A Department of Ecology Report

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Moses Lake (Dunes) Wastewater Treatment Plant Class II Wastewater Inspection April 27-29, 1998

Abstract

An announced Class II wastewater inspection of the Moses Lake (Dunes) wastewater treatment plant (WWTP) was conducted April 27-29, 1998. The inspection was conducted in conjunction with a Class II groundwater inspection of the WWTP and in conjunction with Class II wastewater and groundwater inspections of the nearby Basic American Foods facility. The Moses Lake WWTP was performing well during the inspection. Effluent quality was good as measured by conventional parameters of 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). The effluent met the permit limit for flow and the design criteria for BOD_5 and TSS loading. A recommendation to seek an independent calibration of the flow meter was made.

Ecology Manchester Laboratory analyses of samples collected by Ecology and Moses Lake gave close results for both influent and effluent composite samples, indicating that the collection techniques were comparable. Some discrepancies between Ecology and Moses Lake laboratory analytical results were found. It is recommended that Moses Lake investigate possible causes of low BOD_5 results.

Volatile organic analysis compounds were found in low concentrations in the WWTP influent. Of the base-neutral acid extractables (semivolatile organics) (BNA) found in the influent, benzoic acid (143 µg/L est.) was found in the highest concentration. Other than acetone, a probable sampling equipment residue, toluene (0.13 µg/L est.) was the only volatile organic analysis (VOA), found in the influent. Four BNAs were found in the effluent sample. Benzoic acid (3.1 µg/L est.) was the BNA found in the highest concentration. All VOAs and BNAs found in the effluent sample were in concentrations below applicable state groundwater quality criteria. Bis(2-ethylhexy)phthalate in the effluent sample (2.1 µg/L) was found at a concentration 35% of groundwater quality criteria. A recommendation is made to initiate organic analyses of Moses Lake groundwater monitoring well samples and to continue monitoring organic compounds in the Moses Lake WWTP effluent.

by Steven Golding
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Arsenic, copper, lead, silver, and zinc were detected in the effluent composite sample. Because lead and zinc were found in the transfer blank in concentrations close to those found in the effluent sample, the finding of lead and zinc in the effluent may be false. All metals detected in the effluent were found in concentrations below Washington state water quality criteria for groundwaters.

Summary

Flow Measurements

The flow measured by the WWTP flow meter was 13% higher than that estimated by Ecology. The flow of 2.09 MGD measured from 0830 on April 28 to 0830 on April 29 was used to represent flow during the inspection.

State Waste Discharge Permit Compliance/General Chemistry

The Moses Lake WWTP was performing well during the inspection. Effluent quality as measured by conventional parameters of 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) was good. The effluent met the permit limit for flow and the design criteria for BOD_5 and TSS loading. Daily monitoring reports from March 1995 to March 1996 show higher than permitted flow, BOD_5 loading, and TSS loading for the permit in effect at the time of the inspection. The permit was amended in May 1998, to increase permitted flows, BOD_5 loading, and TSS loading.

The total dissolved solids (TDS) concentration in the Moses Lake effluent exceeded drinking water standards. A concurrent Groundwater Class II Inspection found nitrate-nitrite as N to increase to 5.46 mg/L downgradient on the WWTP site. The drinking water standard for nitrate as N is 10 mg/L. There was no significant reduction in ammonia concentrations by nitrification across the plant.

Split Sample Results

Ecology Manchester Laboratory analyses of samples collected by Ecology and Moses Lake gave close results for both influent and effluent composite samples. This indicates that the collection techniques were comparable, and Ecology and Moses Lake samples were likely both representative of the wastewater streams being sampled.

Some discrepancies between Ecology and Moses Lake laboratory analytical results were found. Ecology's BOD_5 results were consistently higher than those of Moses Lake, with an average relative percent difference (RPD) of 31%. Ecology TDS analysis results were consistently higher than Moses Lake analysis results and Ecology conductivity analytical results were consistently lower than Moses Lake analytical results.

Priority Pollutant Scans

Organics

Seventeen priority pollutant and other target volatile organic analysis (VOA) compounds were detected in the influent sample. Other than acetone, a solvent used to clean sampling equipment, the other VOAs detected were in low concentrations (5.3 µg/L or lower). Eighteen base-neutral acid extractables (BNAs) were detected in the influent sample. Of the BNAs found in the influent, benzoic acid (143 µg/L est.) was found in the highest concentration.
Two priority pollutant and other target VOAs were detected in the effluent samples. Other than acetone (3.6 µg/L), toluene (0.13 µg/L est.) was the only VOA found in the influent. Four BNAs were found in the effluent sample. Benzoic acid (3.1 µg/L est.) was the BNA found in the highest concentration. All VOAs and BNAs found in the effluent sample were in concentrations below applicable state groundwater quality criteria. Bis(2-ethylhexy)phthalate in the effluent sample (2.1 µg/L) was found in a concentration 35% of groundwater quality criteria.

Metals

Arsenic, copper, lead, silver, and zinc were detected in the effluent composite sample. Because lead and zinc were found in the transfer blank in concentrations close to those found in the effluent sample, the finding of lead and zinc in the effluent may be false. All metals detected in the effluent were found in concentrations below Washington state water quality criteria for groundwaters.

Recommendations

- The flow meter should be calibrated by an independent calibrator to verify the Moses Lake calibration.

- Moses Lake should investigate possible causes of low BOD_5 results including making certain that equipment cleaning is not leaving residual disinfectant that can affect the test.

Continued organic analyses should be conducted on Moses Lake WWTP effluent and expanded to included groundwater monitoring well samples as well.

Introduction

An announced Class II wastewater inspection of the Moses Lake (Dunes) wastewater treatment plant (WWTP) was conducted April 27-29, 1998. The inspection was conducted in conjunction with a Class II groundwater inspection of the WWTP and in conjunction with Class II wastewater and groundwater inspections of the nearby BAF facility. The Class II wastewater inspection included sampling of the influent and effluent streams at the Moses Lake WWTP. Groundwater monitoring results appear in separate study reports (Sinclair 1998; 1999).

Facility Description

The Moses Lake (Dunes) Wastewater Treatment Plant was constructed in 1984 to replace the trickling filter plant which discharged to Moses Lake (Ecology, 1994a). At the time, the highest priority for building the plant was to remove the discharge from the lake to reduce nutrient loading and resultant algal blooms in the lake. The treatment alternative chosen was a large pump station and force main located at the old plant site to transfer raw wastewater from the City to an aerated lagoon plant with rapid infiltration to ground at a site approximately fives miles southeast in an area locally known as the sand dunes (Figure 1). The City's new treatment and land disposal facility is bordered on the west by Basic American Foods potato processing's land treatment site (Figure 1). Concerns have been raised about groundwater quality impacts from both the Moses Lake WWTP and BAF's land application of wastewater.

