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MOSES LAKE WATER QUALITY DATA, 1982

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INTRODUCTION

The data presented herein were collected in 1982 by Lynn Singleton and other Water Quality Investigations Section (WQIS) staff during receiving water surveys in Moses Lake. The Ecology Eastern Regional Office (ERO) asked WQIS to perform the work in order to measure lake water quality before and after cessation of discharge from the city of Moses Lake Wastewater Treatment Plant (WTP). Completion of the receiving water studies was precluded because an ongoing lake restoration program includes comprehensive post-restoration monitoring. Sampling is scheduled to begin in 1987 and should provide data concerning water quality improvements.

BACKGROUND

Moses Lake is a 6,800 acre (2,750 ha) impoundment of Crab Creek in eastern Washington (Figure 1). Although natural in origin, a dam was installed to control water levels. Moses Lake is eutrophic, with a mean depth of 18.5 ft. (5.6 m) and a flushing rate of about twice per year. Two arms of the lake, Parker Horn and Pelican Horn, partially surround the city of Moses Lake (pop. 11,000).

The lake is fed by Crab Creek, Rocky Ford Creek, small irrigation wasteways, and ground water inputs. Release of water occurs at two outlet structures located at the southern end of the lake. One outlet is operated by the Bureau of Reclamation, while the other is operated by the Moses Lake Irrigation District. Several smaller withdrawals from Moses Lake provide additional irrigation water to area farmers.

Research in the 1960s and 1970s by Eugene Welch (University of Washington) and others found excessive nutrient loads were encouraging nuisance algal growths in Moses Lake. Poor irrigation practices in the basin and direct discharge of Moses Lake WTP effluent to the lake were major causes of enrichment. Welch and others felt that eutrophication could be controlled by improved land-use practices in the watershed, diversion of the WTP discharge, and controlled addition of low-nutrient Columbia River dilution water to Moses Lake.

A lake restoration project was initiated in 1977. Features of the restoration program included: 1) implementation of a land-use management program to improve irrigation-land practices; 2) cessation of WTP discharges to the lake; 3) dilution of nutrient-rich Moses Lake water by adding nutrient-poor East Low Canal water to Parker Horn via Rocky Coulee Wasteway and lower Crab Creek; and 4) diversion of water from Parker Horn to Pelican Horn via a pipe and pumping facility.

The land-use management program is ongoing and scheduled to continue through 1989. Participants include the Department of Ecology, Environmental Protection Agency, Soil Conservation Service, Moses Lake Irrigation District, and City of Moses Lake. WTP discharges were terminated in March 1984 upon construction of a new WTP with land application. Diversion of East Low Canal (i.e., Columbia River) water to Parker Horn during summer months began in 1977 and pumping of lake water from Parker Horn to Pelican Horn began in 1982.

METHODS

Water quality samples were collected at 13 stations in the immediate Moses Lake watershed (Figure 1). Sites 1-10 were located on the lake, while sites 11-13 characterized tributary inflows. Temperature, pH, conductivity, dissolved oxygen, and oxidation-reduction potential were measured *in situ* with a Hydrolab. Water transparency was determined using a 20-cm Secchi disk. Water samples were collected with a Kemmerer bottle, iced, kept in the dark, and transported to the Ecology Environmental Laboratory within 24 hours for analysis as per EPA (1979) and APHA *et al*. (1980).

Composite receiving water samples were collected by combining equal aliquots of water from all depths sampled. Chlorophyll and pheophytin composites were collected from the euphotic zone, which was taken as two times the Secchi disk depth. Each composite sample was drawn from at least three depths. Composite samples were collected from the WTP and International Titanium Incorporated (ITI) every 30 minutes over a 24-hour period.

Streamflow measurements in Crab Creek were obtained from records of USGS gage 12467000 (USGS, 1985). Flow at Rocky Ford Creek was estimated using the procedure of Buchanan and Somers (1969); current velocities required for discharge estimation were measured with a Marsh-McBirney current meter. Flows in the Rocky Coulee Wasteway were approximated by F. Jensen (Bureau of Reclamation, personal communication). WTP flows were provided by Roger Ray of Ecology's ERO.

