the study and none are a result of the study The study indicated that the main problems were the turbulence at the manhole at Boulder Drive and Quartz Valley near the treatment facility, undersized suction blowers on the filtration system, ineffectiveness of the current filtering system because the treatment train covers allow too much infiltration of air into the system thus destroying the negative pressure under the covers which then does not draw odors from the treatment trains into the filter, the wrong type and size of filter.

The study had nothing to do with Sage Brush nor sound attenuation. It recommends redesign of the Quartz Valley manhole to eliminate the turbulence and add a connection to the filtration system to cause a negative pressure in the manhole and installation of a multi-stage wet filtration system sufficient in size to cause negative pressures in all the treatment train vessels including the metering house, aeration basins, sludge wasting basins and the manhole at Quartz Valley.

It is still my belief that one of the pressure lines from the CIE to the gravity system should be eliminated or thoroughly flushed on a regular basis mitigate odors up stream from the treatment facility. I also know that when the CIE pumps run the gravity flow line in the boulders is super charged causing a higher pressure in the manholes that force air from the manholes. (Supercharge of a gravity line is when the inflow into the manholes exceed the capacity of the out flow pipe and the outflow pipe fills completely and partially fills the manhole displacing the air in the manhole.0

APPENDIX C

ODOR CONTROL
MANUFACTURER INFORMATION



USFilter

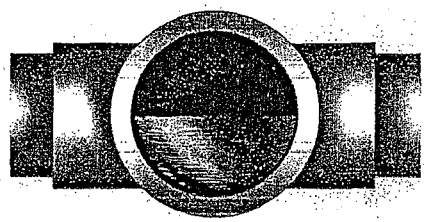
BIOXIDE®

...THE NATURAL SOLUTION

BIOXIDE ... THE NATURAL SOLUTION

To meet the needs of the industry, USFilter's Davis Process Products has developed BIOXIDE® as a means to eliminate the odor, corrosion and safety problems associated with hydrogen sulfide in sewage. In addition, BIOXIDE® combats most other odors commonly found in wastewater treatment systems. BIOXIDE® is a unique, proven product because it achieves sewage odor control naturally, rather than chemically. As a result, BIOXIDE® both *removes* dissolved hydrogen sulfide and prevents its formation. This fact makes the BIOXIDE® process ideally suited to provide effective and affordable odor control throughout the entire collection system.

BIOXIDE® is a patented process which controls hydrogen sulfide odors and corrosion biologically. Introduction of nitrate oxygen via addition of BIOXIDE® solution into a waste stream creates an environment in which certain naturally occurring bacteria thrive. These bacteria utilize the dissolved hydrogen sulfide which is present as a part of their metabolism, thereby cost-effectively removing any dissolved hydrogen sulfide from the wastewater. This process eliminates the odor, corrosion and safety problems associated with atmospheric hydrogen sulfide. This removal mechanism, patented by USFilter's Davis Process Products in 1990, allows economical elimination of dissolved hydrogen sulfide for a far broader range of wastewater collection system odor problems than previously considered possible with nitrate addition to prevent anaerobic biological activity. The BIOXIDE® process has a proven track record for controlling hydrogen sulfide in a variety of collection system applications, with over 1,000 installations throughout the U.S. and Canada. Dissolved hydrogen sulfide concentrations of over 50 ppm are reduced to <0.1 ppm in the most severe applications.



CONTAINS NO HAZARDOUS SUBSTANCES

Many options to control or eliminate odor compromise safety by reaction and flammability. Their storage and handling is often hazardous and costs are high, making them economically impracticable. Based upon the requirements of a particular odor problem, USFilter's Davis Process Products will design and administer a BIOXIDE® solution dosage strategy to stimulate and sustain the biological process. BIOXIDE® is an aqueous solution of non-hazardous nitrate salt (as defined by the EPA CERCLA list). Therefore, the use of BIOXIDE® releases no hazardous substances to the environment, nor does it expose workers or the public to potentially dangerous situations.

REDUCES BOD

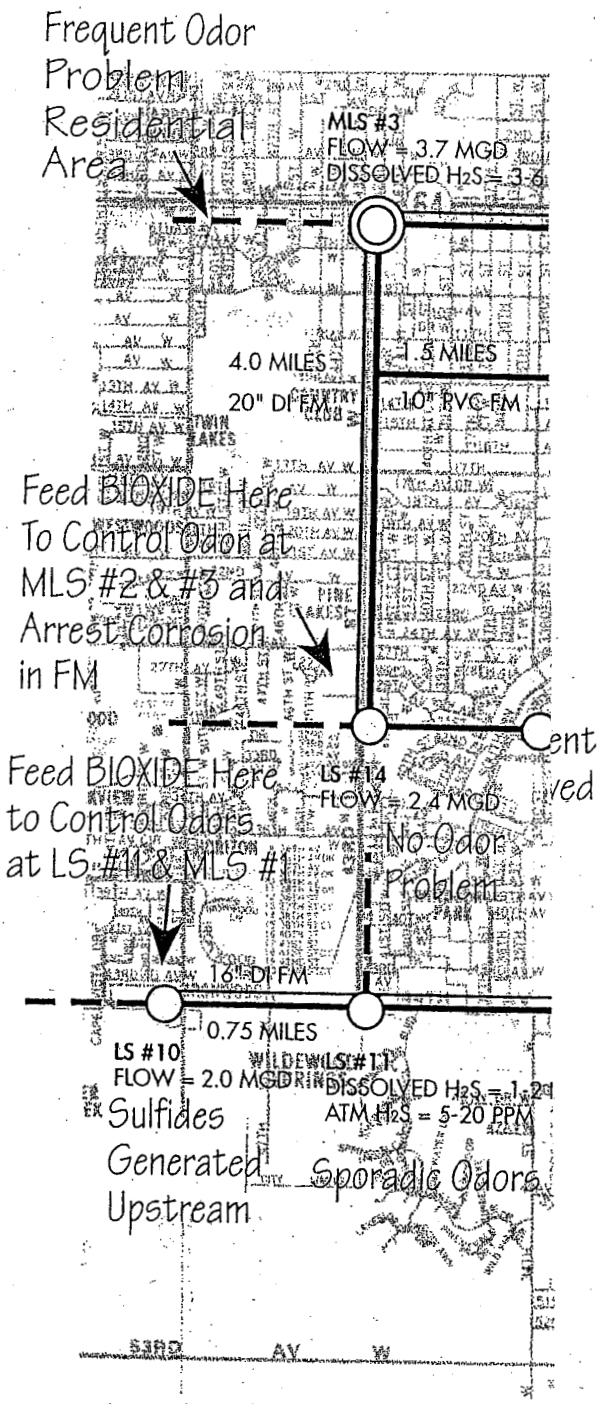
Because BIOXIDE® achieves odor control biologically, an additional benefit of its use is sewage BOD reduction. Therefore, a potential secondary benefit of BIOXIDE® is reduced BOD loading and increased treatment plant capacity where BOD loading is limiting.

TREATS OTHER COMMON SEWAGE ODORS

Hydrogen sulfide is normally the predominant sewage odor problem. However, other odorous sulfur compounds such as mercaptans and organic sulfides can also contribute to odor problems. The biological environment created by BIOXIDE® will effectively remove these problem compounds as well.

ARRESTS CORROSION

Collection system and treatment plant equipment and structures of concrete or metal are severely corroded by atmospheric hydrogen sulfide. While no product can reverse the damage already caused by existing corrosion, BIOXIDE® reduces further corrosion by effectively eliminating dissolved hydrogen sulfide, the source of atmospheric hydrogen sulfide.



The system il
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system. This a
Process Produ

The BIOXIDE® System for odor control is a complete program which is guaranteed to solve specific odor problems within wastewater collection and treatment systems. USFilter's Davis Process Products guarantees your 100% satisfaction with the ability of BIOXIDE® to deliver the results which it has been employed to attain. In order to provide such a guarantee, USFilter's Davis Process Products thoroughly analyzes each odor control problem using our experienced technical personnel to survey your system characteristics. The survey results are then analyzed by our staff to determine the optimum application. Once this analysis is complete, a proposal is then submitted identifying the particular odor problems in the system and the effectiveness of BIOXIDE® as a corrective measure.

Upon completion of the survey, a field test is arranged to demonstrate the effectiveness of BIOXIDE®. USFilter's Davis Process Products designs a custom BIOXIDE® solution feed program with the optimum application locations for cost effective sulfide removal, based on our survey. Our trained technicians then install and start up the system. This installation is supported by thorough operator training, follow-up evaluation and troubleshooting services.

WHEN COMPARED TO ALTERNATIVE METHODS, BIOXIDE® EXCELS IN EFFICIENCY, SAFETY AND COST EFFECTIVENESS

BIOXIDE® VS. OXIDIZERS

Chemical oxidizers such as Chlorine, Hydrogen Peroxide and Potassium Permanganate are commonly used to control hydrogen sulfide odors. In comparison to BIOXIDE®, these materials have several negatives. There are high reactivity and flammability risks involved in the use of such oxidizers. These safety hazards make expensive storage and handling techniques and equipment a necessity. While these costly steps reduce the risks involved with using these oxidizers, the liability associated with their use remains.

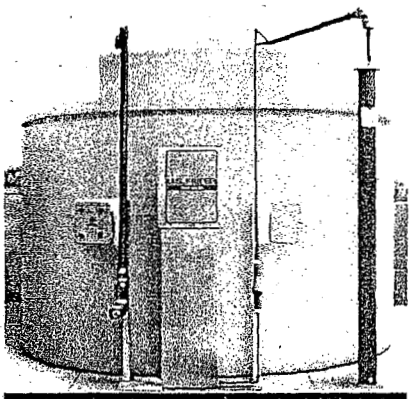
In addition, oxidizers trigger a chemical, rather than a biological reaction within the system. The oxidizing mechanism of these products is not specific to hydrogen sulfide and therefore excess dosage (compared to theoretical) is the norm. This contributes to the relatively high cost. However, BIOXIDE® is a biological process specific to odor compounds and, unlike oxidizers, it is also effective in preventing the formation of dissolved hydrogen sulfide.

BIOXIDE® VS. PH ADJUSTMENTS

Another alternative method to controlling Hydrogen Sulfide odors is the use of Sodium Hydroxide to adjust the pH. This method kills many helpful organisms which are present in the sewage, making it detrimental to plant operations. BIOXIDE® enhances biological organism growth thereby complementing the natural operation of the plant. Furthermore, caustic treatment such as pH adjustment cannot be sustained on a continuous basis. In contrast, BIOXIDE® is suited for continuous treatment making it a much more effective, and consistent method of odor control.

BIOXIDE® VS. BACTERIA ADDITION

The addition of volumes of "new" bacteria is not effective in controlling hydrogen sulfide because the sewage is not conducive to their growth. The difficulty in achieving consistent dosage and lack of stability contribute to the ineffectiveness and high cost of bacteria addition. In contrast, the BIOXIDE® process provides the nutrients via a stable, easily metered aqueous solution, which promotes the growth of naturally occurring bacteria within the sewage collection system.



Typical BIOXIDE® Above-Ground Storage and Metered Delivery System

BIOXIDE® VS. METAL SALTS

Metal salts are normally the most economical means of dissolved hydrogen sulfide control. However, metal salts are specific to the removal of hydrogen sulfide, therefore they commonly leave other odor compounds untreated. BIOXIDE® can provide equivalent effectiveness and economy in a natural manner rather than via a chemical process while treating a broader range of odor causing compounds. In addition, BIOXIDE® provides extra benefits in the form of BOD reduction.

BIOXIDE® VS. VAPOR PHASE TREATMENT

Vapor phase technologies such as adsorption systems or air scrubbers control odors by ventilating and treating the atmosphere in one geographic area. BIOXIDE® controls odor compounds within the sewage preventing their release to the atmosphere. In short, BIOXIDE® prevents an odor problem from its source, while vapor phase technologies treat the problem after it exists. Similarly, BIOXIDE® eliminates the severe corrosion caused by atmospheric hydrogen sulfide making it a significantly more effective means of reducing corrosion than vapor phase treatment. These differences make BIOXIDE® a better value for odor and corrosion control in most cases.

BIOXIDE® IS A SAFE, EASY-TO-HANDLE METHOD OF ODOR CONTROL

One of the primary factors which should be taken into consideration when selecting any process for use in wastewater treatment systems, is the safety of those who will be handling the materials. The safety of BIOXIDE® is documented by the fact that it is the only leading method of treatment for dissolved hydrogen sulfide which is not on the EPA CERCLA list of hazardous substances. This fact clears BIOXIDE® for convenient underground storage.

USFILTER'S DAVIS PROCESS PRODUCTS - THE INDUSTRY LEADER IN THE DEVELOPMENT OF ODOR CONTROL SYSTEMS

USFilter's Davis Process Products is a recognized leader in the development of innovative products for the control of odors in wastewater collection and treatment systems. USFilter's Davis Process Products established a revolutionary hydrogen sulfide control product in 1978 with the development of ODOPHOS®. With the introduction of BIOXIDE®, AQuit™, Bioxide-AQ™, POLY-STAGE™ Air Scrubbing Systems, and various other products and services, USFilter's Davis Process Products has developed the only complete selection of odor control systems for sewer systems and industry. These products offer alternative approaches to the total odor control problem, making USFilter's Davis Process Products the company with a solution for every odor control problem. Regional distribution and service locations are in Temecula, CA; Wilmington, DE; Sarasota, FL; Canton, GA; Granite City, IL; Florence, SC and Seguin, TX.

OUTSTANDING SERVICE SINCE 1938 IS YOUR ASSURANCE OF SATISFACTION

Davis Water & Waste Industries, Inc. was founded in 1938 and has been an industry leader in the design, manufacture and distribution of products that help to meet the world demand for clean water. USFilter acquired Davis and all its divisions in 1996. In 1999 USFilter was acquired by Vivendi, creating the world's largest and most comprehensive supplier of water and wastewater equipment and services. The size, strength and stellar reputation of Davis, USFilter and Vivendi represent your guarantee that USFilter's Davis Process Products will continue to provide thorough service, ethical business practice, effective products and service after the sale.

