

APPENDICES FOR TRAVEL TIME ESTIMATES METHODOLOGY

In this report, travel time represents the number of hours for the river water to flow from one point to another, usually town to town. Speed at a particular location in feet per second (fps) was converted to miles per hour (mph) for use in travel time estimates. Discharge, discharge rate, or flow rate all refer to the volume of water passing a point per time, cubic feet per second (cfs). The discharge rate normally increases with miles downstream, thus the discharge at Healdsburg was used as a reference point.

Five appendices contain data relevant to the travel time estimates:

Appendix A - Formalin spill data

Appendix B - U.S. Army Corps of Engineers flood crest data

Appendix C - U.S. Geological Survey velocity/discharge data

Appendix D - Coyote Dam accidental release

Appendix E - Comparison of methods

A short explanation of each method precedes the data for each appendix.

APPENDIX A

Formalin Data

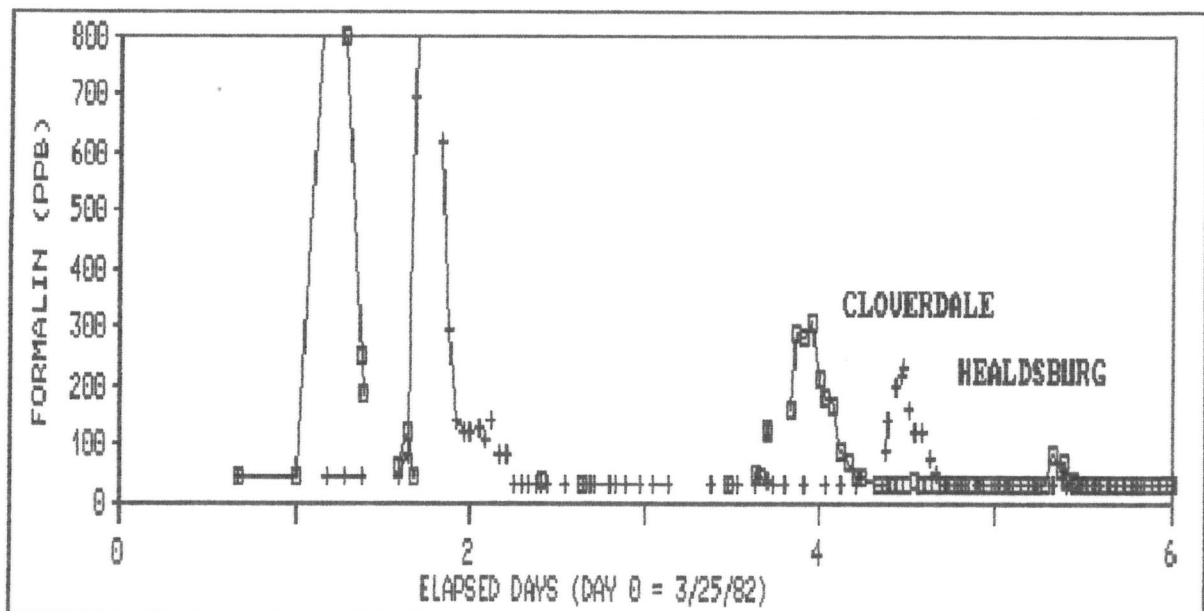
The data included herein were obtained from the North Coast Regional Water Quality Control Board files on the March, 1982, spill of formalin from a parked railroad tank car in Ukiah, California. These data were used to estimate travel times for the Russian River and include:

- 1 - explanation of methods
- 2 - raw monitoring data
- 3 - monitoring data arranged on a single time line
- 4 - single time line monitoring data with interpolation between points to aid in computer plotting
- 5 - plots of concentration vs time
- 6 - formalin travel time measurements

Monitoring data from the March, 1982 formalin spill into the Russian River at Ukiah were entered onto a computerized spreadsheet, and formalin concentrations were plotted against time for each downstream sampling location.

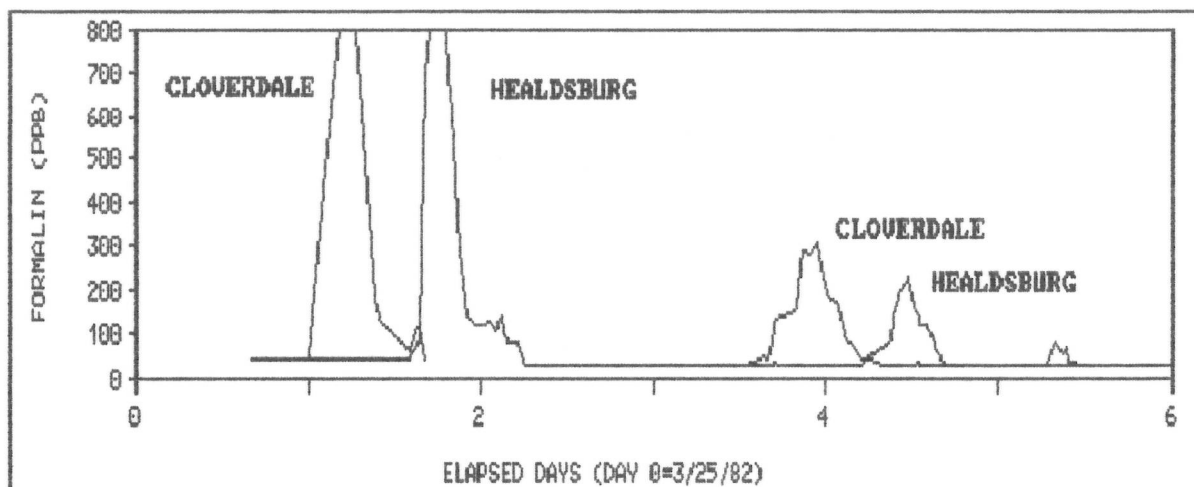
Since sampling times at each location differed, the concentration data for all sites were combined onto another spreadsheet with a single time line, consisting of the sampling times for all the sites. This had the effect of spreading out the data at any one site, causing visual fragmentation of the concentration/time curves as a result of site-to-site differences in sampling times.

Formalin concentrations at two Russian River sites from March 25 to March 31, 1982.



To obtain a more continuous computer-generated curve through the data points, interpolations of the concentrations between known values were approximated, and new plots made. The actual and interpolated concentration/time plots, were essentially identical; the fragmentation simply was reduced as in the following example:

Interpolated formalin data for two Russian River sites from March 25 to March 31, 1982.



Two distinct peaks in formalin concentration are evident at the various monitoring sites. The distinct peak shapes and time separation from site to site leaves little doubt that these were two separate waves of formalin passing down the river. Using the interpolated versions of the formalin concentration/time plots, the differences were measured between the various sites for the two recognizable peaks with a precision of one hour. Where possible, measurements were taken for the time differences between peaks' leading edges, modes, and trailing edges. Where recognizable features, such as shoulders, occurred on the peaks, those time differences were also measured. Unfortunately, the sampling frequency was not sufficient to always catch the leading edge of the formalin pulse as it passed the collection site. Thus, some stretches of the river were represented by only one or two time measurements, while others had several. Travel times were checked by adding or subtracting the measured times of river subsections. For example, the travel time from Cloverdale to Wohler minus that from Healdsburg to Wohler was the travel time from Cloverdale to Healdsburg.

