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MEMORANDUM
September 9, 1983

To: Files

From: Tim Determan and John Bernhardt

Subject: Progress Report No. 3; Burley Lagoon and Minter Bay Survey

This is the third of a series of status reports on the Burley Lagoon/ Minter Bay bacteriological survey.

Ambient Monitoring

Burley Lagoon and Minter Bay and their respective watersheds are classified as AA (extraordinary) waters under the Washington State Water Quality Standards. Fecal coliform criteria are summarized below.

Freshwaters

Part 1. Fecal coliform organisms shall not exceed a geometric mean value of 50 organisms/100 mL;

Part 2. Not more than 10 percent of samples shall exceed 100 organisms/100 mL.

Marine Waters

Part 1. Fecal coliform organisms shall not exceed a geometric mean value of 14 organisms/100 mL;

Part 2. Not more than 10 percent of samples shall exceed 43 organisms/100 mL.

In addition to water quality criteria, DSHS and FDA policy states that shellfish exceeding 230 FC organisms per 100 gr of tissue are not deemed to be marketable.

Table 1 summarizes fecal coliform data collected during routine background sampling. The value shown on each sampling date is the geometric mean of two replicates. The status of the waters is determined under terms of Part 1 of the FC water quality standard for that particular date. Violations are indicated by a box.

A cursory examination of Table 1 suggests a general degradation in water quality since May 31. This decrease in water quality correlates with a reduction in stream flows. However, peak FC densities occurred during thunderstorms at most stations on July 26, especially in Burley watershed. These elevated fecal coliform levels were associated with increased suspended sediments and stream flows.

The elevated FC levels in streams during low flow may be due to lack of dilution of background watershed sources by wintertime runoff. However, some studies have suggested that fecal coliform may survive to reproduce in sediments of streams and estuaries. One study has shown that increase of stream flow by release of water from a reservoir resulted in marked elevation of FC levels without land-derived runoff, probably due to entrainment of FC surviving in stream sediments.

A statistical summary of the data is shown in Table 2. This approach documents summertime degraded water quality conditions at most stream stations. Geometric means were substantially higher in all cases. Elevations at stations in undeveloped areas (V0.0, X0.2) were not sufficient to cause violations. However, significant post-May 31 violations have occurred at all downstream stations. Several stations (M0.0; M1.3; H0.1; UN0.0; Br0.0) had violations that had not occurred during the winter/spring period. Several upstream sites (H3.1; Br1.8) showed summertime violations although there are no apparent sources.

Recent violations have occurred at mid-estuary stations, also. No substantive change has occurred to marine waters incoming from Henderson Bay. It is interesting to note that the shellfish marketability standard has not yet been violated in oyster samples from either estuary shellfish station since January 10, 1983.

Other Studies

In late May and June, intensive sampling was conducted in Burley Lagoon and Minter Bay to determine the distribution of fecal coliform in water, oysters, and sediments. Results are summarized in Figures 1 through 4. Water samples were collected at high slack tide. Shellfish and sediment samples were collected within two weeks of collecting water samples. Data show significant violations of the FC water standards. At Minter

Bay, the geometric mean of all samples was 43 FC/100 mL (n = 55) and 58 percent exceeded 43 FD/100 mL. The highest values occurred in nearshore waters. At Burley Lagoon, the geometric mean of all samples was 24 FC/100 mL (n = 52) and 38 percent exceeded 43 FC/100 mL.

Several other studies have been partially completed or are currently underway. These are as follows:

1. Fecal coliform mortality under various enviornmental conditions.

2. The contribution of groundwaters to FC levels in the estuaries.

3. The effect of handling on FC levels in oysters.

4. The role of sediments in streams and estuaries on reservoirs of FC.

5. Dilution and disperson in Minter Bay.

TAD:JB:cp

Attachments

Table 1. Summary of Burley Lagoon and Minter Bay fecal coliform sampling data.

