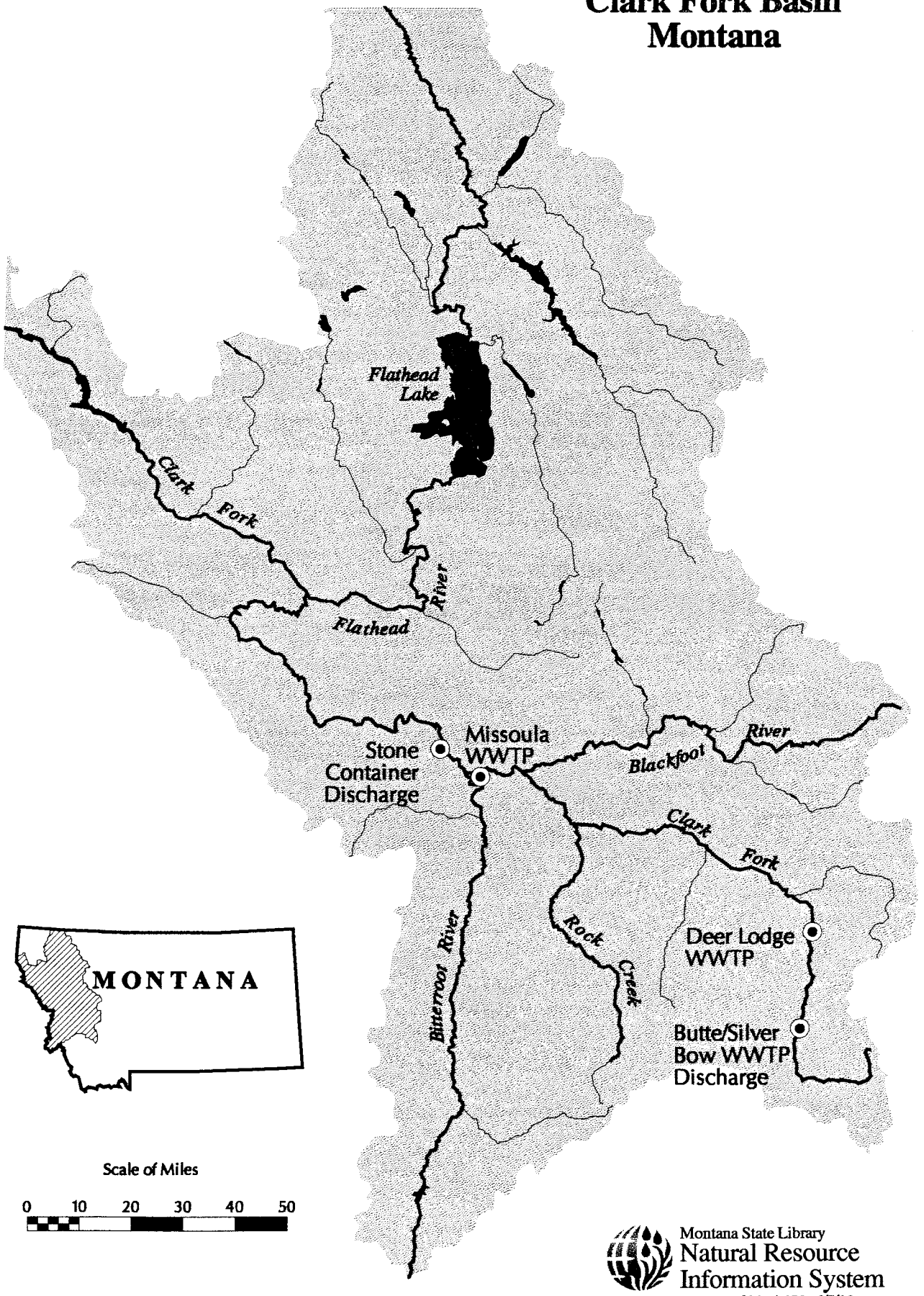
Appendix A

Clark Fork Basin Montana



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Appendix B: Agencies' Clark Fork Model

The Clark Fork River nutrient model predicts total phosphorus and total nitrogen concentrations in the Clark Fork River from nutrient concentrations and stream flow adjusted with a gain/loss factor. Several assumptions have been made to simplify the calculations and needed inputs. The assumptions are:

1) Constant concentration. The concentration of nutrients in the tributaries and from point sources remains the same as flow changes. The calibration nutrient concentrations were based on the average of July, August and September monitored values. Long term summer mean concentrations could improve the calibration and acceptability of the inputs.

2) Critical flow conditions: 30Q10. The critical period of algae growth is during the summer low flow periods. At these times, the minimal dilution of the point sources and warm water can result in maximum algae growth and large daily changes in dissolved oxygen concentrations. Using the 30Q10 acknowledges that the in-stream nutrient conditions may not be met once in a 10 year period because of the extreme low flow.

3) Gain/loss factor. The gain/loss factor represents the combined effects of algal uptake of nutrients and groundwater and tributary increases or decreases that have not been explicitly input to the model. The factor is assumed to remain constant for the purpose of the model predictions. The factor in fact probably changes with flow, time of year, and between years, and is influenced by the amount of periphyton growth.

4) Steady state. The model is steady state; that is, diel and day-to-day variations are not addressed.

5) Flow increment factor. Adjustment of flow between stations was made by using a flow increment factor. Flow increases or decreases did not contain nutrients. Therefore, increases in flow diluted the in-stream concentrations and decreases concentrated the in-stream concentrations. The impact of these nutrient-free flow modifications is greatest at low flow conditions.

6) Clark Fork mainstem predictions. The mixed conditions, end-of-segment, predicted concentrations are the expected values in the Clark Fork mainstem, regardless of the spreadsheet row name.

The attached model runs illustrate expected values for the following scenarios:

- **Model Run A**: Calibration, Clark Fork River, Summer (corresponds to Calibration Conditions in Table 2, page 16.)
- **Model Run B**: 30Q10, No controls in place
- **Model Run C**: 30Q10, VNRP reductions in place (corresponds to Predicted Summertime Conditions in Table 2, page 16.)

MODEL RUN A: CLARK FORK RIVER SUMMER CONDITIONS

Average summer (July, August, September 1991) flow scenario. Flows along mainstem are adjusted to approximate average summer flow conditions for 1991.
Based on data from Montana DEQ 525 report, 1992. Last spreadsheet modification May 1998.