AQuit™, Bioxide-AQ™ and POLY-STAGE™ as used throughout this document are trademarked names owned by USFilter's Davis Process Products. BIOXIDE® and ODOPHOS® as used throughout this document are registered names owned by USFilter's Davis Process Products. 1990 U.S. Patent # 4,911,843, # 5,385,842, # 5,500,368 and other patents pending.

DP-D401-BX-BR-1103

USFilter
2650 Tallevast Road
Sarasota, FL 34243
(941) 355-2971 *phone*
1-800-345-3982 *toll free*
(941) 351-4756 *fax*
www.usfilter.com
© 2003 USFilter

Carbon Filters and Accessories (CF, CFR, CFB)

Carbon Filters (CF)

Orenco carbon filters are used to reduce the odor of sewer gases. Containing granulated activated impregnated carbon, the UV resistant PVC housing slips onto standard Schedule 40-size pipe. Carbon recharge packages and adapter bushings are available. Custom sizes available.

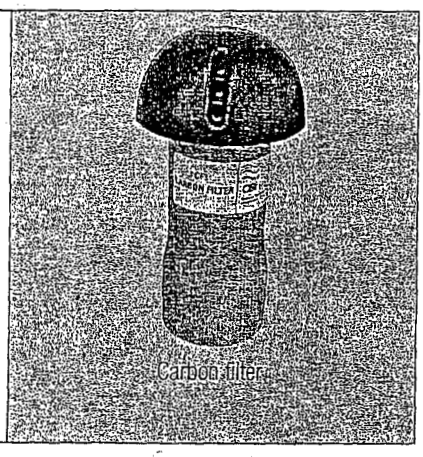
For carbon filter lids refer to *Lids (FL)* on page 4.

NOMENCLATURE

CF □

Filter diameter:
3 = 3"
4 = 4"

Carbon filter


Carbon filter

Carbon Filter Recharge Packages (CFR)

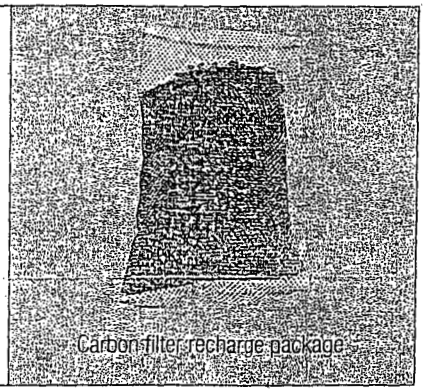
Orenco carbon filter recharge packs are used as a simple, clean method of refilling carbon filters. Offered in a ready-to-drop-in pouch for all standard carbon filter sizes.

NOMENCLATURE

CFR □

Carbon filter diameter (inches):
3 = 3"
4 = 4"
12 = 12" (for lids)

Carbon filter recharge package


Carbon filter recharge package

Carbon Filter Bushings (CFB)

Orenco carbon filter bushings are used to adapt the mounting flange of the carbon filter to an existing vent outlet of different diameter. Molded of PVC.

NOMENCLATURE

CFB □□

Bushing size (inches):
32 = 3" to 2" reducer
42 = 4" to 2" reducer
43 = 4" to 3" reducer

Carbon filter bushing

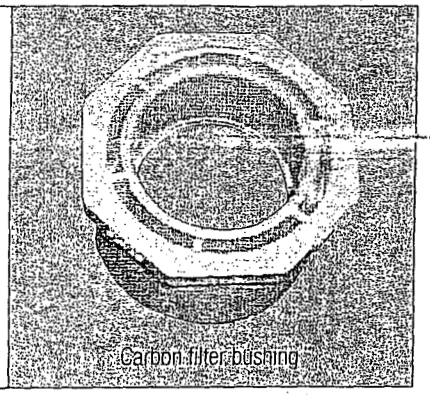
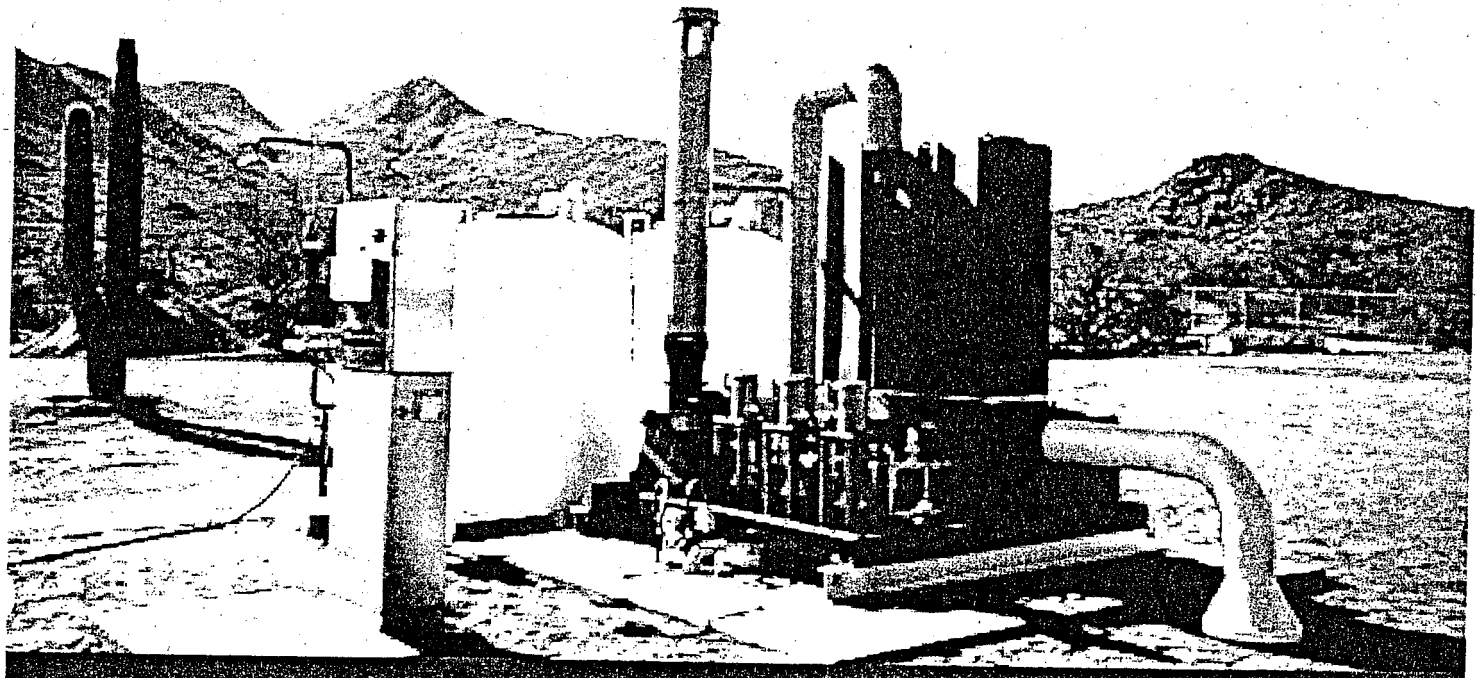

Carbon filter bushing

TABLE 52. CARBON FILTER, RECHARGE PACKAGE, AND BUSHING EXAMPLES

Model code	Description
CF3	Carbon filter with weather cap, 3" diameter
CFR3	Activated carbon refill package, for 3" diameter filter
CFB32	Bushing for carbon filter, mounts CF3 to 2" diameter outlet

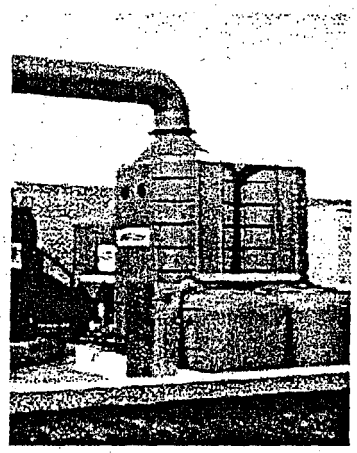


POLY-STAGE™

ODOR CONTROL

SYSTEMS

USFILTER'S POLY-STAGE™ ODOR CONTROL SYSTEMS



KEY ADVANTAGES

- ⅓ THE CHEMICAL COST OF CONVENTIONAL SCRUBBERS
- 99.5% H_2S REMOVAL
- EFFICIENT REMOVAL OF AMMONIA AND ORGANIC ODORS
- LOW PROFILE AND COMPACT SIZE
- FACTORY ASSEMBLED FOR EASE OF INSTALLATION
- USFILTER GUARANTEE

Municipal and industrial water and wastewater treatment plants supply our growing communities with a vital resource: clean water. In the process of treating our water, some processes generate odorous gases. As a good neighbor, often in close proximity to the general public, these facilities must contain and neutralize any odors created. USFilter offers a complete line of odor treatment solutions.

A preferred solution is wet chemical scrubbing. USFilter's Poly-Stage™ Odor Control System is a patented[1], multi-stage, multi-chemistry wet scrubber system that can be configured to remove hydrogen sulfide (H_2S), ammonia (NH_3) and organic odors from municipal and industrial processes. Each installation is custom designed to maximize removal efficiency of the odorous compounds and to minimize chemical consumption. Performance is guaranteed.

The compact design of the Poly-Stage scrubbers occupies a fraction of the space required by conventional packed tower systems, with better chemical utilization and lower installation and maintenance costs. Each system is completely factory pre-assembled and mechanically tested prior to shipment.

USFilter offers L-Series and DD-71 Series Poly-Stage systems. The L-Series scrubbers are designed to handle air flow rates of up to 1,000 cfm and the DD-71 Series systems are designed to handle air flow rates from 1,000 cfm to 6,000 cfm.

Within each of the two series, three models are offered: the Simplex, the Duplex and the Triplex scrubbers. The Simplex scrubber is a single-stage scrubber suitable for lower air flow rates and odor loads, and up to 95% H_2S removal. The Duplex scrubber is a two-stage scrubber suitable for moderate air flow rates and odor loads, and up to 99% H_2S removal. The Triplex scrubber is a three-stage scrubber suitable for higher air flow rates and odor loads, and for 99.5%+ H_2S removal.

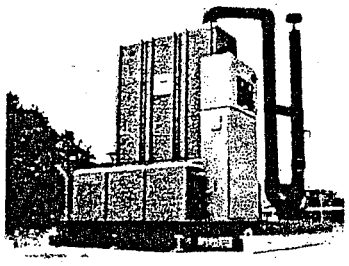
The Duplex and Triplex models are designed to minimize chemical costs by using relatively inexpensive sodium hydroxide (caustic) to remove 70-80% of the odors in the first stage(s), and then treating the remaining odors with a combination of sodium hypochlorite (bleach) and caustic in the last stage. Four-stage Quadriplex systems have also been built to treat NH_3, H_2S and organics in a single system.

HDXLPE CONSTRUCTION

USFilter's Poly-Stage scrubbers use rotationally molded vessels of High Density Crosslinked Polyethylene (HDXLPE). The unique rotational molding technique creates a vessel without seams or joints which mitigates leaks.

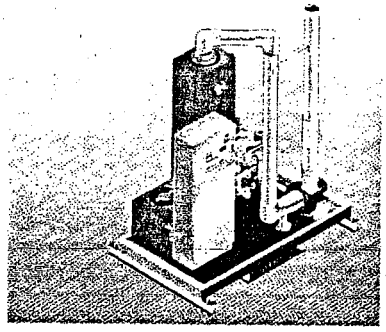
The vessels are chemically resistant to concentrated acids, alkalis and oxidizers and are designed to operate in very harsh environments, with constant exposure to weather and UV attack.

[1] Poly-Stage systems are covered under U.S. Patent Number 4,948,402, Re. 35, 234

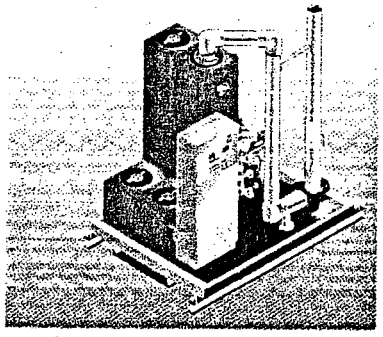


USFilter's L-Series Scrubber is a skid-mounted, modular design, once-through, packaged odor control system. Each system includes one to three stages of gas absorption, an individual integral sump for each stage, mist eliminator, induced draft exhaust fan, exhaust stack, recirculation and metering pumps, piping, valves, fittings, instrumentation and controls to make a complete and functional system. Each system is completely factory assembled and tested prior to shipment. The L-Series scrubbers are sized to handle air flow rates up to 1,000 cfm.

