Nonradiological Liquid Effluent Monitoring Program FY 1991 Annual Report

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ABSTRACT

A monitoring program for nonradioactive parameters and pollutants in liquid effluents was initiated in October 1985 for facilities operated by EG&G Idaho, Inc., for the U.S. Department of Energy at the Idaho National Engineering Laboratory. Program design and implementation are discussed in this report. Design and methodologies for sampling, analysis, and data management are also discussed. Monitoring results for 12 liquid effluent streams from fiscal year 1987 through fiscal year 1991 are presented with emphasis on fiscal year 1991 (October 1990 through September 1991) activities.

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CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	v
ACRONYMS AND ABBREVIATIONS	ix
1. INTRODUCTION	1
2. SAMPLING DESIGN AND METHODOLOGY	3
3. ANALYTICAL DESIGN AND METHODOLOGY	6
4. DATA MANAGEMENT AND ASSESSMENT'	10
5. QUALITY ASSURANCE	13
6. EFFLUENT STREAM DESCRIPTIONS AND DATA	14
6.1 Stream 001—TRA Effluent to Cold Waste Pond	14
6.2 Stream 002—TRA Effluent to Chemical Leaching Pond	15
6.3 Stream 003—TRA Effluent to Retention Basin	16
6.4 Stream 004—TRA Effluent to STP Trickling Filter Pond	16
6.5 Stream 008—TAN TSF Effluent from Sewage Treatment Plant	16
6.6 Stream 009—TAN TSF Effluent to Drainage Pond	17
6.7 Stream 010—CTF Effluent to Liquid-Disposal Pond	17
6.8 Stream 013—CFA Effluent from CLRF	18
6.9 Stream 014—CFA Effluent to Sewage Treatment Plant	18
6.10 Stream 015—CFA Oil/Water Separator Effluent	19
6.11 Stream 016—IRC Waste Effluent	19
6.12 Stream 017—WCB Waste Effluent	19
7. REFERENCES	21
Appendix A—Effluent Stream Data	A-1
Appendix B—Statistical Methods	B-1

TABLES

1.	Pertinent regulatory codes and orders.	2
2.	Identification of effluent streams sampled during FY 1991.	4
3.	Dates of sample collection in FY 1991	5
4.	Analyte parameters for effluent streams sampled during FY 1991.	7
5.	Analyte parameters and methods. ^a	8
6.	Reporting limits.	9
7.	FY 1991 statistical limits chart key.	11
8.	FY 1991 data key.	12
9.	Holding times for effluent stream samples.	13

ACRONYMS AND ABBREVIATIONS

AA	atomic adsorption
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CLRF	Central Laundry and Respirator Facility
CTF	Containment Test Facility
DOE	Department of Energy
DOE-ID	DOE Idaho Field Office
USEPA	United States Environmental Protection Agency
FY	fiscal year
GC/MS	gas chromatography/mass spectrometry
GFAAS	graphite furnace atomic absorption spectrometry
IC	ion chromatography
ICP-AES	inductively coupled plasma-atomic emission spectrometry
IDAPA	Idaho Administrative Procedures Act
INEL	Idaho National Engineering Laboratory
IRC	INEL Research Center
NPDES	National Pollutant Discharge Elimination System
PBF	Power Burst Facility
RCRA	Resource Conservation and Recovery Act
SOW	statement of work
STP	sewage treatment plant

TAN	Test Area North
TDS	total dissolved solids
TOC	total organic carbon
TRA	Test Reactor Area
TSF	Technical Support Facility
TSS	total suspended solids
VOC	volatile organic compound
WCB	Willow Creek Building

Nonradiological Liquid Effluent Monitoring Program FY 1991 Annual Report

1. INTRODUCTION

The Nonradiological Liquid Effluent Monitoring Program was instituted by EG&G Idaho, Inc. (EG&G Idaho), in fiscal year 1986 (FY 1986). Its purpose is to provide environmental monitoring for nonradioactive parameters and pollutants in liquid waste effluents generated within facilities operated by EG&G Idaho at the Idaho National Engineering Laboratory (INEL). This effort involves sampling, analysis, and data interpretation carried out under a rigorous quality assurance program.

Before the implementation of this program, there had been no cohesive sampling and analysis effort directed towards nonradioactive species in the liquid effluents generated by various operations at the INEL. However, in 1984, an agreement between the Department of Energy (DOE) and the United States Environmental Protection Agency (USEPA) mandated the establishment of nonradiological environmental monitoring at DOE facilities to ensure compliance with applicable Federal, state, and local regulations, and to ensure the protection of human health and the environment. Each DOE facility is unique, and the level of monitoring effort is determined on a case-by-case basis, consistent with regulatory requirements and the degree of environmental assurance that activities at that particular site require.

DOE and DOE Idaho Field Office (DOE-ID) orders were issued requiring that a comprehensive effluent monitoring plan be developed and implemented at the INEL. Pertinent regulatory codes and orders are listed in Table 1. EG&G Idaho's Safety organization developed a set of preliminary facility monitoring plans, which identified effluent sampling locations and parameters that delineated minimum criteria for program operation.

Effluent monitoring is the collection and analysis of samples and other measurements for the purpose of establishing the type and concentration of pollutants in liquid discharges from facilities. Because of the technical expertise and analytical equipment necessary to operate an USEPA-auditable program, EG&G Idaho's Safety organization decided that the most practical approach to implementing the nonradiological liquid effluent monitoring portion of the preliminary facility monitoring plans would be to have this monitoring conducted on a Site-wide basis by a single organization. This led to the formation of the Nonradiological Liquid Effluent Monitoring Program, administered by the Environmental Monitoring Unit. The objective of the program is to monitor, evaluate, and report onsite discharges of liquid effluents in the vicinity of DOE sites to assess the levels of pollutants and their possible impact on the public and the environment.

Table 1. Pertinent regulatory codes and orders.

Source	Title	Compliance date
DOE Order 5480.1	"Environmental, Safety, and Health Protection Program"	
DOE Order 5484.1 Chapter III	"Environmental Protection, Safety, and Protection Information Reporting Requirements"	
40 CFR 260	"Hazardous Waste Management System: General"	
Executive Order 12088	"Federal Compliance with Pollution Control Standards"	
IDAPA 16.01.2200		March 3, 1987
IDAPA 16.01.2420.02		January 5, 1985
IDAPA 16.01.2420.04		November 20, 1987
DOE Order 5400.1 Chapter IV	"General Environmental Protection Program"	November 9, 1991
City Order Section 8, Chapter 7, and Industrial Wastewater Acceptance Forms for INEL Research Center		Issue of permit (January 1991)

2. SAMPLING DESIGN AND METHODOLOGY

Liquid effluent streams identified in the preliminary facility monitoring plans issued by Safety were used as a basis for determining which effluents were included in the initial monitoring effort of FY 1986. This "monitoring plan" contained the rationale and design criteria for the monitoring program, extent and frequency of monitoring and measurements, procedures for laboratory analyses, quality assurance requirements, and program implementation. The data set on which these monitoring plans were based was extremely limited at that time, and continuing modifications have been made as the database has expanded. Effluent streams that were sampled during FY 1991 are listed in Table 2. A brief description of each effluent stream is provided in Section 6.

The sample collection program reflects specific facility needs. The sampling schedule for each effluent stream was designed to provide the maximum amount of data from the limited number of sampling excursions possible during the fiscal year. The initial sampling design required individual effluent streams to be grab-sampled once each quarter, beginning in October 1985, for three consecutive days, resulting in a total of 12 sampling excursions per effluent per year. Sampling was conducted at midweek (Tuesday, Wednesday, Thursday) during periods when the facilities were in a normal operation mode. This approach was intended to allow evaluation of short-term and long-term variations in normal effluent stream composition. For those effluents where composite samplers were operational, composite as well as grab samples were obtained to allow for more effective evaluation and selection of sampling methodologies. Stream 3 was sampled by compositor only, as grab sampling at that location was deemed impractical.

The theoretical statistical implications of the original sampling schedule (a nested design with days fixed) were reviewed, and it was decided to change the schedule design, beginning with the third quarter of FY 1986 (April 1986). The statisticians involved in the design process believed that a better estimate of the day-to-day variation of the effluent streams could be obtained by considering it a random effect from a normal distribution; thus, they decided that the sampling days for each effluent stream should be selected at random. This stratified random approach to sampling is in agreement with current sampling theory (Pitard 1989). The sampling schedule for FY 1991 is presented in Table 3.

The sampling strategy was designed to provide accurate measurements of the concentration of pollutants in the effluent discharges. Sampling frequency and type are determined by considering the purpose for which the data are obtained. Locations are chosen, when practical, at the point at which the data most closely represent what is being released. Effluents discharging under a permit are monitored at the point where the applicable standards apply.

Field measurements taken during each sampling excursion included effluent temperature, pH, and conductivity. All field measurements were taken on separate grab samples, rather than on samples designated for laboratory analyses.

Table 2. Identification of effluent streams sampled during FY 1991.

Stream number	Location
001	Test Reactor Area (TRA) effluent to cold waste pond (MTR-612)
002	TRA effluent to chemical leaching pond (MTR-631)
003	TRA effluent to retention basin (TRA-636) and monitoring shelter (MTR-712)
004	TRA effluent to sewage treatment plant (STP) trickling filter pond (TRA-732)
008	Test Area North (TAN)/Technical Support Facility (TSF) effluent to STP (TAN-623)
009	TAN/TSF effluent to drainage pond (TAN-655)
010	Containment Test Facility (CTF) effluent to liquid disposal pond
013	Central Facilities Area (CFA) effluent from Central Laundry and Respirator Facility (CFA-617)
014	CFA STP effluent to drain field
015	CFA effluent to oil/water separator (CFA-655)
016	INEL Research Center (IRC) waste effluent
017	Willow Creek Building (WCB) waste effluent

Table 3. Dates of sample collection in FY 1991.

Stream number	Sampling dates			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
001	10/30/90	1/03/91	4/09/91	7/03/91
	NS	2/07/91	5/29/91	8/29/91
	12/06/90	3/26/91	NS	9/18/91
002	10/30/90	1/03/91	4/09/91	NS
	NS	NS	5/29/91	NS
	12/06/90	3/26/91	6/12/91	NS
003	10/30/90	1/03/91	NS	NS
	NS	NS	5/29/91	NS
	12/06/90	3/26/91	6/12/91	NS
004	10/30/90	1/03/91	4/09/91	7/03/91
	11/29/90	2/07/91	5/29/91	8/29/91
	12/06/90	3/26/91	6/12/91	9/18/91
005	--	--	--	7/09/91
008	10/04/90	1/08/91	4/03/91	7/31/91
	11/13/90	2/26/91	5/21/91	8/15/91
	12/11/90	3/14/91	6/05/91	9/11/91
009	10/04/90	1/08/91	4/03/91	7/31/91
	11/13/90	2/26/91	5/21/91	8/15/91
	12/11/90	3/14/91	6/05/91	9/11/91
010	10/04/90	1/08/91	4/03/91	NS
	11/13/90	2/26/91	5/21/91	NS
	12/11/90	3/14/91	NS	NS
013	10/10/90	1/29/91	4/16/91	7/16/91
	11/08/90	2/12/91	5/22/91	8/21/91
	12/18/90	3/12/91	6/26/91	NS
014	10/10/90	1/29/91	4/16/91	7/16/91
	11/08/90	2/12/91	5/22/91	8/21/91
	12/18/90	3/12/91	6/26/91	9/18/91
015	10/10/90	NS		NS7/16/91
	11/08/90	NS	NS	8/21/91
	NS	NS	6/26/91	9/18/91
016	10/17/90	1/24/91	4/25/91	7/23/90
	11/19/90	2/20/91	5/14/91	8/14/90
	12/13/90	3/21/91	6/18/91	NS
017	10/17/90	1/24/91	4/25/91	7/23/90
	11/19/90	2/20/91	5/14/91	8/14/90
	12/13/90	3/21/91	6/18/91	NS

NS = not sampled.

3. ANALYTICAL DESIGN AND METHODOLOGY

Parameters of interest for each liquid effluent stream were specified in the preliminary facility monitoring plans and were used as a basis to begin characterization of the effluent streams for the initial sampling effort in FY 1986. Parameters monitored in FY 1991 (see Table 4) were changed from previous years to accommodate new regulations, orders, and codes, and to reflect the changing processes at the INEL.

Standard methods are used to analyze samples whenever such methods are required by regulatory programs. Analyses not required by regulations are conducted as determined by site-specific conditions. All methods used in the analysis of the effluent samples are USEPA methods (USEPA 1980) or approved equivalents (see Table 5). Selection of the specific method used for a particular parameter is dependent on the sample matrix and on laboratory capability. Because matrix effects can influence the precision, accuracy, and achievable detection limits of the analysis (see Table 6), it is vital that these effects be minimized by selection of the proper analytical methodology.

The metals data (including hexavalent chromium) for this report were obtained by either graphite furnace atomic absorption spectrometry (GFAAS) or by inductively coupled plasma-atomic emission spectrometry (ICP-AES). Mercury was determined using cold vapor atomic absorption spectrometry (CVAAS). Anions data (including fluoride, chloride, nitrate, phosphate, bromide, and sulfate) were determined by ion chromatography (IC) methods. Total dissolved solids (TDS) and total suspended solids (TSS) data were obtained by gravimetric techniques. Total organic carbon (TOC) data were determined by persulfate oxidation and ultraviolet detection, and cyanide was determined by distillation followed by colorimetric analysis. Volatile organic compounds were determined by gas chromatography/mass spectrometry (GC/MS).

Table 4. Analyte parameters for effluent streams sampled during FY 1991.

Stream number	Analyte parameters
001	Metals ^a , anions ^b , TOC ^c
002	Metals, anions, TOC, TDS ^d
003	Metals, anions, TOC
004	Metals, anions, TOC
008	Metals, anions, TOC
009	Metals, anions, TOC
010	Metals, anions, TOC
013	Metals, anions, TOC, TDS, TSS ^e
014	Metals, anions, TOC
015	Metals, anions, TOC
016	Metals, anions, cyanide, TOC, TDS, hexavalent chromium, TSS, VOC ^f
017	Metals, anions, cyanide, TOC, TDS, hexavalent chromium, TSS, VOC ^f

a. Metals include: arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, zinc, silver, nickel, and thallium.

b. Anions include: fluoride, chloride, nitrate, phosphate, and sulfate.

c. TOC - total organic carbon.

d. TDS - total dissolved solids.

e. TSS - total suspended solids.

f. VOC - volatile organic compounds.

Table 5. Analyte parameters and methods.^a

Parameter	Preparation method		Analysis method ^b	
	ICP-AES	GFAAS	ICP-AES	GFAAS
Metals				
Arsenic	200.7	206.2	200.7	206.2
Barium	200.7	--	200.7	--
Cadmium	200.7	--	200.7	--
Chromium	200.7	218.2	200.7	218.2
Lead	200.7	239.2	200.7	239.2
Nickel	200.7	--	200.7	239.2
Selenium	200.7	270.2	200.7	270.2
Silver	200.7	--	200.7	--
Mercury	--	245.1 ^b	--	245.1 ^b
Thallium	200.7	279.2	200.7	279.2
Zinc	200.7	--	200.7	--
Anions				
Fluoride	Not applicable		300.0	
Chloride				
Nitrate				
Phosphate				
Sulfate				
TOC	Not applicable		415.1	
TDS	Not applicable		160.1	
TSS	Not applicable		160.2	
Hexavalent chromium	EPA SW-846, Method 7196		EPA SW-846, Method 7196	
pH	Not applicable		150.1	
Conductivity	Not applicable		120.1	
Cyanide (total)	335.2		335.2	
VOCs	Not applicable		EPA SW-846 Method 8240	

a. Unless otherwise stated, all methods cited in this table are from EPA-600/4-79-020, *Method for Chemical Analysis of Water and Wastes* (USEPA 1980). Methods 200.7 and 300.0 are additions to this methods manual. Depending on the sample matrix, equivalent EPA-approved methods in EPA SW-846 and CLP SOW No. 785 were sometimes used.

b. Cold vapor atomic absorption spectrometry (CVAAS).

Table 6. Reporting limits.

Parameter	Instrument detection limit ^a
Metals	
Silver	10.0 ppb (ICP)
Arsenic	10.0 ppb (ICP); 1 ppb (furnace AA ^b)
Barium	200.0 ppb (ICP)
Cadmium	5.0 ppb (ICP)
Chromium	10.0 ppb (ICP)
Copper	25.0 ppb (ICP)
Mercury	0.2 ppb (furnace AA)
Nickel	40.0 ppb (ICP)
Lead	5.0 ppb (furnace AA)
Selenium	10.0 ppb (furnace AA)
Thallium	10.0 ppb (furnace AA)
Zinc	20.0 ppb (ICP)
Chromium (hexavalent)	10.0 ppb
Anions	
Chloride	1.0 ppm (IC)
Fluoride	0.5 ppm (IC)
Nitrate	1.0 ppm (IC)
Phosphate	0.1 ppm (IC)
Sulfate	1.0 ppm (IC)
TOC	1.0 ppm
TDS	10.0 ppm
TSS	5.0 ppm
Cyanide	20.0 ppb

a. Instrument detection limit is the minimum analyte concentration level that can be discriminated from background. For most instrumentation, the quantitation limit is somewhat higher.

b. AA - atomic adsorption.

4. DATA MANAGEMENT AND ASSESSMENT

The inherent variability associated with field and laboratory activities must be well defined in order for monitoring data to be effectively interpreted. The sampling and analysis scheme developed for the Nonradiological Liquid Effluent Monitoring Program was designed to provide data for a statistical model yielding information about the source and magnitude of variability in effluent stream composition.

The total variability in the measurement of an analyte parameter is the sum of two variance components: day-to-day variability of the effluent itself, and variation between replicate samples collected on the same day (i.e., variation due to sampling). In the model, the sources of variability are assumed to be random effects. Because the field replicates are nested in sampling days, and days are randomly chosen, the overall statistical model is a nested, random effects model.

The sampling and analysis variance components represent the inherent variation in a data point and, as long as they are quantified, are important to the effluent monitoring program as quality control checks on the sampling and analytical processes. The variance attributable to the stream itself is of primary importance in characterization and monitoring of an effluent, because it reflects a change in the character of an effluent.

It is expected that the main contributor to analyte level variability will be the variation of effluent stream composition from day to day. If the variance due to field replicates is high (sampling variance), this may reflect the inhomogeneous character of the stream or indicate that the sampling method did not obtain representative samples.

Statistical limits charts present the monthly concentration data for each effluent stream along with two statistical confidence levels. These statistical limits charts are presented for each parameter in each stream in Appendix A. Statistical confidence limits are calculated for each parameter, based on the estimate of the variance of the analyte concentrations around the combined mean for FY 1987 and FY 1988. The symbols used to define the statistical limits chart parameters are summarized in Table 7. The lowest line of the statistical limits chart is the analyte concentration mean for FY 1987 through FY 1990. In general, the Level 1 control limit (the middle line on the statistical limits chart) is set at the upper 95% confidence limit on the individual measurements. Thus, a measurement exceeding the Level 1 control limit has a 1 in 20 (5%) chance of being attributable to random fluctuations in concentration levels, based on the FY 1987 through FY 1990 results. The Level 2 statistical confidence limit (the top line on the statistical limits chart) is set at the upper 99% confidence limit on the individual measurements and thus, has only a 1 in 100 (1%) chance of being exceeded because of random fluctuations in actual concentrations. Values that exceed the Level 2 statistical confidence limit generally indicate a deviation from the normal stream characteristics for the analyte in question. Both upper and lower statistical confidence limits are represented for pH; both limits are at Level 2.

Note that an excursion above the Level 2 limit does *not* imply that regulatory standards have been exceeded, but does indicate a deviation from normal operating conditions, a situation that should be investigated. The statistical limits chart can help identify potential problems at a correctable stage.

Table 7. FY 1991 statistical limits chart key.

Symbol	Explanation
"X"	First replicate sample
"Δ"	Second replicate sample
"—"	Mean
"--"	Level 1
"_ _"	Level 2

The statistical analysis developed for the Nonradiological Liquid Effluent Monitoring Program was designed to indicate the source and magnitude of variability of effluent stream composition. The total variability in the actual sample concentration of an analyte parameter (sampling variability) is treated as the sum of two variance components: day-to-day variability of the effluent itself, and variation (for any reason) between replicate samples collected on the same day. This information is presented as quarterly means and variance components.

Table 8 explains the codes used for summarizing the annual data. Day-to-day variability is listed in the STD DAY column and variability between replicates is listed in the STD REP column. The total variability for a quarterly mean is given in the STD MEAN column.

Data from FY 1987 through FY 1990 were used to set individual stream statistical confidence limits.

Samples for which the analyte concentration is less than the minimum amount detectable by the analytical method are treated as missing data points in the statistical analysis of variance. This is done because of considerable disagreement concerning statistically valid methods for dealing with values below the practical quantitation limit. For the purposes of effluent monitoring, it was deemed to be more defensible to place a high bias on the mean by deleting the values below the practical quantitation limit, as opposed to placing a low bias on the mean by equating the value below the practical quantitation limits with zero.

Table 8. FY 1991 data key.

Code	Explanation
QTR	Quarter, given as XXqY, where XX is fiscal year and Y is quarter designation
MEAN	Quarterly mean concentration
STD MEAN	Standard error of quarterly mean
STD DAY	Standard deviation associated with the day of sampling (day-to-day variation)
STD REP	Standard deviation associated with field replicates within a day
N	Total possible number of field replicates
NMISS	Total number of missing data points
NLTD	Number of values that were below the practical quantitation limit
"X"	Value below the practical quantitation limit
."	Missing data (e.g., not sampled)

5. QUALITY ASSURANCE

A quality assurance (QA) program addressing analytical concerns is designed to ensure that data of a known quality are produced by the analyses. The Nonradiological Liquid Effluent Monitoring QA Program follows the guidance provided in QAMS-005/80 as a best management practice. Quality control practices are used to identify and resolve any problems caused by possible matrix effects, contamination, or instrument malfunction. The QA program for the Nonradiological Liquid Effluent Monitoring Program is commensurate with its nature and complexity in accordance with DOE Order 5400.1. Issues such as minimum criteria for accuracy, precision, completeness, minimum training/qualifications of personnel, organization and responsibilities, corrective action (in case of an out-of-control operation), calibration and standardization of analytical instrumentation, sampling and analytical methodology, sample and data tracking, chain of custody, and audit/evaluation programs are addressed and documented in the *Effluent Monitoring Handbook for Operational Facilities* (EG&G Idaho 1992). The 7-7-7 rule is currently used by the USEPA in the analysis of water and wastewater samples (USEPA 1977). This means that any wastewater study requires the analysis of a minimum of seven samples, seven blanks, and seven spiked blanks before inferences concerning the usability of the data can be made.

The observation of sample holding times for each analyte parameter of interest is crucial to the production of data of known quality. The holding time is the maximum amount of time that a sample may be stored between time of collection and analysis, and still permit meaningful analytical results. Holding times for effluent stream samples, as presented in Table 9, meet USEPA regulatory guidelines.

Table 9. Holding times for effluent stream samples.

Parameter	Holding time
Metals	6 months
Mercury	28 days
Anions: chloride, sulfate, fluoride	28 days
Anions: nitrate, phosphate	48 hours
Cyanide	14 days
TOC	28 days
TDS/TSS	7 days
VOCs	14 days
pH	Field measurement
Conductivity	Field measurement
Dissolved oxygen	Field measurement
Hexavalent chromium	24 hours

6. EFFLUENT STREAM DESCRIPTIONS AND DATA

Water is used at INEL facilities in a variety of processes and operations. The final liquid effluents released to the environment are composed of discharges from diverse sources. In many cases, the impact of water usage by a given facility process on influent water quality is minimal, creating relatively clean wastewater effluents that are roughly comparable in quality to the influent source. In other cases, however, wastewater effluents contain pollutants characteristic of particular processes. In order for effluent composition to be effectively interpreted, the characteristics of typical contributing sources must be assessed. Because of the great diversity of effluents from INEL facilities, the nature of the contributing sources for each effluent must be considered in stream-specific interpretation of data.

There are two major classes of liquid effluents from EG&G Idaho facilities: those generated by numerous contributing sources within a facility, and those generated by a single source (i.e., a unique process or operation). For effluents generated by numerous contributing sources within a facility (i.e., nonspecific sources), operations have relatively little effect on water quality. Annual mean concentrations of individual pollutants usually lie in a relatively narrow range, well below regulated levels. General trends can often be attributed to a unique contributing source or operating history.

For a single-source effluent, a change associated with its source has a more direct impact on the observed character of the effluent than does a comparable change in a stream generated by nonspecific sources. A single-source effluent may be homogeneous or highly variable, depending on the nature of its source. Thus, interpretation of data from a single-source effluent requires consideration of the contributing source. Unless the contributing sources are of similar nature, stream-to-stream comparisons with other single-source effluents are generally not useful.

In Sections 6.1 through 6.12, each liquid effluent stream is described, and data are discussed on a stream-by-stream basis. Whenever possible, the observed data are correlated with the known operating history of the facility or the known character of the contributing sources. Comparisons with similar effluents are made whenever practical.

DOE Order 5480 prohibits the discharge of Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste. All site effluents are below the regulatory limits for characteristically hazardous RCRA metals. Effluent Streams 16 and 17 discharge into the City of Idaho Falls sewer system, and are thus included under the City's National Pollutant Discharge Elimination System (NPDES) permit. There were no detected discharges above the City of Idaho Falls sewer regulations.