Sampling Location	Sampling Results													
	January		February		March	April		May		June		July		August
	10-11	17-18	7-8	21-22	21-22	4-5	18-20	2-3	31-6/1	12-13	27	11	25	8
BURLEY LAGOON														
Burley Creek														
Headwaters (BU 5.2)	--	--	--	21	1	7	2	12	5	18	10	18	/1284/	36
Lower Creek (BU 0.6)	--	--	--	/379/	17	46	/58/	/85/	/253/	/145/	/61/	/54/	/2179/	/163/
Near Mouth (BU 0.3)	36	--	/89/	/184/	25	/202/	/69/	/71/	/203/	/210/	/50/	/30/	/<400/	/178/
Unnamed Trib. (X 0.2)	--	--	--	<1	<1	1	<1	2	10	5	1	3	29	5
Purdy Creek														
Headwaters (P 3.6)	--	--	--	4	2	1	<1	2	7	3	5	8	/250/	16
Near Mouth (P 0.1	/122/	14	5	/255/	6	46	9	/95/	/102/	/134/	/238/	/101/	/3250/	/186/
Unnamed Trib. (V 0.0)	--	--	--	3	1	9	<1	2	33	/56/	3	6	/170/	17
Bear Creek														
Headwaters (BR 1.8)	--	--	--	3	1	4	49	17	/2800**/	/160**/	/205/	/64/	/5250/	/68**/
Near Mouth (BR 0.0)	--	/53/	--	/58/	40	/76/	7	22	/152/	/550/	/67/	/118/	/702/	/194/
Marine Waters														
Mid-lagoon (BES)	10	3	14	5	3*	<1*	6*	5*	/43*/	/27*/	8*	/27*/	/31/	/26*/
Lagoon Outlet (BEX)	5	4	6	<1	4*	6*	/20*/	7*	16*	2*	<2*	5*	2	<2*
Oyster Tissue	--	230	130	50	70	50	11	130	140	20	90	80	230	80
MINTER BAY														
Minter Creek														
Headwaters (M 4.4)	46	5	3	34	71	4	1	2	13	34	7	6	/74/	21
Lower Creek (M 1.3)	/88/	21	15	41	/54/	12	23	32	/344/	/309/	/54/	/56/	/810/	/96/
Near Mouth (M 0.0)	48	42	12	24	24	15	12	28	/75/	/114/	/64/	41	/323/	/54/
Huge Creek														
Headwaters (H 3.1)	11	2	1	4	1	<1	<1	<1	/630/	/105/	8	32	/1849/	15
Near Mouth (H 0.1)	14	25	9	16	24	15	7	21	/145/	/70/	/125/	/59/	/278/	45
Unnamed Creek														
Headwaters (UN 2.0)	/114/	16	2	29	2	4	51	35	/138/	/59/	/370/	/95/	/134/	/79/
Near Mouth (UN 0.0)	/78/	15	5	7	3	/64/	/63/	22	/67/	/69/	46	/355/	/173/	/76/
Marine Waters														
Mid-bay (MES)	/63/	10	5	9	/62*/	12*	/17*/	/71*/	/218*/	/51*/	/32*/	/101*/	/42/	--
Bay Outlet (MEX)	/75/	3	3	/17/	/43*/	13*	2*	10*	--	2*	/40*/	2*	1	<2*
Oyster Tissue	/1300/	230	20	15	130	80	11	5	110	50	20	130	20	230

NOTE: All of the analyses are Membrane Filter (MF) except for the marine samples which are Most Probable Number (MPN).
/ / means either a water or tissue standard was violated.

*Most Probable Number water sample.
**Stream dry; sample taken from downstream drainage ditch. Heavy rainfall, runoff.

Table 2. Background monitoring program data summary.