The Moses Lake WWTP treatment process consists of influent screening and degritting at the Central Operations Facility (COF), conveyance of wastewater through an approximately five mile long force main to the Moses Lake WWTP, followed by treatment in four aeration basins, followed by two settling basins, two coarse rock filters and eight rapid infiltration basins used in an alternating fashion (Figure 2). Seven of the eight rapid infiltration basins are used for infiltration. The other is used for dumping of grit, sand, and other debris from sewer cleaning operations.

Objectives

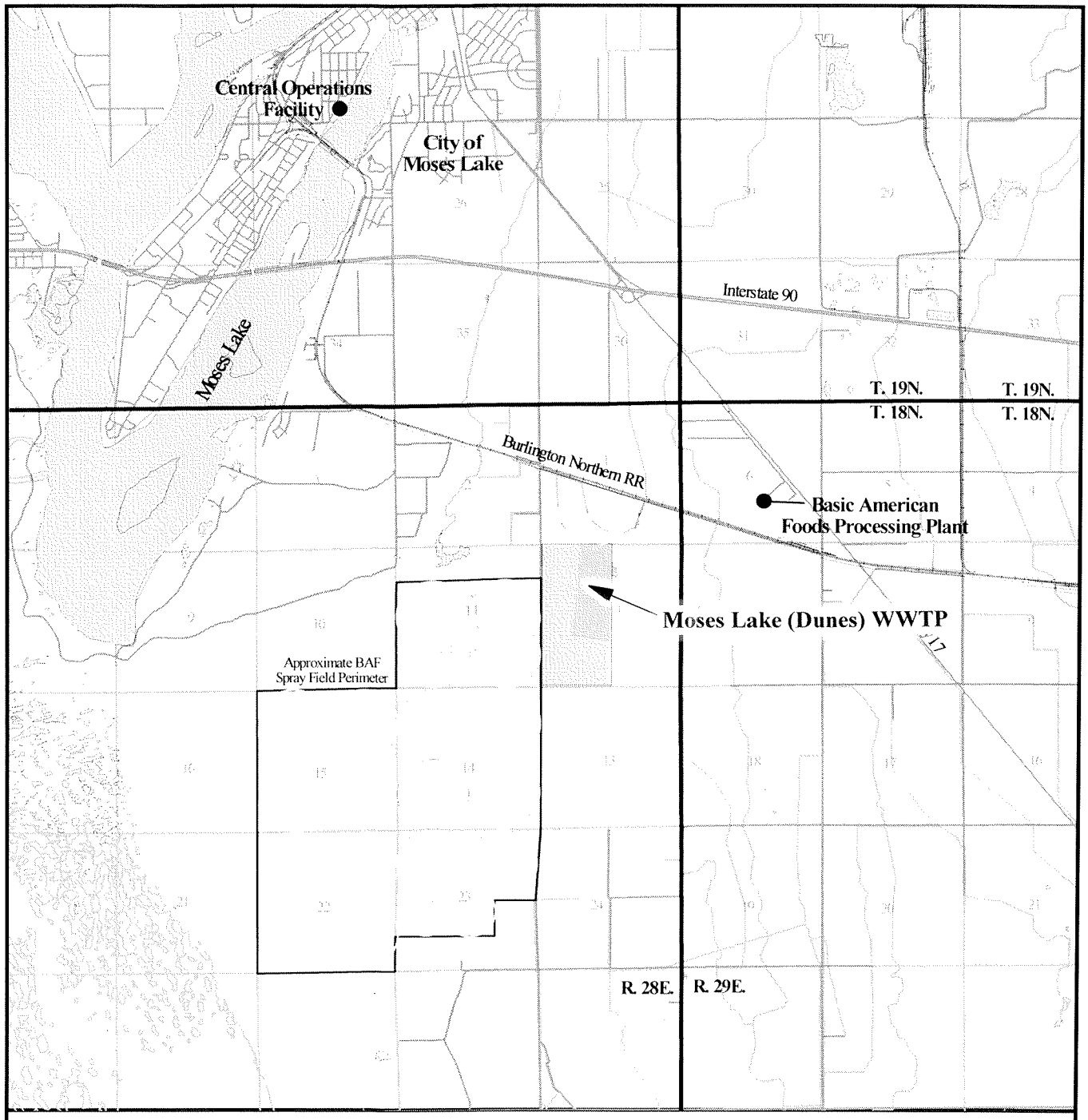
Objectives of the inspection included:

- evaluate Moses Lake WWTP permit compliance
- evaluate Moses Lake WWTP effluent sampling procedures with split samples
- compare effluent sample results with state groundwater quality criteria

Procedures

Ecology collected Moses Lake WWTP influent and effluent samples to determine parameters included in the State Waste Discharge Permit. Additional nutrient samples of influent and effluent were included to characterize nutrient concentrations across the plant. Sodium, calcium, magnesium, and chloride analyses for effluent samples were included to provide information concerning these parameters of interest in groundwater and for agronomic analyses.

Composite 24-hour samples of Moses Lake WWTP influent (Inf) and effluent (Eff) were collected by Ecology. Grab samples were also collected in addition to the composite samples. Moses Lake also collected 24-hour composite influent (Inf-M) and effluent (Eff-M) samples.



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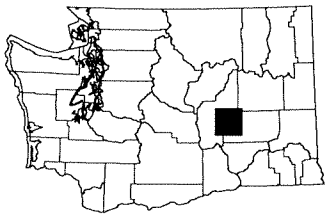

- Moses Lake Well Site
- Township Boundary
- Section Boundary
- Rail Lines
- Lakes and Ponds
- Major Roads
- Rivers and Irrigation Ditches

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Figure 1
City of Moses Lake, Dunes
Wastewater Treatment Plant

