

Figure 3-1. Kodiak Urban Lakes watershed map

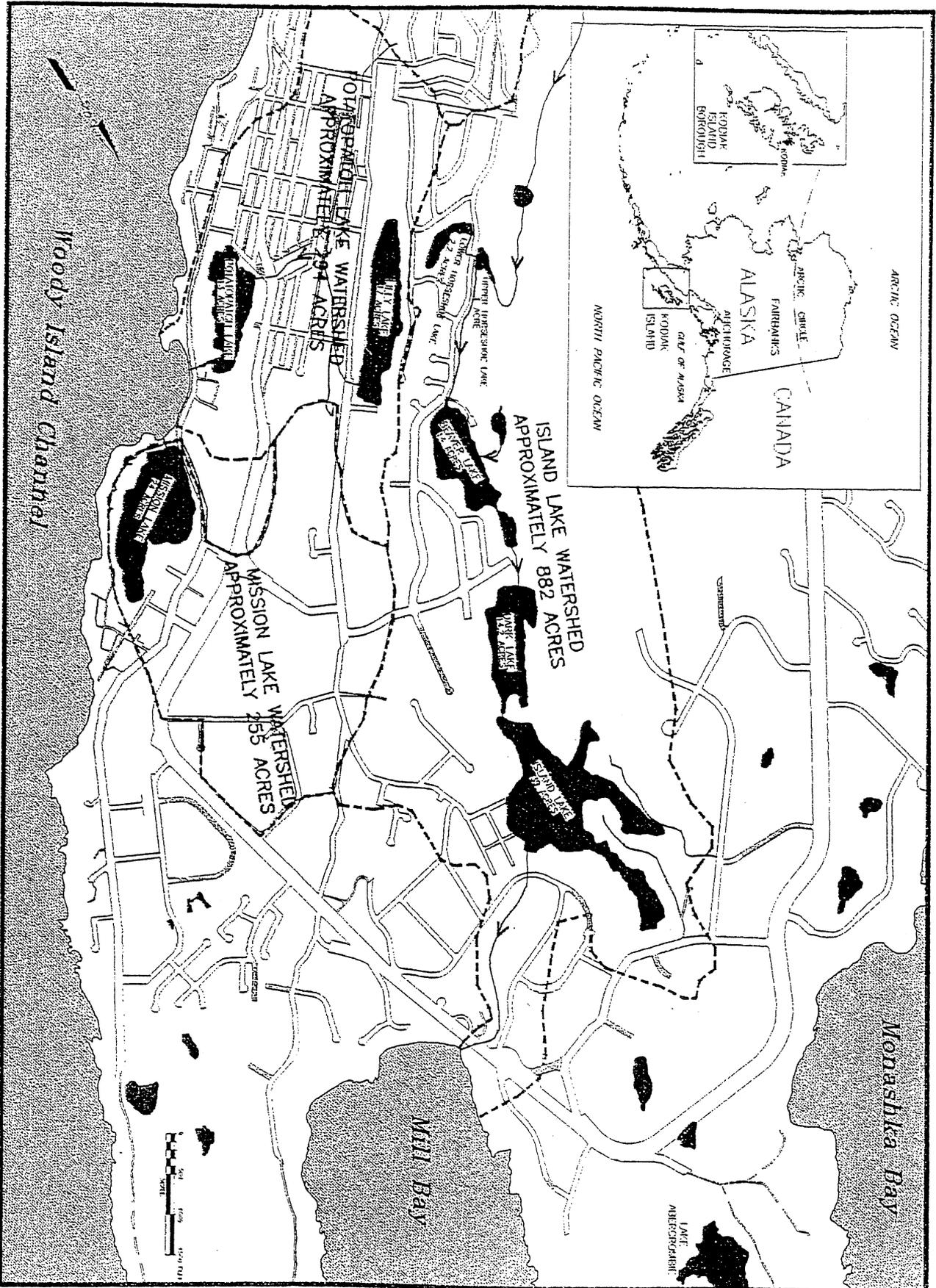


Table 4-2

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Lake and Watershed Characteristics