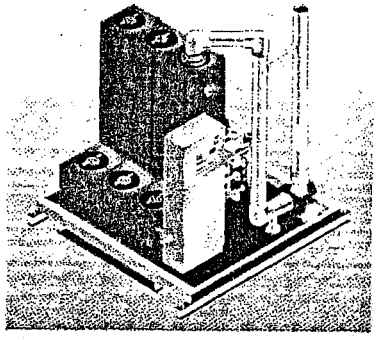
L-Series Simplex System
Skid Dimensions: 5'-0"L x 8'-0"W
Footprint Required*: 13'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 300 lbs.
Operating Weight: 1,000 lbs.
Fan HP: 0.5 to 2.0
Pump HP: 0.33



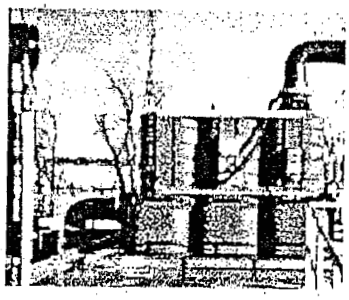
L-Series Duplex System
Skid Dimensions: 6'-3"L x 8'-6"W
Footprint Required*: 15'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 750 lbs.
Operating Weight: 1,500 lbs.
Fan HP: 1.0 to 3.0
Pump HP (Total): 0.67



L-Series Triplex System
Skid Dimensions: 7'-3"L x 8'-6"W
Footprint Required*: 16'-0"L x 9'-6"W
System Height: 7'-2"
Shipping Weight: 1,500 lbs.
Operating Weight: 2,500 lbs.
Fan HP: 1.0 to 3.0
Pump HP (Total): 1.0



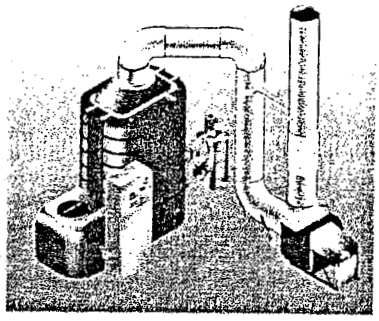
* Includes chemical storage tanks



USFilter's DD-71 Series Scrubber is a modular design, once-through, packaged odor control system. Each system includes one to three stages of gas absorption, an individual integral sump for each stage, mist eliminator, induced draft exhaust fan, exhaust stack, recirculation and metering pumps, piping, valves, fittings, instrumentation and controls to make a complete and functional system. Each system is completely factory assembled and tested prior to shipment. The DD-71 series scrubbers are sized to handle air flow rates up to 6,000 cfm.

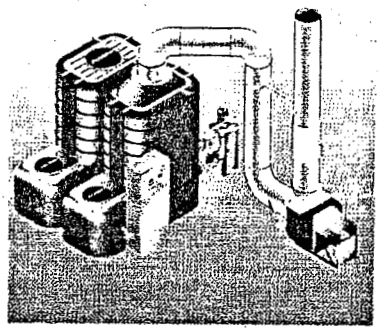
DD-71 Simplex System

Vessel Dimension: 3'-8"L x 8'-0"W x 7'-6"H
Footprint Required*: 18'-6"L x 20'-0"W
Shipping Weight: 1,800 lbs.
Operating Weight: 5,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP: 3.0



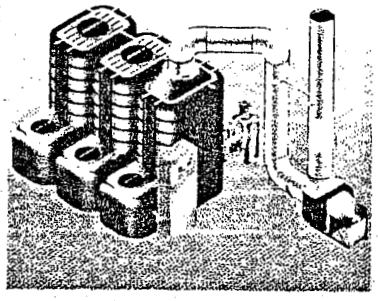
DD-71 Duplex System

Vessel Dimension: 7'-4"L x 8'-0"W x 7'-6"H
Footprint Required*: 22'-0"L x 20'-0"W
Shipping Weight: 2,800 lbs.
Operating Weight: 10,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP (Total): 6.0



DD-71 Triplex System

Vessel Dimension: 11'-0"L x 8'-0"W x 7'-6"H
Footprint Required*: 25'-6"L x 20'-0"W
Shipping Weight: 4,000 lbs.
Operating Weight: 15,000 lbs.
Fan HP: 5.0 to 10.0
Pump HP (Total): 9.0

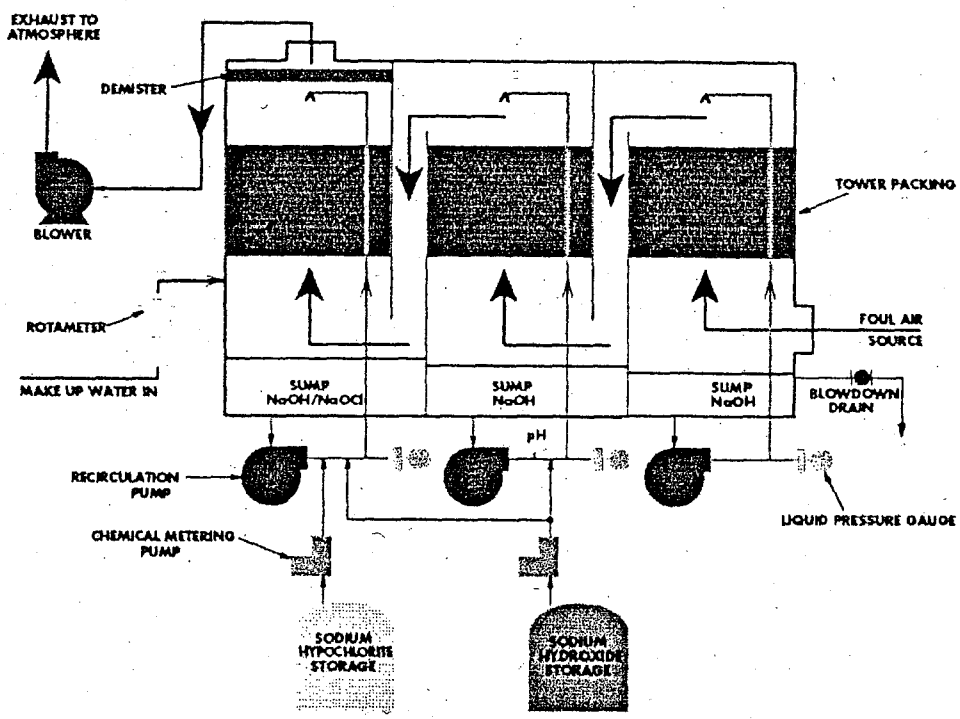


* Includes chemical storage tanks

PROCESS DESCRIPTION

The schematic diagram below illustrates a typical Triplex configuration for hydrogen sulfide removal. The system utilizes sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl) to react with and remove the odorous compounds present in the air stream.

In Stage 1, the process gas is pre-treated with the blowdown from Stage 2 to remove 70-80% of the incoming H_2S. The gas then passes through Stage 2, which is fed with blowdown from Stage 3 as well as with fresh NaOH solution to provide removal of an additional 70-80% of the remaining H_2S. The gas then passes through Stage 3, which is fed with fresh NaOCl and NaOH solutions, to provide a strong oxidation reaction to remove the remaining H_2S and other odors.



CUSTOM DESIGNS

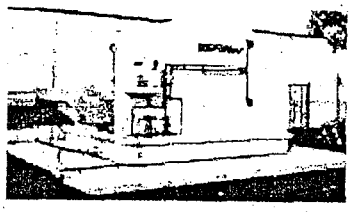
The Poly-Stage scrubber system can be configured to remove ammonia and hydrogen sulfide in the same scrubber. The system chemistry can also be configured to remove odorous organic compounds that cannot be controlled effectively with a conventional caustic and bleach scrubber.

OTHER VAPOR PHASE ODOR CONTROL PRODUCTS BY USFILTER

LO/PRO ODOR CONTROL SYSTEM

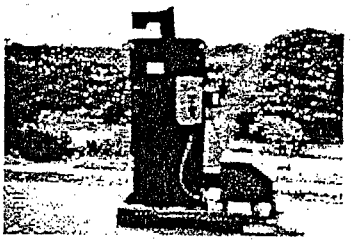
The patented LO/PRO® Multi-Stage Packaged Scrubber System is one of the most technically advanced and cost-effective scrubber systems available. The LO/PRO is a factory pre-assembled system of unitary construction which can do the work of conventional packed towers in less than half the space and at a fraction of the cost. Each installation is custom designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Performance is guaranteed with removal efficiencies in excess of 99.0% and air flow rates up to 25,000 cfm.

ZABOCS BIOLOGICAL SYSTEM



The ZABOCS™ Biological Odor Control System is an advanced multi-media system which combines gas absorption, adsorption and biological treatment to capture and then eliminate organic and inorganic odors from wastewater process air streams. The unique combination of proprietary Biodagene™ and Biocarb™ media enables the ZABOCS system to treat three times the air volume compared to similarly sized conventional biofilter systems, while immediately treating odors with zero acclimation time.

CARBON ADSORPTION SYSTEMS



Carbon adsorption is an effective solution to many odor control problems. It is particularly useful for small air flows, remote locations, and control of specific volatile organic compounds that are difficult to remove by wet scrubbing.

We offer a complete line of carbon adsorption systems, ranging from small modular systems (100 cfm and up) to larger, dual-bed systems up to 20,000 cfm.

To find out more about how to put USFilter to work for you, contact us at

USFilter

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USFilter

LO/PRO®

PACKAGED

ODOR CONTROL

SYSTEM

Municipal and industrial water and wastewater treatment plants supply our growing communities with a vital resource: clean water. During the water treatment process, odorous gases such as hydrogen sulfide, ammonia and organic compounds can be generated. As a good neighbor, often in close proximity to the general public, and to meet the ever increasing requirements for air quality permits, these facilities must contain and neutralize any odors created.

A preferred solution is wet chemical scrubbing. A wet scrubber mixes odorous gases with a stream of liquid chemicals that react with and neutralize the offensive compounds. RJ Environmental Products offers a complete line of wet scrubber odor control systems. By far our most popular, versatile and effective product is the LO/PRO® Packaged Odor Control System.

Since its introduction in 1994, the LO/PRO has become the industry leader. It is the result of more than 25 years of experience developing, designing, building and testing wet scrubber systems. To date there are more than 250 LO/PRO scrubber systems in operation worldwide.

USFilter sets the standard for odor control technology. Our experience, reputation and product line are unequalled in the industry.

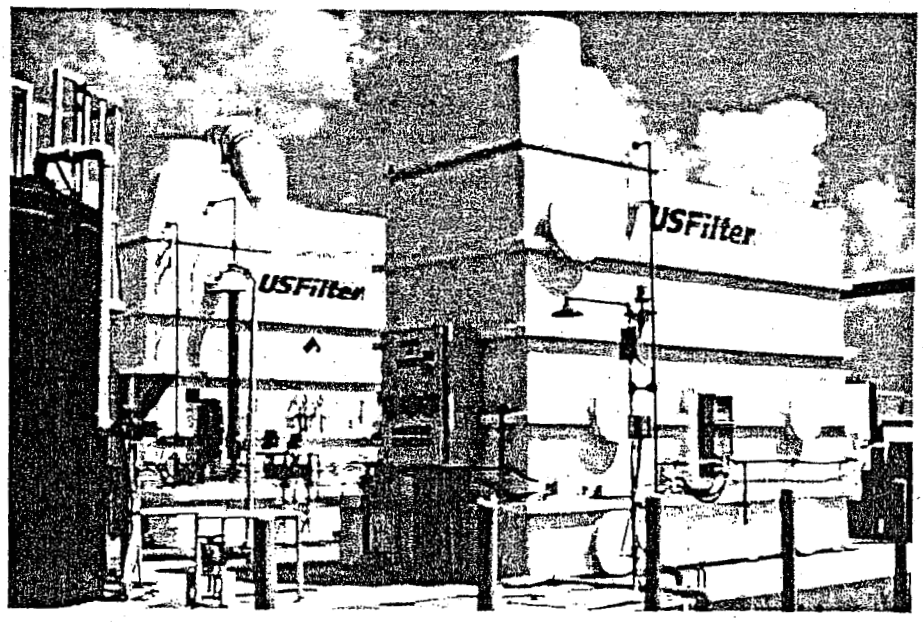
SUPERIOR TECHNOLOGY

The LO/PRO® Odor Control System is the most technologically advanced and cost effective scrubber system available. The LO/PRO is a patented[1], multi-stage, multi-chemistry wet scrubber system which can be configured to remove hydrogen sulfide, ammonia, or organic odors from municipal and industrial process gases.

Each installation is custom-designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Performance is guaranteed, with removal efficiencies in excess of 99.0% and airflow rates up to 24,500 cfm.

Each system is completely factory pre-assembled and mechanically tested prior to shipment. Premium vinylester fiberglass reinforced plastic (FRP) construction provides superior strength and corrosion resistance. The compact design occupies a fraction of the space required by conventional packed tower systems, with better chemical utilization and lower installation and maintenance costs.

- PATENTED PROCESS
- VERSATILE DESIGN
- LOW PROFILE/ COMPACT SIZE
- SINGLE SOURCE RESPONSIBILITY
- GUARANTEED PERFORMANCE
- FACTORY ASSEMBLED
- EASY INSTALLATION



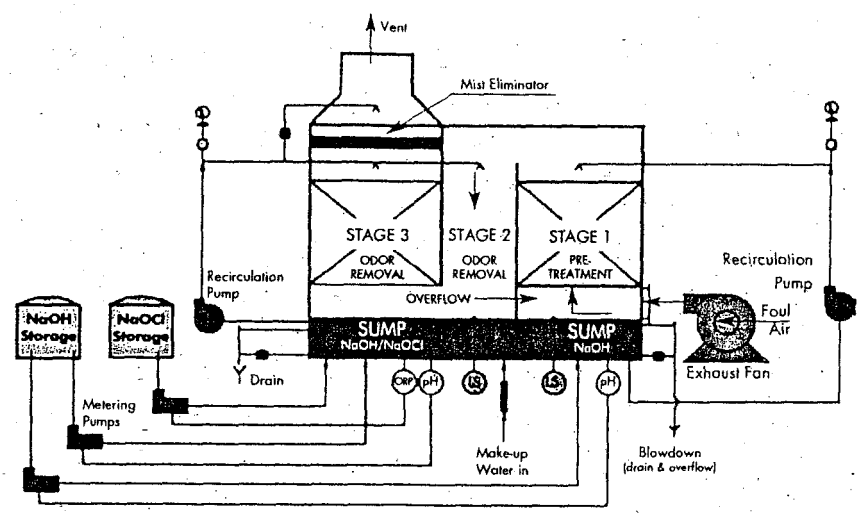
[1]The United States Patent and Trademark Office has recognized the novelty of the design of the LO/PRO with the award of two patents (U.S. Patent Nos. 5,876,662 and 6,174,498). An additional patent application is now pending. USFilter is the only company able to offer the innovative odor control systems covered by these patents.

H_2S REMOVAL

PROCESS CONFIGURATION

The schematic diagram below illustrates a typical LO/PRO configuration for hydrogen sulfide (H_2S) removal. In Stage 1, the process gas is pre-treated with blowdown from Stage 2/3 as well as with fresh caustic solution to remove 70-80% of the incoming H_2S.