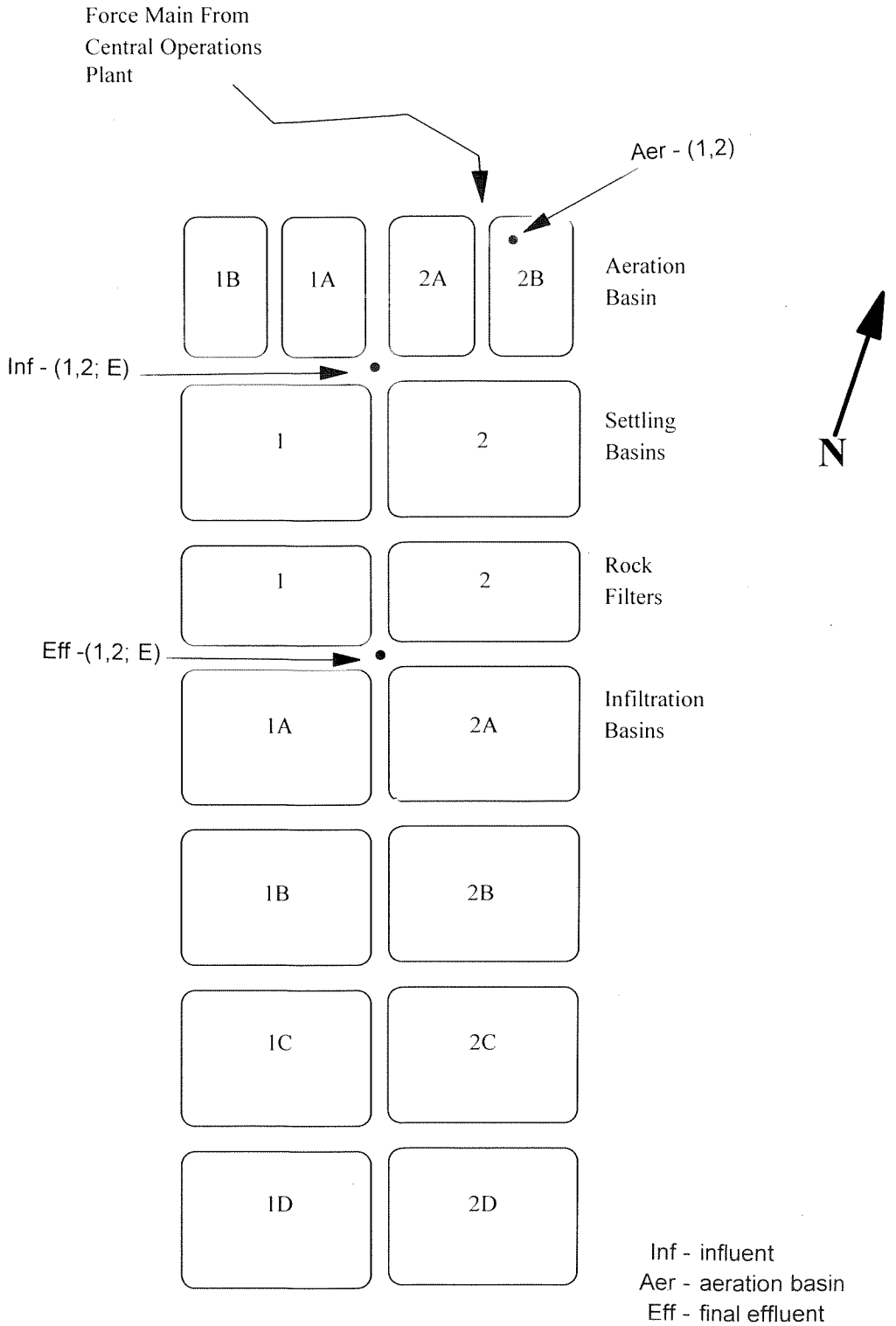

Figure 2
City of Moses Lake, Dunes WWTP,
Generalized Facility Schematic

Note: Not to Scale

A more detailed description of sampling procedures appears in Appendix A. Sampling station descriptions appear in Table 1. The sampling schedule, parameters analyzed, and sample splits are included in Appendix B. Ecology analytical methods and laboratories performing the analyses are summarized in Appendix C. Ecology field and laboratory QA/QC are summarized in Appendix D. Quality assurance cleaning procedures are included in Appendix E. Priority pollutant organic and metals scan results appear in Appendix F. A glossary appears in Appendix G.

Results and Discussion

Flow Measurements

Moses Lake measures influent flow from wastewater depth in a 12-inch Parshall flume as measured by an ultrasonic flow meter. Moses Lake performed a flow meter calibration during the inspection. During the calibration, instantaneous flow was determined to be 2.7 MGD. The flow depth at the time was 11 1/4 inches, with a corresponding flow of 2.35 MGD (Grant, 1989). This is 13% lower than the calibrated flow. Water level fluctuations in the flume of 1/2 inch contributed less than 0.1 MGD of error to this disparity. The flow meter should be calibrated by an independent calibrator to verify the Moses Lake calibration.

Flow for the 24-hour period from 0830 on April 28 to 0830 on April 29 as indicated on the plant's influent totalizing meter was 2.09 MGD. This flow will be used to represent WWTP flow during the inspection.

State Waste Discharge Permit Compliance/General Chemistry

The Moses Lake WWTP was performing well during the inspection. Effluent quality as measured by conventional parameters of 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) was good as defined by Metcalf and Eddy in Wastewater Engineering: Treatment, Disposal, Reuse (Metcalf and Eddy, 1991 - Table 2). The effluent met the permit limit for flow and the design criteria for BOD_5 and TSS loading during the inspection, as required by the permit (Table 3). As Table 3 shows, the permit includes influent loading limits but no effluent quality limits.

For the period from March 1995 to March 1996, Moses Lake reported an annual average daily flow rate of 1.78 MGD, an annual average BOD_5 loading of 5,153 lbs/day, and an annual average TSS loading of 3,994 lbs/day (Ecology, 1997). These were all higher than permitted annual averages (Table 3).

The permit was amended on May 14, 1998, after the inspection, to increase permitted annual average flow to 2.50 MGD, annual average BOD_5 loading to 7,785 lbs/day, and annual average TSS loading to 5,967 lbs/day, consistent with design criteria.

Table 1 - Sampling Station Descriptions - Moses Lake, April 1998.

Station	Type	Collector	Description
Inf-1,2	grab	Ecology	Influent samples obtained downstream of the Parshall flume in the splitter box. Flow in the splitter box was well-mixed.
Inf-E	comp	Ecology	Influent samples obtained downstream of the Parshall flume in the splitter box. Flow in the splitter box was well-mixed and the compositor intake was covered during normal flow.
Inf-M	comp	M. Lake	Influent was obtained with the intake placed in the downstream end of the Parshall flume in a well-mixed region.
Aer-1,2	grab	Ecology	Aeration basin samples were taken from aeration basin 2B (the eastern-most basin) in a well-mixed region near the basin outlet.
Eff- 1,2	grab	Ecology	Effluent was collected one foot upstream of the weir in the effluent box, one foot below the surface.
Eff-E	comp	Ecology	Effluent was collected one foot upstream of the weir in the effluent box, one foot below the surface.
Eff-M	comp	M. Lake	Effluent was collected with the intake in the effluent box, upstream of the weir.

