UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

SEP 1 6 1999

MEMORANDUM

SUBJECT: Five-Year Review Report for the Pester Refinery Site, El Dorado, Kansas

FROM: Catherine Barrett, Regional Project Manager
Missouri/Kansas Remedial Branch

THRU: Glenn Curtis, Chief
Iowa/Nebraska Remedial Branch

TO: Michael Sanderson, Director
Superfund Division

Attached for your concurrence is the Five-Year Review Report for the Pester Refinery site located in El Dorado, Kansas. The remedial action (RA) for this site is currently in the long-term response action phase and includes bioremediation/soil flushing, consolidation, and dewatering of the on-site ponds as part of the final closure of the site. Available information indicates that this RA as constructed and implemented is protective of human health and the environment. The Kansas Department of Health and Environment (KDHE) is negotiating a Consent Order with the responsible party, Fina Oil and Chemical Company, for the completion of the RA activities and final closure of the site. The KDHE has reviewed this five-year review report, and their comments were incorporated.

Attachment

cc: Carol Bass, EPA, HQ (with attachment)
Kurt Limesand, KDHE (with attachment)

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION VII (EPA)

Five-Year Review of Remedial Action

Pester Refinery

El Dorado, Kansas

I. INTRODUCTION

A. Statutory Authority

The Environmental Protection Agency (EPA), in cooperation with the Kansas Department of Health and Environment (KDHE), has conducted this five-year review of a Superfund remedial action at the Pester Refinery site, El Dorado, Kansas, pursuant to Section 121 (c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), to Section 300.430 (f) (4) (ii) of the National Oil and Hazardous Substances Contingency Plan (NCP), and pursuant to EPA /Office of Solid Waste and Emergency Response (OSWER) Directives 9355.7-02 (May 23, 1991) Structure and Component of Five-Year Reviews, 9355.7-02A (July 26, 1994) The First Supplement of the Five-Year Review Guidance, and 9355.7-03A (December 21, 1995) The Second Supplement of the Five-Year Review Guidance.

The purpose of a five-year review is to ensure that a remedial action remains protective of public health and the environment and that the remedy is functioning as intended. This five-year review is a “Type I” review, which is the most basic, and is appropriate for the review of most sites.

This five-year review report is a part of EPA’s file and administrative record for the site.

B. Site History

The EPA placed this site on the National Priorities List (NPL) on January 31, 1989. The Pester Refinery site is located on a 10-acre tract to the north and west of the city of El Dorado, Butler County, Kansas. The site is located in the southwest quarter of Section 25, Township 25, South, Range 5 East, Butler County, Kansas.

Industrial and agricultural lands surround the site. West of the site is an active refinery owned and operated by Coastal Refining and Marketing, Inc. (Coastal), and a Santa Fe Railroad spur that services the refinery. Wastewater treatment and aeration ponds owned and operated by Coastal are located south of the site. The West Branch Walnut River flows along the north and east edge of the area to be remediated. Agricultural land lies east of the site across the river.

The site lies within the Osage Plains section (Flint Hills Upland subsection) of the Central Lowland Physiographic province. In general, the topography is characterized by flat-topped, steep-sided hills capped by chert-bearing limestone. The site is underlain by terrace and alluvial sediments of Pleistocene-Recent age deposited by the West Branch Walnut River and Permian age units of the Barneston Limestone Formation. There are three aquifers beneath the site: (1) an alluvial aquifer ranging in thickness from 2 to 17 feet and consisting of clayey silts and fine sands with local gravel beds; (2) an upper limestone bedrock aquifer (Fort Riley Limestone Member of the Barneston Limestone) consisting of thin to massively bedded fossiliferous limestone and clayey shale; and, (3) a lower limestone bedrock aquifer (Florence Limestone Member of the Barneston Limestone) consisting of fillliliferous limestone with interbedded chert. There is a confining calcareous shale (Oketo Shale Member) separating the upper and lower bedrock aquifers.

Groundwater in the region is drawn primarily from the shallow bedrock aquifers (Fort Riley and Florence limestones), with lesser amounts from the shallow alluvial aquifer because that aquifer is less commonly present. The bedrock aquifers are characterized by jointed and fractured limestone that may be confined.

The direction of groundwater flow in the alluvial aquifer at the site is generally northeast and east toward the river with the possibility of some radial flow to the south and southwest of the burn pond. Data suggest that the alluvial aquifer and the Fort Riley Limestone aquifer are hydraulically connected and are locally recharged by the ponds on the site. Groundwater within the Fort Riley Limestone aquifer is interpreted to flow northeast and east from the ponds with partial discharge into the West Branch Walnut River. Groundwater in the Florence Limestone aquifer is interpreted to flow eastward from the site.

The refinery occupying the area immediately west of the site was constructed in 1917, soon after the discovery of oil in El Dorado in 1915. The refinery and surrounding area were purchased by Fina Oil and Chemical Company in 1958. The burn pond was built by Fina around the time of the purchase. Fina disposed of petroleum waste products generated by normal refinery operations by running a pipe from the refinery to the burn pond. The pond was used to store various refinery byproducts such as slop oil emulsion solids, API separator sludge, and heat exchanger bundle cleaning sludge. A general practice for Fina was to ignite the waste product as it came out of the pipe, with the result that the waste which did not burn, was discharged out of the pipe into the pond.

The site historically contained a burn pond, a stormwater pond, and a smaller settling pond. The dike separating the burn pond and the larger stormwater pond was breached, resulting in a U-shaped pond. Eventually the dike between the stormwater pond and the settling pond also was breached, creating common water between all three ponds.

An open interceptor trench was installed in the late 1950s or early 1960s to intercept seepage from the burn pond to the West Branch Walnut River. The trench was excavated to the top of weathered bedrock and sloped to the east where fluids were collected and pumped back up to the ponds on site. Although typically effective, the trench occasionally overflowed or was inundated and carried contaminants into the river.

On January 1, 1977, Pester purchased the refinery from Fina and continued refinery operations. Pester filed for bankruptcy on February 25, 1985. Subsequent to Pester's bankruptcy, Coastal Derby Refining Company (now Coastal Refining and Marketing, Inc.) purchased the refinery with the exception of the tract of land containing the burn pond. The tract occupied by the burn pond is still owned by Pester.

On February 28, 1986, KDHE Administrative Order # 86-E-16 was issued requiring Pester to conduct a site investigation of this surface impoundment, perform monitoring, and submit a Burn Pond Closure Plan.

The Pester Refinery Company site was placed on the NPL on January 31, 1989, by the EPA pursuant to its authority under CERCLA, as amended by SARA. Following initial investigations, a Consent Order was signed between Pester, Fina, and KDHE (April 19, 1990) to conduct remedial investigation/feasibility study (RI/FS) activities at the site.

During late March 1992, a subsurface interceptor trench was constructed on the north and east sides of the burn pond between the pond and the West Branch Walnut River to prevent the seepage of contamination from the burn pond into the river in those areas. This trench extended east and south of the existing open interceptor trench. The subsurface interceptor trench was dug into weathered bedrock and sloped to a central collection point. Appreciable thicknesses of oil that accumulate at the central collection point are periodically skimmed off of the water in the trench and disposed. Water extracted from the subsurface trench system is discharged back to the burn pond.

A Record of Decision (ROD) was issued for the site in September 1992. The ROD split the site into two operable units, a soil and sludge operable unit (OUI) and a groundwater operable unit (OU2), because groundwater contamination at the site had not been adequately characterized at that time. The main remedial elements specified in the ROD for OU1 included: excavation of sludge from the three interconnected ponds; separation of the sludge into Recovered Refinery Feedstock (RRF oil), water, and residual solids; treatment, transportation, and off-site disposal of the residual solids; transportation of the RRF oil for incorporation into the refining process; and bioremediation of the contaminated soils in the ponds.

It was determined subsequent to the execution of the ROD that the remedy described therein was not implementable because there were no available refineries which held a permit to accept off-site Resource Conservation and Recovery Act (RCRA) hazardous wastes for recycling, making the transportation of sludge materials off site infeasible. An Explanation of Significant Differences (ESD) was prepared to document changes to the ROD and the reasons these changes were made. The remedy was modified by the ESD to incorporate an alternative method of treating the sludge material. The modified remedy included three-phase separation of the pond sludge on site. The water phase was to be sent to the Coastal Derby Wastewater Treatment Plant, which operates under a National Pollutant Discharge Elimination System (NPDES) permit. The oily phase was to be taken off site to be recycled. The residual solids (or “filter cake”) were to be further treated on site to meet Best Demonstrated Available Technology Standards to meet the land ban requirement for land disposal. The treated filter cake was then to be disposed at a RCRA-permitted treatment, storage, and disposal facility in compliance with the off-site policy.

The KDHE, Fina, and Pester entered into a Consent Order to complete a Remedial Design/Remedial Action (RD/RA) for OU1 of the site in September 1993. The treatability study for the soil was completed in the fall of 1994. The pond sludge dredging and removal and recycling of oil contained in the sludge began in December 1995 and continued through March 1996. The bioremediation design document for the soil portion of OU1 establishes the organization and technical basis for the bioremediation of the pond soils. Bioremediation of the pond soils is being conducted in a phased approach. Phase I has been completed and focused on remediating half of the stormwater pond while simultaneously gathering bioremediation performance data. Phase II is underway and is focused on addressing the remainder of the stained soil in the ponds.

