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WATER-QUALITY DATA FOR POTTER MARSH, ANCHORAGE, ALASKA

by

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INTRODUCTION

Potter Marsh is a 564-acre wetland located 10 miles south of downtown Anchorage (fig. 1). The marsh was created in 1917 when the Alaska Railroad built a railroad embankment on the tidal flats between Rabbit Creek and Potter Creek. Culverts at the north end of the marsh allow saltwater to enter during high tide and streamflow to exit during low tide. Tidal effects in the marsh are limited to a relatively small area around the culverts. A combination of abundant emergent and submergent vegetation and open water provides excellent waterfowl feeding and nesting habitat. Peak bird populations are viewed during the spring and fall migration. The marsh also provides habitat for wetland wildlife such as muskrat and beaver, and rearing habitat for salmon fry and other fish species. Easy access along the New Seward Highway makes Potter Marsh the most popular viewing area of wetland wildlife in the Anchorage area.

Potter Marsh became part of Potter Point State Game Refuge in 1971. A workshop in 1983 recommended a planning task force be established to develop a comprehensive management plan for Potter Marsh (National Audubon Society and Anchorage Audubon Society, 1983). Subsequently, the marsh became part of Anchorage Coastal Wildlife Refuge in 1988. A draft management plan for the refuge was written by the Alaska Department of Fish and Game (1990). It provides guidance on management of the marsh and Anchorage coastal wetlands, but does not include the entire Potter Marsh watershed.

The Potter Marsh watershed encompasses approximately 25 square miles and includes the Rabbit Creek, Little Rabbit Creek, and Little Survival Creek drainage basins. Several hydrologic investigations were undertaken in the 1980's in response to increased land development in the watershed. The Alaska Department of Fish and Game (1982) described surface water hydrology. The U.S. Geological Survey collected hydrologic data for Rabbit Creek, Little Rabbit Creek, and Little Survival Creek (Still and Cosby, 1989; U.S. Geological Survey, 1990). Geologic and hydrologic characteristics of the Potter Marsh area were presented in Schmoll and Emanuel (198 1) and Emanual and Cowing (1982). Ott Water Engineers (1985) prepared a stormwater drainage plan for the Little Rabbit Creek to Potter Creek area. Munter (1987) observed that 78 percent of the water in the marsh is sustained by direct precipitation, surface water and groundwater inputs from the Little Survival Creek drainage basin, and several intermittent streams between Little Rabbit Creek and Potter Creek (fig. 2). This 'south Potter Marsh' drainage basin maintains the water level in the portion of the marsh that is prime habitat for wetland birds, wildlife, and fish.

Recent concerns about new land development plans in the watershed have prompted municipal government, state and federal agencies, and the Alaska Center for the Environment to initiate a coordinated hydrologic study of the watershed and a planning effort for a watershed management plan. To support this effort, this report presents previously unpublished water-quality data collected by the Alaska Department of Natural Resources in March 1984. The objective of the investigation is to document water quality in the southern part of the marsh during the winter.