The gas then passes through Stages 2 and 3, where a strong oxidation reaction removes all remaining H_2S. Chemical utilization is optimized through precise control of pH and ORP levels in the scrubber liquid.



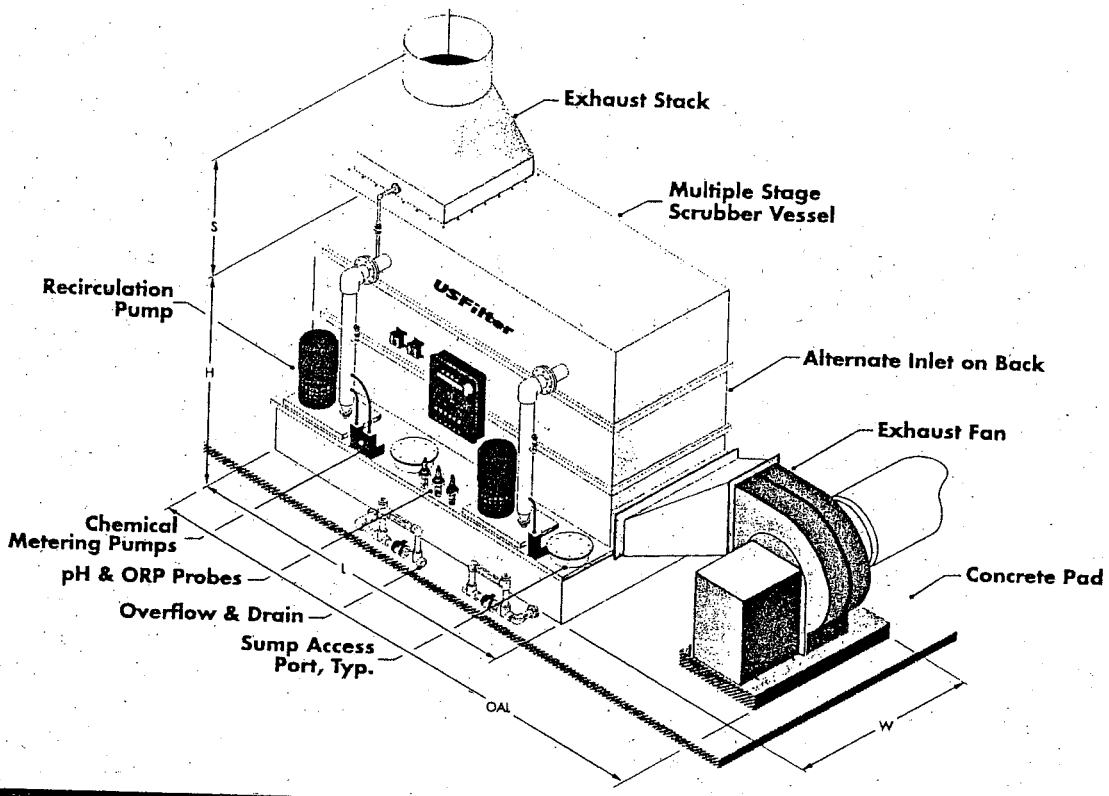
COMBINED H_2S AND NH_3 REMOVAL

LO/PRO systems have been designed for removal of hydrogen chloride, hydrogen fluoride, and other acid gases. Systems can also be configured to remove ammonia (NH_3) and hydrogen sulfide in the same scrubber. In this process, the first stage is maintained at a low pH, and a strongly acidic solution removes more than 99% of the ammonia. In the second and third stages, sodium hydroxide (caustic) and sodium hypochlorite (bleach) in the solution remove more than 99% of the hydrogen sulfide.

CUSTOM DESIGNS

The chemistry can be configured to remove mercaptans and other odorous organic compounds that cannot be controlled effectively with a conventional caustic and bleach scrubber. We have also designed unique odor control systems that operate at high pressure or high vacuum, systems that treat gases containing up to 50% carbon dioxide and/or methane, and systems that treat concentrations in excess of 60,000 ppm H_2S.

LO/PRO® DESIGN INFORMATION

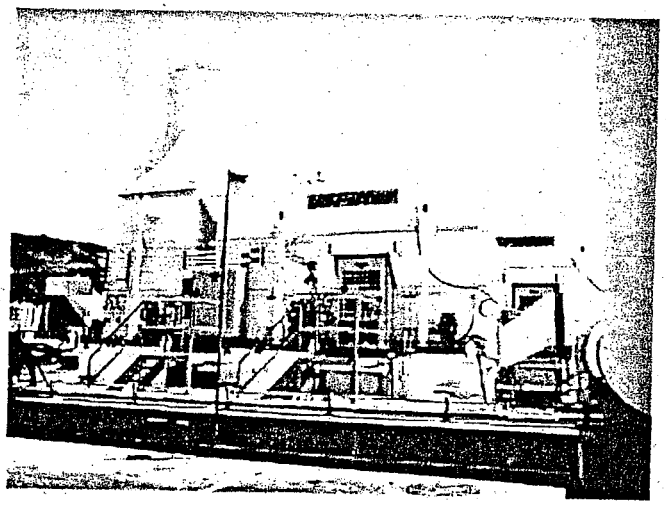


LO/PRO DESIGN INFORMATION

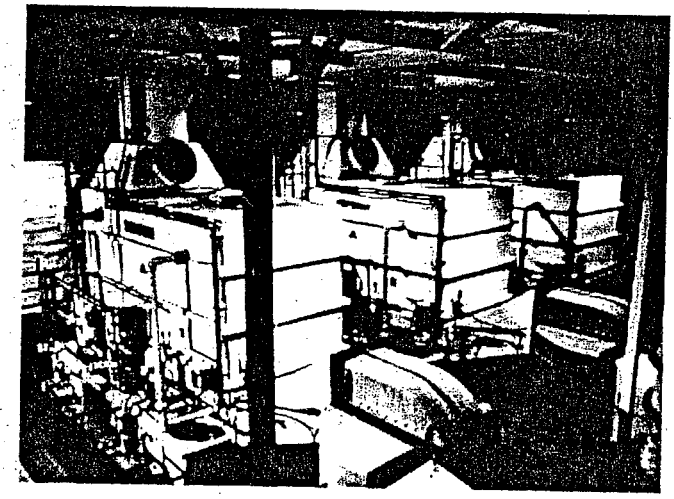
Model	Airflow Rate	Scrubber Dimensions LxWxH	Overall Length [OAL]	Shipping Wt	Operating Wt	Fan Motor[1]	Recirc Pump 1 Motor	Recirc Pump 2 Motor
Unit	cfm *m³/hr*	ft *mm*	ft *mm*	lb *kg*	lb *kg*	HP *kW*	HP *kW*	HP *kW*
LP-1500	1,000 *1,700*	4.50 x 4.00 x 8.50 *1,370 x 1,220 x 2,590*	9.00 *2,740*	1,000 *450*	3,500 *1,600*	5.0 *3.7*	1.5 *1.1*	2.0 *1.5*
LP-1750	1,300 *2,200*	5.25 x 4.25 x 9.25 *1,600 x 1,300 x 2,820*	10.00 *3,050*	1,600 *700*	4,500 *2,000*	5.0 *3.7*	2.0 *1.5*	3.0 *2.2*
LP-2000	1,700 *2,900*	6.00 x 4.50 x 9.25 *1,830 x 1,370 x 2,820*	11.00 *3,350*	2,200 *1,000*	6,000 *2,700*	7.5 *5.6*	2.0 *1.5*	5.0 *3.7*
LP-2250	2,200 *3,700*	6.75 x 4.75 x 9.25 *2,060 x 1,450 x 2,820*	12.50 *3,810*	2,500 *1,100*	7,000 *3,200*	7.5 *5.6*	3.0 *2.2*	5.0 *3.7*
LP-2500	2,700 *4,600*	7.50 x 5.00 x 9.50 *2,290 x 1,520 x 2,900*	13.00 *3,960*	3,100 *1,400*	8,000 *3,600*	7.5 *5.6*	3.0 *2.2*	5.0 *3.7*
LP-2750	3,300 *5,600*	8.25 x 5.25 x 9.50 *2,520 x 1,600 x 2,900*	15.00 *4,570*	3,700 *1,700*	9,500 *4,300*	7.5 *5.6*	5.0 *3.7*	5.0 *3.7*
LP-3000	4,000 *6,800*	9.00 x 5.50 x 10.50 *2,740 x 1,680 x 3,200*	15.50 *4,720*	4,400 *2,000*	11,000 *5,000*	10.0 *7.5*	5.0 *3.7*	5.0 *3.7*
LP-3500	5,500 *9,300*	8.75 x 6.00 x 11.00 *2,670 x 1,830 x 3,350*	16.00 *4,880*	5,000 *2,300*	12,000 *5,500*	15.0 *11.2*	5.0 *3.7*	5.0 *3.7*
LP-4000	7,100 *12,100*	10.00 x 6.50 x 11.00 *3,050 x 1,980 x 3,350*	17.50 *5,330*	5,600 *2,500*	14,500 *6,600*	15.0 *11.2*	5.0 *3.7*	7.5 *5.6*
LP-4500	9,100 *15,500*	11.25 x 7.00 x 11.25 *3,430 x 2,130 x 3,430*	19.50 *5,940*	6,200 *2,800*	17,000 *7,700*	20.0 *14.9*	5.0 *3.7*	7.5 *5.6*
LP-5000	11,200 *19,000*	12.50 x 7.50 x 11.50 *3,810 x 2,290 x 3,500*	20.50 *6,250*	6,800 *3,100*	19,500 *8,900*	25.0 *18.6*	7.5 *5.6*	7.5 *5.6*
LP-5500	13,600 *23,100*	13.75 x 8.00 x 11.75 *4,190 x 2,440 x 3,580*	22.00 *6,710*	7,500 *3,400*	22,000 *10,000*	30.0 *22.4*	7.5 *5.6*	10.0 *7.5*
LP-6000	16,200 *27,500*	15.00 x 8.50 x 12.00 *4,570 x 2,590 x 3,660*	24.00 *7,320*	8,300 *3,800*	25,500 *11,600*	40.0 *29.8*	7.5 *5.6*	10.0 *7.5*
LP-6500	20,000 *34,000*	16.25 x 9.00 x 12.25 *4,950 x 2,740 x 3,730*	26.00 *7,930*	9,100 *4,100*	28,500 *13,000*	50.0 *37.3*	10.0 *7.5*	15.0 *11.2*
LP-7000	24,500 *41,600*	17.50 x 9.50 x 12.50 *5,330 x 2,900 x 3,810*	27.00 *8,230*	10,000 *4,500*	32,000 *14,500*	60.0 *44.7*	10.0 *7.5*	25.0 *18.6*

S – Stack Height (minimum 5 ft.)
1 – Fan HP based on 2 in. water column inlet duct loss

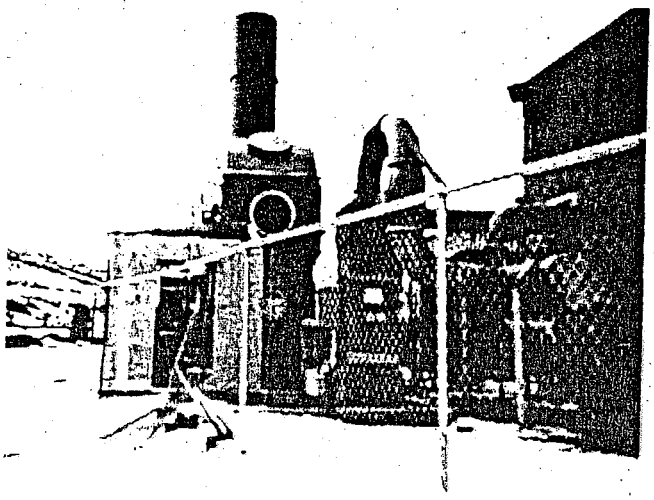
Los Angeles, CA				
Application	Hyperion WWTP Influent Pump Station			
Air Flow Rate (CFM)	2 systems, 20,000 cfm each			
Chemicals	NaOH and NaOCl			
Design Efficiency	99.0%			
Dimensions L x W x H (ft)	16.25 x 9.0 x 12.25			
Performance	**Average**		**Peak**	
	North	**South**	**North**	**South**
Inlet H_2S (ppm)	46.0	43.2	200	200
Outlet H_2S (ppm)	0.024	0.016	0.058	0.024
Removal Efficiency	99.95%	99.96%	99.97%	99.99%

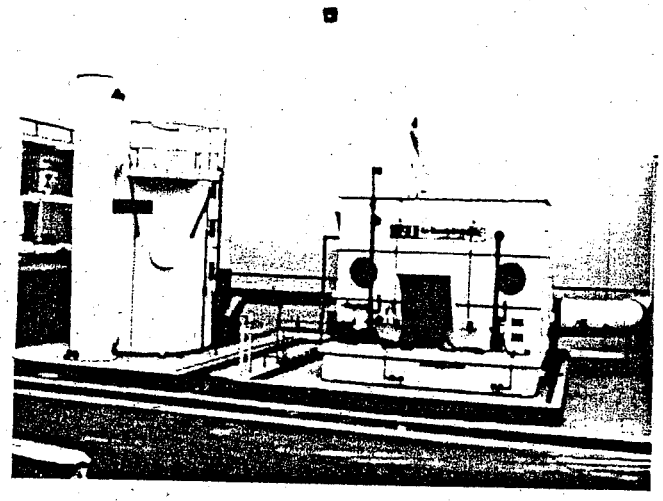


Las Vegas, NV						
Application	Las Vegas WRF, Primary Clarifiers					
Air Flow Rate (CFM)	7 systems, 24,500 cfm each					
Chemicals	NaOH and NaOCl					
Design Efficiency	99.5% at peak					
Dimensions L x W x H (ft)	17.5 x 9.5 x 12.5					
Performance	**Average**			**Peak**		
	#2	**#3**	**#4**	**#2**	**#3**	**#4**
Inlet H_2S (ppm)	11.2	10.6	11.0	22.6	22.3	20.8
Outlet H_2S (ppm)	0.01	0.00	0.03	0.01	0.01	0.02
Removal Efficiency	99.92%	99.97%	99.75%	99.96%	99.96%	99.89%