In December 1993, Fina and KDHE entered into a Consent Order to conduct RI/FS activities for the OU2.

The Focused/Abbreviated RI for the OU2 was directed toward augmenting information on the nature and distribution of groundwater and groundwater contamination at the site collected during the original site-wide RI. Fina retained Sharp and Associates to perform the OU2 RI/FS activities. Sharp and Associates identified the following goals for the OU2 RI: (1) to gain further understanding of groundwater flow at the site; (2) to assess interaction between aquifers; and, (3) to define the extent of groundwater contamination. The field work for completion of the OU2 RI was conducted in June 1994.

The following three aquifer units were defined for OU2: (1) alluvial; (2) upper bedrock (Fort Riley Limestone); and, (3) lower bedrock (Florence Limestone).

In August 1996, Fina requested that KDHE permit the construction of an extension of the northwestern end of the subsurface interceptor trench at the site to replace the existing open interceptor trench. The open trench is subject to flooding by the West Branch Walnut River and has overflowed on several occasions, releasing wastes into the river. The KDHE approved the interim measure, and the trench extension has been completed.

Certain aspects of the OU1 remedy have contributed to the mitigation of groundwater contamination and have diminished the potential risk posed by that contamination. Exposure controls implemented as elements of the OU1 remedy include institutional controls in the form of a deed restriction controlling development of the property and a fence to restrict site access, the removal of the material that served as the original source of groundwater contamination (sludge in the ponds), and the operation of the underground interceptor trench.

With the dredging of the oily sludge from the ponds, the source for groundwater contamination has likely been removed. The levels of contamination can reasonably be expected to remain constant or decline following the removal of the source. With the presence of an active bioremediation system in the ponds and the recirculation of biologically active groundwater through the pond, alluvial aquifer, interceptor trench, and treatment train, it is anticipated that treatment and biodegradation and other natural attenuation processes will continue to reduce the concentration of chemicals of concern in alluvial groundwater.

The shallow alluvial aquifer is the most significantly impacted water-bearing zone at the site, but is not employed as a drinking water source in the area and does not yield sufficient water to serve as a domestic water supply. Given the maximum saturated thickness of approximately twenty feet for the combined saturated zones of these aquifers that are in communication with each other, the projected maximum sustained yield of the aquifers would be insufficient to serve as a permitted domestic water supply in Kansas. In addition, the total dissolved solids content of water from the thin veneer of saturated alluvium at the upgradient edge of the site exceeds the Secondary Maximum Contaminant Limit (SMCL) for that parameter, suggesting that the water would be non-potable as a result of taste, odor, color, or other non-aesthetic effects. The underlying upper bedrock aquifer, while significantly less impacted, contains elevated concentrations of volatile organic compounds (VOCs), arsenic, and barium. Both the alluvial aquifer and the upper bedrock aquifer normally discharge to the West Branch Walnut River, but are currently being captured by the underground interceptor trench. No chemicals of concern for the site have been detected at significant concentrations in the lower bedrock aquifer, a potential drinking water aquifer. The presence of the shale zone within the upper bedrock aquifer appears to act as an aquifer, isolating the lower bedrock aquifer to some extent from the downward migration of contaminants present in the overlying aquifers.

The original subsurface interceptor trench was constructed during 1992 on the north and east sides of the burn pond between the pond and the West Branch Walnut River to prevent the seepage of contamination from the burn pond into the river in those areas. This trench extended east and south of the open interceptor trench. The subsurface interceptor trench was dug into weathered bedrock and sloped to a central collection point. Water extracted from the subsurface trench system at the collection point is treated by oil-water separation and mechanical filtration and is discharged back to the burn pond. The open interceptor trench was replaced by Fina in August, 1996, when the KDHE approved the trench extension of the northwestern end of the subsurface interceptor trench. The KDHE and EPA anticipate that the process of extracting, treating, and returning the water to the ponds for recirculation will also reduce the concentrations of contaminants in groundwater through oil-water separation, physical filtration, biodegradation, and other natural attenuation processes.

Contamination in the alluvial aquifer, which is not considered a drinking water aquifer based on potential yield and inorganic quality, extends from the upgradient edge of the site property to the river, to the east and north, and to the southern property boundary to the south based on flow direction. The existing subsurface interceptor trench which was constructed as a component of the OU1 remedy serves as a barrier to groundwater contaminant migration to the river. The alluvial aquifer terminates at the river. The highest concentrations of VOCs were present in the alluvial aquifer. VOCs identified in the alluvial aquifer during the OU2 RI included benzene, ethylbenzene, toluene, and total xylenes. Benzene is present at concentrations in excess of the maximum contaminant level (MCL). Semi-volatile organic compounds (SVOCs) identified in the alluvial aquifer included low concentrations of polycyclic aromatic hydrocarbon compounds, phenols, phthalates, naphthalene, and methylnaphthalene. Arsenic, barium, chromium, and lead were present above background concentrations in the alluvial aquifer. Separate-phase hydrocarbons were present in several wells during the OU2 RI sampling.

The upper bedrock aquifer (Fort Riley Limestone) is locally recharged by the ponds on the site. Groundwater is interpreted as flowing north and east from the ponds and discharging to the West Branch Walnut River. Trace concentrations of benzene, toluene, and total xylenes were detected in a well completed in the upper bedrock aquifer upgradient of the site in 1990. No VOCs were detected in the sample collected from the upgradient well during the OU2 RI. A sample collected in 1990 from a well located downgradient of the burn pond and screened in the upper bedrock aquifer contained higher levels of benzene, toluene, and total xylenes relative to the upgradient well and low levels of arsenic and barium; subsequent samples have not contained elevated concentrations of metals or VOCs. Low concentrations of several SVOCs were detected in the upper bedrock aquifer during the 1994 OU2 RI.

The lower bedrock aquifer (Florence Limestone) is separated from the upper bedrock aquifer by an aquiclude, the Oketo Shale. A background sample collected in the lower bedrock aquifer in 1990 contained trace concentrations of toluene and total xylenes; no VOCs were detected above detection limits at this location during the OU2 RI. Samples collected from a well completed in the lower bedrock aquifer downgradient of the ponds contained no VOCs or SVOCs above detection limits. Arsenic and barium were detected at concentrations below the MCLs for those substances in 1994 and may reflect the naturally-occurring background concentrations for those metals in the aquifer.

Surface water samples were collected from the West Branch Walnut River during the OU2 RI and analyzed for VOCs; no VOCs were present above detection limits.

The subsurface interceptor trench was designed to capture and recirculate water from the ponds to maintain the aqueous bioremediation system. The trench serves to contain the groundwater plume and to prevent further migration of contaminated groundwater from the hydraulically connected alluvial and upper bedrock aquifers to the river.

At the completion of the OU2 RI/FS, a ROD was issued in September 1998 for the OU2 remedy, which approved the no action alternative, with groundwater monitoring and sediment monitoring. Because the risk from the groundwater falls within the acceptable range, no further action is necessary to protect human health and the environment from exposure to the groundwater at the site. The alluvial aquifer is not a usable drinking water source, and the expectation is that contamination levels at the site will probably continue to be reduced as a result of the OU1 remediation activities. The operation of the subsurface interceptor trench as a component of the OU1 remedy is effectively preventing any off-site migration of contaminated water, and institutional controls will prevent any future well drilling at the site. The mitigative measures which are components of the OU1 remedy include institutional controls in the form of a deed restriction controlling development of the property and a fence to restrict site access, the treatment and/or removal of the source material (sludge in the pond), and the operation of the underground interceptor trench. The underground interceptor trench was constructed to prevent separate-phase hydrocarbon and dissolved-phase seeps from the ponds from reaching the river and to recirculate trench effluent to the ponds to maintain the aqueous bioremediation system. It is anticipated that the process of recirculation of the water to the ponds will reduce the concentrations of contaminants in groundwater through oil-water separation, physical filtration, biodegradation, and other natural attenuation processes. After two years, the frequency of monitoring and sediment sampling will be re-evaluated.

On October 16, 1998, the aqueous bioremediation system in the northern half of the stormwater pond, including eight 75-Hp surface aerators and one 20-Hp aspirating mixer used to mix the stained soils and provide oxygen for biodegradation, was shut down for the winter months. Prior to the shut down, Fina’s contractor, Sharp and Associates, added soils to the bioremediation system which had been dredged from the S1 pond and south burn pond.

On March 29, 1999, the bioremediation system was brought back on-line, and daily sampling of the bioremediation system was initiated on March 30, 1999. The data from the daily samples will be evaluated to determine whether the system is operating efficiently. Daily parameters include: heterotrophic plate count, total organic carbon, mixed liquor volatile suspended solids, nitrogen (kjeldahl), phosphorus, chemical oxygen demand, total suspended solids, and on-site respirometry. The mist fence along the northern side of the stormwater pond was re-installed to intercept the mist that is generated by the surface aerators. The daily data indicate that the system efficiency began to increase during the month of May. This can be seen by the increase in the respirometry rate and Mixed Liquor Volatile Suspended Solids (MLVSS). A five-day biological oxygen demand analysis is conducted on some of the daily samples.

