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Pre-Impoundment Water Quality Study for the Dolores project

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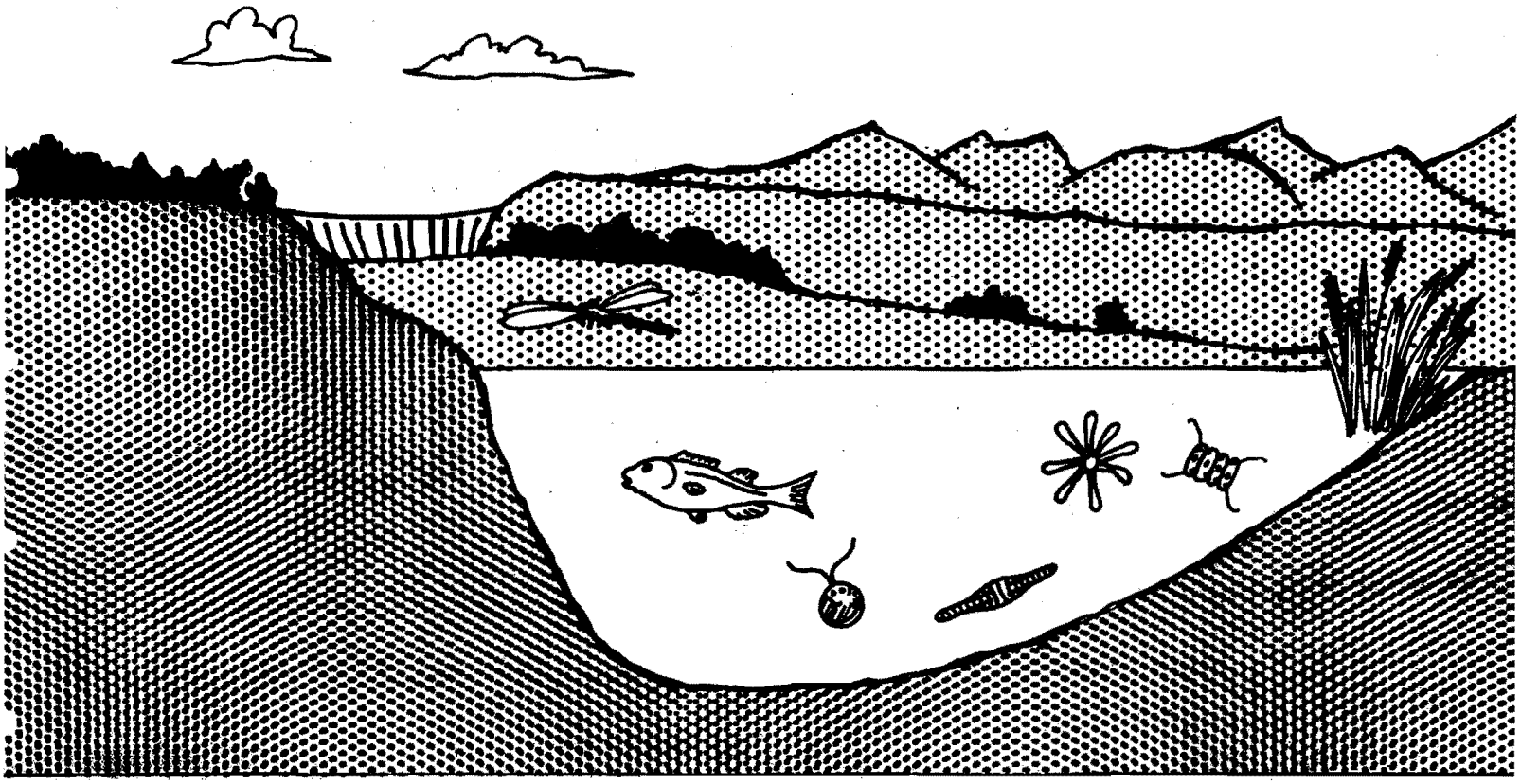

Utah Water Research Laboratory
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used for the analyses of total Kjeldahl nitrogen, dissolved metals, cyanide and NO_3/NO_2 were preserved as outlined in Table 2.

Immediately following sample coding and pre-treatment (filtration and/or preservation), analyses were performed for total phosphorus, orthophosphate, alkalinity, cyanide, nitrate and nitrite. On some occasions the analyses of nitrate/nitrite and cyanide were postponed until the following day. When this was necessary the samples for NO_3/NO_2 and cyanide were preserved.

The analyses of calcium, total hardness, sulfate, chloride, total dissolved solids, total Kjeldahl nitrogen, hexavalent chromium and fluoride were completed within seven days using the methods listed in Table 1.

The data obtained for each water quality station during this study was subjected to statistical analysis to determine the means, maximum, minimum, range, standard deviation and coefficient of variation for each constituent. In addition the water quality data for each station was compared to the proposed Colorado Water Quality Standards for agricultural use, raw water supply and the protection of the aquatic biota (Appendix A). This analysis was based on the number of times in which the concentration of a constituent exceeded the proposed standard for that constituent with respect to the number of times a detectable concentration of the constituent was analyzed (Appendix D). In Tables 6 and 7 the comparison is made on the basis of the total number of samples analyzed since for most constituents if the concentration is below the detection limit of analyses it is below the proposed standards. For some metals (cadmium, mercury, silver, copper and zinc) the proposed standards for the protection of the

Table 1. Analytical methods used in water quality survey.[1]

Analysis	Units/Sensitivity	Method
Non Metallic Constituents		
Total hardness	1 mg/l as $CaCO_3$	EDTA Titrimetric. *S.M.* p. 202
pH		pH electrode. *S.M.* p. 460
Total alkalinity	1 mg/l as $CaCO_3$	Potentiometric. *S.M.* p. 278
Carbonate hardness	1 mg/l as $CaCO_3$	Calculated from $CaCO_3$
Bicarbonate hardness	1 mg/l as $CaCO_3$	Calculated from $CaCO_3$
Total dissolved solids	1 mg/l	Gravimetric. *S.M.* p. 82
Chloride, dissolved	mg/l, 2 place	Titrimetric ($HgNO_3$) *S.M.* p. 304
Sulfate, dissolved	mg/l, 2 place	Turbidimetric ($BaCl_2$) *S.M.* p. 496
Fluoride, dissolved	mg/l, 2 place	Ion selective electrode *S.M.* p. 391
Cyanide, total	mg/l, 2 place	Ion selective electrode *S.M.* p. 372
Phosphorus, total	mg/l, 2 place	Persulfate digestion *S.M.* p. 466
Phosphate, ortho	mg/l, 2 place	Ascorbic acid *S.M.* p. 481
Nitrogen, total organic	mg/l, 2 place	Kjeldahl. *S.M.* p. 437
Nitrate	mg/l, 2 place	Cadmium reduction (automated) *S.M.* p. 620
Metallic Constituents		
Aluminum, total; dissolved	µg/l, 3 place	Atomic absorption (AA) *S.M.* p. 152
Arsenic, total; dissolved	µg/l, 3 place	Atomic Absorption (Vapor generation) *S.M.* p. 159

Table 1. Continued.