RESULTS

Table 1 presents water quality data from Moses Lake and several tributary streams. Table 2 presents wastewater quality data from Moses Lake WTP and ITI, which began discharging industrial wastewater to the city sewer in March 1982. A bibliography of additional studies addressing Moses Lake water quality can be found in Appendix A.

Flow patterns in 1982 were variable. Dilution water flows exceeded 700 cfs during the June 1982 survey, but ceased August 2 (F. Jensen, Bureau of Reclamation, personal communication). Diversion of lake water from Parker Horn to Pelican Horn began July 1, 1982 at a rate of 50 cfs. Pumping during that year ceased October 2. Hence, diversion of low nutrient waters to Pelican Horn was not occurring during either the June or September water quality surveys.

LITERATURE CITED

APHA *et al*. (American Public Health Association, American Water Works Association, and Water Pollution Control Federation), 1980. Standard Methods for the Examination of Water and Wastewater. 15th ed., Washington D.C., 1134 pp.

Buchanan, T.J., and W.P. Somers, 1969. Discharge measurements at gaging stations. In: Techniques of Water-Resources Investigations of the United States Geological Survey, Book 3: Applications of Hydraulics. U.S. Govt. Printing Office, Washington, D.C., 65 pp.

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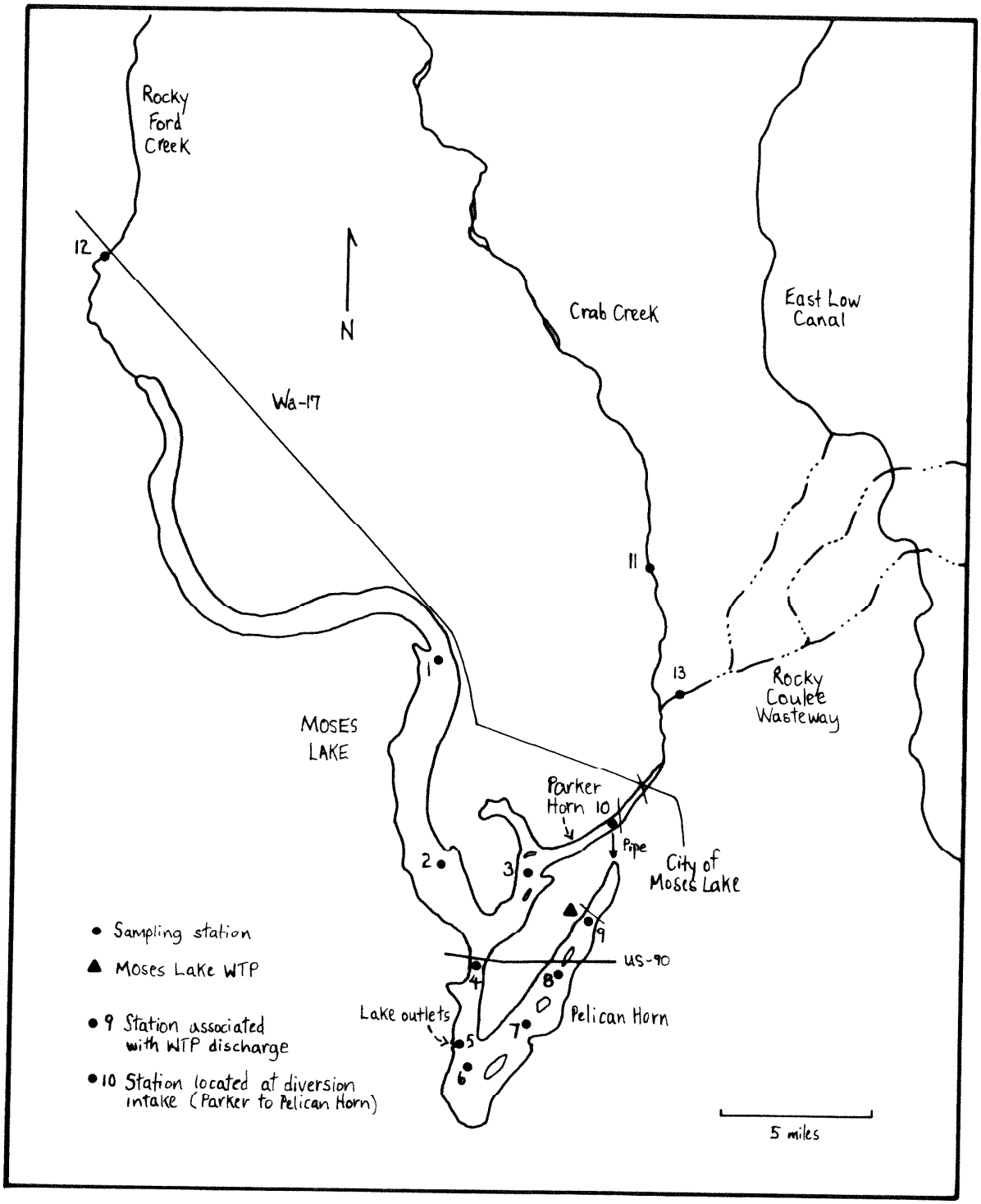