Lake	Watershed Area (acres)	Lake Area (acres)	Lake Volume (acre-ft)	Mean Lake Depth (feet)	Mean Annual Flow (cfs)	Water Deln. Time (days)
Upper Horseshoe	10	2.2	4.4	2.0	0.05	44
Lower Horseshoe	37	1.0	1.5	1.5	0.19	4
Beaver	421	14.3	57	4.0	2.37	12
Dark	495	14.4	128	8.9	2.80	23
Island	745	39.0	506	13.0	4.26	60
Lilly	95	16.5	76	4.6	0.51	75
Potalopatch	298	12.7	32	2.5	1.66	10
Mission	281	23.5	68	2.9	1.56	22
Abercrombie	200	18.7	242	13.0	1.10	111

Table 3-1A: Upper Horseshoe Lake

Overview:

This lake is small, very shallow, and the watershed area is only about 9 acres. There is no inlet stream, and much of the lake water is recharged by groundwater, although there is also considerable surface runoff from adjacent residential lots during storms. The high groundwater component resulted in elevated color and iron concentration. Juvenile silver salmon were present. The lake is moderately fertilized (mesotrophic), and had moderately high fecal coliform bacteria counts. The lake is nearly covered by yellow lilies during the summer, and its appearance could be improved by increasing the depth of water. A design project to accomplish this has been funded by the City of Kodiak, and construction is scheduled for Fall 1997.

Surface Area: 2.6 acre

Average Depth: 2 feet

Maximum Depth: 3.5 feet

Sept. Weed Cover: 90%; yellow lily dominant with burr reed, bladderwort, and pondweed common.

Cumulative Watershed Area: 10 acres

Upstream lakes: 0 acres

Undeveloped: 1.4 acres

Residential: 5.5 acres

Commercial / Institutional: 0 acres

Trophic State Indicators:

Total Phosphorus: 16 ug/L meso

Chlorophyll a: 1.8 ug/L oligo

Secchi Clarity: 0.9+ m eu

Theoretical Water Retention Time: 54 days

Zooplankton Biomass: 216 mg/m²

Fish Catch Rate and Condition: 8.4 fish/trap; Avg. Length 74 mm; Avg. Condition 1.20

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml): Average 574 ; 2 of 6 samples >100; Max. 2430

Turbidity: 7.3 NTU

Color: 24.8 Pt units

Iron: 2673 ug/l

pH: 6.76

Conductivity: 150 umhos/cm

Other: The outlet elevation of this lake is controlled by a culvert which passes under Selief Lane. The lake level will be raised by 6" to 12" by regrading this culvert in Fall 1997.

Table 3-1B: Lower Horseshoe Lake

Overview: This lake is small and very shallow. The outflow of Upper Horseshoe enters this lake, as does the runoff from another 24 acres of residential land. This includes 1700 linear feet of the unpaved section of Selief Lane. Silt produced by the breakdown of the gravel used to build the road enters Lower Horseshoe Lake, and results in the highest levels of turbidity of all the lakes studied. This looks unattractive, cuts light available for photosynthesis, and may adversely affect rearing silver salmon by decreasing their feed and interfering with their ability to see their prey. Color, iron, phosphorus, and organic carbon were all quite high. Fecal coliform bacteria were very high at times. The retention time is very short, and zooplankton abundance is low.

Surface Area: 1.2 acres

Average Depth: 1.5 feet

Maximum Depth: 3 feet

Sept. Weed Cover: 60%; yellow lily dominant with burr reed, horsetail, and pondweeds.

Cumulative Watershed Area: 37 acres

Upstream lakes: 2.6 acres

Undeveloped: 3.7 acres

Residential: 29 acres

Commercial / Institutional: 0 acres

Trophic State Indicators:

Total Phosphorus: 55 ug/L eu

Chlorophyll_a: 1.1 ug/L oligo

Secchi Clarity: 0.4 m eu

Theoretical Water Retention Time: 5 days

Zooplankton biomass: 7 mg/m²

Fish Catch Rate and Condition: 4.7 fish/trap; Avg. Length 73 mm; Avg. Condition 1.20

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml): Average 840, 3 of 6 samples >100, Max. 2470

Turbidity: 48.4 NTU

Color: 41.8 Pt units

Iron: 4462 ug/l

pH: 6.94

Conductivity: 199 umhos/cm

Other: If Selief Lane were paved, the turbidity and siltation problems in Lower Horseshoe Lake would be greatly reduced.