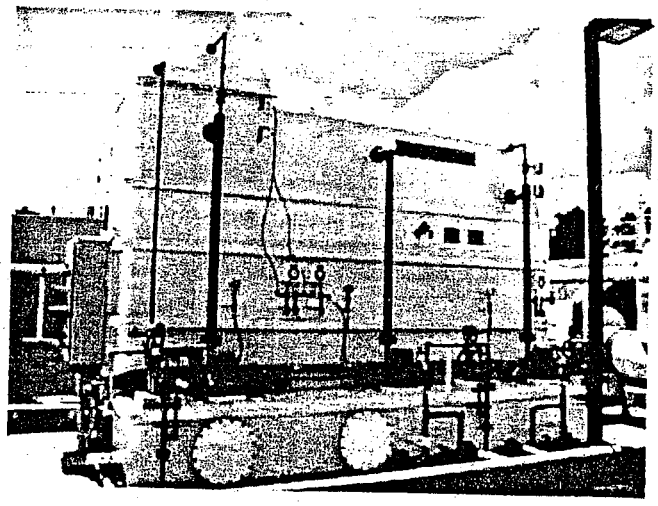


Avon, CO		
Application	Avon WWTP, ATAD Process	
Air Flow Rate (CFM)	3,000	
Chemicals	NaOH, NaOCl and H_2SO_4	
Design Efficiency	99.0%	
Dimensions L x W x H (ft)	11.0 x 5.5 x 10.0	
Performance	**H_2S**	**Mercaptans**
Inlet H_2S (ppm)	8.0	6.0
Outlet H_2S (ppm)	0.02	ND
Removal Efficiency	99.75%	>99.0%

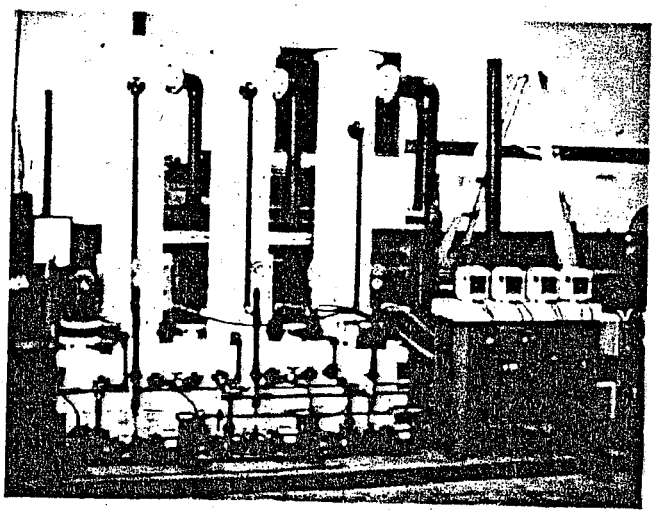




Samsung Corp., Tijuana, Mexico		
Application	Acid Gas Scrubbers (3)	
Air Flow Rate (CFM)	10,600 to 21,200	
Chemicals	NaOH	
Design Efficiency	99.9%	
Dimensions L x W x H (ft)	13.5 x 8.0 x 13.0	
Performance	**HCl**	**HF**
Inlet H_2S (ppm)	350	350
Outlet H_2S (ppm)	<0.35	<0.35
Removal Efficiency	99.9%	99.9%



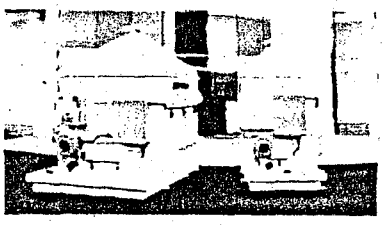
Bonita Springs, FL		
Application	Hydrogen Sulfide and Ammonia Scrubber	
Air Flow Rate (CFM)	8,035	
Chemicals	NaOH, NaOCl and H_2SO_4	
Design Efficiency	99.5%	
Dimensions L x W x H (ft)	11.25 x 7.0 x 11.25	
Performance	**H_2S**	**NH_3 (design)**
Inlet (ppm)	100	200
Outlet (ppm)	0.022	<1.0
Removal Efficiency	99.98%	99.5%



Continental Grain Co., Capiata, Paraguay		
Application	Bio Gas Scrubber	
Air Flow Rate (CFM)	250	
Chemicals	NaOH and NaOCl	
Design Efficiency	95.0%	
Dimensions L x W x H (ft)	12.5 x 5.5 x 9.1	
Performance	**Average**	**Peak**
Inlet H_2S (ppm)	18,000	26,000
Outlet H_2S (ppm)	0.7	0.7
Removal Efficiency	99.99%	99.99%

OTHER ODOR CONTROL PRODUCTS

BIOLOGICAL ODOR CONTROL SYSTEMS

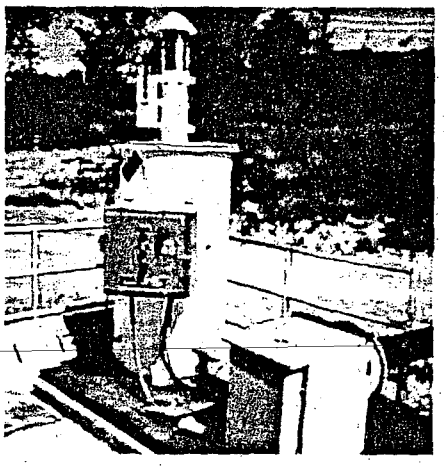


USFilter offers several biological odor control systems. The ZABOCS™ biofilter system is designed for flow rates from 100 to 5,000 cfm, and is ideal for unattended, remote pump stations. Better than 99% H_2S removal is achieved reliably, with minimal maintenance. The USFilter Bioscrubber system is designed for flow rates from 2,000 to 20,000 cfm and higher. The Bioscrubber system uses unique light weight, high surface area media to allow high air volumes in a compact space. All USFilter biological odor control systems are supported by custom bio-nutrients which enhance and accelerate the biological degradation of odorous compounds.

CARBON ADSORPTION SYSTEMS

Carbon adsorption is an effective solution to many odor control problems. It is particularly useful for small air flows, remote locations, and control of specific volatile organic compounds that are difficult to remove by wet scrubbing.

We offer a complete line of carbon adsorption systems, ranging from small modular systems (100 cfm and up) to larger, dual-bed systems (up to 15,000 cfm).



ADDITIONAL ODOR CONTROL TECHNOLOGIES

USFilter offers the most comprehensive selection of odor control technologies available. Please contact us for information on additional vapor-phase technologies such as biofiltration or liquid-phase technologies including the patented Bioxide® Process, AQuit,® Odophos,® and hydrogen peroxide.

RJ Environmental Products sets the standard for reliable, economical, and effective odor control systems.

USFilter

A Siemens Business

RJ Environmental Products
13100 Gregg Street, Suite B
Poway, CA 92064
858-486-8500 *phone*
858-486-8501 *fax*

www.usfilter.com

USFilter reserves the right to change the specifications referred to in this literature at any time, without prior notice. AQuit, Bioxide, LO/PRO, Odophos and ZABOCS are trademarks of USFilter Corporation or its affiliates.

RJ-LP-BR-0804

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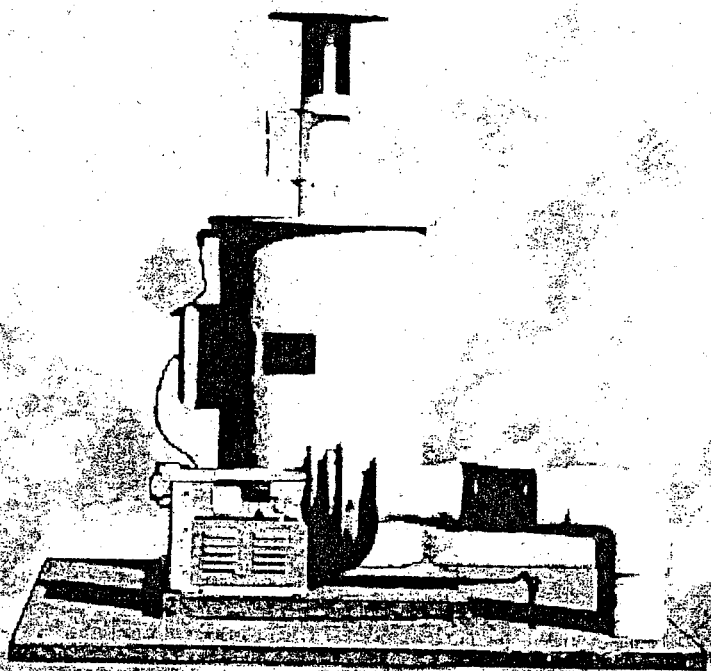


USFilter

CARBON ADSORBER ODOR CONTROL SYSTEMS

RJC SERIES

MODULAR CARBON ADSORBER SYSTEMS

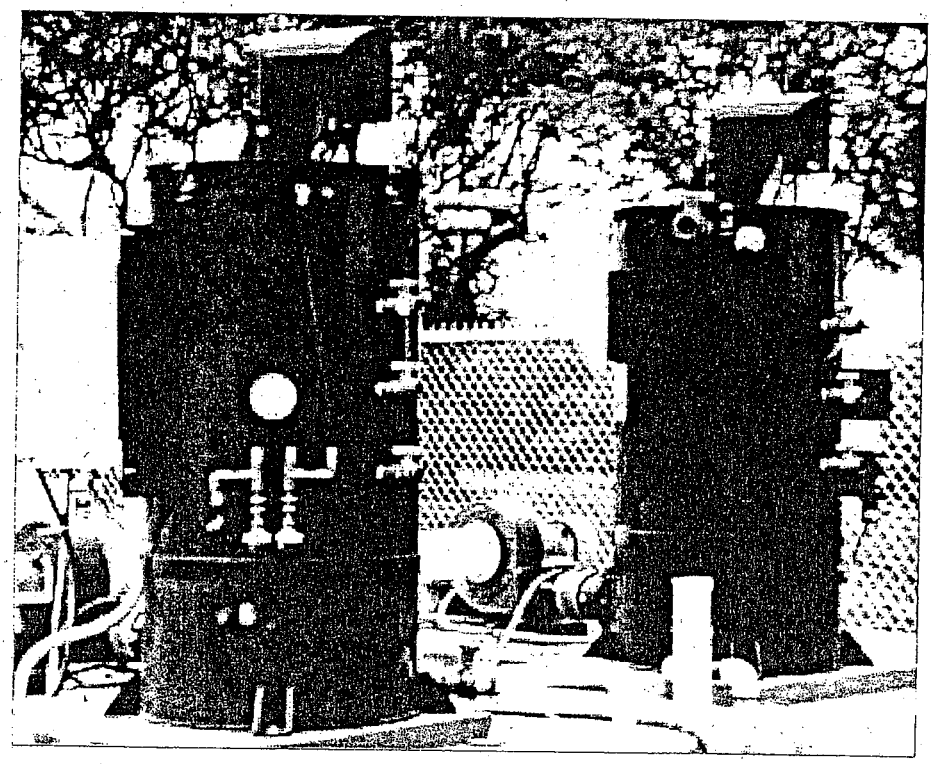
USFilter's RJC™ Series Modular Carbon Adsorbers are skid-mounted, pre-assembled systems ranging in flow capacity from 100 cfm to 1,400 cfm. Vessels are offered in either polypropylene or fiberglass reinforced plastic (FRP) and fans are available in epoxy coated stainless steel or FRP. Passive systems are also available which use natural process ventilation in place of the fan. The carbon media type is selected based on the specific application.

USFilter's Modular Carbon Adsorbers are often used to remove hydrogen sulfide (H_2S) from municipal wastewater. The RJC series adsorbers remove in excess of 99% of the inlet hydrogen sulfide and are designed to provide one or more years of bed life.[1]

The RJC Series Adsorbers only require inlet ducting, drain piping and power to the control panel to be completely operational.

FEATURES

- Pre-assembled and skid-mounted for simple installation
- Models for air flow rates from 100 to 1,400 cfm
- Passive flow systems available
- High performance carbon media
- Vessel constructed of polypropylene or premium vinylester fiberglass reinforced plastic
- Fan manufactured of stainless steel or fiberglass reinforced plastic
- Includes control panel, drain and grounding rod
- Available with volume control damper, carbon sample ports, differential pressure gauge



Two carbon adsorption systems in Makena, HI.

[1] Based on inlet H_2S concentrations below 7 ppm, at the maximum listed flow rate, and based on the adsorption capacity of Westates UOCH-KP carbon.

TYPICAL APPLICATIONS

- Hydrogen Sulfide
- Municipal Sewage Odors
- Industrial VOC Control

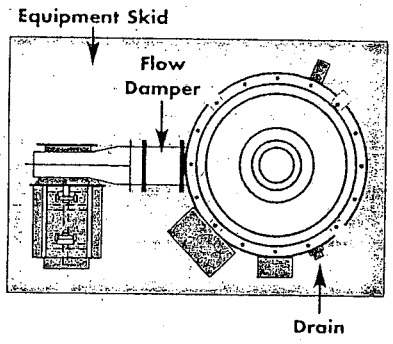
Carbon adsorption is an effective means of odor control for many applications. Carbon adsorbers can efficiently remove a variety of inorganic and organic compounds from municipal and industrial process air. Typical compounds adsorbed include hydrogen sulfide, aldehydes, ketones, and a wide range of industrial solvents and volatile organic compounds.