Analysis	Units/Sensitivity	Method
Barium, dissolved[2]	µg/l, 2 place	Atomic absorption *S.M.* p. 152
Boron, dissolved	mg/l, 2 place	Carmine. *S.M.* p. 290
Calcium	mg/l, 2 place	Titrimetric (EDTA) *S.M.* p. 189
Cadmium, total; dissolved	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Chromium, dissolved[2]	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Chromium, hexavalent	µg/l, 3 place	Colorimetric, *S.M.* p. 192
Copper, total; dissolved	µg/l, 3 place	Atomic absorption *S.M.* p. 148
Iron, total; dissolved	µg/l, 3 place	Atomic absorption *S.M.* p. 148
Lead, total; dissolved	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Magnesium, dissolved	mg/l, 2 place	Calculated from calcium and total hardness
Manganese, total; dissolved	µg/l, 3 place	Atomic absorption *S.M.* p. 148
Mercury, total; dissolved	µg/l, 3 place	Atomic absorption (Cold vapor) *S.M.*p. 56
Molybdenum, total; dissolved	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Nickel, total; dissolved	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Potassium, dissolved	mg/l, 2 place	Flame photometric, *S.M.* p. 234
Selenium, total; dissolved	µg/l, 2 place	Atomic absorption (Vapor generation) *S.M.* p. 159
Silver, total; dissolved	µg/l, 3 place	Atomic absorption (Flameless) EPA p. 78

Table 1. Continued.

Analysis	Units/Sensitivity	Method
Sodium, dissolved	mg/l, 2 place	Flame photometric, *S.M.* p. 250
Zinc, total; dissolved	µg/l, 3 place	Atomic absorption, *S.M.* p. 148

[1]Sources of analytical methods:

S.M. = *Standard Methods for Examination of Water and Wastewater.* 14th Ed. (1975). APHA.

EPA = USEPA (1976a). *Methods for Chemical Analysis of Water and Wastes.*

[2]These analysis were not included in original contract. Analysis of these constituents began in January, 1978.

Table 2. Methods of storage and preservation of samples used in the water quality survey.

Constitutent	Preservative	Storage
Metals[1]	3 ml 50% "mercury free" HNO_3/l	Several months (refrigerated)
TKN	0.8 ml conc. H_2SO_4/l	Max. of 7 days in dark amber glass bottle (refrigerated)
NO_3-NO_2	1 drop chloroform per 12 ml vials	Max. of 2 days in stoppered vials (refrigerated)
CN^-	pH adjusted to 12 with ionic strength adjuster	Up to 24 hours (refrigerated)

[1]Sample bottles (500 ml) for "total metals" contained 1.5 ml HNO_3 when shipped to field.

aquatic biota are below the detection limits of analyses. Since there may have been instances in which the concentration of one of these metals was less than the detection limit of analysis but still greater than the proposed standard for the protection of the aquatic biota, the comparisons for these metals with the proposed standards in Tables 6 and 7 are enclosed in parenthesis.

Results

The water quality data obtained during this study is presented in Appendix B. Statistical analyses of these data, including the mean, range, standard deviation and coefficient of variance for each water quality parameter are presented in Appendix C.

The water quality study for the Dolores River began in May, 1977, and ended in August, 1978. It included 17 sampling rounds (two in June, 1977, and one in each of the other 15 months). Forty-four analyses were to be performed on each sample between May, 1977, and December, 1977, and 49 analyses were to be performed on each sample from January, 1978 through the end of the study. Thus, a total of 788 analyses were to be performed. Forty-four of these analyses (5.6 percent of the total) were not completed because the sample for June 30, 1977 was not received. An additional 8 water quality analyses were omitted (1.0 percent). Overall 93 percent of the scheduled analyses were completed.

In order to check the reliability of these analyses, an ion balance was computed for each sample analyzed. The error in each ion balance was computed as follows:

$$\% \text{ error} = \frac{|\Sigma M^{+n} - \Sigma M^{-n}|}{\Sigma M^{+n} - \Sigma M^{-n}} \times 100 \qquad (1)$$

The ion balance calculations for each sampling period are presented in Table 4. The frequency distribution of errors in the ion balances is presented in Table 5 and graphically in Figure 6. For the 15 sampling periods in which all the constituents used in the ion balance calculations were determined, the error in the ion balances was less than 10 percent for 80 percent of the samples.

Table 3. Dolores Project water quality survey - missing parameter values.[a]

Sampling Round	Station	Analysis not performed	Reason for Omission
1	15	Hex. chromium	Analysis omitted
2		Sulfate; hex. chromium	Analysis omitted
3		All	No samples received
10		Fluoride	Analysis omitted
14		Selenium (tot.; diss.); arsenic (tot.; diss.)	Analysis omitted

[a]When total hardness was not determined, magnesium concentration could not be calculated. When alkalinity was not determined, inorganic carbon species (HCO_3^-, $CO_3^=$) could not be determined.

Table 4. Ion balance calculations for the Dolores water quality survey.

DOLORES PROJECT

STATION 151 DOLORES AT DOLORES

	5/25/77	* 6/16	* 6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/18/78	2/15	3/21	4/18	5/18	6/16	7/19	8/24
CA	46.0	44.0	0.0	52.0	52.0	59.0	61.0	72.0	81.0	81.0	79.0	70.0	37.0	32.0	25.0	41.0	46.0
MG	2.0	9.0	0.0	7.0	-1.0	13.0	9.0	6.0	9.0	13.0	9.0	3.0	5.0	-1.0	2.0	5.0	5.0
NA	9.0	12.0	0.0	18.0	16.0	41.0	16.0	16.0	18.0	16.0	14.0	18.0	8.0	3.0	2.0	8.0	8.0
K	2.0	3.0	0.0	2.0	2.0	2.0	2.7	1.7	13.7	1.8	1.8	2.3	1.4	2.2	2.0	2.0	3.0
HCO3	93.0	96.0	0.0	122.0	111.0	118.0	133.0	145.0	156.0	157.0	174.0	141.0	91.0	68.0	59.0	89.0	109.0
CO3	7.0	9.0	0.0	7.0	6.0	2.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CL	18.0	11.0	0.0	19.0	14.0	15.0	16.0	32.0	28.0	30.0	30.0	22.0	18.0	2.0	3.0	5.0	5.0
SO4	26.0	0.0	0.0	42.0	41.0	50.0	45.0	57.0	67.0	59.0	75.0	45.0	19.0	16.0	33.0	19.0	24.0
STDS	203.0	184.0	0.0	269.0	242.0	300.0	282.7	338.7	372.7	357.8	382.8	301.3	179.4	123.2	126.0	169.0	205.0
MTDS	130.0	196.0	0.0	242.0	140.0	185.0	289.0	289.0	275.0	246.0	315.0	264.0	126.0	101.0	97.0	0.0	173.0
SC	2.903	3.535	0.000	4.005	3.342	5.848	4.549	4.826	5.916	5.853	5.337	4.582	2.641	1.784	1.550	2.856	3.131
SA	3.049	2.410	0.000	3.990	3.589	3.864	4.048	5.169	5.305	5.215	5.888	4.378	2.723	1.750	1.952	2.317	2.925
ADIFF	0.147	1.124	0.000	0.014	0.247	1.984	0.501	0.344	0.611	0.639	0.550	0.204	0.082	0.034	0.402	0.540	0.207
ERR(%)	2.462	18.912	0.000	0.179	3.558	20.427	5.827	3.438	5.443	5.770	4.903	2.278	1.528	0.963	11.466	10.433	3.411