	(Period Prior to May 31)					(Period since May 31)				
	Geometric Mean	Percent Exceeding Maximum Limit	Violation Summary Water Part 1	Water Part 2	Shellfish	Geometric Mean	Percent Exceeding Maximum Limit	Violation Summary Water Part 1	Water Part 2	Shellfish
BURLEY LAGOON										
Burley Creek										
(Bu5.2)	5	0	No	No	--	30	17	No	Yes	--
(Bu0.6)	68	20	Yes	Yes	--	223	83	Yes	Yes	--
(Bu0.3)	76	29	Yes	Yes	--	165	83	Yes	Yes	--
(X0.2)	1	0	No	No	--	5	0	No	No	--
Purdy Creek										
(P3.6)	2	0	No	No	--	10	17	No	Yes	--
(P0.1)	29	25	No	Yes	--	334	100	Yes	Yes	--
(V0.0)	2	0	No	No	--	22	17	No	Yes	--
Bear Creek										
(Br1.8)	6	0	No	No	--	409	67	Yes	Yes	--
(Br0.0)	34	0	No	No	--	212	83	Yes	Yes	--
Marine Waters										
(BES)	3	0	No	No	--	24	0	Yes	No	--
(BEX)	8	0	No	No	--	4	0	No	No	--
Oyster Tissue	69	0	--	--	No	85	0	--	--	No
MINTER BAY										
Minter Creek										
(M4.4)	8	0	No	No	--	17	0	No	No	--
(M1.3)	29	0	No	No	--	178	50	Yes	Yes	--
(M0.0)	23	0	No	No	--	85	33	Yes	Yes	--
Huge Creek										
(H3.1)	2	0	No	No	--	89	50	Yes	Yes	--
(H0.0)	15	0	No	No	--	99	50	Yes	Yes	--
Unnamed Creek										
(UN2.0)	14	13	No	Yes	--	120	50	Yes	Yes	--
(UN0.0)	18	0	No	No	--	100	33	Yes	Yes	--
Marine Waters										
(MES)	20	38	Yes	Yes	--	77	60	Yes	Yes	--
(MEX)	10	12	No	Yes	--	4	0	No	No	--
Oyster Tissue	52	0	--	--	No	63	0	--	--	No