Table 2. General Chemistry Results - Moses Lake, April 1998

Parameter	Location:	Inf-1	Inf-2	Inf - E	Inf-M	Aer-1	Aer-2
	Type:	grab	grab	comp	comp	grab	grab
	Date:	4/28	4/28	4/28-29	4/28-29	4/28	4/28
	Time:	0835	1335	0800-0800	0800-0800	0845	1345
	Lab Log #:	188130	188131	188133	188134	188135	188136
GENERAL CHEMISTRY							
Conductivity (umhos/cm)		947	997	949	951		
Alkalinity (mg/L CaCO3)				319	303		
Hardness (mg/L CaCO3)				147			
TS (mg/L)				792	791	776	827
TNVS (mg/L)				513	510	525	456
TSS (mg/L)		119	194	122	118	111	100
TNVSS (mg/L)				22	32	34	35
TDS (mg/L)							
Sodium (ug/L)				135,000			
Calcium (ug/L)				36,800			
Magnesium (ug/L)				10,500			
Chloride (mg/L)				65.8			
OXYGEN DEMAND PARAMETERS							
BOD5 (mg/L)				182	166		
COD (mg/L)				390	400		
TOC (water - mg/L)		68.6	63.9	52.3	55.0		
NUTRIENTS							
Total Kjeldahl Nitrogen (TKN - mg/L)				21.0	20.6		
NH3-N (mg/L)		14.7	21.6	16.8	16.3		
NO2+NO3-N (mg/L)		0.010 U	0.010 U	0.010 U	0.010 U		
Total-P (mg/L)		6.21 J	5.32	3.99	4.29		
Ortho-PO4-P (mg/L)				2.45			
MISCELLANEOUS							
F-Coliform MF (#/100mL)							
FIELD OBSERVATIONS							
Temperature (C)		17.5	19.7			16.4	18.6
Temp-cooled (C)				4.6	6.6		
pH		7.49	7.36	7.56	7.48	7.20	7.00
Conductivity (umhos/cm)		962	1068	1061	6.6	968	959

Table 2. Moses Lake, April 1998 (Cont'd)

Parameter	Locatn:	Eff-1	Eff-2	Eff-E	Eff-M	Eff-3	Eff-4
	Type:	grab	grab	comp	comp	grab	grab
	Date:	4/28	4/28	4/28-29	4/28-29	4/29	4/29
	Time:	0915	1405	0800-0800	0800-0800	0845	0850
	Lab Log #:	188137	188138	188139	188140	188141	188142
GENERAL CHEMISTRY							
Conductivity (umhos/cm)		979	990	952	956		
Alkalinity (mg/L CaCO3)				316	318		
Hardness (mg/L CaCO3)				139			
TS (mg/L)				632	631		
TNVS (mg/L)				486	494		
TSS (mg/L)		4	4	3	3		
TNVSS (mg/L)				1 U	1 U		
TDS (mg/L)				601			
Sodium (ug/L)				135,000			
Calcium (ug/L)				33,600			
Magnesium (ug/L)				10,900			
Chloride (mg/L)				69.0			
OXYGEN DEMAND PARAMETERS							
BOD5 (mg/L)				20	20		
COD (mg/L)				89	85		
TOC (water - mg/L)		16.7	17.3	19.9	18.3		
NUTRIENTS							
Total Kjeldahl Nitrogen (TKN - mg/L				17.4	17.2		
NH3-N (mg/L)		19.2	19.6	16.5	16.3		
NO2+NO3-N (mg/L)		0.074	0.088	0.439	0.436		
Total-P (mg/L)		3.98	3.92	3.87	3.90		
Ortho-PO4-P (mg/L)				2.85			
MISCELLANEOUS							
F-Coliform MF (#/100mL)						3,000	27,000
FIELD OBSERVATIONS							
Temperature (C)		16.1	18.4				
Temp-cooled (C)				5.5	8.8		
pH		7.58	7.59	7.64	7.54		
Conductivity (umhos/cm)		1060	1054	1060	1050		

Inf - influent
Eff - effluent
Aer - aeration
E - Ecology sample
M - Moses Lake sample

J - estimated value
U - the analyte was not detected at or above the reported result.

Table 3. State Waste Discharge Permit Limits and Inspection Results - Moses Lake April, 1998

Parameter	Permit Limits* Annual Average	Inspection Results Composite Samples	Grab Samples
BOD5 influent loading	4,200 lbs/day	1778 lbs/day	
TSS influent loading	3,357 lbs/day	2127 lbs/day	
Flow	2.30 MGD	2.09 MGD **	

* Based on design criteria as specified in the permit.

** Totalizer reading from 0800 on 03-18-97 to 0800 on 03-19-97.

The total dissolved solids (TDS) concentration in the Moses Lake effluent was 601 mg/L. This exceeds the drinking water standards for TDS (500 mg/L). The BAF Class II Groundwater Inspection carried out concurrently with this inspection found groundwater concentrations of TDS exceeding drinking water standards in BAF monitoring wells adjacent to and downgradient from the Moses Lake WWTP site (Sinclair, 1998).

Groundwater monitoring wells show an increase in concentrations of nitrate-nitrite as N at the WWTP site from a background level of 0.248 mg/L to a downgradient concentration of 5.46 mg/L (Sinclair, 1999). The drinking water standard for nitrate as N is 10 mg/L. A comparison of 24-hour composite influent and effluent ammonia and nitrate-nitrite concentrations indicates that there was no significant reduction in ammonia concentrations by nitrification across the plant. There are no limits for ammonia in the state waste discharge permit.

Split Sample Results

Samples were split to determine the comparability of Ecology and Moses Lake laboratory results and sampling methods (Table 4). Ecology Manchester Laboratory analyses of samples collected by Ecology and Moses Lake gave close results for both influent and effluent composite samples. This indicates that the collection techniques were comparable, and likely both Ecology and Moses Lake samples were representative of the wastewater streams being sampled.

Table 4. Split Sample Results Comparison - Moses Lake, April 1998

	Location:	Inf-E	Inf-M	Eff-E	Eff-M
	Type:	comp	comp	comp	comp
	Date:	4/28-29	4/28-29	4/28-29	4/28-29
	Time:	0800-0800	0800-0800	0800-0800	0800-0800
	Lab Log #:	188133			
	Sampled by:	Ecology	Moses Lake	Ecology	Moses Lake
Parameter	Analysis by:				
BOD_5 (mg/L)					
	Ecology	182	166	20	20
	Moses Lake	124	140	13	15
TSS (mg/L)					
	Ecology	122	118	3	3
	Moses Lake	138	154	4	6
TDS (mg/L)					
	Ecology	670	673	601	628
	Moses Lake	618	610	577	585
Conductivity (uS/cm)					
	Ecology	949	951	952	956
	Moses Lake	994	1000	999	1004

Inf - influent sample

Eff - effluent sample

E - Ecology sample

M - Moses Lake sample

comp - composite sample

Some discrepancies between Ecology and Moses Lake laboratory analytical results were found. Ecology's BOD_5 results were consistently higher than those of Moses Lake, with an average relative percent difference (RPD) of 31%. Moses Lake should investigate possible causes of low BOD_5 results including making certain that the cleaning of equipment is not leaving residual disinfectant affecting the test. Ecology TDS analysis results were consistently higher than Moses Lake analysis results and Ecology conductivity analytical results were consistently lower than Moses Lake analytical results. TDS and conductivity results also differed consistently between Ecology and Moses Lake analyses. The difference between Ecology and Moses Lake TSS results was not significant given the variability in suspended solids inherent in domestic wastewater influent.