The groundwater interceptor trench continues to operate. The water from the trench is treated by the water treatment system which consists of oil/water separation and filtration and is discharged. The water treatment system began operation on February 16, 1999, and, during the months following, has facilitated the dewatering of the southern half of the burn pond. During the month of July 1999, 580,150 gallons of treated water were discharged to the West Branch of the Walnut River.

The verification sampling and closure plan for the S1 pond and southern half of the burn pond was submitted by Fina's contractor, Sharp and Associates. The S1 pond and southern half of the burn ponds were drained to allow for verification sampling and for the eventual site grading and final closure. Verification sampling was conducted during June 1999; however, based on the fact that the results of the analyses have shown that the concentrations of contaminants found still remain above clean-up goals, further remediation of the ponds stained soils was determined to be required.

II. DESCRIPTION OF THE REMEDIAL ACTION

In compliance with the Consent Order, the responsible party has designed and implemented the remedial action for OU1 as set forth in the ROD which was signed on September 30, 1992. The OU1 ROD was supplemented by an ESD completed in September 1993 and by a second ESD completed in September 1998. The responsible party has removed and processed the sludge on site, and the soil is being treated by a process of in-situ flushing and bioremediation. Following removal of the pond sludge, the ponds were filled with water. Any soil contaminants which are mobilized by the aqueous solution will flow to the interceptor trench for collection, treatment, and reintroduction to the ponds. The subsurface interceptor trench was incorporated into the OU1 remedy to extract seepage from the ponds and maintain hydraulic control, preventing the discharge of separate-phase hydrocarbons and dissolved-phase contaminants into the adjacent river while simultaneously maintaining the water level in the aqueous bioremediation system. Treatment of the trench effluent prior to reintroduction of the effluent to the ponds also serves to reduce the mass of contaminants in the ponds and seepage. The treatment process includes initially pumping the water from below the oil/water interface in the interceptor trench to preclude the recirculation of separate-phase hydrocarbons and mechanical filtration to remove suspended contaminants. After this treatment cycle, the water is discharged back into the pond cavities. Aeration of the stained soils/water mixture is provided in the northern half of the stormwater pond via surface aerators. The aeration augments biodegradation of organic contaminants in the pond water. Stained soils from the S1 pond and the southern half of the burn pond have been dredged out and stockpiled in the southern half of the stormwater pond and the northern half of the burn pond and fed into the treatment area in the northern half of the stormwater pond to provide a continuous source of hydrocarbon material as food for microbes in the treatment area. Nutrients and other additives determined to optimize the efficiency of the biodegradation of hydrocarbon material were added. The aeration of the ponds, soil additions, and nutrient additions, were suspended during the winter months when the temperature of the pond water precludes effective biodegradation.

The remedial action includes monitoring designed to determine if the treatment process is effective. Monitoring has included collection and analysis of samples of fluids from the interceptor trench and the treated effluent to determine the effectiveness of the treatment system and the need for additional pretreatment prior to discharge back into the ponds. Soil monitoring is designed to detect the concentration levels of contaminants of concern in the soils to ensure performance standards of the system are attained. Groundwater monitoring and sediment monitoring will be included in the Supplemental Remedial Action Plan in accordance with the OU2 ROD. The groundwater sampling and the sediment sampling will be conducted quarterly; and, after two years, the frequency of sampling will be re-evaluated.

III. POST RESPONSE ACTION ACTIVITIES

A. National Priorities List

This site has not yet been deleted from the NPL.

B. Operation and Maintenance and Monitoring

The operation and maintenance phase of the project will include groundwater monitoring and sediment monitoring. The responsible party will conduct the groundwater monitoring, the sediment monitoring, and long-term maintenance of the site in accordance with an Operation and Maintenance Plan, which will be developed following the completion of the remedial action.

C. Five-year Review Inspection

The site was visited during October 1998 prior to the shut down of the bioremediation system during the winter months. At the time of re-activation of the bioremediation/soil-flushing system during the month of March 1999, a site visit was conducted. The temperature of 52 degrees has been the temperature at which the bioremediation system has been shown to remain active with microbes functioning as intended and providing the required level of treatment.

During June 3-4, 1999, a site visit was conducted by KDHE in order to observe the verification sampling conducted by Fina’s contractor, Sharp and Associates, and to collect split samples for the purpose of quality assurance/quality control oversight. The verification sampling analysis results are attached to this report. Upon reviewing the analytical data, it is apparent that a good portion of the material sampled for verification testing collected from the south burn pond exceeds the KDHE risk-based, standards; and as a result, additional material from the south burn pond will be transferred to the stormwater pond for further remediation. Sharp and Associates will utilize a trackhoe with a 50-foot arm to transfer material from the south burn pond to the stormwater pond, where this material will be subsequently transferred into the bioreactor. The depth of material that will need to be transferred will vary over the different regions of the pond. In the locations of GP-1, GP-5, and GP-6, where impacted materials were identified at subsurface depths ranging from 4 to 10 feet below grade surface, the soil overlaying these impacted materials will be stockpiled on site. The stockpiled material will be sampled before it is used as fill material in the closure of the S1 and south burn pond. Once the material from the south burn pond and berm has been transferred, Fina will notify KDHE that Fina is prepared to take verification samples again.

Daily sampling of the bioremediation system was initiated on March 29, 1999. The data indicate that the system efficiency began to increase during the month of May. This can be seen by the increase in the respirometry rate and MLVSS. The five-day biological oxygen demand analysis was conducted on some of the daily samples in May. The food to microorganism ratio is similar to that of an extended aeration activated sludge system. The operating system data are provided as attachments to this report.

IV. RESULTS OF THE FIVE-YEAR REVIEW/PROTECTIVENESS

Available information indicates that the remedial action which has been constructed at this site continues at this time to be protective of human health, welfare, and the environment. The remedial action will continue to be implemented with the ongoing bioremediation/soil-flushing remedy. The groundwater monitoring and sediment monitoring will be conducted as stipulated in the Supplemental Remedial Action Plan. Land uses have not changed within the area of the site.

V. NEXT FIVE-YEAR REVIEW

Since hazardous substances remain at this site in concentrations which would be unacceptable for unlimited use and unrestricted exposure, five-year reviews of this remedial action will continue, unless this statutory requirement is eliminated or unless all such levels of hazardous substances are subsequently removed from the site. A review of the protectiveness of the remedy will continue every five years. The next five-year review of this site will be initiated in the year 2004.