	~~EFFLUENT/TRIBUTARY CONDITIONS~~~						~~~UPSTREAM CONDITIONS~~~						~~~MIXED CONDITIONS~~~ (beginning of segment)		
STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP ug/l	TN ug/l-N
1 Butte WWTP	**8.80**	**51.66**	**2400.00**	**204.21**	**9487.00**	0.22	8.00	1.5459	79	43.11	2203		16.80	1295	6018
2 Silver Bow Cr. blw CT	1.00	0.00	0.00	0.00	0.00	2.00	16.80	53.20	1295	247.31	6018		17.80	1222	5681
3 Silver Bow @ Miles Cr	10.00	0.00	0.00	0.00	0.00	1.00	17.80	51.10	1174	238.79	5485		27.80	752	3512
4 Silver Bow @ ab WSPs	5.50	0.00	0.00	0.00	0.00	0.50	27.80	22.81	336	118.26	1739		33.30	280	1452
5 WSP disch/Mill-Willow Bypass	2.00	**0.00**	**0.00**	**0.00**	0.00	0.50	33.30	9.40	115	54.60	670		35.30	109	632
6	0.00	0.00	0.00	0.00	0.00	0.50	35.30	6.80	79	41.22	477		35.30	79	477
7 Warm Sprs Cr @ mouth	1.12	0.00	0.00	0.00	0.00	0.75	35.30	6.80	79	41.22	477		36.42	76	463
8 Clar Fork blw WS Creek	0.25	0.00	0.00	0.00	0.00	0.50	36.42	6.03	68	37.10	416		36.67	67	414
9 Clark Fork nr Dempsey	6.00	0.00	0.00	0.00	0.00	0.75	36.67	5.94	66	37.36	417		42.67	57	358
10 Clark Fork @ Sager Ln Brdg	6.25	0.00	0.00	0.00	0.00	1.25	42.67	4.65	45	41.91	402		48.92	39	350
10a Clark Fork av Deer Lodge	16.00	0.00	0.00	0.00	0.00	2.00	48.92	3.99	33	45.03	376		64.92	25	284
11 Deer Lodge Discharge	**2.80**	8.55	**1249.00**	**35.46**	**5177.00**	0.00	64.92	3.13	20	50.51	318		67.72	71	519
12 Clark F. ab L. Blackfoot	21.00	0.00	0.00	0.00	0.00	1.40	67.72	11.68	71	85.97	519		88.72	54	396
Little Blackfoot River	77.00	6.59	35.00	40.87	217.00	0.00	88.72	13.28	61	69.00	318		165.72	49	271
Gold Creek	16.00	4.42	113.00	9.67	247.00	0.00	165.72	19.87	49	109.87	271		181.72	55	269
13 Clark Fork below Gold Cr	13.13	0.00	0.00	0.00	0.00	1.25	181.72	24.29	55	119.54	269		194.85	51	251
Flint Creek	30.00	5.58	76.00	28.11	383.00	0.00	194.85	18.80	39	103.80	218		224.85	44	240
14 Clark F. @ Bonita	152.50	0.00	0.00	0.00	0.00	3.05	224.85	24.37	44	131.91	240		377.35	26	143
Rock Creek	338.00	10.75	13.00	173.62	210.00	0.00	377.35	27.54	30	319.91	347		715.35	22	282
15 Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	715.35	38.29	22	493.54	282		715.35	22	282
16 Blackfoot R nr mouth	1016.00	22.37	9.00	521.90	210.00	0.00	715.35	32.76	19	673.99	385		1731.35	13	282
17 Clark F blw Milltown Dam	-25.00	0.00	0.00	0.00	0.00	-10.00	1731.35	55.13	13	1195.89	282		1706.35	13	287
18 Clark F ab Missoula	0.00	0.00	0.00	0.00	0.00	0.00	1706.35	59.51	14	1107.95	265		1706.35	14	265
Ground Water abv Missoula	16.20	2.38	60.00	19.81	500.00	0.00	1706.35	74.83	18	881.07	211		1722.55	18	214
20 Missoula WWTP discharge	**12.80**	**78.68**	**2513.00**	**382.48**	**12216.00**	0.00	1722.55	77.21	18	900.89	214		1735.35	37	302
Ground Water below Missoula	**24.30**	**3.57**	**60.00**	**29.72**	**500.00**	0.00	1735.35	155.89	37	1283.37	302		1759.65	37	305
21 Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	1735.35	157.26	37	1294.96	305		1735.35	37	305
21a Clark Fork ab Bitteroot	0.00	0.00	0.00	0.00	0.00	0.00	1735.35	137.49	32	1673.59	394		1735.35	32	394
22 Bitterroot R nr mouth	**1105.60**	**58.19**	**21.52**	**990.40**	**366.22**	0.00	1735.35	137.49	32	1673.59	394		2840.95	28	383
23 Clark F at Harper Brdg	-37.50	0.00	0.00	0.00	0.00	-5.00	2840.95	195.68	28	2663.99	383		2803.45	29	388
23a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	2803.45	129.55	19	1580.10	230		2803.45	19	230
24 Stone Container Direct Dischar	**0.00**	**0.00**	**905.00**	**0.00**	**1101.00**	0.00	2803.45	129.55	19	1580.10	230		2803.45	19	230
25 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	**997.00**	0.00	2803.45	129.55	19	1580.10	230		2815.75	22	234
26 Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	152.66	22	1610.10	234		2815.75	22	234
27 Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	137.60	20	2131.26	309		2815.75	20	309
28 Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	137.60	20	2131.26	309		2815.75	20	309
									20						

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP ug/l	TN ug/l-N
Bitterroot River above mouth	1013.00	44.60	18.00	718.59	290.00	0.00	0.00	0.00	0	0.00	0		1013.00	18	290
Ground Water to Bitterroot River	92.60	13.59	60.00	271.81	1200.00	0.00	1013.00	44.60	18	718.59	290		1105.60	22	366
22 Bitterroot R nr mouth	1105.60	0.00	**0.00**	**0.00**	**0.00**	0.00	1105.60	58.19	22	990.40	366		1105.60	22	366

MODEL RUN A

STREAM SEGMENT	CLARK FORK MILE MARK	DISTANCE (cumul.) miles	TIME (cumul.) hours	FLOW cfs	TP Target ug/l	TP ug/l	summer '91 calibration value	TP kg/day	TN Target ug/l	TN ug/l-N	summer '91 calibration value	TN kg/day
Upstream Values...	**-28.00**	-0.50	-0.05	8.00	20.0	**79**	**79**	1.5459	300.00	**2203**	**2203**	43.11
1 Butte WWTP	**-27.50**	0.00	0.00	16.80	20.0	**1295**		53.2033	300.00	**6018**		247.31
2 Silver Bow Cr. blw CT	**-27.00**	0.50	0.73	17.80	20.0	**1174**		51.10	300.00	**5485**		238.79
3 Silver Bow @ Miles Cr	**-17.00**	10.50	15.40	27.80	20.0	**336**		22.81	300.00	**1739**		118.26
4 Silver Bow @ ab WSPs	**-6.00**	21.50	31.53	33.30	20.0	**115**		9.40	300.00	**670**		54.60
5 WSP disch/Mill-Willow Bypass	**-2.00**	25.50	37.39	35.30	20.0	**79**		6.80	300.00	**477**		41.22
6	**-2.00**	25.50	37.39	35.30	20.0	**79**		6.80	300.00	**477**		41.22
7 Warm Sprs Cr @ mouth	**-0.50**	27.00	39.59	36.42	20.0	**68**		6.03	300.00	**416**		37.10
8 Clar Fork blw WS Creek	**0.00**	27.50	40.33	36.67	20.0	**66**	**65**	5.94	300.00	**417**	**417**	37.36
9 Clark Fork nr Dempsey	**8.00**	35.50	52.06	42.67	20.0	**45**		4.65	300.00	**402**		41.91
10 Clark Fork @ Sager Ln Brdg	**13.00**	40.50	59.39	48.92	20.0	**33**		3.99	300.00	**376**		45.03
10a Clark Fork av Deer Lodge	**21.00**	48.50	71.12	64.92	20.0	**20**	**20**	3.13	300.00	**318**	**320**	50.51
11 Deer Lodge Discharge	**21.00**	48.50	71.12	67.72	20.0	**71**		11.68	300.00	**519**		85.97
12 Clark F. ab L. Blackfoot	**36.00**	63.50	93.12	88.72	20.0	**61**	**61**	13.28	300.00	**318**	**317**	69.00
Little Blackfoot River	**36.00**	63.50	93.12	165.72	20.0	**49**		19.87	300.00	**271**		109.87
Gold Creek	**36.00**	63.50	93.12	181.72	20.0	**55**		24.29	300.00	**269**		119.54
13 Clark Fork below Gold Cr	**46.50**	74.00	108.52	194.85	20.0	**39**	**39**	18.80	300.00	**218**	**217**	103.80
Flint Creek	**46.50**	74.00	108.52	224.85	20.0	**44**		24.37	300.00	**240**		131.91
14 Clark F. @ Bonita	**96.50**	124.00	181.84	377.35	20.0	**30**	**30**	27.54	300.00	**347**	**343**	319.91
Rock Creek	**96.50**	124.00	181.84	715.35	20.0	**22**		38.29	300.00	**282**		493.54
15 Clark F. @ Turah	**113.50**	141.00	206.77	715.35	20.0	**19**	**19**	32.76	300.00	**385**	**383**	673.99
16 Blackfoot R nr mouth	**119.50**	147.00	215.57	1731.35	20.0	**13**		55.13	300.00	**282**		1195.89
17 Clark F blw Milltown Dam	**122.00**	149.50	219.23	1706.35	20.0	**14**		59.51	300.00	**265**		1107.95
18 Clark F ab Missoula	**129.50**	157.00	230.23	1706.35	20.0	**18**	**18**	74.83	300.00	**211**	**210**	881.07
Ground Water abv Missoula	**129.51**	157.01	230.23	1722.55	20.0	**18**		77.21	300.00	**214**		900.89
20 Missoula WWTP discharge	**129.51**	157.01	230.23	1735.35	39.0	**37**		155.89	300.00	**302**		1283.37
Ground Water below Missoula	**129.51**	157.01	230.24	1759.65	39.0	**37**		159.46	300.00	**305**		1313.09
21 Clark F @ Shuffield's	**131.51**	159.01	233.17	1735.35	39.0	**32**	**32**	137.49	300.00	**394**	**393**	1673.59
21a Clark Fork ab Bitteroot	**134.51**	162.01	237.57	1735.35	39.0	**32**		137.49	300.00	**394**		1673.59
22 Bitterroot R nr mouth	**134.51**	162.01	237.57	2840.95	39.0	**28**		195.68	300.00	**383**		2663.99
23 Clark F at Harper Brdg	**142.01**	169.51	248.56	2803.45	39.0	**19**	**19**	129.55	300.00	**230**	**230**	1580.10
23a Clark F ab Stone Container	**144.51**	172.01	252.23	2803.45	39.0	**19**		129.55	300.00	**230**		1580.10
24 Stone Container Direct Dischai	**144.51**	172.01	252.23	2803.45	39.0	**19**		129.55	300.00	**230**		1580.10
25 Stone Container Pond Seepag	**145.51**	173.01	253.70	2815.75	39.0	**22**		152.66	300.00	**234**		1610.10
26 Clark F @ Huson	**154.01**	181.51	266.16	2815.75	39.0	**20**	**20**	137.60	300.00	**309**	**310**	2131.26
27 Clark F nr Alberton	**164.51**	192.01	281.56	2815.75	39.0	**20**		137.60	300.00	**309**		2131.26
28 Clark F @ Superior	**202.51**	230.01	337.28	2815.75	39.0	**20**		137.60	300.00	**309**		2131.26