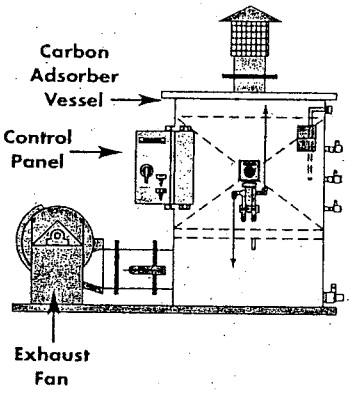
Carbon adsorbers are particularly useful for low air flows, low odor loads, remote locations, and for the control of specific volatile organic compounds. We offer a complete line of carbon adsorption systems, ranging from skid-mounted modular systems to custom designed, single and dual-bed systems capable of handling air flows in excess of 20,000 cfm.

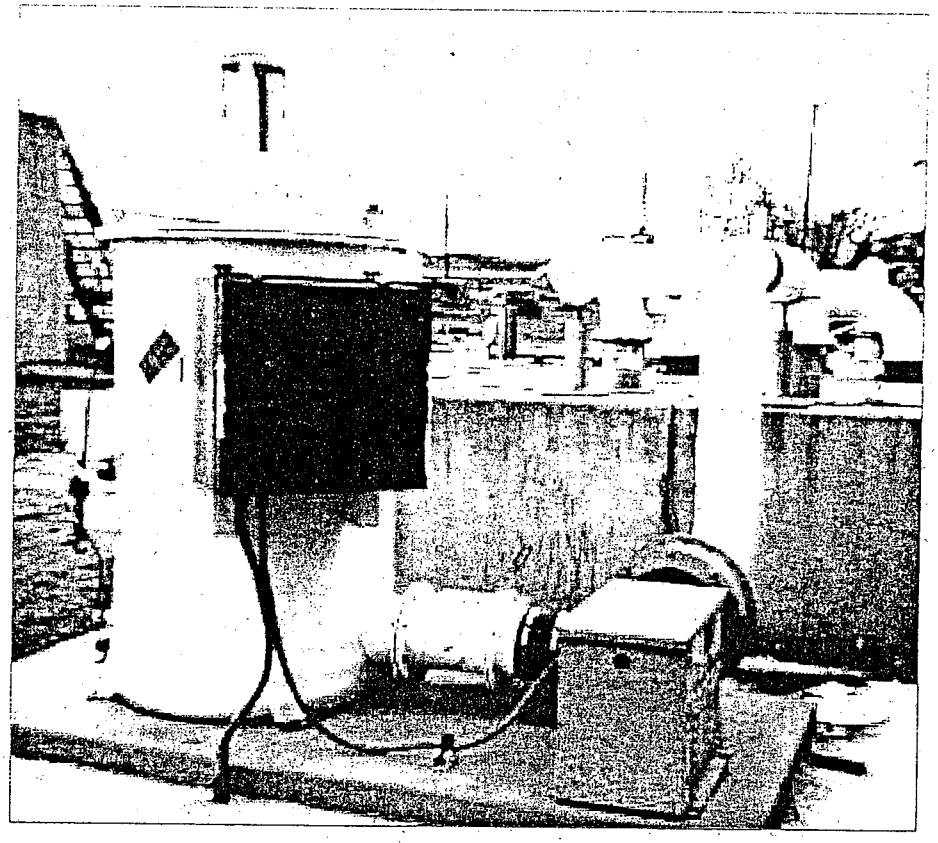
PROCESS DESCRIPTION

USFilter's Carbon Adsorber is a once-through, chemical adsorption process. Odorous compounds (H_2S and malodorous organics) are removed from the air stream by adsorption onto the activated carbon porous surface. Foul air from various sources is collected and passed through the adsorber. After entering the vessel, the foul air flows through a densely packed bed of activated carbon media. The cleaned air continues through the vessel and is exhausted through the stack.

The carbon media is selected based on the expected inlet contaminants and their concentrations. For hydrogen sulfide, we recommend USFilter's UOCH-KP caustic impregnated media. The caustic impregnant (KOH) catalyzes the oxidation of hydrogen sulfide to product elemental sulfur and water and greatly increases the H_2S capacity of the carbon media. The sulfur produced is adsorbed on the internal surface of the activated carbon while the water is mainly lost to the flowing air gas stream. The flowing air stream dissipates the heat. For VOC's, we recommend pelletized anthracite media that offers high adsorption capacity with minimal pressure drop. Other carbon media types are available for specific applications.







FRP Carbon Adsorption System in Hagerstown, MD.

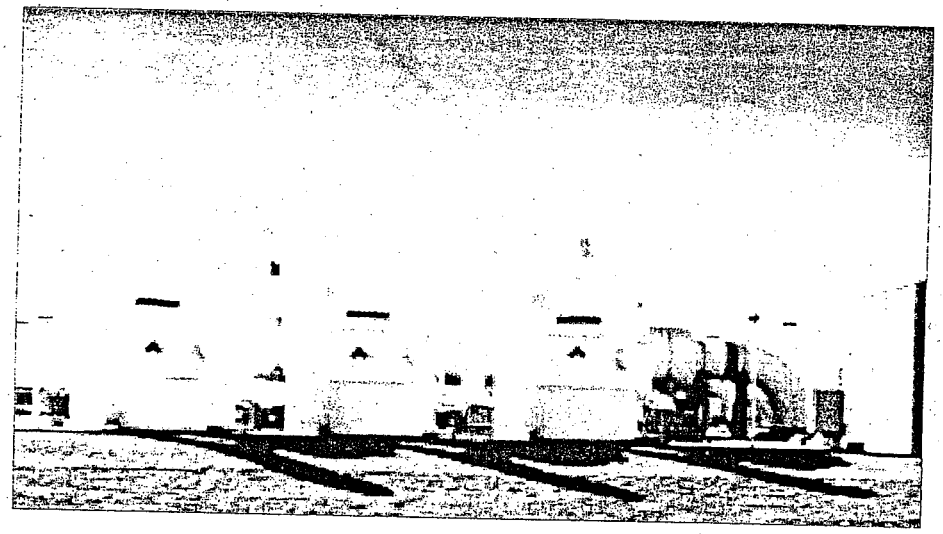
SIZING INFORMATION

Model #	Air Flow Rate (cfm)	Carbon Quantity (lbs)	Vessel Dia x Height (ft)	Approximate Skid Length x Width (ft.)	Operating Weight (lbs)	Inlet & Outlet Dia. (in.)	Fan Motor (HP)
RJC-100	Up to 100	200	1.5 x 5.0	4.3 x 3.2	700	4	1.0
RJC-200	100–200	360	2.0 x 5.0	5.3 x 3.5	1,000	6	1.0
RJC-300	200–300	570	2.5 x 5.0	5.8 x 3.8	1,300	6	1.5
RJC-400	300–450	820	3.0 x 5.0	6.3 x 4.1	1,700	8	1.5
RJC-600	450–600	1,120	3.5 x 5.5	7.7 x 4.9	2,500	8	2.0
RJC-800	600–800	1,450	4.0 x 5.5	8.3 x 4.9	3,200	10	2.0
RJC-1000	800–1,000	1,850	4.5 x 5.5	8.8 x 5.2	4,000	10	3.0
RJC-1200	1,000–1,400	2,300	5.0 x 5.5	9.1 x 5.6	4,700	12	5.0

CONVENTIONAL CARBON ADSORBER SYSTEMS

For larger air flow rates, USFilter offers custom designed single and dual bed carbon adsorbers, often used as a polishing stage following a wet scrubber system. Carbon adsorber units can be designed to handle in excess of 20,000 cfm.

As with the modular carbon adsorber systems, the carbon media type is selected based on the specific application.



Three carbon adsorption units in Glendale, AZ (dual bed).

SIZING INFORMATION*

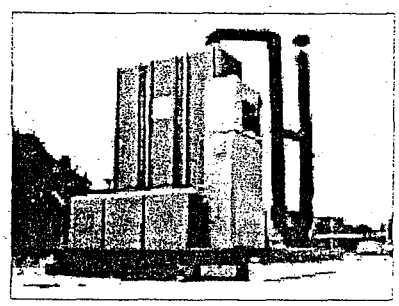
Air Flow Rate (cfm)	Vessel Dia. (ft.)	Bed Type	Vessel Height (ft.)	Footprint Required (ft.)	Fan Motor (HP)
1,700	6.0	Single	8.0	11.0 x 8.0	5.0
3,000	8.0	Single	8.0	15.0 x 10.0	7.5
4,700	10.0	Single	8.0	17.0 x 12.0	10.0
6,800	12.0	Single	8.0	20.0 x 14.0	15.0
9,400	10.0	Dual	13.0	19.0 x 12.0	20.0
11,400	11.0	Dual	13.0	20.0 x 13.0	20.0
13,600	12.0	Dual	13.0	21.0 x 14.0	25.0
20,000	14.0	Dual	13.0	23.0 x 16.0	40.0

*These are examples only, based on a superficial velocity of approximately 60 feet per minute.

LO/PRO™ ODOR CONTROL SYSTEM

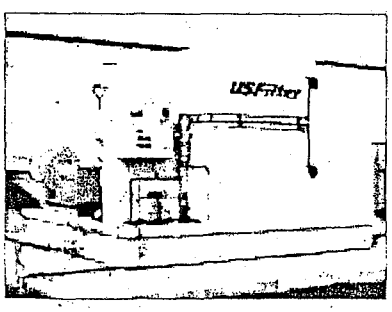
The patented LO/PRO™ Multi-Stage Packaged Scrubber System is one of the most technically advanced and cost-effective scrubber systems available. The LO/PRO is a factory pre-assembled system of unitary construction which can do the work of conventional packed towers in less than half the space and at a fraction of the cost. Each installation is custom designed to maximize efficiency and minimize chemical consumption, in coordination with other customer requirements. Performance is guaranteed with removal efficiencies in excess of 99.0% and air flow rates up to 24,500 cfm.

POLY-STAGE™ SCRUBBING TECHNOLOGY



The "L" Series and "DD71" Series Air Scrubbers provide a cost-effective, trouble free and flexible method to eliminate contaminants for all types of odor and fume control in air streams up to 6,000 cfm. The modular Poly-Stage™ scrubbing technology, using the packed-bed wet scrubbing process with a variety of chemical treatments, has proven effective for a wide range of airborne contaminants. With this patented technology, each module contains an integral packed bed, sump and re-circulation system. All vessels are seamless, maintenance free and guaranteed against failure for five years when used according to specifications.

ZABOCS™ BIOLOGICAL ODOR CONTROL SYSTEMS



The ZABOCS™ Biological Odor Control System is an advanced multi-media system which combines gas absorption, adsorption and biological treatment to capture and then eliminate organic and inorganic odors from wastewater process air streams. The unique combination of proprietary Biodagene™ and Biocarb™ media enables the ZABOCS system to treat three times the air volume compared to similar sized conventional biofilter systems, while immediately treating odors with zero acclimation time.

To find out more about how to put USFilter to work for you, contact us at

USFilter

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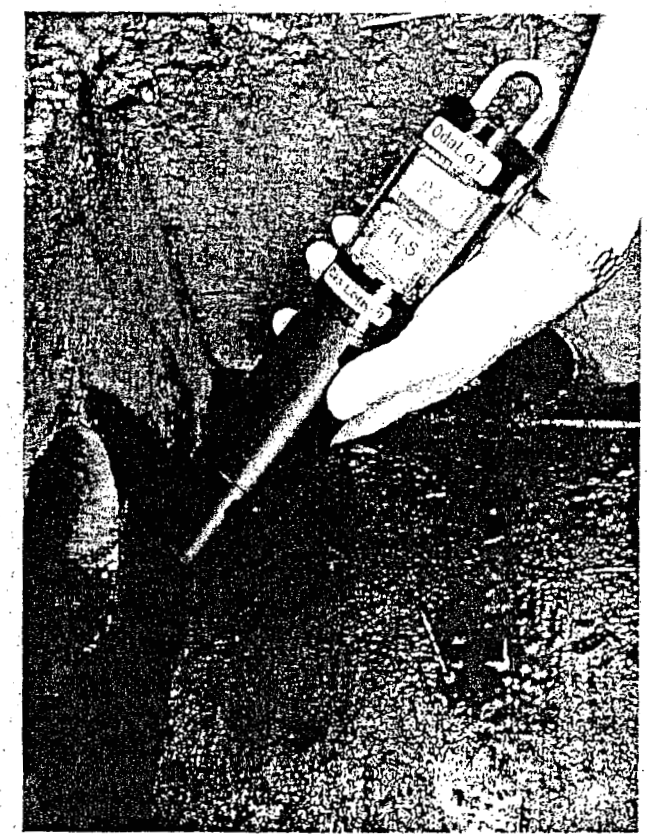
CS-ODOR-BR-0302

NEW !

OdaLog® Low Range Hydrogen Sulfide Gas Logger

For odor and corrosion studies

The OdaLog® Low Range Gas Logger was developed for locating and monitoring low-level hydrogen sulfide gas emissions (0.01 to 2.00 ppm).