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

RUSS. RIVER EST.				NORGARD				HOPLAND				CLOVERDALE				HEALDSBURG			
DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.
	hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)	(1982)	hr min	Days	(ppb)
3/25	0 0	0		3/25	0 0	0		3/25	16 15	0.68	42	3/25	15 53	0.66	42	3/25	16 5	0.67	42
3/26	8 45	1.36	42	3/26	0 0	1		3/26	0 30	1.02	180	3/26	0 1	1.00	42	3/26	3 48	1.16	42
	14 45	1.61	59	3/27	0 0	2			4 40	1.19	150		4 5	1.17	980		6 10	1.26	42
3/27	9 10	2.38	30	3/28	10 4	3.41	260		7 2	1.29	220		6 40	1.28	800		8 0	1.33	42
	14 40	2.61	30		10 5	3.42	11000		9 0	1.38	140		8 55	1.37	250		14 0	1.58	42
3/28	10 25	3.43	570		13 3	3.54	80		9 22	1.39	150		9 20	1.39	190		15 15	1.64	85
	10 38	3.44	450		14 20	3.60	110		14 40	1.61	42		14 10	1.59	63		16 20	1.68	700
	15 35	3.65	150		15 5	3.62	110		15 10	1.63	62		15 30	1.65	123		16 40	1.69	1200
	15 45	3.66	130		15 10	3.63	130		17 25	1.73	42		16 5	1.67	42		17 0	1.71	1700
	16 35	3.69	91		16 10	3.67	80		23 23	1.97	42	3/27	9 45	2.41	41		18 0	1.75	3200
	17 40	3.74	99		17 10	3.72	60	3/27	5 30	2.23	30		15 15	2.64	30		19 0	1.79	2100
	20 0	3.83	37		19 30	3.81	34		9 25	2.39	36	3/28	11 22	3.47	30		20 0	1.83	620
	22 20	3.93	48		21 50	3.91	30		14 55	2.62	30		15 10	3.63	53		21 0	1.88	300
	23 35	3.98	30		23 0	3.96	54	3/28	4 0	3.17	30		15 45	3.66	46		22 0	1.92	140
3/29	1 20	4.06	38	3/29	0 50	4.03	32		9 0	3.37	75		16 40	3.69	120		23 0	1.96	120
	2 38	4.11	30		2 10	4.09	58		9 0	3.38	85		16 45	3.70	130	3/27	0 0	2.00	120
	3 45	4.16	30		3 14	4.13	30		11 1	3.46	275		19 45	3.82	160		1 10	2.05	130
	6 35	4.27	30		6 5	4.25	30		11 10	3.47	280		20 45	3.86	289		2 0	2.08	110
	9 12	4.38	50		8 46	4.37	30		12 45	3.53	280		21 45	3.91	287		2 55	2.12	140
	10 42	4.45	30		10 13	4.43	30		16 20	3.68	170		22 45	3.95	310		4 0	2.17	85
	13 35	4.57	30		14 0	4.58	30	3/29	9 40	4.40	45		23 45	3.99	210		5 0	2.21	83
	15 40	4.65	30		16 10	4.67	30		14 20	4.60	30	3/29	0 45	4.03	180		6 0	2.25	30
	16 55	4.70	46		18 0	4.75	30		18 50	4.78	30		1 45	4.07	170		7 0	2.29	30
	21 30	4.90	30		18 30	4.77	55		19 15	4.80	30		2 45	4.11	90		8 0	2.33	30
	22 45	4.95	38		19 0	4.79	59		19 35	4.82	30		3 45	4.16	71		9 0	2.38	30
	23 30	4.98	30	3/30	8 10	5.34	30		20 10	4.84	30		4 45	4.20	48		9 55	2.41	33
3/30	0 15	5.01	37		9 45	5.41	50		23 5	4.96	30		5 45	4.24	47		10 5	2.42	30
	2 5	5.09	44		12 0	5.50	100	3/30	23 50	4.99	30		7 45	4.32	30		10 21	2.43	30
	3 30	5.15	80	*	13 25	5.56	100		1 5	5.05	30		8 45	4.36	30		13 0	2.54	34
	5 42	5.24	130		14 30	5.60	160		2 30	5.10	39		9 45	4.41	35		15 0	2.63	30
	7 0	5.29	90		16 35	5.69	30		4 0	5.17	52		10 45	4.45	30		16 20	2.68	30
	8 25	5.35	50		17 30	5.73	50		6 0	5.25	65		11 45	4.49	30		17 0	2.71	30
	9 45	5.41	30		17 53	5.75	30		7 20	5.31	100		12 45	4.53	40		19 0	2.79	30
	11 30	5.48	30		20 8	5.84	30		8 47	5.37	80		13 45	4.57	30		20 0	2.83	30
	12 14	5.51	30		21 26	5.89	30		10 5	5.42	30		14 45	4.61	35		21 0	2.88	30
	12 45	5.53	41	3/31	2 15	6.09	30		10 20	5.43	30		15 45	4.66	30		23 0	2.96	30
	14 45	5.61	150		5 0	6.21	30		11 45	5.49	40		16 45	4.70	30	3/28	1 0	3.04	30
	15 40	5.65	85		7 50	6.33	30		12 37	5.53	30		17 45	4.74	30		3 0	3.13	30
	15 55	5.66	50		11 15	6.47	30		13 0	5.54	30		18 45	4.78	30		9 6	3.38	30
	16 50	5.70	30		13 46	6.57	30		15 25	5.64	30		19 45	4.82	30		11 23	3.47	30
	17 45	5.74	56		16 3	6.67	30		16 0	5.67	30		20 45	4.86	30		12 17	3.51	30
	18 8	5.76	36		18 27	6.77	30		16 20	5.68	50		21 45	4.91	30		15 0	3.63	30
	18 45	5.78	41		21 10	6.88	30		17 15	5.72	30		22 45	4.95	30		17 0	3.71	38
	20 50	5.87	30		23 25	6.98	30		17 38	5.73	30		23 48	4.99	30		17 35	3.73	30
	22 30	5.94	30	4/1	1 45	7.07	30		21 15	5.89	30	3/30	0 45	5.03	30		19 0	3.79	30
	23 30	5.98	30		3 50	7.16	30		22 58	5.96	30		1 45	5.07	30		22 0	3.92	30
3/31	2 35	6.11	30		7 0	7.29	30		23 0	5.97	30		2 45	5.11	30	3/29	1 0	4.04	30
	5 15	6.22	30		9 0	7.38	30	3/31	2 6	6.09	30		3 45	5.16	30		3 0	4.13	30
	7 45	6.32	30		11 10	7.47	10		3 18	6.14	30		4 45	5.20	30		5 0	4.21	30
	10 20	6.43	30	4/12	15 25	18.64	10		4 50	6.20	30		5 45	5.24	30		8 30	4.35	90
	12 45	6.53	30						7 0	6.29	30		6 45	5.28	30		9 0	4.38	140
	16 25	6.68	30						10 20	6.43	30		7 45	5.32	85		10 0	4.42	200

Dcml.Days = Time in fractional (decimal) days

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

RUSS. RIVER EST.				NORGARD				HOPLAND				CLOVERDALE				HEALDSBURG			
DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.
	hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)	(1982)	hr min	Days	(ppb)
	18 45	6.78	30						13 20	6.56	30		8 45	5.36	60		11 0	4.46	220
	21 30	6.90	30						16 40	6.69	30		9 14	5.38	70		11 0	4.47	230
	23 40	6.99	30						17 50	6.74	30		9 45	5.41	40		12 0	4.50	160
4/1	2 25	7.10	30						22 50	6.95	30		10 45	5.45	40		13 0	4.54	120
	4 45	7.20	30					4/1	2 40	7.11	30		10 55	5.46	30		14 0	4.58	120
	7 20	7.31	30						4 0	7.17	30		11 45	5.49	30		15 0	4.63	80
	10 0	7.42	30						6 30	7.27	30		12 45	5.53	30		16 0	4.67	51
	11 30	7.48	10						9 0	7.38	30		13 4	5.54	30		17 0	4.71	30
	13 0	7.54	10						12 25	7.52	10		13 45	5.57	30		18 0	4.75	30
	16 0	7.67	10					4/2		8.00			14 45	5.61	30		19 0	4.79	30
	18 10	7.76	10					4/3		9.00			15 45	5.66	30		20 0	4.83	30
	19 0	7.79	10					4/4		10.00			15 55	5.67	30		22 0	4.92	30
	20 23	7.85	10					4/5		11.00			16 45	5.70	35	3/30	0 0	5.00	30
	21 18	7.89	10					4/6		12.00			17 45	5.74	30		2 0	5.08	30
	22 10	7.92	10					4/7		13.00			18 12	5.76	30		4 0	5.17	30
4/2	0 16	8.01	10					4/8		14.00			19 10	5.80	33		6 0	5.25	30
	1 6	8.05	10					4/9		15.00			19 45	5.82	30		8 0	5.33	30
	1 54	8.08	10					4/10		16.00			20 45	5.86	30		10 0	5.42	30
	2 43	8.11	10					4/11		17.00			21 45	5.91	30		12 0	5.50	30
	4 50	8.20	10					4/12		18.00			22 45	5.95	30		14 0	5.58	30
	6 0	8.25	10					4/13	12 15	19.51	10		23 45	5.99	30		16 0	5.67	30
	6 45	8.28	10						14 24	19.60	10	3/31	0 45	6.03	30	3/31	5 45	6.24	30
	7 30	8.31	10						14 30	19.61	10		1 35	6.07	30		12 0	6.50	30
	8 45	8.36	10						18 0	19.75	10		2 45	6.11	30		16 0	6.67	40
	10 30	8.44	10						21 30	19.90	10		3 45	6.16	30		18 0	6.75	30
	12 35	8.52	10					4/14	1 30	20.06	30		4 45	6.20	30		20 0	6.83	30
	16 0	8.67	10						2 50	20.12	360		5 45	6.24	30		22 0	6.92	30
	21 0	8.88	10						3 33	20.15	37		6 45	6.28	30	4/1	2 0	7.08	30
4/3	0 30	9.02	10						4 28	20.19	10		8 45	6.36	30		4 0	7.17	30
	6 0	9.25	10						5 35	20.23	150		9 45	6.41	30		6 0	7.25	30
	8 49	9.37	19						6 30	20.27	40		10 45	6.45	30		8 0	7.33	30
	12 44	9.53	13						7 20	20.31	30		11 45	6.49	30		10 0	7.42	30
	16 27	9.69	10						8 10	20.34	160		12 45	6.53	30		12 0	7.50	30
	20 55	9.87	10						9 15	20.39	91		13 45	6.57	30		14 0	7.58	10
4/4	0 40	10.03	10						10 35	20.44	87		14 45	6.61	30		22 0	7.92	10
	5 7	10.21	42						11 25	20.48	10		15 45	6.66	30				
	8 38	10.36	42						13 25	20.56	340		16 45	6.70	30				
	12 32	10.52	42						14 30	20.60	460		18 0	6.75	30				
	16 56	10.71	42						15 30	20.65	10		22 0	6.92	30				
	20 39	10.86	42						16 50	20.70	10	4/1	2 0	7.08	30				
4/5	0 26	11.02	42						18 31	20.77	37		6 0	7.25	30				
	5 3	11.21	42						19 32	20.81	38		10 0	7.42	35				
	8 39	11.36	42						20 25	20.85	10		13 0	7.54	10				
	13 10	11.55	42						21 40	20.90	10		14 0	7.58	10				
	17 10	11.72	42						22 28	20.94	10		18 0	7.75	10				
	22 21	11.93	42						23 31	20.98	10		22 0	7.92	10				
4/6	6 47	12.28	42					4/15	1 35	21.07	10	4/2	2 0	8.08	10				
	15 14	12.63	42						2 25	21.10	28		6 0	8.25	35				
4/7	1 20	13.06	10						3 30	21.15	10		8 0	8.33	10				
	6 45	13.28	10						4 30	21.19	10		10 0	8.42	10				
	15 15	13.64	10						5 20	21.22	10		14 0	8.58	10				
	23 30	13.98	15						7 0	21.29	10		17 0	8.71	10				