Table 3-1C: Beaver Lake

Overview: The runoff from approximately 250 acres of undeveloped brush and forest on the side of Pillar Mountain joins the water leaving Lower Horseshoe Lake before the combined flow follows Selief Lane in a ditch next to the road. The runoff from about 30 acres of additional residential land (including about 2500 additional linear feet of unpaved roadway) drains into the ditch. This flow enters Beaver Lake. Fecal coliform bacteria counts were very high at the inlet to Beaver Lake. There may be a problem with a sewage leak somewhere along the Selief ditch. Beaver Lake is relatively shallow, and the retention time is short. Zooplankton abundance is low. The heavy input of clean water off Pillar Mountain dilutes the silt and nutrients from Selief Lane and nearby residences.

Surface Area: 14.3 acres

Average Depth: 4.0 feet

Maximum Depth: 7.5 feet

Sept. Weed Cover: 40%; yellow lily dominant, horsetail, burr reed, rush, and pondweeds common.

Cumulative Watershed Area: 421 acres

Upstream lakes: 6.3 acres

Undeveloped: 336 acres

Residential: 62 acres

Commercial / Institutional: 6 acres

Trophic State Indicators:

Total Phosphorus: 10 ug/L meso

Chlorophyll a: 1.0 ug/L oligo

Secchi Clarity: 1.2 m eu

Theoretical Water Retention Time: 12 days

Zooplankton Biomass: 15 mg/m²

Fish Catch Rate and Condition: 26 fish/trap; Avg. Length 79 mm; Avg. Condition 1.17

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml):

at inlet to lake: Average 1120, 5 of 7 samples >100, Max. 5400

at outlet from lake: Average 79, 1 of 5 samples >100, Max. 310

Turbidity: 5.2 NTU

Color: 17.4 Pt units

Iron: 811 ug/l

pH: 6.82

Conductivity: 113 umhos/cm

Other: Freshwater mussels (*Anodonta beringiana*) are present in Beaver Lake and downstream. They filter the water, and remove silt particles as well as phytoplankton (microalgae).

Table 3-1D: Dark Lake

Overview: Dark Lake is surrounded by sitka spruce, and lies to the north of a ridge. This shades the lake for much of the fall and winter. The ice melts about two weeks later in Dark Lake than in the other nearby lakes. The watershed above Dark Lake is 86% undeveloped. This is greater than for any of the other lakes except Gertrude Lake at Ft. Abercrombie Park. The water quality is proportionately good, with low levels of turbidity, color, iron, phosphorus, and fecal coliforms. The lake is comparatively deep, and the retention time is moderate. A moderate zooplankton population is sustained.

Surface Area: 14.4 acres

Average Depth: 8.9 feet

Maximum Depth: 15.2 feet

Sept. Weed Cover: 10%; pondweed scattered, yellow lily in patches.

Cumulative Watershed Area: 495 acres

Upstream lakes: 17 acres

Undeveloped: 396 acres

Residential: 64 acres

Commercial / Institutional: 6 acres

Trophic State Indicators:

Total Phosphorus: 9 ug/L oligo

Chlorophyll_a: 0.6 ug/L oligo

Secchi Clarity: 2.7 m eu

Theoretical Water Retention Time: 23 days

Zooplankton Biomass: 190 mg/m²

Fish Catch Rate and Condition: 7.7 fish/trap; Avg. Length 69 mm; Avg. Condition 1.21

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml): Average 18, 0 of 5 samples >100, Max. 60

Turbidity: 3.2 NTU

Color: 15.3 Pt units

Iron: 576 ug/l

pH: 6.73

Conductivity: 111 umhos/cm

Table 3-1E: Island Lake

Overview: Island Lake is the largest and deepest of the lakes studied. 76% of the upstream watershed is undeveloped, so the water quality is good (although not quite as good as Dark Lake), with low levels of turbidity, color, iron, phosphorus, and fecal coliforms. This lake is often used by neighborhood children for swimming. Very high fecal coliform bacteria counts were measured sporadically in the creek near Island Lake Park and at the Island Lake Park beach in the lake. This creek drains the residential, commercial, and industrial areas near Safeway. Coliform counts remained low at the lake outlet. Fecal coliform bacteria monitoring during the summer is recommended to ensure that there is no significant health risk to swimmers.

Surface Area: 39.0 acres

Average Depth: 13.0 feet

Maximum Depth: 30 feet

Sept. Weed Cover: 10%; yellow lily locally abundant, pondweed and burr reed in sparse patches.