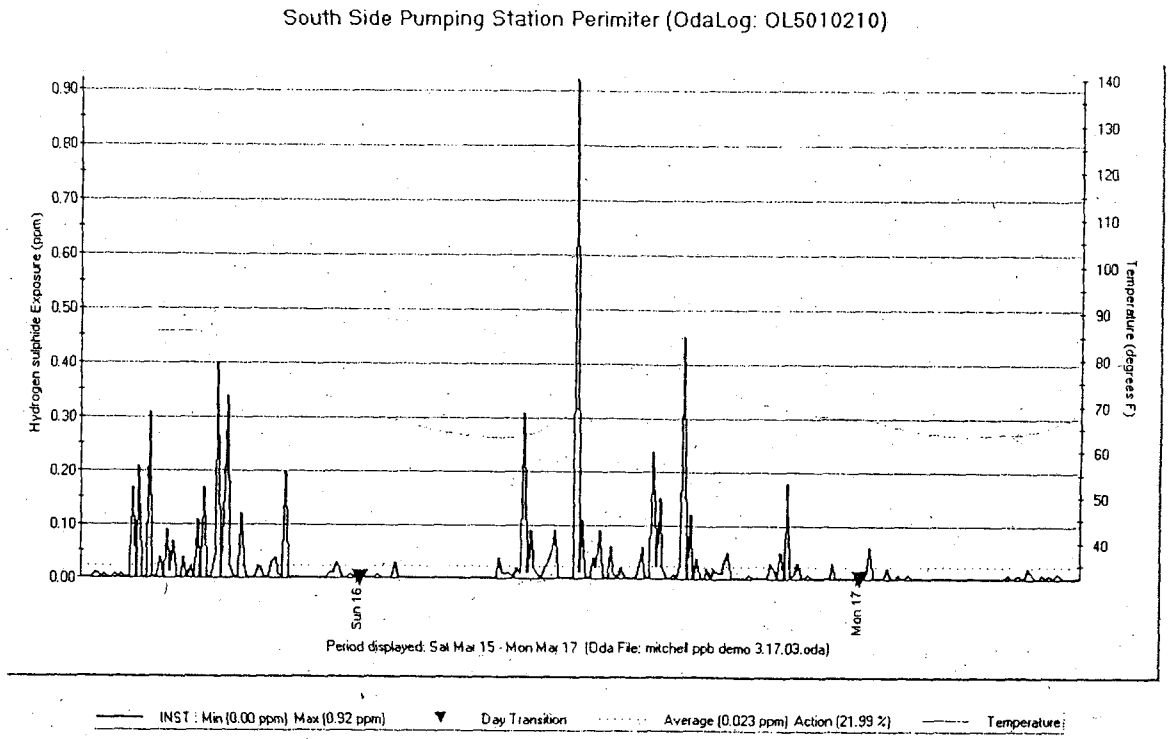


Typical applications include:

- Odor monitoring
- Control room monitoring
- Scrubber performance testing
- Ambient air analysis
- H_2S source detection
- Research projects

Detection Instruments Corporation
5815 N Black Canyon Highway • Suite 103 • Phoenix, AZ 85015 • Phone: 602-797-0630
www.detectioninstruments.com

An internal data logger records H_2S gas concentrations for later downloading of data in tabular or graphical form, using the standard OdaLog® Software.



- Infra-red data transmission
- Customize for specific applications
- Zooming capabilities
- Export to other spreadsheets

SPECIFICATIONS

Measurement range:	0.00 to 2.00 ppm
Logging/Sampling Interval	10 minutes to 1 hour
Memory capacity	30000 data points
Relative humidity range:	15 – 90% (non-condensing)
Pressure range:	Atmospheric, +/- 10%
External dimensions:	62mm (2.44") diameter X 345mm (13.6") long
Instrument weight:	Approximately 900 grams (2.0 lbs.)
Instrument Temperature Range	0° C to 40° C and 6° C change/Hr maximum (32° F to 104° F and 11° F change/Hr maximum)
Environmental protection	IP54 (dust and splash protected)
Zero drift (NTP)	+/- 0.01 ppm
Conditions: NTP, fresh air, taken over 10 consecutive sample cycles	
Precision	5% Relative Standard Deviation
Conditions: NTP, 0.20 ppm H2S applied, taken over 10 consecutive sample cycles.	
Accuracy	+/- 10% of reading 0.10 to 2.00 ppm
Conditions: NTP, 0.20 ppm applied, taken over 10 consecutive sample cycles.	

POWER SUPPLY

CPU Battery Type and Life	3.6V, 2/3 AA size Lithium cell, 2 months
Pump Battery and Life	1.5V "C" Size Alkaline, 7 days

WARRANTY

12 month warranty on electronics and sensors, 3 months on pumps and mechanical parts, when used in accordance with operation manual (excluding calibration and freight costs).

NTP defined as: Temperature = 20° C, Pressure = 1 Atmosphere

In the interest of continued improvements, we reserve the right to change design features without prior notice.

DETECTION INSTRUMENTS Corporation

OdaLog Low Range Hydrogen Sulfide Gas Logger

Part #	Description	Price
OL50	**OdaLog Low Range Hydrogen Sulfide Gas Logger** Range: 0.01 - 2.00 parts per million H_2S. Includes: Operation manual, magnetic allen tool, 2 - 3.6v lithium ion batteries, 4 "C" batteries, calibration fitting and hanging kit consisting of 3 feet of coated cable and 2 carabiners. Software sold separately.	$ 2,995.00
OLES	**OdaLog Environmental Shelter** Shields OdaLog from direct sunlight/temperature fluctuations.	$ 195.00
OLS	**OdaLog Software Kit (used with OL50, OL04, OL05, OL45)** Includes: Software (CD disc), infra red communications link, pushing tool/IR link stand.	$ 275.00
OLLRMK	**OdaLog Low Range Maintenance Kit** Includes: (2) 3.6 volt lithium ion battery, (4) "C" batteries, (4) filters, (2) absorbent packs, (1) allen tool, (1) switch cover, (1) O-ring, (1) calibration cup.	$ 75.00
OLLRCASE	**OdaLog Low Range Carrying Case** Holds three Low Range OdaLogs. Dimensions: 19 1/8" L x 15 7/16" W x 7 9/16" D	$ 195.00
OLLRGAS	**OdaLog Low Range Hydrogen Sulfide Gas Calibration Kit** Includes: 5 ppm Hydrogen Sulfide gas, carrying case, 0.25 lpm gas regulator, and dilution module.	$ 645.00
OLCYL5	**Gas Cylinder** - 5 ppm H_2S gas cylinder	$ 145.00
OLLRCAL	**OdaLog Low Range Calibration** Includes: Replacement of filter, batteries, a complete inspection and calibration of unit.	$ 145.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

All prices are FOB, Phoenix, AZ All prices in U.S. Dollars Updated July 21, 2004

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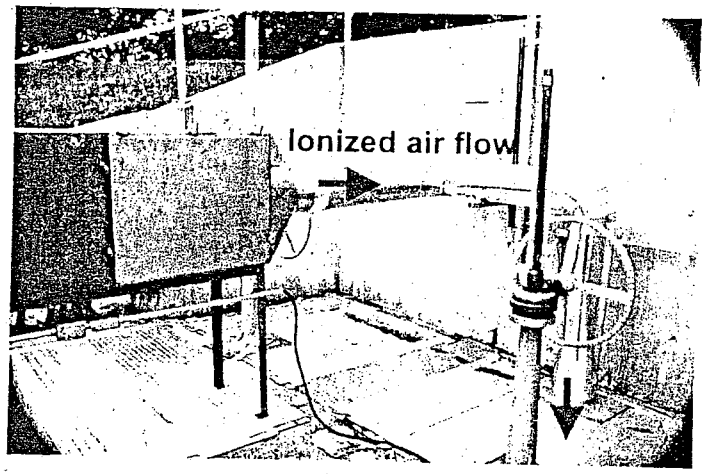
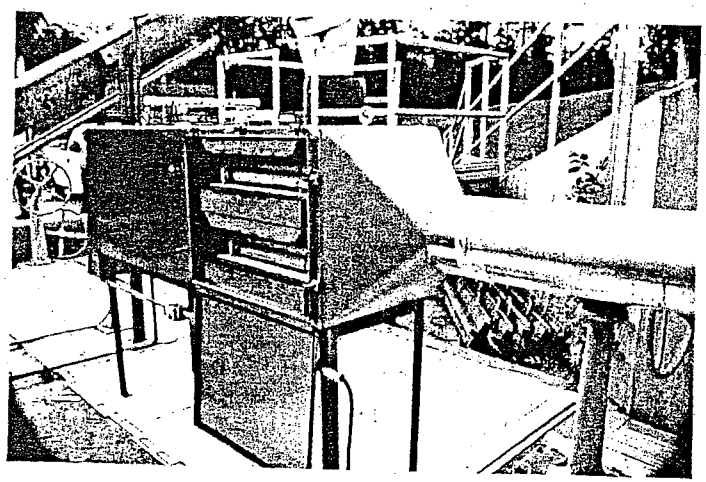
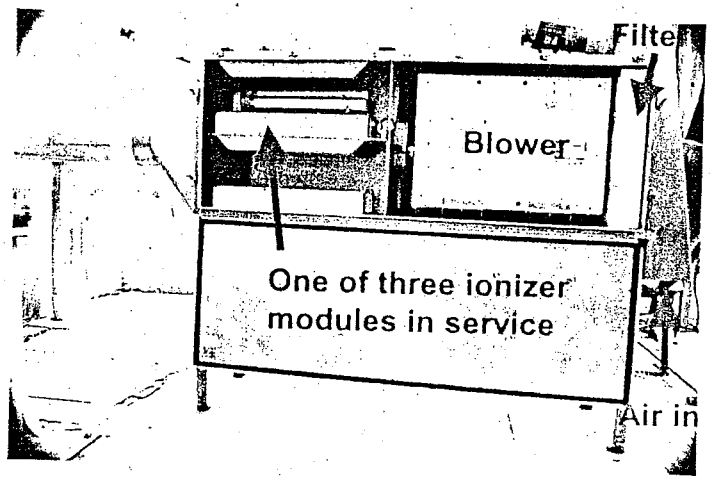
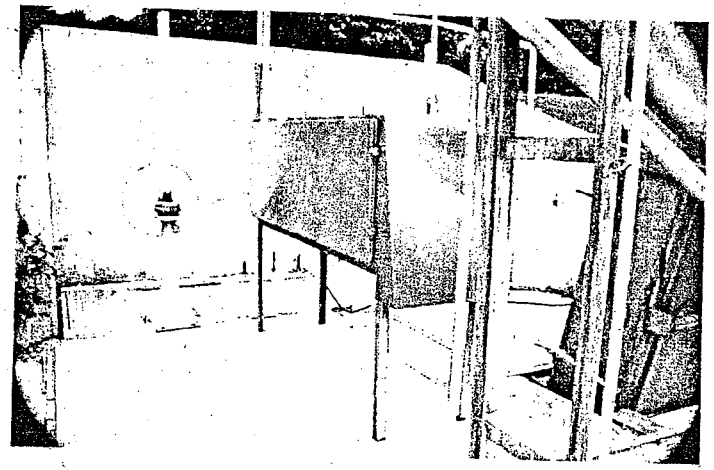
www.detectioninstruments.com

Pre-Engineered Standard System - San Jacinto River Authority, The Woodlands, Texas – Air Ionized Odor Control Plant #1 Mechanical Bar Screen at Plant Influent









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Pittsburgh, PA 15237
Phone: 412-366-1977
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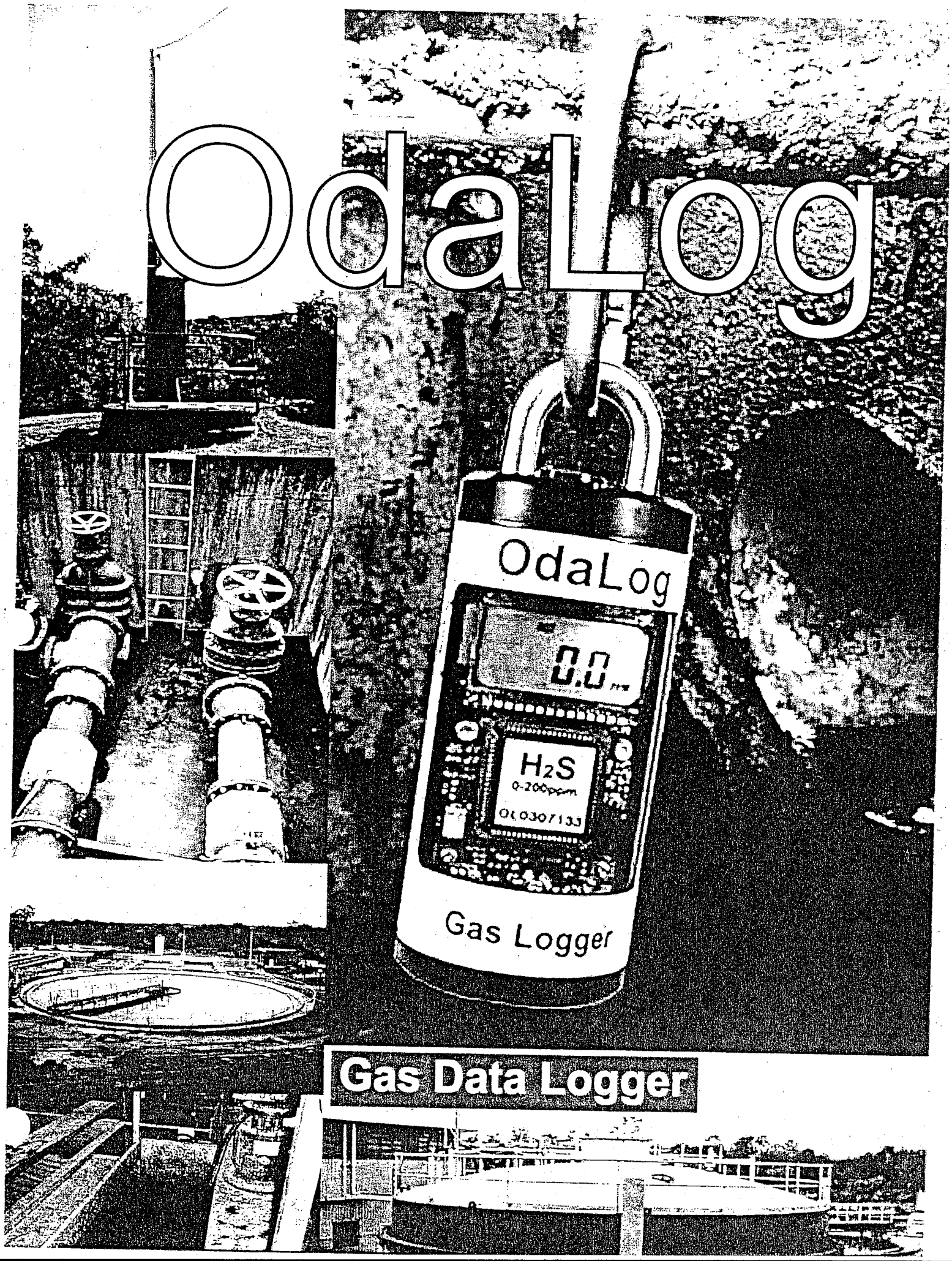
www.trans-tech.org

OdaLog



Gas Data Logger

PURPOSE DESIGNED

The OdaLog has been specifically designed for the Wastewater Industry, primarily for locating at or close to the source of Hydrogen Sulphide emissions such as within sewerage pumping stations and receiving manholes.