6.1 Stream 001—TRA Effluent to Cold Waste Pond

This effluent is generated by the cold waste drains within the Test Reactor Area (TRA). The cold drains are located throughout TRA, including laboratories and craft shops. Maintenance cleaning waste, and floor and yard drains are examples of intermittent TRA discharges that might be expected to alter water quality parameters during normal operation. The cold waste pond also receives secondary cooling water from the reactor when it is in operation. The cold waste effluents collect at the cold well sump and sampling station, and are pumped out to the cold waste leaching

pond, which is located outside the TRA fence. Data collected from FY 1987 through FY 1991 indicate that the TRA cold waste effluent is homogenous. The pH range for field data collected in FY 1991 was 2.8 to 9.0.

All RCRA metal concentrations are below the applicable regulatory limits.

Tables A-1 through A-4 list the data for FY 1991 for Stream 1. Table A-5 lists the statistical confidence limits for Stream 1, and Table A-6 lists the quarterly means and variance components for FY 1991. The statistical limits charts in Figures A-1 through A-18 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 1 for FY 1988 through FY 1991.

6.2 Stream 002—TRA Effluent to Chemical Leaching Pond

The TRA effluent to the chemical leaching pond is generated by water treatment processes at the TRA demineralizer facility. The ion-exchange process uses electrically charged resin beads to attract and adsorb oppositely charged ions from the water until the resin's exchange sites are filled with ions from the water. When the exchange capacity of the resin is saturated, the resin bed is regenerated by rinsing the resin with an appropriate chemical solution. Cation-exchange regeneration, which uses sulfuric acid as a regenerant, is carried out approximately every other day, and produces nearly 600 gal of wastewater. Anion-exchange regeneration uses a sodium-hydroxide regenerant, and is performed approximately every third day, yielding 12,000 gal of wastewater. Ion-exchange regeneration waste streams typically contain mineral salts removed from the water, excess regenerant chemicals, and rinse waters from the regeneration process. Specific waste stream constituents anticipated in regeneration wastewater include calcium, sodium and magnesium salts, iron, copper, zinc, aluminum, manganese, potassium, chlorides, sulfates, sulfuric acid, and sodium hydroxide.

Data collected from FY 1987 through FY 1991 for this stream are consistent with the nature of the stream's source. The largest degree of variability is associated with the pH parameter. This is not unexpected, because the effluent includes cation and anion regenerant, and the discharges may be quite acidic or basic. Water quality parameters determined from FY 1987 through FY 1991 are consistent with the large quantities of dissolved salts in demineralizer effluents. The high annual mean conductivity (26,000 μ S) and high annual dissolved solids (23,000 mg/L) result from the elevated levels of dissolved salts and free ions introduced during the regeneration process. The field pH measurement range for FY 1991 was 2.2 to 10.5.

All RCRA metal concentrations are below the applicable regulatory limits.

Tables A-7 through A-9 list the data for FY 1991 for Stream 2. Table A-10 lists the statistical confidence limits for Stream 2, and Table A-11 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-19 through A-38 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 2 for FY 1988 through FY 1991.

6.3 Stream 003—TRA Effluent to Retention Basin

This effluent is generated by low-level radioactive waste drains at TRA. These drains are located throughout TRA in laboratories and craft shops, and within the reactor facilities. The effluent streams collect at the retention basin inlet. When the retention basin is full, the effluent is automatically pumped to a leaching pond that is located outside the TRA fence.

Composite data collected from FY 1987 through FY 1991 indicate that the wastewater discharged to the retention basin does not contain any RCRA characteristic metals above the regulatory limits.

The pH is decreasing and can be attributed to the waste minimization steps taken to decrease the amount of "cold" effluents discharged to the retention basin. Therefore, the effluent is not diluted as much, resulting in higher concentration of the parameters and a more acidic effluent stream. The field measurement pH range for FY 1991 was 4.0 to 9.2.

Tables A-12 through A-15 list the data for FY 1991 for Stream 3. Table A-16 lists the statistical confidence limits for Stream 3, and Table A-17 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-39 through A-51 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 3 for FY 1988 through FY 1991.

6.4 Stream 004—TRA Effluent to STP Trickling Filter Pond

The TRA effluent to the sewage treatment plant (STP) trickling filter pond receives discharged wastewater from sanitary sewer drains throughout the TRA area. Grab sample data collected from FY 1987 through FY 1991 are comparable to data obtained for the three other STP effluents on site. The field measurement pH range for FY 1991 was 6.6 to 8.4.

All RCRA metal concentrations were below regulatory limits.

Tables A-18 through A-21 list the data for FY 1991 for Stream 4. Table A-22 lists the statistical confidence limits for Stream 4, and Table A-23 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-52 through A-68 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 4 for FY 1988 through FY 1991.

6.5 Stream 008—TAN TSF Effluent from Sewage Treatment Plant

The Test Area North (TAN) Technical Support Facility (TSF) TRA effluent from the STP trickling filter pond receives discharged wastewater from sanitary sewer drains throughout the TRA area. Grab sample data collected from FY 1987 through FY 1991 are comparable to data obtained for the three other STP effluents on site.

Data collected from FY 1987 through FY 1991 support characterization of the TAN TSF effluent as a homogeneous wastewater stream. The field pH measurement range for FY 1991 was 6.2 to 8.1.

All RCRA metals are below regulatory limits.

Tables A-24 through A-27 list the data for FY 1991 for Stream 8. Table A-28 lists the statistical confidence limits for Stream 8, and Table A-29 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-69 through A-86 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 8 for FY 1988 through FY 1991.

6.6 Stream 009—TAN TSF Effluent to Drainage Pond

The TAN TSF effluent to the drainage pond receives wastewater discharges from a variety of contributing sources. Boiler blowdown, such as that generated in the Service Building, is expected to contribute inorganic salts concentrated from feedwater (calcium and magnesium salts, chlorides, and sulfates), corrosion products (metal oxides), and any chemical additives. Wastewater from the demineralizer system is expected to contribute mineral salts from makeup water, and excess regenerant chemicals (sodium hydroxide and sulfuric acid). Low-level radioactive waste drains, such as those found in TAN-615, TAN-633, and TAN-607, are not expected to contribute significant levels of pollutants to the effluent stream. Data from FY 1987 through FY 1991 are generally consistent with these anticipated discharges.

The TAN TSF effluent receives intermittent discharges from a number of contributing sources, which result in an inhomogeneous discharge. This variability is most apparent for the water quality parameters of pH and conductivity. The high conductivity level can be attributed to the soluble salts introduced from the boiler blowdown and demineralizer regenerant discharges. The demineralizer wastewater may also contribute to the observed variance in pH. The field pH measurement range for FY 1991 data was 6.7 to 9.0.

All RCRA metal concentrations are below regulatory limits.

Tables A-30 through A-33 list the data for FY 1991 for Stream 9. Table A-34 lists the statistical confidence limits for Stream 9, and Table A-35 lists the quarterly means and variance components for FY 1987 and FY 1991. The statistical limits charts in Figures A-87 through A-105 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 9 for FY 1988 through FY 1991.

6.7 Stream 010—CTF Effluent to Liquid-Disposal Pond

The Containment Test Facility (CTF) effluent to the liquid disposal pond receives wastewater from low-level radioactive waste drains and sumps throughout the CTF area. Characterization of data collected from FY 1987 through FY 1991 indicates that this is a homogeneous effluent stream. Although the CTF is now inactive, analyte concentrations have not decreased, which indicates that

past operations had minimal impact on water quality. Monitoring was discontinued at this location in June of 1991. The field measurement pH range for FY 1991 was 6.9 to 8.5.

All RCRA metal concentrations are below regulatory limits.

Tables A-36 through A-38 list the data for FY 1991 for Stream 10. Table A-39 lists the statistical confidence limits for Stream 10, and Table A-40 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-106 through A-124 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 10 for FY 1988 through FY 1991.

6.8 Stream 013—CFA Effluent from CLRF

Effluent characterization data collected for Stream 13 from FY 1987 through FY 1991 are consistent with the operations and processes that generate wastewater at the Central Laundry and Respirator Facility.

The discharged effluent is generated by routine maintenance and laundry operations, and may contain radioactive and nonradioactive contaminants. Composition of the effluent stream is quite variable, which is expected since a limited number of sources introduce contaminants and with minimal dilution.

Water quality parameters associated with this effluent are consistent with typical laundry and decontamination operations. The annual mean pH is slightly basic (9.0). Dilution factors, uneven work distribution in the laundry, and variable chemical-use rates all contribute to the observed inhomogeneity of this waste stream. Concentrations of anions in the laundry effluent reflect the types of cleaning agents used in the facility. The field pH measurement range was 8.0 to 9.7 .

All RCRA metal concentrations are below regulatory limits.

Tables A-41 through A-44 list the data for FY 1991 for Stream 13. Table A-45 lists the statistical confidence limits for Stream 13, and Table A-46 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-125 through A-145 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 13 for FY 1988 through FY 1991.

6.9 Stream 014—CFA Effluent to Sewage Treatment Plant

The Central Facilities Area (CFA) effluent to the STP receives wastewater from sanitary sewer drains throughout the CFA. These drains have major potential for affecting the chemical characteristics of the overall CFA effluent. A number of unique discharge sources exist, including chemical laboratories, the craft shops, the cafeteria, the warehouse, photographic services, vehicles services, the laundry facility, and the dispensary. Data collected from FY 1987 through FY 1991 support the characterization of this stream as homogenous, but with a larger standard day-to-day variance than other effluents on site. The field measurement pH range for FY 1991 was 7.0 to 9.5.

All RCRA metal concentrations are below regulatory limits.

Tables A-47 through A-50 list the data for FY 1991 for Stream 14. Table A-51 lists the statistical confidence limits for Stream 14, and Table A-52 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-146 through A-164 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 14 for FY 1988 through FY 1991.

6.10 Stream 015—CFA Oil/Water Separator Effluent

The oil/water separator collects nonpoint-source waste oils and water associated with the floor drains and vehicle maintenance areas of CFA-664. Data collected from FY 1987 through FY 1991 support historical trends in contaminant concentrations. The field pH measurement range for FY 1991 was 7.7 to 8.8.

All RCRA metal concentrations are below regulatory limits.

Tables A-53 through A-56 list the data for FY 1991 for Stream 15. Table A-57 lists the statistical confidence limits for Stream 15, and Table A-58 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-165 through A-183 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 15 for FY 1988 through FY 1991.

6.11 Stream 016—IRC Waste Effluent

This effluent is generated by drain discharges from all laboratories and discharge from the mechanical room. The field pH measurement range for FY 1991 was 6.3 to 8.2. There were no discharges containing concentrations above the regulations of the City of Idaho Falls.

Tables A-59 through A-61 list the data for FY 1991 for Stream 16. Tables A-62 through A-66 list the statistical confidence limits for Stream 16, and Table A-67 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-184 through A-203 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 16 for FY 1988 through FY 1991.

6.12 Stream 017—WCB Waste Effluent

This effluent is generated by the wastewater from the Willow Creek Building (WCB). Contributing sources are the discharge from Micrographics, Reprographics, the Print Shop sinks and drains, and the x-ray photoprocessor in Medical. In most respects, the overall WCB wastewater effluent is quite characteristic of the known contributing sources. The field measurement pH range for FY 1991 was 7.0 to 9.0.

Tables A-68 through A-71 list the data for FY 1991 for Stream 17. Tables A-12 through A-76 list the statistical confidence limits for Stream 17, and Table A-77 lists the quarterly means and variance components for FY 1987 through FY 1991. The statistical limits charts in Figures A-204

through A-225 present the statistical confidence limits and monthly concentration data for each analyte detected for Stream 17 for FY 1988 through FY 1991.

7. REFERENCES

- EG&G Idaho, 1992, *Effluent Monitoring Handbook for Operational Facilities*, EGG-ER-8044, current revision.
- Pitard, Francis F., 1989, *Pierre Gy's Sampling Theory and Sampling Practice*, CRC Press, Inc.
- USEPA, 1977, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, USEPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March.
- USEPA, 1980, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, USEPA Monitoring and Support Laboratory, Cincinnati, Ohio, March.

Appendix A

Effluent Stream Data

Figure A-1
Conductivity Stream 1 Concentrations
 RCRA Guideline Not Applicable

Figure A-2
pH Stream 1 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

RCRA Guideline Not Applicable

Figure A-4
CI Stream 1 Concentrations
 RCRA Guideline Not Applicable

RCRA Guideline Not Applicable

Figure A-6
NO3 Stream 1 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

Figure A-8
SO4 Stream 1 Concentrations
 RCRA Guideline Not Applicable

Figure A-9
Ag Stream 1 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-10
As Stream 1 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-11

Figure A-12
Cd Stream 1 Concentrations
 RCRA Characteristic Guideline = 1000 µg/l

Figure A-13
Cr Stream 1 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-15
Hg Stream 1 Concentrations
 RCRA Characteristic Guideline = 200 $\mu\text{g/l}$

Figure A-16
Pb Stream 1 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-17
Se Stream 1 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-18
Zn Stream 1 Concentrations
 RCRA Guideline Not Applicable

Table A-1

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=1 (TRA effluent to cold waste ponds) QUARTER=91q1 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	2480	2.84	3.50	29.2	X	11.1	1.30
Oct	2	1050	6.65	3.50	29.0	X	11.0	0.63
Nov	1	432	8.09	X	11.8	X	4.60	0.14
Nov	2	426	8.06	X	11.8	X	4.00	0.13
Dec	1	X	X	3.80	37.9	X	12.8	4.00
Dec	2	1210	9.01	3.90	35.8	X	12.8	4.00

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	575	X	5.10	66.8	X	7.60	17.0
Oct	2	543	X	5.00	67.2	X	14.8	13.8
Nov	1	28.9	X	X	44.1	X	X	13.9
Nov	2	28.6	X	X	27.0	X	X	9.20
Dec	1	511	X	5.30	94.2	X	11.4	21.8
Dec	2	491	X	5.50	92.4	X	10.4	20.6

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.16	79.2	X	X	X	24.3
Oct	2	0.14	78.8	X	X	X	9.10
Nov	1	0.23	X	2.80	X	X	20.7
Nov	2	2.30	X	3.80	X	X	11.6
Dec	1	X	16.4	X	X	X	31.6
Dec	2	X	16.7	X	X	X	20.4

'.' - missing

'X' - below practical quantitation level

Table A-2

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=1 (TRA effluent to cold waste ponds) QUARTER=91q2 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	1090	8.78	7.10	29.0	0.30	3.70	X
Jan	2	1070	8.45	5.20	28.5	0.30	3.10	X
Feb	1	1250	7.75	5.70	35.5	0.40	4.00	X
Feb	2	X	X	X	36.7	0.40	4.00	X
Mar	1	504	7.80	X	10.0	X	X	0.07
Mar	2	429	7.91	1.00	10.0	X	X	0.06

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	419	X	X	X	X	8.70	X
Jan	2	405	X	X	X	X	9.70	X
Feb	1	437	X	X	X	X	7.10	X
Feb	2	422	X	X	X	X	7.80	X
Mar	1	21.0	X	X	X	X	X	X
Mar	2	20.0	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	17.7
Jan	2	X	X	X	X	X	16.7
Feb	1	X	X	X	X	X	X
Feb	2	X	X	X	X	X	13.3
Mar	1	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-3

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=1 (TRA effluent to cold waste ponds) QUARTER=91q3 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	1260	7.57	1.79	33.2	0.44	7.62	5.69
Apr	2	X	X	1.82	33.6	0.43	7.44	5.75
May	1	1620	7.53	X	11.2	0.20	1.99	0.14
May	2	1270	7.57	X	11.9	0.16	1.95	0.07

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	498	X	6.50	125	X	12.2	6.40
Apr	2	500	X	6.50	133	X	14.2	6.40
May	1	714	13.1	X	46.8	X	X	4.80
May	2	734	10.7	X	44.3	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	X	X	X	4.20
Apr	2	X	X	X	X	X	3.70
May	1	X	X	5.60	X	X	X
May	2	X	X	3.50	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-4

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=1 (TRA effluent to cold waste ponds) QUARTER=91q4 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	1060.0	7.67	2.51	28.4	0.38	4.32	5.63
Jul	2	1010.0	7.85	2.47	29.1	0.38	4.54	6.00
Aug	1	900.0	7.43	3.24	29.0	0.38	5.65	6.22
Aug	2	910.0	7.84	2.62	29.3	0.39	5.23	5.17
Sep	1	64.2	7.86	2.21	32.4	0.34	6.78	7.10
Sep	2	62.0	7.90	2.58	32.2	0.41	6.80	6.85

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	446	X	X	113	X	7.70	5.50
Jul	2	414	X	X	109	X	7.40	5.50
Aug	1	413	X	10.5	118	X	77.4	52.3
Aug	2	412	X	20.1	157	X	90.6	322
Sep	1	476	X	8.30	98.1	X	40.9	9.00
Sep	2	491	X	7.90	97.3	X	42.2	22.5

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	3.90	X	X	X
Jul	2	X	X	2.90	X	X	X
Aug	1	X	X	4.50	2.70	X	19.0
Aug	2	X	17.7	19.7	X	X	117
Sep	1	X	28.0	X	X	X	6.10
Sep	2	X	27.1	X	X	X	6.10

'.' - missing

'X' - below practical quantitation level

Table A-5
SUMMARY STATISTICS

STREAM=1 (TRA effluent to cold waste ponds)

ANALYTE	FY87-FY90 MEAN	STD	N	LEVEL1	LEVEL2	GUIDELINE
Cond (μ S)	900	387	94	1550	1820	N/A
pH	7.65	0.26	91	l 7.12 u 8.17	l 6.95 u 8.34	l 6.5 u 8.5
TOC (mg/l)	4.31	3.62	40	10.5	13.2	N/A
Cl (mg/l)	24.1	10.4	87	41.4	48.8	N/A
F (mg/l)	0.31	0.19	27	0.65	0.80	N/A
NO3 (mg/l)	9.90	4.49	78	17.4	20.6	N/A
PO4 (mg/l)	7.29	10.3	66	24.6	32.0	N/A
SO4 (mg/l)	278	235	92	671	837	N/A
Ag (μ g/l)	11.6	3.44	12	18.0	21.3	5000
As (μ g/l)	51.4	94.8	19	220	300	5000
Ba (μ g/l)	101	49.6	59	185	221	100,000
Cd (μ g/l)	7.18	4.88	16	16.0	20.3	1000
Cr (μ g/l)	12.4	4.73	31	20.6	24.2	5000
Cu (μ g/l)	22.4	31.7	29	77.3	102	N/A
Hg (μ g/l)	0.31	0.26	26	0.76	0.97	200
Ni (μ g/l)						N/A
Pb (μ g/l)	23.0	17.9	21	54.5	69.3	5000
Se (μ g/l)	92.0	127	14	325	441	1000
Tl (μ g/l)	172	153	6	505	729	N/A
Zn (μ g/l)	41.7	39.6	25	111	142	N/A

Guideline - RCRA Characteristic Guidelines
N/A - not applicable

Table A-6

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=1 (TRA effluent to cold waste ponds) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	1119	434	489	717	5	1	0
	91q2	869	251	417	39.2	5	1	0
	91q3	1383	.	.	.	3	0	3
	91q4	668	305	527	20.8	6	0	0
pH	91q1	6.93	1.33	1.70	1.91	5	1	0
	91q2	8.14	0.29	0.47	0.17	5	1	0
	91q3	7.56	.	.	.	3	0	3
	91q4	7.76	0.07	0.00	0.18	6	0	0
TOC (mg/l)	91q1	3.67	0.17	0.25	0.05	4	0	2
	91q2	2.17	1.99	1.33	4.51	6	0	0
	91q3	1.81	.	.	.	2	0	4
	91q4	2.60	0.17	0.19	0.29	6	0	0
Cl (mg/l)	91q1	25.9	7.40	12.8	0.86	6	0	0
	91q2	25.0	7.77	13.5	0.53	6	0	0
	91q3	22.5	10.9	15.4	0.40	4	0	0
	91q4	30.1	1.12	1.93	0.32	6	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.07	0.29	0.49	0.00	6	0	0
	91q3	0.31	0.13	0.18	0.02	4	0	0
	91q4	0.38	0.00	0.00	0.03	6	0	0
NO3 (mg/l)	91q1	9.38	2.59	4.48	0.25	6	0	0
	91q2	3.70	0.30	0.37	0.30	4	2	0
	91q3	4.75	2.78	3.93	0.09	4	0	0
	91q4	5.55	0.68	1.18	0.19	6	0	0
PO4 (mg/l)	91q1	1.70	1.17	2.03	0.27	6	0	0
	91q2	0.07	.	.	.	2	0	4
	91q3	2.91	2.81	3.97	0.04	4	0	0
	91q4	6.16	0.41	0.63	0.47	6	0	0
SO4 (mg/l)	91q1	363	168	291	15.4	6	0	0
	91q2	287	134	231	8.39	6	0	0
	91q3	612	113	159	10.0	4	0	0
	91q4	442	21.4	35.6	14.4	6	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	11.9	.	.	.	2	0	4
	91q4	X	.	.	.	0	0	6

Table A-6 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=1 (TRA effluent to cold waste ponds) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
As (µg/l)	91q1	5.22	0.17	0.23	0.11	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	6.50	.	.	.	2	0	4
	91q4	6.63	5.48	9.07	3.94	6	0	0
Ba (µg/l)	91q1	65.3	16.7	28.5	7.02	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	87.3	41.7	58.9	4.19	4	0	0
	91q4	115	11.7	16.8	16.0	6	0	0
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	11.1	0.15	0.00	3.63	4	0	2
	91q2	2.22	6.13	10.6	0.50	6	0	0
	91q3	13.2	.	.	.	2	0	4
	91q4	44.4	22.1	38.1	5.42	6	0	0
Cu (µg/l)	91q1	16.1	2.80	4.56	2.37	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	5.87	.	.	.	3	0	3
	91q4	69.5	58.9	65.9	110	6	0	0
Hg (µg/l)	91q1	0.19	0.04	0.06	0.01	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Ni (µg/l)	91q1	47.8	31.2	44.2	0.25	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	24.3	.	.	.	3	0	3
Pb (µg/l)	91q1	3.30	.	.	.	2	0	4
	91q2	X	.	.	.	0	0	6
	91q3	4.55	.	.	.	2	0	4
	91q4	4.50	4.11	5.59	6.22	6	0	0

Table A-6 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=1 (TRA effluent to cold waste ponds) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	2.70	.	.	.	1	0	5
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	19.6	3.20	0.00	8.56	6	0	0
	91q2	15.9	.	.	.	3	0	3
	91q3	3.95	.	.	.	2	0	4
	91q4	24.0	22.1	25.8	40.0	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-19
Conductivity Stream 2 Concentrations
 RCRA Guideline Not Applicable

Figure A-20

pH Stream 2 Concentrations

RCRA Characteristic Guideline = 2 to 12.5

Figure A-21
TDS Stream 2 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

Figure A-23
Cl Stream 2 Concentrations
 RCRA Guideline Not Applicable

Figure A-24
F Stream 2 Concentrations
 RCRA Guideline Not Applicable

NO₃ (mg/l)

300

200

100

0

— Mean

--- Level 1

— Level 2

FY 89 FY 90 FY 91

Figure A-26
SO4 Stream 2 Concentrations
 RCRA Guideline Not Applicable

Figure A-27
Ag Stream 2 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-28
As Stream 2 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-29
Ba Stream 2 Concentrations
 RCRA Characteristic Guideline = 100000 µg/l

Figure A-30
Cd Stream 2 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-31
Cr Stream 2 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-32
Cu Stream 2 Concentrations
 RCRA Guideline Not Applicable

Figure A-33
Hg Stream 2 Concentrations
 RCRA Characteristic Guideline = 200 µg/l

Figure A-34
NI Stream 2 Concentrations
 RCRA Guideline Not Applicable

Figure A-35
Pb Stream 2 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-36
Se Stream 2 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-37
T1 Stream 2 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

Table A-7

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=2 (TRA effluent to chemical leaching pond) QUARTER=91q1 -

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	43500	2.18	13200	12.7	X	X	X	X
Oct	2	X	X	12300	12.6	X	X	X	X
Nov	1	X	X	X	X	X	X	X	X
Nov	2	X	X	X	X	X	X	X	X
Dec	1	20600	9.10	4850	9.10	419	X	196	X
Dec	2	20900	9.01	4640	5.60	453	X	235	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	36900	X	X	165	X	77.4	396
Oct	2	37400	X	X	108	X	73.1	405
Nov	1	X	X	X	X	X	X	X
Nov	2	X	X	X	X	X	X	X
Dec	1	12400	X	68.0	274	X	94.7	27.3
Dec	2	12300	X	68.0	297	X	93.6	21.3

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	2.40	27.3	X	X	X	62.2
Oct	2	2.60	35.5	X	X	X	85.0
Nov	1	X	X	X	X	X	X
Nov	2	X	X	X	X	X	X
Dec	1	1.40	21.9	X	X	X	38.3
Dec	2	1.60	X	X	X	X	39.2

'.' - missing

'X' - below practical quantitation level

Table A-8

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=2 (TRA effluent to chemical leaching pond) QUARTER=91q2

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	27200	10.38	28500	X	25.8	0.50	X	X
Jan	2	27300	10.41	29100	X	24.5	0.50	X	X
Feb	1	X	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X	X
Mar	1	981	6.54	8840	2.00	28.0	X	X	0.12
Mar	2	992	7.43	9230	1.00	48.0	X	X	0.12