		miles	hours	cfs	ug/l	ug/l		kg/day	ug/l	ug/l-N		kg/day
Bitterroot River above mouth	**0.00**	0.00	0.00	0.00	20.0	**18.00**		0.00	300.00	**290**		0.00
Ground Water to Bitterroot River	**2.00**	2.00	2.93	1013.00	20.0	**21.52**		53.32	300.00	**366**		907.45
22 Bitterroot R nr mouth	**4.00**	4.00	5.87	1105.60	20.0	**21.52**		58.19	300.00	**366**		990.40

MODEL RUN B: 30Q10, NO CONTROLS IN PLACE

Low flow conditions with no controls in place for any source. Constant concentrations for tributaries and other sources. Flows along mainstem are adjusted to approximate flow conditions for 30Q10. Last spreadsheet modification April 1988.

	~~EFFLUENT/TRIBUTARY CONDITIONS~~~						~~~UPSTREAM CONDITIONS~~~						~~~MIXED CONDITIONS~~~ (beginning of segment)		
STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP ug/l	TN ug/l-N
1 Butte WWTP	**8.80**	**51.66**	**2400.00**	**204.21**	**9487.00**	0.00	14.00	2.7054	79	75.44	2203		22.80	975	5014
2 Silver Bow Cr. blw CT	0.00	0.00	0.00	0.00	0.00	0.00	22.80	54.36	975	279.63	5014		22.80	975	5014
3 Silver Bow @ Miles Cr	0.00	0.00	0.00	0.00	0.00	0.00	22.80	52.25	937	268.03	4806		22.80	937	4806
4 Silver Bow @ ab WSPs	0.00	0.00	0.00	0.00	0.00	0.00	22.80	23.61	423	114.64	2056		22.80	423	2056
5 WSP disch/Mill-Willow Bypass	0.00	**0.00**	**0.00**	**0.00**	0.00	0.00	22.80	9.86	177	45.04	808		22.80	177	808
6	0.00	0.00	0.00	0.00	0.00	0.10	22.80	7.17	129	32.07	575		22.80	129	575
7 Warm Sprs Cr @ mouth	0.15	0.00	0.00	0.00	0.00	0.10	22.80	7.17	129	32.07	575		22.95	128	571
8 Clar Fork blw WS Creek	0.05	0.00	0.00	0.00	0.00	0.10	22.95	6.37	113	28.23	503		23.00	113	502
9 Clark Fork nr Dempsey	0.80	0.00	0.00	0.00	0.00	0.10	23.00	6.27	111	28.44	505		23.80	108	488
10 Clark Fork @ Sager Ln Brdg	0.50	0.00	0.00	0.00	0.00	0.10	23.80	4.91	84	31.90	548		24.30	83	537
10a Clark Fork av Deer Lodge	0.80	0.00	0.00	0.00	0.00	0.10	24.30	4.22	71	34.27	577		25.10	69	558
11 Deer Lodge Discharge	**2.80**	8.55	**1249.00**	**35.46**	**5177.00**	0.00	25.10	3.30	54	38.44	626		27.90	174	1083
12 Clark F. ab L. Blackfoot	33.00	0.00	0.00	0.00	0.00	2.20	27.90	11.86	174	73.90	1083		60.90	80	496
Little Blackfoot River	16.00	1.37	35.00	8.49	217.00	0.00	60.90	13.48	90	46.74	314		76.90	79	294
Gold Creek	7.00	1.93	113.00	4.23	247.00	0.00	76.90	16.88	90	55.23	294		83.90	92	290
13 Clark Fork below Gold Cr	0.00	0.00	0.00	0.00	0.00	0.00	83.90	18.82	92	59.46	290		83.90	92	290
Flint Creek	10.00	1.86	76.00	9.37	383.00	0.00	83.90	12.80	62	50.65	247		93.90	64	261
14 Clark F. @ Bonita	100.00	0.00	0.00	0.00	0.00	2.00	93.90	14.66	64	60.02	261		193.90	31	127
Rock Creek	110.00	3.50	13.00	56.50	210.00	0.00	193.90	17.08	36	145.56	307		303.90	28	272
15 Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	303.90	20.58	28	202.06	272		303.90	28	272
16 Blackfoot R nr mouth	359.00	7.90	9.00	184.41	210.00	0.00	303.90	17.61	24	275.94	371		662.90	16	284
17 Clark F blw Milltown Dam	57.50	0.00	0.00	0.00	0.00	23.00	662.90	25.52	16	460.35	284		720.40	14	261
18 Clark F ab Missoula	34.50	0.00	0.00	0.00	0.00	23.00	720.40	31.12	18	380.33	216		754.90	17	206
Ground Water abv Missoula	16.20	2.38	60.00	19.81	500.00	0.00	754.90	35.06	19	339.16	184		771.10	20	190
20 Missoula WWTP discharge	**12.80**	**78.68**	**2513.00**	**382.48**	**12216.00**	0.00	771.10	37.44	20	358.98	190		783.90	61	387
Ground Water below Missoula	**24.30**	**3.57**	**60.00**	**29.72**	**500.00**	0.00	783.90	116.12	61	741.46	387		808.20	61	390
21 Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	783.90	116.09	61	747.99	390		783.90	61	390
21a Clark Fork ab Bitteroot	0.00	0.00	0.00	0.00	0.00	0.00	783.90	102.74	54	943.37	492		783.90	54	492
22 Bitterroot R nr mouth	**445.60**	**29.15**	**26.74**	**522.50**	**479.37**	0.00	783.90	102.74	54	943.37	492		1229.50	44	487
23 Clark F at Harper Brdg	-30.00	0.00	0.00	0.00	0.00	-4.00	1229.50	131.89	44	1465.87	487		1199.50	45	500
23a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	1199.50	91.42	31	927.06	316		1199.50	31	316
24 Stone Container Direct Dischar	**0.00**	**0.00**	**905.00**	**0.00**	**1101.00**	0.00	1199.50	91.42	31	927.06	316		1199.50	31	316
25 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	**997.00**	0.00	1199.50	91.42	31	927.06	316		1211.80	39	323
26 Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	114.52	39	957.06	323		1211.80	39	323
27 Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	103.22	35	1266.84	427		1211.80	35	427
28 Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	103.22	35	1266.84	427		1211.80	35	427
									35						

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP ug/l	TN ug/l-N
Bitterroot River above mouth	353.40	15.56	18.00	250.69	290.00	0.00	0.00	0.00	0	0.00	0		353.00	18	290
Ground Water to Bitterroot River	92.60	13.59	60.00	271.81	1200.00	0.00	353.00	15.56	18	250.69	290		445.60	27	479
22 Bitterroot R nr mouth	445.60	0.00	**0.00**	**0.00**	**0.00**	0.00	445.60	29.15	27	522.50	479		445.60	27	479