Figure 1. Map of Moses Lake and tributary streams, showing location of sampling stations and City of Moses Lake WTP.

TABLE 1. WATER QUALITY DATA COLLECTED IN MOSES LAKE AND TRIBUTARIES IN THE SUMMER OF 1982
("-" denotes parameter not measured or data missing)

Station	Date	FIELD									LABORATORY																
		Depth (m) a/	Flow (cfs)	pH (S.U.)	Temperature (°C)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Oxidation-Reduction Potential (mV)	Secchi Disk Transparency (ft)	Specific Conductance (umhos/cm)	NO_3-N (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	O-PO_4-P (mg/L)	T-PO_4-P (mg/L)	Total Suspended Solids (mg/L)	Sodium as Na (mg/L)	Potassium as K (mg/L)	Chloride as Cl (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Calcium Hardness as $CaCO_3$ (mg/L)	Total Hardness as $CaCO_3$ (mg/L)	Chlorophyll a (ug/L)	Pheophytin a (ug/L)	Fecal Coliform (No./100 ml)
1	6/15/82	0	-	8.4	22.6	305	9.6	114	138	12.2	-	0.09	< 0.01	0.13	0.02	0.04	-	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.3	20.7	278	8.6	99	144	-	-	0.07	< 0.01	0.07	0.02	0.06	-	-	-	-	-	-	-	-	-	-	-
		4	-	8.3	20.2	293	8.6	98	148	-	-	0.07	< 0.01	0.11	0.03	0.07	-	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	275	-	-	-	-	-	-	19	5.1	5.4	140	120	130	-	-	-
	6/16/82	0	-	8.7	22.6	274	5.9	70	186	12.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	-	-	-	-	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	266	-	-	-	-	-	-	17	4.4	5	110	88	100	12	0.5	-
	9/9/82	0	-	8.7	22.5	248	-	-	157	6.0	-	0.02	< 0.01	0.16	0.03	0.07	-	-	-	-	-	-	-	-	-	-	-
		2	-	8.6	22.4	248	-	-	154	-	-	0.03	< 0.01	0.13	0.03	0.07	-	-	-	-	-	-	-	-	-	-	-
		4	-	8.5	21.4	250	-	-	156	-	-	0.03	< 0.01	0.18	0.03	0.06	-	-	-	-	-	-	-	-	-	-	-
2	6/15/82	0	-	8.4	20.5	246	10.0	114	141	13.0	-	0.02	< 0.01	0.01	0.01	0.03	-	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.4	19.5	254	9.6	108	149	-	-	0.02	< 0.01	0.02	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-