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	21400	X	52.0	X	X	19.3	13.2
Jan	2	18800	X	40.0	X	X	6.90	X
Feb	1	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X
Mar	1	6630	X	X	X	X	130	X
Mar	2	6900	X	X	X	X	90.0	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	1.59	19.0	X	X	X	23.3
Jan	2	1.73	X	X	X	X	X
Feb	1	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X
Mar	1	0.50	X	X	X	X	160
Mar	2	0.50	X	X	X	X	550

'.' - missing

'X' - below practical quantitation level

Table A-9

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=2 (TRA effluent to chemical leaching pond) QUARTER=91q3 -

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	27800	8.96	16600	2.98	378	2.05	93.2	0.75
Apr	2	X	X	16800	3.12	368	2.11	93.4	0.87
May	1	36900	8.38	23600	0.66	28.8	0.54	8.30	0.21
May	2	37200	9.19	25400	0.70	35.0	0.52	8.48	0.20
Jun	1	37500	10.50	14200	1.40	69.0	1.26	16.5	0.69
Jun	2	37400	10.54	24400	1.78	66.1	1.30	16.5	0.66

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	11200	X	15.9	122	X	49.3	5.30
Apr	2	11200	X	42.7	101	X	48.9	8.10
May	1	16600	X	74.4	249	X	7.60	9.20
May	2	15300	X	X	402	X	13.5	9.60
Jun	1	15800	X	34.9	425	X	25.2	12.5
Jun	2	15800	X	30.3	254	X	24.0	10.8

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	1.10	X	X	X	X	4.90
Apr	2	1.20	X	X	X	X	25.5
May	1	0.97	X	9.40	X	X	X
May	2	1.20	14.8	X	X	X	X
Jun	1	1.60	13.8	X	X	X	X
Jun	2	1.50	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-10

SUMMARY STATISTICS

STREAM=2 (TRA effluent to chemical leaching pond)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	26000	8740	92	40000	46000	N/A
pH	8.18	3.10	92	l 2.00 u 12.5	l 2.00 u 12.5	l 6.5 u 8.5
TDS (mg/l)	23000	9840	92	40000	47000	N/A
TOC (mg/l)	7.31	7.47	49	20.0	25.5	N/A
Cl (mg/l)	248	156	65	510	622	N/A
F (mg/l)	10.5	17.8	14	43.1	59.4	N/A
NO3 (mg/l)	105	74.9	49	232	287	N/A
PO4 (mg/l)						N/A
SO4 (mg/l)	17000	9240	88	33000	39000	N/A
Ag (μ g/l)	38.8	55.6	9	148	208	5000
As (μ g/l)	83.9	84.5	19	234	305	5000
Ba (μ g/l)	217	140	72	451	551	100,000
Cd (μ g/l)	6.99	3.27	14	13.0	16.0	1000
Cr (μ g/l)	74.4	39.7	84	141	169	5000
Cu (μ g/l)	48.4	46.9	53	128	162	N/A
Hg (μ g/l)	2.62	1.82	89	5.66	6.95	200
Ni (μ g/l)	38.8	20.5	39	73.7	89.1	N/A
Pb (μ g/l)	50.0	35.0	18	113	142	5000
Se (μ g/l)	375	454	9	1270	1760	1000
Tl (μ g/l)	89.0	156	11	385	540	N/A
Zn (μ g/l)	33.3	23.0	60	72.0	88.7	N/A

Guideline - RCRA Characteristic Guidelines

N/A - not applicable

Table A-11

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=2 (TRA effluent to chemical leaching pond) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	28000	.	.	.	3	3	0
	91q2	14000	13000	19000	50.3	4	2	0
	91q3	35000	2838	4729	158	5	1	0
	91q4	X	.	.	.	0	0	6
pH	91q1	6.76	.	.	.	3	3	0
	91q2	8.69	1.70	2.39	0.45	4	2	0
	91q3	9.51	0.62	0.98	0.41	5	1	0
	91q4	X	.	.	.	0	0	6
TDS (mg/l)	91q1	8748	4003	5651	462	4	2	0
	91q2	19000	9883	14000	332	4	2	0
	91q3	20000	2293	2613	4229	6	0	0
	91q4	X	.	.	.	0	0	6
TOC (mg/l)	91q1	10.0	2.65	3.54	1.75	4	2	0
	91q2	1.50	.	.	.	2	0	4
	91q3	1.77	0.69	1.19	0.17	6	0	0
	91q4	X	.	.	.	0	0	6
TSS (mg/l)	91q2	32.0	.	.	.	2	0	4
	91q3	595	.	.	.	2	0	4
	91q4	X	.	.	.	0	0	6
Cl (mg/l)	91q1	436	.	.	.	2	2	2
	91q2	31.6	6.42	5.69	10.0	4	2	0
	91q3	157	108	187	4.95	6	0	0
	91q4	X	.	.	.	0	0	6
F (mg/l)	91q1	X	.	.	.	0	2	4
	91q2	0.50	.	.	.	2	0	4
	91q3	1.30	0.45	0.77	0.03	6	0	0
	91q4	X	.	.	.	0	0	6
NO3 (mg/l)	91q1	216	.	.	.	2	2	2
	91q2	X	.	.	.	0	0	6
	91q3	39.4	27.1	46.9	0.12	6	0	0
	91q4	X	.	.	.	0	0	6
PO4 (mg/l)	91q1	X	.	.	.	0	2	4
	91q2	0.12	.	.	.	2	0	4
	91q3	0.56	0.18	0.32	0.05	6	0	0
	91q4	X	.	.	.	0	0	6
SO4 (mg/l)	91q1	25000	12000	18000	255	4	2	0
	91q2	13000	6666	9384	1275	4	2	0
	91q3	14000	1559	2674	531	6	0	0
	91q4	X	.	.	.	0	0	6

Table A-11 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=2 (TRA effluent to chemical leaching pond) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Ag (µg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
As (µg/l)	91q1	68.0	.	.	.	2	2	2
	91q2	46.0	.	.	.	2	0	4
	91q3	30.5	1.04	0.00	38.1	6	0	0
	91q4	X	.	.	.	0	0	6
Ba (µg/l)	91q1	211	74.5	103	30.7	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	259	73.8	109	94.1	6	0	0
	91q4	X	.	.	.	0	0	6
Cd (µg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	84.7	9.45	13.3	2.22	4	2	0
	91q2	61.5	48.5	66.9	20.9	4	2	0
	91q3	28.1	11.3	19.4	2.46	6	0	0
	91q4	X	.	.	.	0	0	6
Cu (µg/l)	91q1	212	188	266	5.41	4	2	0
	91q2	13.2	.	.	.	1	0	5
	91q3	9.25	1.43	2.29	1.35	6	0	0
	91q4	X	.	.	.	0	0	6
Hg (µg/l)	91q1	2.00	0.50	0.70	0.14	4	2	0
	91q2	1.08	0.58	0.82	0.07	4	2	0
	91q3	1.26	0.15	0.24	0.11	6	0	0
	91q4	X	.	.	.	0	0	6
Ni (µg/l)	91q1	28.2	.	.	.	3	2	1
	91q2	19.0	.	.	.	1	0	5
	91q3	14.3	.	.	.	2	0	4
	91q4	X	.	.	.	0	0	6
Pb (µg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	9.40	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6

Table A-11 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=2 (TRA effluent to chemical leaching pond) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Se (µg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Tl (µg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	56.2	17.4	23.3	11.4	4	2	0
	91q2	244	.	.	.	3	0	3
	91q3	15.2	.	.	.	2	0	4
	91q4	X	.	.	.	0	0	6

'.' - missing, too little data to calculate value
'X' - below practical quantitation level (BPQL)

PCRA Guideline Not Applicable

Figure A-40
pH Stream 3 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

PCRA Guideline Not Applicable

Figure A-42
Cl Stream 3 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

Figure A-45
Cd Stream 3 Concentrations
 RCRA Characteristic Guideline = 1000 µg/l

Figure A-46
Cr Stream 3 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-47
Cu Stream 3 Concentrations
 RCRA Guideline Not Applicable

Figure A-48
Hg Stream 3 Concentrations
 RCRA Characteristic Guideline = 200 µg/l

Figure A-49
Ni Stream 3 Concentrations
 RCRA Guideline Not Applicable

Figure A-50
Pb Stream 3 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-51
Zn Stream 3 Concentrations
 RCRA Guideline Not Applicable

Table A-12

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=3 (TRA effluent to retention basin) QUARTER=91q1 ----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	117	4.22	X	X	X	X	X
Oct	2	53	4.35	X	X	X	X	X
Nov	1	5	7.43	X	X	X	1.40	X
Nov	2	1	7.43	X	X	X	X	X
Dec	1	120	8.62	X	X	X	2.60	X
Dec	2	220	8.30	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	2.20	X	X	X	X	8.60	X
Oct	2	2.20	3.50	X	X	X	X	X
Nov	1	X	X	X	X	X	X	X
Nov	2	X	X	X	X	X	X	8.00
Dec	1	0.63	X	X	X	X	9.00	21.0
Dec	2	0.36	X	X	X	X	X	6.90

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.21	X	2.20	X	X	X
Oct	2	0.20	X	4.30	X	X	X
Nov	1	2.30	X	X	X	X	27.9
Nov	2	2.30	X	X	X	X	20.8
Dec	1	X	X	X	X	X	30.4
Dec	2	X	X	3.20	X	X	22.5

'.' - missing

'X' - below practical quantitation level

Table A-13

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=3 (TRA effluent to retention basin) QUARTER=91q2 ----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	12.0	9.22	5.20	X	X	X	X
Jan	2	9.0	8.99	X	X	X	X	X
Feb	1	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X
Mar	1	66.2	5.43	X	X	X	X	X
Mar	2	X	X	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	X	X	X	X	X	X	X
Jan	2	X	X	X	X	X	X	X
Feb	1	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X
Mar	1	X	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	17.4
Jan	2	X	X	X	X	X	17.1
Feb	1	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X
Mar	1	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-14

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=3 (TRA effluent to retention basin) QUARTER=91q3 ----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
May	1	98.9	5.53	X	X	X	X	X
May	2	5.2	5.90	X	X	X	X	X
Jun	1	170.0	6.38	X	X	X	X	X
Jun	2	7.3	7.07	X	X	X	0.11	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
May	1	X	X	X	1.30	X	X	X
May	2	X	X	X	X	X	X	X
Jun	1	X	X	X	X	X	X	X
Jun	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
May	1	X	X	1.30	X	X	X
May	2	X	X	X	X	X	5.90
Jun	1	X	X	8.10	X	X	6.00
Jun	2	X	X	X	X	X	9.60

'.' - missing

'X' - below practical quantitation level

Table A-15

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=3 (TRA effluent to retention basin) QUARTER=91q4 ----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	41.9	5.72	X	X	X	X	0.03
Jul	2	X	6.18	X	X	X	0.02	0.09
Aug	1	94.0	5.34	X	X	X	X	X
Aug	2	22.9	6.47	X	X	X	0.02	X
Sep	1	X	6.00	X	X	X	0.03	X
Sep	2	X	4.00	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	X	X	X	X	X	X	X
Jul	2	0.62	X	X	X	X	X	X
Aug	1	X	X	X	X	X	X	10.9
Aug	2	X	X	X	X	X	X	5.40
Sep	1	X	X	X	X	X	X	X
Sep	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	X	X	X	7.50
Jul	2	X	10.2	X	X	X	8.40
Aug	1	X	X	X	X	X	X
Aug	2	X	13.0	X	X	X	X
Sep	1	X	X	X	X	X	X
Sep	2	X	12.0	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-16

SUMMARY STATISTICS

STREAM=3 (TRA effluent to retention basin)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	21.4	15.0	82	46.6	57.3	N/A
pH	7.41	0.95	88	l 5.52 u 9.31	l 4.90 u 9.92	l 6.5 u 8.5
TOC (mg/l)	1.92	2.88	21	7.01	9.37	N/A
Cl (mg/l)	0.79	1.11	27	2.72	3.59	N/A
F (mg/l)						N/A
NO3 (mg/l)	0.82	0.74	26	2.11	2.70	N/A
PO4 (mg/l)						N/A
SO4 (mg/l)	0.77	0.92	29	2.36	3.07	N/A
Ag (μ g/l)						5000
As (μ g/l)						5000
Ba (μ g/l)						100,000
Cd (μ g/l)	8.01	3.68	11	15.0	18.6	1000
Cr (μ g/l)	10.1	5.54	18	20.0	24.7	5000
Cu (μ g/l)	14.9	7.51	13	28.8	35.8	N/A
Hg (μ g/l)	0.42	0.36	18	1.06	1.36	200
Ni (μ g/l)	59.0	39.6	10	135	176	N/A
Pb (μ g/l)	13.6	9.78	24	30.7	38.6	5000
Se (μ g/l)						1000
Tl (μ g/l)						N/A
Zn (μ g/l)	24.5	13.0	39	46.6	56.4	N/A

Guideline - RCRA Characteristic Guidelines
 N/A - not applicable

Table A-17

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=3 (TRA effluent to retention basin) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	86.0	48.2	76.1	48.5	6	0	0
	91q2	29.1	.	.	.	3	0	3
	91q3	70.3	18.3	0.00	93.9	4	0	0
	91q4	52.9	.	.	.	3	0	3
pH	91q1	6.72	1.26	2.17	0.14	6	0	0
	91q2	7.88	.	.	.	3	0	3
	91q3	6.22	0.51	0.66	0.39	4	0	0
	91q4	5.62	0.31	0.00	0.96	6	0	0
TOC (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	5.20	.	.	.	1	0	5
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cl (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
NO3 (mg/l)	91q1	2.00	.	.	.	2	0	4
	91q2	X	.	.	.	0	0	6
	91q3	0.11	.	.	.	1	0	5
	91q4	0.02	.	.	.	3	0	3
PO4 (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	0.06	.	.	.	2	0	4
SO4 (mg/l)	91q1	1.35	0.85	1.20	0.135	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	0.62	.	.	.	1	0	5
Ag (μ g/l)	91q1	3.50	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
As (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-17 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=3 (TRA effluent to retention basin) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Ba (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	1.30	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	8.80	.	.	.	2	1	3
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cu (µg/l)	91q1	12.0	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	8.15	.	.	.	2	0	4
Hg (µg/l)	91q1	1.25	1.05	1.48	0.01	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Ni (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	11.7	.	.	.	3	0	3
Pb (µg/l)	91q1	3.23	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	4.70	.	.	.	2	0	4
	91q4	X	.	.	.	0	0	6
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-17 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=3 (TRA effluent to retention basin) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Zn (µg/l)	91q1	25.4	1.05	0.00	5.31	4	0	2
	91q2	17.3	.	.	.	2	0	4
	91q3	7.17	.	.	.	3	0	3
	91q4	7.95	.	.	.	2	0	4

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-52
Conductivity Stream 4 Concentrations
 RCRA Guideline Not Applicable

Figure A-53
pH Stream 4 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

Figure A-55

Cl Stream 4 Concentrations

RCRA Guideline Not Applicable

Figure A-56
F Stream 4 Concentrations
 RCRA Guideline Not Applicable

Figure A-57
NO3 Stream 4 Concentrations
 RCRA Guideline Not Applicable

Figure A-58
PO4 Stream 4 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

Figure A-60
As Stream 4 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-61
Ba Stream 4 Concentrations
 RCRA Characteristic Guideline = 100000 $\mu\text{g/l}$

Figure A-62
Cd Stream 4 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-63
Cr Stream 4 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-64
Cu Stream 4 Concentrations
 RCRA Guideline Not Applicable

Figure A-65
Hg Stream 4 Concentrations
 RCRA Characteristic Guideline = 200 $\mu\text{g/l}$

Figure A-66
Ni Stream 4 Concentrations
 RCRA Guideline Not Applicable

Figure A-67
Pb Stream 4 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-68
Zn Stream 4 Concentrations
 RCRA Guideline Not Applicable

Table A-18

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=4 (TRA effluent to STP) QUARTER=91q1 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	935	6.59	12.6	29.5	X	19.6	4.00
Oct	2	623	7.17	11.4	29.0	X	19.6	4.10
Nov	1	593	7.87	6.20	34.0	X	27.7	5.50
Nov	2	X	X	5.10	34.2	X	28.1	5.50
Dec	1	596	8.02	7.40	49.9	X	29.9	5.00
Dec	2	619	7.86	5.40	44.5	X	29.4	4.80

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	28.2	X	1.50	27.9	X	6.60	15.7
Oct	2	28.1	X	1.50	45.9	X	X	17.7
Nov	1	22.6	X	X	35.7	X	X	29.2
Nov	2	22.8	X	X	38.2	X	X	21.4
Dec	1	21.0	X	1.30	49.7	X	X	22.8
Dec	2	20.8	X	1.60	49.8	X	X	26.0

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.12	X	3.10	X	X	77.4
Oct	2	0.08	X	2.60	X	X	65.6
Nov	1	2.30	X	X	X	X	69.2
Nov	2	2.40	X	X	X	X	63.0
Dec	1	X	X	5.10	X	0.67	74.2
Dec	2	X	X	3.50	X	X	74.3

'.' - missing

'X' - below practical quantitation level

Table A-19

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=4 (TRA effluent to STP) QUARTER=91q2 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	577	8.34	5.30	25.0	X	7.40	2.04
Jan	2	548	8.06	12.5	24.8	X	7.40	2.04
Feb	1	543	8.44	9.30	24.2	0.20	10.0	6.12
Feb	2	X	X	7.90	23.6	0.10	10.0	6.12
Mar	1	793	8.00	35.0	43.0	X	X	6.50
Mar	2	671	7.02	40.0	45.0	X	X	6.50

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	27.5	X	X	X	X	X	X
Jan	2	27.5	X	X	X	X	X	X
Feb	1	27.3	X	X	X	X	X	15.5
Feb	2	27.3	X	X	X	X	X	9.90
Mar	1	19.0	X	X	300	X	X	X
Mar	2	19.0	X	X	200	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	0.42	X	X	X	X	56.0
Jan	2	X	X	X	X	X	64.3
Feb	1	X	X	6.20	X	X	125
Feb	2	X	X	X	X	X	116
Mar	1	X	X	X	X	X	140
Mar	2	X	X	X	X	X	130

'.' - missing

'X' - below practical quantitation level

Table A-20

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=4 (TRA effluent to STP) QUARTER=91q3 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	687	8.17	11.8	46.7	0.23	10.8	6.88
Apr	2	X	X	10.3	49.0	0.17	10.3	7.34
May	1	659	7.41	11.7	22.0	0.27	15.7	9.42
May	2	619	7.22	11.6	22.1	0.18	16.0	9.18
Jun	1	649	7.66	12.0	22.2	0.15	12.2	5.35
Jun	2	541	7.54	8.28	20.6	0.15	12.0	5.26

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	21.9	5.90	X	62.4	X	9.20	18.5
Apr	2	22.1	X	X	68.0	X	13.8	24.1
May	1	21.0	X	X	74.5	X	11.1	27.2
May	2	21.1	X	X	71.5	X	9.60	27.6
Jun	1	23.6	X	X	56.1	X	X	8.70
Jun	2	22.7	X	X	57.7	X	X	9.10

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	3.20	X	X	91.2
Apr	2	X	X	3.70	X	X	105
May	1	X	X	7.80	X	X	173
May	2	X	X	7.80	X	X	163
Jun	1	X	X	2.20	X	X	51.8
Jun	2	X	X	2.20	X	X	42.3

'.' - missing

'X' - below practical quantitation level

Table A-21

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=4 (TRA effluent to STP) QUARTER=91q4 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	515	7.84	7.64	23.2	0.14	10.9	5.78
Jul	2	496	7.12	7.41	23.2	0.14	11.3	5.63
Aug	1	697	6.69	10.1	47.4	0.11	13.6	12.9
Aug	2	505	7.46	9.86	46.9	0.11	13.3	12.4

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	24.9	X	X	61.2	X	X	16.0
Jul	2	23.5	X	X	53.9	X	7.40	25.2
Aug	1	23.6	X	X	52.8	X	27.0	32.7
Aug	2	23.9	X	3.50	51.6	X	24.0	24.0

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	0.22	X	4.90	X	X	78.2
Jul	2	X	X	4.20	X	X	53.2
Aug	1	X	14.2	2.00	X	X	71.2
Aug	2	X	X	3.10	X	X	71.3

'.' - missing

'X' - below practical quantitation level

Table A-22
SUMMARY STATISTICS

STREAM=4 (TRA effluent to STP)

ANALYTE	FY87-FY90 MEAN	STD	N	LEVEL1	LEVEL2	GUIDELINE
Cond (μ S)	527	76.9	94	655	710	N/A
pH	7.40	0.35	95	1 6.71 u 8.10	1 6.49 u 8.32	1 6.5 u 8.5
TOC (mg/l)	9.21	3.92	48	15.9	18.8	N/A
Cl (mg/l)	34.0	14.4	91	58.0	68.2	N/A
F (mg/l)	0.17	0.10	15	0.35	0.44	N/A
NO3 (mg/l)	30.9	7.71	88	43.8	49.3	N/A
PO4 (mg/l)	5.14	1.74	90	8.04	9.27	N/A
SO4 (mg/l)	22.4	5.75	90	32.0	36.1	N/A
Ag (μ g/l)						5000
As (μ g/l)	49.4	74.7	16	184	250	5000
Ba (μ g/l)	55.4	17.1	56	84.1	96.6	100,000
Cd (μ g/l)	16.1	25.3	9	65.7	93.3	1000
Cr (μ g/l)	10.1	5.11	24	19.0	23.1	5000
Cu (μ g/l)	18.4	12.3	38	39.5	48.7	N/A
Hg (μ g/l)	0.39	0.36	30	1.01	1.28	200
Ni (μ g/l)						N/A
Pb (μ g/l)	11.6	10.8	27	30.4	38.9	5000
Se (μ g/l)						1000
Tl (μ g/l)						N/A
Zn (μ g/l)	76.5	37.9	87	140	167	N/A

Guideline - RCRA Characteristic Guidelines
N/A - not applicable

Table A-23

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=4 (TRA effluent to STP) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	673	60.0	0.00	156	5	1	0
	91q2	626	64.1	96.1	62.7	5	1	0
	91q3	631	24.0	0.00	57.6	5	1	0
	91q4	553	47.7	0.00	96.5	4	0	0
pH	91q1	7.50	0.38	0.59	0.30	5	1	0
	91q2	7.97	0.28	0.27	0.51	5	1	0
	91q3	7.60	0.23	0.38	0.11	5	1	0
	91q4	7.28	0.20	0.00	0.53	4	0	0
TOC (mg/l)	91q1	8.02	2.00	3.39	1.05	6	0	0
	91q2	18.3	9.58	16.4	3.62	6	0	0
	91q3	10.9	0.44	0.00	1.64	6	0	0
	91q4	8.75	1.23	1.73	0.17	4	0	0
Cl (mg/l)	91q1	36.8	5.36	9.15	2.22	6	0	0
	91q2	30.9	6.54	11.3	0.86	6	0	0
	91q3	30.4	8.71	15.1	1.14	6	0	0
	91q4	35.2	12.0	16.9	0.25	4	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.15	.	.	.	2	0	4
	91q3	0.19	0.02	0.02	0.04	6	0	0
	91q4	0.13	0.02	0.02	0.00	4	0	0
NO3 (mg/l)	91q1	25.7	3.10	5.37	0.26	6	0	0
	91q2	8.70	1.30	1.84	0.00	4	2	0
	91q3	12.8	1.57	2.71	0.26	6	0	0
	91q4	12.3	1.17	1.65	0.25	4	0	0
PO4 (mg/l)	91q1	4.82	0.42	0.73	0.09	6	0	0
	91q2	4.89	1.43	2.47	0.00	6	0	0
	91q3	7.24	1.16	1.99	0.22	6	0	0
	91q4	9.17	3.46	4.90	0.26	4	0	0
SO4 (mg/l)	91q1	23.9	2.18	3.77	0.12	6	0	0
	91q2	24.6	2.80	4.85	0.00	6	0	0
	91q3	22.1	0.61	1.02	0.38	6	0	0
	91q4	24.0	0.23	0.00	0.72	4	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	5.90	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6

Table A-23 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=4 (TRA effluent to STP) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
As (µg/l)	91q1	1.47	0.03	0.00	0.15	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	3.50	.	.	.	1	0	5
Ba (µg/l)	91q1	41.2	4.28	5.23	7.42	6	0	0
	91q2	250	.	.	.	2	0	4
	91q3	65.0	4.65	7.83	2.67	6	0	0
	91q4	54.9	2.67	2.73	3.70	4	0	0
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	6.60	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	5.62	5.32	9.11	1.98	6	0	0
	91q4	19.5	.	.	.	3	0	3
Cu (µg/l)	91q1	22.1	2.73	4.01	3.54	6	0	0
	91q2	12.7	.	.	.	2	0	4
	91q3	19.2	5.44	9.29	2.30	6	0	0
	91q4	24.5	3.87	3.16	6.33	4	0	0
Hg (µg/l)	91q1	1.22	1.12	1.59	0.054	4	0	2
	91q2	0.42	.	.	.	1	0	5
	91q3	X	.	.	.	0	0	6
	91q4	0.22	.	.	.	1	0	5
Ni (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	14.2	.	.	.	1	0	5
Pb (µg/l)	91q1	3.58	0.73	0.84	0.84	4	0	2
	91q2	6.20	.	.	.	1	0	5
	91q3	4.48	1.70	2.94	0.20	6	0	0
	91q4	3.55	1.00	1.34	0.65	4	0	0
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-23 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=4 (TRA effluent to STP) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Tl (µg/l)	91q1	0.67	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	70.6	2.39	1.54	5.44	6	0	0
	91q2	105	22.9	39.4	6.45	6	0	0
	91q3	104	35.1	60.5	7.97	6	0	0
	91q4	68.5	2.77	0.00	12.5	4	0	0