Dcml.Days = Time in fractional (decimal) days

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

RUSS. RIVER EST.				NORGARD				HOPLAND				CLOVERDALE				HEALDSBURG			
DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.
	hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)	(1982)	hr min	Days	(ppb)
4/8	7 40	14.32	15					8 45	21.36	10		18 0	8.75	10					
	14 10	14.59	26					9 25	21.39	10		22 0	8.92	10					
4/9	9 55	15.41	20					10 10	21.42	10		4/3 2 0	9.08	10					
4/10	10 5	16.42	19					10 30	21.44	40		5 15	9.22	10					
4/11	9 45	17.41	28					11 20	21.47	40		10 0	9.42	10					
4/12	9 55	18.41	29					11 30	21.48	10		14 0	9.58	10					
	15 40	18.65	230					12 30	21.52	40		18 0	9.75	10					
4/13	10 0	19.42	18					13 25	21.55	10		22 0	9.92	10					
	14 10	19.59	22					13 30	21.56	40		4/4 2 0	10.08	10					
	17 30	19.73	18					14 30	21.60	40		6 0	10.25	42					
	18 45	19.78	10					14 45	21.61	23		10 0	10.42	42					
	19 45	19.82	180					15 30	21.64	40		14 0	10.58	42					
	20 45	19.86	10					15 40	21.65	19		18 0	10.75	42					
	21 45	19.91	42					16 30	21.69	40		22 0	10.92	42					
	22 45	19.95	10					16 35	21.70	24		4/5 2 0	11.08	42					
	23 45	19.99	53					17 30	21.72	40		6 0	11.25	42					
4/14	0 45	20.03	10					17 30	21.73	11		4/6 0 0	12.00						
	1 45	20.07	41					18 5	21.75	13		4/7 0 0	13.00						
	2 45	20.11	10					18 30	21.77	40		4/8 0 0	14.00						
	3 49	20.16	88					18 50	21.78	30		4/9 0 0	15.00						
	4 47	20.20	70					19 30	21.81	40		4/10 0 0	16.00						
	6 7	20.25	30					19 50	21.83	19		4/11 0 0	17.00						
	6 43	20.28	20					20 30	21.85	40		4/12 0 0	18.00						
	7 40	20.32	10					20 50	21.87	10		4/13 12 5	19.50	10					
	8 45	20.36	10					21 50	21.91	10		14 0	19.58	10					
	9 45	20.41	510					22 50	21.95	10		14 57	19.62	10					
	11 0	20.46	10					23 50	21.99	16		15 0	19.63	19					
	11 45	20.49	10					4/16 0 50	22.03	17		19 0	19.79	10					
	12 45	20.53	22					1 50	22.08	19		20 0	19.83	46					
	14 0	20.58	140					2 55	22.12	16		21 0	19.88	10					
	14 50	20.62	46					3 50	22.16	18		22 0	19.92	10					
	15 50	20.66	10					4 55	22.20	10		23 0	19.96	10					
	17 55	20.75	10					5 55	22.25	19		4/14 0 0	20.00	10					
	18 57	20.79	10					6 55	22.29	17		1 0	20.04	11					
	19 55	20.83	10					7 55	22.33	11		2 0	20.08	10					
	21 55	20.91	10					13 15	22.55	10		3 0	20.13	31					
	21 55	20.91	10					16 20	22.68	10		4 0	20.17	10					
	22 45	20.95	10					20 45	22.86	10		5 0	20.21	10					
	23 55	21.00	10					4/17 0 30	23.02	10		6 0	20.25	10					
4/15	1 55	21.08	230					4 31	23.19	10		7 0	20.29	10					
	2 50	21.12	10					8 30	23.35	10		8 0	20.33	10					
	3 50	21.16	10					11 50	23.49	10		9 0	20.38	10					
	4 30	21.19	19					15 50	23.66	10		10 0	20.42	10					
	5 46	21.24	10					19 50	23.83	10		11 0	20.46	10					
	7 30	21.31	10					4/18 0 30	24.02	10		12 0	20.50	10					
	9 5	21.38	10					4 30	24.19	10		13 0	20.54	10					
	9 45	21.41	10					8 25	24.35	12		14 0	20.58	10					
	10 45	21.45	10					11 50	24.49	14		15 0	20.63	10					
	11 45	21.49	10					15 50	24.66	10		18 0	20.75	10					
4/16	0 0	22						19 50	24.83	14		19 0	20.79	10					
4/17	0 0	23						4/19 0 30	25.02	23		20 0	20.83	10					
4/18	0 0	24						4 30	25.19	22		21 0	20.88	10					

Dcml.Days = Time in fractional (decimal) days

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

RUSS. RIVER EST.				NORGARD				HOPLAND				CLOVERDALE				HEALDSBURG				
DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	DATE	Time	Dcml	CONC.	
	hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)		hr min	Days	(ppb)	(1982)	hr min	Days	(ppb)	
4/19	0	0	25					8	30	25.35	10	22	0	20.92	10					
4/20	0	0	26					12	30	25.52	10	23	0	20.96	10					
4/21	0	0	27					16	25	25.68	10	4/15	0	0	21.00	10				
4/22	0	0	28					20	35	25.86	10	1	0	21.04	10					
4/23	0	0	29					4/20	0	30	26.02	10	3	0	21.13	10				
4/24	0	0	30					4	30	26.19	10	4	0	21.17	10					
4/25	0	0	31					8	15	26.34	10	5	0	21.21	10					
4/26	0	0	32					12	30	26.52	10	6	0	21.25	10					
4/27	0	0	33					14	35	26.61	21	7	0	21.29	10					
4/28	0	0	34					16	30	26.69	10	8	0	21.33	10					
4/29	0	1	35.00	40				20	30	26.85	20	9	0	21.38	10					
	4	0	35.17	40				4/21	0	30	27.02	10	10	0	21.42	10				
	8	0	35.33	40				4	30	27.19	12	11	0	21.46	10					
	12	0	35.50	40				8	50	27.37	13	12	0	21.50	10					
	16	0	35.67	40				20	35	27.86	17	14	0	21.58	10					
4/30	0	1	36.00	40				4/22	1	30	28.06	10	15	0	21.63	10				
	4	0	36.17	40				4	30	28.19	10	16	0	21.67	10					
	8	0	36.33	40				8	20	28.35	37	17	0	21.71	18					
	12	0	36.50	40				12	20	28.51	16	21	0	21.88	10					
	16	0	36.67	40				16	10	28.67	17	4/16	1	0	22.04	10				
	20	0	36.83	40				20	49	28.87	10	5	0	22.21	14					
								4/23	0	35	29.02	10	8	0	22.33	10				
								4	30	29.19	10									
								8	10	29.34	10									
								12	20	29.51	10									
								16	10	29.67	10									
								20	15	29.84	10									
								4/24	0	10	30.01	10								
								4	5	30.17	10									
								8	10	30.34	12									
								12	49	30.53	10									
								16	55	30.70	10									
								19	50	30.83	10									
								23	45	30.99	10									
								4/25	8	30	31.35	40								
								12	25	31.52	12									
								15	50	31.66	10									
								20	35	31.86	10									
								4/26	0	30	32.02	10								
								4	30	32.19	10									
								8	20	32.35	10									
								12	20	32.51	10									
								15	17	32.64	10									
								20	36	32.86	10									
								4/27	0	30	33.02	15								
								4	30	33.19	13									
								8	30	33.35	10									
								12	20	33.51	10									
								16	35	33.69	10									
								20	32	33.86	10									
								4/28	0	30	34.02	10								
								4	40	34.19	12									