		4	-	8.1	18.2	254	7.8	85	166	-	-	0.03	< 0.01	0.05	0.03	0.05	-	-	-	-	-	-	-	-	-	-	-
		6	-	7.9	17.4	232	6.8	73	178	-	-	0.04	< 0.01	0.08	0.02	0.04	-	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	250	-	-	-	-	-	-	15	3.7	3.8	120	110	120	4.2	1.2	-
	6/16/82	-	-	-	-	-	-	-	-	13.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	262	-	-	-	-	-	-	17	5.2	4	110	88	100	6.8	0.5	-
	9/9/82	0	-	8.4	21.9	248	-	-	165	7.0	-	0.03	< 0.01	0.25	0.04	0.07	-	-	-	-	-	-	-	-	-	-	-
		2	-	8.4	21.7	248	-	-	164	-	-	0.03	< 0.01	0.25	0.05	0.09	-	-	-	-	-	-	-	-	-	-	-
		4	-	8.3	21.5	248	-	-	164	-	-	0.03	< 0.01	0.30	0.05	0.10	-	-	-	-	-	-	-	-	-	-	-
		6	-	8.3	21.2	248	-	-	164	-	-	0.03	< 0.01	0.28	0.04	0.07	-	-	-	-	-	-	-	-	-	-	-
		8	-	7.9	21.0	251	-	-	173	-	-	0.03	0.01	0.50	0.08	0.08	-	-	-	-	-	-	-	-	-	-	-
3	6/15/82	0	-	8.5	22.0	210	10.6	125	183	> 7.0 b/	-	0.02	< 0.01	0.02	< 0.01	0.03	-	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.4	21.4	206	8.9	104	178	-	-	0.02	< 0.01	0.03	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	218	-	-	-	-	-	-	8.7	2.4	3.1	98	88	96	6.0	2.2	-
	6/16/82	-	-	-	-	-	-	-	-	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	257	-	-	-	-	-	-	18	5.0	5	110	92	100	29	11	-
	9/9/82	0	-	8.8	22.6	258	-	-	144	3.9	-	< 0.01	< 0.01	0.05	0.03	0.09	-	-	-	-	-	-	-	-	-	-	-
		2	-	8.8	22.4	257	-	-	141	-	-	< 0.01	< 0.01	0.03	0.03	0.10	-	-	-	-	-	-	-	-	-	-	-

Footnotes: a/ C = Composite sample, surface to bottom (composites for chlorophyll and pheophytin from euphotic zone only).

b/ Secchi depth greater because disk on bottom.

c/ Estimated (FC count was less than the required minimum of 20 colonies per plate).

d/ Approximate (F. Jensen, Bureau of Reclamation, personal communication).

TABLE 1. WATER QUALITY DATA COLLECTED IN NOSES LAKE AND TRIBUTARIES IN THE SUMMER OF 1982 (Continued)
("-" denotes parameter not measured or data missing)