'.' - missing, too little data to calculate value
'X' - below practical quantitation level (BPQL)

Figure A-69
Conductivity Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-70
pH Stream 8 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

RCRA Guideline Not Applicable

Figure A-72
Cl Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-73
F Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-74
NO₃ Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-75
PO4 Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-76
SO4 Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-77
Ag Stream 8 Concentrations
 RCRA Characteristic Guidelines = 5000 µg/l

Figure A-78
As Stream 8 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-79
Ba Stream 8 Concentrations
 RCRA Characteristic Guideline = 100000 $\mu\text{g/l}$

Figure A-80
Cd Stream 8 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-81
Cr Stream 8 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-82
Cu Stream 8 Concentrations
 RCRA Guideline Not Applicable

Figure A-83
Hg Stream 8 Concentrations
 RCRA Characteristic Guideline = 200 µg/l

Figure A-84
Pb Stream 8 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-85
Se Stream 8 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-86
Zn Stream 8 Concentrations
 RCRA Guideline Not Applicable

Table A-24

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=8 (TAN TSF effluent to STP) QUARTER=91q1 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	465	7.07	5.00	24.8	X	18.6	3.00
Oct	2	465	7.11	5.10	24.0	X	18.5	2.90
Nov	1	711	7.82	5.40	94.0	X	20.6	3.10
Nov	2	702	7.82	7.30	96.1	X	20.5	3.20
Dec	1	498	8.18	5.50	31.4	X	20.2	4.50
Dec	2	507	7.78	7.10	31.2	X	19.9	4.60

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	34.2	X	X	66.9	X	X	16.2
Oct	2	34.4	X	X	70.5	X	X	18.0
Nov	1	34.8	X	2.00	X	X	X	X
Nov	2	34.8	X	1.80	78.2	X	8.10	14.1
Dec	1	33.8	X	2.40	89.3	X	X	13.1
Dec	2	33.8	X	2.10	74.7	X	X	9.10

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.10	X	2.80	X	X	65.7
Oct	2	0.20	X	2.50	X	X	58.7
Nov	1	0.08	X	4.20	X	X	X
Nov	2	0.10	X	8.30	X	X	52.8
Dec	1	0.21	18.1	X	X	X	36.8
Dec	2	0.08	18.4	X	X	X	30.7

'.' - missing

'X' - below practical quantitation level

Table A-25

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=8 (TAN TSF effluent to STP) QUARTER=91q2 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	491	8.07	8.20	29.8	0.10	4.60	X
Jan	2	489	7.84	8.20	30.8	0.10	4.60	X
Feb	1	531	8.08	7.10	38.4	0.20	5.10	1.53
Feb	2	521	7.91	6.60	37.8	0.20	5.20	1.53
Mar	1	582	8.09	X	40.0	X	X	4.33
Mar	2	571	7.80	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	36.5	X	X	X	X	X	X
Jan	2	37.6	X	X	X	X	X	17.9
Feb	1	42.7	X	X	X	X	X	X
Feb	2	42.8	X	X	X	X	5.30	X
Mar	1	36.0	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	31.2
Jan	2	X	X	X	X	X	30.3
Feb	1	X	X	X	X	X	61.6
Feb	2	X	X	X	X	X	60.5
Mar	1	X	X	X	X	X	40.0
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-26

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=8 (TAN TSF effluent to STP) QUARTER=91q3 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	742	6.22	11.8	65.9	0.21	10.5	7.62
Apr	2	677	7.53	11.2	64.6	0.23	12.3	7.25
May	1	776	6.57	13.2	67.0	0.22	8.10	9.27
May	2	488	7.02	13.9	63.4	0.21	8.28	9.30
Jun	1	472	6.92	10.1	16.2	0.20	5.67	4.59
Jun	2	424	7.37	10.2	17.7	0.19	5.67	4.44

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	41.0	X	X	102	X	9.20	X
Apr	2	54.8	X	X	102	X	9.40	X
May	1	34.8	X	X	112	X	X	21.6
May	2	36.2	X	3.00	114	X	X	15.0
Jun	1	24.0	X	4.00	81.1	X	X	X
Jun	2	25.3	X	X	78.6	X	7.10	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	X	X	X	45.7
Apr	2	X	X	X	X	X	32.4
May	1	X	X	15.2	X	X	83.4
May	2	X	X	3.10	X	X	78.1
Jun	1	X	X	9.10	X	X	60.4
Jun	2	X	X	2.30	X	X	59.3

'.' - missing

'X' - below practical quantitation level

Table A-27

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=8 (TAN TSF effluent to STP) QUARTER=91q4 -----

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	586.0	7.43	13.3	33.0	0.27	10.0	6.30
Jul	2	565.0	7.55	14.7	33.0	0.23	9.92	6.43
Aug	1	37.7	7.27	8.48	31.4	0.25	8.90	13.3
Aug	2	35.2	7.46	8.12	33.2	0.27	9.06	13.0
Sep	1	43.3	7.00	12.6	52.6	0.20	18.6	7.89
Sep	2	41.9	7.74	12.9	52.9	0.26	18.1	8.32

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	38.2	X	3.90	107	X	10.7	12.2
Jul	2	38.0	X	3.90	108	X	5.00	8.80
Aug	1	37.7	X	X	97.8	X	8.60	7.40
Aug	2	41.2	X	X	98.4	X	7.00	13.0
Sep	1	37.9	X	3.40	104	X	16.4	5.40
Sep	2	38.6	X	3.60	112	X	21.3	4.50

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	X	X	X	84.7
Jul	2	X	X	X	X	X	85.1
Aug	1	X	X	3.80	X	X	64.4
Aug	2	X	9.00	2.70	X	X	70.3
Sep	1	X	13.8	2.40	2.20	X	52.1
Sep	2	X	X	2.90	X	X	55.2

'.' - missing

'X' - below practical quantitation level

Table A-28

SUMMARY STATISTICS

STREAM=8 (TAN TSF effluent to STP)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	563	117	92	759	843	N/A
pH	7.30	0.36	94	1 6.59 u 8.02	1 6.36 u 8.25	1 6.5 u 8.5
TOC (mg/l)	13.2	12.6	51	34.5	43.7	N/A
Cl (mg/l)	44.9	26.6	91	89.4	108	N/A
F (mg/l)	0.33	0.27	27	0.80	1.02	N/A
NO3 (mg/l)	22.9	7.94	95	36.2	41.8	N/A
PO4 (mg/l)	3.63	1.40	85	5.96	6.96	N/A
SO4 (mg/l)	35.9	5.23	91	44.7	48.4	N/A
Ag (μ g/l)	52.6	102	13	242	337	5000
As (μ g/l)	37.8	76.6	19	174	238	5000
Ba (μ g/l)	101	27.2	59	147	167	100,000
Cd (μ g/l)	4.94	1.17	28	6.98	7.90	1000
Cr (μ g/l)	9.35	3.34	36	15.1	17.6	5000
Cu (μ g/l)	26.1	19.3	58	58.7	72.7	N/A
Hg (μ g/l)	0.38	0.31	41	0.91	1.14	200
Ni (μ g/l)						N/A
Pb (μ g/l)	24.6	35.8	31	86.4	114	5000
Se (μ g/l)	40.7	84.5	13	197	276	1000
Tl (μ g/l)						N/A
Zn (μ g/l)	118	78.5	87	249	305	N/A

Guideline - RCRA Characteristic Guidelines

N/A - not applicable

Table A-29

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=8 (TAN TSF effluent to STP) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	558	75.0	130	5.20	6	0	0
	91q2	531	25.1	43.2	6.12	6	0	0
	91q3	597	77.5	103	122	6	0	0
	91q4	218	179	309	8.65	6	0	0
pH	91q1	7.63	0.27	0.46	0.16	6	0	0
	91q2	7.96	0.02	0.00	0.17	6	0	0
	91q3	6.94	0.11	0.00	0.59	6	0	0
	91q4	7.41	0.04	0.00	0.32	6	0	0
TOC (mg/l)	91q1	5.90	0.43	0.17	1.01	6	0	0
	91q2	7.53	0.67	0.94	0.25	4	2	0
	91q3	11.7	0.99	1.69	0.38	6	0	0
	91q4	11.7	1.73	2.97	0.60	6	0	0
Cl (mg/l)	91q1	50.2	22.5	38.9	0.92	6	0	0
	91q2	35.4	3.14	5.22	0.58	5	1	0
	91q3	49.1	16.1	27.8	1.68	6	0	0
	91q4	39.3	6.70	11.6	0.75	6	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.02	0.20	0.33	0.00	5	1	0
	91q3	0.21	0.01	0.01	0.01	6	0	0
	91q4	0.25	0.01	0.00	0.03	6	0	0
NO3 (mg/l)	91q1	19.7	0.60	1.04	0.13	6	0	0
	91q2	4.87	0.27	0.39	0.05	4	2	0
	91q3	8.43	1.66	2.83	0.75	6	0	0
	91q4	12.4	2.98	5.15	0.21	6	0	0
PO4 (mg/l)	91q1	3.55	0.50	0.87	0.07	6	0	0
	91q2	2.46	.	.	.	3	0	3
	91q3	7.08	1.39	2.40	0.16	6	0	0
	91q4	9.20	2.03	3.51	0.22	6	0	0
SO4 (mg/l)	91q1	34.3	0.29	0.50	0.08	6	0	0
	91q2	39.1	2.24	3.71	0.55	5	1	0
	91q3	36.0	6.72	10.9	5.69	6	0	0
	91q4	38.6	0.43	0.00	1.46	6	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
As (μ g/l)	91q1	2.08	0.17	0.21	0.18	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	3.50	.	.	.	2	0	4
	91q4	1.47	2.24	3.87	0.08	6	0	0

Table A-29 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=8 (TAN TSF effluent to STP) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Ba (µg/l)	91q1	75.9	4.38	4.69	7.52	5	0	1
	91q2	X	.	.	.	0	0	6
	91q3	98.3	9.75	16.9	1.31	6	0	0
	91q4	105	3.22	5.07	3.30	6	0	0
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	8.10	.	.	.	1	0	5
	91q2	5.30	.	.	.	1	0	5
	91q3	8.57	.	.	.	3	0	3
	91q4	11.5	3.68	5.97	3.14	6	0	0
Cu (µg/l)	91q1	14.1	1.98	2.87	2.19	5	0	1
	91q2	17.9	.	.	.	1	0	5
	91q3	18.3	.	.	.	2	0	4
	91q4	8.55	1.80	2.47	2.70	6	0	0
Hg (µg/l)	91q1	0.13	0.02	0.00	0.07	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Ni (µg/l)	91q1	18.3	.	.	.	2	0	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	11.4	.	.	.	2	0	4
Pb (µg/l)	91q1	4.45	1.80	2.09	2.06	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	4.28	3.30	4.07	5.67	6	0	0
	91q4	1.30	1.66	2.85	0.49	6	0	0
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	2.20	.	.	.	1	0	5
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-29 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=8 (TAN TSF effluent to STP) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Zn (µg/l)	91q1	48.9	9.62	15.7	4.64	5	0	1
	91q2	44.7	10.3	17.2	0.71	5	1	0
	91q3	59.9	12.0	20.4	5.86	6	0	0
	91q4	68.6	9.04	15.5	2.73	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-87

Conductivity Stream 9 Concentrations

RCPRA Guideline Not Applicable

Figure A-88
pH Stream 9 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

PCPA Guideline Not Applicable

Figure A-90

CI Stream 9 Concentrations

RCRA Guideline Not Applicable

Figure A-91
F Stream 9 Concentrations
 RCRA Guideline Not Applicable

RCRA Guideline Not Applicable

Figure A-93
PO4 Stream 9 Concentrations
 RCRA Guideline Not Applicable

Figure A-94
SO4 Stream 9 Concentrations
 RCRA Guideline Not Applicable

Figure A-95
Ag Stream 9 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

PCPA Characteristic Guideline = 5000 $\mu\text{g/L}$

Figure A-97
Ba Stream 9 Concentrations
 RCRA Characteristic Guideline = 100000 $\mu\text{g/l}$

Figure A-98
Cd Stream 9 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

PCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-100
Cu Stream 9 Concentrations
 RCRA Guideline Not Applicable

Figure A-101

Figure A-102

NI Stream 9 Concentrations

RCRA Guideline Not Applicable

RCRA Characteristic Guideline = 5000 µg/l

Figure A-104
Se Stream 9 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-105

Zn Stream 9 Concentrations

PCRA Guideline Not Applicable

Table A-30

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=9 (TAN TSF effluent to drainage pond) QUARTER=91q1 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	P04 (mg/l)
Oct	1	457	7.27	4.00	23.6	X	15.0	2.30
Oct	2	455	7.33	4.00	23.9	X	15.0	2.30
Nov	1	642	7.75	5.30	80.4	X	17.3	2.70
Nov	2	649	7.77	5.20	79.9	X	17.3	2.90
Dec	1	510	8.68	4.00	42.3	X	14.3	2.60
Dec	2	521	8.38	3.80	42.4	X	14.1	2.50

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	34.6	X	X	66.0	X	X	15.2
Oct	2	34.5	X	1.00	63.3	X	X	14.1
Nov	1	36.2	X	1.90	74.7	X	X	18.0
Nov	2	36.2	X	1.80	73.1	X	7.70	15.2
Dec	1	36.5	X	2.50	59.6	X	X	18.3
Dec	2	36.6	X	2.30	67.1	X	X	15.7

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.18	X	4.30	X	X	41.3
Oct	2	0.09	X	4.00	X	X	75.2
Nov	1	0.14	X	4.10	X	X	45.9
Nov	2	0.15	21.6	X	X	X	37.3
Dec	1	X	28.3	2.50	X	X	28.3
Dec	2	0.16	16.3	2.60	X	X	33.5

'.' - missing

'X' - below practical quantitation level

Table A-31

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=9 (TAN TSF effluent to drainage pond) QUARTER=91q2 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	541	7.91	6.80	52.1	0.10	4.60	X
Jan	2	540	7.95	7.30	52.1	0.10	4.60	X
Feb	1	585	8.96	X	19.1	0.20	1.10	X
Feb	2	590	8.46	X	19.3	0.20	1.10	X
Mar	1	737	8.37	X	74.0	X	X	0.82
Mar	2	689	6.96	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	38.5	X	X	X	X	5.10	X
Jan	2	40.1	X	X	X	X	X	X
Feb	1	39.4	X	X	X	X	X	X
Feb	2	40.6	X	X	X	X	7.90	X
Mar	1	38.0	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	25.8
Jan	2	X	X	3.34	X	X	28.8
Feb	1	X	X	X	X	X	45.8
Feb	2	X	X	X	X	X	46.0
Mar	1	X	X	4.00	X	X	50.0
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-32

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=9 (TAN TSF effluent to drainage pond) QUARTER=91q3 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	694	6.75	7.17	61.2	0.21	12.3	4.22
Apr	2	X	X	6.80	61.9	0.23	12.2	4.77
May	1	940	6.66	7.02	100	0.20	6.00	4.99
May	2	771	7.69	7.38	98.8	0.20	6.78	5.11
Jun	1	233	6.57	6.26	15.8	0.20	3.63	3.00
Jun	2	418	7.71	6.49	15.8	0.19	3.81	2.91

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	40.4	X	X	101	5.90	7.50	X
Apr	2	53.6	X	X	106	X	10.2	6.50
May	1	32.2	X	3.30	118	X	X	11.9
May	2	31.8	X	3.70	122	X	X	8.40
Jun	1	25.8	X	X	92.4	X	X	X
Jun	2	26.8	X	X	89.2	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	X	X	X	21.1
Apr	2	X	13.9	X	X	X	60.6
May	1	X	X	X	X	X	47.4
May	2	X	X	X	X	X	42.0
Jun	1	X	X	7.10	X	X	54.2
Jun	2	X	X	2.50	X	X	54.2

'.' - missing

'X' - below practical quantitation level

Table A-33

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=9 (TAN TSF effluent to drainage pond) QUARTER=91q4 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	523.0	7.84	6.09	25.2	0.22	5.89	2.55
Jul	2	X	X	5.82	25.8	0.22	6.11	3.43
Aug	1	25.3	7.07	4.76	30.8	0.26	6.47	8.32
Aug	2	35.5	7.42	4.49	31.6	0.26	7.75	9.76
Sep	1	42.0	6.86	5.91	45.7	0.23	12.2	6.95
Sep	2	35.4	7.86	5.78	44.0	0.21	11.9	6.27

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	38.4	2.90	X	104	X	7.40	13.3
Jul	2	39.0	X	3.90	98.4	X	8.00	10.0
Aug	1	40.5	X	X	104	X	5.30	7.40
Aug	2	40.2	X	X	103	X	7.00	10.2
Sep	1	37.4	X	4.60	166	X	29.9	48.5
Sep	2	38.0	X	4.60	156	X	31.1	33.2

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	5.10	X	X	71.5
Jul	2	X	X	5.80	X	X	95.5
Aug	1	X	X	3.30	X	X	70.3
Aug	2	X	X	44.3	X	X	72.5
Sep	1	0.24	18.3	32.6	X	X	123
Sep	2	0.30	18.9	26.1	X	X	113

'.' - missing

'X' - below practical quantitation level

Table A-34

SUMMARY STATISTICS

STREAM=9 (TAN TSF effluent to drainage pond)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	575	125	88	784	873	N/A
pH	7.68	0.57	96	l 6.55 u 8.82	l 6.18 u 9.19	l 6.5 u 8.5
TOC (mg/l)	11.8	13.3	52	34.3	44.0	N/A
Cl (mg/l)	55.1	36.8	86	117	143	N/A
F (mg/l)	0.39	0.28	33	0.87	1.09	N/A
NO3 (mg/l)	17.5	5.88	95	27.3	31.5	N/A
PO4 (mg/l)	2.64	1.27	85	4.77	5.68	N/A
SO4 (mg/l)	38.6	8.10	94	52.1	57.9	N/A
Ag (μ g/l)	14.9	14.0	11	41.3	55.2	5000
As (μ g/l)	28.5	54.5	19	126	171	5000
Ba (μ g/l)	99.0	26.6	61	144	163	100,000
Cd (μ g/l)	6.04	2.38	26	10.2	12.1	1000
Cr (μ g/l)	11.3	5.54	37	20.8	24.9	5000
Cu (μ g/l)	36.3	37.7	76	99.5	126	N/A
Hg (μ g/l)	0.52	0.45	39	1.28	1.62	200
Ni (μ g/l)	14.2	4.29	10	22.5	26.9	N/A
Pb (μ g/l)	26.5	38.7	28	93.7	124	5000
Se (μ g/l)	111	149	9	403	566	1000
Tl (μ g/l)						N/A
Zn (μ g/l)	119	89.9	90	270	334	N/A

Guideline - RCRA Characteristic Guidelines
 N/A - not applicable

Table A-35

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=9 (TAN TSF effluent to drainage pond) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	539	56.0	96.8	5.39	6	0	0
	91q2	614	51.5	88.1	19.7	6	0	0
	91q3	611	179	284	125	5	1	0
	91q4	132	147	244	6.07	5	1	0
pH	91q1	7.86	0.36	0.62	0.13	6	0	0
	91q2	8.10	0.31	0.33	0.61	6	0	0
	91q3	7.08	0.02	0.00	0.77	5	1	0
	91q4	7.41	0.14	0.00	0.53	5	1	0
TOC (mg/l)	91q1	4.38	0.43	0.75	0.09	6	0	0
	91q2	7.05	.	.	.	2	0	4
	91q3	6.85	0.25	0.40	0.23	6	0	0
	91q4	5.47	0.43	0.73	0.17	6	0	0
Cl (mg/l)	91q1	48.7	16.6	28.7	0.24	6	0	0
	91q2	43.3	15.9	26.6	0.10	5	1	0
	91q3	58.9	24.2	41.9	0.57	6	0	0
	91q4	33.8	5.74	9.93	0.81	6	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.02	0.20	0.33	0.00	5	1	0
	91q3	0.21	0.01	0.01	0.01	6	0	0
	91q4	0.23	0.01	0.02	0.01	6	0	0
NO3 (mg/l)	91q1	15.5	0.93	1.61	0.08	6	0	0
	91q2	2.85	1.75	2.47	0.00	4	2	0
	91q3	7.46	2.53	4.38	0.33	6	0	0
	91q4	8.39	1.86	3.19	0.55	6	0	0
PO4 (mg/l)	91q1	2.55	0.14	0.24	0.09	6	0	0
	91q2	0.82	.	.	.	1	0	5
	91q3	4.17	0.63	1.07	0.23	6	0	0
	91q4	6.21	1.76	3.00	0.74	6	0	0
SO4 (mg/l)	91q1	35.8	0.62	1.07	0.06	6	0	0
	91q2	39.3	0.53	0.46	1.00	5	1	0
	91q3	35.1	6.17	9.99	5.41	6	0	0
	91q4	38.9	0.77	1.31	0.37	6	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	2.90	.	.	.	1	0	5

Table A-35 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=9 (TAN TSF effluent to drainage pond) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
As (µg/l)	91q1	1.90	0.38	0.63	0.11	5	0	1
	91q2	X	.	.	.	0	0	6
	91q3	3.50	.	.	.	2	0	4
	91q4	4.37	.	.	.	3	0	3
Ba (µg/l)	91q1	67.3	3.32	5.25	3.32	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	105	8.45	14.5	2.92	6	0	0
	91q4	122	19.6	33.7	4.70	6	0	0
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	5.90	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Cr (µg/l)	91q1	7.70	.	.	.	1	0	5
	91q2	6.50	.	.	.	2	0	4
	91q3	8.85	.	.	.	2	0	4
	91q4	14.8	7.87	13.6	0.88	6	0	0
Cu (µg/l)	91q1	16.1	0.73	0.51	1.62	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	8.93	.	.	.	3	0	3
	91q4	20.4	10.2	17.1	6.49	6	0	0
Hg (µg/l)	91q1	0.14	0.00	0.00	0.05	5	0	1
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	0.27	.	.	.	2	0	4
Ni (µg/l)	91q1	22.1	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	13.9	.	.	.	1	0	5
	91q4	18.6	.	.	.	2	0	4
Pb (µg/l)	91q1	3.50	0.58	0.96	0.16	5	0	1
	91q2	3.67	.	.	.	2	0	4
	91q3	4.80	.	.	.	2	0	4
	91q4	19.5	7.22	3.58	16.9	6	0	0
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-35 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=9 (TAN TSF effluent to drainage pond) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	43.6	7.96	9.26	14.4	6	0	0
	91q2	39.3	7.42	12.3	1.50	5	1	0
	91q3	46.6	3.97	0.00	16.3	6	0	0
	91q4	91.0	14.0	23.0	10.7	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-106
Conductivity Stream 10 Concentrations
 RCRA Guideline Not Applicable

Figure A-107
pH Stream 10 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

RCRA Guideline Not Applicable

Figure A-109
CI Stream 10 Concentrations
 RCRA Guideline Not Applicable

Figure A-110
F Stream 10 Concentrations
 RCRA Guideline Not Applicable

Figure A-111
NO3 Stream 10 Concentrations
 RCRA Guideline Not Applicable

RCRA Guideline Not Applicable

Figure A-113

SO4 Stream 10 Concentrations

RCRA Guideline Not Applicable

Figure A-114
Ag Stream 10 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-115
As Stream 10 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-116
Ba Stream 10 Concentrations
 RCRA Characteristic Guideline = 100000 $\mu\text{g/l}$

Figure A-117
Cd Stream 10 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-118
Cr Stream 10 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-119
Cu Stream 10 Concentrations
 RCRA Guideline Not Applicable

Figure A-120
Hg Stream 10 Concentrations
 RCRA Characteristic Guideline = 200 $\mu\text{g/l}$

RCRA Guideline Not Applicable

Figure A-122
Pb Stream 10 Concentrations
 RCFA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-123
Se Stream 10 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-124
Zn Stream 10 Concentrations
 RCRA Guideline Not Applicable

Table A-36

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=10 (CTF effluent to liquid disposal pond) QUARTER=91q1 -

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	391	6.97	X	16.8	0.51	3.40	X
Oct	2	393	6.94	X	16.6	X	3.30	X
Nov	1	415	8.00	X	17.4	X	2.60	0.14
Nov	2	402	7.97	X	17.6	X	2.60	X
Dec	1	432	8.51	X	17.0	X	2.80	0.13
Dec	2	407	8.13	X	17.1	X	2.80	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	34.8	X	1.20	50.9	X	X	12.0
Oct	2	35.1	X	2.00	54.1	X	X	14.5
Nov	1	34.5	23.2	1.70	55.0	X	X	8.70
Nov	2	34.5	X	1.50	53.9	X	X	X
Dec	1	34.0	X	2.50	57.9	X	X	9.20
Dec	2	34.4	X	2.50	55.9	X	X	8.10

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	X	X	X	X	X	8.70
Oct	2	X	20.4	X	X	X	14.8
Nov	1	X	X	X	X	X	22.8
Nov	2	X	X	X	X	X	22.3
Dec	1	X	15.1	X	X	X	25.0
Dec	2	X	X	X	X	X	14.8

'.' - missing

'X' - below practical quantitation level

Table A-37

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=10 (CTF effluent to liquid disposal pond) QUARTER=91q2 -