Dcml.Days = Time in fractional (decimal) days

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

RUSS. RIVER EST.			NORGARD			HOPLAND				CLOVERDALE			HEALDSBURG		
DATE	Time	Dcm1 CONC.	DATE	Tm.	Dcm1 CONC.	DATE	Time	Dcm1 CONC.	DATE	Time	Dcm1 CONC.	DATE	Time	Dcm1 CONC.	
hr min	Days	(ppb)	hr min	Days	(ppb)	hr min	Days	(ppb)	hr min	Days	(ppb)	(1982)	hr min	Days	(ppb)
						8	30	34.35							
						12	25	34.52							
						15	49	34.66							
						20	30	34.85							

RAW FORMALIN CONCENTRATION DATA FOR MARCH, 1982 SPILL

WOHLER BRIDGE				ODD FELLOWS RD				GUERNEVILLE				MONTE RIO				DUNCAN MILLS			
DATE	Time	Dcml	CONC	DATE	Time	Dcml	CONC	DATE	Time	Dcml	CONC	DATE	Time	Dcml	CONC	DATE	Time	Dcml	CONC
(1982)	hr.min	Days	(ppb)	(1982)	hr.min	Days	(ppb)	(1982)	hr. min	Days	(ppb)	(1982)	hr. min	Days	(ppb)	(1982)	hr. min	Days	(ppb)
	2 0	5.08	30																
	4 0	5.17	30																
	6 0	5.25	30																
	8 0	5.33	30																
	10 0	5.42	30																
	12 0	5.50	40																
	15 17	5.64	30																
3/31		6.00																	
4/1	6 0	7.25	30																
	7 0	7.29	30																
	9 25	7.39	30																
	10 20	7.43	30																
	11 30	7.48	10																
	11 30	7.48	30																
	12 30	7.52	10																
	12 35	7.52	30																
	13 30	7.56	30																
	23 20	7.97	10																
4/2	1 20	8.06	10																
	3 20	8.14	10																
	5 20	8.22	10																
	7 20	8.31	10																

FORMALIN CONCENTRATION DATA COMBINED ON SINGLE TIME LINE

DATE	DATE	TIME	Dcml	CLOVERDL.	HEALDBG.	HOPLAND	WOHLER BR.	GUERNVL.	MONTE RIO	DUN.MILLS
(1982)	(1982)	hr min	Davs	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.
					(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
3/25	3/25	15 53	0.66	42	42	42	42			
3/26	3/26	0 1	1.00	42		180				
		4 5	1.17	980	42	150				
		6 40	1.28	800	42	220				
		8 55	1.37	250	42	140	42			
		9 20	1.39	190		150				
			1.42							2600
		14 10	1.59	63	42	42	42			
		15 30	1.65	123	85	62	42			
		16 5	1.67	42	700		42			
			1.69		1200					
			1.71		1700					
			1.75		3200	42				
			1.79		2100					
			1.81					42	42	
			1.83		620					
			1.88		300					
			1.92		140					
			1.96		120	42	950			
			1.98				650			
			2.00		120		330			
			2.02				210			
			2.04				170			
			2.05		130					
			2.06				130			
			2.08		110		110			
			2.1				140			
			2.12		140					
			2.13				140			
			2.17		85					
			2.19				160			
			2.21		83		130			
			2.23			30	90			
			2.25		30		72			
			2.28				72			
			2.29		30		56			
			2.31				44			
			2.33		30					
			2.38		30	36				
3/27	3/27	9 45	2.41	41	33		30			
			2.42							2600
			2.43					274	1700	
			2.44		30		30	660		
			2.46				30			
			2.47						710	
			2.48				30			
			2.54		34		30		650	1300
			2.55							1290
			2.56					120	140	
			2.57					82		
			2.58					128		
			2.62			30				

FORMALIN CONCENTRATION DATA COMBINED ON SINGLE TIME LINE

DATE (1982)	DATE (1982)	TIME LINE		CLOVERDL. CONC.	HEALDBG. CONC. (ppb)	HOPLAND CONC. (ppb)	WOHLER BR. CONC. (ppb)	GUERNVL. CONC. (ppb)	MONTE RIO CONC. (ppb)	DUN.MILLS CONC. (ppb)
		hr	min	Days						
		15	15	2.64	30		30			
				2.68			29	140		
				2.69					160	
				2.71			30			
				2.79			30			
				2.83			30			
				2.88			30			
				2.96			30			
				2.97				30		
				2.99				30		
				3.03				30		
				3.04						
				3.13						
				3.17			30			
				3.37			75			
				3.38			85			
				3.43						30
				3.45				30	30	
				3.46			275			
3/28	3/28	11	22	3.47	30		30			
				3.53			280			
				3.61				30		
		15	10	3.63	53		34			
		15	45	3.66	46					
				3.68			170			
		16	40	3.69	120					
		16	45	3.70	130					
				3.73						
				3.79						
		19	45	3.82	160					
		20	45	3.86	289					
		21	45	3.91	287					
		22	45	3.95	310					
		23	45	3.99	210					
3/29	3/29	0	45	4.03	180					
		1	45	4.07	170					
		2	45	4.11	90					
		3	45	4.16	71					
		4	45	4.20	48					
		5	45	4.24	47					
		7	45	4.32	30					
		8	45	4.36	30					
				4.38						
		9	45	4.41	35		45		30	30
				4.42				30		
				4.44						
		10	45	4.45	30					
				4.46						
				4.47						
		11	45	4.49	30					
				4.5						
		12	45	4.53	40					

FORMALIN CONCENTRATION DATA COMBINED ON SINGLE TIME LINE

DATE (1982)	DATE (1982)	TIME LINE		CLOVERDL. CONC.	HEALDBG. CONC. (ppb)	HOPLAND CONC. (ppb)	WOHLER BR. CONC. (ppb)	GUERNVL. CONC. (ppb)	MONTE RIO CONC. (ppb)	DUN.MILLS CONC. (ppb)
		hr	min	Days						
				4.54	120		110			
		13	45	4.57	30					
				4.58			170			
		14	45	4.61	35	30				65
				4.63			130	30	30	
				4.64			170			
		15	45	4.66	30	51				
				4.67			98			
		16	45	4.70	30	30				
				4.71			31			
				4.72			30			
		17	45	4.74	30	30				
				4.75			37			
		18	45	4.78	30	30	30			
				4.79			30			
		19	45	4.82	30	30	30			
				4.83			30			
		20	45	4.86	30		30	30		
		21	45	4.91	30	30	30	30		
		22	45	4.95	30		30			
		23	48	4.99	30	30	30		30	
3/30	3/30	0	45	5.03	30		30			
		1	45	5.07	30	30	30		30	
		2	45	5.11	30		39			
		3	45	5.16	30		52	30		
		4	45	5.20	30					
		5	45	5.24	30	30	65	30		
		6	45	5.28	30					
		7	45	5.32	85	30	100	30		
		8	45	5.36	60		80			
		9	14	5.38	70				30	
		9	45	5.41	40	30	30	30		
		10	45	5.45	40		30			
		10	55	5.46	30					
		11	45	5.49	30	30	40	40		
		12	45	5.53	30		30			
		13	4	5.54	30		30			
		13	45	5.57	30	30				
		14	45	5.61	30			30	30	30
				5.64			30			
		15	45	5.66	30		30			
		15	55	5.67	30		30			
				5.68		30	50			
		16	45	5.70	35		30			
		17	45	5.74	30		30			
		18	12	5.76	30					
		19	10	5.80	33					
		19	45	5.82	30					
		20	45	5.86	30					
		21	45	5.91	30		30			
		22	45	5.95	30		30			
		23	45	5.99	30					