MODEL RUN B

STREAM SEGMENT	CLARK FORK MILE MARK	DISTANCE (cumul.) miles	TIME (cumul.) hours	FLOW cfs	TP Target ug/l	TP ug/l	TP kg/day	TN Target ug/l	TN ug/l-N	TN kg/day
Upstream Values...	**-28.00**	-0.50	-0.05	14.00	20.0	**79**	2.7054	300.00	**2203**	75.44
1 Butte WWTP	**-27.50**	0.00	0.00	22.80	20.0	**975**	54.3627	300.00	**5014**	279.63
2 Silver Bow Cr. blw CT	**-27.00**	0.50	0.73	22.80	20.0	**937**	52.25	300.00	**4806**	268.03
3 Silver Bow @ Miles Cr	**-17.00**	10.50	15.40	22.80	20.0	**423**	23.61	300.00	**2056**	114.64
4 Silver Bow @ ab WSPs	**-6.00**	21.50	31.53	22.80	20.0	**177**	9.86	300.00	**808**	45.04
5 WSP disch/Mill-Willow Bypass	**-2.00**	25.50	37.39	22.80	20.0	**129**	7.17	300.00	**575**	32.07
6	**-2.00**	25.50	37.39	22.80	20.0	**129**	7.17	300.00	**575**	32.07
7 Warm Sprs Cr @ mouth	**-0.50**	27.00	39.59	22.95	20.0	**113**	6.37	300.00	**503**	28.23
8 Clar Fork blw WS Creek	**0.00**	27.50	40.33	23.00	20.0	**111**	6.27	300.00	**505**	28.44
9 Clark Fork nr Dempsey	**8.00**	35.50	52.06	23.80	20.0	**84**	4.91	300.00	**548**	31.90
10 Clark Fork @ Sager Ln Brdg	**13.00**	40.50	59.39	24.30	20.0	**71**	4.22	300.00	**577**	34.27
10a Clark Fork av Deer Lodge	**21.00**	48.50	71.12	25.10	20.0	**54**	3.30	300.00	**626**	38.44
11 Deer Lodge Discharge	**21.00**	48.50	71.12	27.90	20.0	**174**	11.86	300.00	**1083**	73.90
12 Clark F. ab L. Blackfoot	**36.00**	63.50	93.12	60.90	20.0	**90**	13.48	300.00	**314**	46.74
Little Blackfoot River	**51.00**	78.50	115.11	76.90	20.0	**90**	16.88	300.00	**294**	55.23
Gold Creek	**51.00**	78.50	115.11	83.90	20.0	**92**	18.82	300.00	**290**	59.46
13 Clark Fork below Gold Cr	**61.50**	89.00	130.51	83.90	20.0	**62**	12.80	300.00	**247**	50.65
Flint Creek	**61.50**	89.00	130.51	93.90	20.0	**64**	14.66	300.00	**261**	60.02
14 Clark F. @ Bonita	**111.50**	139.00	203.83	193.90	20.0	**36**	17.08	300.00	**307**	145.56
Rock Creek	**111.50**	139.00	203.83	303.90	20.0	**28**	20.58	300.00	**272**	202.06
15 Clark F. @ Turah	**128.50**	156.00	228.76	303.90	20.0	**24**	17.61	300.00	**371**	275.94
16 Blackfoot R nr mouth	**134.50**	162.00	237.56	662.90	20.0	**16**	25.52	300.00	**284**	460.35
17 Clark F blw Milltown Dam	**137.00**	164.50	241.22	720.40	20.0	**18**	31.12	300.00	**216**	380.33
18 Clark F ab Missoula	**138.50**	166.00	243.42	754.90	20.0	**19**	35.06	300.00	**184**	339.16
Ground Water abv Missoula	**138.50**	166.00	243.42	771.10	20.0	**20**	37.44	300.00	**190**	358.98
20 Missoula WWTP discharge	**138.50**	166.00	243.42	783.90	39.0	**61**	116.12	300.00	**387**	741.46
Ground Water below Missoula	**138.50**	166.00	243.42	808.20	39.0	**61**	119.68	300.00	**390**	771.18
21 Clark F @ Shuffield's	**140.50**	168.00	246.35	783.90	39.0	**54**	102.74	300.00	**492**	943.37
21a Clark Fork ab Bitteroot	**143.50**	171.00	250.75	783.90	39.0	**54**	102.74	300.00	**492**	943.37
22 Bitterroot R nr mouth	**143.50**	171.00	250.75	1229.50	39.0	**44**	131.89	300.00	**487**	1465.87
23 Clark F at Harper Brdg	**151.00**	178.50	261.75	1199.50	39.0	**31**	91.42	300.00	**316**	927.06
23a Clark F ab Stone Container	**153.50**	181.00	265.42	1199.50	39.0	**31**	91.42	300.00	**316**	927.06
24 Stone Container Direct Disch	**153.50**	181.00	265.42	1199.50	39.0	**31**	91.42	300.00	**316**	927.06
25 Stone Container Pond Seepa	**154.50**	182.00	266.88	1211.80	39.0	**39**	114.52	300.00	**323**	957.06
26 Clark F @ Huson	**163.00**	190.50	279.35	1211.80	39.0	**35**	103.22	300.00	**427**	1266.84
27 Clark F nr Alberton	**173.50**	201.00	294.74	1211.80	39.0	**35**	103.22	300.00	**427**	1266.84
28 Clark F @ Superior	**211.50**	239.00	350.47	1211.80	39.0	**35**	103.22	300.00	**427**	1266.84

		miles	hours	cfs	ug/l	ug/l	kg/day	ug/l	ug/l-N	kg/day
Bitterroot River above mouth	**0.00**	0.00	0.00	0.00	20.0	**18.02**	0.00	300.00	**290**	0.00
Ground Water to Bitterroot River	**2.00**	2.00	2.93	353.00	20.0	**26.74**	23.09	300.00	**479**	413.92
22 Bitterroot R nr mouth	**4.00**	4.00	5.87	445.60	20.0	**26.74**	29.15	300.00	**479**	522.50

MODEL RUN C: 30Q10, VNRP REDUCTIONS IN PLACE

Summer (July, August, September 1991) low flow 30Q10 scenario. Effluent concentrations modified to meet technology-based effluent quality of 10,000 ug/l TN and 1,000 ug/l TP for Butte and Missoula WWTP's. Includes flow reduction of 4.5 mgd (7 cfs) from Butte WWTP for other industrial use and Silver Lake water diversion to Warm Springs Creek, 24 mgd (37.2 cfs.) Missoula flow at 10-year projection. New line added above Missoula WWTP to indicate 20% nonpoint source control for mainstem (not tributaries) above Missoula; used gain/loss factor to make reduction of nutrient concentration. Missoula area groundwater concentrations reduced 10% for TP, 40% for TN.
Last spreadsheet modification, June 1998.