		FIELD									LABORATORY																
Station	Date	Depth (m) a/	Flow (cfs)	pH (S.U.)	Temperature (°C)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Oxidation-Reduction Potential (mV)	Secchi Disk Transparency (ft)	Specific Conductance (umhos/cm)	NO_3-N (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	O-PO_4-P (mg/L)	T-PO_4-P (mg/L)	Total Suspended Solids (mg/L)	Sodium as Na (mg/L)	Potassium as K (mg/L)	Chloride as Cl (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Calcium Hardness as $CaCO_3$ (mg/L)	Total Hardness as $CaCO_3$ (mg/L)	Chlorophyll a (ug/L)	Pheophytin a (ug/L)	Fecal Coliform (No./100 mL)
4	6/15/82	0	-	8.7	22.5	261	9.2	109	183	6.0	-	< 0.01	< 0.01	0.05	0.02	0.04	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.7	22.1	261	9.3	110	178	-	-	< 0.01	< 0.01	0.02	0.02	0.05	-	-	-	-	-	-	-	-	-	-
		4	-	8.6	21.5	261	10.2	119	176	-	-	< 0.01	< 0.01	0.01	0.02	0.05	-	-	-	-	-	-	-	-	-	-
		6	-	8.4	19.5	257	9.2	103	184	-	-	0.02	< 0.01	0.10	0.03	0.06	-	-	-	-	-	-	-	-	-	-
		8	-	7.5	16.4	282	4.9	52	221	-	-	0.01	< 0.01	0.34	0.11	0.20	-	-	-	-	-	-	-	-	-	-
		10	-	7.3	15.4	305	5.2	54	-135	-	-	0.01	< 0.01	0.87	0.27	0.31	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	267	-	-	-	-	-	-	16	4.1	4.6	130	110	120	5.0	1.9	-
	6/16/82	-	-	-	-	-	-	-	-	11.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	262	-	-	-	-	-	-	17	4.6	6	120	96	110	43	3	-
	9/9/82	0	-	9.0	23.4	245	-	-	136	4.1	-	< 0.01	< 0.01	0.04	0.03	0.10	-	-	-	-	-	-	-	-	-	-
		2	-	9.0	23.2	245	-	-	128	-	-	< 0.01	< 0.01	0.02	0.04	0.11	-	-	-	-	-	-	-	-	-	-
		4	-	8.7	22.3	250	-	-	132	-	-	< 0.01	< 0.01	0.05	0.04	0.11	-	-	-	-	-	-	-	-	-	-
		6	-	8.4	21.4	253	-	-	139	-	-	0.03	< 0.01	0.30	0.06	0.08	-	-	-	-	-	-	-	-	-	-
		8	-	7.9	20.7	258	-	-	24	-	-	0.01	< 0.01	0.75	0.16	0.20	-	-	-	-	-	-	-	-	-	-
		10	-	7.2	19.3	292	-	-	-89	-	-	< 0.01	< 0.01	2.7	0.64	0.71	-	-	-	-	-	-	-	-	-	-
5	6/15/82	0	-	8.8	21.8	261	8.1	95	112	>5.5 b/	-	< 0.01	< 0.01	0.03	0.02	0.06	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.7	20.7	258	9.1	104	111	-	-	< 0.01	< 0.01	0.02	0.02	0.04	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	254	-	-	-	-	-	-	15	3.7	5.4	150	100	120	-	-	-
	6/16/82	-	-	-	-	-	-	-	-	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 c/
		C	-	-	-	-	-	-	-	-	246	-	-	-	-	-	-	18	4.8	6	110	80	96	-	-	-
	9/9/82	0	-	8.9	23.2	241	-	-	91	3.2	-	< 0.01	< 0.01	0.07	0.03	0.15	-	-	-	-	-	-	-	-	-	-
		1	-	8.9	22.9	244	-	-	91	-	-	< 0.01	< 0.01	0.06	0.03	0.13	-	-	-	-	-	-	-	-	-	-
6	6/15/82	0	-	8.6	22.4	276	10.1	120	155	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.7	21.6	279	10.2	119	150	-	-	< 0.01	< 0.01	0.06	0.04	0.08	-	-	-	-	-	-	-	-	-	-
		4	-	8.5	19.9	270	10.3	116	155	-	-	< 0.01	< 0.01	0.02	0.03	0.08	-	-	-	-	-	-	-	-	-	-
		6	-	8.0	18.6	265	10.2	112	174	-	-	0.01	< 0.01	0.06	0.06	0.09	-	-	-	-	-	-	-	-	-	-
		8	-	7.7	17.0	279	10.2	109	189	-	-	< 0.01	< 0.01	0.17	0.08	0.08	-	-	-	-	-	-	-	-	-	-
		10	-	7.4	15.8	305	8.0	83	-124	-	-	< 0.01	< 0.01	0.41	0.13	0.17	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	279	< 0.01	< 0.01	0.06	0.02	0.06	-	17	4.3	5.4	130	110	120	8.8	0.9	-
	6/16/82	-	-	-	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	272	-	-	-	-	-	-	18	4.8	6	120	96	100	26	1.7	-

Footnotes: a/ C = Composite sample, surface to bottom (composites for chlorophyll and pheophytin from euphotic zone only).

b/ Secchi depth greater because disk on bottom.

c/ Estimated (FC count was less than the required minimum of 20 colonies per plate).