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	348	8.39	5.30	19.1	0.20	X	X
Jan	2	416	7.78	5.50	18.8	0.20	X	X
Feb	1	417	8.24	7.80	57.7	0.20	4.00	X
Feb	2	420	8.14	3.50	72.7	0.20	4.00	X
Mar	1	492	7.16	X	16.0	X	X	0.03
Mar	2	412	8.05	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	40.1	X	X	X	X	X	X
Jan	2	40.0	X	X	X	X	X	X
Feb	1	49.7	X	X	X	X	X	10.3
Feb	2	49.8	X	X	X	X	X	X
Mar	1	34.0	X	X	X	X	X	X
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	X
Jan	2	X	X	X	X	X	X
Feb	1	X	X	X	X	X	126
Feb	2	X	X	X	X	X	75.6
Mar	1	X	X	X	X	X	60.0
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-38

FY91 ENVIRONMENTAL MONITORING DATA

- STREAM=10 (CTF effluent to liquid disposal pond) QUARTER=91q3 -

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	614	7.31	2.20	16.4	0.24	1.69	0.13
Apr	2	X	X	2.89	16.4	0.27	1.71	0.14
May	1	666	7.55	0.79	17.1	0.23	1.64	0.06
May	2	423	7.89	0.86	17.0	0.21	1.62	0.06

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	34.0	X	X	79.6	X	11.7	X
Apr	2	34.2	X	X	77.0	X	8.40	X
May	1	33.3	X	3.50	77.9	X	X	X
May	2	33.4	X	3.00	77.9	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	X	X	X	6.80
Apr	2	X	X	X	X	X	7.90
May	1	X	X	X	X	X	12.9
May	2	X	X	X	X	X	10.3

'.' - missing

'X' - below practical quantitation level

Table A-39

SUMMARY STATISTICS

STREAM=10 (CTF effluent to liquid disposal pond)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	395	22.7	92	433	449	N/A
pH	7.79	0.46	89	l 6.88 u 8.71	l 6.58 u 9.00	l 6.5 u 8.5
TOC (mg/l)	3.04	3.99	25	9.99	13.2	N/A
Cl (mg/l)	16.5	4.06	88	23.2	26.1	N/A
F (mg/l)	0.28	0.18	38	0.59	0.73	N/A
NO3 (mg/l)	3.42	1.17	87	5.38	6.22	N/A
PO4 (mg/l)	0.77	0.82	29	2.19	2.83	N/A
SO4 (mg/l)	35.0	3.86	88	41.4	44.2	N/A
Ag (μ g/l)	7.25	1.95	12	10.9	12.8	5000
As (μ g/l)	37.4	81.3	19	182	250	5000
Ba (μ g/l)	79.9	31.6	61	133	156	100,000
Cd (μ g/l)	6.16	4.10	11	13.9	18.0	1000
Cr (μ g/l)	8.96	4.18	24	16.3	19.6	5000
Cu (μ g/l)	24.7	21.2	35	61.1	77.3	N/A
Hg (μ g/l)	0.47	0.45	21	1.26	1.62	200
Ni (μ g/l)	51.6	76.7	9	202	286	N/A
Pb (μ g/l)	23.3	23.5	21	64.8	84.1	5000
Se (μ g/l)	130	186	13	473	646	1000
Tl (μ g/l)						N/A
Zn (μ g/l)	35.1	27.0	46	80.9	101	N/A

Guideline - RCRA Characteristic Guidelines
 N/A - not applicable

Table A-40

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=10 (CTF effluent to liquid disposal pond) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	407	7.99	11.2	11.5	6	0	0
	91q2	418	20.2	17.5	42.9	6	0	0
	91q3	568	.	.	.	3	0	3
pH	91q1	7.75	0.41	0.70	0.16	6	0	0
	91q2	7.96	0.18	0.00	0.44	6	0	0
	91q3	7.58	.	.	.	3	0	3
TOC (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	5.53	0.13	0.00	2.15	4	2	0
	91q3	1.68	0.86	1.19	0.35	4	0	0
Cl (mg/l)	91q1	17.1	0.23	0.39	0.12	6	0	0
	91q2	36.9	17.3	28.3	7.50	5	1	0
	91q3	16.7	0.33	0.46	0.05	4	0	0
F (mg/l)	91q1	0.51	.	.	.	1	0	5
	91q2	0.06	0.21	0.35	0.00	5	1	0
	91q3	0.24	0.02	0.02	0.02	4	0	0
NO3 (mg/l)	91q1	2.92	0.22	0.38	0.04	6	0	0
	91q2	4.00	.	.	.	2	0	4
	91q3	1.66	0.03	0.05	0.01	4	0	0
PO4 (mg/l)	91q1	0.13	.	.	.	2	0	4
	91q2	0.03	.	.	.	1	0	5
	91q3	0.10	0.04	0.05	0.01	4	0	0
SO4 (mg/l)	91q1	34.5	0.22	0.35	0.20	6	0	0
	91q2	42.7	4.61	7.69	0.07	5	1	0
	91q3	33.7	0.37	0.52	0.11	4	0	0
Ag (μ g/l)	91q1	23.2	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
As (μ g/l)	91q1	1.92	0.29	0.45	0.33	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	3.25	.	.	.	2	0	4
Ba (μ g/l)	91q1	54.6	1.27	1.89	1.60	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	78.1	0.20	0.00	1.30	4	0	0
Cd (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6

Table A-40 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=10 (CTF effluent to liquid disposal pond) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cr (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	10.1	.	.	.	2	0	4
Cu (µg/l)	91q1	10.5	1.67	2.59	1.37	5	0	1
	91q2	10.3	.	.	.	1	0	5
	91q3	X	.	.	.	0	0	6
Hg (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
Ni (µg/l)	91q1	17.8	.	.	.	2	0	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
Pb (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
Zn (µg/l)	91q1	18.1	3.25	4.46	4.86	6	0	0
	91q2	87.2	.	.	.	3	0	3
	91q3	9.48	2.12	2.83	1.41	4	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-125
Conductivity Stream 13 Concentrations
RCRA Guidelines Not Applicable

Figure A-126
pH Stream 13 Concentrations
 RCRA Characteristic Guideline - 2 to 12.5

Figure A-127
TDS Stream 13 Concentrations
 RCRA Guideline Not Applicable

Figure A-128
TOC Stream 13 Concentrations
 RCRA Guideline Not Applicable

RCRA Guideline Not Applicable

Figure A-130
Cl Stream 13 Concentrations
 RCRA Guideline Not Applicable

Figure A-131
F Stream 13 Concentrations
 RCRA Guideline Not Applicable

PCRA Guideline Not Applicable

PCRA Guidelines Not Applicable

Figure A-134
SO4 Stream 13 Concentrations
 RCRA Guideline Not Applicable

Figure A-135
Ag Stream 13 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-136
As Stream 13 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-137
Ba Stream 13 Concentrations
 RCRA Characteristic Guideline = 100,000 $\mu\text{g/l}$

Figure A-138
Cd Stream 13 Concentrations
 RCRA Characteristic Guideline = 1000 µg/l

Figure A-139
Cr Stream 13 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-140
Cu Stream 13 Concentrations
 RCRA Guideline Not Applicable

Figure A-141
Hg Stream 13 Concentrations
 RCRA Characteristic Guideline = 200 $\mu\text{g/l}$

Figure A-142
Ni Stream 13 Concentrations
 RCRA Guideline Not Applicable

Figure A-143
Pb Stream 13 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-144
Se Stream 13 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-145
Zn Stream 13 Concentrations
 RCRA Guideline Not Applicable

Table A-41

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=13 (CFA effluent from CLRF) QUARTER=91q1 -----

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	770	8.04	425	60.4	86.0	X	11.4	0.54
Oct	2	877	8.14	410	60.5	84.0	X	11.2	0.52
Nov	1	X	X	579	183	96.8	0.67	11.6	1.00
Nov	2	X	X	553	184	94.9	0.67	11.7	1.00
Dec	1	1270	9.57	602	320	97.0	3.10	13.7	1.10
Dec	2	1170	9.67	931	187	102	2.90	14.9	1.10

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	84.3	X	2.30	X	X	19.9	36.3
Oct	2	82.6	X	2.20	X	10.1	18.0	29.2
Nov	1	137	X	4.10	88.2	12.2	18.3	52.3
Nov	2	135	X	3.80	X	9.30	15.4	38.5
Dec	1	98.9	X	5.40	11.7	X	57.6	149
Dec	2	105	X	4.80	36.1	X	45.0	140

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.17	X	13.5	X	X	74.6
Oct	2	0.22	X	13.9	X	X	64.6
Nov	1	0.13	23.2	32.4	X	X	205
Nov	2	0.12	X	31.5	X	X	196
Dec	1	X	33.7	26.9	X	X	162
Dec	2	0.28	37.7	21.8	X	X	150

'.' - missing

'X' - below practical quantitation level

Table A-42

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=13 (CFA effluent from CLRF) QUARTER=91q2 -----

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	1400	8.98	925	56.0	104	0.20	4.00	X
Jan	2	1380	8.96	938	48.5	104	0.20	4.00	X
Feb	1	1210	9.27	875	88.0	95.6	0.20	3.90	X
Feb	2	1490	9.25	886	88.0	92.9	0.20	4.20	X
Mar	1	1790	8.80	1170	X	110	X	X	66.4
Mar	2	1610	8.86	X	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	217	X	X	X	X	15.1	41.1
Jan	2	217	X	X	X	X	13.5	42.4
Feb	1	129	X	X	X	X	15.6	26.0
Feb	2	127	X	X	X	X	15.5	35.1
Mar	1	350	X	X	7.00	X	20.0	50.0
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	15.4	X	X	143
Jan	2	X	X	17.0	X	X	158
Feb	1	X	X	19.3	X	X	140
Feb	2	X	X	18.2	X	X	138
Mar	1	X	X	98.0	X	X	210
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-43

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=13 (CFA effluent from CLRF) QUARTER=91q3 -----

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	1260	14.00	955	95.8	108	0.27	4.72	62.1
Apr	2	1250	14.00	939	97.6	112	0.23	4.76	59.1
May	1	1360	9.48	771	138	100	0.25	6.13	84.5
May	2	990	9.25	715	106	99.2	0.20	6.60	41.6
Jun	1	990	8.45	664	102	96.6	0.19	7.04	23.8
Jun	2	971	8.43	706	105	98.2	0.19	7.15	24.2

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	219	X	5.40	11.0	X	9.10	161
Apr	2	221	X	6.40	9.95	X	10.4	160
May	1	113	X	5.80	14.5	6.50	17.5	28.3
May	2	123	X	4.80	9.70	X	20.6	27.9
Jun	1	125	X	X	15.7	X	9.30	19.4
Jun	2	127	X	X	16.7	X	14.9	27.4

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	30.7	X	X	246
Apr	2	X	X	38.0	X	X	242
May	1	0.25	X	99.8	X	X	161
May	2	X	X	89.5	X	X	144
Jun	1	X	X	4.00	4.30	X	27.7
Jun	2	X	X	4.00	5.20	X	29.4

'.' - missing

'X' - below practical quantitation level

Table A-44

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=13 (CFA effluent from CLRF) QUARTER=91q4 -----

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	930	9.28	910	182	108	0.22	7.00	189
Jul	2	970	9.26	1050	176	101	0.19	6.73	67.3
Aug	1	X	X	511	33.5	92.0	0.19	6.55	35.5
Aug	2	X	X	517	30.9	88.7	0.17	6.58	45.2

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	154	X	7.90	16.8	X	21.0	34.3
Jul	2	103	2.30	16.0	22.0	12.8	23.9	112
Aug	1	79.3	X	4.80	22.2	X	22.5	16.9
Aug	2	74.8	X	5.10	23.6	X	18.2	17.0

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	61.0	9.60	X	250
Jul	2	X	X	220	8.40	X	740
Aug	1	X	X	15.2	X	X	102
Aug	2	X	X	15.4	X	X	105

'.' - missing

'X' - below practical quantitation level

Table A-45

SUMMARY STATISTICS

STREAM=13 (CFA effluent from CLRF)

ANALYTE	FY87-FY90		N	LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD				
Cond (μ S)	1040	292	94	1530	1740	N/A
pH	9.03	0.46	93	l 8.11 u 9.94	l 7.82 u 10.2	l 6.5 u 8.5
TDS (mg/l)	649	226	86	1030	1190	N/A
TOC (mg/l)	131	85.4	53	275	338	N/A
TSS (mg/l)	105	176	14	428	588	N/A
Cl (mg/l)	92.8	32.6	91	147	170	N/A
F (mg/l)	1.59	1.35	41	3.89	4.90	N/A
NO3 (mg/l)	13.0	3.53	78	18.9	21.4	N/A
PO4 (mg/l)	1.58	1.35	64	3.85	4.82	N/A
SO4 (mg/l)	82.5	37.9	86	146	173	N/A
Ag (μ g/l)	18.9	12.4	9	43.2	56.8	5000
As (μ g/l)	40.7	93.4	18	208	287	5000
Ba (μ g/l)	51.3	38.1	29	117	147	100,000
Cd (μ g/l)	13.3	8.56	43	27.8	34.2	1000
Cr (μ g/l)	42.1	32.4	74	96.4	120	5000
Cu (μ g/l)	80.6	44.9	85	156	188	N/A
Hg (μ g/l)	0.43	0.37	51	1.06	1.34	200
Ni (μ g/l)	38.0	30.2	29	90.2	114	N/A
Pb (μ g/l)	80.6	92.9	48	238	307	5000
Se (μ g/l)	174	151	9	470	635	1000
Tl (μ g/l)						N/A
Zn (μ g/l)	278	201	91	614	757	N/A

Guideline - RCRA Characteristic Guidelines
 N/A - not applicable

Table A-46

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=13 (CFA effluent from CLRF) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	1022	198	276	73.2	4	2	0
	91q2	1480	111	166	136	6	0	0
	91q3	1137	81.5	92.1	151	6	0	0
	91q4	950	.	.	.	2	0	4
pH	91q1	8.86	0.77	1.08	0.07	4	2	0
	91q2	9.02	0.13	0.22	0.03	6	0	0
	91q3	10.6	1.72	2.98	0.09	6	0	0
	91q4	9.27	.	.	.	2	0	4
TDS (mg/l)	91q1	583	101	147	135	6	0	0
	91q2	959	81.0	135	8.51	5	1	0
	91q3	792	79.5	136	29.3	6	0	0
	91q4	747	233	326	70.1	4	0	0
TOC (mg/l)	91q1	166	56.4	89.9	54.3	6	0	0
	91q2	70.1	17.9	25.1	3.75	4	2	0
	91q3	107	7.56	9.22	13.1	6	0	0
	91q4	106	73.4	104	3.27	4	0	0
TSS (mg/l)	91q1	26.9	2.37	3.34	0.56	4	2	0
	91q2	27.6	7.67	11.9	6.10	5	1	0
	91q3	22.2	7.60	12.0	7.76	6	0	0
	91q4	19.8	3.75	3.67	5.41	4	0	0
Cl (mg/l)	91q1	93.5	4.35	7.36	2.33	6	0	0
	91q2	101	4.61	7.62	1.35	5	1	0
	91q3	102	3.89	6.61	1.79	6	0	0
	91q4	97.4	7.08	9.62	3.87	4	0	0
F (mg/l)	91q1	1.83	1.16	1.65	0.10	4	0	2
	91q2	0.06	0.21	0.35	0.00	5	1	0
	91q3	0.22	0.02	0.02	0.03	6	0	0
	91q4	0.19	0.01	0.01	0.02	4	0	0
NO3 (mg/l)	91q1	12.4	0.95	1.60	0.50	6	0	0
	91q2	4.03	0.03	0.00	0.15	4	2	0
	91q3	6.07	0.70	1.20	0.20	6	0	0
	91q4	6.71	0.15	0.19	0.13	4	0	0
PO4 (mg/l)	91q1	0.88	0.18	0.30	0.01	6	0	0
	91q2	66.4	.	.	.	1	0	5
	91q3	49.2	12.6	18.0	17.5	6	0	0
	91q4	84.3	43.9	44.6	61.1	4	0	0
SO4 (mg/l)	91q1	107	15.4	26.6	2.71	6	0	0
	91q2	208	61.0	102	1.00	5	1	0
	91q3	155	32.7	56.6	4.24	6	0	0
	91q4	103	25.7	31.6	25.6	4	0	0

Table A-46 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=13 (CFA effluent from CLRF) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Ag (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	2.30	.	.	.	1	0	5
As (µg/l)	91q1	3.77	0.83	1.42	0.28	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	2.73	2.87	4.96	0.58	6	0	0
	91q4	8.45	3.50	4.04	4.05	4	0	0
Ba (µg/l)	91q1	45.3	.	.	.	3	0	3
	91q2	7.00	.	.	.	1	0	5
	91q3	12.9	1.70	2.57	2.05	6	0	0
	91q4	21.1	1.75	1.58	2.69	4	0	0
Cd (µg/l)	91q1	10.5	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	6.50	.	.	.	1	0	5
	91q4	12.8	.	.	.	1	0	5
Cr (µg/l)	91q1	29.0	11.1	18.9	5.34	6	0	0
	91q2	15.9	1.57	2.55	0.80	5	1	0
	91q3	13.6	2.79	4.45	2.67	6	0	0
	91q4	21.4	1.05	0.00	2.59	4	0	0
Cu (µg/l)	91q1	74.2	35.3	61.0	7.32	6	0	0
	91q2	38.9	5.55	8.60	4.60	5	1	0
	91q3	70.7	44.9	77.8	3.30	6	0	0
	91q4	45.0	28.1	28.7	38.9	4	0	0
Hg (µg/l)	91q1	0.18	0.04	0.07	0.03	5	0	1
	91q2	X	.	.	.	0	0	6
	91q3	0.25	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Ni (µg/l)	91q1	31.5	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Pb (µg/l)	91q1	23.3	5.29	9.04	2.12	6	0	0
	91q2	33.6	24.2	40.3	0.97	5	1	0
	91q3	44.3	26.6	46.0	5.15	6	0	0
	91q4	77.9	62.6	68.4	79.5	4	0	0

Table A-46 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=13 (CFA effluent from CLRF) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	4.75	.	.	.	2	0	4
	91q4	9.00	.	.	.	2	0	4
Tl (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	142	38.4	66.4	7.36	6	0	0
	91q2	158	19.9	32.7	7.57	5	1	0
	91q3	142	62.4	108	7.16	6	0	0
	91q4	299	196	216	245	4	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-146
Conductivity Stream 14 Concentrations
 RCRA Guideline Not Applicable

Figure A-147
pH Stream 14 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

PCRA Guideline Not Applicable

Figure A-149
CI Stream 14 Concentrations
 RCRA Guideline Not Applicable

Figure A-150

F Stream 14 Concentrations

RCRA Guideline Not Applicable

Figure A-151
NO₃ Stream 14 Concentrations
 RCRA Guideline Not Applicable

Figure A-152
PO4 Stream 14 Concentrations
RCRA Guideline Not Applicable

Figure A-153
SO4 Stream 14 Concentrations
 RCRA Guideline Not Applicable

Figure A-154
Ag Stream 14 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-155
As Stream 14 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-156
Ba Stream 14 Concentrations
 RCRA Characteristic Guideline = 100000 µg/l

Figure A-157
Cd Stream 14 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-158
Cr Stream 14 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-159

Cu Stream 14 Concentrations

RCRA Guideline Not Applicable

Figure A-160
Hg Stream 14 Concentrations
 RCRA Characteristic Guideline = 200 µg/l

Figure A-161
NI Stream 14 Concentrations
 RCRA Guideline Not Applicable

The figure is a scatter plot with a line graph showing Lead (Pb) concentration in micrograms per liter (ug/l) over time. The y-axis ranges from 0 to 150 ug/l in increments of 10. The x-axis represents time, with labels for years 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, and 2000. Data points are plotted for two levels: Level 1 (marked with 'X' and 'Δ') and Level 2 (marked with '*'). A solid line represents the Mean, and a dashed line represents Level 2. The data shows a significant peak in Pb concentration around 1990, reaching approximately 145 ug/l. The concentration then decreases and remains relatively stable between 1995 and 2000.

Year	Level 1 (ug/l)	Level 2 (ug/l)	Mean (ug/l)
1989	145	145	145
1990	145	145	145
1991	145	145	145
1992	145	145	145
1993	145	145	145
1994	145	145	145
1995	145	145	145
1996	145	145	145
1997	145	145	145
1998	145	145	145
1999	145	145	145
2000	145	145	145

Figure A-163
Se Stream 14 Concentrations
 RCRA Characteristic Guideline = 1000 $\mu\text{g/l}$

Figure A-164

Zn Stream 14 Concentrations

RCRA Guideline Not Applicable

Table A-47

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=14 (CFA STP effluent to drain field) QUARTER=91q1 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	901	7.34	18.0	181	X	X	2.90
Oct	2	971	7.04	17.9	182	X	8.40	6.10
Nov	1	X	X	7.70	182	X	8.90	3.00
Nov	2	X	X	7.20	173	X	8.90	3.00
Dec	1	1650	9.46	19.4	368	X	12.9	3.10
Dec	2	1540	8.79	33.0	358	X	12.9	3.40

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	54.1	X	1.20	35.2	5.90	8.90	18.1
Oct	2	54.5	X	1.50	39.0	X	10.7	18.2
Nov	1	42.1	X	1.10	55.8	X	X	9.30
Nov	2	41.7	X	X	56.4	X	6.30	6.80
Dec	1	47.7	X	2.00	52.9	X	10.6	14.4
Dec	2	48.0	X	2.20	56.0	X	8.10	16.1

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.29	X	7.10	X	X	67.6
Oct	2	0.32	X	5.90	X	X	64.4
Nov	1	0.14	X	5.30	X	X	38.6
Nov	2	0.12	X	5.20	X	X	30.0
Dec	1	X	17.5	4.50	X	X	46.9
Dec	2	X	17.3	3.20	X	0.66	46.1

'.' - missing

'X' - below practical quantitation level

Table A-48

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=14 (CFA STP effluent to drain field) QUARTER=91q2 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	1180	8.00	7.40	212	0.20	4.00	X
Jan	2	1090	7.76	7.00	224	0.20	3.60	X
Feb	1	2040	8.40	27.7	433	0.20	2.00	3.31
Feb	2	2040	8.18	31.1	442	0.20	1.90	3.83
Mar	1	1740	6.69	X	300	X	X	4.85
Mar	2	1460	7.95	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	54.3	X	X	X	X	8.20	12.0
Jan	2	54.2	X	X	X	X	7.70	11.5
Feb	1	58.2	X	X	X	X	9.00	25.1
Feb	2	60.3	X	X	X	X	10.3	26.0
Mar	1	56.0	X	X	7.00	X	X	20.0
Mar	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	7.60	X	X	77.0
Jan	2	X	X	3.40	X	X	88.1
Feb	1	X	X	10.4	X	X	104
Feb	2	X	X	10.2	X	X	104
Mar	1	X	X	9.00	X	X	90.0
Mar	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-49

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=14 (CFA STP effluent to drain field) QUARTER=91q3 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Apr	1	1140	6.08	6.12	206	0.24	7.86	4.34
Apr	2	99	9.78	5.97	202	0.24	7.84	4.56
May	1	1640	6.30	26.3	256	0.25	3.76	10.5
May	2	1180	7.74	16.5	231	0.24	4.07	11.4
Jun	1	1220	7.02	9.66	230	0.20	4.47	7.19
Jun	2	1210	7.66	8.23	283	0.20	4.43	7.96

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Apr	1	40.2	X	X	66.9	X	X	X
Apr	2	41.0	X	X	67.9	X	X	X
May	1	56.3	X	X	65.2	X	7.80	10.8
May	2	49.3	X	X	64.4	X	6.60	10.0
Jun	1	55.6	X	X	84.6	X	10.6	13.6
Jun	2	48.0	X	X	84.8	X	10.6	10.2

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	X	X	X	X	28.6
Apr	2	X	X	X	X	X	32.1
May	1	X	X	9.20	5.20	X	71.6
May	2	X	X	5.70	X	X	69.2
Jun	1	X	X	4.20	5.60	2.30	41.5
Jun	2	X	X	3.80	5.00	X	39.4

'.' - missing

'X' - below practical quantitation level

Table A-50

FY91 ENVIRONMENTAL MONITORING DATA

--- STREAM=14 (CFA STP effluent to drain field) QUARTER=91q4 ---

MONTH	REP	Cond (μ S)	pH	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	840.0	8.00	5.66	182	0.23	6.75	9.76
Jul	2	906.0	8.04	5.46	168	0.22	6.91	9.09
Aug	1	1110.0	7.60	10.4	256	0.21	9.01	10.3
Aug	2	1030.0	7.79	10.3	258	0.20	10.0	X
Sep	1	61.1	7.81	4.76	178	X	16.3	4.16
Sep	2	62.2	8.15	5.55	201	0.19	7.62	6.92

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	43.3	X	X	73.2	X	12.5	15.9
Jul	2	43.0	2.10	3.50	70.2	X	12.8	15.9
Aug	1	52.6	X	3.40	76.8	X	13.3	15.7
Aug	2	53.2	X	X	79.2	X	21.9	8.20
Sep	1	33.1	X	X	68.2	X	23.8	4.50
Sep	2	40.5	X	2.40	67.4	X	24.4	4.50