Priority Pollutant Scans

Organics

Seventeen priority pollutant and other target volatile organic analysis (VOA) compounds were detected in the influent sample (Table 5). Acetone was found in the highest concentration (109 µg/L). Because acetone was used in cleaning the collection beaker, the concentration found may not be representative of the influent. The other VOAs detected were in low concentrations (less than or equal to 5.3 µg/L). Eighteen base-neutral acid extractables (BNAs) were detected in the influent sample. Of the BNAs found in the influent, benzoic acid (143 µg/L est.) was found in the highest concentration. The BNA found in the next highest concentration was 4-methylphenol (38 µg/L). Other than caffeine, used as a tracer of domestic wastewater effluents in receiving waters, all other BNA were found in concentrations of 12 µg/L (est.) or lower.

Two priority pollutant and other target VOAs were detected in the effluent samples. Other than acetone (3.6 µg/L), toluene (0.13 µg/L est.) was the only VOA found in the influent. Four BNAs were found in the effluent sample. Benzoic acid (3.1 µg/L est.) was the BNA found in the highest concentration. All VOAs and BNAs found in the effluent sample were in concentrations below applicable state groundwater quality criteria (Table 5). Bis(2-ethylhexy)phthalate in the effluent sample (2.1 µg/L) was found in a concentration 35% of groundwater quality criteria. All other BNAs found in the effluent sample were in low concentrations (0.14 µg/L est. or lower). It is recommended that the analysis of organic compounds be initiated on Moses Lake groundwater monitoring well samples as well as continued monitoring of Moses Lake WWTP effluent.

Metals

Arsenic, copper, lead, silver, and zinc were detected in the effluent composite sample (Table 5). Because lead and zinc were found in the transfer blank in concentrations close to those found in the effluent sample, the finding of lead and zinc in the effluent may be false. All metals detected in the effluent were found in concentrations below Washington state water quality criteria for groundwaters.

Table 5. Comparison of Organic Compounds and Metals Detected with Ground Water Quality Criteria - Moses Lake, April 1998

		Location:	Inf-1	Inf-2	Eff-1	Eff-2	Washington State
		Type:	grab	grab	grab	grab	Water Quality Criteria
		Date:	4/28	4/28	4/28	4/28	for Ground Waters
		Time:	0835	1335	0915	1405	
		Lab Log#:	188130	188131	188137	188138	
	VOA Compounds		ug/L	ug/L	ug/L	ug/L	
(Group)[1]							
	Acetone		**109**	**78**	**3**	**3.6**	
	Carbon Disulfide		**0.72 J**	2 U	2 U	2 U	
	2-Butanone (MEK)		**5.3**	**4.4**	2 U	2 U	
b	cis-1,2-Dichloroethene		1 U	**0.28 J**	1 U	1 U	
a	Chloroform		**2.9**	**1.9**	1 U	1 U	7.0 ug/L
	Tetrahydrofuran		**0.6 J**	1 U	1 U	1 U	
a	Dibromomethane		**0.25 J**	**0.22 J**	1 U	1 U	
	Toluene		**2**	**2**	**0.13 J**	**0.13 J**	
	Tetrachloroethene		**0.38 J**	**0.24 J**	1 U	1 U	
	Ethylbenzene		**0.074 J**	**0.31 J**	1 U	1 U	
	m&p-Xylene		**0.2 J**	**1.7 J**	2 U	2 U	
	o-Xylene		1 U	**0.54 J**	1 U	1 U	
	1,2,4-Trimethylbenzene		**0.32 J**	1 U	1 U	1 U	
	p-Isopropyltoluene		**3.4**	**2.3**	1 U	1 U	
h	1,4-Dichlorobenzene		**1.6**	**1.5**	1 U	1 U	4 ug/L
	n-Butylbenzene		**0.11 J**	1 U	1 U	1 U	
	Naphthalene		**1.2**	**1.2**	1 U	1 U	

		Location:	Inf-E	Eff-E	Washington State
		Type:	comp	comp	Water Quality Criteria
		Date:	4/28-29	4/28-29	for Ground Waters
		Time:	0800-0800	0800-0800	
		Lab Log#:	188133	188139	
	BNA Compounds				
(Group)[1]					
	Phenol		**12 J**	0.27 UJ	
h	1,4-Dichlorobenzene		**1.1 J**	0.27 U	4 ug/L
	Benzyl Alcohol		**9.6** J	0.13 UJ	
	4-Methylphenol		**38**	0.27 U	
	Isophorone		1.3 U	**0.09 J**	
	Benzoic Acid		**143 E**	**3.1 J**	
	2,4-Dichlorophenol		**1.3 U**	0.14 J	
n	Naphthalene		**0.2 J**	0.27 U	
	4-Chloroaniline		**1.6 J**	0.13 UJ	
	2-Methylnaphthalene		**0.23 J**	0.13 U	
	1-Methylnaphthalene		**0.18 J**	0.27 U	
n	Acenaphthylene		**0.4 J**	0.27 U	
i	Diethyl Phthalate		**6.6**	0.27 U	
k	N-Nitrosodiphenylamine		**1.1 J**	0.27 U	17 ug/L
	Caffeine		**27**	0.13 U	
i	Di-n-Butyl Phthalate		**1.9**	0.27 U	
i	Butylbenzyl Phthalate		**3.2**	0.27 U	
i	Bis(2-Ethylhexyl)Phthalate		**17**	**2.1**	6 ug/L

References

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Sinclair, Kirk, 1998. Basic American Foods Class II Groundwater Inspection, Washington State Department of Ecology, Olympia, WA.

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Appendix A. Sampling Procedures - Moses Lake, April 1998

Ecology Isco composite samplers were set up to collect equal volumes of sample every 30 minutes for 24 hours. The samples were then divided into subsamples for analysis. The compositors were iced to preserve samples.

The Moses Lake influent compositor collected a flow-weighted sample. The Moses Lake effluent compositor is normally set to collect sample once every 30 minutes. During this inspection, the compositor was set to collect equal volumes of sample once per hour in order to provide a greater volume of sample for split sample analyses.

Ecology and Moses Lake influent and effluent composite samples were split for both Ecology and Moses Lake laboratory analysis. Sampler configurations and locations are summarized in Figure 2 and Table 1.