FORMALIN CONCENTRATION DATA COMBINED ON SINGLE TIME LINE

DATE (1982)	DATE (1982)	TIME LINE		CLOVERDL. CONC.	HEALDBG. CONC. (ppb)	HOPLAND CONC. (ppb)	WOHLER BR. CONC. (ppb)	GUERNVL. CONC. (ppb)	MONTE RIO CONC. (ppb)	DUN.MILLS CONC. (ppb)
		Time hr min	Dcal Days							
3/31	3/31	0	45	6.03	30					
		1	35	6.07	30	30				
		2	45	6.11	30					
		3	45	6.16	30	30				
		4	45	6.20	30	30				
		5	45	6.24	30		30			
		6	45	6.28	30	30	30			
		8	45	6.36	30					
		9	45	6.41	30	30	30			
		10	45	6.45	30		30			
		11	45	6.49	30	30	30			
		12	45	6.53	30		30			
		13	45	6.57	30	30	30			
		14	45	6.61	30					
		15	45	6.66	30	30				
		16	45	6.70	30	30				
		18	0	6.75	30	30	30			
				6.83	30					
		22	0	6.92	30	30	30	10		
				7						30
4/1	4/1	2	0	7.08	30	30	30	10	30	30
				7.17		30	30	10	30	30
		6	0	7.25	30	30	30	10	30	30
				7.33		30		10	30	30
				7.38			30			
		10	0	7.42	35	30				
				7.5		30		30		30
				7.52			10			
		13	0	7.54	10					
		14	0	7.58	10	10		10		10
		18	0	7.75	10					
		22	0	7.92	10	10				

COMBINED FORMALIN DATA WITH INTERPOLATIONS BETWEEN DATA POINTS

DATE	TIME LINE			CLOVERDL.	HEALDBG.	HOPLAND	WOHLER BR.	GUERNVL.	MONTE RIO	DUN.MILLS		
	DATE	Time	Dcal	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.		
	hr	min	Days	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)		
3/25	3/25	15	53	0.66	42	42	42					
3/26	3/26	0	1	1.00	42	42	180	42				
		4	5	1.17	800	42	150	42				
		6	40	1.28	800	42	220	42				
		8	55	1.37	250	42	140	42				
		9	20	1.39	190	42	150	42				
				1.42	130	42	90	42			800	
		14	10	1.59	63	42	42	42				
		15	30	1.65	123	85	62	42				
		16	5	1.67	42	700	42	42				
				1.69		800	42					
				1.71		800	42					
				1.75		800	42					
				1.79		800	42					
				1.81		700	42			42	42	
				1.83		620	42					
				1.88		300	42					
				1.92		140	42					
				1.96		120	42	800				
				1.98		120	42	650				
				2.00		120	42	330				
				2.02		120	42	210				
				2.04		130	42	170				
				2.05		130	42	150				
2.06				120	42	130						
2.08		110	30	110								
2.1		125	30	140								
2.12		140	30	140								
2.13		110	30	140								
2.17		85	30	150								
2.19		84	30	160								
2.21		83	30	130								
2.23		55	30	90								
2.25		30	30	72								
2.28		30	30	72								
2.29		30	30	56								
2.31		30	32	44								
2.33		30	34	35								
2.38		30	36	35								
3/27	3/27	9	45	2.41	41	33	30					
				2.42		30	30			800		
				2.43		30	30	274	800			
				2.44		30	30	660				
				2.46		30	30					
				2.47		30	30		710			
				2.48		30	30		680			
				2.54		34	30		650	800		
				2.55		30	30			800		
				2.56		30	30	120	140			
				2.57		30	30	82				
				2.58		30	30	128				
				2.62		30	30	130				

COMBINED FORMALIN DATA WITH INTERPOLATIONS BETWEEN DATA POINTS

DATE	TIME LINE			CLOVERDL.	HEALDBG.	HOPLAND	WOHLER BR.	GUERNVL.	MONTE RIO	DUN.MILLS
	DATE	Time	Dcm1	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.
		hr min	Days	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
		15 15	2.64	30	30		30	135		
			2.68		30		29	140		
			2.69		30		30		160	
			2.71		30		30			
			2.79		30		30			
			2.83		30		30			
			2.88		30		30			
			2.96		30		30			
			2.97		30			30		
			2.99		30			30		
			3.03		30			30		
			3.04		30			30		
			3.13		30			30		
			3.17		30	30		30		
			3.37		30	75		30		
			3.38		30	85		30		
			3.43		30	145		30		30
			3.45		30	210		30	30	
			3.46		30	275	30	30		
3/28	3/28	11 22	3.47	30	30	280	30	30		
			3.53	35	30	280	30	30		
			3.61	42	30	240	30	30	60	32
		15 10	3.63	53	30	220	34			
		15 45	3.66	46	30	200				
			3.68	80	30	170				
		16 40	3.69	120	35					
		16 45	3.70	130	38					
			3.73	140	30					
			3.79	150	30					
		19 45	3.82	160	30					
		20 45	3.86	289	30					
		21 45	3.91	287	30					
		22 45	3.95	310	30					
		23 45	3.99	210	30					
3/29	3/29	0 45	4.03	180	30					
		1 45	4.07	170	30					
		2 45	4.11	90	30					
		3 45	4.16	71	30					
		4 45	4.20	48	30					
		5 45	4.24	47	50					
		7 45	4.32	30	70					
		8 45	4.36	30	90					
			4.38	32	140					
		9 45	4.41	35	170	45		30	30	30
			4.42	32	200					
			4.44	30	210		60			
		10 45	4.45	30	215					
			4.46	30	220					
			4.47	30	230					
		11 45	4.49	30	195					
			4.5	30	160		90			
		12 45	4.53	40	140		100			

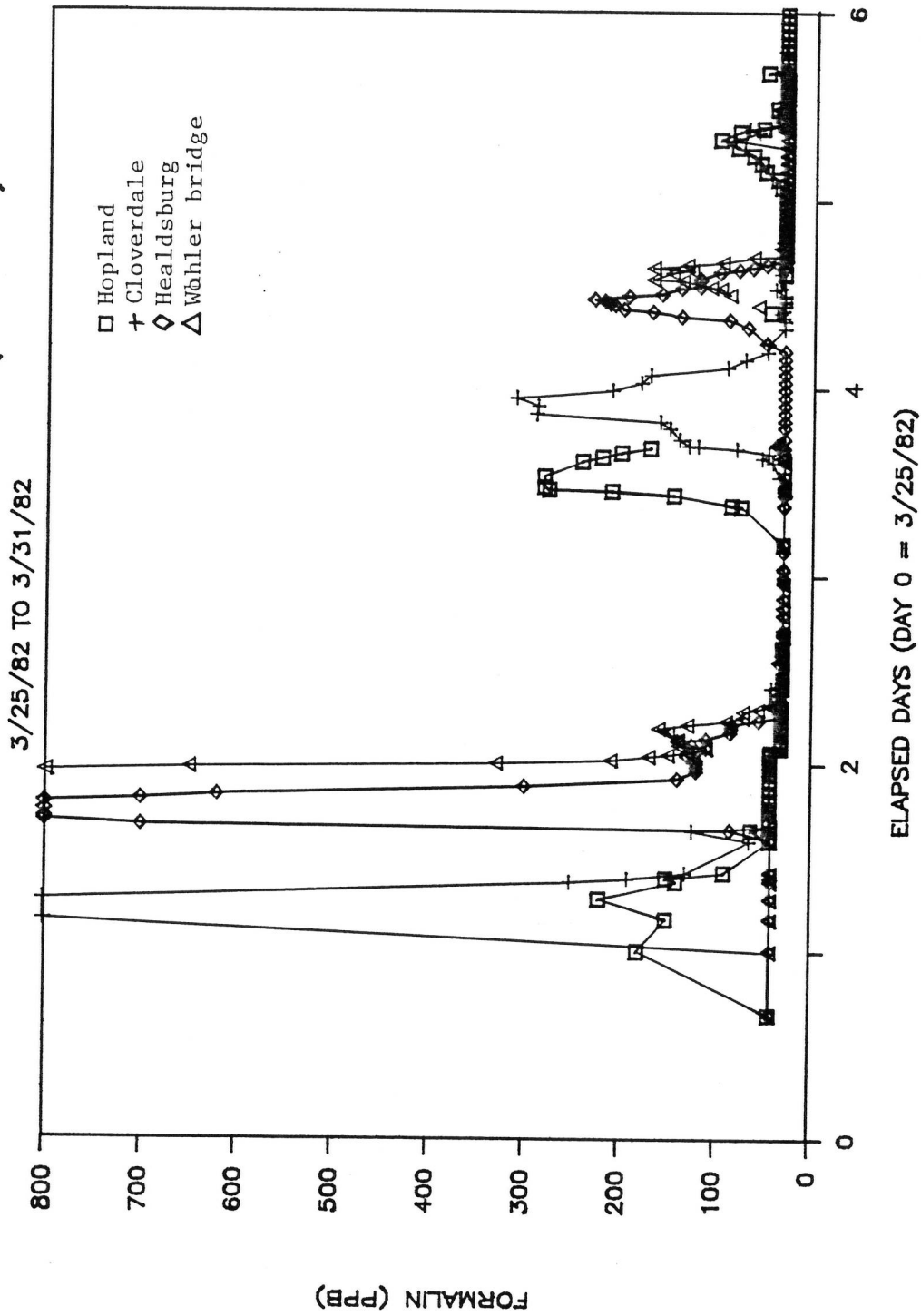
COMBINED FORMALIN DATA WITH INTERPOLATIONS BETWEEN DATA POINTS