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	X	4.20	X	X	44.6
Jul	2	X	X	4.60	4.80	X	41.7
Aug	1	X	X	7.20	X	X	53.9
Aug	2	X	X	13.0	3.10	X	53.6
Sep	1	X	14.0	3.50	X	X	27.6
Sep	2	0.21	X	3.00	X	X	30.7

'.' - missing

'X' - below practical quantitation level

Table A-51

SUMMARY STATISTICS

STREAM=14 (CFA STP effluent to drain field)

ANALYTE	FY87-FY90 MEAN	STD	N	LEVEL1	LEVEL2	GUIDELINE
Cond (μ S)	952	260	94	1390	1570	N/A
pH	7.52	0.33	96	l 6.85 u 8.19	l 6.63 u 8.40	l 6.5 u 8.5
TOC (mg/l)	15.0	13.3	52	37.5	47.3	N/A
Cl (mg/l)	199	67.6	94	312	360	N/A
F (mg/l)	0.57	0.61	27	1.63	2.11	N/A
NO3 (mg/l)	18.4	8.38	89	32.5	38.4	N/A
PO4 (mg/l)	5.06	4.81	88	13.1	16.5	N/A
SO4 (mg/l)	46.6	10.1	94	63.5	70.6	N/A
Ag (μ g/l)	9.18	4.37	11	17.5	21.8	5000
As (μ g/l)	54.1	105	11	253	357	5000
Ba (μ g/l)	68.4	15.5	60	94.5	106	100,000
Cd (μ g/l)	6.34	1.84	11	9.82	11.7	1000
Cr (μ g/l)	11.4	3.98	47	18.2	21.1	5000
Cu (μ g/l)	23.5	11.8	56	43.4	52.0	N/A
Hg (μ g/l)	0.29	0.18	38	0.60	0.73	200
Ni (μ g/l)	17.2	10.6	12	37.0	47.1	N/A
Pb (μ g/l)	23.6	36.2	39	85.5	113	5000
Se (μ g/l)						1000
Tl (μ g/l)						N/A
Zn (μ g/l)	70.5	31.4	93	123	145	N/A

Guideline - RCRA Characteristic Guidelines
 N/A - not applicable

Table A-52

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=14 (CFA STP effluent to drain field) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	1266	330	464	65.2	4	2	0
	91q2	1592	261	445	120	6	0	0
	91q3	1082	238	248	465	6	0	0
	91q4	668	309	534	42.7	6	0	0
pH	91q1	8.16	0.97	1.34	0.37	4	2	0
	91q2	7.83	0.28	0.31	0.53	6	0	0
	91q3	7.43	0.27	0.00	1.64	6	0	0
	91q4	7.90	0.10	0.14	0.16	6	0	0
TOC (mg/l)	91q1	17.2	5.43	8.54	5.56	6	0	0
	91q2	18.3	11.1	15.7	1.71	4	2	0
	91q3	12.1	4.71	7.64	4.04	6	0	0
	91q4	7.02	1.67	2.88	0.33	6	0	0
Cl (mg/l)	91q1	241	61.2	106	5.51	6	0	0
	91q2	322	74.1	123	7.50	5	1	0
	91q3	235	15.8	21.4	24.0	6	0	0
	91q4	207	25.3	43.1	11.0	6	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.06	0.21	0.35	0.00	5	1	0
	91q3	0.23	0.01	0.02	0.00	6	0	0
	91q4	0.04	0.17	0.09	0.40	6	0	0
NO3 (mg/l)	91q1	10.4	1.54	2.56	0.00	5	0	1
	91q2	2.87	0.93	1.30	0.21	4	2	0
	91q3	5.41	1.23	2.13	0.13	6	0	0
	91q4	9.44	1.48	0.47	3.57	6	0	0
PO4 (mg/l)	91q1	3.58	0.46	0.00	1.31	6	0	0
	91q2	4.00	.	.	.	3	0	3
	91q3	7.67	1.89	3.25	0.49	6	0	0
	91q4	8.05	1.54	2.34	1.42	5	1	0
SO4 (mg/l)	91q1	48.0	3.58	6.20	0.26	6	0	0
	91q2	56.6	1.68	2.69	1.05	5	1	0
	91q3	48.4	3.91	6.08	4.23	6	0	0
	91q4	44.3	4.68	7.82	3.03	6	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	2.10	.	.	.	1	0	5

Table A-52 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=14 (CFA STP effluent to drain field) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
As (μg/l)	91q1	1.60	0.31	0.50	0.18	5	0	1
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	3.10	.	.	.	3	0	3
Ba (μg/l)	91q1	49.2	6.08	10.4	2.02	6	0	0
	91q2	7.00	.	.	.	1	0	5
	91q3	72.3	6.25	10.8	0.53	6	0	0
	91q4	72.5	2.97	5.02	1.60	6	0	0
Cd (μg/l)	91q1	5.90	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cr (μg/l)	91q1	8.92	0.96	1.12	1.54	5	0	1
	91q2	5.04	5.67	9.43	0.70	5	1	0
	91q3	3.93	5.06	8.76	0.49	6	0	0
	91q4	18.1	3.32	5.17	3.52	6	0	0
Cu (μg/l)	91q1	13.8	3.00	5.13	1.23	6	0	0
	91q2	18.9	4.65	7.73	0.51	5	1	0
	91q3	5.77	5.40	9.30	1.43	6	0	0
	91q4	10.8	3.34	5.37	3.06	6	0	0
Hg (μg/l)	91q1	0.22	0.09	0.12	0.02	4	0	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	0.21	.	.	.	1	0	5
Ni (μg/l)	91q1	17.4	.	.	.	2	0	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	14.0	.	.	.	1	0	5
Pb (μg/l)	91q1	5.20	0.77	1.22	0.72	6	0	0
	91q2	8.12	1.61	2.18	2.10	5	1	0
	91q3	3.15	2.76	4.67	1.44	6	0	0
	91q4	5.92	2.12	3.26	2.38	6	0	0
Se (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	5.27	.	.	.	3	0	3
	91q4	3.95	.	.	.	2	0	4

Table A-52 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=14 (CFA STP effluent to drain field) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Tl (µg/l)	91q1	0.66	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	2.30	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	48.9	9.23	15.8	3.76	6	0	0
	91q2	92.6	7.21	11.3	5.55	5	1	0
	91q3	47.1	12.0	20.8	1.93	6	0	0
	91q4	42.0	7.12	12.3	1.74	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-165
Conductivity Stream 15 Concentrations
 RCRA Guideline Not Applicable

Figure A-166
pH Stream 15 Concentrations
 RCRA Characteristic Guideline = 2 to 12.5

Figure A-167
TDS Stream 15 Concentrations
 RCRA Guideline Not Applicable

RCRA Guideline Not Applicable

Figure A-169
Cl Stream 15 Concentrations
 RCRA Guideline Not Applicable

Figure A-170
F Stream 15 Concentrations
 RCRA Guideline Not Applicable

Figure A-171

NO3 Stream 15 Concentrations

RCRA Guideline Not Applicable

Figure A-172

PO4 Stream 15 Concentrations

RCRA Guideline Not Applicable

Figure A-173
SO4 Stream 15 Concentrations
 RCRA Guideline Not Applicable

Figure A-174
Ag Stream 15 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-175
As Stream 15 Concentrations
 RCRA Characteristic Guideline = 5000 $\mu\text{g/l}$

Figure A-176
Ba Stream 15 Concentrations
 RCRA Characteristic Guideline = 100000 $\mu\text{g/l}$

Figure A-177
Cd Stream 15 Concentrations
 RCRA Characteristic Guideline = 1000 µg/l

Figure A-178
Cr Stream 15 Concentrations
 RCRA Characteristic Guideline = 5000 µg/l

Figure A-179
Cu Stream 15 Concentrations
 RCRA Guideline Not Applicable

Figure A-180
Hg Stream 15 Concentrations
 RCRA Characteristic Guideline = 200 µg/l

Figure A-181
NI Stream 15 Concentrations
 RCRA Guidelines Not Applicable

Figure A-183
Zn Stream 15 Concentrations
RCRA Guideline Not Applicable

Table A-53

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=15 (CFA oil/water separator effluent) QUARTER=91q1 ---

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Oct	1	X	X	611	167	82.4	X	X	1.50
Oct	2	805	7.74	600	176	83.9	X	X	1.60
Nov	1	X	X	468	95.2	93.3	X	6.20	0.27
Nov	2	X	X	429	95.8	89.5	X	6.60	0.19
Dec	1	X	X	X	X	X	X	X	X
Dec	2	X	X	X	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Oct	1	47.1	X	2.30	170	14.5	109	77.7
Oct	2	47.0	X	2.80	180	15.8	116	78.8
Nov	1	44.7	X	1.90	144	10.1	298	106
Nov	2	44.7	X	2.20	146	10.4	328	103
Dec	1	X	X	X	X	X	X	X
Dec	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	0.55	24.0	48.8	X	X	1780
Oct	2	0.45	46.4	148	X	X	1930
Nov	1	0.10	113	103	X	0.77	1240
Nov	2	0.10	118	109	X	X	1390
Dec	1	X	X	X	X	X	X
Dec	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-54

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=15 (CFA oil/water separator effluent) QUARTER=91q2 ---

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jan	1	1250	7.75	X	X	X	X	X	X
Jan	2	X	X	X	X	X	X	X	X
Feb	1	X	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X	X

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jan	1	X	X	X	X	X	X	X
Jan	2	X	X	X	X	X	X	X
Feb	1	X	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X	X

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	X	X
Jan	2	X	X	X	X	X	X
Feb	1	X	X	X	X	X	X
Feb	2	X	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-55

-- STREAM=15 (CFA oil/water separator effluent) QUARTER=91q3 ---

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jun	1	960	8.69	1250	372	105	0.28	X	126
Jun	2	940	8.79	1120	356	98.0	0.27	X	122

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jun	1	46.4	X	X	201	8.20	99.5	243
Jun	2	43.1	X	X	198	X	95.2	230

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jun	1	X	94.4	164	3.10	X	4250
Jun	2	X	88.9	186	X	2.00	3870

'' - missing

'X' - below practical quantitation level

Table A-56

FY91 ENVIRONMENTAL MONITORING DATA

-- STREAM=15 (CFA oil/water separator effluent) QUARTER=91q4 ---

MONTH	REP	Cond (μ S)	pH	TDS (mg/l)	TOC (mg/l)	Cl (mg/l)	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)
Jul	1	723.0	7.93	418	28.8	86.6	0.18	4.03	3.46
Jul	2	692.0	7.96	410	28.3	87.6	0.19	4.14	3.15
Aug	1	X	X	X	44.3	128	0.20	X	7.10
Aug	2	X	X	X	49.9	123	0.20	X	8.05
Sep	1	77.3	8.28	X	194	199	0.35	X	85.7
Sep	2	77.7	8.49	X	206	205	0.36	X	83.8

MONTH	REP	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	Cu (μ g/l)
Jul	1	44.9	X	X	91.9	14.3	106	182
Jul	2	44.2	X	X	89.0	8.80	91.4	156
Aug	1	40.4	X	3.40	138	X	29.0	34.5
Aug	2	39.6	X	X	136	6.00	29.5	36.4
Sep	1	32.6	X	8.60	201	56.5	75.6	130
Sep	2	34.1	X	8.30	217	64.8	82.0	137

MONTH	REP	Hg (μ g/l)	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	59.4	57.8	4.00	X	832
Jul	2	X	60.6	51.0	4.00	X	717
Aug	1	X	17.1	81.7	X	X	398
Aug	2	X	10.3	75.6	X	X	395
Sep	1	0.21	64.8	230	X	X	1660
Sep	2	X	59.8	245	X	X	1710

'.' - missing

'X' - below practical quantitation level

Table A-57

SUMMARY STATISTICS

STREAM=15 (CFA oil/water separator effluent)

ANALYTE	FY87-FY90			LEVEL1	LEVEL2	GUIDELINE
	MEAN	STD	N			
Cond (μ S)	835	285	90	1310	1510	N/A
pH	7.75	0.66	96	l 6.43 u 9.06	l 6.01 u 9.48	l 6.5 u 8.5
TDS (mg/l)	538	184	86	846	977	N/A
TOC (mg/l)	46.8	28.8	84	95.1	116	N/A
Cl (mg/l)	136	76.0	90	263	317	N/A
F (mg/l)	0.91	0.85	38	2.37	3.01	N/A
NO3 (mg/l)	9.52	5.51	69	18.8	22.7	N/A
PO4 (mg/l)	1.92	1.52	50	4.49	5.61	N/A
SO4 (mg/l)	46.8	10.2	89	63.8	71.0	N/A
Ag (μ g/l)	9.23	3.98	11	16.8	20.7	5000
As (μ g/l)	47.4	104	18	234	323	5000
Ba (μ g/l)	182	120	63	384	471	100,000
Cd (μ g/l)	13.3	7.98	58	26.8	32.6	1000
Cr (μ g/l)	57.8	48.5	78	139	174	5000
Cu (μ g/l)	107	106	84	284	359	N/A
Hg (μ g/l)	0.51	0.42	28	1.24	1.57	200
Ni (μ g/l)	60.4	46.9	40	140	176	N/A
Pb (μ g/l)	114	81.7	44	252	313	5000
Se (μ g/l)						1000
Tl (μ g/l)						N/A
Zn (μ g/l)	846	630	94	1900	2340	N/A

Guideline - RCRA Characteristic Guidelines

N/A - not applicable

Table A-58

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=15 (CFA oil/water separator effluent) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	805	.	.	.	1	5	0
	91q2	1250	.	.	.	1	0	5
	91q3	950	.	.	.	2	0	4
	91q4	393	315	445	15.5	4	2	0
pH	91q1	7.74	.	.	.	1	5	0
	91q2	7.75	.	.	.	1	0	5
	91q3	8.74	.	.	.	2	0	4
	91q4	8.16	0.22	0.30	0.11	4	2	0
TDS (mg/l)	91q1	527	78.5	110	20.3	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	1185	.	.	.	2	0	4
	91q4	414	.	.	.	2	0	4
TOC (mg/l)	91q1	134	38.0	53.6	4.51	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	364	.	.	.	2	0	4
	91q4	91.9	54.3	94.0	5.41	6	0	0
Cl (mg/l)	91q1	87.3	4.12	5.65	2.04	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	102	.	.	.	2	0	4
	91q4	138	33.8	58.4	3.21	6	0	0
F (mg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	0.27	.	.	.	2	0	4
	91q4	0.25	0.05	0.09	0.01	6	0	0
NO3 (mg/l)	91q1	6.40	.	.	.	2	2	2
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	4.08	.	.	.	2	0	4
PO4 (mg/l)	91q1	0.89	0.66	0.93	0.06	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	124	.	.	.	2	0	4
	91q4	31.9	26.5	45.8	0.85	6	0	0
SO4 (mg/l)	91q1	45.9	1.17	1.66	0.05	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	44.7	.	.	.	2	0	4
	91q4	39.3	3.25	5.61	0.75	6	0	0
Ag (μ g/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6

Table A-58 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=15 (CFA oil/water separator effluent) -----
 (continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
As (μg/l)	91q1	2.30	0.25	0.29	0.29	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	6.77	.	.	.	3	0	3
Ba (μg/l)	91q1	160	15.0	20.9	5.10	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	200	.	.	.	2	0	4
	91q4	145	34.5	59.5	6.69	6	0	0
Cd (μg/l)	91q1	12.7	2.45	3.43	0.67	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	8.20	.	.	.	1	0	5
	91q4	24.2	18.5	31.7	6.06	6	0	0
Cr (μg/l)	91q1	213	100	141	15.4	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	97.3	.	.	.	2	0	4
	91q4	68.9	20.6	35.5	6.51	6	0	0
Cu (μg/l)	91q1	91.4	13.1	18.5	1.60	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	237	.	.	.	2	0	4
	91q4	113	39.9	68.7	11.0	6	0	0
Hg (μg/l)	91q1	0.30	0.20	0.28	0.05	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	0.21	.	.	.	1	0	5
Ni (μg/l)	91q1	75.3	40.1	56.2	11.5	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	91.7	.	.	.	2	0	4
	91q4	45.3	15.8	27.3	3.48	6	0	0
Pb (μg/l)	91q1	102	3.80	0.00	49.7	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	175	.	.	.	2	0	4
	91q4	124	57.4	99.3	7.17	6	0	0
Se (μg/l)	91q1	X	.	.	.	0	2	4
	91q2	X	.	.	.	0	0	6
	91q3	3.10	.	.	.	1	0	5
	91q4	4.00	.	.	.	2	0	4

Table A-58 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=15 (CFA oil/water separator effluent) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Tl (µg/l)	91q1	0.77	.	.	.	1	2	3
	91q2	X	.	.	.	0	0	6
	91q3	2.00	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	1585	270	374	106	4	2	0
	91q2	X	.	.	.	0	0	6
	91q3	4060	.	.	.	2	0	4
	91q4	952	382	661	51.2	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-184
Conductivity Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-185

pH Stream 16 Concentrations

Guideline - 6.5 to 8.5

Figure A-186
TDS Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-187
TOC Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-188
TSS Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-189

CI Stream 16 Concentrations

IF City Sewer Guideline Not Applicable

Figure A-190
F Stream 16 Concentrations
 IF City Sewer Guidelines Not Applicable

Figure A-191
NO3 Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-192
PO4 Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-193
SO4 Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-194
Ag Stream 16 Concentrations
 IF City Sewer Guideline = 500 $\mu\text{g/l}$

Figure A-195
As Stream 16 Concentrations
 IF City Sewer Guidelines = 500 $\mu\text{g/l}$

Figure A-196
Ba Stream 16 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-197
Cr Stream 16 Concentrations
 IF City Sewer Guideline = 500 µg/l

Figure A-198
CrVI Stream 16 Concentrations
 IF City Sewer Guideline = 90 $\mu\text{g/l}$

Figure A-199
Cu Stream 16 Concentrations
 IF City Sewer Guideline = 1500 $\mu\text{g/l}$

Figure A-200
Hg Stream 16 Concentrations
 IF City Sewer Guideline = 50 µg/l

Figure A-201
NI Stream 16 Concentrations
 IF City Sewer Guidelines Not Applicable

Figure A-202
Pb Stream 16 Concentrations
 IF City Sewer Guideline = 1500 $\mu\text{g/l}$

Figure A-203
Zn Stream 16 Concentrations
 IF City Sewer Guideline = 1500 $\mu\text{g/l}$

Table A-59

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q2 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Jan	1	617	7.60	X	360	20.9	4.00	20.7
Jan	2	597	7.94	X	367	17.6	3.00	20.7
Feb	1	618	6.54	X	565	31.4	14.0	41.5
Feb	2	604	7.32	X	573	31.4	35.0	41.3
Mar	1	780	7.93	X	310	9.00	12.0	26.0
Mar	2	X	X	X	310	9.00	16.0	27.0

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Jan	1	0.30	2.50	X	43.1	X	X
Jan	2	0.30	2.40	X	45.1	X	X
Feb	1	X	5.60	X	46.3	X	X
Feb	2	0.30	5.30	1.53	46.3	X	X
Mar	1	X	2.40	1.10	X	X	X
Mar	2	X	2.20	1.10	X	X	X

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Jan	1	X	X	X	X	37.5	X
Jan	2	X	X	X	X	36.7	X
Feb	1	X	X	X	X	77.9	X
Feb	2	X	X	X	X	76.3	X
Mar	1	X	X	X	X	30.0	X
Mar	2	X	X	X	X	30.0	X

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	4.30	X	X	36.6
Jan	2	X	4.80	X	X	36.1
Feb	1	14.3	X	X	X	64.7
Feb	2	12.4	X	X	X	68.9
Mar	1	X	X	X	X	30.0
Mar	2	X	X	X	X	X

'.' - missing

'X' - below practical quantitation level

Table A-60

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q3 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Apr	1	635	7.83	X	283	8.77	16.0	37.2
Apr	2	X	X	X	311	7.51	15.0	X
May	1	627	6.30	X	215	2.12	X	17.4
May	2	547	7.59	X	203	2.15	X	18.0
Jun	1	706	7.72	X	265	3.34	4.00	12.8
Jun	2	550	7.18	X	276	4.13	X	13.0

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Apr	1	0.41	4.30	1.77	50.5	X	X
Apr	2	X	X	X	X	X	X
May	1	0.67	4.81	0.31	47.0	X	X
May	2	0.62	4.54	0.78	52.6	X	X
Jun	1	0.58	5.09	26.4	42.5	3.20	4.90
Jun	2	0.62	5.96	34.9	47.5	5.50	3.70

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Apr	1	98.2	X	X	X	70.1	X
Apr	2	95.3	X	X	X	58.6	X
May	1	69.4	X	X	X	28.8	X
May	2	67.8	X	8.40	X	24.0	X
Jun	1	78.6	X	X	X	197	X
Jun	2	79.2	X	X	X	222	0.49

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	3.50	X	X	66.0
Apr	2	15.0	8.50	X	X	69.5
May	1	X	X	X	X	24.8
May	2	X	1.80	X	X	14.6
Jun	1	25.5	2.00	X	X	54.1
Jun	2	22.7	2.70	X	X	61.6

'.' - missing

'X' - below practical quantitation level

Table A-61

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q4 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Jul	1	612	7.22	X	253	3.82	6.00	18.1
Jul	2	622	7.72	X	295	3.05	X	18.2
Aug	1	862	8.26	X	326	5.54	X	15.3
Aug	2	764	8.08	X	286	4.44	X	15.4
Sep	1	452	8.08	X	290	0.56	X	11.4
Sep	2	429	7.82	X	273	0.78	X	10.3

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Jul	1	0.30	19.9	1.93	40.4	3.70	4.00
Jul	2	0.35	19.9	1.84	40.2	3.30	6.10
Aug	1	0.40	6.40	0.93	39.3	2.50	X
Aug	2	0.43	7.40	0.92	38.6	X	4.20
Sep	1	0.26	3.63	0.26	43.0	5.10	X
Sep	2	0.25	3.83	0.10	43.3	5.20	X

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Jul	1	82.6	X	X	X	54.5	0.230
Jul	2	87.9	X	X	X	56.7	X
Aug	1	89.6	X	X	X	42.4	X
Aug	2	86.9	X	X	X	45.6	X
Sep	1	105	8.00	29.2	X	40.6	X
Sep	2	103	6.40	30.7	X	44.6	X

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	4.60	X	X	28.1
Jul	2	X	2.20	X	X	29.9
Aug	1	X	5.50	X	X	29.7
Aug	2	X	4.70	X	X	23.1
Sep	1	19.8	2.70	X	X	20.7
Sep	2	28.0	X	X	X	20.8

'.' - missing

'X' - below practical quantitation level

Table A-62

SUMMARY STATISTICS

STREAM=16 (IRC waste effluent)

ANALYTE	FY87-FY90 MEAN	STD	N	LEVEL1	LEVEL2	GUIDELINE
Cond (μ S)	549	41.8	93	619	648	N/A
pH	7.55	0.36	96	1 6.83 u 8.27	1 6.60 u 8.51	1 6.5 u 8.5
CN (mg/l)						0.5
TDS (mg/l)	294	58.0	93	391	432	N/A
TOC (mg/l)	6.17	4.85	88	14.3	17.7	N/A
TSS (mg/l)	3.57	1.74	14	6.76	8.35	N/A
Cl (mg/l)	17.1	6.42	91	27.9	32.4	N/A
F (mg/l)	0.73	0.97	31	2.39	3.14	N/A
NO3 (mg/l)	10.3	3.12	90	15.5	17.7	N/A
PO4 (mg/l)	1.14	1.18	30	3.17	4.08	N/A
SO4 (mg/l)	43.5	7.06	91	55.3	60.3	N/A
Ag (μ g/l)	22.5	18.2	21	54.7	69.7	500
As (μ g/l)	2.85	1.82	15	6.17	7.79	500
Ba (μ g/l)	94.3	22.2	62	132	148	N/A
Cd (μ g/l)						500
Cr (μ g/l)	10.9	4.67	35	18.9	22.5	500
CrVI (μ g/l)	10.8	9.63	21	27.8	35.7	90
Cu (μ g/l)	63.4	22.6	92	101	117	1500
Hg (μ g/l)	0.45	0.29	33	0.95	1.18	50
Ni (μ g/l)	476	1020	13	2360	3310	1500
Pb (μ g/l)	14.3	9.17	62	29.7	36.4	1500
Se (μ g/l)						N/A
Tl (μ g/l)						N/A
Zn (μ g/l)	60.0	22.1	90	96.8	113	1500

Guideline - City of Idaho Falls Sewer Regulatory Guidelines
 N/A - not applicable

Table A-63

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q1 -----

MONTH	REP	COMPOUND	CONCENTRATION (µg/l)
Oct	1	Dibromochloromethane	0.80
Oct	1	Toluene	0.87
Oct	1	all other compounds	X
Nov	1	all compounds	X
Dec	1	all compounds	X

'X' - below practical quantitation level

Table A-64

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q2 -----

MONTH	REP	COMPOUND	CONCENTRATION (µg/l)
Jan	1	1,1,1-Trichloroethane	3.4
Jan	1	all other compounds	X
Feb	1	Acetone	222.0
Feb	1	Methylene Chloride	3.0
Feb	1	all other compounds	X
Mar	1	Toluene	4.0
Mar	1	all other compounds	X

'X' - below practical quantitation level

Table A-65

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q3 -----

MONTH	REP	COMPOUND	CONCENTRATION (µg/l)
Apr	1	4-Penten-2-OL (TIC)	100
Apr	1	Acetone	2300
Apr	1	all other compounds	X
May	1	Chloroform	7
May	1	all other compounds	X
Jun	1	Acetone	48
Jun	1	all other compounds	X