	~~EFFLUENT/TRIBUTARY CONDITIONS~~~						~~~UPSTREAM CONDITIONS~~~					~~~MIXED CONDITIONS~~~ (beginning of segment)		
STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
1 Butte WWTP	**1.80**	**4.40**	**1000.00**	**44.03**	**10000.00**	**0.00**	14.00	2.7054	79	75.44	2203	15.80	184	3091
2 Silver Bow Cr. blw CT	0.00	0.00	0.00	0.00	0.00	0.00	15.80	7.11	184	119.46	3091	15.80	184	3091
3 Silver Bow @ Miles Cr	0.00	0.00	0.00	0.00	0.00	0.00	15.80	6.83	177	115.35	2985	15.80	177	2985
4 Silver Bow @ ab WSPs	0.00	0.00	0.00	0.00	0.00	0.00	15.80	3.05	79	57.13	1478	15.80	79	1478
5 WSP disch/Mill-Willow Bypass	0.00	0.00	0.00	0.00	0.00	0.00	15.80	1.26	32	26.37	682	15.80	32	682
SILVER LAKE transfer to Warm Springs	37.20	0.91	10.00	22.75	250.00	0.10	15.80	0.91	24	19.91	515	53.00	14	329
7 Warm Sprs Cr @ mouth	0.15	0.00	0.00	0.00	0.00	0.10	53.00	1.82	14	42.66	329	53.15	14	328
8 Clar Fork blw WS Creek	0.05	0.00	0.00	0.00	0.00	0.10	53.15	1.61	12	38.39	295	53.20	12	295
9 Clark Fork nr Dempsey	0.80	0.00	0.00	0.00	0.00	0.10	53.20	1.59	12	38.67	297	54.00	12	293
10 Clark Fork @ Sager Ln Brdg	0.50	0.00	0.00	0.00	0.00	0.10	54.00	1.24	9	43.38	328	54.50	9	325
10a Clark Fork av Deer Lodge	0.80	0.00	0.00	0.00	0.00	0.10	54.50	1.07	8	46.61	350	55.30	8	345
11 Deer Lodge Discharge	**0.00**	0.00	**1249.00**	**0.00**	**5177.00**	0.00	55.30	0.84	6	52.28	386	55.30	6	386
12 Clark F. ab L. Blackfoot	33.00	0.00	0.00	0.00	0.00	2.20	55.30	0.84	6	52.28	386	88.30	4	242
Little Blackfoot River	16.00	1.37	35.00	8.49	217.00	0.00	88.30	0.95	4	41.96	194	104.30	9	198
Gold Creek	7.00	1.93	113.00	4.23	247.00	0.00	104.30	2.32	9	50.45	198	111.30	16	201
13 Clark Fork below Gold Cr	0.00	0.00	0.00	0.00	0.00	0.00	111.30	4.25	16	54.68	201	111.30	16	201
Flint Creek	10.00	1.86	76.00	9.37	383.00	0.00	111.30	3.29	12	47.48	174	121.30	17	192
14 Clark F. @ Bonita	100.00	0.00	0.00	0.00	0.00	2.00	121.30	5.15	17	56.85	192	221.30	10	105
Rock Creek	110.00	3.50	13.00	56.50	210.00	0.00	221.30	5.82	11	137.88	255	331.30	11	240
15 Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	331.30	9.32	11	194.38	240	331.30	11	240
16 Blackfoot R nr mouth	359.00	7.90	9.00	184.41	210.00	0.00	331.30	7.97	10	265.45	328	690.30	9	266
17 Clark F blw Milltown Dam	22.50	0.00	0.00	0.00	0.00	9.00	690.30	15.88	9	449.87	266	712.80	9	258
18 Clark F ab Missoula	61.75	0.00	0.00	0.00	0.00	9.50	712.80	17.14	10	416.79	239	774.55	9	220
Nonpoint reduction to CFR mainstem	0.00	0.00	0.00	0.00	0.00	0.00	774.55	20.90	11	341.72	180	774.55	11	180
Ground Water abv Missoula	16.20	2.14	54.00	11.89	300.00	0.00	774.55	17.40	9	273.41	144	790.75	10	147
20 Missoula WWTP discharge	**16.50**	**40.36**	**1000.00**	**403.61**	**10000.00**	0.00	790.75	19.54	10	285.30	147	807.25	30	349
Ground Water below Missoula	**24.30**	**3.21**	**54.00**	**17.83**	**300.00**	0.00	807.25	59.90	30	688.91	349	831.55	31	347
21 Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	807.25	61.27	31	686.09	347	807.25	31	347
21a Clark Fork ab Bitteroot	0.00	0.00	0.00	0.00	0.00	0.00	807.25	53.56	27	886.69	449	807.25	27	449
22 Bitterroot R nr mouth	**445.60**	**27.79**	**25.50**	**413.78**	**379.62**	0.00	807.25	53.56	27	886.69	449	1252.85	27	424
23 Clark F at Harper Brdg	-30.00	0.00	0.00	0.00	0.00	-4.00	1252.85	81.36	27	1300.47	424	1222.85	27	435
23a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	1222.85	53.86	18	771.35	258	1222.85	18	258
24 Stone Container Direct Discharg	**0.00**	**0.00**	**905.00**	**0.00**	**1101.00**	0.00	1222.85	53.86	18	771.35	258	1222.85	18	258
25 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	**997.00**	0.00	1222.85	53.86	18	771.35	258	1235.15	25	265
26 Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	76.97	25	801.35	265	1235.15	25	265
27 Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	69.38	23	1060.73	351	1235.15	23	351
28 Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	69.38	23	1060.73	351	1235.15	23	351

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
Bitterroot River above mouth	353.40	15.56	18.00	250.69	290.00	0.00	0.00	0.00	0	0.00	0	353.00	18	290
Ground Water to Bitterroot River	92.60	12.23	54.00	163.09	720.00	0.00	353.00	15.56	18	250.69	290	445.60	25	380
22 Bitterroot R nr mouth	445.60	0.00	0.00	0.00	0.00	0.00	445.60	27.79	25	413.78	380	445.60	25	380

MODEL RUN C

STREAM SEGMENT	CF MILE	DISTANCE (cumul.) miles	TIME (cumul hours	FLOW cfs	TP Target ug/l	TP ug/l	TP kg/day	TN Target ug/l	TN ug/l-N	TN kg/day
Upstream Values...	-28	-0.50	0	14	20.0	79	2.71	300	2203	75.44
1 Butte WWTP	-27	0.00	0	16	20.0	184	7.11	300	3091	119.46
2 Silver Bow Cr. blw CT	-27	0.50	1	16	20.0	177	6.83	300	2985	115.35
3 Silver Bow @ Miles Cr	-17	10.50	15	16	20.0	79	3.05	300	1478	57.13
4 Silver Bow @ ab WSPs	-6	21.50	32	16	20.0	32	1.26	300	682	26.37
5 WSP disch/Mill-Willow Bypass	-2	25.50	37	16	20.0	24	0.91	300	515	19.91
SILVER LAKE transfer to Warm Sprin	-2	25.50	37	53	20.0	14	1.82	300	329	42.66
7 Warm Sprs Cr @ mouth	-1	27.00	40	53	20.0	12	1.61	300	295	38.39
8 Clar Fork blw WS Creek	0	27.50	40	53	20.0	12	1.59	300	297	38.67
9 Clark Fork nr Dempsey	8	35.50	52	54	20.0	9	1.24	300	328	43.38
10 Clark Fork @ Sager Ln Brdg	13	40.50	59	54	20.0	8	1.07	300	350	46.61
10a Clark Fork av Deer Lodge	21	48.50	71	55	20.0	6	0.84	300	386	52.28
11 Deer Lodge Discharge	21	48.50	71	55	20.0	6	0.84	300	386	52.28
12 Clark F. ab L. Blackfoot	36	63.50	93	88	20.0	4	0.95	300	194	41.96
Little Blackfoot River	36	63.50	93	104	20.0	9	2.32	300	198	50.45
Gold Creek	36	63.50	93	111	20.0	16	4.25	300	201	54.68
13 Clark Fork below Gold Cr	47	74.00	109	111	20.0	12	3.29	300	174	47.48
Flint Creek	47	74.00	109	121	20.0	17	5.15	300	192	56.85
14 Clark F. @ Bonita	97	124.00	182	221	20.0	11	5.82	300	255	137.88
Rock Creek	97	124.00	182	331	20.0	11	9.32	300	240	194.38
15 Clark F. @ Turah	114	141.00	207	331	20.0	10	7.97	300	328	265.45
16 Blackfoot R nr mouth	120	147.00	216	690	20.0	9	15.88	300	266	449.87
17 Clark F blw Milltown Dam	122	149.50	219	713	20.0	10	17.14	300	239	416.79
18 Clark F ab Missoula	129	156.00	229	775	20.0	11	20.90	300	180	341.72
Nonpoint reduction to CFR mainstem	130	157.00	230	775	20.0	9	17.40	300	144	273.41
Ground Water abv Missoula	130	157.01	230	791	20.0	10	19.54	300	147	285.30
20 Missoula WWTP discharge	130	157.01	230	807	39.0	30	59.90	300	349	688.91
Ground Water below Missoula	130	157.01	230	832	39.0	31	63.11	300	347	706.74
21 Clark F @ Shuffield's	132	159.01	233	807	39.0	27	53.56	300	449	886.69
21a Clark Fork ab Bitteroot	135	162.01	238	807	39.0	27	53.56	300	449	886.69
22 Bitterroot R nr mouth	135	162.01	238	1253	39.0	27	81.36	300	424	1300.47
23 Clark F at Harper Brdg	142	169.51	249	1223	39.0	18	53.86	300	258	771.35
23a Clark F ab Stone Container	145	172.01	252	1223	39.0	18	53.86	300	258	771.35
24 Stone Container Direct Discl	145	172.01	252	1223	39.0	18	53.86	300	258	771.35
25 Stone Container Pond Seep	146	173.01	254	1235	39.0	25	76.97	300	265	801.35
26 Clark F @ Huson	154	181.51	266	1235	39.0	23	69.38	300	351	1060.73
27 Clark F nr Alberton	165	192.01	282	1235	39.0	23	69.38	300	351	1060.73
28 Clark F @ Superior	203	230.01	337	1235	39.0	23	69.38	300	351	1060.73

		miles	hours	cfs	ug/l	ug/l	kg/day	ug/l	ug/l-N	kg/day
Bitterroot River above mouth	0	4.00	0	0	20.0	18.02	0.00	300	290	0.00
Ground Water to Bitterroot River	2	4.00	3	353	20.0	25.50	22.02	300	380	327.79
22 Bitterroot R nr mouth	4	4.00	6	446	20.0	25.50	27.79	300	380	413.78

Appendix C: Excerpts, Clark Fork-Pend Oreille Watershed
Water Quality Monitoring Program Sampling and Analysis Plan

Table of Contents

APPENDICES

1.0 Introduction

The mission of the Tri-State Implementation Council has been to develop a management strategy to restore and protect designated water uses within the Clark Fork-Pend Oreille Basin. The monitoring subcommittee oversees water quality monitoring efforts and makes recommendations to improve the basin-wide monitoring program.