Cumulative Watershed Area: 745 acres

Upstream lakes: 29 acres

Undeveloped: 503 acres

Residential: 145 acres

Commercial / Institutional: 34 acres

Trophic State Indicators:

Total Phosphorus: 11 ug/L meso

Chlorophyll_a: 0.9 ug/L oligo

Secchi Clarity: 2.4 m meso

Theoretical Water Retention Time: 60 days

Zooplankton Biomass: 427 mg/m²

Fish Catch Rate and Condition: 11 fish/trap; Avg. Length 75 mm; Avg. Condition 1.13

Water Quality:

Fecal Coliform Bacteria:

inlet near Island Lake Park: Average 440, 6 of 8 samples >100, Max. 1800

outlet from Island Lake: Average 19, 0 of 7 samples >100, Max. 70

Turbidity: 3.9 NTU

Color: 11.3 Pt units

Iron: 431 ug/l

pH: 6.81

Conductivity: 135 umhos/cm

Table 3-1F: Lilly Lake

Overview: Lilly Lake's primary use is as a seaplane base. The municipal airstrip adjoins the lake to the north. Commercial lots adjoin the lake to the east, and residential lots adjoin the lake to the west. The appearance of the lake shore is marred by trash behind some of the commercial lots. The watershed is relatively small relative to the size of the lake, so the water retention time is long compared to most of the other study lakes. Zooplankton are not abundant in Lilly Lake, however. This is inconsistent with the trend in other lakes, where zooplankton abundance tracks with increasing depth and longer retention time. The lake is not particularly nutrient enriched in comparison with Potatopatch Lake (into which it drains) or Mission Lake. Lilly Lake has been stocked with rainbow trout.

Surface Area: 16.5 acres

Average Depth: 4.6 feet

Maximum Depth: 7.5 feet

Sept. Weed Cover: 40%; yellow lily dominant, pondweed abundant submerged, bladderwort abundant, burr reed sparse.

Cumulative Watershed Area: 95 acres

Upstream lakes: 0 acres

Undeveloped: 9 acres

Residential: 40 acres

Commercial / Institutional: 29 acres

Trophic State Indicators:

Total Phosphorus: 11 ug/L meso

Chlorophyll a: 2.0 ug/L oligo

Secchi Clarity: 1.8+ m eu

Theoretical Water Retention Time: 75 days

Zooplankton Biomass: 13 mg/m²

Fish Catch Rate and Condition: Stocked with rainbow trout. 4.2 fish/trap; Avg. Length 81 mm; Avg. Condition 1.04

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml): Average 23, 0 of 6 samples >100, Max. 70

Turbidity: 3.8 NTU

Color: 11.6 Pt units

Iron: 454 ug/l

pH: 6.98

Conductivity: 186 umhos/cm

Other: ADF&G has suggested that a hydrocarbons analysis of some rainbow trout from Lilly Lake might be advisable to check for avgas or fuel oil contamination. Oil slicks and small oil have occasionally affected Lilly Lake in recent years.

Table 3-1G: Potatopatch Lake

Overview: Potatopatch Lake is chronically turbid, and the unattractive brown color of the water was one of the motivators behind the formation of the Clean Lakes for Kodiak group. The Potatopatch Lake watershed has the least percentage of undeveloped land of all the study lakes except Lower Horseshoe. The lake is quite shallow, and the average water retention time is only 10 days. Zooplankton biomass is very small, but fish trapping results indicated high relative abundance and the best growth of stocked silver salmon in comparison with the other lakes. Turbidity values track well with iron concentrations in the lake, and they may reflect precipitated high concentrations of iron in water from the Baranof Park area, which was formerly a lake bed and town dump. Alternatively, the high turbidity may be caused by non-point silt inputs from the watershed or by wind action on the shallow soft bottom sediments. Further study is needed to determine which is the dominant cause.

Surface Area: 12.7 acres

Average Depth: 2.5 feet

Maximum Depth: 4.3 feet

Sept. Weed Cover: 60%; pondweeds dominant, burr reed common NE end, yellow lily sparse clumps E shore, ditch grass (*Ruppia maritima*) common near outlet.

Cumulative Watershed Area: 298 acres

Upstream lakes: 17 acres

Undeveloped: 35 acres

Residential / Parks: 143 acres

Commercial / Institutional: 91 acres

Trophic State Indicators:

Total Phosphorus: 43 ug/L eu

Chlorophyll *a*: 4.7 ug/L meso

Secchi Clarity: 0.5 m eu

Theoretical Water Retention Time: 10 days

Zooplankton Biomass: 1 mg/m²

Fish Catch Rate and Condition: 21 fish/trap; Avg. Length 98 mm; Avg. Condition 1.10

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml): Average 157, 2 of 6 samples >100, Max. 470

Turbidity: 15.3 NTU

Color: 16.2 Pt units

Iron: 1170 ug/l

pH: 7.44

Conductivity: 530 umhos/cm

Other: The elevation of the bottom of the outlet culvert is 9.7 feet above mean lower low water (MLLW). Lake level is about +10.4 MLLW. Inspection of the tide tables shows that seawater can flow into the lake on about 20 high tides per year. Seaweed was seen in the lake on several occasions, and conductivity, calcium, magnesium, and alkalinity are elevated.