DATE	DATE	TIME LINE		CLOVERDL.	HEALDBG.	HOPLAND	WOHLER BR.	GUERNVL.	MONTE RIO	DUN.MILLS
		Time	Dcal	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.	CONC.
		hr	min	Days	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
				4.54	35	120				
		13	45	4.57	30	120				
				4.58	32	120				
		14	45	4.61	35	100	30			65
				4.63	32	80		30	30	
				4.64	30	65				
		15	45	4.66	30	51				
				4.67	30	40				
		16	45	4.70	30	30				
				4.71	30	30				
				4.72	30	30				
		17	45	4.74	30	30				
				4.75	30	30				
		18	45	4.78	30	30	30			
				4.79	30	30	30			
		19	45	4.82	30	30	30			
				4.83	30	30	30			
		20	45	4.86	30	30	30	30		
		21	45	4.91	30	30	30	30		
		22	45	4.95	30	30	30			
		23	48	4.99	30	30	30			
3/30	3/30	0	45	5.03	30	30	30			
		1	45	5.07	30	30	35			30
		2	45	5.11	30	30	39			
		3	45	5.16	30	30	52			
		4	45	5.20	30	30	57			
		5	45	5.24	30	30	65			
		6	45	5.28	30	30	82			
		7	45	5.32	85	30	100			
		8	45	5.36	60	30	80			
		9	14	5.38	70	30	55			30
		9	45	5.41	40	30	30	30		
		10	45	5.45	40	30	30			
		10	55	5.46	30	30	35			
		11	45	5.49	30	30	40			
		12	45	5.53	30	30	30			
		13	4	5.54	30	30	30			
		13	45	5.57	30	30	30			
		14	45	5.61	30	30	30	30	30	30
				5.64	30	30	30			
		15	45	5.66	30	30	30			
		15	55	5.67	30	30	30			
				5.68	32	30	50			
		16	45	5.70	35		30			
		17	45	5.74	30		30			
		18	12	5.76	30		30			
		19	10	5.80	33		30			
		19	45	5.82	30		30			
		20	45	5.86	30		30			
		21	45	5.91	30		30			
		22	45	5.95	30		30			
		23	45	5.99	30		30			

COMBINED FORMALIN DATA WITH INTERPOLATIONS BETWEEN DATA POINTS

DATE	DATE	TIME LINE			CLOVERDL. CONC. (ppb)	HEALDBG. CONC. (ppb)	HOPLAND CONC. (ppb)	WOHLER BR. CONC. (ppb)	GUERNVL. CONC. (ppb)	MONTE RIO CONC. (ppb)	DUN.MILLS CONC. (ppb)		
		Time	Dcml	Days									
3/31	3/31	0	45	6.03	30		30						
		1	35	6.07	30		30						
		2	45	6.11	30		30						
		3	45	6.16	30		30						
		4	45	6.20	30		30						
		5	45	6.24	30	30	30		30				
		6	45	6.28	30		30		30				
		8	45	6.36	30		30		30				
		9	45	6.41	30		30		30				
		10	45	6.45	30		30		30				
		11	45	6.49	30	30	30		30				
		12	45	6.53	30		30		30				
		13	45	6.57	30		30		30				
		14	45	6.61	30								
		15	45	6.66	30	30							
		16	45	6.70	30		30						
		18	0	6.75	30	30	30						
							30						
			22	0	6.92	30	30	30	10				
					7							30	
		4/1	4/1	2	0	7.08	30	30	30	10	30		30
						7.17		30	30	10	30		30
6	0			7.25	30	30	30	10	30		30		
				7.33		30		10	30		30		
				7.38			30						
10	0			7.42	35	30							
				7.5		30			30		30		
				7.52			10						
13	0			7.54	10								
14	0			7.58	10	10			10		10		
18	0			7.75	10								
22	0	7.92	10	10									
4/2	4/2	2	0	8.08	10								

HOP.-CLOV.-HLD SB.-WLER (EDITED)



Formalin concentrations for Hopland, Cloverdale, Healdsburg, Wohler bridge.

WOHLER—GRNVILLE—M.RIO—D.MILLS

3/25/82 TO 3/31/82

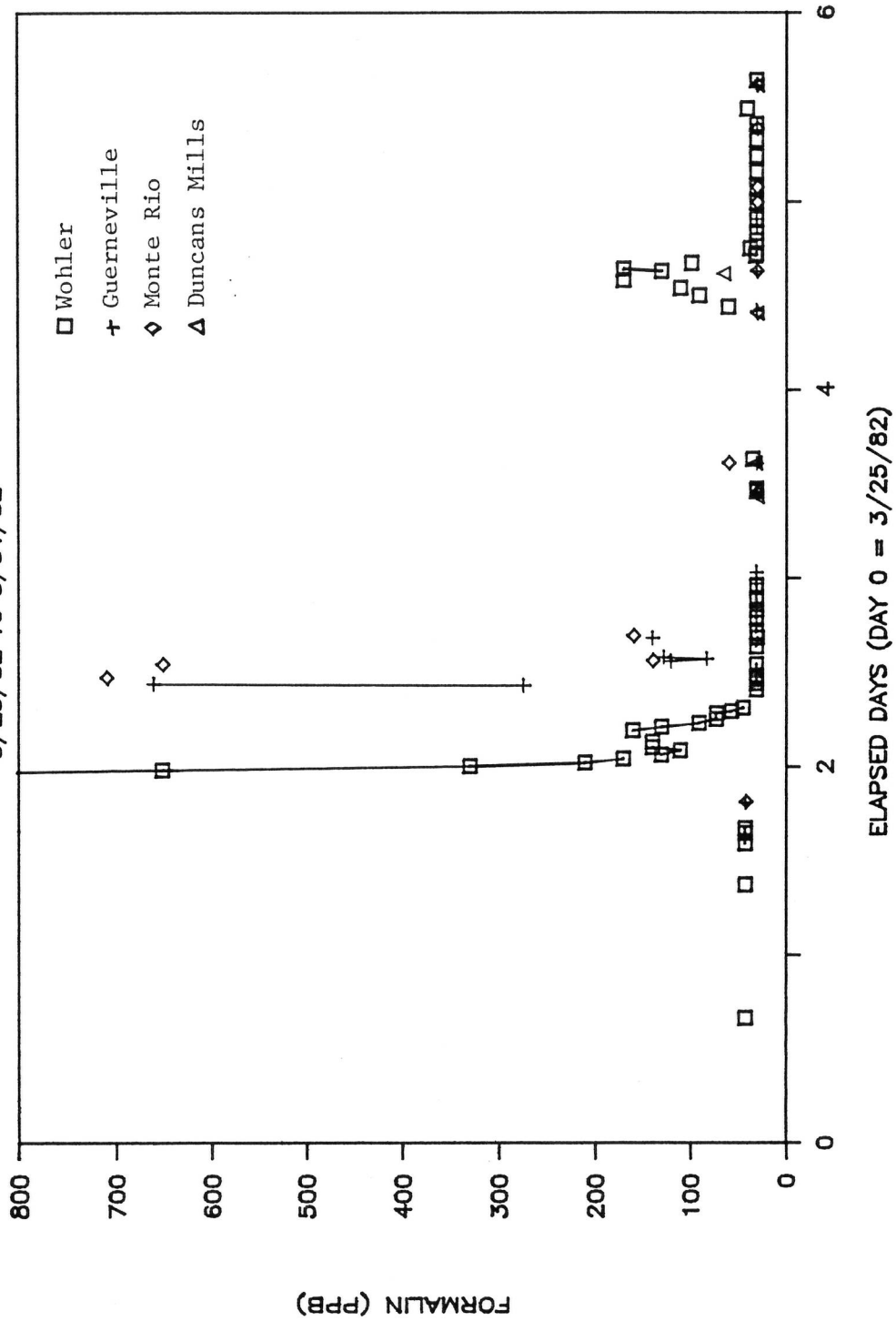
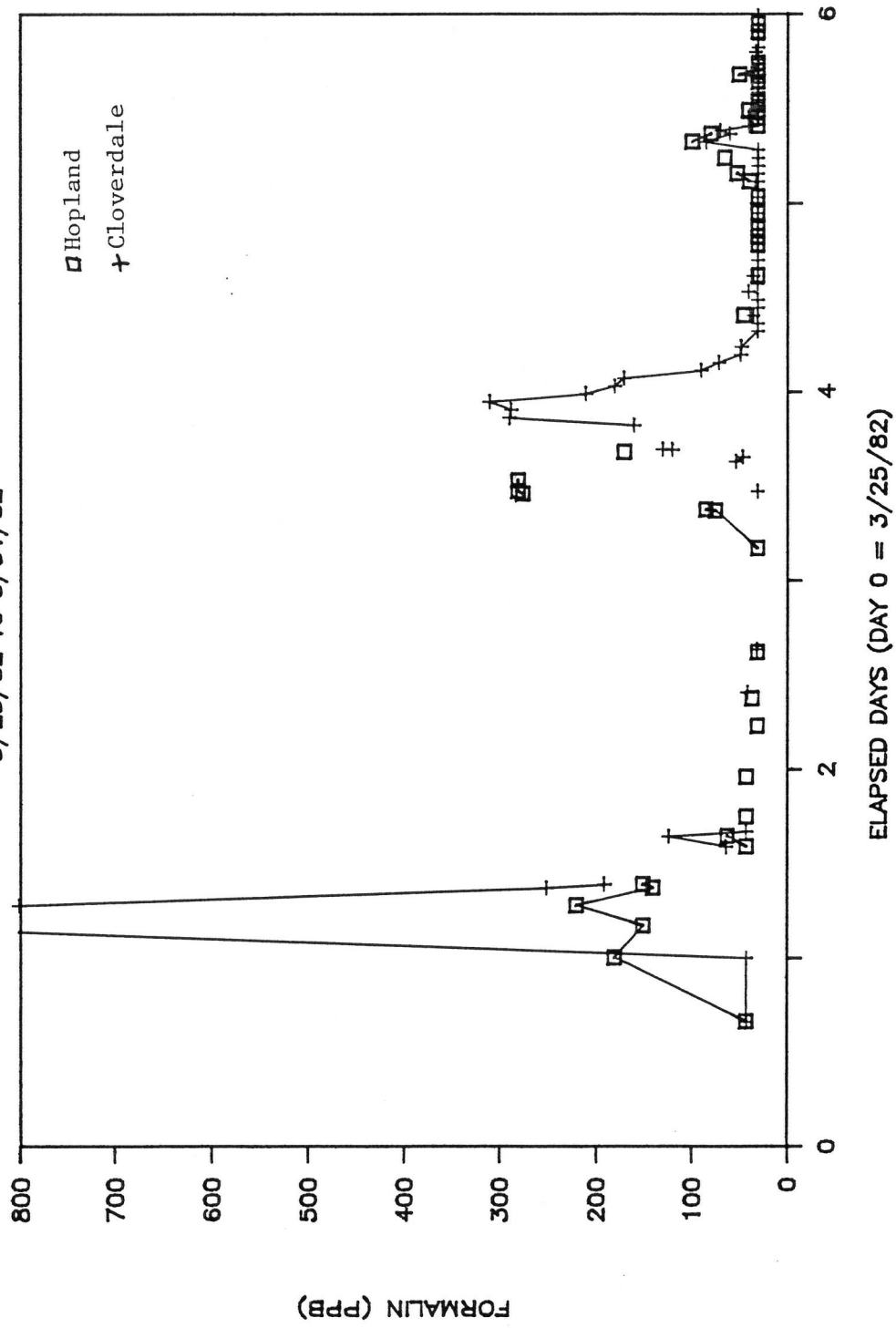