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		FIELD									LABORATORY																
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	9/9/82	0	-	8.8	22.7	243	-	-	179	4.0	-	< 0.01	< 0.01	0.03	0.03	0.11	-	-	-	-	-	-	-	-	-	-
		2	-	8.6	22.4	244	-	-	179	-	-	0.02	< 0.01	0.11	0.03	0.08	-	-	-	-	-	-	-	-	-	-
		4	-	8.4	21.3	246	-	-	181	-	-	< 0.01	< 0.01	0.16	0.05	0.10	-	-	-	-	-	-	-	-	-	-
		6	-	8.4	21.0	246	-	-	183	-	-	0.01	< 0.01	0.18	0.04	0.08	-	-	-	-	-	-	-	-	-	-
		8	-	8.2	20.7	247	-	-	184	-	-	0.01	< 0.01	0.43	0.09	0.13	-	-	-	-	-	-	-	-	-	-
		10	-	7.0	19.2	290	-	-	-111	-	-	< 0.01	< 0.01	3.6	0.63	0.71	-	-	-	-	-	-	-	-	-	-
7	6/15/82	0	-	8.9	23.1	285	8.3	100	119	3.5	-	< 0.01	< 0.01	0.02	0.03	0.07	-	-	-	-	-	-	-	-	-	1 c/
		2	-	8.9	22.2	287	8.7	103	119	-	-	< 0.01	< 0.01	0.04	0.02	0.07	-	-	-	-	-	-	-	-	-	-
		4	-	8.4	20.2	282	8.3	94	134	-	-	0.01	< 0.01	0.10	0.04	0.04	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	285	-	-	-	-	-	-	18	4.5	6.1	130	120	120	9.1	0.8	-
	6/16/82	-	-	-	-	-	-	-	-	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	253	-	-	-	-	-	-	18	5.0	6	110	84	100	82	4	-
	9/9/82	0	-	9.0	22.9	245	-	-	172	2.5	-	< 0.01	< 0.01	0.03	0.04	0.16	-	-	-	-	-	-	-	-	-	-
		2	-	8.8	21.8	245	-	-	168	-	-	< 0.01	< 0.01	0.02	0.04	0.13	-	-	-	-	-	-	-	-	-	-
		4	-	8.5	21.4	254	-	-	178	-	-	< 0.01	< 0.01	0.16	0.07	0.12	-	-	-	-	-	-	-	-	-	-
8	6/15/82	0	-	8.9	23.7	290	9.9	120	145	3.0	-	< 0.01	< 0.01	0.01	0.03	0.07	-	-	-	-	-	-	-	-	-	< 1
		2	-	8.9	23.5	291	9.4	114	137	-	-	< 0.01	< 0.01	0.08	0.07	0.12	-	-	-	-	-	-	-	-	-	-
		C	-	-	-	-	-	-	-	-	291	-	-	-	-	-	-	18	4.6	6.9	130	110	120	7.8	2.9	-
	6/16/82	-	-	-	-	-	-	-	-	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
		C	-	-	-	-	-	-	-	-	266	-	-	-	-	-	-	19	5.2	6	110	88	110	66	1.2	-
	9/9/82	0	-	9.0	23.4	255	-	-	168	3.0	-	< 0.01	< 0.01	0.03	0.03	0.12	-	-	-	-	-	-	-	-	-	-
		2	-	9.0	22.8	256	-	-	155	-	-	0.01	< 0.01	0.04	0.03	0.15	-	-	-	-	-	-	-	-	-	-
9	6/15/82	0	-	9.4	26.1	456	8.2	104	120	-	459	0.02	< 0.01	0.03	0.53	0.69	-	49	11	23	190	140	150	56	14	< 1
	6/16/82	0	-	9.1	24.0	455	8.2	100	120	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/8/82	0	-	-	-	-	-	-	-	-	388	-	-	-	-	-	-	-	-	10	170	140	160	37	8.8	9 c/
	9/9/82	0	-	8.6	22.1	360	-	-	184	1.5	-	0.18	0.02	0.04	0.21	0.24	-	-	-	-	-	-	-	-	-	-
10	6/15/82	0	-	-	-	-	-	-	-	-	192	0.11	< 0.01	0.05	0.03	0.05	-	5.1	1.4	-	-	-	-	-	-	8 c/
	9/8/82	0	-	-	-	-	-	-	-	-	266	-	-	-	-	-	-	18	5.0	4	110	80	96	-	-	3 c/
	9/9/82	0	-	-	-	-	-	-	-	2.2	-	0.02	< 0.01	0.05	0.01	0.09	-	-	-	-	-	-	-	-	-	-