Attachments

Michael J. Sanderson, Director
Superfund Division

9/15/99
Date

Attachment A

Bioreactor Operating Data

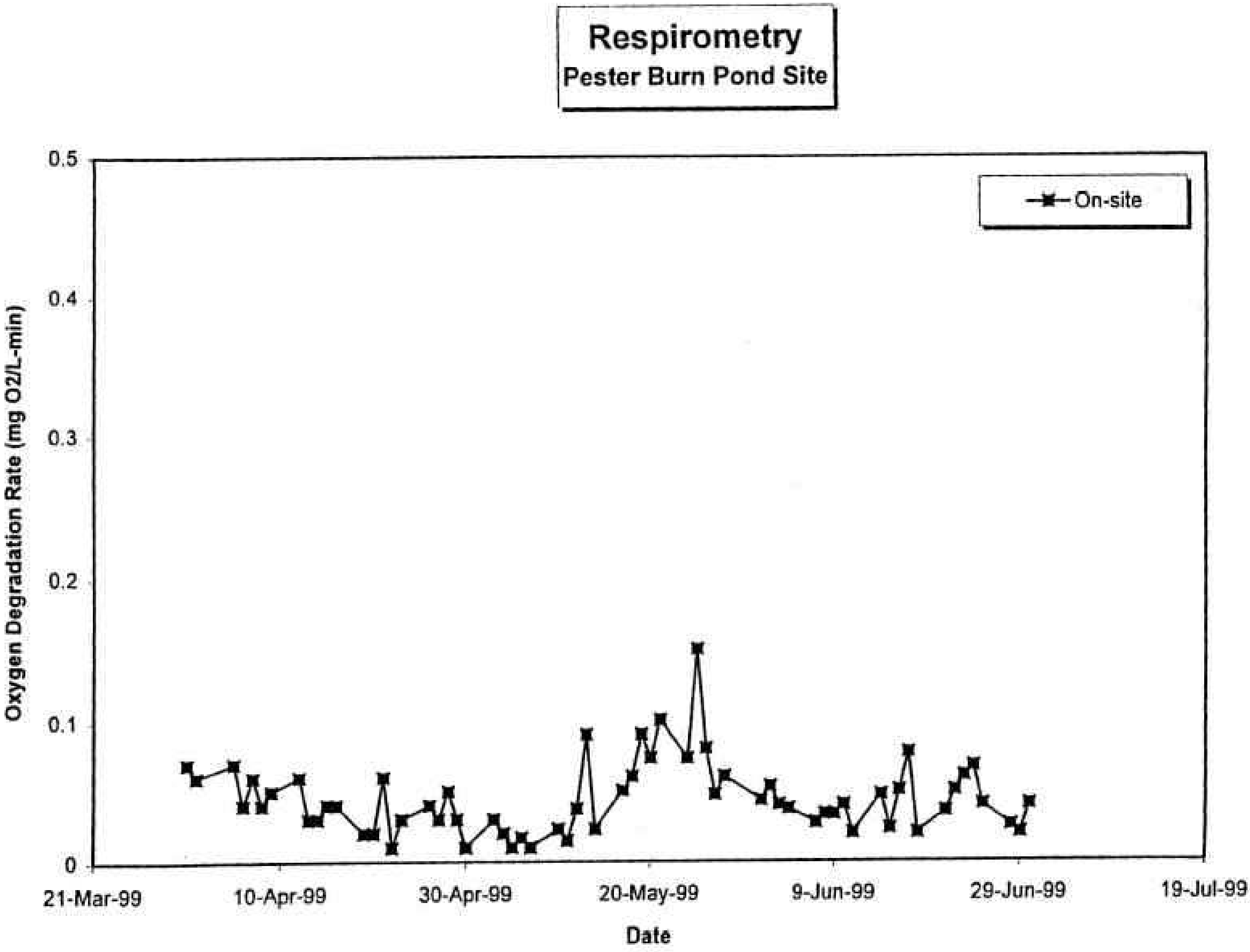
Date	On-site Respirometry (mg O_2/L-min) (avg. of 3 depths)	Ammonia as nitrogen (mg/L)	Nitrate (N) (mg/L)	Nitrite (N) (mg/L)	Total Nitrogen (mg/L)	Phosphorus (mg/L)	pH	Temp (C)	COD (mg/l)	Plate Count (cfu/mL)	TOC (mg/L)	MLVSS (mg/L)	BOD 5 day	Food to Microragism ratio (BOD/MLVSS)	Suspended Solids (mg/L)	Comments
1-Jun-99	0.043	7.6	7.9	2.3	17.8	0.41	7.77	20.5	436	680,000	86	94	35	0.37	258	
2-Jun-99	0.053	6.6	7.2	1.9	15.7	0.18	7.68	18.6	572	750,000	110	192	54	0.28	724	
3-Jun-99	0.04	4.6	7.3	2	13.9	0.64	7.71	20	610	1,000,000	100	178	48	0.27	634	
4-Jun-99	0.037	3.2	6.8	2	12	0.2	7.84	23	468	2,200,000	87	136	100	0.74	532	Dredge discharge line plugged
7-Jun-99	0.027	2.3	5.5	1.9	9.7	1.13	7.91	20.8	506	720,000	83	92	31	0.34	348	
8-Jun-99	0.033	1.5	4.2	1.6	7.3	0.49	7.84	22.8	422	2,200	61	74	44	0.59	274	
9-Jun-99	0.033	0.1	45	0.5	45.6	0.86	7.85	23.5	342	2,100,000	130	87	18	0.21	308	8 tons fertilizer added
10-Jun-99	0.04	115	50	2.1	167.1	0.82	7.91	20.6	550	1,400,000	130	92	24	0.26	318	
11-Jun-99	0.02	113.2	48	1.8	163	1.3	7.96	20.3	576	3,400,000	140	90	22	0.24	306	
14-Jun-99	0.047	92.5	43	2	137.5	2.85	8.56	20.7	294	830,000	110	49	35	0.71	145	Dredge back on line
15-Jun-99	0.023	149	42	3.1	194.1	1.32	8.13	17.1	544	2,200,000	120	120	54	0.45	412	15,000 gal “seed” Material added
16-Jun-99	0.05	125	42	3.7	170.7	0.24	8.16	17.5	680	6,500,000	120	184	300	1.63	666	
17-Jun-99	0.077	141	40	3.3	184.3	1	8.14	14.4	664	8,000,000	110	214	42	0.20	754	
18-Jun-99	0.02	112	40	3.9	155.9	0.99	8.13	15.8	858	510,000	110	272	73	0.27	998	
21-Jun-99	0.035	23.8	26	5.2	55	1.01	8.15	21	464	5,500,000	87	96			358	
22-Jun-99	0.05	91.5	25	6.1	122.6	0.44	7.66	21.8	504	1,700,000		188			694	
23-Jun-99	0.06	87.5	21	6.2	114.7	0.33	7.88	20.8	716	3,200,000	85	320			1190	
24-Jun-99	0.067						7.99	22.5			87					
25-Jun-99	0.04						7.95	21.1			82					
28-Jun-99	0.025						7.63	26.1								
29-Jun-99	0.02						7.79	19.1								
30-Jun-99	0.04						7.67	21.2								