Table 3-1H: Mission Lake

Overview: Mission Lake is high in nutrients and very productive. The lake is shallow, and it has been heavily colonized by aquatic weeds. Seawater frequently enters the lake when the tide gate gets clogged by debris. An overflowing sewer line has discharged raw sewage to the lake for brief periods in 1994, 1995, and 1997. The water retention time is about 22 days. Zooplankton biomass is very low, but primary production in the form of aquatic weeds and microalgae blooms is high. Excessive production could lead to oxygen depletion following a period of sunny days with little wind. Fish trapping efforts in 1995 indicated fast growth of silver salmon compared with that in the Island Lake watershed. Some outmigrating smolt are lost to predators in the intertidal zone when they leave the lake at low tide.

Surface Area: 23.5 acres

Average Depth: 2.9 feet

Maximum Depth: 4.5 feet

Sept. Weed Cover: 80%; pondweeds dominant, ditch grass (*Ruppia maritima*) common near the tide gate.

Cumulative Watershed Area: 281 acres

Upstream lakes: 0 acres

Undeveloped: 123 acres

Residential / Parks: 90 acres

Commercial / Institutional: 47 acres

Trophic State Indicators:

Total Phosphorus: 33 ug/L eu

Chlorophyll a: 4.5 ug/L meso

Secchi Clarity: 0.8 m eu

Theoretical Water Retention Time: 22 days

Zooplankton Biomass: 1 mg/m²

Fish Catch Rate and Condition: 5.9 fish/trap; Avg. Length 91 mm; Avg. Condition 1.10

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml):

Inlet near Horn & Burch residences: Average 243, 3 of 7 samples >100, Max. 800

Outlet from Mission Lake: Average 34, 1 of 7 samples >100, Max. 130

Turbidity: 8.2 NTU

Color: 18.0 Pt units

Iron: 731 ug/l

pH: 3.34

Conductivity: 1406 umhos/cm

Other: The elevation of the rim of the outlet weir is 8.9 feet above mean lower low water (MLLW). Lake level is about +9.0 MLLW. Inspection of the tide tables shows that sea level is higher than lake level on about 160 high tides per year. The tide gate is in need of repair and continuing maintenance if the lake is to remain freshwater.

Table 3-1I: Gertrude Lake (Ft. Abercrombie State Park)

Overview: Gertrude Lake is within the boundaries of Fort Abercrombie State Park. There is very little development within the watershed, and that is reflected in the excellent water quality. Gertrude Lake is relatively deep, so the water retention time is over 100 days. The undeveloped watershed and long retention time produce the highest zooplankton biomass and the lowest turbidity and iron of all the study lakes. Gertrude Lake is popular with swimmers.

Surface Area: 18.7 acres

Average Depth: 13.0 feet

Maximum Depth: 28 feet

Sept. Weed Cover: 5%; yellow lily dominant; pondweeds, burr reed, bladderwort common; quillwort sparse

Cumulative Watershed Area: 200 acres

Upstream lakes: 0 acres

Undeveloped: 181 acres

Residential / Parks: 0 acres

Commercial / Institutional: 0 acres

Trophic State Indicators:

Total Phosphorus: 10 ug/L meso

Chlorophyll_a: 0.8 ug/L oligo

Secchi Clarity: 4.3 m meso

Theoretical Water Retention Time: 111 days

Zooplankton Biomass: 884 mg/m²

Fish Catch Rate and Condition: Stocked with rainbow trout. 1.7 fish/trap; Avg. Length 71 mm; Avg. Condition 1.18

Water Quality:

Fecal Coliform Bacteria (cfu/100 ml):

Inlet to Lake: Average 36, 0 of 3 samples >100, Max. 100

Limno sampling station in lake: 1 sample only, 0 cfu/100 ml

Turbidity: 1.4 NTU

Color: 15.9 Pt units

Iron: 193 ug/l

pH: 6.93

Conductivity: 194 umhos/cm

Table 4-1A

Kodiak Urban Lakes - Individual watershed acreage and land use.