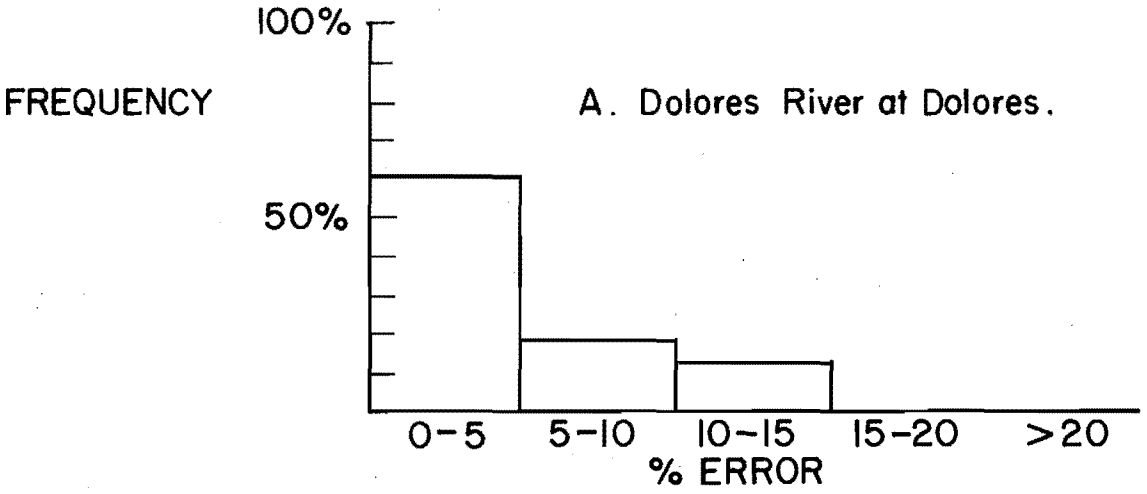
STDS = Sum of the constituents (mg/ℓ)
MTDS = Laboratory measured TDS (mg/ℓ)
SC = Sum of cations (meq/ℓ)
SA = Sum of anions (meq/ℓ)
ADIFF = Absolute difference between SC and SA (meq/ℓ)
ERR(%) = (ADIFF)/(SC + SA) x 100
* = Indicated date where one or more constituents have not been recorded.
- = Indicates that the concentration was below detection limit.

Table 5. Frequency distribution of errors in the ion balances for the Dolores River.

Station 15: Dolores at Dolores

Err(%)	Number	% of total
0 - 5	9	60
5 - 10	3	20
10 - 15	2	13.3
15 - 20	0	0
>20	1	6.7
Missing Data	2	
Total	17	

Figure 1. Frequency distribution of errors in ion balance for the Dolores water quality study.



Discussion

During this study the water from the Dolores River at Dolores had a total dissolved solids (TDS) concentration of between 97 and 315 mg/l ($\bar{x}$ = 204 mg/l). The Dolores River water is fairly well buffered, having an alkalinity between 59 and 159 mg/l (as $CaCO_3$) and can be classified as being "moderately hard" to "hard" (Sawyer and McCarty, 1978), having a total hardness of between 71 and 255 mg/l as $CaCO_3$.

A comparison between the water quality data collected during this study and the proposed Colorado Water Quality Standards (Appendix D) indicates that the Dolores River is a suitable source for raw water supply with respect to most water quality constituents. The concentrations of two metals (total cadmium and total mercury) and one non-metal (cyanide) exceeded the proposed water supply standard on several occasions. None of these constituents exceeded the proposed standards during more than 25 percent of the sampling periods (Table 6).

The water from the Dolores River exceeded the proposed agricultural use standards for total cadmium during 3 out of 16 sampling rounds and for total cyanide, total copper and total manganese once each (Table 6). However, the sampling periods in which these constituents exceeded the proposed standards were in the spring and fall, not during the irrigation season. During the summer months (June through September) none of the proposed standards for agricultural use were exceeded. The salinity of the Dolores River was very low and should pose no hazard to irrigated crops.

The proposed Colorado Water Quality Standards for the protection of the aquatic biota were exceeded by numerous metals during this study. The

Table 6. Constituents that exceeded the proposed Colorado Water Quality Standards in the Dolores at Dolores.(1)

Parameter	Water Use					
	Class II Water Supply		Agriculture		Aquatic Biota	
	N/T(2)	%	N/T(2)	%	N/T(2)	%
Aluminum (dissolved)	-	-	-	-	13/16	81
Cadmium(3)	3/16	19	3/16	19	(7/16)	(44)
Copper(3)	0/16	0	1/16	6	(8/16)	(50)
Iron (total)	-	-	-	-	2/16	13
Lead	0/10	0	0/10	0	2/10	20
Manganese (total)	-	-	1/16	6	1/16	6
Mercury(3)	2/16	13	-	-	(11/16)	(69)
Silver(3)	1/16	6	-	-	(2/16)	(13)
Zinc(3)	0/16	0	0/16	0	(11/16)	(69)
Cyanide	1/16	6	1/16	6	8/16	50

(1) Proposed Colorado Water Quality Standards in Appendix B.

(2) N/T = number of samples exceeding standard compared with total number of samples analyzed.

(3) Parenthesis indicate that the proposed standard was below the detection limit of analyses.

proposed standards for dissolved aluminum, total cyanide, total copper, total mercury, and total zinc were exceeded during at least half the sampling periods (Table 6). The standards for several other metals (total cadmium, total iron, total lead, total manganese, and total silver) were exceeded during one or more sampling periods. Algal bioassays were conducted at the UWRL on waters from the Dolores River during September, 1977, November, 1977, January, 1978, March, 1978, and May, 1978, using the Algal Assay Procedure: Bottle Test (EPA, 1971). None of these bioassays indicated that the growth of S. capricornutum was suppressed by metal toxicity in water from the Dolores River at Dolores. However, during the September, 1977, bioassay tests, samples were included from other sites along the Dolores River. In these bioassays the growth of S. capricornutum was suppressed as the result of metal toxicity in the sample obtained from the Dolores River immediately above the tailing piles at Rico, Colorado.

APPENDIX A

Proposed Colorado Water Quality Standards

Table A-1 Proposed Colorado water quality standards: Class II water supply.