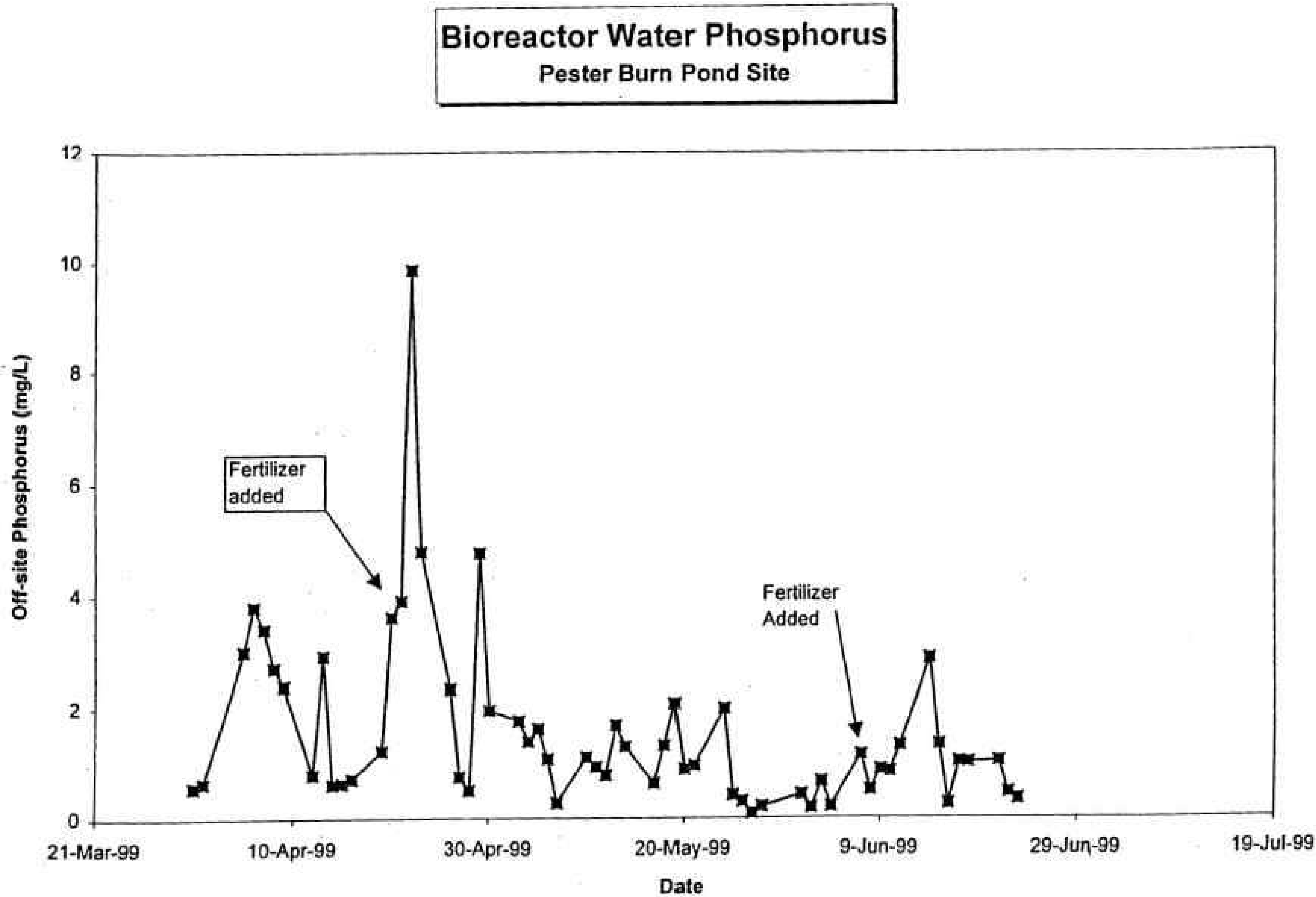
Operational Data - Daily Records

Pester Burn Pond Site

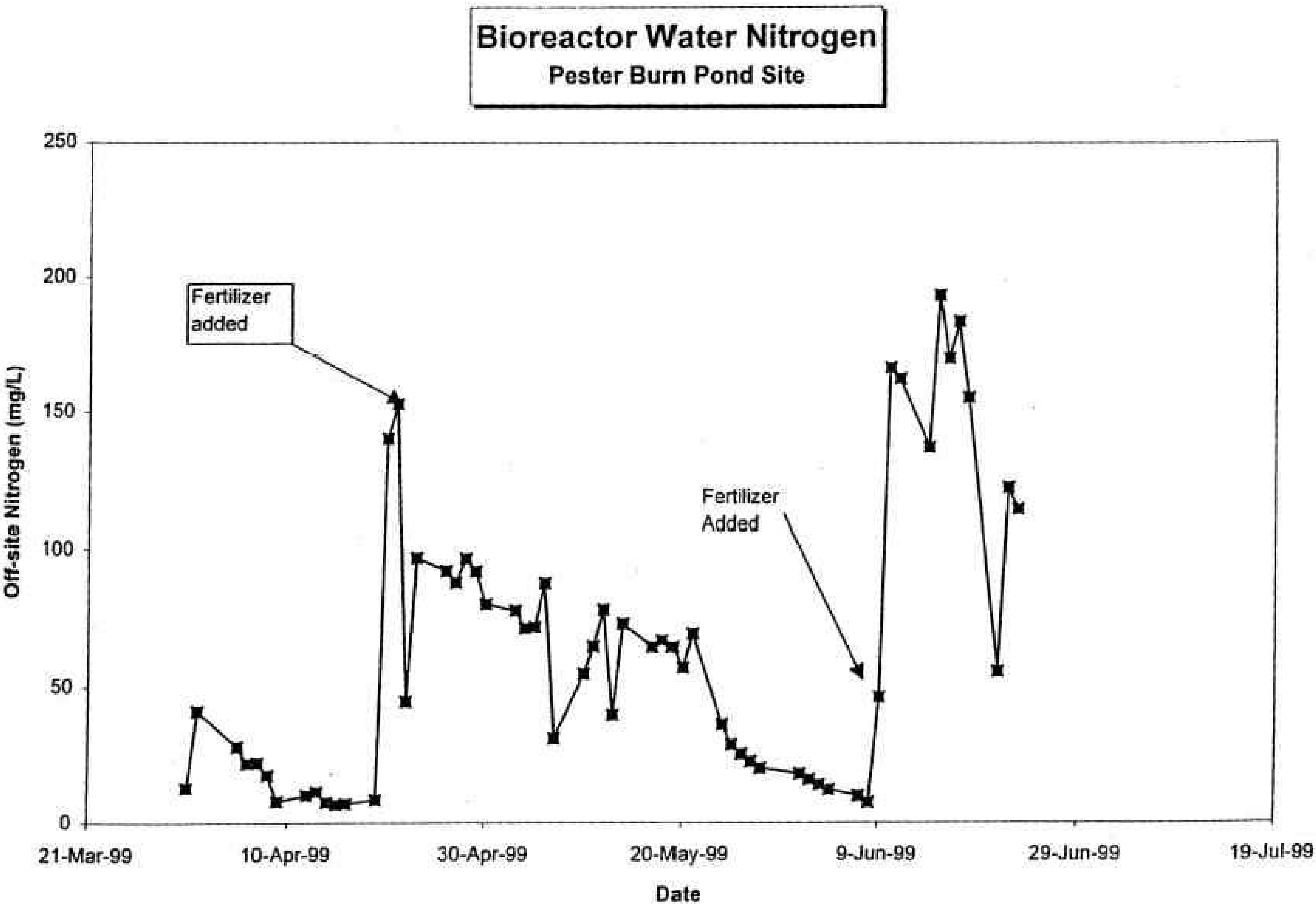
El Dorado, KS

Date	On-site Respirometry (mg O_2/L-min) (avg. of 3 depths)	Ammonia as nitrogen (mg/L)	Nitrate (N) (mg/L)	Nitrite (N) (mg/L)	Total Nitrogen (mg/L)	Phosphorus (mg/L)	pH	Temp (C)	COD (mg/l)	Plate Count (cfu/mL)	TOC (mg/L)	MLVSS (mg/L)	BOD 5 day	Food to Microorganism ratio (BOD/MLVSS)	Suspended Solids (mg/L)	Comments
31-Mar-99	0.07	13			13	0.55	8.06	14.2	840	1,100,000	53	132			920	15,000 gal seed Material 3/25/99
1-Apr-99	0.06	41			41	0.63	8.21	14.8	740	16,500	50	184			784	
5-Apr-99	0.07	28.2			28.2	3	7.71	15.3	1120	80,000,000	110	365			1560	
6-Apr-99	0.04	21.9			21.9	3.8	8.07	10.3	500	10,000,000	69	295			1100	
7-Apr-99	0.06	22.1			22.1	3.4	7.89	13.2	371	28,000,000	97	248			816	
8-Apr-99	0.04	17.6			17.6	2.7	7.93	19.1	261	22,000,000	69	180.4			978	
9-Apr-99	0.05	7.84	< 2	< 3	7.84	2.39	7.94	12.2	1185	15,000,000	68	344			1185	
12-Apr-99	0.06	10.1	< 2	< 3	10.1	0.77	7.67	9.5	1108	18,000,000	87	780			1108	
13-Apr-99	0.03	11.4	< 2	< 3	11.4	2.91	7.96	12.7	870	2,900,000	77	272			1000	
14-Apr-99	0.03	7.5	< 2	< 3	7.5	0.8	7.89	13.3	822	6,100,000	73	220			788	
15-Apr-99	0.04	6.6	< 2	< 3	6.6	0.61	7.79	8.1	1110	100,000	91	348			1324	
16-Apr-99	0.04	8.9	< 2	< 3	8.9	0.89	7.90	6.9	368	4,600,000	70	300			1072	
19-Apr-99	0.02	8.4	< 2	< 3	8.4	1.2	7.52	11.8	880	3,300,000	78	304			1016	8 tons fertilizer added
20-Apr-99	0.02	91.2	49	< 3	140.2	3.8	7.95	13.2	990	5,100,000	110	308			1072	
21-Apr-99	0.06	104	49	< 3	153	3.9	8.08	17.5	704	8,000,000		204			804	
22-Apr-99	0.01	2.3	42	< 3	44.3	9.87	7.98	18.4	737	8,000,000	100	220			812	
23-Apr-99	0.03	60.4	35	1.4	96.8	4.78	7.87	13	944	190,000	87	268			1172	5,000 gal "seed" material added
26-Apr-99	0.04	58.6	32	1.4	92	2.33	7.97	14.8	738	2,300,000	89	248			992	
27-Apr-99	0.03	57.4	29	1.3	87.7	0.73	8.02	13.5	748	1,400,000	97	260			1164	
28-Apr-99	0.05	66.8	29	1.7	98.5	0.49	8.38	12.6	714	1,400,000	85	216	18	0.08	840	
29-Apr-99	0.03	63.3	26.8	1.7	91.8	4.75	8.04	12.3	690	780,000	84	200	75	0.38	784	
30-Apr-99	0.01	50.6	27.5	1.7	79.8	1.95	7.7	13	664	410,000	78	272		0.00	840	
3-May-99	0.03	48.3	27	1.8	77.3	1.76	8.15	18.4	880	1,200,000	81	268	49	0.18	860	
4-May-99	0.02	44.6	24	2.4	71	1.38	7.89	17.8	570	3,000,000	39	164	56	0.34	692	
5-May-99	0.01	44.4	25	2	71.4	1.81	7.98	14.2	404	1,400,000	37	132	28	0.21	596	
6-May-99	0.017	60.9	24	2.6	87.5	1.05	8.21	11.8	602	570,000	33	280	36	0.13	868	
7-May-99	0.01	3.8	24	3	30.8	0.27	7.91	10.1	628	610,000	82	216	60	0.28	728	
10-May-99	0.023	28	23	3.3	54.3	1.08	8.2	17.5	428	1,700,000	83	164	37	0.23	660	
11-May-99	0.015	39	22	3.3	64.3	0.91	8.01	16.2	356	1,900,000	92	198	41	0.21	736	
12-May-99	0.037	52	22	3.7	77.7	0.76	7.85	13.5	740	3,000,000	76	276	66	0.24	1320	15,000 gal "seed" material added
13-May-99	0.09	14.4	21	4	39.4	1.67	7.82	11.8	660	3,400,000	74	204	109	0.53	960	
14-May-99	0.023	47.3	21	4.3	72.6	1.28	7.85	14.7	670	9,900,000	87	220	330	1.50	912	
17-May-99	0.05	42.1	18.5	3.5	64.1	0.61	7.85	20.7	495	80,000	73	70	40	0.57	254	
18-May-99	0.06	45.5	17	3.9	66.4	1.3	7.66	18.2	1220	2,500,000	84	408	105	0.26	1640	
19-May-99	0.09	43.4	17	3.7	64.1	2.06	7.84	15.7	1090	4,800,000	83	408	66	0.16	1860	
20-May-99	0.073	36.1	16	4.5	56.6	0.86	7.12	17	1240	8,400,000	86	448	138	0.31	1932	
21-May-99	0.1	51.4	14	3.6	69	0.93	7.44	17.8	1070	6,500,000	88	428	122	0.29	1776	
24-May-99	0.073	19.6	12	4.1	35.7	1.98	7.72	15.6	890	1,200,000	97	320	69	0.22	1420	
25-May-99	0.15	13	12	3.5	28.5	0.4	7.56	16.3	950	3,600,000	93	328	74	0.23	1396	
26-May-99	0.08	10.3	11	3.7	25	0.29	7.57	14.4	1030	4,000,000	96	408	160	0.39	1672	
27-May-99	0.047	9.5	10	3	22.5	0.08	7.43	14.1	1010	4,000,000	110	398	73	0.18	1514	
28-May-99	0.06	7.7	9.4	2.8	19.9	0.2	7.82	14.8	910	1,400,000	97	320	120	0.38	1208	
1-Jun-99	0.043	7.6	7.9	2.3	17.8	0.41	7.77	20.5	436	880,000	88	94	35	0.37	258	
2-Jun-99	0.053	6.6	7.2	1.9	15.7	0.18	7.88	18.8	572	750,000	110	192	54	0.28	724	
3-Jun-99	0.04	4.6	7.3	2	13.9	0.64	7.71	20	610	1,000,000	100	178	48	0.27	634	
4-Jun-99	0.037	3.2	6.8	2	12	0.2	7.84	23	468	2,200,000	87	136	100	0.74	532	Dredge discharge line plugged
7-Jun-99	0.027	2.3	5.5	1.9	9.7	1.13	7.91	20.8	506	720,000	83	92	31	0.34	348	
8-Jun-99	0.033	1.5	4.2	1.6	7.3	0.48	7.84	22.8	422	2,200	61	74	44	0.59	274	
9-Jun-99	0.033	0.1	45	0.5	45.6	0.86	7.85	23.5	342	2,100,000	130	87	18	0.21	308	8 tons fertilizer added
10-Jun-99	0.04	118	50	7.1	167.1	0.82	7.91	20.8	550	1,400,000	130	92	24	0.26	318	
11-Jun-99	0.02	113.2	48	1.8	163	1.3	7.96	20.3	576	3,400,000	140	90	22	0.24	308	
14-Jun-99	0.047	92.5	43	2	137.5	2.85	8.56	20.7	294	830,000	110	49	35	0.71	145	Dredge back on line
15-Jun-99	0.023	149	42	3.1	194.1	1.32	8.12	17.1	544	7,200,000	120	120	54	0.45	412	15,000 gal "seed" Material added
16-Jun-99	0.05	125	42	3.7	170.7	0.24	8.16	17.5	660	8,500,000	120	184	300	1.63	666	
17-Jun-99	0.077	141	40	3.3	184.3	1	8.14	14.4	664	8,000,000	110	214	42	0.20	754	
18-Jun-99	0.02	112	40	3.9	155.9	0.99	8.13	15.8	858	510,000	110	272	73	0.27	998	
21-Jun-99	0.035	23.8	26	5.2	55	1.01	8.15	21	464	5,500,000	87	96			358	
22-Jun-99	0.05	91.5	25	6.1	122.6	0.44	7.86	21.8	504	1,700,000		188			694	
23-Jun-99	0.06	87.5	21	6.2	114.7	0.33	7.86	20.8	718	3,200,000	85	320			1190	
24-Jun-99	0.067						7.89	22.5			87					
25-Jun-99	0.04						7.85	21.1			82					
28-Jun-99	0.025						7.83	26.1								
29-Jun-99	0.02						7.79	19.1								
30-Jun-99	0.04						7.67	21.2								