INDIVIDUAL WATERSHED AREAS (acres)

	Lake Surface	Undeveloped Residential	Commercial Institutional	Park	TOTAL		
Upper Horseshoe	2.2	1.4	5.5		9		
Lower Horseshoe	1.0	2.3	23.9		27		
Upstream Selief		250			250		
Beaver Lake	14	82	33	6	135		
Dark Lake	14	60	2		76		
Island Lake	39	107	81	28	254		
Lilly Lake	17	9	40	29	95		
Potatopatch Lake	13	26	89	41	21	14	204
Mission Lake	24	123	80	37	10	10	282

INDIVIDUAL WATERSHED LAND USE (percent)

	Lake Surface	Undeveloped Residential	Commercial Institutional	Park	TOTAL		
Upper Horseshoe	24.1	15.8	60.1		100.0		
Lower Horseshoe	3.7	8.5	87.9		100.0		
Upstream Selief		100.0			100.0		
Beaver Lake	10.6	60.7	24.3	4.5	100.0		
Dark Lake	18.9	78.9	2.3		100.0		
Island Lake	15.3	41.9	31.8	11.0	100.0		
Lilly Lake	17.4	9.5	42.1	30.5	100.0		
Potatopatch Lake	6.2	12.6	43.6	20.4	10.3	6.9	100.0
Mission Lake	8.3	43.5	28.3	13.0	3.6	3.4	100.0

NOTE: In multi-lake systems, areas and percentages for downstream lakes exclude all upstream lakes and their watersheds.

Table 4-1B

Kodiak Urban Lakes - Cumulative watershed acreage and land use.

CUMULATIVE WATERSHED AREAS (acres)

Lake	Undeveloped	Commercial	Park	TOTAL
Surface	Residential	Institutional		
Upper Horseshoe	2.2	1.4	5.5	9
Lower Horseshoe	3.2	3.7	29	36
Upstream Selief		254	29	283
Beaver Lake	18	336	62	422
Dark Lake	32	396	64	498
Island Lake	71	503	145	752
				0
Lilly Lake	17	9	40	95
Potatopatch Lake	29	35	129	298
				0
Mission Lake	24	123	80	282
				37
				10
				10

CUMULATIVE WATERSHED LAND USE (percent)

Lake	Undeveloped	Commercial	Park	TOTAL
Surface	Residential	Institutional		
Upper Horseshoe	24.1	15.8	60.1	100.0
Lower Horseshoe	8.8	10.3	80.9	100.0
Upstream Selief	0.0	89.6	10.4	100.0
Beaver Lake	4.2	79.7	14.8	100.0
Dark Lake	6.4	79.5	12.8	100.0
Island Lake	9.4	66.8	19.3	100.0
				4.5
Lilly Lake	17.5	9.7	42.3	100.0
Potatopatch Lake	9.8	11.7	43.2	100.0
				23.6
				7.1
				4.7
Mission Lake	8.3	43.5	28.3	100.0
				13.0
				3.6
				3.4

NOTE: In multi-lake systems, areas and percentages for downstream lakes include all upstream lakes and their watersheds.

Table 4-3
Surface Temperature, Surface Oxygen Concentration,
and Secchi Clarity

TEMPERATURE (C)							
	Mar 8,20	May 3	June 22	July 30	Aug 29	Oct 16	AVG.
UHshoe	0.0	10.0	13.0	14.9	15.2	7.0	10.0
LHshoe	0.0	9.5	13.0	14.7	15.4	6.0	9.8
Beaver	0.0	9.5	12.5	14.6	14.2	6.5	9.6
Dark	0.0	8.0	16.3	15.7	14.3	6.7	10.2
Island	0.0	9.5	15.5	15.7	15.1	7.0	10.5
Lilly	0.0	10.5	13.7	16.0	15.2	6.5	10.3
Ppatch	2.0	10.0	12.9	16.0	13.8	7.5	10.4
Mission	2.0	13.0	13.2	16.2	14.1	7.0	10.9
Abercrom	1.0	8.0	14.5	16.2	15.6	7.0	10.4