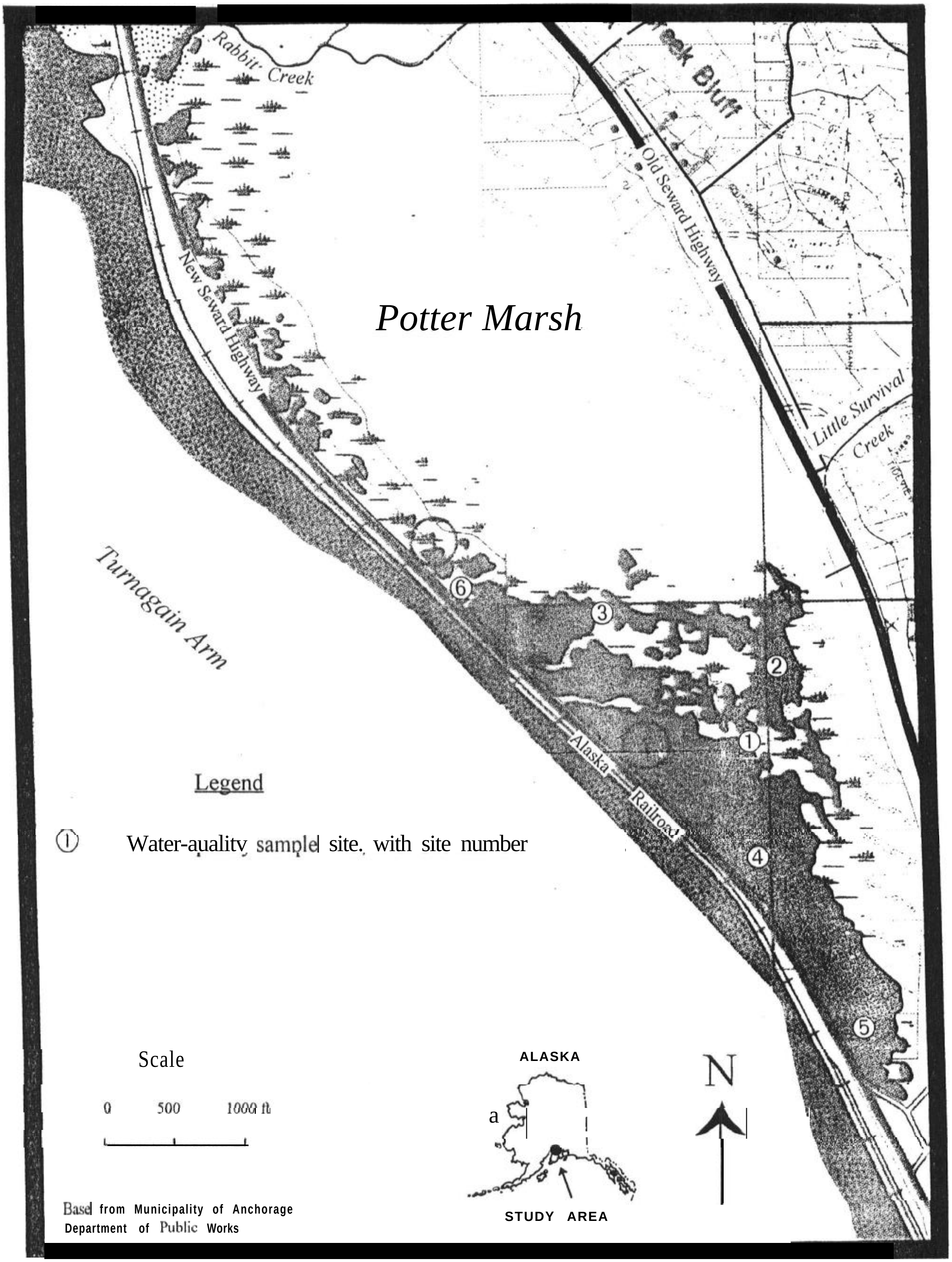
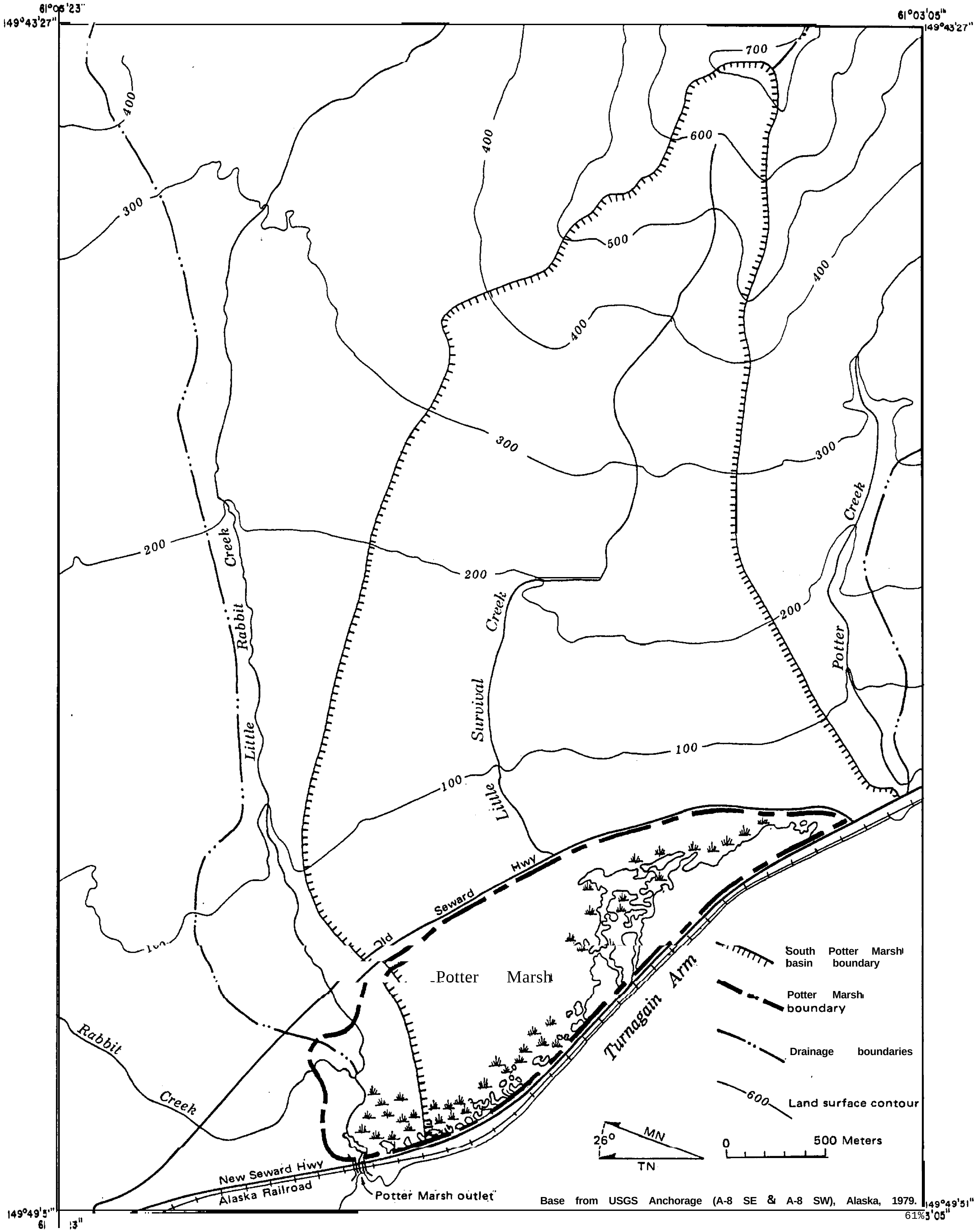