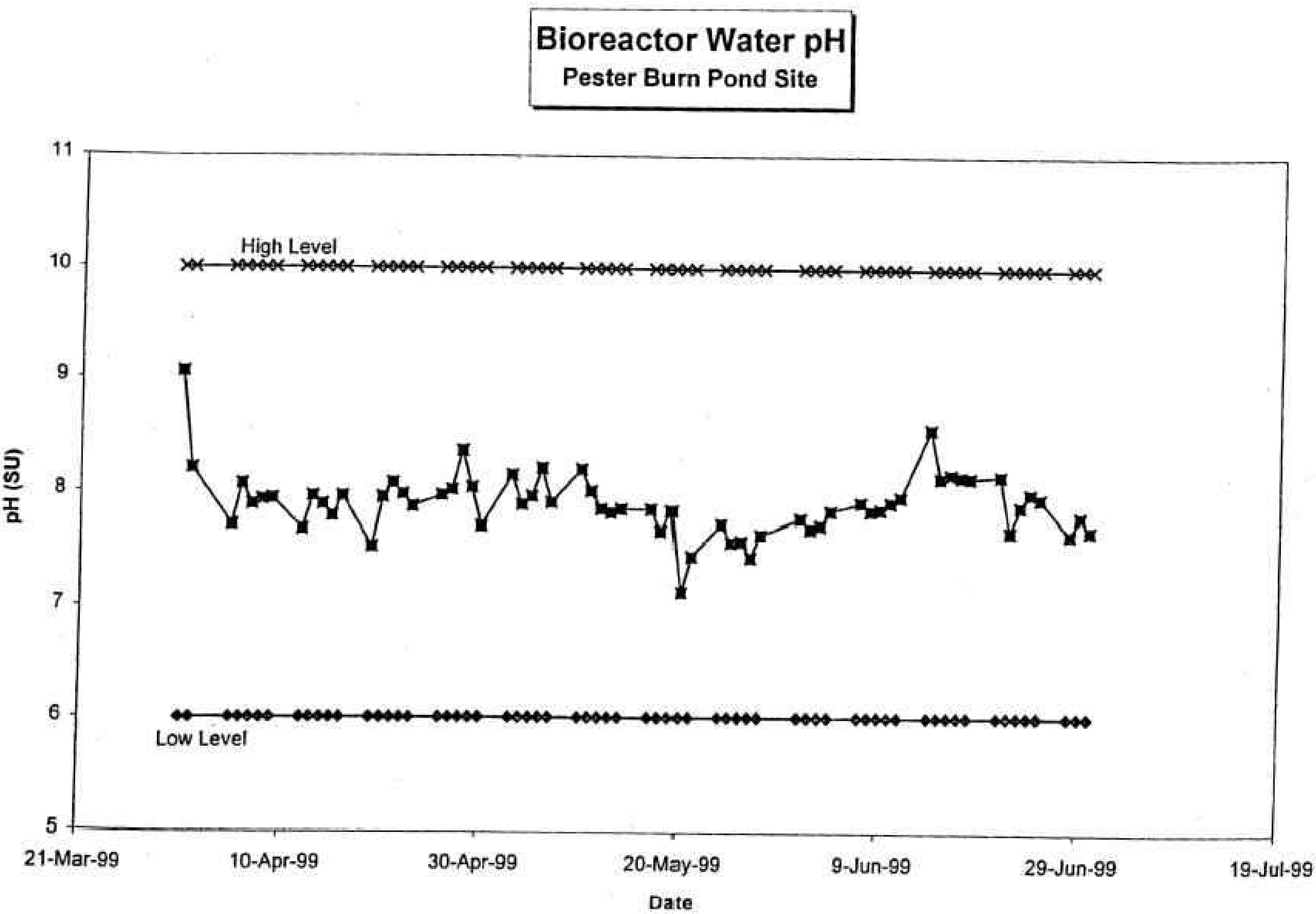

Respirometry
Pester Burn Pond Site
On-site
Oxygen Degradation Rate (mg O2/L-min)
0.5
0.4
0.3
0.2
0.1
0
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date