Appendix B. Sampling Schedule - Moses Lake, April 1998

Parameter	Location:	Inf-1	Inf-2	TrnsBlk	Inf-E	Inf-M
	Type:	grab	grab	grab	comp	comp
	Date:	4/28	4/28	4/27	4/28-29	4/28-29
	Time:	0835	1335	1420	0800-0800	0800-0800
	Lab Log #:	188130	188131	188132	188133	188134
Conductivity		E	E		EM	EM
Alkalinity					E	E
Hardness					E	E
TS					E	E
TNVS					E	E
TSS		E	E		EM	EM
TNVSS					E	E
Sodium					E	
Calcium					E	
Magnesium					E	
Chloride					E	
BOD5					EM	EM
COD					E	E
TOC (water)		E	E		E	E
Total Kjeldahl Nitrogen (TKN)					E	E
NH3-N		E	E		E	E
NO2 + NO3-N		E	E		E	E
NO2-N					E	E
Total-P		E	E		E	E
Ortho-PO4-P					E	E
VOC (water)		E	E			
VOC (water - spike, dupe)						
BNAs (water)					E	
BNAs (water - spike, dupe)						
PP Metals (water)				E	E	
PP Metals (water - spike, dupe)						
F-Coliform MF (#/100mL)						

Inf - influent
Eff - effluent
Aer - aeration basin
- E - Ecology sample
- M - Moses Lake sample
E - Ecology analysis
M- Moses Lake analysis

Appendix B. Moses Lake, April 1998 (Cont'd)

Parameter II	Locatn:	Aer-1	Aer-2	Eff-1	Eff-2	Eff-E	Eff-M	Eff-3	Eff-4
	Type:	grab	grab	grab	grab	comp	comp	grab	grab
	Date:	4/28	4/28	4/28	4/28	4/28-29	4/28-29	4/29	4/29
	Time:	0845	1345	0915	1405	0800-0800	0800-0800	0845	0850
		188135	188136	188137	188138	188139	188140	188141	188142
Conductivity				E	E	EM	EM		
Alkalinity						E	E		
Hardness						E	E		
TS		E	E			E	E		
TNVS	Inf - influent	E	E			E	E		
TSS	Eff - effluent	E	E	E	E	EM	EM		
TNVSS	Aer - aeration E		E			E	E		
Sodium	- E - Ecology sample					E			
Calcium	- M - Moses Lake sample					E			
Magnesium	E - Ecology analysis					E			
Chloride	M- Moses Lake analysis					E			
BOD5						EM	EM		
COD						E	E		
TOC (water)				E	E	E	E		
Total Kjeldahl Nitrogen (TKN						E	E		
NH3-N				E	E	E	E		
NO2 + NO3-N				E	E	E	E		
NO2-N						E	E		
Total-P				E	E	E	E		
Ortho-PO4-P						E	E		
VOC (water)				E	E				
VOC (water - spike, dupe)									
BNAs (water)						E			
BNAs (water - spike, dupe)									
PP Metals (water)						E			
PP Metals (water - spike, dupe)						E			
F-Coliform MF (#/100mL)								E	E

Appendix C. Ecology Analytical Methods - Moses Lake, April 1998

Laboratory Analysis	Method Used for Ecology Analysis	Laboratory Performing Analysis
Conductivity	EPA, Revised 1983: 120.1	Ecology Manchester Laboratory
Alkalinity	EPA, Revised 1983: 310.1	Ecology Manchester Laboratory
Hardness	EPA, Revised 1983: 130.2	Ecology Manchester Laboratory
TS	EPA, Revised 1983: 160.3	Ecology Manchester Laboratory
TNVS	EPA, Revised 1983: 160.3	Ecology Manchester Laboratory
TSS	EPA, Revised 1983: 160.2	Ecology Manchester Laboratory
TNVSS	EPA, Revised 1983: 160.2	Ecology Manchester Laboratory
TDS	EPA, Revised 1983: 160.1	Ecology Manchester Laboratory
Sodium	EPA, Revised 1983: 200.7	Ecology Manchester Laboratory
Calcium	EPA, Revised 1983: 200.7	Ecology Manchester Laboratory
Magnesium	EPA, Revised 1983: 200.7	Ecology Manchester Laboratory
Chloride	EPA, Revised 1983: 300.0	Ecology Manchester Laboratory
BOD5	EPA, Revised 1983: 405.1	Ecology Manchester Laboratory
COD	EPA, Revised 1983: 410.1	Sound Analytical
TOC (water)	EPA, Revised 1983: 160.2	Ecology Manchester Laboratory
Total Kjeldahl Nitrogen (TKN)	EPA, Revised 1983: 351.3	Ecology Manchester Laboratory
NH3-N	EPA, Revised 1983: 350.1	Ecology Manchester Laboratory
NO2+NO3-N	EPA, Revised 1983: 353.2	Ecology Manchester Laboratory
Total-P	EPA, Revised 1983: 365.3	Ecology Manchester Laboratory
Ortho-PO4-P	EPA, Revised 1983: 365.3	Ecology Manchester Laboratory
F-Coliform MF	APHA, 1989: 9222D.	Ecology Manchester Laboratory
VOC (water) - Extensive TICs	EPA, 1986: 8260	Ecology Manchester Laboratory
BNAs (water) - Extensive TICs	EPA, 1986: 8270	Ecology Manchester Laboratory
PP Metals (water)	EPA, Revised 1983: 200-299	Ecology Manchester Laboratory

METHOD BIBLIOGRAPHY

APHA-AWWA-WPCF, 1989. Standard Methods for the Examination of Water and Wastewater, 17th Edition.

EPA, Revised 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (Rev. March, 1983).

EPA, 1986: SW846. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, 3rd Ed., November 1986.

Appendix D. Quality Assurance/Quality Control (QA/QC) - Moses Lake, April 1998.

SAMPLING QA/QC

Ecology quality assurance procedures for sampling included cleaning of sampling equipment for priority pollutant analyses prior to the inspection to prevent sample contamination (Appendix E). Chain-of-custody procedures were followed to assure the security of the samples (Ecology, 1994b).

General Chemistry Analyses

The data generated by the analysis of these samples can be used noting the qualifications that appear in Table 2 (General Chemistry Results). Total phosphorus (TP) for sample 188130 (Inf-1) and the associated duplicate are qualified by estimates. The RPD is outside the acceptance window.

Holding times, instrument calibration, procedural blanks, spiked sample analyses, and spike and duplicate sample results, and laboratory control sample analyses were all within established regulatory quality assurance guidelines.

Priority Pollutant Organics Analyses

The data is usable as reported. For VOAs, no target compounds were detected in the laboratory blanks. For BNAs, low levels of some analytes were detected in the laboratory blanks. All analytes were considered native to the sample when the concentration was at least five times the associated method blank, or ten times for phthalates. All surrogate recoveries were within acceptable limits. Analyses occurred within recommended holding times. All VOA matrix spike recoveries were within acceptable limits. BNA analytes with recoveries below 50% in one or both spikes have been qualified as estimates in the corresponding samples.

Metals Analyses

Data quality for metals met all quality assurance and quality control criteria. No significant quality assurance issues were noted with the data. Analyses occurred within recommended holding times. All initial and continuing calibration verification standards were within the relevant method control limits. The procedural blanks associated with these samples showed no analytically significant level of analyte. All spike recoveries were within acceptable limits. The relative percent difference for the analytes of all spiked and duplicate spiked samples were within acceptance windows.