OXYGEN (mg/l)							
	Mar 8,20	May 3	June 22	July 30	Aug 29	Oct 16	AVG.
UHshoe	4.3	11.3	10.6	10.1	9.2	12.2	9.6
LHshoe	8.2	11.4		10.1	9.8	12.5	
Beaver	10.6	11.4	10.7	10.1	10.2	12.3	10.9
Dark	9.2	11.8	9.7	9.8	10.6	12.3	10.6
Island	10.4	11.4	9.9	9.8	10.4	12.2	10.7
Lilly	8.6	11.1	10.3	9.9	10.1	12.3	10.4
Ppatch	12.2	11.3	10.6	9.9	10.2	12.0	11.0
Mission	8.4	10.5	10.5	9.9	9.9	12.2	10.2
Abercrom	9.6	11.8	10.1	9.8	10.1	12.2	10.6

SECCHI CLARITY (meters)							
	May 3	June 22	July 30	Aug 29	Oct 16	AVG.	
UHshoe	0.5	1.0	1.0	1.0	1.0	0.9	
LHshoe	1.0	0.3	0.3	0.3	0.2	0.4	
Beaver	1.5	1.3	1.6	0.8	1.0	1.2	
Dark	1.5	2.8	3.3	4.0	1.8	2.7	
Island	1.5	2.7	3.0	3.0	2.0	2.4	
Lilly	2.0	1.5	2.0	2.0	1.5	1.8	
Ppatch	0.6	0.5	0.5	0.5	0.5	0.5	
Mission	1.2	0.8	0.7	0.8	0.6	0.8	
Abercrom	4.3	4.5	5.0	4.5	3.0	4.3	

Table 4-5A

Limnological Water Quality Summary

Lake	Specific conductance (umhos/cm)	pH (Units)	Alkalinity (mg/L)	Turbidity (NTU)	Color (Pt units)	Calcium (mg/L)	Iron (ug/L)
Upper Horseshoe	150	6.76	37	7.3	24.8	14.5	2673
Lower Horseshoe	199	6.94	45	48.4	41.8	17.4	4462
Beaver	113	6.82	24	5.2	17.4	9.0	811
Dark	111	6.73	22	3.2	15.3	8.1	576
Island	135	6.81	25	3.9	11.3	10.7	431
Lilly	186	6.98	28	3.8	11.6	10.3	454
Potatopatch	530	7.44	40	15.3	16.2	16.4	1170
Mission	1406	8.34	45	8.2	18.0	21.9	731
Abercrombie	194	6.93	22	1.4	15.9	8.0	193

Table 4-5B

Limnological Water Quality Summary

Lake	Total-P (ug/L P)	Total Kjeldahl nitrogen (ug/L N)	Ammonia (ug/L N)	Nitrate+ nitrite (ug/L N)	Organic carbon (ug/L)	Chloro-phyll a (ug/L)	Phaeo-phytin a (ug/L)	Zooplankton biomass (mg/m ²)	Hydraulic Detention Time (days)
Upper Horseshoe	16	441	36	22	871	1.8	1.1	216	44
Lower Horseshoe	55	475	60	113	1291	1.1	0.8	7	4
Beaver	10	233	13	75	300	1.0	0.5	15	12
Dark	9	212	16	86	187	0.6	0.3	190	23
Island	11	208	13	99	211	0.9	0.4	427	60
Lilly	11	313	20	56	322	2.0	0.7	13	75
Potalopatch	43	487	25	68	659	4.7	1.9	1	10
Mission	33	437	4	8	659	4.5	1.3	1	22
Abercrombie	10	237	6	6	233	0.8	0.3	884	111

Table 4-6, Limnology Sample Elemental Analyses (page 1 of 2)