Parameter	Standard
Physical	
D.O. (mg/ℓ)[1]	Aerobic[2]
pH	5.0-9.0
Suspended solids and turbidity	[3]
Temperature	X
TDS (mg/ℓ)	Y
Biological	
Algae[4]	Free of toxic and objectionable algae
Fecal coliforms (#/100 mℓ)	1,000
Inorganics	
Ammonia (mg/ℓ as N)	0.5
Total residual chlorine (mg/ℓ)	X
Cyanide (mg/ℓ)	0.2
Fluoride (mg/ℓ)	[5]
Nitrate (mg/ℓ as N)	10
Nitrite (mg/ℓ as N)	1.0
Sulfide as H_2S (mg/ℓ)	0.05
Boron (mg/ℓ)	X
Chloride (mg/ℓ)	250
Magnesium (mg/ℓ)	125
Sodium adsorbtion ratio	X
Sulfate (mg/ℓ)	250
Phosphorus (mg/ℓ as P)	Bioassay[6]
Toxic Metals (mg/ℓ)	
Aluminum	X
Arsenic	0.05
Barium	1.0
Beryllium	X
Cadmium	0.01
Chromium	0.05
Copper	1.0
Iron	0.3 (soluble)
Lead	0.05
Manganese	0.05 (soluble)
Mercury	0.002
Molybdenum	Y
Nickel	X

X = numerical limit generally not needed for protection of classified use.

Y = limit may be required but there is insufficient data for setting a general standard.

Table A-1 Continued.

Parameter	Standards
Toxic Metals (mg/ℓ)	
Selenium	0.01
Silver	0.05
Thallium	X
Zinc	5.0
Organics[7] ($\frac{\mu g}{\ell}$)	
Chlorinated pesticides[8]	
Aldrin[9]	Y
Chlordane[9]	Y
Dieldrin[8]	Y
DDT[9]	Y
Endrin	0.2
Heptachlor[9]	Y
Lindane	4
Methoxychlor	Y
Mirex	100
Toxaphene	5
Organophosphate pesticides[8]	
Demeton	Y
Endosulfan	Y
Guthion	Y
Malathion	Y
Parathion	Y
Chlorophenoxy Herbicides	
2, 4-D	100
2, 4, 5-TP	10
PCB's[10]	Y
Phenol	1
Radiological[11] (pCi/ℓ)	
Alpha[11, 12]	15
Beta[11, 12]	50
Cesium 134	80
Plutonium	15
Radium 226 and 228[12, 13]	5
Strontium 90[12, 13]	8
Thorium 230 and 232	60
Tritium	20,000
Uranium (total, mg/ℓ)	5

[1]Where dissolved oxygen levels less than the standard occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]Fluoride limits vary from 2.4 mg/ℓ at 12.0 C and below, to 1.4 mg/ℓ between 26.3 C and 32.5 C, based upon the annual average of the maximum daily air temperature (see *National Interim Primary Drinking Water Regulations* for specific limitations).

[6]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*.

[7]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[8]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[9]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposure to a minimum (EPA).

[10]Every reasonable effort should be made to minimize human exposure (EPA).

[11]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[12]If Alpha or Beta are measured in excess of 15 or 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[13]Maximum permissible concentrations including naturally occurring or background contributions.

Table A-2 Proposed Colorado water quality standards (non-metallic): Protection of Aquatic Biota.

Parameter	Cold Water Biota	Warm Water Biota
Physical		
D.O. (mg/ℓ)[1]	6.0 7.0 (spawning)[2]	5.0
pH	6.5 - 9.0	6.5 - 9.0
Suspended solids and turbidity	[3]	[3]
Temperature (°C)	Maximum 20°C w/ 3° increase[4]	Maximum 30°C w/ 3° increase[4]
TDS (mg/ℓ)	Y	Y
Biological		
Algae[5]	Free from objectionable and toxic algae	Same as Cold Water
Fecal coliforms	X	X
Inorganics		
Ammonia (mg/ℓ as N)	0.02 unionized	0.10 unionized
Total residual chlorine (mg/ℓ)	0.002	0.01
Cyanide (mg/ℓ)	0.005	0.005
Fluoride (mg/ℓ)	X	X
Nitrate (mg/ℓ as N)	X	X
Nitrite (mg/ℓ as N)	0.05	0.5
Sulfide as H_2S (mg/ℓ)	0.002 undissociated	0.002 undissociated
Boron (mg/ℓ)	X	X
Chloride (mg/ℓ)	X	X
Magnesium (mg/ℓ)	X	X
Sodium adsorbtion ratio	X	X
Sulfate (mg/ℓ)	X	X
Phosphorus (mg/ℓ as P)	Bioassay[6]	Bioassay[6]
Organics[7] ($\frac{\mu g}{\ell}$)		
Chlorinated Pesticides[8]		
Aldrin[9]	0.003	0.003
Chlordane	0.01	0.01
Dieldrin[9]	0.003	0.003
DDT	0.001	0.001
Endrin	0.004	0.004
Heptachlor	0.001	0.001
Lindane	0.01	0.01
Methoxychlor	0.03	0.03
Mirex	0.001	0.001
Toxaphene	0.005	0.005

Table A-2 Continued.

Parameter	Cold Water Biota	Warm Water Biota
Organophosphate Pesticides[8]		
Demeton	1	1
Endosulfan	0.003	0.003
Guthion	0.01	0.01
Malathion	1	1
Parathion	0.04	0.04
Chlorophenoxy Herbicides		
2, 4-D	Y	Y
2, 4, 5-TP	Y	Y
PCB's	0.001	0.001
Phenols	1	1
Radiological[10] in (pCi/ℓ)		
Alpha (excluding uranium and radium[11])	15	15
Beta (excluding Sr^{90} [11]	50	50
Cesium 134	80	80
Plutonium 238, 239, and 240	15	15
Radium 226 and 228	5	5
Strantium 90[12]	8	8
Thorium 230 and 232	60	60
Tritium	20,000	20,000
Uranium (total)[13]	--	--

X = numerical limit generally not needed for protection of classified use.

Y = limit may be required but there is insufficient data for setting a general standard.

[1]Where dissolved oxygen levels less than the standard occur naturally a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]A 7 mg/ℓ standard, during periods of spawning of coldwater fish, shall be set on a case by case basis as defined in the NPDES permit for those dischargers whose effluent would affect fish spawning.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate and duration deemed deleterious to the resident aquatic life. Generally, a maximum 3°C increase over a minimum of a 4-hour period, lasting for 12 hours maximum, is deemed acceptable for discharges fluctuating in volume or temperature. Where temperature increases cannot be maintained within this range using BMP, BATEA, and BPWITT control measures, the Division will determine whether the resulting temperature increases preclude an Aquatic Life classification.

[5]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[6]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association.

[7]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[8]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[9]Aldrin and dieldrin in combination should not exceed 0.000003 mg/ℓ.

[10]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[11]If Alpha or Beta are measured in excess of 15 of 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[12]Maximum permissible concentrations including naturally occurring or background contribution.