Appendix E. Priority Pollutant Metals Cleaning Procedures - Moses Lake, April 1998

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURES

1. Wash with laboratory detergent (phosphate-free)
2. Rinse several times with tap water
3. Rinse with 10% HNO_3 solution
4. Rinse three times with distilled/deionized water
5. Rinse with high purity acetone
6. Rinse with high purity hexane
7. Allow to dry and seal with aluminum foil

Appendix F. VOA, BNA, and Metals Scan Results - Moses Lake - April, 1998

	Location:	Inf-1	Inf-2	Eff-1	Eff-2
	Type:	grab	grab	grab	grab
	Date:	4/28	4/28	4/28	4/28
	Time:	0835	1335	0915	1405
	Lab Log#:	188130	188131	188137	188138
VOA Compounds		ug/L	ug/L	ug/L	ug/L
Dichlorodifluoromethane		1 U	1 U	1 U	1 U
Chloromethane		1 U	1 U	1 U	1 U
Vinyl Chloride		1 U	1 U	1 U	1 U
Bromomethane		1 U	1 U	1 U	1 U
Chloroethane		1 U	1 U	1 U	1 U
Trichlorofluoromethane		1 U	1 U	1 U	1 U
Ethyl Ether		1 U	1 U	1 U	1 U
1,1,2 Trichlorotrifluoroethane		1 U	1 U	1 U	1 U
1,1-Dichloroethene		1 U	1 U	1 U	1 U
Acetone		109	78	3	3.6
Methyl Iodide		1 U	1 U	1 U	1 U
Carbon Disulfide		0.72 J	2 U	2 U	2 U
Allyl Chloride		1 U	1 U	1 U	1 U
Methylene Chloride		2 U	2 U	2 U	2 U
Acrylonitrile		1 U	1 U	1 U	1 U
2-Methyoxy-2-Methylpropane		1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene		1 U	1 U	1 U	1 U
1,1-Dichloroethane		1 U	1 U	1 U	1 U
2-Butanone (MEK)		5.3	4.4	2 U	2 U
cis-1,2-Dichloroethene		1 U	0.28 J	1 U	1 U
2,2-Dichloropropane		1 U	1 U	1 U	1 U
Methyl acrylate		1 U	1 U	1 U	1 U
Methyacrilonitrile		1 U	1 U	1 U	1 U
Bromochloromethane		1 U	1 U	1 U	1 U
Chloroform		2.9	1.9	1 U	1 U
Tetrahydrofuran		0.6 J	1 U	1 U	1 U
1,1,1-Trichloroethane		1 U	1 U	1 U	1 U
1-Chlorobutane		1 U	1 U	1 U	1 U
1,1-Dichloropropene		1 U	1 U	1 U	1 U
Carbon Tetrachloride		1 U	1 U	1 U	1 U
1,2-Dichloroethane		1 U	1 U	1 U	1 U
Benzene		1 U	1 U	1 U	1 U
Trichloroethene		1 U	1 U	1 U	1 U
1,2-Dichloropropane		1 U	1 U	1 U	1 U
Methyl Methacrylate		1 U	1 U	1 U	1 U
Dibromomethane		0.25 J	0.22 J	1 U	1 U
Bromodichloromethane		1 U	1 U	1 U	1 U
2-Nitropropane		1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene		1.1 U	1.1 U	1.1 U	1.1 U
4-Methyl-2-Pentanone (MIBK)		2 U	2 U	2 U	2 U
1,1-Dichloropropanone		1 U	1 U	1 U	1 U
Toluene		2	2	0.13 J	0.13 J
trans-1,3-Dichloropropene		0.94 U	0.94 U	0.94 U	0.94 U
Ethylmethacrylate		1 U	1 U	1 U	1 U
1,1,2-Trichloroethane		1 U	1 U	1 U	1 U

Appendix F. Moses Lake, April 1998 (Cont'd)

Location:	Inf-1	Inf-2	Eff-1	Eff-2
Type:	grab	grab	grab	grab
Date:	4/28	4/28	4/28	4/28
Time:	0835	1335	0915	1405
Lab Log#:	188130	188131	188137	188138
VOA Compounds (cont'd)	ug/L	ug/L	ug/L	ug/L
1,3-Dichloropropane	1 U	1 U	1 U	1 U
2-Hexanone	2 U	2 U	2 U	2 U
Tetrachloroethene	**0.38 J**	**0.24 J**	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U
1,2-Dibromoethane (EDB)	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U
1,1,1,2-Tetrachloroethane	1 U	1 U	1 U	1 U
Ethylbenzene	**0.074 J**	**0.31 J**	1 U	1 U
m&p-Xylene	**0.2 J**	**1.7 J**	2 U	2 U
o-Xylene	1 U	**0.54 J**	1 U	1 U
Styrene (Ethenylbenzene)	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U
Isopropylbenzene	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U
Trans-1,4-Dichloro-2-butene	1 U	1 U	1 U	1 U
1,2,3-Trichloropropane	1 U	1 U	1 U	1 U
Bromobenzene	1 U	1 U	1 U	1 U
n-Propylbenzene	1 U	1 U	1 U	1 U
2-Chlorotoluene	1 U	1 U	1 U	1 U
1,3,5-Trimethylbenzene	1 U	1 U	1 U	1 U
4-Chlorotoluene	1 U	1 U	1 U	1 U
tert-Butylbenzene	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	**0.32 J**	1 U	1 U	1 U
Pentachloroethane	1 U	1 U	1 U	1 U
sec-Butylbenzene	1 U	1 U	1 U	1 U
p-Isopropyltoluene	**3.4**	**2.3**	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	**1.6**	**1.5**	1 U	1 U
n-Butylbenzene	**0.11 J**	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U
Hexachloroethane	1 U	1 U	1 U	1 U
1,2-Dibromo-3-Chloropropane	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	1 U	1 U	1 U	1 U
Hexachlorobutadiene	1 U	1 U	1 U	1 U
Naphthalene	**1.2**	**1.2**	1 U	1 U
1,2,3-Trichlorobenzene	1 U	1 U	1 U	1 U

U - The analyte was not detected at or above the associated value.

J - The analyte was positively identified. The associated numerical value is an estimate.

bold - detected analyte

E - Reported result is an estimate because of the presence of interference.

grab - grab sample

Appendix F. Moses Lake, April 1998 (Cont'd)