Its purpose is to log levels of H_2S in the range 0-200 ppm for later downloading of data in tabular or graphical form to highlight significant variations in H_2S levels over time.

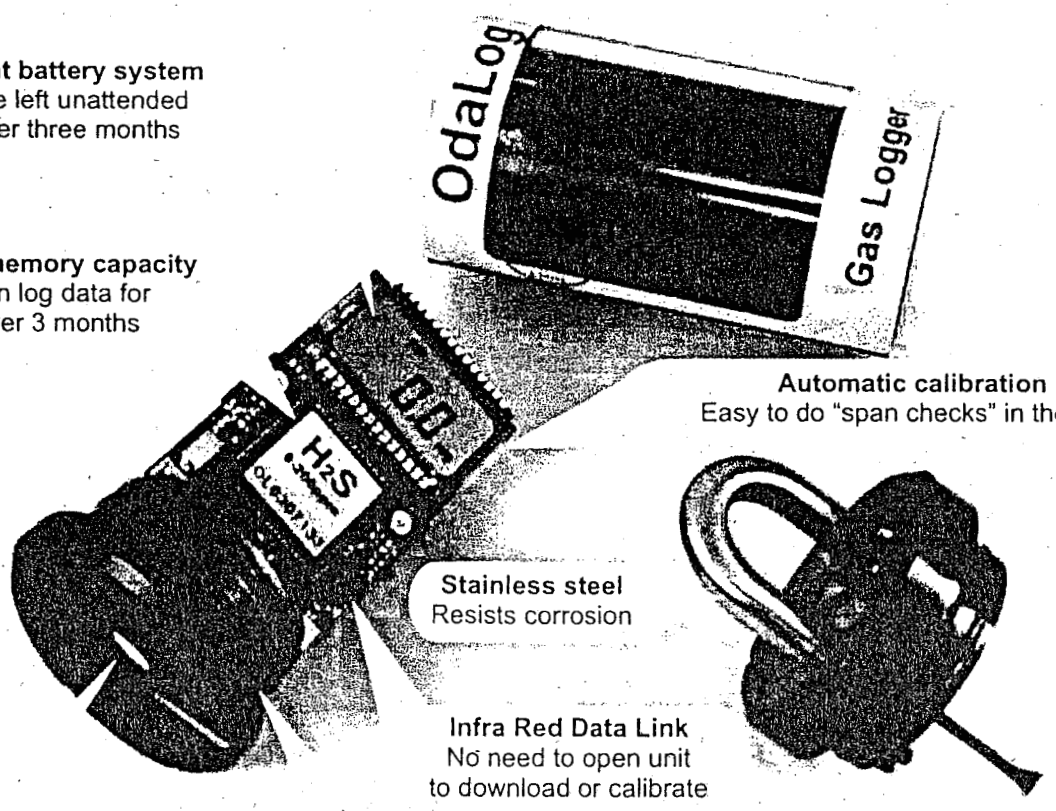
Due to the nature of the environment in which the instrument has to operate, it has been designed to be splash resistant, robust, small, and able to log data for extended periods of time.

Clear LCD display
Shows gas reading, time of day, Temperature, battery volts, % Log used, logging interval.

Durable non-corrosive plastic body
Survives in harsh Wastewater environment

Efficient battery system
Can be left unattended for over three months

High memory capacity
Can log data for over 3 months



Automatic calibration
Easy to do "span checks" in the field

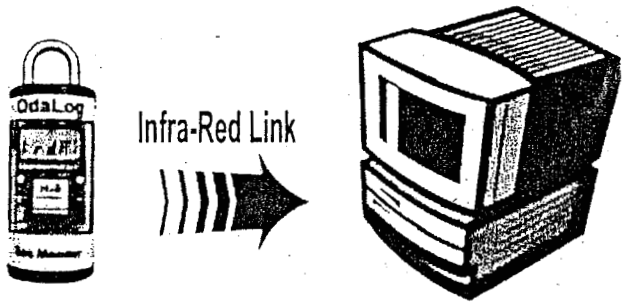
Stainless steel
Resists corrosion

Infra Red Data Link
No need to open unit to download or calibrate

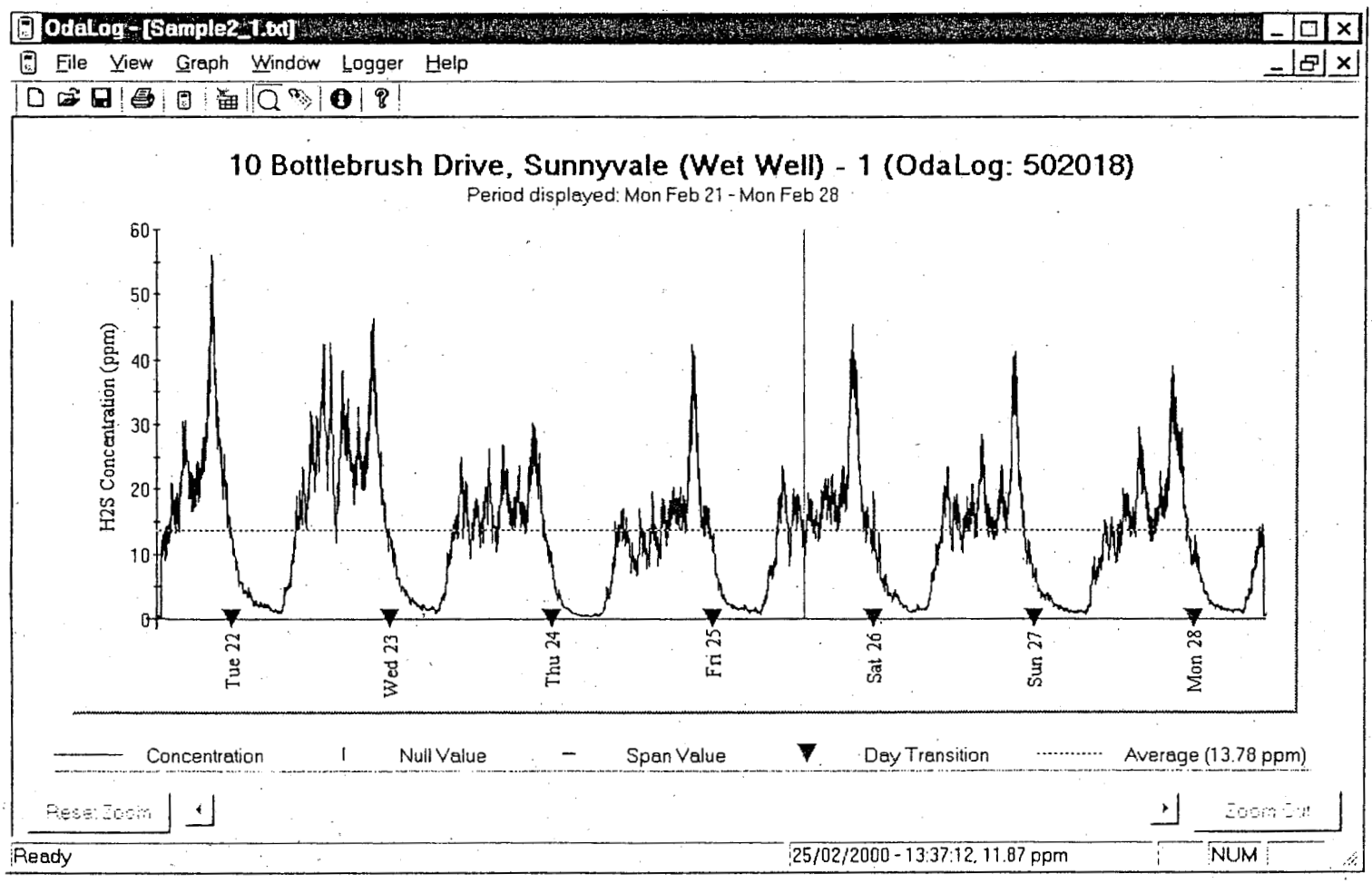
Filter over sensor
Repels splashes

Double O-Ring seals
Prevent water ingress

LONG TERM RECORDING



- Displays Line Graphs
- Ability to zoom in on selected time periods
- Ability to export data to spreadsheets
- Ability to customise graphical scale and mark time intervals on X-axis
- Records Odalog serial number on printout and allows graphs to be labelled
- Uses Infra Red Communication for downloading and configuring



32,000 logging intervals allow very detailed or very long studies e.g.

- Over 3 months at 5 minute intervals
- Over 3 weeks at 1 minute intervals
- Over 3 days at 10 second intervals

SPECIFICATIONS

SENSOR TYPE:	Electrochemical Hydrogen Sulphide
X RANGE:	0 to 999.9 ppm
D RANGE:	0 to 200.0 ppm
ACCURACY AT STP:	+/- 1.0 ppm
RESOLUTION:	0.1 ppm
RESPONSE TIME:	T90 < 60 seconds
PRESSURE RANGE:	Atmospheric +/- 10%
RELATIVE HUMIDITY RANGE:	15 to 90% (non-condensing)
LCD DISPLAY:	00.0 to 999.9
INSTRUMENT TEMP RANGE:	-10 C to +40 C
EXTERNAL DIMENSIONS:	165mm x 62mm Dia
INSTRUMENT WEIGHT:	450 grams

POWER SUPPLY

BATTERY :	3 x 1.5V AA Alkaline Batteries or 1 x 3.6V Lithium Battery (1-136 or 1-137)
BATTERY LIFE:	Alkaline Batteries Over 3 Months or Lithium Battery Over 6 Months

DATA LOGGER

MEMORY CAPACITY:	32,000 Readings
LOGGING INTERVAL:	Selectable from 1 second to 1 hour (e.g.) 1 min interval logs for 22 days, 5 min interval logs for over 3 mths

Approvals

RINSIC SAFETY:	Standards Australia AUS Ex 2478X, certified to: Ex ia I/IIC T4 IP66/67 NEMKO 03 ATEX134, certified to: I M2 / II 2 GD, EEx ia I/IIC T4 IP66/67
ELECTROMAGNETIC COMPATIBILITY:	The OdaLog Type I and accessories have been tested and conform to the requirements of C-Tick, CE & FCC.

SERVICING

We recommend that the OdaLog is returned to an authorized App-Tek service centre at least once every six months for a full inspection, software upgrade as developed, calibration, test for linearity and to have new batteries fitted.

WARRANTY

12 month warranty when used in accordance with operation manual (excluding calibration & freight costs).

Authorized Distributor

Detection Instruments Corp.
5815 N. Black Canyon Highway, Suite 103, Phoenix, AZ 85015
Free: 866.632.5647
Fax: 602.797.0631

Manufactured By

App-Tek INTERNATIONAL PTY LTD
ABN 28 089 678 339

Address:
Unit 13/6 Pinacle Street Brendale Queensland Australia 4500
P.O.Box 5523 Brendale Queensland Australia 4500

Web Page:
http://www.odalog.com

n the interest of continued improvement, we reserve the right to change design features without prior notice.

DETECTION INSTRUMENTS Corporation

OdaLog Hydrogen Sulfide Gas Data Logger

PART #	DESCRIPTION	PRICE
OL04	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-50 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OL05	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-200 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OL45	**OdaLog Hydrogen Sulfide Gas Data Logger** Range: 0-1000 PPM H2S, Includes: Operation manual, Magnetic Allen tool, Calibration fitting. Software sold separately.	$ 1,295.00
OLS	**OdaLog Software Kit,** (used with OL04, OL05, OL45) Includes: Software (CD disc), Infra Red Communications Link, Pushing Tool/IR Link Stand, O-Ring grease.	$ 275.00
OLS-USB	**OdaLog Software Kit with USB adapter** (used with OL04, OL05, OL45) Includes: Sofware (CD disc), Infra Red Communications Link with USB Adapter, Pushing Tool/IR Link Stand.	$ 305.00
OLGAS	**OdaLog Hydrogen Sulfide Gas Calibration Kit** Includes Test Gas, Gas regulator, Plastic Carrying Case.	$ 395.00
OLCASE	**OdaLog Carrying Case**: Rugged, corrosion & dust proof case. Dimensions: 10 5/8" L x 9 3/4" W x 4 15/16" D, Holds three loggers.	$ 125.00
MOSS-2	**Multiple OdaLog Sampling System-2** Includes: Operation Manual, ¼" OD tubing (20ft.), power adapter and connectors. OdaLogs and software sold separately.	$ 995.00

OdaLog Hydrogen Sulfide Gas Data Logger Spare Parts

PART #	DESCRIPTION	PRICE
12-002kit	**OdaLog** Infra Red Communications Link with Stand	$ 135.00
12-002USBKit	OdaLog Infra Red Communications Link with USB adapter and Stand	$ 65.00
OLSEN	**OdaLog** Replacement Sensor (please specify gas type and range).	$ 250.00
OLMK	**OdaLog** Maintenance Kit Includes: Filters (4), Absorbent pack (2) AA Batteries (6), Switch Cover (1), Calibration Cup (1), O-Ring (1) Desiccant Packs (2), Allen Tool (1)	$ 50.00
OLCAL	**OdaLog** Calibration Includes: Calibration, battery & filter replacement & complete inspection.	$ 65.00
OLCYL	**OdaLog** Replacement Gas Cylinder: Hydrogen Sulfide gas. Available in 25 / 50 / 100 ppm gas concentration, 58 liter cylinder.	$ 145.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

All prices are FOB, Phoenix, AZ All prices in U.S. Dollars Updated March 5, 2004