'X' - below practical quantitation level
TIC - Tentatively Identified Compound

Table A-66

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=16 (IRC waste effluent) QUARTER=91q4 -----

MONTH	REP	COMPOUND	CONCENTRATION (μ g/l)
Jul	1	all compounds	X
Aug	1	Acetone	68
Aug	1	Ethanol (TIC)	8
Aug	1	Tetrahydrofuran (TIC)	10
Aug	1	Toluene	10
Aug	1	Unknown (TIC)	2
Aug	1	all other compounds	X
Sep	1	all compounds	X

'X' - below practical quantitation level
TIC - Tentatively Identified Compound

Table A-67

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=16 (IRC waste effluent) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	606	36.9	61.3	7.00	5	1	0
	91q2	643	51.3	85.0	12.2	5	1	0
	91q3	613	8.07	0.00	87.7	5	1	0
	91q4	624	108	184	41.3	6	0	0
pH	91q1	7.43	0.26	0.43	0.11	5	1	0
	91q2	7.47	0.32	0.44	0.43	5	1	0
	91q3	7.32	0.23	0.00	0.70	5	1	0
	91q4	7.86	0.21	0.32	0.24	6	0	0
CN (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
TDS (mg/l)	91q1	271	12.5	21.2	6.00	6	0	0
	91q2	414	78.9	137	4.34	6	0	0
	91q3	259	26.1	44.2	13.2	6	0	0
	91q4	287	9.66	0.00	24.7	6	0	0
TOC (mg/l)	91q1	1.27	0.07	0.10	0.10	6	0	0
	91q2	19.9	6.47	11.2	1.35	6	0	0
	91q3	4.67	1.80	3.08	0.61	6	0	0
	91q4	3.03	1.26	2.15	0.55	6	0	0
TSS (mg/l)	91q1	9.00	.	.	.	2	0	4
	91q2	14.0	6.06	8.49	8.74	6	0	0
	91q3	11.7	.	.	.	3	0	3
	91q4	6.00	.	.	.	1	0	5
Cl (mg/l)	91q1	18.8	0.63	1.08	0.21	6	0	0
	91q2	29.5	6.17	10.7	0.42	6	0	0
	91q3	19.7	6.76	11.3	0.32	5	1	0
	91q4	14.8	2.13	3.67	0.45	6	0	0
F (mg/l)	91q1	X	.	.	.	0	0	6
	91q2	0.30	.	.	.	3	0	3
	91q3	0.58	0.07	0.11	0.03	5	1	0
	91q4	0.33	0.05	0.08	0.02	6	0	0
NO3 (mg/l)	91q1	9.55	0.44	0.75	0.12	6	0	0
	91q2	3.40	1.03	1.77	0.15	6	0	0
	91q3	4.94	0.37	0.51	0.45	5	1	0
	91q4	10.2	4.95	8.56	0.42	6	0	0

Table A-67 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=16 (IRC waste effluent) -----
 (continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
PO4 (mg/l)	91q1	1.11	.	.	.	3	0	3
	91q2	1.24	.	.	.	3	0	3
	91q3	12.8	10.9	17.9	4.27	5	1	0
	91q4	1.00	0.49	0.85	0.07	6	0	0
SO4 (mg/l)	91q1	41.1	0.80	1.39	0.15	6	0	0
	91q2	45.2	1.10	1.39	1.00	4	2	0
	91q3	48.0	1.76	0.89	3.75	5	1	0
	91q4	40.8	1.24	2.13	0.321	6	0	0
Ag (μg/l)	91q1	3.60	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	4.35	.	.	.	2	0	4
	91q4	2.97	1.44	2.12	1.84	6	0	0
As (μg/l)	91q1	1.78	0.26	0.44	0.15	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	4.30	.	.	.	2	0	4
	91q4	4.77	.	.	.	3	0	3
Ba (μg/l)	91q1	91.5	6.83	10.6	7.29	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	81.4	8.22	14.2	1.37	6	0	0
	91q4	92.5	5.81	9.91	2.56	6	0	0
Cd (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	7.20	.	.	.	2	0	4
Cr (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	8.40	.	.	.	1	0	5
	91q4	30.0	.	.	.	2	0	4
CrVI (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cu (μg/l)	91q1	42.9	5.05	8.59	2.27	6	0	0
	91q2	48.1	14.7	25.4	0.73	6	0	0
	91q3	100	55.8	96.3	11.4	6	0	0
	91q4	47.4	4.12	6.95	2.28	6	0	0

Table A-67 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=16 (IRC waste effluent) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Hg (µg/l)	91q1	0.24	.	.	.	3	0	3
	91q2	X	.	.	.	0	0	6
	91q3	0.49	.	.	.	1	0	5
	91q4	0.23	.	.	.	1	0	5
Ni (µg/l)	91q1	18.1	.	.	.	2	0	4
	91q2	13.4	.	.	.	2	0	4
	91q3	21.1	.	.	.	3	0	3
	91q4	23.9	.	.	.	2	0	4
Pb (µg/l)	91q1	3.30	.	.	.	1	0	5
	91q2	4.55	.	.	.	2	0	4
	91q3	2.92	1.64	2.30	2.36	6	0	0
	91q4	2.95	1.39	1.85	2.18	6	0	0
Se (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Tl (µg/l)	91q1	0.77	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Zn (µg/l)	91q1	41.0	5.04	7.87	5.35	6	0	0
	91q2	36.0	17.8	27.3	20.5	6	0	0
	91q3	48.4	14.6	25.1	5.36	6	0	0
	91q4	25.4	2.44	3.73	2.79	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Figure A-204
Conductivity Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-205
pH Stream 17 Concentrations
 Guideline = 6.5 to 8.5

Figure A-206
CN Stream 17 Concentrations
 IF City Sewer Guideline = 0.5 mg/l

Figure A-207
TDS Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-208
TOC Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-209
TSS Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-210
Cl Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-211
F Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-212
NO3 Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

IF City Sewer Guideline Not Applicable

Figure A-214
SO4 Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-215
Ag Stream 17 Concentrations
 IF City Sewer Guideline = 500 $\mu\text{g/l}$

Figure A-216
As Stream 17 Concentrations
 IF City Sewer Guideline = 500 $\mu\text{g/l}$

Figure A-217
Ba Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-218
Cd Stream 17 Concentrations
 IF City Sewer Guideline = 500 $\mu\text{g/l}$

IF City Sewer Guideline = 500 µg/l

Figure A-220
CrVI Stream 17 Concentrations
 IF City Sewer Guideline = 80 $\mu\text{g/l}$

Figure A-221

Cu Stream 17 Concentrations

IF City Sewer Guideline = 1500 µg/l

Figure A-222
Hg Stream 17 Concentrations
 IF City Sewer Guideline = 50 µg/l

Figure A-223
NI Stream 17 Concentrations
 IF City Sewer Guideline Not Applicable

Figure A-224
Pb Stream 17 Concentrations
 IF City Sewer Guideline = 1500 $\mu\text{g/l}$

Figure A-225
Zn Stream 17 Concentrations
 IF City Sewer Guideline = 1500 $\mu\text{g/l}$

Table A-68

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q1 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Oct	1	927	7.48	X	444	77.0	85.0	72.8
Oct	2	X	X	X	430	79.6	83.5	74.0
Nov	1	715	8.99	74.8	351	65.4	222	69.2
Nov	2	856	8.00	109	345	71.5	311	64.4
Dec	1	955	8.04	X	658	120	468	37.0
Dec	2	953	7.02	X	666	120	260	37.2

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Oct	1	1.20	5.70	11.6	57.4	79.0	1.20
Oct	2	1.20	5.80	12.1	57.1	78.7	1.30
Nov	1	0.91	X	10.7	74.6	X	1.60
Nov	2	0.92	X	10.8	69.3	X	1.30
Dec	1	2.80	X	29.5	74.4	248	2.90
Dec	2	2.00	X	28.1	75.3	430	1.60

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Oct	1	190	X	7.20	X	91.1	0.12
Oct	2	28.2	X	X	X	89.6	0.13
Nov	1	85.1	X	X	X	46.8	0.31
Nov	2	83.1	X	X	X	45.7	0.30
Dec	1	42.6	X	X	X	225	0.20
Dec	2	44.6	X	X	11.1	207	0.19

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Oct	1	X	3.30	X	X	45.3
Oct	2	X	3.30	X	X	43.6
Nov	1	X	X	X	X	50.0
Nov	2	X	X	X	X	41.7
Dec	1	X	3.90	X	X	86.6
Dec	2	X	4.40	X	X	117

'.' - missing

'X' - below practical quantitation level

Table A-69

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q2 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Jan	1	837	7.72	X	580	58.6	108	62.6
Jan	2	837	7.68	X	648	56.0	112	60.5
Feb	1	1150	8.28	13.9	888	31.0	140	80.6
Feb	2	854	7.77	72.5	758	32.9	142	77.9
Mar	1	991	8.75	X	490	129	310	78.0
Mar	2	X	X	X	510	130	94.0	79.0

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Jan	1	0.30	X	4.33	55.2	X	X
Jan	2	0.30	X	4.08	53.2	X	X
Feb	1	0.30	1.70	5.87	60.7	38.6	X
Feb	2	0.30	1.90	5.87	60.3	91.7	X
Mar	1	X	2.20	12.0	X	40.0	X
Mar	2	X	0.15	12.0	X	40.0	X

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Jan	1	X	X	X	X	130	X
Jan	2	X	X	X	X	150	X
Feb	1	X	X	5.30	X	72.3	X
Feb	2	X	X	X	X	111	X
Mar	1	X	X	X	X	80.0	X
Mar	2	X	X	X	X	90.0	X

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jan	1	X	X	X	X	141
Jan	2	X	4.10	X	X	198
Feb	1	11.6	X	X	X	77.3
Feb	2	X	X	X	X	131
Mar	1	X	X	X	X	40.0
Mar	2	X	X	X	X	50.0

'.' - missing

'X' - below practical quantitation level

Table A-70

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q3 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Apr	1	989	7.62	X	618	122	149	92.6
Apr	2	88	7.52	X	613	121	63.0	93.4
May	1	1230	9.05	X	495	92.4	210	89.9
May	2	840	8.36	X	542	103	308	87.3
Jun	1	883	7.78	X	424	62.5	396	44.2
Jun	2	914	8.04	X	451	136	401	81.8

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Apr	1	0.31	X	17.0	67.7	117	X
Apr	2	0.30	X	17.0	67.3	126	X
May	1	0.36	0.06	35.2	73.5	141	X
May	2	0.33	X	33.7	80.3	981	X
Jun	1	0.32	0.03	27.9	52.5	30.9	X
Jun	2	0.32	0.11	11.8	58.8	97.9	X

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Apr	1	55.7	X	X	X	47.6	X
Apr	2	55.7	X	X	X	52.3	X
May	1	105	X	X	X	92.7	X
May	2	95.7	X	X	X	146	X
Jun	1	101	X	6.00	X	90.4	X
Jun	2	82.4	X	X	X	182	X

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Apr	1	X	3.20	X	X	74.3
Apr	2	X	7.00	X	X	73.2
May	1	X	3.40	X	X	188
May	2	X	2.70	X	X	37.5
Jun	1	9.90	4.60	X	X	105
Jun	2	X	X	X	X	51.6

'.' - missing

'X' - below practical quantitation level

Table A-71

FY91 ENVIRONMENTAL MONITORING DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q4 -----

MONTH	REP	Cond (μ S)	pH	CN (mg/l)	TDS (mg/l)	TOC (mg/l)	TSS (mg/l)	Cl (mg/l)
Jul	1	900	8.78	X	453	80.3	226	94.0
Jul	2	818	8.11	X	494	64.0	174	53.8
Aug	1	366	7.15	X	1050	73.0	149	37.6
Aug	2	516	7.62	X	466	132	302	66.3
Sep	1	736	7.89	X	574	50.7	190	57.6
Sep	2	907	8.36	X	382	53.5	162	83.2

MONTH	REP	F (mg/l)	NO3 (mg/l)	PO4 (mg/l)	SO4 (mg/l)	Ag (μ g/l)	As (μ g/l)
Jul	1	0.29	0.04	29.3	62.2	19.7	X
Jul	2	0.37	0.07	29.7	85.8	17.1	X
Aug	1	0.28	0.09	25.8	56.8	77.7	X
Aug	2	0.27	0.08	41.9	65.0	69.2	X
Sep	1	0.26	X	10.3	58.6	37.1	X
Sep	2	0.26	0.43	35.5	67.6	54.7	X

MONTH	REP	Ba (μ g/l)	Cd (μ g/l)	Cr (μ g/l)	CrVI (μ g/l)	Cu (μ g/l)	Hg (μ g/l)
Jul	1	80.4	X	X	X	78.9	0.21
Jul	2	96.3	X	X	X	120	X
Aug	1	94.1	X	X	X	122	6.20
Aug	2	91.9	X	X	X	134	X
Sep	1	1760	6.40	32.1	X	126	X
Sep	2	149	X	31.8	X	112	X

MONTH	REP	Ni (μ g/l)	Pb (μ g/l)	Se (μ g/l)	Tl (μ g/l)	Zn (μ g/l)
Jul	1	X	4.20	X	X	151
Jul	2	X	X	X	X	113
Aug	1	X	X	X	X	142
Aug	2	X	X	X	X	111
Sep	1	X	3.80	X	1.10	49.8
Sep	2	X	4.00	X	X	93.1

'.' - missing

'X' - below practical quantitation level

Table A-72

SUMMARY STATISTICS

STREAM=17 (WCB waste effluent)

ANALYTE	FY87-FY90 MEAN	STD	N	LEVEL1	LEVEL2	GUIDELINE
Cond (μ S)	688	178	92	986	1110	N/A
pH	7.68	0.29	88	1 7.09 u 8.27	1 6.90 u 8.46	1 6.5 u 8.5
CN (mg/l)	18.6	22.1	17	58.3	77.3	0.5
TDS (mg/l)	361	122	94	565	652	N/A
TOC (mg/l)	30.8	47.2	92	110	143	N/A
TSS (mg/l)	21.1	29.6	14	75.3	102	N/A
Cl (mg/l)	14.2	3.00	87	19.2	21.4	N/A
F (mg/l)	0.80	0.64	32	1.90	2.39	N/A
NO3 (mg/l)	9.76	3.90	89	16.3	19.0	N/A
PO4 (mg/l)	7.13	11.2	43	26.3	34.7	N/A
SO4 (mg/l)	57.6	19.6	94	90.3	104	N/A
Ag (μ g/l)	321	344	90	896	1140	500
As (μ g/l)	3.02	2.14	10	7.13	11.34	500
Ba (μ g/l)	54.1	15.3	60	79.9	91.1	N/A
Cd (μ g/l)	6.15	2.54	11	10.9	13.5	500
Cr (μ g/l)	17.6	14.8	42	42.9	54.0	500
CrVI (μ g/l)	8.03	10.2	16	26.5	35.5	90
Cu (μ g/l)	127	55.9	94	221	261	1500
Hg (μ g/l)	0.40	0.31	37	0.919	1.15	50
Ni (μ g/l)						1500
Pb (μ g/l)	17.8	15.3	57	43.5	54.6	1500
Se (μ g/l)						N/A
Tl (μ g/l)						N/A
Zn (μ g/l)	37.4	18.8	71	68.9	82.4	1500

Guideline - City of Idaho Falls Sewer Regulatory Guidelines
 N/A - not applicable

Table A-73

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q1 -----

MONTH	REP	COMPOUND	CONCENTRATION ($\mu\text{g/l}$)
Oct	1	Acetone	98.50
Oct	1	Toluene	0.54
Oct	1	all other compounds	X
Nov	1	1,4-Dichlorobenzene	4.60
Nov	1	Acetone	21.20
Nov	1	all other compounds	X
Dec	1	all compounds	X

'X' - below practical quantitation level

Table A-74

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q2 -----

MONTH	REP	COMPOUND	CONCENTRATION ($\mu\text{g/l}$)
Jan	1	Acetone	19.0
Jan	1	all other compounds	X
Feb	1	all compounds	X
Mar	1	1,1,1,-Trichloroethane	21.0
Mar	1	Ethylbenzene	1.4
Mar	1	Toluene	1.1
Mar	1	all other compounds	X

'X' - below practical quantitation level

Table A-75

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q3 -----

MONTH	REP	COMPOUND	CONCENTRATION ($\mu\text{g/l}$)
Apr	1	Acetone	110.0
Apr	1	Unknown (TIC)	3.7
Apr	1	all other compounds	X
May	1	all compounds	X
Jun	1	Acetone	7
Jun	1	all compounds	X

'X' - below practical quantitation level

TIC - Tentatively Identified Compound

Table A-76

FY91 ENVIRONMENTAL MONITORING VOLATILE ORGANICS DATA

----- STREAM=17 (WCB waste effluent) QUARTER=91q4 -----

MONTH	REP	COMPOUND	CONCENTRATION (µg/l)
Jul	1	Acetone	25
Jul	1	all compounds	X
Aug	1	Acetone	19
Aug	1	all other compounds	X
Sep	1	Acetone	25
Sep	1	all other compounds	X

'X' - below practical quantitation level

Table A-77

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=17 (WCB waste effluent) -----

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Cond (μ S)	91q1	881	58.0	81.1	70.5	5	1	0
	91q2	934	54.5	0.00	148	5	1	0
	91q3	824	148	0.00	401	6	0	0
	91q4	707	134	220	98.7	6	0	0
pH	91q1	7.91	0.34	0.22	0.71	5	1	0
	91q2	8.04	0.29	0.43	0.26	5	1	0
	91q3	8.06	0.34	0.54	0.30	6	0	0
	91q4	7.99	0.31	0.47	0.39	6	0	0
CN (mg/l)	91q1	91.9	.	.	.	2	0	4
	91q2	43.2	.	.	.	2	0	4
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
TDS (mg/l)	91q1	482	93.4	162	7.02	6	0	0
	91q2	646	94.6	158	60.4	6	0	0
	91q3	524	51.5	87.7	22.2	6	0	0
	91q4	570	94.1	0.00	252	6	0	0
TOC (mg/l)	91q1	88.9	15.8	27.3	2.71	6	0	0
	91q2	72.9	29.2	50.6	1.38	6	0	0
	91q3	106	7.69	0.00	30.3	6	0	0
	91q4	75.6	14.7	18.2	25.0	6	0	0
TSS (mg/l)	91q1	238	82.0	126	92.4	6	0	0
	91q2	151	27.0	0.00	88.2	6	0	0
	91q3	255	84.5	141	53.3	6	0	0
	91q4	201	14.3	0.00	67.0	6	0	0
Cl (mg/l)	91q1	59.1	11.2	19.3	2.02	6	0	0
	91q2	73.1	5.78	9.96	1.45	6	0	0
	91q3	81.5	9.35	12.0	15.4	6	0	0
	91q4	65.4	6.81	0.00	22.7	6	0	0
F (mg/l)	91q1	1.50	0.45	0.75	0.33	6	0	0
	91q2	0.03	0.27	0.46	0.00	6	0	0
	91q3	0.32	0.01	0.02	0.01	6	0	0
	91q4	0.29	0.02	0.03	0.03	6	0	0
NO3 (mg/l)	91q1	5.75	.	.	.	2	0	4
	91q2	0.92	0.59	0.83	0.84	6	0	0
	91q3	0.07	.	.	.	3	0	3
	91q4	0.12	0.05	0.00	0.19	6	0	0

Table A-77 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=17 (WCB waste effluent) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
PO4 (mg/l)	91q1	17.1	5.84	10.1	0.61	6	0	0
	91q2	7.36	2.37	4.10	0.10	6	0	0
	91q3	23.8	5.40	8.11	6.59	6	0	0
	91q4	28.7	3.18	0.00	12.2	6	0	0
SO4 (mg/l)	91q1	68.0	5.45	9.31	2.20	6	0	0
	91q2	57.3	3.15	4.40	1.02	4	2	0
	91q3	66.7	6.15	10.3	3.79	6	0	0
	91q4	66.0	4.05	0.00	10.8	6	0	0
Ag (µg/l)	91q1	209	130	172	91.0	4	0	2
	91q2	31.7	22.1	35.0	21.7	6	0	0
	91q3	249	157	121	344	6	0	0
	91q4	45.9	15.9	26.9	8.05	6	0	0
As (µg/l)	91q1	1.65	0.31	0.36	0.55	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Ba (µg/l)	91q1	78.9	19.1	0.00	66.1	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	82.6	13.7	22.9	8.49	6	0	0
	91q4	379	288	180	658	6	0	0
Cd (µg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	6.40	.	.	.	1	0	5
Cr (µg/l)	91q1	7.20	.	.	.	1	0	5
	91q2	5.30	.	.	.	1	0	5
	91q3	6.00	.	.	.	1	0	5
	91q4	32.0	.	.	.	2	0	4
CrVI (µg/l)	91q1	11.1	.	.	.	1	0	5
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Cu (µg/l)	91q1	118	50.9	87.9	7.39	6	0	0
	91q2	106	17.3	27.1	18.2	6	0	0
	91q3	102	26.4	33.9	43.3	6	0	0
	91q4	115	8.43	6.63	18.4	6	0	0

Table A-77 (continued)

QUARTERLY MEANS AND VARIANCE COMPONENTS

----- STREAM=17 (WCB waste effluent) -----
(continued)

ANALYTE	QTR	MEAN	STD MEAN	STD DAY	STD REP	N	N MISS	N BPQL
Hg (μg/l)	91q1	0.21	0.05	0.09	0.01	6	0	0
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	3.20	.	.	.	2	0	4
Ni (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	11.6	.	.	.	1	0	5
	91q3	9.90	.	.	.	1	0	5
	91q4	X	.	.	.	0	0	6
Pb (μg/l)	91q1	3.72	0.43	0.57	0.25	4	0	2
	91q2	4.10	.	.	.	1	0	5
	91q3	3.15	1.10	0.00	3.12	6	0	0
	91q4	4.00	.	.	.	3	0	3
Se (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	X	.	.	.	0	0	6
Tl (μg/l)	91q1	X	.	.	.	0	0	6
	91q2	X	.	.	.	0	0	6
	91q3	X	.	.	.	0	0	6
	91q4	1.10	.	.	.	1	0	5
Zn (μg/l)	91q1	64.0	18.9	31.4	12.9	6	0	0
	91q2	106	36.0	58.0	32.2	6	0	0
	91q3	88.3	12.3	0.00	65.2	6	0	0
	91q4	110	19.3	27.6	26.7	6	0	0

'.' - missing, too little data to calculate value

'X' - below practical quantitation level (BPQL)

Appendix B

Statistical Methods

APPENDIX B

STATISTICAL METHODS

THE EXPERIMENTAL DESIGN: A NESTED CLASSIFICATION

Quantifying the concentrations of analytes in potentially nonhomogeneous wastewater streams involves estimating (a) the average concentration of each analyte and (b) the variability in the concentration of each analyte.

The average of any given analyte concentration is subject to uncertainties that arise from sampling fluctuations. For example, water samples are drawn from effluent points of waste streams on different days; thus, a portion of the total variation in the analyte concentration is due to the day of sampling. Also within a given day, a number of water samples are drawn from the stream. Each sample is termed a replicate, and its average analyte concentration varies from that of other replicates drawn on that day. This replicate-to-replicate variation of the analyte concentration is called experimental error.

The importance of correctly partitioning the analyte concentration variation is this: subsequent water samples will be drawn from the waste streams on a monthly basis and will be declared as being within a controlled limit of analyte concentration or as being outside those controlled limits. The controlled limits are based directly on a function of these variance components.

The statistical model used to determine these variance components is called a nested or hierarchical classification. The effects in the model (day and replicate) are random effects; thus the model is called a random model. For example, days of sampling were chosen randomly, and no determination was made as to whether analyte concentrations on a specific day were significantly different from those on another specified day. Using this model, any inferences are thus extended to all possible days in the population of days.

The data, analyte concentrations, were measured on a water sample replicate taken on a given day; the replicates are nested within days so each

replicate is unique to a day. The object of using this model is to quantify the variance components in analyte concentration measurements.

THE STATISTICAL MODEL

Notation

Let

i = index the sampling day

j = index of the water sample replicate

X_{ij} = analyte concentration of the j th water sample replicate drawn on the i th sampling day

a = number of days sampled so that $i = 1, \dots, a$

b_i = number of replicates drawn on the i th day, so that $j = 1, \dots, b_i$ for day i ; if an equal number of replicates are drawn on each sampling day, then $b_1 = b_2 = \dots = b$ and $j = 1, \dots, b$

$j(i)$ = "j nested within i." In the model, replicates are nested within days and are represented as $\beta_{j(i)}$

The Model

Analyte levels are modeled with the nested design as follows:

$$x_{ij} = \mu + \alpha_i + \beta_{j(i)}$$

where

x_{ij} = analyte concentration of the j th replicate taken on the i th day.

μ = true mean of the process being studied, that is, the true mean concentration of the analyte in the waste stream of interest.

α_i = deviation of the mean analyte concentration for a day from the true overall mean, μ . This deviation, α_i , has zero mean and can be represented by random (independent) drawings from a normal distribution having a fixed variance σ_α^2 . That is, $\alpha_i \sim N(0, \sigma_\alpha^2)$.

$\beta_{j(i)}$ = deviation of the mean analyte concentration of a water sample replicate from the true daily mean analyte concentration. This deviation, $\beta_{j(i)}$, has zero mean and can be represented by random (independent) drawings from a normal distribution having fixed variance σ_β^2 . That is, $\beta_{j(i)} \sim N(0, \sigma_\beta^2)$.