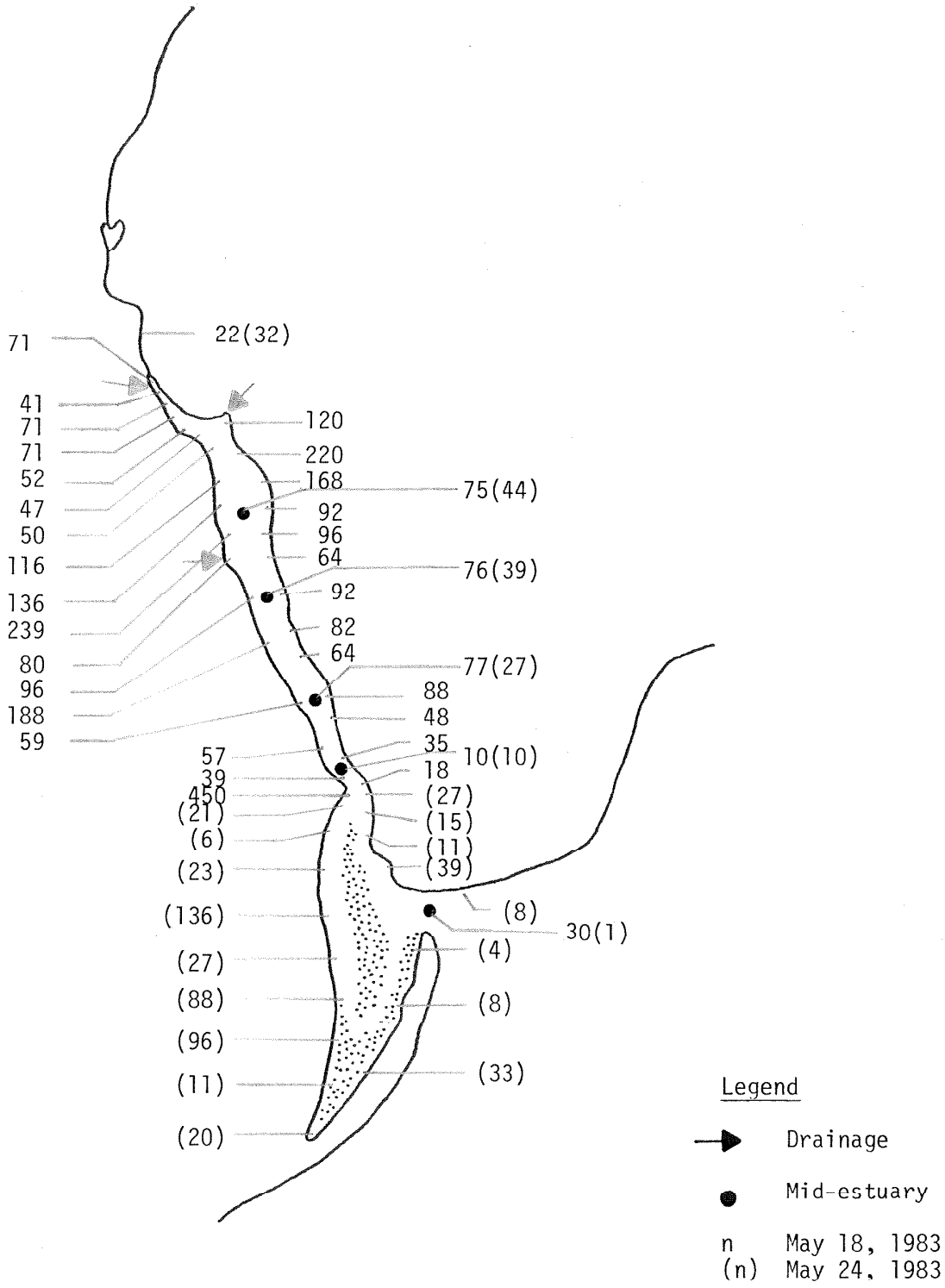

Figure 1. Fecal coliform levels (org/100 mL) in Minter Bay at higher high water on May 18 and 24, 1983.

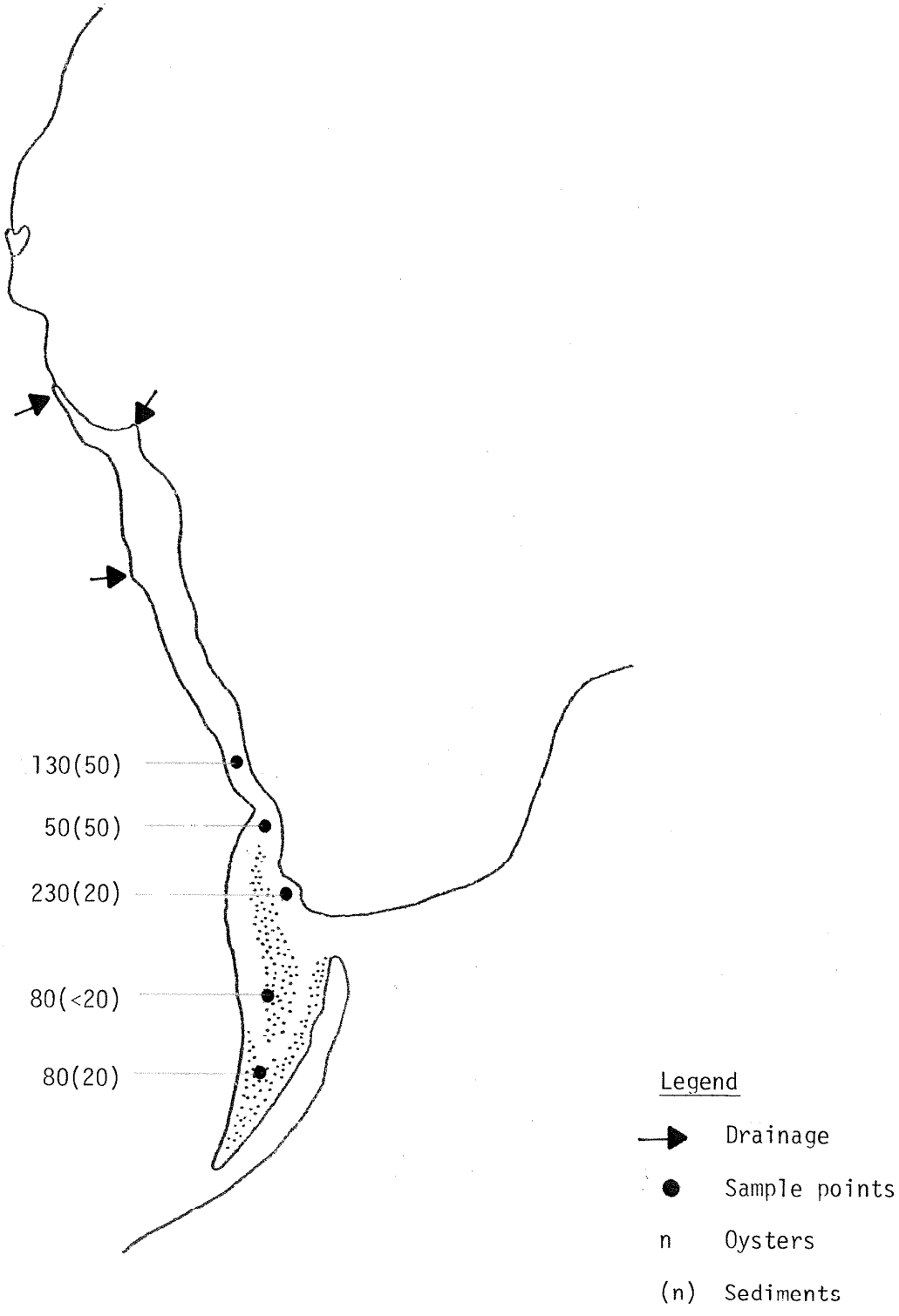

Figure 2. Fecal coliform levels in sediments and oyster tissue (org/100 gr) in Minter Bay on June 6 and 7, 1983.