The monitoring program described in this report includes sampling design to detect long-term trends in water quality and meet monitoring objectives identified by the Tri-State Implementation Council. The program is a statistically based design derived from analysis of approximately 10 years of historical data (Land and Water, 1995). This document recommends procedures for sample collection, analysis, and reporting to ensure technically sound water quality monitoring throughout the watershed.

1.1 Tri-State Monitoring Goals and Objectives

Eight priority water quality monitoring objectives are defined for the Clark Fork-Pend Oreille Watershed. These include:

1) trend detection of nutrient concentrations in tributaries and mainstem of the Clark Fork River,
2) assessment of trends in periphyton in the Clark Fork mainstem,
3) assessment of compliance with mid-summer nutrient targets for the Clark Fork,
4) estimation of nutrient loads to Lake Pend Oreille,
5) assessment of trends in periphyton in the Lake Pend Oreille nearshore,
6) trend analysis of Secchi disk transparency in Lake Pend Oreille
7) trend assessment of nutrient concentrations in the Pend Oreille River and nutrient concentrations and fecal coliform in tributaries, and
8) assessment of macrophyte composition and density in the Pend Oreille River.

The objective of monitoring is to generate reliable information on water quality trends and status for watershed managers. Analysis of approximately 10 years of historical nutrient and periphyton data for the watershed provided statistical design criteria for the monitoring program (Land and Water, 1995). Sampling frequencies and locations are optimized to maximize information for watershed management decision making while minimizing monitoring costs. Individual management/monitoring goals are outlined with appropriate statistical criteria in the following sections:

1.1.1 Clark Fork River, Nutrient Trend Detection

MANAGEMENT GOAL:	Improve water quality
MONITORING GOAL:	Detect significant trends in nutrient concentrations
DEFINITION OF WATER QUALITY:	Total phosphorus, total nitrogen, ortho phosphate, dissolved inorganic nitrogen.
DEFINITION OF TREND:	50% change in 10 year period at 95% confidence level, 90% power or 40% change at 90% C.L., 80% power
STATISTICAL METHODOLOGY:	Seasonal Kendall with Sen slope estimate
STATISTICAL HYPOTHESIS:	Ho: No trend exists Ha: Trend exists
DATA ANALYSIS RESULT:	Conclusions regarding presence of trends Provide estimate of trend magnitude
INFORMATION PRODUCT:	Management goal met when no trend exists, or indicates improvement

1.1.2 Clark Fork River, Nuisance Algae

MANAGEMENT GOAL:	Control Nuisance Algae
MONITORING GOAL:	Detect significant trends in attached algae
DEFINITION OF WATER QUALITY:	Chlorophyll *a* (mg/m2)/ Ash Free Dry Weight (g/m2)
DEFINITION OF TREND:	35% change in 10 years at 90% C.L., 80% Power, for annual, 50% change at 90% C.L., 80% power
STATISTICAL METHODOLOGY:	Kendall with Sen slope estimate
STATISTICAL HYPOTHESIS:	Ho: No trend exists Ha: Trend exists
DATA ANALYSIS RESULT:	Conclusions regarding presence of trends Provide estimate of trend magnitude
INFORMATION PRODUCT:	Management goal met when slope indicates improvement

1.1.3 Clark Fork River, Instream Nutrient Targets

MANAGEMENT GOAL:	Achieve Instream Nutrient Targets
MONITORING GOAL:	Evaluate excursions of summer nutrient concentrations
DEFINITION OF NUTRIENT TARGETS:	20 μg/L total phosphorus upstream of Missoula; 39 μg/L total phosphorus downstream on Missoula; 300 μg/L total nitrogen; ortho phosphate 6 μg/L, dissolved inorganic N 30 μg/L
STATISTICAL METHODOLOGY:	Excursion Analysis, 95% below target/year, 95% C.L.
STATISTICAL HYPOTHESIS:	Ho: Proportion <= .05 Ha: Proportion > .05
DATA ANALYSIS RESULT:	Conclusions regarding achievement of targets
INFORMATION PRODUCT:	Management goal met when target achieved or exceeded

Table 4. Sampling Frequency by Station - Clark Fork River

Station	Name	Frequency
00	Silver Bow above WWTP	N12
02.5	Silver Bow at Opportunity, replaces 03	N12, S6
04	Discharge AMC pond 2 (Silver Bow)	N12
05	Mill-Willow bypass at mouth	N12
06	Warm Springs Creek near mouth	N12
07	Clark Fork below Warm Springs Creek	N12, S6
09	Clark Fork at Deer Lodge	N12, P10
10	Clark Fork above Little Blackfoot River	N12, S6, P10
10.2	Little Blackfoot River near mouth	N4
11	Clark Fork at Gold Creek Bridge	N12
11.5	Flint Creek near mouth	N4
12	Clark Fork at Bonita	N12, P10
12.5	Rock Creek near mouth	N12
13	Clark Fork at Turah	N12
14	Blackfoot River near mouth	N12
15.5	Clark Fork above Missoula	N12, P10
18	Clark Fork at Shuffields	N12, S6, P10
19	Bitterroot near mouth	N12
20	Clark Fork at Harper Bridge	N12
22	Clark Fork at Huson	N12, S6, P10
22.5	Ninemile Creek near mouth	N4
25	Clark Fork above Flathead	N12, P10
26	Flathead River near mouth	N12
26.6	Little Bitterroot near mouth	N4
26.7	Crow Creek near mouth	N4
26.9	Mission Creek near mouth	N4
27	Clark Fk above Thomp. Fls Reservoir	N12
27.5	Thompson River near mouth	N4
28	Clark Fk above Noxon Rapids Reservoir	N12
29	Clark Fork at Noxon Bridge	N12
29.5	Bull River near mouth	N4
30	Clark Fork below Cabinet Gorge Dam	N18

Codes: N12=nutrient parameters, 12 samples/year
S6 = Summer nutrient levels, 6 samples in addition to regular monitoring
P10= Periphyton, 10 replicates per site

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Appendix E:
Clark Fork River Voluntary Nutrient Reduction Program
Response to Public Comments

Introduction

This document contains public comments received on the July 1996 draft of the Clark Fork River Voluntary Nutrient Reduction Program (VNRP.) Notices that the draft plan was available for public review were published in the *Montana Standard* and the *Missoulian*. The public comment period ended August 15, 1996. Public meetings were held in Missoula (July 23, 1996) and Butte (July 30, 1996) to hear comments and concerns. Those meetings were taped recorded and the comments received are summarized (paraphrased) below. Responses to written comments follow the responses to comments at the public meetings. Responses to all comments are provided by the Tri-State Implementation Council's nutrient target subcommittee and appear in italic.

PUBLIC MEETINGS

- Are all dischargers signing on to the VNRP?

  Yes, although a few items remain to be worked out, we are expecting everyone who has been involved to sign.

- You plan to achieve reductions over the next ten years. Will the measures all begin at once for a smooth reduction or go in fits and starts?

  It will be highly variable from source to source. For example, in Missoula it will be a few years yet or not until they implement biological nutrient removal; in Butte it will occur in stages; in Deer Lodge they should be ready for construction next spring.

- Regarding the timeline, is there any plan at the half-way mark or somewhere during the program to look at whether actual reductions are being made? Are you hoping for measurable reductions along the way?

  We will review the program every 3 years; but at this point we have no rigid milestones for any of the facilities; our approach is cooperative. We are looking for the most cost-effective solutions to reach the desired water quality goals for the river by the end of the ten years.