Figure 2

Formalin concentrations for Wohler bridge, Guerneville, Monte Rio, Duncans Mills.

HOPLAND-CLOVERDALE

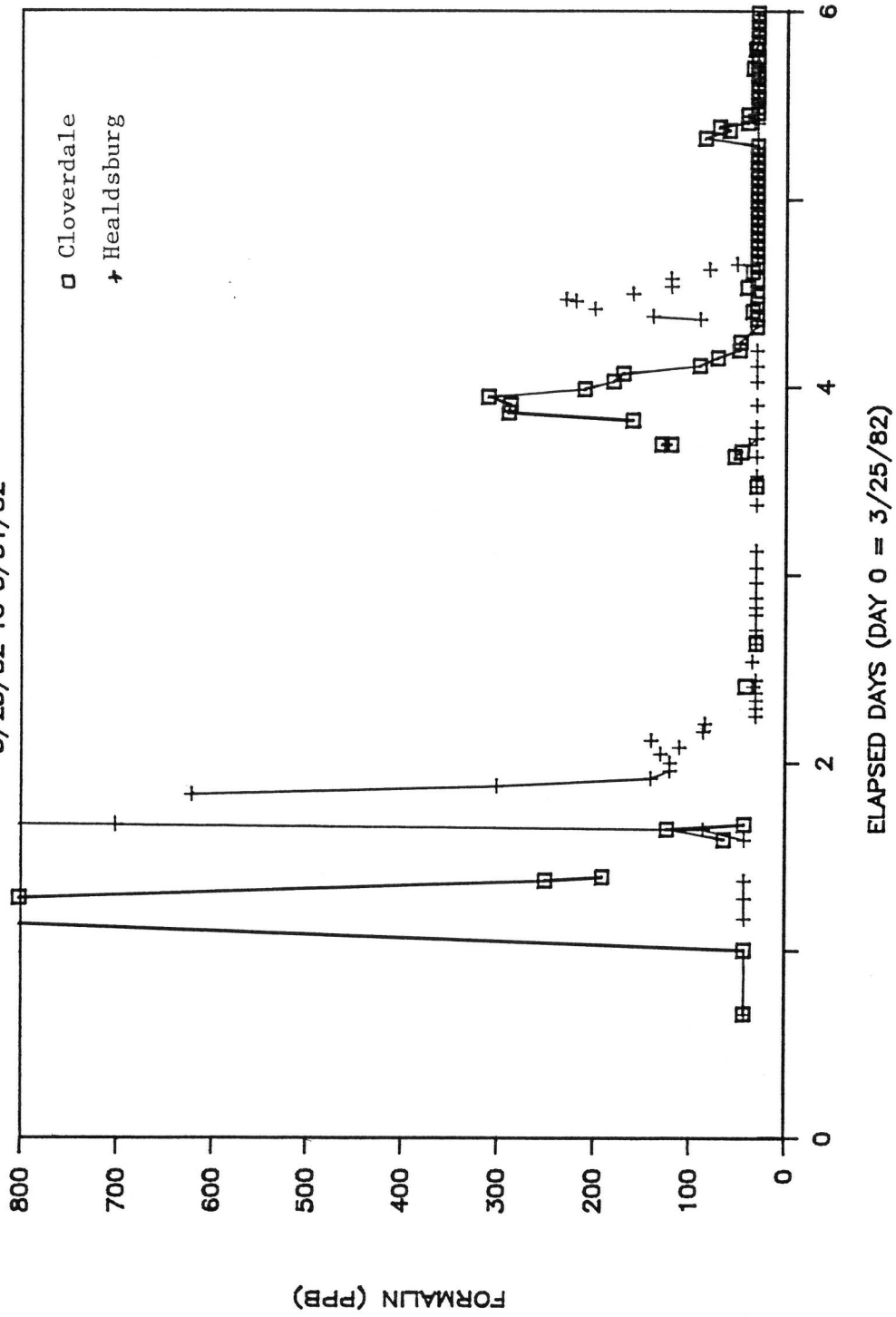
3/25/82 TO 3/31/82



Formalin concentrations at Hopland and Cloverdale

CLOVERDALE--HEALDSBURG

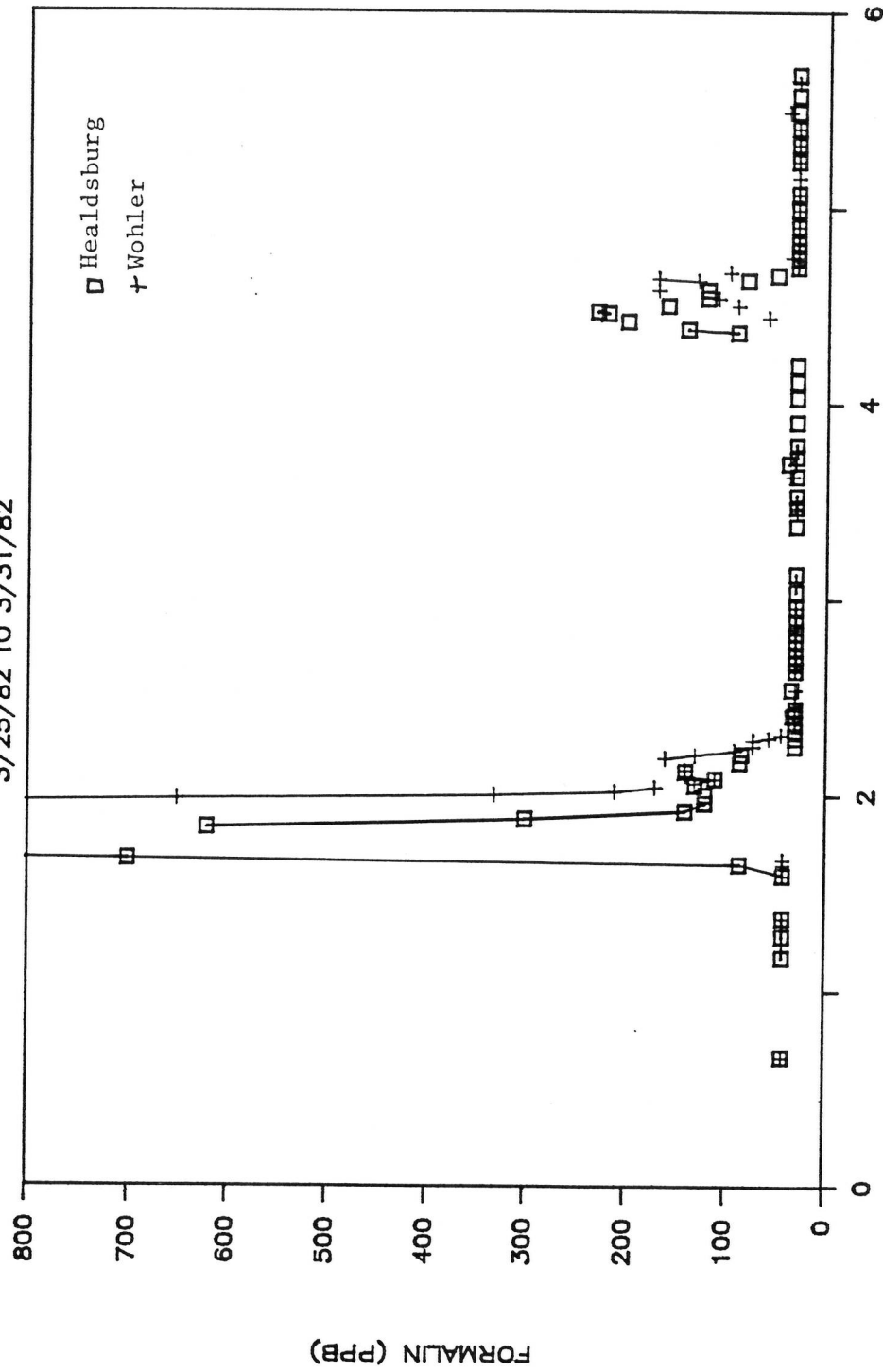
3/25/82 TO 3/31/82



Formalin concentrations at Cloverdale and Healdsburg.

HEALDSBURG—WOHLER

3/25/82 TO 3/31/82

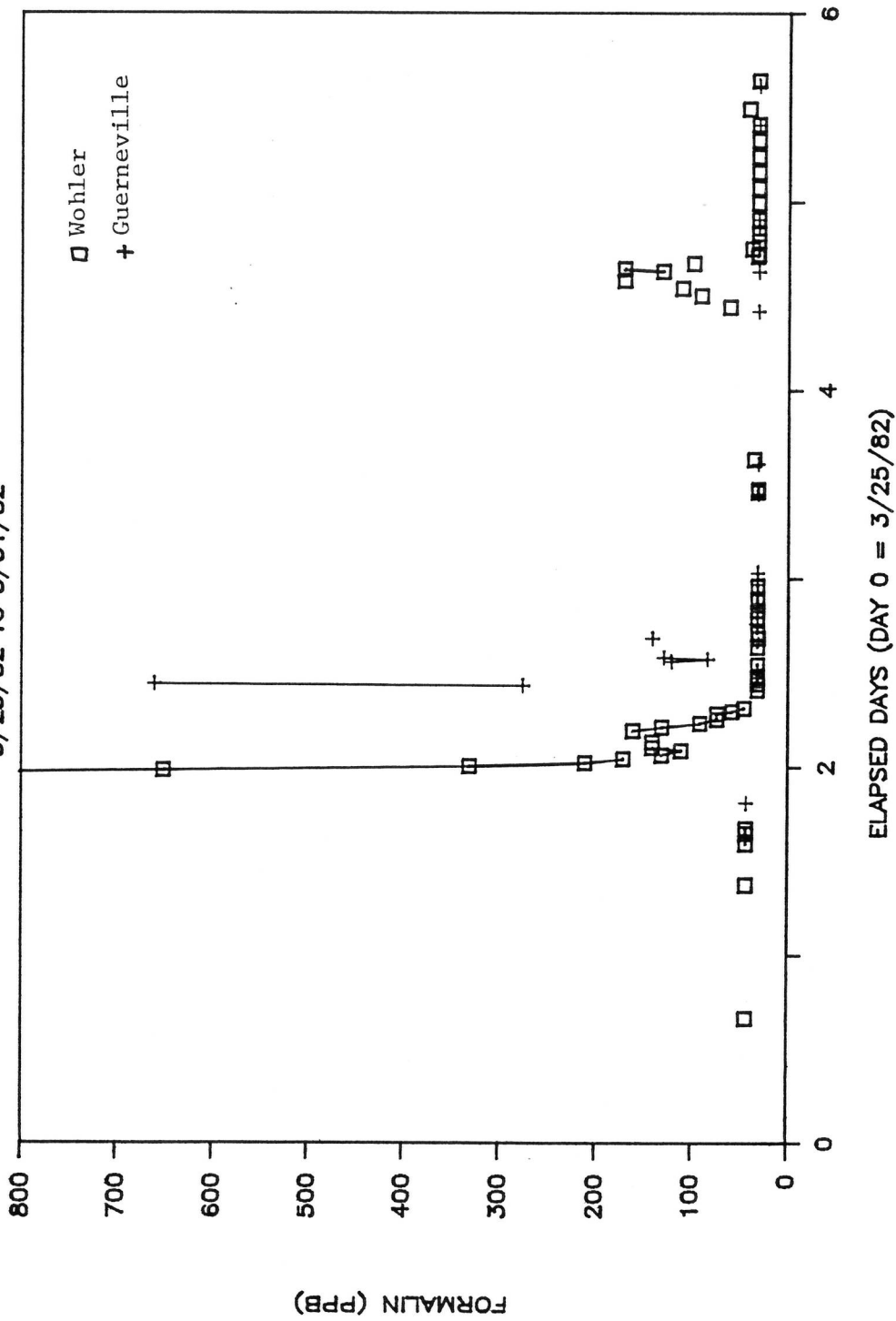


ELAPSED DAYS (DAY 0 = 3/25/82)

Formalin concentrations at Healdsburg and Wohler bridge.

WOHLER-GUERNEVILLE

3/25/82 TO 3/31/82



Formalin concentrations at Wohler bridge and Guerneville.

MEASUREMENTS OF FORMALIN TRAVEL TIME
IN HOURS FROM "INTERPOLATED" PLOTS.

	POINT	HOP-CLO (Hours)	HOP-HLD (Hours)	HOP-WOH (Hours)