[13]See Uranium in Table A-3 for aquatic life limitations.

Table A-3 Proposed Colorado water quality standards (metallic): Protection of Aquatic Biota.

Parameter	Water Hardness[1] - Cold and Warm Water Biota				
	0-100	100-200	200-300	300-400	over 400
Toxic Metals[2] (mg/ℓ)					
Aluminum (soluble)	0.1	0.1	0.1	0.1	0.1
Arsenic	0.05	0.05	0.05	0.05	0.05
Barium	X	X	X	X	X
Beryllium	0.01	0.3	0.6	0.9	1.1
Cadmium	0.004	0.001	0.005	0.01	0.015
Chromium	0.1	0.1	0.1	0.1	0.1
Copper	0.01	0.01	0.01	0.02	0.04
Iron	1.0	1.0	1.0	1.0	1.0
Lead[3]	0.004	0.025	0.050	0.100	0.150
Manganese	1.0	1.0	1.0	1.0	1.0
Mercury	0.00005	0.00005	0.00005	0.00005	0.00005
Molybdenum	X	X	X	X	X
Nickel	0.05	0.10	0.20	0.30	0.40
Selenium	0.05	0.05	0.05	0.05	0.05
Silver	0.00010	0.00010	0.00015	0.00020	0.00025
Thallium	0.15	0.15	0.15	0.15	0.15
Uranium	0.03	0.2	0.4	0.8	1.4
Zinc	0.05	0.05	0.10	0.30	0.60

X = numerical limit generally not needed for protection of classified use.

[1]Concentrations of total alkalinity or other chelating agents attributable to municipal, industrial or other discharges or agriculatural practices should not alter the total alkalinity or other chelating agents of the receiving water by more than 20 percent. Where the complexing capacity of the receiving water is altered by more than 20 percent or where chelating agents are released to the receiving water which are not naturally characteristic of that water, specific effluent limitations on pertinent parameters will be established. In no case shall instream modification or alteration of total alkalinity or other chelating agents be permitted without Commission authorization.

[2]Bioassay procedures may be used to establish criteria or standards for a particular situation. Requirements for bioassay procedures outlined in Section 3.1.10, Colorado Water Quality Standards, May 2. 1978.

[3]For bioassay lead concentration is based on soluble lead measurements (*i.e.* non-filterable lead using a 0.45 micron filter).

Table A-4 Proposed Colorado water quality standards: Agricultural Use.

Parameter	Standard
Physical	
D.O. (mg/ℓ)[1]	Aerobic[2]
pH	X
Suspended solids and turbidity	[3]
Temperature	X
TDS (mg/ℓ)	Y
Biological	
Algae[4]	Free of toxic and objectionable algae
Fecal coliforms (#/100 mℓ)	1,000
Inorganics	
Ammonia (mg/ℓ as N)	X
Total residual chlorine (mg/ℓ)	X
Cyanide (mg/ℓ)	0.2
Fluoride (mg/ℓ)	X
Nitrate (mg/ℓ as N)	100[5]
Nitrite (mg/ℓ as N)	10[5]
Sulfide as H_2S (mg/ℓ)	X
Boron (mg/ℓ)[2]	0.75
Chloride (mg/ℓ)	X
Magnesium (mg/ℓ)	X
Sodium adsorbtion ratio	X
Sulfate (mg/ℓ)	X
Phosphorus (mg/ℓ as P)	X
Toxic Metals (mg/ℓ)	
Aluminum	X
Arsenic	0.1
Barium	X
Beryllium	0.1
Cadmium	0.01
Chromium	0.0
Copper	0.2
Iron	X
Lead	0.1
Manganese	0.2
Mercury	X
Molybdenum	Y
Nickel	0.2

X = numerical limit generally not needed for protection of classified use.

Y = limit may be required but there is insufficient data for setting a general standard.

Table A-4 Continued.

Parameter	Standard
Toxic Metals (mg/ℓ)	
Selenium	0.02
Silver	X
Thallium	X
Zinc	2.0
Organics[6], ($\frac{\mu g}{\ell}$)	
Chlorinated Pesticides[7]	
Aldrin[8]	Y
Chlordane[8]	Y
Dieldrin[8]	Y
DDT[8]	Y
Endrin	Y
Heptachlor[8]	Y
Lindane	Y
Methoxychlor	Y
Mirex	Y
Toxaphene	Y
Organophosphate Pesticides[7]	
Demeton	Y
Endosulfan	Y
Guthion	Y
Malathion	Y
Parathion	Y
Chlorophenoxy Herbicides	
2, 4-D	Y
2, 4, 5-TP	Y
PCB's[9]	Y
Phenol	Y
Radiological[10] (pCi/ℓ)	
Alpha[11, 12]	15
Beta[11, 12]	50
Cesium	80
Plutonium	15
Radium 226, and 228[12]	5
Strontium 90[12]	8
Thorium 230 and 232	60
Tritium	20,000
Uranium (total, mg/ℓ)	5

[1]Where dissolved oxygen levels, less than the standard, occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blut-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, or allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]In order to provide a reasonable margin of safety to allow for unusual situations such as extremely high water ingestion or nitrite formation in slurries, the NO_3-N plus NO_2-N content in drinking waters for livestock and poultry should be limited to 100 ppm or less, and the NO_2-N content alone be limited to 10 ppm or less.

[6]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[7]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[8]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposeure to a minimum (EPA).

[9]Every reasonable effort should be made to minimize human exposure (EPA).

[10]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[11]If Alpha or Beta are measured in excess of 15 or 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[12]Maximum permissible concentrations including naturally occurring or background contributions.

Table A-5 Proposed Colorado water quality standards: Recreational Use.

Parameter	Standard	
	Class I (Primary Contact)	Class II (Secondary Contact)
Physical		
D.O.[1] ($\frac{mg}{\ell}$ D.O.)	Aerobic[2]	Aerobic[2]
pH	6.5-9.0	X
Suspended solids and turbidity	X	X
Temperature	X	X
TDS (mg/ℓ)	X	X
Biological		
Algae[4]	Free of objectionable and toxic algae	Free of objectionable and toxic algae
Fecal coliforms (#/100 mℓ)	200	1,000
Inorganics		
Ammonia ($\frac{mg}{\ell}$ as N)	X	X
Chloride (mg/ℓ)	X	X
Cyanide (mg/ℓ)	X	X
Fluoride (mg/ℓ)	X	X
NO_3 (mg/ℓ as N)	X	X
NO_2 (mg/ℓ as N)	X	X
Sulfide as H_2S (mg/ℓ)	X	X
Boron (mg/ℓ)[2]	X	X
Chloride (mg/ℓ)	X	X
Magnesium (mg/ℓ)	X	X
SAR	X	X
Sulfate (mg/ℓ)	X	X
Phosphorus (mg/ℓ as P)	Bioassay[5]	Bioassay[5]
Toxic Metals (mg/ℓ)		
Aluminum	X	X
Arsenic	X	X
Barium	X	X
Beryllium	X	X
Cadmium	X	X
Chromium	X	X
Copper	X	X
Iron	X	X
Lead	X	X
Manganese	X	X
Mercury	X	X
Molybdenum	X	X
Nickel	X	X
Selenium	X	X

Table A-5 Continued.