	Limit of Detection (ug/liter)	EPA aquatic life criterion (ug/liter)		Upper	Lower	Beaver	Dark	Island	Lilly	Potato-	Mission	Gertrude	
		Horseshoe	Horseshoe	patch									
Lithium	1			9	37	25	27	33	44	50	41	14	Lithium
Boron	1	300		2	15	4	8	1	9	50000	78000	22000	Boron
Sodium				12000	16000	11000	12000	15000	22000	50000	9600	3100	Sodium
Magnesium				2500	5600	2500	2800	4100	4300	6200	9600	3100	Magnesium
Aluminum				51	400	98	85	79	53	200	140	24	Aluminum
Silicon				640	2720	3070	3270	2700	1300	2240	3030	2970	Silicon
Phosphorus	50			110	850	1200	60	70	120	70	4800	1300	Phosphorus
Potassium					3200	1500	1500	2500	3100	3500	4800	1300	Potassium
Calcium				16000	38000	13000	13000	21000	24000	16000	17000	7200	Calcium
Scandium	0.2			0.6	1.9	1.1	1.4	1.9	2.1	0.4	0.3		Scandium
Titanium				2.6	8.6	2.9	4.4	3.9	4.2	2.5	3	1.4	Titanium
Vanadium	0.2			0.5	1.3	0.4	0.5	0.8	0.5	0.5	0.6	0.3	Vanadium
Chromium		11/1/20		0.4	1.8	0.7	0.5	0.7	1	0.6	0.6		Chromium
Manganese				140	730	280	210	300	700	260	130	24	Manganese
Iron		1000		2200	6200	1000	690	620	710	960	580	150	Iron
Cobalt	0.07			0.9	3	0.99	0.56	0.62	0.6	0.88	0.52		Cobalt
Nickel	0.5			1.7	7	3.4	2.9	3.8	5.2	2.8	1.1		Nickel
Copper	0.5			0.5	6	1.5	1.6	2.7	4.8	1	5		Copper
Zinc	1				37	14	1.6	7	13	20			Zinc
Gallium	0.1				0.2	0.1			0.1				Gallium
Germanium	0.1				0.4		0.2	0.3	0.2				Germanium
Arsenic	1	50		1	3		1		260	1	2	63	Arsenic
Bromine				120	290	79	88	130	260	240	320		Bromine
Selenium	1	10/7/60			11	6	6	15	15	1			Selenium
Rubidium				0.6	1.8	0.7	0.8	1.3	1.7	1.3	1.5	0.6	Rubidium
Strontium				92	210	81	83	130	140	110	120	55	Strontium
Yttrium	0.05			0.08	0.33	0.11	0.11	0.13	0.06	0.05	0.06		Yttrium

Table 4-6, Limnology Sample Elemental Analyses (page 2 of 2)

	Limit of Detection (ug/liter)	EPA aquatic life criterion (ug/liter)		Upper Horseshoe	Lower Horseshoe	Beaver	Dark	Island	Lilly	Potato-patch	Mission	Gertrude	
		aquatic life	criterion										
Molybdenum	0.1												Molybdenum
Silver	0.05	0.12			0.06	0.1		0.2	0.11	0.2	0.2		Silver
Palladium	0.05				0.05				0.06				Palladium
Cadmium	0.1	0.66			0.1	0.1	0.1		0.2	0.1	0.2	0.1	Cadmium
Tin	0.1				0.2				0.1	0.1	0.2	0.1	Tin
Tellurium	0.2				0.2	0.3	0.3		0.4	0.4	0.2	0.1	Tellurium
Iodine				70	220	42	40	80	240	98	110	16	Iodine
Cesium	0.05		0.07		0.23	0.09	0.11	0.18	0.24	0.17	0.13		Cesium
Barium		1000	13		37	13	13	16	9.1	9.3	5.4	6.4	Barium
Lanthanum	0.05				0.11		0.05	0.05		0.1			Lanthanum
Cerium	0.05		0.11		0.28	0.08	0.09	0.08		0.07	0.09		Cerium
Praseodymium	0.05				0.05								Praseodymium
Neodymium	0.1								0.1				Neodymium
Samarium	0.05				0.07								Samarium
Gadolinium	0.05								0.05				Gadolinium
Dysprosium	0.05				0.05		0.05						Dysprosium
Erbium	0.05				0.05			0.05	0.07				Erbium
Ytterbium	0.05	0.012			0.3		0.3	0.4	0.2				Ytterbium
Mercury	0.1		0.44		1.8	0.98	0.33	0.42	1.1	1.1	0.57	0.35	Mercury
Lead										0.03	0.03		Lead
Uranium	0.02				0.02								Uranium

- Notes:
- 1) All concentrations are given in units of ug / liter (equivalent to parts per billion).
 - 2) All samples were collected during the late July 1995 sampling event.
 - 3) The EPA aquatic life criteria for Chromium are 11 ug/l for the hexavalent state and 120 ug/l for the trivalent state.
 - 4) The EPA aquatic life criteria for Selenium are 10 ug/l for the Selenite ion and 760 ug/l for the Selenate ion.
 - 5) Many of the aquatic life criteria are hardness dependent. Values corresponding to 50 mg/l hardness as CaCO3 are used above.
 - 6) Blank detection limits are given where all samples were above detection limits. Blank EPA aquatic life criteria are given where there is none. Blank sample concentrations are given where the element was present at a concentration below detection limits.