PEAK 2	L.E.	7	24	29
	PEAK	10	22.5	26.5
	T.E.		20	20.5
	L.S.	7	24	26
AVERAGE CALCULATED		8	22.63	25.5
		9	21.36	24.76

	POINT	CLO-HLD (Hours)	CLO-WOH (Hours)	HLD-WOH (Hours)
PEAK 1	L.E.	14.5		
	PEAK	12.5		
	T.E.	14	16.5	2.5
	T.S.	12.5	15.5	3.5
	T.S.2	12.5		3
	AVERAGE CALCULATED	13.2 13	16	3 2.8

PEAK 2	L.E.	16		
	PEAK	13.5	16.5	4
	T.E.	12	13	1.5
	L.S.	14	17	3.5
	L.S.2	13	18	3
	T.S.	12.5		
	T.S.2	12.5		
AVERAGE CALCULATED		13.36 13.12	16.12	3 2.76

L.E. Leading Edge
T.E. Trailing Edge
L.S. Leading Shoulder
T.S. Trailing Shoulder

HOP=HOPLAND BRIDGE
CLOV=CLOVERDALE; CROCKER ROAD BRIDGE
HLD=HEALDSBURG; HWY.101 BRIDGE
WOH=WOHLER ROAD BRIDGE

CALCULATED TIMES ARE ADDITION OR SUBTRACTION OF TRAVEL TIMES
FOR RIVER SEGMENTS.