FROM THE MODEL TO THE ANALYSIS OF VARIANCE

The following discussion includes dot notation ($x_{i.}$, $x_{.j}$). The dot replaces a subscript and indicates that all values covered by the subscript have been summed. So:

$$x_{i.} = \sum_j x_{ij}$$

$$x_{.j} = \sum_i \sum_j x_{ij} = \sum_i x_{i.}$$

The true parameters of the model are unknown but are estimated from the data. The model, as presented in the previous section, can be written in terms of deviations:

$$x_{ij} = \mu + \alpha_i + \beta_{j(i)}$$

<p>Overall mean, estimated by $\bar{x}_{..}$</p>	<p>Deviation of overall mean from daily mean, estimated by $\bar{x}_{i.} - \bar{x}_{..}$</p>	<p>Deviation of daily mean from replicate, estimated by $x_{ij} - \bar{x}_{i.}$</p>
---	---	--

$$= \bar{x}_{..} + (\bar{x}_{i.} - \bar{x}_{..}) + (x_{ij} - \bar{x}_{i.})$$

and can be rewritten as

$$(x_{ij} - \bar{x}_{..}) = (\bar{x}_{i.} - \bar{x}_{..}) + (x_{ij} - \bar{x}_{i.})$$

The sum of squared deviations from the overall mean is then

$$\begin{aligned} \sum_i^a \sum_j^b (x_{ij} - \bar{x}_{..})^2 &= \sum_i^a \sum_j^b [(\bar{x}_{i.} - \bar{x}_{..}) + (x_{ij} - \bar{x}_{i.})]^2 \\ &= \sum_i^a \sum_j^b (\bar{x}_{i.} - \bar{x}_{..})^2 + \sum_i^a \sum_j^b (x_{ij} - \bar{x}_{i.})^2 \end{aligned}$$

No cross-product terms appear on the right hand side because the sums of deviations from means are restricted to be zero. The expression can be further reduced to

$$\sum_i^a \sum_j^b (x_{ij} - \bar{x}_{..})^2 = b \sum_i^a (\bar{x}_{i.} - \bar{x}_{..})^2 + \sum_i^a \sum_j^b (x_{ij} - \bar{x}_{i.})^2$$

where

$$b \sum_i^a (\bar{x}_{i.} - \bar{x}_{..})^2 = \text{the sum of squares for days}$$

$$\sum_i^a \sum_j^b (x_{ij} - \bar{x}_{i.})^2 = \text{the sum of squares for replicates within days.}$$

This partitioning or breakdown of variation characterized in the model is summarized in an analysis of variance (ANOVA) table. The object of the table is to identify and quantify the sources of variation in the analyte concentration measurements. The first column in the table identifies the accountable sources of variation. In this case, the first source is due to sampling day and the second is due to variation among replicates within a sampling day (experimental error).

The remaining columns in the ANOVA table quantify the respective sources of variation. These are the degrees of freedom (df), sums of squares (SS), mean square (MS), and expected mean square (EMS). The degrees of freedom for each sum of squares are the numbers by which the sum of squares are divided to obtain an unbiased estimate of the expected mean square. Thus, the mean square is SS/df. The table to be filled out is presented in Figure B-1.

Expected Mean Square

In statistical terms, the expected value of a statistic is the average value taken over an infinite number of similar samples. Consider the statistic $\bar{x}$, the sample mean. The expected or average value of $\bar{x}$ taken over

<u>Source of Variation</u>	<u>df</u>	<u>Sum of squares (SS)</u>	<u>Mean Square (MS)</u>	<u>Expected Mean Square (EMS)</u>
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Figure B-1. Analysis of variance table headings.

an infinite number of samples, written $E(\bar{x})$, is the population mean, μ_x . That is,

$$\begin{aligned}
 E(\bar{x}) &= E\left(\frac{\sum_i x_i}{n}\right) = \frac{1}{n} E\left(\sum_i x_i\right) = \frac{1}{n} \left(\sum_i E(x_i)\right) \\
 &= \frac{1}{n} (E x_1 + E x_2 + \dots + E x_n) = \frac{1}{n} \cdot n \cdot E(x_i) = E x_i = \mu_x
 \end{aligned}$$

This follows since

$$E(c) = c, \text{ a constant}$$

$$E(cX) = cE(X)$$

$$E(X_1 + X_2) = EX_1 + EX_2.$$

Another basic theorem of expected values is $E(x - \mu_x)^2 = \sigma_x^2$, the variance of x . This is true since

$$E(x - \mu_x)^2 = E(x^2 - 2x\mu_x + \mu_x^2)$$

$$= E\chi^2 - E2\chi\mu_x + E\mu_x^2$$

$$= E\chi^2 - 2\mu_x E\chi + \mu_x^2 \text{ since } 2, \mu_x, \text{ and } \mu_x^2 \text{ are constants}$$

$$= E\chi^2 - \mu_x^2$$

$$= \sigma_x^2 \text{ by definition.}$$

The expected value of the sample variance, s^2 , is σ^2 ; symbolically

$$E(s^2) = \left[\frac{\sum (\chi_i - \bar{\chi})^2}{n - 1} \right] = \sigma_x^2 .$$

The statistic $\sum_i (\chi_i - \bar{\chi})^2$ is referred to as the sum of squares, or SS_x . It is actually the sum of squared deviations of the sample values from their sample mean. The expected value of SS_x is

$$E(SS_x) = E \left[\sum_i (\chi - \bar{\chi})^2 \right] = (n - 1) \sigma_x^2$$

where $n - 1$ represents the degrees of freedom associated with the sum of squares. When a sum of squares is divided by its degrees of freedom, an average squared deviation from the mean is the result. This statistic, SS/df , is thus called the mean square, or MS , and the expected mean square, $E(MS) = E \left(\frac{SS}{df} \right)$, is σ^2 of the variable being tested.

The general equations for the expected mean squares of a balanced nested design with random terms are these:

<u>Source</u>	<u>EMS</u>
A	$\sigma_B^2 + b\sigma_A^2$
B(A)	σ_B^2

Variance Components

Once the analysis of variance table has been completed, i.e. values for the mean squares have been determined and equations for the expected mean squares have been derived, the variance components can then be estimated. This is done simply by equating the expected mean squares to the mean squares and solving for s_A^2 and s_B^2 . That is, for the balanced case as discussed in the previous section:

σ_B^2 is estimated by $s_B^2 = MS[B(A)]$

σ_A^2 is estimated by $s_A^2 = \frac{1}{b} MS(A) - s_B^2$.

The total variability then is simply $s^2 = s_A^2 + s_B^2$ and it can be said that

$\frac{s_A^2}{s^2} \times 100\%$ of the total variation is due to factor A

$\frac{s_B^2}{s^2} \times 100\%$ of the total variation is due to factor B.

Estimating the Variance of the Sample Mean from the Variance Components

For FY-88, analyte concentration control charts are constructed based on FY-87 data. That is, a mean analyte concentration is plotted on a chart that has an upper limit based on the variance of the sample mean. If the plotted value is within the upper limit, the process is said to be in control. If the plotted value is above the upper limit, the process is out of control by definition and further investigation into the source of the problem is needed.

Therefore the variance of the sample mean, $s_{\bar{x}}^2$, is needed. the sample

mean $\bar{y}$, is simply $\frac{\sum_i \sum_j x_{ij}}{ab}$, or the sum of all observations divided by the number of observations. But because our model states

$x_{ij} = \mu + \alpha_i + \beta_{j(i)}$, it follows that

$$(\bar{x})\mu = \frac{1}{ab} \sum_i^a \sum_j^b [\mu + \alpha_i + \beta_{j(i)}] .$$

The variance of $\bar{x}$ is then derived as follows for the balanced case:

$$Var(\bar{x}) = Var \left\{ \frac{1}{ab} \sum_i^a \sum_j^b [\mu + \alpha_i + \beta_{j(i)}] \right\}$$

$$= \left(\frac{1}{ab} \right)^2 \text{Var} \sum_i^a \sum_j^b [\mu + \alpha_i + \beta_{j(i)}]$$

$$= \left(\frac{1}{ab} \right)^2 \text{Var} \sum_i^a \left[b\mu + b\alpha_i + \sum_j^b \beta_{j(i)} \right]$$

$$= \left(\frac{1}{ab} \right)^2 \text{Var} \left[ab\mu + b \sum_i^a \alpha_i = \sum_i^a \sum_j^b \beta_{j(i)} \right]$$

$$= \left(\frac{1}{ab} \right)^2 \left\{ (ab)^2 \text{Var}(\mu) + (b)^2 \sum_i^a \text{Var}(\alpha_i) + \sum_i^a \sum_j^b \text{Var} [\beta_{j(i)}] \right\}$$

$$= \left(\frac{1}{ab} \right)^2 \left[0 + (b)^2 a \sigma_\alpha^2 + ab \sigma_\beta^2 \right]$$

$$= \frac{1}{a} s_\alpha^2 + \frac{1}{ab} s_\beta^2 .$$

This form can be put in terms of the expected mean squares for days, $\sigma_\beta^2 + b \sigma_\alpha^2$ such that $\text{Var} (\bar{x}) = \frac{1}{ab} (\sigma_\beta^2 + b \sigma_\alpha^2) = \frac{1}{ab} \text{EMS (days)}$. Therefore, the variance of the sample mean can be estimated by $\frac{1}{ab}$ (MS days).

The derivation of the sample mean variance with unbalanced data is similar. Because the number of measurements may differ, that is b_i may not

necessarily equal b, the form for $\text{Var}(\bar{x})$ cannot be reduced as neatly as in the balanced case. In the unbalanced case,

$$\text{Var}(\bar{x}) = \frac{1}{n^2} \left(n + \sum_i \sum_j n_{ij}^2 \sigma_\beta^2 + \sum_i n_i^2 \sigma_\alpha^2 \right).$$

EXAMPLE: ANALYSIS OF NESTED CLASSIFICATION OF TOC DATA

In general, b replicate water samples were drawn from a waste stream on a days. The replicate water samples were then split into n laboratory samples, upon which the analyte concentrations were measure. The model is:

$$X_{ij} = \mu + \alpha_i + \beta_{j(i)}$$

where

X_{ij} = analyte concentration of the jth water sample replicate taken on the ith sampling day.

The model assumes $\alpha_i \sim N(0, \sigma_\alpha^2)$, $\beta_{j(i)} \sim N(0, \sigma_\beta^2)$, and each of the α_i and $\beta_{j(i)}$ are independent or random drawings from their respective normal distributions. Table B-1 summarizes the generalized analysis of variance (ANOVA) table for a nested classification with balanced data.

As an example, two water sample replicates were drawn from a waste stream on three days. TOC concentration (mg/L) were measured on these replicates. The data are presented in Table B-2.

Table B-1. Generalized ANOVA table for nested classification with balanced data.

Source	df	SS	EMS
Day	$a - 1$	$\sum_i^a x_{i.}^2/b - x_{..}^2/b - x_{..}^2/ab$	$b\sigma_\alpha^2 + \sigma_\beta^2$
Replicate within day	$a(b - 1)$	$\sum_i^a \sum_j^b x_{ij}^2 - \sum_i^a x_{i.}^2/b$	σ_β^2
Total	$ab - 1$	$\sum_i^a \sum_j^b x_{ij}^2 - x_{..}^2/ab$	

a = number of days sampled.

b = number of replicates drawn on each day.

Table B-2. Balanced data set: levels of TOC (mg/L).

Day, i $i = 1, \dots, a$ $a = 3$ days	Replicate, j $j = 1, \dots, b$ $b = 2$ replicates	Measurement, x_{ij}	$x_{i.}$	$x_{..}$
1	1	3.15	6.37	-
	2	3.22		
2	1	2.17	3.69	-
	2	1.52		
3	1	1.08	2.25	12.31
	2	1.17		

Total sample size = $ab = (3)(2) = 6$ measurements.

The sums of squares and degrees of freedom calculations are:

Source = day

$$df = a - 1 = 3 - 1 = 2$$

$$SS = (6.37^2 + 3.69^2 + 2.25^2)/2 - (12.31)^2/6$$

$$= 29.63 - 25.26$$

$$= 4.37.$$

Source = replicate within day

$$df = a(b - 1) + 3(2 - 1) = 3$$

$$SS = (3.15^2 + \dots + 1.17^2) - 29.63$$

$$= 29.85 - 29.63$$

$$= 0.22.$$

Table B-3 presents the results of this analysis in ANOVA table form.

From the variance components, it can be said that of the overall variability, s^2 :

$$(s_b^2/s_{total}^2) = 100\% = (0.07/0.78) = 100\% = 9\% \text{ is due to analyte concentration differences in replicates taken within a day}$$

$$(s_a^2/s_{total}^2) = 100\% = (0.71/0.78) = 100\% = 91\% \text{ is due to analyte measurement differences over days.}$$

Table B-3. ANOVA results of balanced TOC data set.

Source of variation	df	SS	MS	EMS	Variance component
Among day	2	4.37	2.19	$\sigma_\beta^2 + 3\sigma_\alpha^2$	0.71
Among replicates within days	<u>3</u>	<u>0.22</u>	0.07	σ_β^2	<u>0.07</u>
Total	5	4.59	—	—	0.78

Variance component estimates:

$$\sigma_\beta^2 \text{ is estimated by } s_\beta^2 = 0.07$$

$$\sigma_\alpha^2 \text{ is estimated by } s_\alpha^2 = (2.19 - 0.07)/3 = 0.71$$

The variance of the sample mean is

$$\text{Var}(\bar{x}) = \frac{1}{ab} (\sigma_\beta^2 + B\sigma_\alpha^2) = \frac{1}{ab} \text{EMS (days)} \text{ and is estimated by}$$

$$s_{\bar{x}}^2 = \frac{1}{ab} [MS (\text{days})]$$

$$= \frac{1}{6} (2.19)$$

$$= 0.365.$$

CONTROL CHART THEORY

The control chart is a statistical tool used primarily to study a continuous process. The process of concern here is the concentration of an analyte in various wastewater streams. Even under uniform conditions, the analyte concentration is a varying process. The purpose of plotting values on a control chart is to keep track of the process so that management can identify high concentrations indicating that investigation and/or action is necessary.

Among the analyte concentrations, as mentioned, there is bound to be variation; this variation is natural to the process and is due to random or chance causes. If variation in the process is due only to chance causes, the process is said to be in control. If, however, a significant deviation detected in the process can be traced to an assignable cause, the process is said to be out of control, and attempts are made to identify and eliminate the cause.

If an excessively high analyte concentration is detected, it can be attributed to either (a) an assignable cause or (b) a chance cause. If it is the former, change may have taken place in the underlying process. Given a set of data, control chart methods can be used to determine the cause.

The basic concept of control charts is not complicated. Any varying quantity forms a distribution if chance causes are present. The quantity therefore has a mean and variance. Consider the quantity $\bar{x}$; it has a normal distribution parameterized by a mean and variance. (See Figure B-2.) Very few points of this distribution lie in the tail regions. Specifically, 0.00135 or 0.135% of the area under this curve is beyond $\bar{x} + 3\sigma$ and $\bar{x} - 3\sigma$. So, if variability in the process is due only to chance cause, there is approximately one out of a thousand chances that a value will be larger than

Figure B-2. Basic concept of an $\bar{x}$ control chart.

$\bar{x} + 3\sigma$. Although it is possible for an analyte concentration to be this large due simply to chance cause, it is much more likely that it would be high due to an assignable cause.

Thus, the decision rule is this: if a value is outside the determined limits, generally $\bar{x} \pm 3\sigma$, it typically has an assignable cause. The process is said to be out of control until the cause is identified and eliminated. If a value is plotted within the determined concentration, it is concluded that no reliable evidence of an assignable cause is present. The process is then said to be in control.

A process in control has obvious advantages over a nonmonitored process:

- The process is free from variation worth identifying. Hence, there is no reason to tamper with it.
- Quality performance is improved simply because the act of getting a process in control entails eliminating assignable causes.
- The process becomes predictable; in cases, decreasing the frequency of inspection or sampling may be justified.

No Set Standards versus Given Standards

The methods used to construct a control chart depend on the situation. For example, if nothing is known about the population under consideration, it is determined whether the sampling results are homogeneous (e.g., whether they come from a single population). Statistically, the purpose is to test the hypothesis that k samples are from a single population with constant but unknown parameter. It is common to apply this reasoning until the process is under control. Therefore, the limits or standards are set by the process itself and subsequent sampling results are compared to these determined standards. It must be assumed that no conditions are changed from the preliminary state to the subsequent sampling.

However, if set standards or limits are given and need not be determined, the object is to compare observed parameter estimates to the set standards. Statistically, the hypothesis tested is that the samples are all drawn from a population with known parameters.

Subgroups

Sampling from the population is a critical step in the control chart method. Sample results plotted on a chart need to represent subgroups that are as homogeneous as possible. If an assignable cause is present, it is much more likely to show up in differences between subgroups. If the subgroups are not homogeneous, that is, if large differences exist among members of the subgroup, results due to an assignable cause may be less evident.

The subgroups for this program are water samples drawn on a quarterly basis from wastewater streams. For some of the analytes under consideration, that is, those whose standards are not set, their processes will be studied for one year in order to eliminate as many assignable causes as possible. With one year of data analyzed, it is hoped that the processes will be left with variation due only to chance causes. Four quarterly sets of samples will be drawn and analyzed; the results will then be used to construct control charts under stabilized conditions.

Constructing the $\bar{x}$ Control Chart

A control chart for the process average, $\bar{x}$, has a center line (CL) and two upper control limits (UL1 and UL2). These are constructed as follows:

CL = $\bar{\bar{x}}$ = analyte concentration averaged over four quarters

UL1 = $\bar{\bar{x}} + 2s/(C_4 n)$ = upper concentration 1 limit

UL2 = $\bar{\bar{x}} + 3s/(C_4 n)$ = upper concentration 2 limit where

$$C_4 = \left(\frac{2}{n-1} \right)^{1/2} \frac{\left(\frac{n-2}{2} \right)!}{\left(\frac{n-3}{2} \right)!}.$$

Only for pH are lower control limits constructed:

LL1 = $\bar{\bar{x}} - 2s/(C_4 n)$ = lower concentration 1 limit

LL2 = $\bar{\bar{x}} - 3s/(C_4 n)$ = lower concentration 2 limit.

The variance estimate, s^2 , is calculated depending on the homogeneity of the quarterly variances. First, therefore, the variances s_i^2 are tested over k quarters to determine if each s_i^2 estimates the same theoretical variance σ^2 .

A test for homogeneous variances was developed by M. S. Bartlett in 1937. The test, referred to as Bartlett's M Test, assumes the variances are from normal distributions and, secondly, that random samples were drawn independently from the populations.

The null hypothesis of equal variances is tested without the requirement that the k estimates are based on equal sample sizes. The test statistic is

$$M = (N - k) \ln(s_p^2) - \sum_i (n_i - 1) \ln(s_i^2) .$$

Under the null hypothesis, M is distributed approximately χ^2 with k - 1 degrees of freedom.

M is biased upward, so if the calculated value exceeds the critical χ^2 value, an adjustment is necessary. Specifically, M is divided by

$$C = 1 + \frac{1}{3(k - 1)} \left(\sum_i \frac{1}{n_i - 1} - \frac{1}{N - k} \right)$$

and is still compared to χ^2_{k-1} .

If the sample sizes are all equal, that is $n_1 = n_2 = \dots = n_k = n$, the formulas are simplified:

$$s_p^2 = \sum_i s_i^2 / k$$

$$M = (N - k) \ln(s_p^2) - (n - 1) \cdot \sum_i \ln(s_i^2)$$

$$C = 1 + \frac{1}{3(k-1)} \left(\frac{k}{n-1} - \frac{1}{N-k} \right) .$$

If the test statistic M/C does exceed the critical value, it is concluded that at least one of the k estimates is not estimating the same theoretical variance, σ^2 . If the k quarterly variance estimates, s_i^2 , do not prove to be different, the estimates can then be pooled into a single estimate, s_p^2 . The pooling simply weights each variance estimate, s_i^2 , by its sample size n_i :

$$s_p^2 = \frac{(n_1 - 1) s_1^2 + (n_2 - 1) s_2^2 + \dots + (n_k - 1) s_k^2}{(n_1 - 1) + (n_2 - 1) + \dots + (n_k - 1)}$$

$$= \sum_i (n_i - 1) s_i^2 / (N - k)$$

where

$$N = \sum_i n_i .$$

If variance estimates show evidence of not estimating the same theoretical variance, σ^2 , and if a particular transformation is appropriate, then the data are transformed. The transformed data are then tested again for equal variances. If these estimates are still nonhomogeneous, then a variance is calculated by pooling all of the data over all quarters and determining a single estimate, s^2 . That is:

$$s^2 = \sum_{quarters} \sum_{days} \sum_{reps} (x_{ijk} - \bar{\bar{x}})^2 / (N - 1)$$

and this estimate is used in forming the control limits.

Out-of-Control Criteria

It is natural for a process in control to exhibit the following characteristics:

- Most points are near the center line.
- A few points are spread out and approach the three sigma control limits.
- None of the points exceed the three sigma control limits.

If any of the following situations occur, it is unnatural for the process, and an assignable cause should be sought:

- A single point outside the three sigma control limits
- Two out of three successive points outside the two sigma warning limits
- Seven out of eight points in a row on one side of the center line.

It is possible to apply more rules than those listed above. Too many rules, however, will result in a higher probability of incorrect conclusions, such as saying the process is out of control when it is not.

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GLOSSARY OF STATISTICAL TERMS

Analysis of Variance (ANOVA)—A statistical technique used to divide the total variation of the measured variable into meaningful components.

Assignable Cause—An identifiable event in a process that in some way changes the population and affects the control charts. An assignable cause may, for example, result in a change in the process average and/or variability and/or may cause cyclic or erratic shifts in the process.

Balanced—An experimental design is "balanced" when there exists an equal number of observations for every combination of the classification factors, e.g., the same number of replicates within each day sampled.

Chance Cause or Random Cause—Slight, natural changes in conditions of the process causing random variation in the population. This variation is the sum of the effects of all chance causes; no major part of the total variation can be traced to a single cause.

Components of Variance—See variance components.

Control Chart—A statistical device used primarily for the study and control of repetitive processes. The chart typically is based on the upper and/or lower control limits; points outside these limits signal a process "out of control."

Controlled Process—A process for which the control chart shows no points outside the limits and no nonrandom variation within the limits.

Degrees of Freedom—The number of "free" elements associated with a mathematical expression. The degrees of freedom for a variance estimate are, in general, the number of observations used minus the number of parameters that must be estimated from the data in order to calculate the estimated variance. For example,

$$\sum_i^n (x_i - \bar{x})^2$$

has $n - 1$ degrees of freedom since there are n observations and one parameter, μ , is being estimated by $\bar{x}$.

Deviation-Difference; typically refers to difference in an observation and its mean, $x - \mu$ or $s - \bar{x}$.

Expected Mean Square (EMS)—The mathematical expected value of the mean square.

Expected Value—The average value of a variable or statistic if it were calculated from an infinite number of equal-sized samples from a given population, denoted $E(x)$.

Experimental Error—Variation among experimental units.

Experimental Unit—The smallest unit of experimental material that can be treated independently of all other units, e.g., replicates.

Hierarchical Design—An experimental design in which the units are classified in a nested manner, e.g., replicates are chosen within days.

Mean—Average or expected value of a variable.

Of a sample, $\bar{x} = \sum_i^n x_i/n$.

Of a population, $\mu = E(x)$.

Mean Square—An unbiased estimate of a population variance. Determined by dividing the sum of squared deviations by its degrees of freedom, $MS = SS/df$.

Nested Design—See hierarchical design.

Pooled Variance—A weighted average of k sample variances, $s_1^2, s_2^2, \dots, s_k^2$, with weights proportional to the degrees of freedom for the s_i^2 .

$$s_p^2 = \frac{\sum_i^n (n_i - 1) s_i^2}{\sum_i^n (n_i - 1)} .$$

Random Effects Model—An experimental design in which the concentrations of the factors (such as days) are randomly selected and inferences are extended to all concentrations of the populations (of which the observed concentrations are random samples). In a random model, the experimenter is not usually interested in testing hypotheses, setting confidence limits, or making contrasts; rather he is interested in estimating components of variance.

Replicate—A repetition of the experiment. When a concentration of a factor appears more than once, the experiment is said to be replicated.

Sample—A subset of measurements taken from a population, usually on which to make inferences about the population. Unless otherwise specified, it is assumed to be a random sample from the population.

Source of variation in an ANOVA—The experimental characteristics or factors of a variable to which portions of the total variability are attributed.

Standard Deviation—Square root of the variance.

Statistical Hypothesis—An assumption about a population being sampled.

Subgrouping—Dividing a group of items into smaller subsets of the group so that the subgroups are as homogeneous as possible. To be of analytical value, the segregation of the items should be such that if assignable causes are present, they will be common to all elements of one or more subgroups.

Sum of Square—Sum of squared deviations from the mean, $\sum (x_i - \bar{x})^2$; used in the ANOVA table as a method of partitioning the total variability into portions due to identified sources.

Variance—The expectation of $(x - \mu)^2$ where μ is the mean of the random variable x .

Of a sample, $s^2 = \sum_i^n (x_i - \bar{x})^2 / n - 1$.

Of a population, $\sigma^2 = E(x - \mu)^2$.

Variance Components—An analysis used to estimate the proportion of overall variance contributed by each factor in the model.

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