- After 3 years are you looking to find at least some reduction?

Yes. However, in-stream monitoring results are affected by variable stream flows and other conditions from year to year, so it will take long term monitoring to really judge our progress.

- Since monitoring in-stream can be iffy, the easiest and most effective place to monitor discharges would be end of pipe. Also it's best to do this if we don't have the money to do sufficient in-stream monitoring. End-of-pipe results will show that point sources have done their part, then in-stream monitoring can complement that by telling us if nonpoint sources are wiping out what the point sources have accomplished.

  Agree. The point sources identified in the VNRP already do end-of-pipe monitoring and in-stream monitoring.

- I understand changes have been made to deal with growth-related issues. Did you change any allocation numbers?

  No.

- So Missoula is being asked to cut back nutrients and at the same time being asked to take on more load as people hook up?

  Response 1: This is part of the concern from the City of Missoula that if we provide a higher level of treatment at the plant, people will go somewhere else cheaper to develop. This is counter to the city's growth objective to develop in sewered areas. The higher costs would make a disincentive for people to hook up to sewer. We will be working to address this issue in the VNRP.

  Response 2: During summertime low flows, 80% of the nutrient load comes from the four key point sources. Our strategy is two-fold: to restore water quality by focusing on the key point sources over the short term, and to maintain these improvements by getting a handle on nonpoint sources, other point sources and growth-related impacts.

- But you don't want to create a disincentive for people to hook up to the sewer because of potential groundwater problems from septics. At least with the sewer you get the wastewater at one point and then you can treat it.

  Agree. We don't want to trade a point source problem for a nonpoint problem. Nutrient loading from septic seepage will decrease as areas are hooked up to the sewer; also we can work out a system that does not penalize the city for the additional hook-ups.

- Is the urban area of Missoula considered as one overall source that needs to be reduced, or are we just looking at point source? It seems logical that we look at the whole urban area as a source of nutrients whether it's from a discharge pipe or into the ground as nitrates seeping into the river.

Response 1: We have design criteria for the Missoula plant and we already anticipate problems meeting those criteria into the future because of growth and added hook-ups. We're not sure how we'll deal with this yet, other than to evaluate improvements through nonpoint reductions and if we're meeting targets downstream then that would be acceptable and we'd give the Missoula WWTP credit for that.

Response 2: The groundwater contributions from the Bitterroot are being considered in this. We're looking at seepage from both the Clark Fork and the Bitterroot.

Response 3: Agree it makes sense to look at the whole Missoula area, and both point and nonpoint sources.

- Regarding the mention of nutrient trading in the nonpoint section, I recommend that whenever we do nutrient trading we build reduction into it. Without reductions, trading only maintains the status quo, at best. If new development pays for some other water quality clean-up but that clean-up is not successful, meanwhile you've let the new development come in so the overall result is a negative. Recommend a 2-for-1 requirement for nutrient trading so new development would have to pay for double the amount of what their project would add.

  We will consider this when we work out the nutrient trading details.

- What about smaller discharges such as Alberton, Superior, etc.? They aren't set up to do much on nutrient reduction. Maybe nutrient trading is the way to deal with them?

  Yes. For example, in the Bitterroot, we're looking at no increase over the ten year period. We are depending on DEQ to think of this as they renew discharge permits to the smaller discharges; we expect the agency to consider how smaller ones will impact the targets.

- It would strengthen our hand on nonpoint source if we tie it to other nonpoint issues such as floodplains, riparian habitat protection, sewering old developments near the river, preventing new development to maintain riparian areas, etc. I would like to see the subcommittee spend its efforts to reduce/minimize streamside developments.

  Yes. This will fall under the specifics of the nonpoint strategy.

- Does the VNRP suffice as a TMDL for the Clark Fork River?

  Yes. DEQ is looking at this as a functional equivalent to a TMDL. That's why we're (DEQ) involved in this effort.

- What is the legal incentive to carry on from here with the nonpoint strategy? On the Flathead basin TMDL we're really wrestling with nonpoint and having trouble quantifying it.

The VNRP must be equitable. There will be pressure from the 4 point source dischargers for us to address nonpoint since they're being asked to spend money to reduce their loading. We have identified some significant hotspots in the basin where we can make some real improvements (for example, the area upstream of Deer Lodge, and sewering in the lower Bitterroot in the area between Hwy 93 and McClay bridge.) So if we focus on some localized areas where we already know there's a problem, we may not have to change land use practices over a huge area to see some results, at least in the short term. Also, we are sending the VNRP to EPA for approval and they will make sure we focus on nonpoint.

- Thanks to the subcommittee for putting time and effort into this. I have some concerns about what happens if folks don't meet the voluntary goals and I think there needs to be a hammer for nonpoint too, but overall I think this VNRP is a good outcome. Here are a few things to consider when you get to the details on nonpoint:

  - The phosphate detergent bans exempted some phosphate cleaners such as dishwashing detergents and products used by hospitals and painters. The subcommittee should research what other phosphate-free products are now available for these uses, and their costs, to see if eliminating the exemptions is a feasibility. These smaller increments would still be cheaper than some of the other things we're talking about.
  - Riparian zone protection is really the key to protecting the river in the long term. We need more widespread riparian zone standards in the basin's communities.
  - Feedlots/animal confinements next to streams may be a bigger impact than we think. A dollar spend on fencing may be money better spent than a dollar spent on nutrient removal at the plant, if you get down to it. Riparian restoration in areas that have already been hammered is just as important as riparian protection in other areas.
    Yes. Agree there are lots of opportunities here; probably a big issue in Flint Creek drainage, Deer Lodge valley and other areas too.
  - Connection of septics to WWTP's is a goal we should not hinder. It gets the sewage to one place where you can deal with it and gives you a larger rate base to pay for dealing with it.
  - I encourage DEQ to be more active in its enforcement of illegal discharges, even on small-scale activities such as the spill at the Missoula library project that sent sediment into the river.
  - I encourage the subcommittee to look at land application as an option, especially in areas outside those served by sewer where they want to develop at higher densities and don't want to be in the city. Land application needs to be carefully controlled and I think we need to develop some good state standards for it. (Missoula is currently coming up with new regulations for land application and lagoons.)
  - Also look at new septic systems that claim they can remove nutrients; level two treatment can increase densities and pollution. A developer can get credit for nitrogen removal when in fact the system isn't performing very well; there are

also design and maintenance questions; I recommend that the state look into how systems are performing.

Thank you for these recommendations; we concur that they are important. The subcommittee will make note of these as we are considering the details of the nonpoint strategy.

- This is my recommendation for the first project that we tackle under the nonpoint work: develop model floodplain and riparian protection ordinances (even tougher than Missoula's) and take these to the city and county governments in the basin for implementation. The ordinance should deal with development already in the floodplain too. Missoula has an ordinance that a use near a stream or river can be phased or if it's been abandoned for a certain amount of time. This is especially true of a mobile home near the river with a seepage pit or cesspool. If it's vacant for six months, their services cannot be reconnected. Also, any riparian regulations upstream from Missoula should be coordinated with the Superfund effort, which should make it easier for people there to deal with.

  The subcommittee will make note of this recommendation as we are considering the details of the nonpoint strategy.

- What is the Council planning to do next?

  Once EPA approves the VNRP, we will look at: expanding the subcommittee to draw in the best people to work on nonpoint planning; prioritizing issues and timelines; and probably dividing the subcommittee into subgroups to tackle specific areas since nonpoint is so broad. Also, the Council has recently acquired a grant to bring on a VNRP coordinator. This person will assist the subcommittee with involving point and nonpoint stakeholders in VNRP implementation.

- Will you be monitoring the river on a segment-by-segment basis to detect improvements?

  Yes. The Council will be conducting watershed-wide monitoring.

- How closely is Butte/Silver Bow government working with the Superfund project to coordinate clean-up efforts?

  Very closely. We want to coordinate with ARCO and the Superfund clean-up so we can perhaps save some money for the ratepayers. Work is being coordinated with ARCO for the possibility of developing an integrated wetlands system for nutrient removal from the Butte wastewater treatment plant and metal and sulfate removal from Colorado tailings water. We are looking into a wide range of alternatives that includes wastewater re-use, replacing some effluents with fresh water, a Silver Lake pipeline option to irrigate land, and flow augmentation in Warm Springs Creek with Silver Lake water. We will be working with the alternatives in the BOR document;

solutions at Butte will probably be a combination of 3 or 4 options. We want to leave adequate water in Silver Bow Creek, and we want to seek the most cost-effective means to meet the targets.