Parameter	Standard	
	Class I (Primary Contact)	Class II (Secondary Contact)
Toxic Metals (mg/ℓ)		
Silver	X	X
Thallium	X	X
Uranium	X	X
Zinc	X	X
Organics[6]		
Chlorinated Pesticides[7]		
Aldrin[8]	Y	Y
Chlordane[8]	Y	Y
Dieldrin[8]	Y	Y
DDT[8]	Y	Y
Endrin	Y	Y
Heptachlor[8]	Y	Y
Lindane	Y	Y
Methoxychlor	Y	Y
Mirex	Y	Y
Toxaphene	Y	Y
Organophosphate Pesticides[7]		
Demeton	Y	Y
Endosulfan	Y	Y
Guthion	Y	Y
Malathion	Y	Y
Parathion	Y	Y
Chlorophynoxy Herbicides		
2, 4-D	Y	Y
2, 4, 5-TP	Y	Y
PCB's[9]	Y	Y
Phenol	Y	Y
Radiological		
Alpha	X	X
Beta	X	X
Cesium 134	X	X
Plutonium 238, 239, and 240	X	X
Radium 226 and 228	X	X
Strantium	X	X
Thorium 230 and 232	X	X
Tritium	X	X
Uranium (total)	X	X

X = numerical limit generally not needed for protection of classified use.
Y = limit may be required but there is insufficient data for setting a general standard.

[1]Where dissolved oxygen levels, less than the standard, occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspsended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association.

[6]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[7]Numerical limits in tables based on experimental evidence of toxicity. No point source discharge of organic pesticides shall be permitted to state waters.

[8]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposure to a minimum (EPA).

[9]Every reasonable effort should be made to minimize human exposure (EPA).

APPENDIX B

Raw Water Quality Data

Table B-1. Water quality parameter codes.

A. METALLIC CONSTITUENTS
(µg/l unless noted)

101. Aluminium, Dissolved
102. Aluminium, Total
103. Barium, Dissolved
104. Barium, Total
105. Cadmium, Dissolved
106. Cadmium, Total
107. Calcium (mg/l)
108. Chromium, Hexavalent
109. Chromium, Total
110. Copper, Dissolved
111. Copper, Total
112. Hardness, Total
113. Iron, Dissolved
114. Iron, Total
115. Lead, Dissolved
116. Lead, Total
117. Magnesium (mg/l)
118. Manganese, Dissolved
119. Manganese, Total
120. Mercury, Dissolved
121. Mercury, Total
122. Molybdenum, Dissolved
123. Molybdenum, Total
124. Nickel, Dissolved
125. Nickel, Total
126. Potassium (mg/l)
127. Selenium, Dissolved
128. Selenium, Total
129. Silver, Dissolved
130. Silver, Total
131. Sodium (mg/l)
132. Zinc, Dissolved
133. Zinc, Total

B. NON-METALLIC CONSTITUENTS
(mg/l unless noted)

201. Alkalinity, Total
202. Arsenic, Dissolved (µg/l)
203. Arsenic, Total (µg/l)
204. Bicarbonate Hardness
205. Boron
206. Carbonate Hardness
207. Chloride
208. Cyanide
209. Fluoride
210. Nitrogen, Nitrate
211. Nitrogen, Nitrite
212. Nitrogen, Total Organic
213. Phosphorus, Ortho
214. Phosphorus, Total
215. Sulfate
216. Total Dissolved Solids

Table B-2. Water quality data for the Dolores project.

DOLORES PROJECT

STATION 151 DOLORES AT DOLORES

CONF	5/25/77	6/16	6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/19/78	2/15	3/21	4/18	5/16	6/15	7/19	8/24
101	316.	250.		430.	280.	130.	-50.	149.	-50.	386.	148.	-50.	244.	155.	844.	282.	220.
102	332.	270.		1020.	220.	393.	596.	149.	748.	55.	148.	987.	2305.	4700.	1200.	470.	436.
103								-100.	138.	-100.	162.	158.	110.	-100.	-100.	106.	-100.
104								134.	138.	234.	162.	170.	-100.	447.	-100.	120.	-100.
105	-3.	-3.		-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.
106	5.	5.		6.	6.	8.	18.	-3.	-3.	-3.	-3.	-3.	43.	-3.	-3.	-3.	-3.
107	-3.	-3.		52.	52.	59.	61.	72.	41.	81.	79.	70.	37.	32.	25.	61.	85.
108				2.	-1.	-1.	-1.	2.	-1.	-1.	-1.	-1.	5.	5.	2.	-1.	2.
109										-20.	-20.	-20.	-20.	-20.	-20.	-20.	-20.
110	-10.	-10.		-10.	12.	-10.	-10.	-10.	-10.	-10.	30.	-10.	-10.	-10.	-10.	-10.	-10.
111	-10.	14.		11.	16.	40.	585.	-10.	-10.	-10.	185.	-10.	-10.	48.	-10.	11.	-10.
112	124.	148.		159.	132.	203.	190.	207.	240.	255.	235.	184.	110.	73.	71.	124.	134.
113	-21.	-21.		-21.	-21.	-21.	-21.	-21.	28.	-21.	-21.	-21.	61.	46.	45.	119.	54.
114	200.	80.		204.	162.	150.	99.	50.	152.	220.	123.	615.	731.	5007.	730.	434.	1000.
115								-1.	7.	-1.	-1.	-1.	5.	-1.	-1.	-1.	-1.
116								-1.	7.	-1.	-1.	-1.	18.	34.	-1.	29.	-1.
117	2.	0.		7.	-1.	13.	9.	6.	9.	13.	9.	3.	5.	-1.	2.	5.	5.
118	10.	11.		8.	10.	9.	9.	14.	14.	12.	11.	30.	38.	32.	12.	27.	9.
119	31.	21.		36.	17.	37.	22.	14.	21.	12.	18.	158.	52.	1514.	99.	25.	37.
120	0.3	-0.2		0.7	0.4	-0.2	0.5	0.4	-0.2	-0.2	0.9	0.3	0.3	-0.2	-0.2	0.3	3.5
121	0.5	-0.2		5.6	0.6	-0.2	1.2	0.4	-0.2	-0.2	0.9	0.4	0.8	-0.2	0.2	0.9	5.3
122	-5.	6.		15.	6.	10.	-5.	-5.	-5.	-5.	-5.	-5.	-5.	-5.	-5.	-5.	-5.
123	-5.	10.		20.	6.	11.	5.	-5.	-5.	6.	6.	-5.	26.	-5.	-5.	11.	-5.
124	-6.	-6.		-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.
125	21.	32.		25.	-6.	162.	7.	-6.	8.	-6.	-6.	-6.	6.	20.	-6.	-6.	-6.
126	2.8	3.0		2.8	2.0	2.0	2.7	1.7	14.7	1.5	1.8	2.3	1.4	2.2	2.3	2.6	3.3
127	-1.	-1.		-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
128	-1.	-1.		-1.	1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	2.	1.
129	-9.	-9.		-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.
130	51.	-9.		-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	21.	-9.	-9.	-9.	-9.	-9.
131	5.	12.		18.	16.	41.	16.	18.	18.	16.	18.	12.	8.	3.	2.	8.	8.
132	22.	7.		-5.	5.	-5.	9.	13.	-5.	13.	5.	-5.	22.	20.	-5.	14.	-5.
133	76.	148.		150.	334.	322.	1047.	252.	1340.	13.	43.	-5.	124.	358.	-5.	76.	-5.
201	97.	105.		129.	111.	118.	133.	163.	155.	157.	179.	141.	91.	64.	58.	92.	109.
202	-1.	-1.		-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
203	-1.	-1.		-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
204	93.	96.		122.	111.	118.	133.	165.	156.	157.	174.	141.	91.	48.	58.	89.	105.
205	1.33	0.12			0.54	0.09	0.09	0.38	-0.05	-0.05	-0.05	0.12	-0.05	0.71	-0.05	-0.05	-0.05
206	7.	0.		7.	6.	2.	0	0.	0	0	0	0	0	0	0	0	0
207	10.	11.		19.	14.	15.	16.	32.	28.	30.	34.	22.	10.	2.	5.	5.	5.
208	-0.01	-0.01		-0.01	-0.01	-0.01	0.32	0.16	-0.01	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.02	0.04
209	0.02	0.05		0.09	0.09	0.10	0.08	0.09	0.18		0.15	-0.01	-0.01	-0.01	-0.01	0.01	0.12
210	0.03	0.05		0.17	0.76	0.04	0.05	0.07	0.13	0.14	0.21	0.12	0.11	0.15	0.12	0.19	0.07
211	0.001	0.001		0.005	0.003	0.005	-0.001	0.003	0.001	0.002	0.012	0.003	0.002	0.002	0.005	0.003	0.009
212	0.4	0.4		0.7	0.7	-0.1	0.2	0.3	0.1	0.2	-0.1	0.5	-0.1	0.4	0.1	0.5	0.7
213	-0.001	0.003		0.010	0.001	0.002	0.009	0.001	0.002	0.002	0.003	0.006	0.002	0.002	0.003	0.003	0.001
214	0.003	0.012		0.037	0.015	0.007	0.022	0.006	0.005	0.005	0.013	0.020	0.005	0.007	0.009	0.008	0.034
215	20.			42.	41.	50.	45.	57.	47.	59.	75.	65.	13.	14.	33.	19.	29.
216	130.	190.		242.	140.	185.	289.	289.	275.	286.	315.	244.	126.	101.	97.		173.