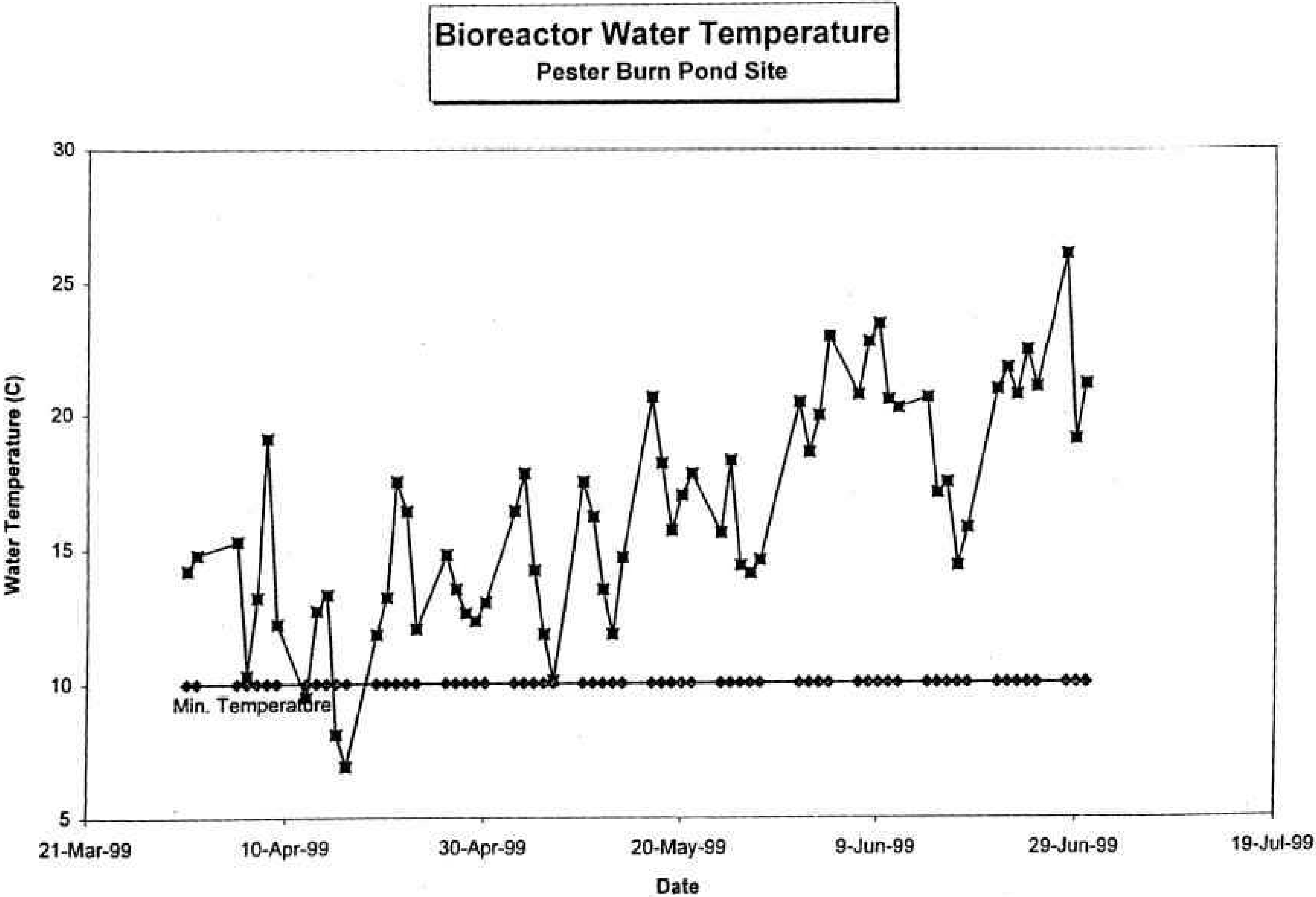


Bioreactor Water Phosphorus
Pester Burn Pond Site
Off-site Phosphorus (mg/L)
12
10
8
6
4
2
0
Fertilizer added
Fertilizer Added
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date

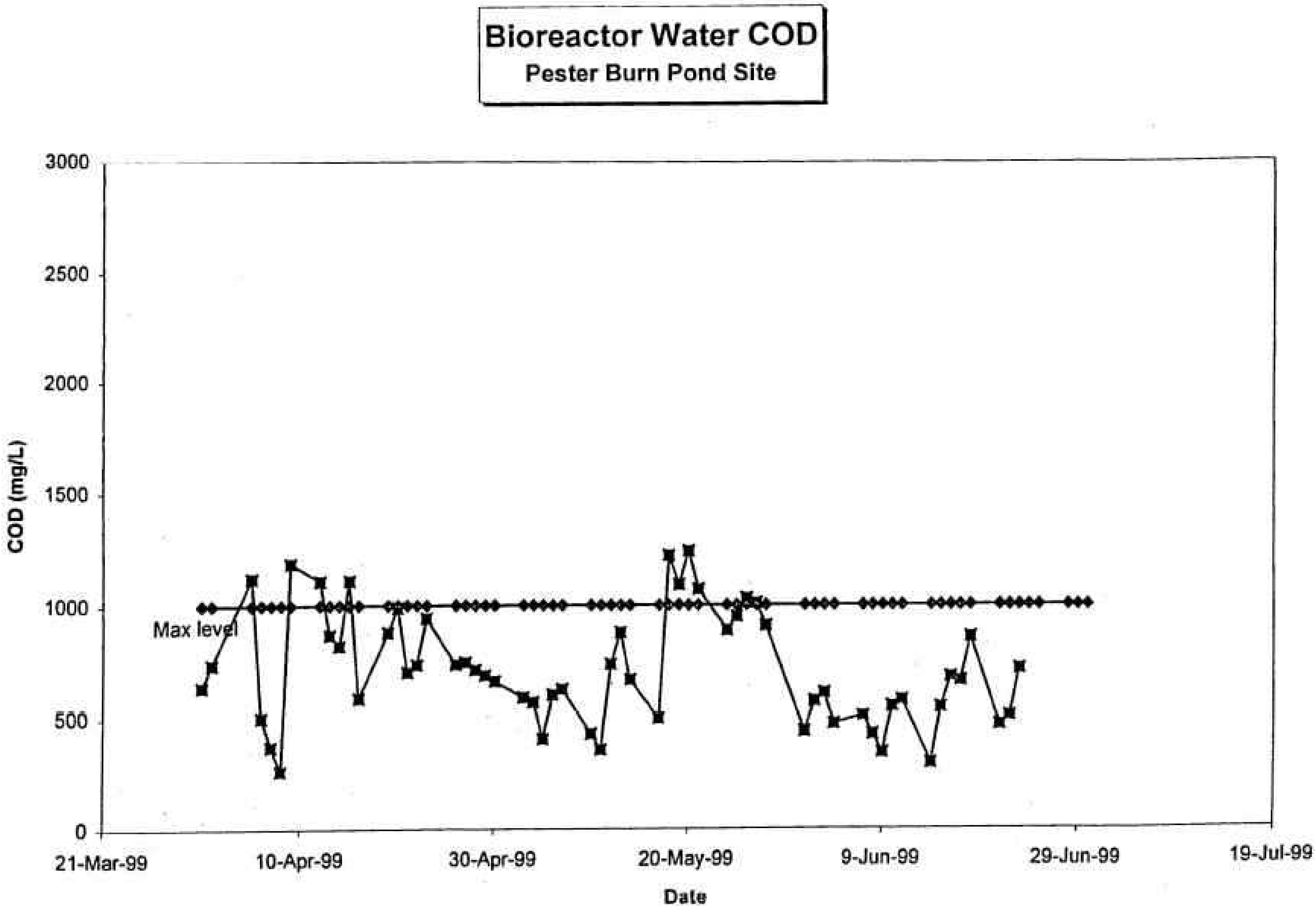


Bioreactor Water Nitrogen
Pester Burn Pond Site
Fertilizer added
Fertilizer Added
Off-site Nitrogen (mg/L)
250
200
150
100
50
0
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date

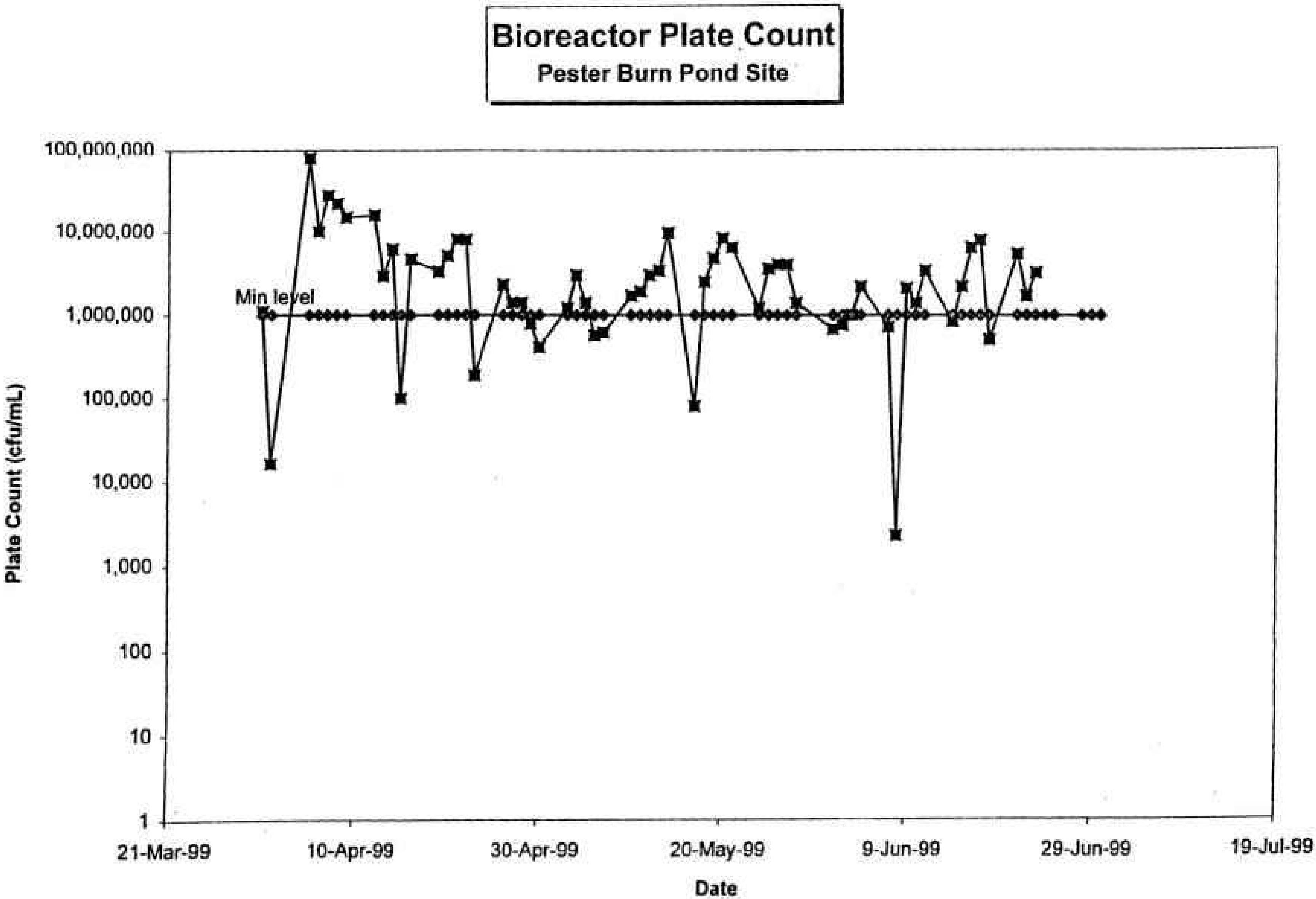

Bioreactor Water pH
Pester Burn Pond Site
High Level
Low Level
pH (SU)
11
10
9
8
7
6
5
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date