Location:	Inf-E		Eff-E	
Type:	comp		comp	
Date:	4/28-29		4/28-29	
Time:	0800-0800		0800-0800	
Lab Log#:	188133		188139	
BNA Compounds				
N-Nitrosodimethylamine	1.3	UJ	0.27	UJ
Pyridine	1.3	U	0.27	U
Aniline	0.65	UJ	0.13	UJ
Phenol	**12**	**J**	0.27	UJ
Bis(2-Chloroethyl)Ether	1.3	U	0.27	U
2-Chlorophenol	1.3	U	0.27	U
1,3-Dichlorobenzene	1.3	U	0.27	U
1,4-Dichlorobenzene	**1.1**	**J**	0.27	U
1,2-Dichlorobenzene	1.3	U	0.27	U
Benzyl Alcohol	**9.6**	**J**	0.13	UJ
2-Methylphenol	1.3	U	0.27	U
2,2'-Oxybis[1-chloropropane]	0.65	U	0.13	U
N-Nitroso-di-n-Propylamine	1.3	U	0.27	U
4-Methylphenol	**38**		0.27	U
Hexachloroethane	1.3	UJ	0.27	UJ
Nitrobenzene	1.3	U	0.27	U
Isophorone	1.3	U	**0.09**	**J**
2-Nitrophenol	3.2	U	0.67	U
2,4-Dimethylphenol	1.3	U	0.27	U
Bis(2-Chloroethoxy)Methane	1.3	U	0.27	U
Benzoic Acid	**143**	**E**	**3.1**	**J**
2,4-Dichlorophenol	1.3	U	**0.14**	**J**
1,2,4-Trichlorobenzene	1.3	U	0.27	U
Naphthalene	**0.2**	**J**	0.27	U
4-Chloroaniline	**1.6**	**J**	0.13	UJ
Hexachlorobutadiene	1.3	U	0.27	U
4-Chloro-3-Methylphenol	1.3	U	0.27	U
2-Methylnaphthalene	**0.23**	**J**	0.13	U
1-Methylnaphthalene	**0.18**	**J**	0.27	U
Hexachlorocyclopentadiene	3.2	UJ	0.67	UJ
2,4,6-Trichlorophenol	1.3	U	0.27	U
2,4,5-Trichlorophenol	1.3	U	0.27	U
2-Chloronaphthalene	0.65	U	0.13	U
2-Nitroaniline	3.2	U	0.67	U
Dimethyl Phthalate	1.3	U	0.27	U
2,6-Dinitrotoluene	3.2	U	0.67	U
Acenaphthylene	**0.4**	**J**	0.27	U
3-Nitroaniline	3.2	UJ	0.67	UJ
Acenaphthene	0.65	U	0.13	U
2,4-Dinitrophenol	52	U	11	U
4-Nitrophenol	3.2	U	0.67	U
Dibenzofuran	0.65	U	0.13	U
2,4-Dinitrotoluene	3.2	U	0.67	U
Diethyl Phthalate	**6.6**		0.27	U
Fluorene	0.65	U	0.13	U
4-Chlorophenyl Phenylether	1.3	U	0.27	U
4-Nitroaniline	3.2	UJ	0.67	UJ

Appendix F. Moses Lake, April 1998 (Cont'd)

Location:	Inf-E	Eff-E
Type:	comp	comp
Date:	4/28-29	4/28-29
Time:	0800-0800	0800-0800
Lab Log#:	188133	188139

BNA Compounds (cont'd)

4,6-Dinitro-2-Methylphenol	13 U	2.7 U
N-Nitrosodiphenylamine	**1.1 J**	0.27 U
Hydrazine, 1,2-Diphenyl-	0.65 U	0.13 U
4-Bromophenyl Phenylether	1.3 U	0.27 U
Hexachlorobenzene	1.3 U	0.27 U
Pentachlorophenol	3.2 U	0.67 U
Phenanthrene	0.65 U	0.13 U
Anthracene	1.3 U	0.27 U
Caffeine	**27**	0.13 U
Carbazole	1.3 U	0.27 U
Di-n-Butyl Phthalate	**1.9**	0.27 U
Fluoranthene	0.65 U	0.13 U
Benzidine	6.5 UJ	1.3 UJ
Pyrene	1.3 U	0.27 U
Retene	1.3 U	0.27 U
Butylbenzyl Phthalate	**3.2**	0.27 U
Benzo(a)Anthracene	1.3 U	0.27 U
3,3'-Dichlorobenzidine	1.3 U	0.27 U
Chrysene	1.3 U	0.27 U
Bis(2-Ethylhexyl)Phthalate	**17**	**2.1**
Di-n-Octyl Phthalate	3.2 U	0.67 U
Benzo(b)Fluoranthene	1.3 U	0.27 U
Benzo(k)Fluoranthene	1.3 U	0.27 U
Benzo(a)Pyrene	0.65 U	0.13 U
Indeno(1,2,3-cd)Pyrene	3.2 U	0.67 U
Dibenzo(a,h)Anthracene	1.3 U	0.27 U
Benzo(g,h,i)Perylene	6.5 UJ	1.3 UJ

U - The analyte was not detected at or above the associated value.

J - The analyte was positively identified. The associated numerical value is an estimate.

UJ - The analyte was not detected at or above the associated estimated value.

bold - detected analyte

E - Reported result is an estimate because of the presence of interference.

comp - composite sample

Appendix F. Moses Lake, April 1998 (Cont'd)

	Location:	Inf-2	Inf - E	Eff-E	Trnsblk
	Type:	grab	comp	comp	grab
	Date:	4/28	4/28-29	4/28-29	4/27
	Time:	1335	0800-0800	0800-0800	1420
	Lab Log#:	188131	188133	188139	188132
		(ug/L)	(ug/L)	(ug/L)	(ug/L)
Metals (total)					
Antimony		1 UJ	**2.3 J**	1 UJ	1 UJ
Arsenic		**3.1**	**3.3**	**3.9**	0.5 U
	Pentavalent				
	Trivalent				
Beryllium		1 U	1 U	1 U	1 U
Cadmium		**1.23**	**0.59**	0.1 U	0.1 U
Chromium		5 U	**5.0**	5 U	**5.3**
	Hexavalent				
	Trivalent				
Copper		**177**	**64.7**	**5.0**	3 U
Lead		**13.4**	**12.6**	**1.49 J**	**0.83 J**
Mercury		**0.12**	**0.46**	0.05 U	0.05 U
Nickel		10 U	10 U	10 U	10 U
Selenium		2 U	2 U	2 U	2 U
Silver		**4.52**	**7.92**	**1.05**	0.1 U
Thallium		0.1 U	0.1 U	0.1 U	0.1 U
Tin					
Zinc		**92.5**	**82.9**	**12**	**5.8**

E - Ecology sample
Inf - influent sample
Eff - effluent sample
Trnsblk - transfer blank

Bold - detected analyte
U - The analyte was not detected at or above the reported result.
J - estimated value
UJ - undetected at estimated detection level

Appendix G. Glossary of Terms – Moses Lake, April 1998.

BAF - Basic American Foods
BNA - base-neutral acid extractables (semivolatile organics)
BOD_5 - five day biochemical oxygen demand
COD - chemical oxygen demand
comp - composite sample
E - Department of Ecology
Eff - effluent
EPA - United States Environmental Protection Agency
g - gram
grab - grab sample
mg - milligram
mg/L - milligram per liter
M- Moses Lake
pH - $-\log_{10}$ (hydrogen ion concentration)
QA - quality assurance
QC - quality control
TNVS - total nonvolatile solids
TNVSS - total nonvolatile suspended solids
TOC - total organic carbon
TS - total solids
TSS - total suspended solids
VOA - volatile organic analysis
WWTP - wastewater treatment plant