APPENDIX C

Statistical Analyses of Water Quality Data

Table C-1. Statistical analysis of the water quality data for the Dolores project.

DOLORES PROJECT

STATION 15: DOLORES AT DOLORES

CODE	CONSTITUENT	MEAN	VARIANCE	S.D.	C OF V	MAX	MIN	RANGE	N
	***** GROUP A: METALLIC CONSTITUENTS *****								
101	ALUMINUM, DISSOLVED (UG/L)	287.5	.3561E+05	188.7	65.6	840.	130.	714.	13
102	ALUMINUM, TOTAL (UG/L)	1006.8	.2630E+07	1621.6	161.1	6700.	55.	6645.	16
103	BARIUM, DISSOLVED (UG/L)	135.8	.5882E+03	24.3	17.9	192.	106.	56.	5
104	BARIUM, TOTAL (UG/L)	231.6	.3829E+05	195.7	84.5	687.	140.	547.	7
105	CADMIUM, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
106	CADMIUM, TOTAL (UG/L)	19.3	.3552E+03	18.8	97.7	49.	5.	44.	7
107	CALCIUM (MG/L)	54.9	.3163E+03	17.8	32.4	81.	25.	56.	16
108	CHROMIUM, HEXAVALENT (UG/L)	2.8	.2567E+01	1.6	56.5	6.	2.	4.	6
109	CHROMIUM, TOTAL (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
110	COPPER, DISSOLVED (UG/L)	21.0	.1620E+03	12.7	60.6	30.	12.	18.	2
111	COPPER, TOTAL (UG/L)	108.8	.3903E+05	197.6	181.7	585.	11.	574.	6
112	HARDNESS, TOTAL AS CACO3 (MG/L)	161.9	.3251E+04	57.0	35.2	255.	71.	184.	16
113	IRON, DISSOLVED (UG/L)	55.3	.1087E+04	33.0	59.6	118.	24.	94.	6
114	IRON, TOTAL (UG/L)	733.4	.2153E+07	1467.5	200.1	6067.	50.	6017.	16
115	LEAD, DISSOLVED (UG/L)	5.0	.8000E+01	2.8	56.6	7.	3.	4.	2
116	LEAD, TOTAL (UG/L)	22.0	.1447E+03	12.0	54.7	34.	7.	27.	4
117	MAGNESIUM (MG/L)	6.9	.1284E+02	3.6	51.7	13.	2.	11.	14
118	MANGANESE, DISSOLVED (UG/L)	16.5	.9880E+02	9.7	59.0	37.	8.	29.	16
119	MANGANESE, TOTAL (UG/L)	129.0	.1376E+06	370.9	287.5	1518.	12.	1502.	16
120	MERCURY, DISSOLVED (UG/L)	0.79	.1012E+01	1.01	127.35	3.6	0.3	3.3	10
121	MERCURY, TOTAL (UG/L)	1.48	.3932E+01	1.98	133.81	5.6	0.2	5.4	11
122	MOLYBDENUM, DISSOLVED (UG/L)	9.3	.1825E+02	4.3	46.2	15.	6.	9.	4
123	MOLYBDENUM, TOTAL (UG/L)	11.2	.5219E+02	7.2	64.4	26.	5.	21.	9
124	NICKEL, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
125	NICKEL, TOTAL (UG/L)	32.2	.2473E+04	49.7	154.3	162.	6.	156.	9
126	POTASSIUM (MG/L)	2.9	.8565E+01	2.9	102.7	14.	1.	12.	16
127	SELENIUM, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
128	SELENIUM, TOTAL (UG/L)	1.3	.3333E+00	0.6	43.3	2.	1.	1.	3
129	SILVER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
130	SILVER, TOTAL (UG/L)	36.0	.4500E+03	21.2	58.9	71.	21.	50.	2
131	SODIUM (MG/L)	13.9	.7966E+02	8.9	64.0	41.	2.	39.	16
132	ZINC, DISSOLVED (UG/L)	13.0	.4356E+02	6.6	50.8	22.	5.	17.	10
133	ZINC, TOTAL (UG/L)	334.8	.1686E+06	410.6	122.6	1340.	13.	1327.	13
	***** GROUP B: NON-METALLIC CONSTITUENTS *****								
201	ALKALINITY, TOTAL AS CACO3 (MG/L)	118.3	.1094E+04	33.1	28.0	174.	59.	115.	16
202	ARSENIC, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
203	ARSENIC, TOTAL (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
204	BICARBONATE HARDNESS AS CACO3 (MG/L)	116.4	.1090E+04	33.0	28.4	174.	59.	115.	16
205	BORON (MG/L)	0.442	.1669E+00	0.409	92.594	1.33	0.09	1.24	9
206	CARBONATE AS CACO3 (MG/L)	6.7	.6667E+01	2.6	38.7	9.	2.	7.	3
207	CHLORIDE (MG/L)	16.8	.9820E+02	9.9	59.2	32.	2.	30.	16
208	CYANIDE (MG/L)	0.074	.1246E-01	0.112	151.327	0.32	0.01	0.31	9
209	FLUORIDE (MG/L)	0.089	.2329E-02	0.048	54.170	0.16	0.01	0.17	11
210	NITROGEN, NITRATE (MG/L)	0.139	.2500E-01	0.158	113.952	0.70	0.03	0.67	16
211	NITROGEN, NITRITE (MG/L)	0.0036	.7400E-05	0.0027	75.5687	0.013	0.001	0.011	15
212	NITROGEN, TOTAL ORGANIC (MG/L)	0.49	.3536E-01	0.19	38.26	0.7	0.2	0.5	12
213	PHOSPHORUS, ORTHO (MG/L)	0.0041	.9834E-05	0.0031	75.8809	0.015	0.001	0.014	15
214	PHOSPHORUS, TOTAL (MG/L)	0.0299	.3147E-02	0.0561	187.3761	0.238	0.003	0.233	16
215	SULFATE (MG/L)	41.5	.3248E+03	18.0	43.4	75.	16.	59.	15
216	TOTAL DISSOLVED SOLIDS (MG/L)	204.1	.5561E+04	74.6	36.5	315.	97.	218.	15