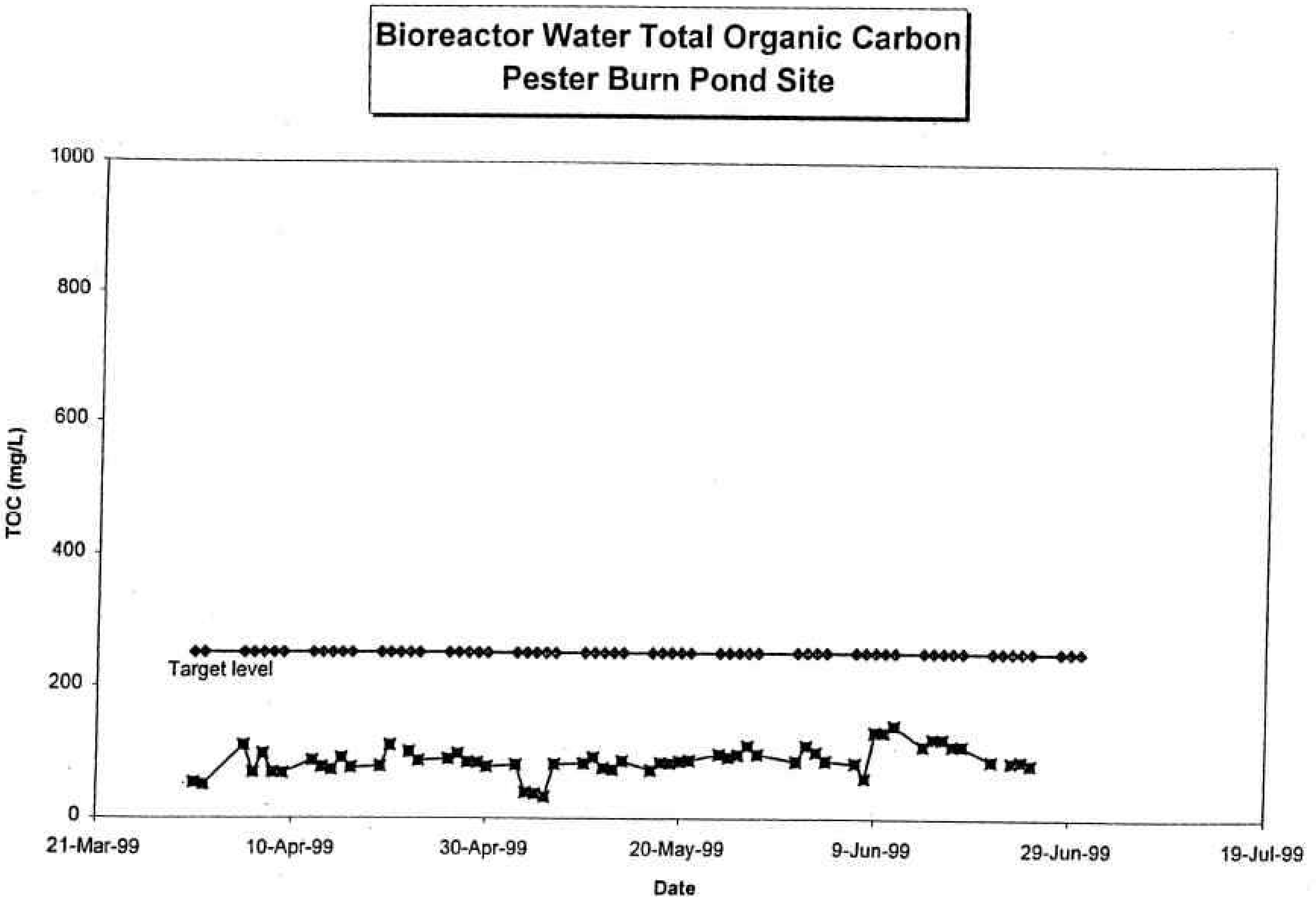


Bioreactor Water Temperature
Pester Burn Pond Site
Water Temperature (C)
30
25
20
15
10
5
Min. Temperature
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date

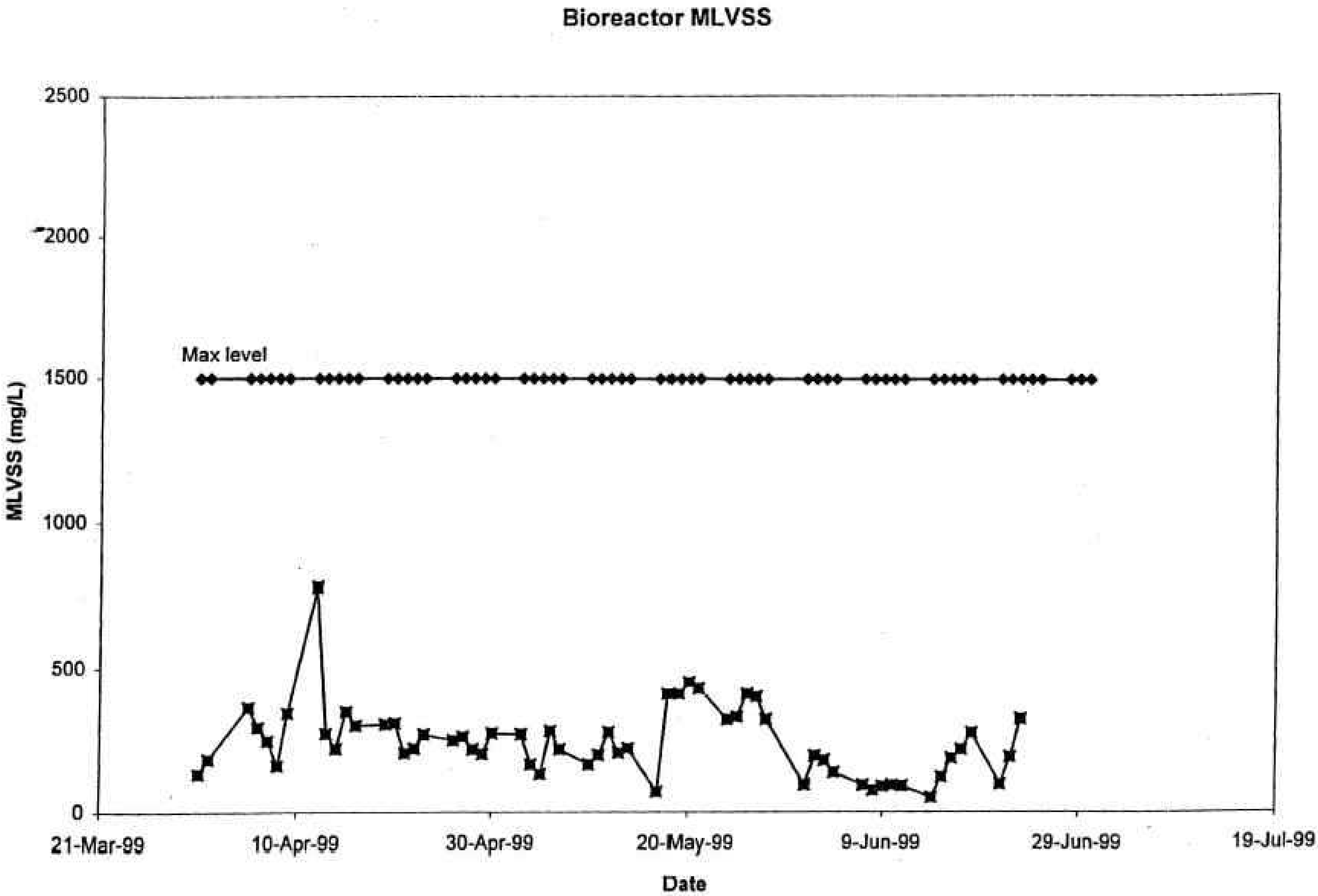


Bioreactor Water COD
Pester Burn Pond Site
3000
2500
2000
1500
1000
500
0
COD (mg/L)
Max level
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date


Bioreactor Plate Count
Pester Burn Pond Site
Min level
100,000,000
10,000,000
1,000,000
100,000
10,000
1,000
100
10
1
Plate Count (cfu/mL)
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date



Bioreactor Water Total Organic Carbon
Pester Burn Pond Site
TOC (mg/L)
1000
800
600
400
200
0
Target level
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date


Bioreactor MLVSS
Max level
MLVSS (mg/L)
2500
2000
1500
1000
500
0
21-Mar-99
10-Apr-99
30-Apr-99
20-May-99
9-Jun-99
29-Jun-99
19-Jul-99
Date