Footnotes: a/ C = Composite sample, surface to bottom (composites for chlorophyll and pheophytin from euphotic zone only).

b/ Secchi depth greater because disk on bottom.

c/ Estimated (FC count was less than the required minimum of 20 colonies per plate).

d/ Approximate (F. Jensen, Bureau of Reclamation, personal communication).

TABLE 1. WATER QUALITY DATA COLLECTED IN MOSES LAKE AND TRIBUTARIES IN THE SUMMER OF 1982 (Continued)
("-" denotes parameter not measured or data missing)

		FIELD									LABORATORY																
Station	Date	Depth (m) a/	Flow (cfs)	pH (S.U.)	Temperature (°C)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Oxidation-Reduction Potential (mV)	Secchi Disk Transparency (ft)	Specific Conductance (umhos/cm)	NO_3-N (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	O-PO_4-P (mg/L)	T-PO_4-P (mg/L)	Total Suspended Solids (mg/L)	Sodium as Na (mg/L)	Potassium as K (mg/L)	Chloride as Cl (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Calcium Hardness as $CaCO_3$ (mg/L)	Total Hardness as $CaCO_3$ (mg/L)	Chlorophyll a (ug/L)	Pheophytin a (ug/L)	Fecal Coliform (No./100 mL)
11	6/10/82	0	54	8.6	17.4	-	14.0	151	-	-	460	0.09	< 0.01	0.04	0.01	0.03	16	18	4.4	4.6	-	200	220	-	-	-
	6/15/82	0	-	-	-	-	-	-	-	-	460	0.65	0.02	0.02	0.02	0.04	-	17	4.0	4.6	210	180	200	-	-	16 c/
	7/12/82	0	75	8.7	25.0	-	18.8	234	-	-	425	0.40	< 0.05	0.28	< 0.01	-	10	18	4.5	5.4	-	160	180	-	-	18 c/
	8/5/82	0	78	8.4	16.4	-	12.8	135	-	-	480	0.06	< 0.05	0.02	< 0.01	0.03	12	19	4.0	7.0	-	200	220	-	-	64
	9/9/82	0	78	8.1	15.1	-	8.7	90	-	-	497	0.72	0.02	0.01	< 0.01	0.02	7	21	5.4	4	230	220	240	-	-	340
12	6/10/82	0	-	8.1	17.6	385	8.5	92	-	-	353	1.2	0.03	0.30	0.14	0.15	24	22	8.1	6.1	-	120	140	-	-	-
	6/15/82	0	-	-	-	-	-	-	-	-	385	0.89	0.04	0.22	0.14	0.18	-	22	7.8	6.1	160	140	150	-	-	71
	7/12/82	0	-	8.2	22.4	370	12.2	145	-	-	364	0.91	0.02	0.08	0.10	0.16	23	23	7.6	7.7	-	120	140	-	-	43
	8/5/82	0	-	7.9	16.0	380	8.4	88	-	-	368	1.1	0.03	0.17	0.10	0.14	-	23	7.6	6.4	-	92	96	-	-	60
	9/9/82	0	-	-	-	-	-	-	-	-	369	1.4	0.04	0.13	0.11	0.14	-	23	7.8	6	150	130	140	-	-	-
	9/16/82	-	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	6/10/82	-	728 d/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/15/82	0	717 d/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1
	9/9/82	0	3 d/	-	-	-	-	-	-	-	396	1.6	0.03	0.04	0.07	0.10	-	21	5.2	6	180	160	170	-	-	-