APPENDIX D

Comparison of Water Quality Data with the Proposed Colorado Water Quality Standards

Table D-1. Comparison of water quality data for the Dolores project with the proposed Colorado Water Quality Standards.

DOLORES PROJECT

STATION 151 DOLORES AT DOLORES

CODE	CONSTITUENT	STANDARD	SOURCE	NUMBER EXCEEDING	NUMBER OF SAMPLES	PERCENT EXCEEDING
101	ALUMINIUM, DISSOLVED (UG/L)	100.000	AG	13	13	100.00
104	BARIUM, TOTAL (UG/L)	1000.000	WS	0	7	0.00
106	CADMIUM, TOTAL (UG/L)	10.000	AG	3	7	42.86
		10.000	WS	3	7	42.86
		0.400	AAL1	0	7	0.00
		1.000	AA12	6	7	85.71
		5.000	AA23	1	7	14.29
		10.000	AA34	0	7	0.00
		15.000	AAG4	0	7	0.00
109	CHROMIUM, TOTAL (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		100.000	AA	0	0	0.00
111	COPPER, TOTAL (UG/L)	200.000	AG	1	8	12.50
		1000.000	WS	0	8	0.00
		10.000	AAL1	1	8	12.50
		10.000	AA12	5	8	62.50
		10.000	AA23	2	8	25.00
		20.000	AA34	0	8	0.00
		40.000	AAG4	0	8	0.00
113	IRON, DISSOLVED (UG/L)	300.000	WS	0	6	0.00
114	IRON, TOTAL (UG/L)	1000.000	AA	2	16	12.50
116	LEAD, TOTAL (UG/L)	100.000	AG	0	4	0.00
		50.000	WS	0	4	0.00
		4.000	AAL1	1	4	25.00
		25.000	AA12	1	4	25.00
		50.000	AA23	0	4	0.00
		100.000	AA34	0	4	0.00
		150.000	AAG4	0	4	0.00
117	MAGNESIUM (MG/L)	125.000	WS	0	14	0.00
118	MANGANESE, DISSOLVED (UG/L)	50.000	WS	0	16	0.00
119	MANGANESE, TOTAL (UG/L)	200.000	AG	1	16	6.25
		1000.000	AA	1	16	6.25
121	MERCURY, TOTAL (UG/L)	2.000	WS	2	11	18.18
		0.050	AA	11	11	100.00
125	NICKEL, TOTAL (UG/L)	200.000	AG	0	9	0.00
		50.000	AAL1	0	9	0.00
		100.000	AA12	0	9	0.00
		200.000	AA23	0	9	0.00
		300.000	AA34	0	9	0.00
		400.000	AAG4	0	9	0.00
126	SELENIUM, TOTAL (UG/L)	20.000	AG	0	3	0.00
		10.000	WS	0	3	0.00
		50.000	AA	0	3	0.00
130	SILVER, TOTAL (UG/L)	50.000	WS	1	2	50.00
		0.100	AAL1	0	2	0.00
		0.100	AA12	2	2	100.00
		0.150	AA23	0	2	0.00
		0.200	AA34	0	2	0.00
		0.250	AAG4	0	2	0.00
133	ZINC, TOTAL (UG/L)	2000.000	AG	0	13	0.00
		5000.000	WS	0	13	0.00
		50.000	AAL1	1	13	7.69
		50.000	AA12	7	13	53.85
		100.000	AA23	3	13	23.08
		300.000	AA34	0	13	0.00
		600.000	AAG4	0	13	0.00
202	ARSENIC, DISSOLVED (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		50.000	AA	0	0	0.00
205	BORON (MG/L)	750.000	AG	0	9	0.00
207	CHLORIDE (MG/L)	250.000	WS	0	16	0.00
208	CYANIDE (MG/L)	0.200	AG	1	8	12.50
		0.200	WS	1	8	12.50
		0.005	AA	8	8	100.00
209	FLUORIDE (MG/L)	2.400	WS	0	11	0.00
210	NITROGEN, NITRATE (MG/L)	100.000	AG	0	16	0.00
		10.000	WS	0	16	0.00
211	NITROGEN, NITRITE (MG/L)	10.000	AG	0	15	0.00
		1.000	WS	0	15	0.00
		0.050	AAC	0	15	0.00
		0.500	AAW	0	15	0.00
215	SULFATE (MG/L)	250.000	WS	0	15	0.00

SOURCE CODES: AA = AQUATIC BIOTA
AAC = AQUATIC BIOTA (COLD)
AAW = AQUATIC BIOTA (WARM)
AAL1 = AQUATIC BIOTA (TOTAL HARDNESS) LESS THAN 100)
AA12 = AQUATIC BIOTA (TOTAL HARDNESS) 100-200)
AA23 = AQUATIC BIOTA (TOTAL HARDNESS) 200-300)
AA34 = AQUATIC BIOTA (TOTAL HARDNESS) 300-400)
AAG4 = AQUATIC BIOTA (TOTAL HARDNESS) GREATER THAN 400)
AG = AGRICULTURE
WS = CLASS 2 MAN WATER SUPPLY

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