WRITTEN COMMENTS

- The proposed in-stream nutrient levels do not appear to be attainable in the future, even with the highest (and most expensive) level of treatment [the City of Missoula] could provide. The design criteria are based on treated wastewater discharge flow rates which are already being exceeded. Missoula could not meet the design criteria at our projected wastewater flow rates for the future, even with the best facility we could construct…The VNRP is not based on an understanding of how growth in future flows and loadings will be accommodated.

  To address this concern, the subcommittee has revised the target for phosphorus; it is now 39 ug/l total P downstream of the Reserve Street bridge at Missoula, but remains 20 ug/l upstream of the bridge where Cladophora is a problem and the 15:1 N:P ratio will be maintained. The subcommittee has also changed its approach to the issues at Missoula by incorporating an equal priority to resolving impacts from septics, offering incentives for hooking up to the WWTP, and giving credit to Missoula for meeting part of its nutrient reduction as additional hook-ups are made.

- Not only will the design criteria limit the City of Missoula's ability to grow, but the margin of safety is based on 7Q10, a flow condition which only occurs for one week in a ten-year period. This is further justification for construction of a very good biological nutrient removal facility, but not necessarily one that guarantees this high level of protection.

  The flow statistic used to compute the margin of safety has since been revised to a 30Q10 stream flow, calculated with actual Clark Fork River data that averages the lowest flow day of the last eleven years during summertime low flows of July, August and September.

- It is imperative to control other nutrient sources as described in Part II, page 17-18. At present there is no comprehensive information in the VNRP on all sources which in total share the assimilative capacity of the Clark Fork…Although the VNRP discusses a strategy for nonpoint sources, new activities, growth-related issues and other point sources, there is little concrete action proposed. These sources have not even been incorporated into the "Agencies Clark Fork model." Without quantification of these other pollutant sources, it will be difficult to implement nutrient trading and other options in the future.

The subcommittee has made substantial revisions to the July draft to reflect priority for nonpoint issues. Reference to Part I and Part II have been eliminated and language has been added to make point and nonpoint actions simultaneous. Working in conjunction with the Missoula City-County Health Department and the County Commissioners, language has been added to develop incentives for sewering areas both within and outside the sewer service area thereby reducing ground-to-surface water contamination; developing a strategy for increased regulation on septics by considering them as point sources; and controlling rural densities through zoning. With the assistance of the City's consultant, Brown & Caldwell, the subcommittee is working on a revised model that includes loading from nonpoint sources; this model will form the basis for nonpoint reductions.

- Without a common commitment from all sources, Missoula could be burdened with a higher standard of treatment at a greater expense to its ratepayers. Equivalent commitments for reductions from other point source contributors and nonpoint sources are not being made and the City of Missoula believes that these commitments should be part of the VNRP.

  The proliferation of septic systems in the Missoula area is a large problem, and the subcommittee believes that the large investment being made to reduce nutrient discharge from the wastewater treatment plant will likely be offset in the long term by septics if the problem is not addressed. The Missoula City-County Health Department has become an active and committed member of the subcommittee and is helping to bring the County Commissioners on line to ensure changes in the way septics will be managed. The subcommittee is also seeking strong commitment from DEQ to help with regulatory back-up of local mitigation measures. In addition, as soon as the VNRP is approved and the VNRP Coordinator is hired, this person's responsibility will be to involve and acquire commitment from a wide array of point and nonpoint sources.

- In conjunction with the City of Missoula's facility planning effort, research has demonstrated that groundwater and surface water are connected in the Missoula valley. Nutrient pollution of groundwater is adversely impacting the quality of surface water in the Clark Fork immediately downstream of Missoula as nutrient-laden groundwater seeps enter the Bitterroot and Clark Fork Rivers. We believe that Missoula County may have the authority to limit the number of septic tanks that can discharge into the Missoula aquifer. In the near future, this may become the most cost-effective way to control contributions to the Clark Fork, especially after the large point sources have been controlled.

  Agree. As discussed above, the subcommittee is working with the health department and the county to line out goals in the VNRP for septic hook-up to the WWTP within the sewer service area and reduced septic densities outside the sewer service area. We are working with DEQ on clarification of authority and assistance from them to give the county some leverage for new density and septic regulations.

- We encourage the City of Butte to meet the in-stream concentration targets at the discharge point, rather than designating all of Silver Bow Creek as a mixing zone. Since 1995 when a Record of Decision was released for Silver Bow Creek/Streamside Tailings Operable Unit through the Superfund process, design work has been ongoing to remove mine waste and remediate the creek to a level at which the creek could maintain a self-reproducing trout fishery. Nutrient levels should be low enough to allow the creek to recover to a level that will support such a fishery and other beneficial uses as well. We encourage the Council to work with Montana DEQ Superfund Division to address appropriate nutrient levels for Silver Bow during remediation, operation and maintenance of the streamside Tailings Operable Unit.

  The presence of nutrients in the stream from the Butte wastewater treatment facility to the Warm Springs ponds actually enhances the removal of metals, which are the primary pollutants of concern in this stretch of water. Until these metals are completely removed, it makes little sense to measure nutrient removal above the Warm Springs ponds. Secondly, the ponds themselves do a good job of removing nutrients and need to be part of the overall solution in solving our problem in the upper Clark Fork basin.

- We encourage coordination of Superfund remedies and nutrient reduction remedies where technically and economically feasible.

  Comment noted.

- Several years of studies must be completed to determine if wetlands are a feasible treatment option for nutrients and metals in the Butte community. Concerns include ability to remove phosphorus over a long period of time, size of land area required, and problems in cold climates. Although wetlands may have the potential to effectively treat the Butte wastewater nutrient problem, we encourage the use of appropriate technologies until the effectiveness of wetlands has been validated by the Montana Tech Wetlands Demonstration Project.

  Agree. The subcommittee is closely following the results of the wetlands project and is also looking into a combination of alternatives at Butte in case the wetlands method proves ineffective over time.

- Because the Clark Fork River is the source of most of Pend Oreille Lake's water and nutrient loading, Idaho DEQ appreciates the commitment of the VNRP subcommittee to provide for a cleaner Clark Fork.

  Comment noted.

- Idaho DEQ is concerned about the specifics of the interim evaluation using the feedback loop approach. The feedback look implies that if what we believe is the best way to control a pollutant is not working based on water quality, then we change how we control the pollutant. The VNRP addresses this approach, but we are

concerned that the parties signatory to the agreement may have different ideas of how this approach will be implemented. It is unclear whether nutrient targets, discharger control measures, or both, will be revised to meet the intent of the VNRP.

Comment noted. As stated in the VNRP, we have developed a re-evaluation mechanism for our program. At least every three years we will look at the in-stream data and assess where we are with meeting the targets. The parties agree that they may have to adjust their control measures if targets aren't being met. As the downstream state, Idaho will benefit from improvements to water quality in the VNRP. It should be noted that after the river enters Idaho, it is not on the Idaho 303(d) list for nutrients.

- As the downstream state, we would like some assurance that mandatory nutrient measures will be instituted if voluntary efforts are unsuccessful at the end of the term of the VNRP.

  Comment noted. The State of Montana does intend to pursue mandatory measures if the voluntary program proves ineffective in meeting the nutrient targets at the end of ten years.

- The VNRP states the margin of safety will be assured by using the 7Q10 stream flow and revised nutrient targets. The revised targets provide for an additional margin of safety of 14% for total nitrogen and 56% for total phosphorus. The Council's monitoring subcommittee's draft alternatives document indicates coefficient of variation for the Clark Fork River nutrient trend detection is 57% for total nitrogen and 65% for total phosphorus. When this data is flow-adjusted, coefficient of variation decreases to 45% for total nitrogen and 48% for total phosphorus. Given the biological variability demonstrated in the river system, can we be assured of providing for an adequate margin of safety?

  Since the July draft, the margin of safety has been revised. It is now based on a 30Q10 stream flow, calculated with actual 11-year Clark Fork River. The subcommittee has confidence in the flow data to account for levels of variability. The nutrient targets are based on a conservative flow estimate that averages the lowest flow day of the last eleven years during summertime low flows of July, August and September. The subcommittee believes that the use of the conservative 30Q10 assumption translates into a significant margin of safety in 9 out of 10 years.