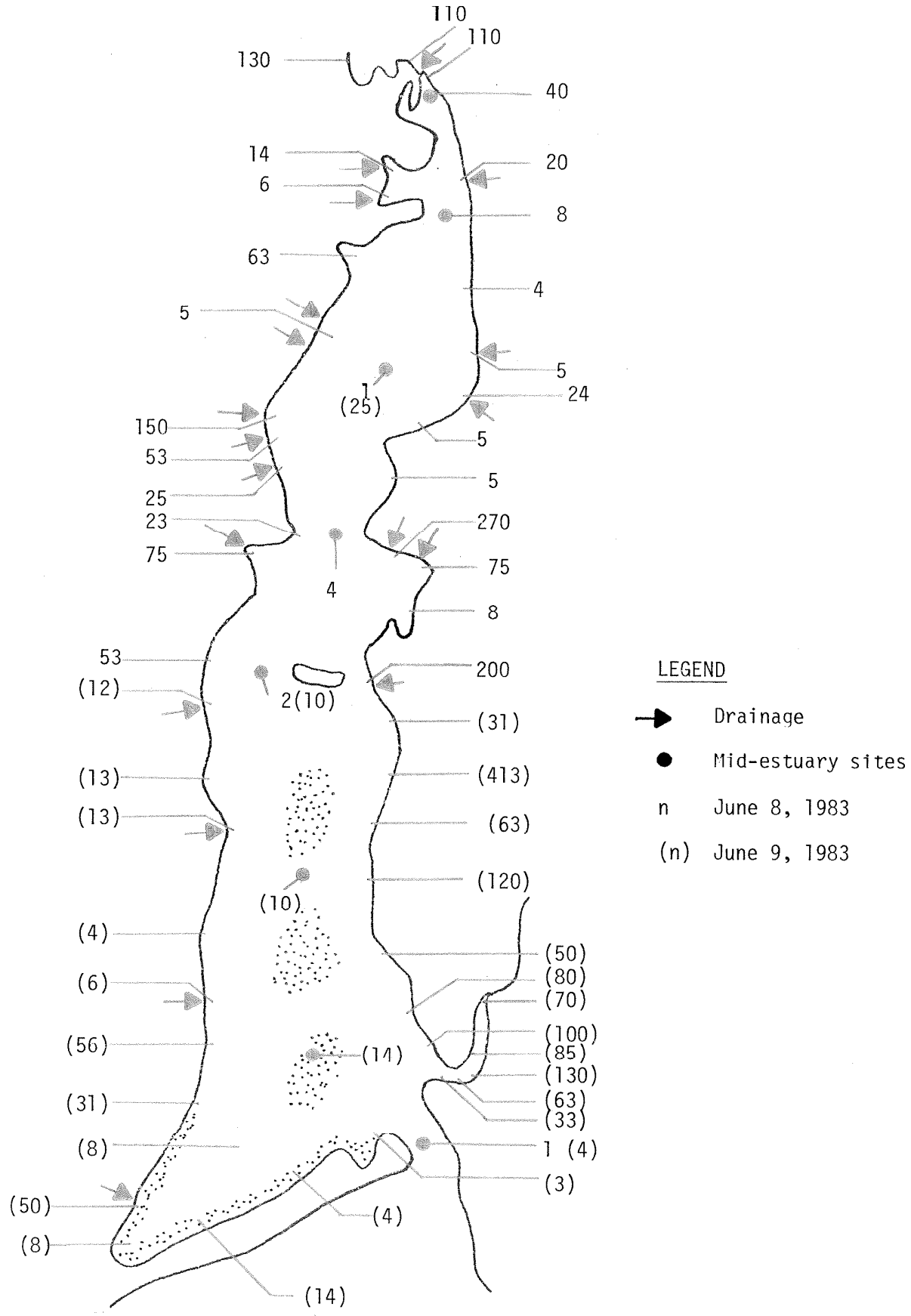

Figure 3. Fecal coliform levels (org/100 mL) in Burley Lagoon at higher high water on June 8 and 9, 1983.