Footnotes: a/ C = Composite sample, surface to bottom (composites for chlorophyll and pheophytin from euphotic zone only).

b/ Secchi depth greater because disk on bottom.

c/ Estimated (FC count was less than the required minimum of 20 colonies per plate).

d/ Approximate (F. Jensen, Bureau of Reclamation, personal communication).

TABLE 2. WASTEWATER QUALITY DATA COLLECTED FROM MOSES LAKE WTP AND INTERNATIONAL TITANIUM, INC. IN THE SUMMER OF 1982
("-" denotes parameter not measured or data missing). All parameters except flow were measured in the Ecology Laboratory.

Site	Date	Flow (MGD)	pH (S.U.)	Specific Conductance (umhos/cm)	BOD_5 (mg/L)	COD (mg/L)	Nutrients					Solids				Turbidity (NTU)	Sodium as Na (mg/L)	Potassium as K (mg/L)	Chloride as Cl (mg/L)	Silica as SiO_2 (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Calcium Hardness as $CaCO_3$ (mg/L)	Total Hardness as $CaCO_3$ (mg/L)	Total Metals						Recov. Oil and Grease (mg/L)	Fecal Coliform (No./100 mL)
							NO_3-N (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	O-PO_4-P (mg/L)	T-PO_4-P (mg/L)	Total Solids (mg/L)	Total Non-Volatile Solids (mg/L)	Total Suspended Solids (mg/L)	Total Non-Volatile Suspended Solids (mg/L)									Copper (mg/L)	Zinc (mg/L)	Nickel (mg/L)	Chromium (mg/L)	Cadmium (mg/L)	Lead (mg/L)		
Moses Lake WTP																															
Influent a/	6/16/82	-	7.5	1,080	110	310	< 0.10	< 0.10	13	3.7	5.7	880	600	170	20	66	120	15	180	60	-	240	240	0.050	0.58	0.03	< 0.01	0.004	0.03	-	-
Unchlorinated Effluent	6/16/82	-	-	-	< 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.015	0.08	0.05	< 0.01	< 0.002	< 0.02	-	-
Chlorinated Effluent a/	6/16/82	1.0	8.0	1,020	< 20	99	4.0	1.3	6.3	4.2	5.3	680	510	16	1	28	120	16	150	62	-	190	200	-	-	-	-	-	-	-	420
	9/8/82	-	-	933	-	-	-	-	-	-	-	660	540	17	10	-	150	20	110	-	200	110	120	-	-	-	-	-	-	-	720
	9/9/82	1.1	-	-	-	-	6.6	1.2	2.3	4.7	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Int. Titanium, Inc.																															
Effluent b/	6/16/82	-	7.4	1,140	< 20	880	1.5	< 0.05	0.65	< 0.05	0.15	10,000	8,500	280	220	200	1,100	20	5,400	13	-	4,500	5,200	0.062	19	0.85	0.14	0.044	0.24	< 1	-
	6/21/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	3.1	0.50	0.05	0.021	0.17	-	-

a/ 24-hr composite sample.

b/ 6/16 - 24-hr composite sample; 6/21 - collected by ITI.

APPENDIX A. ADDITIONAL MOSES LAKE REFERENCES

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