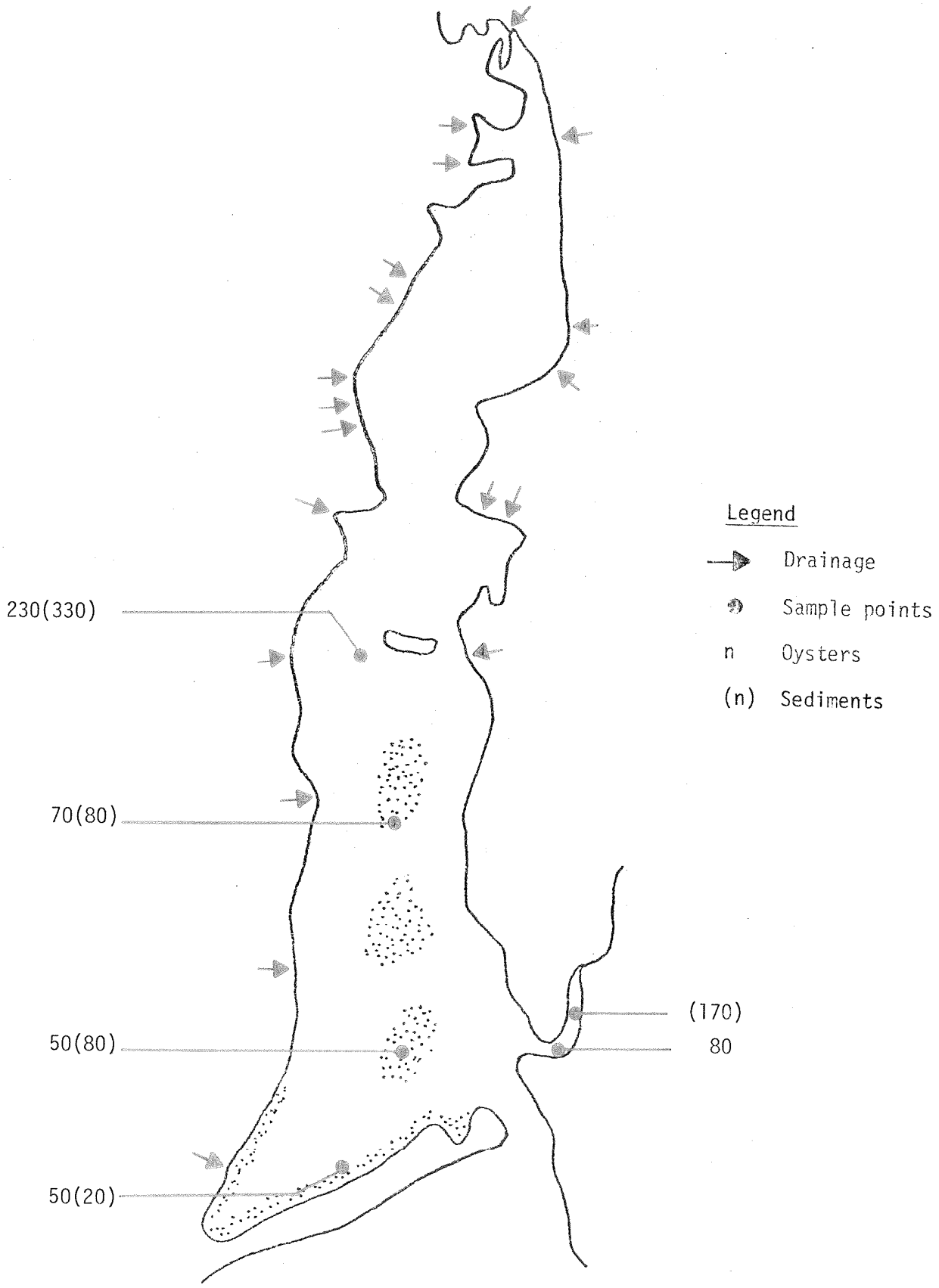

Figure 4. Fecal coliform levels in sediments and oyster tissue (org/100 gr) in Burley Lagoon on June 20, 1983.