Figure 1. Location of water-quality sample sites, Potter Marsh, Anchorage, Alaska.



Base from USGS Anchorage (A-8 SE & A-8 SW), Alaska, 1979.

Figure 2. Delineation of South Potter Marsh basin boundary. [Modified from Munter, 1987].

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The author thanks James A. Munter, formerly with the Alaska Department of Natural Resources, who assisted with data collection. Jim Vohden of the Alaska Department of Natural Resources, Alaska Hydrologic Survey, reviewed the report.

METHODS

Water-quality sampling sites are shown on figure 1. An ice bar was used to make a sampling hole at sites 2, 3, 4, and 5. Sites 1 and 6 were not ice-covered and were sampled from the edge of ice. In-situ water temperature, dissolved oxygen, and specific conductance were measured with a Model 404 1 Hydrolab that was pre- and post-calibrated according to the instrument user guide. On-site pH was measured with an Orion pH meter. Alkalinity was measured on-site by titrating an untreated 100-ml sample with 0.01639N sulfuric acid to an endpoint of pH 4.5 (U.S. Environmental Protection Agency, 1983).

No quality assurance plan was written for the project. Sample collection and handling procedures of the U.S. Geological Survey (1977) were generally followed. Grab samples were taken at the water depths shown in table 1. Samples for major ion analysis were immediately filtered through a 0.45-µm membrane filter. Samples for total trace metal and trace element analysis were acidified with double-distilled 70 percent nitric acid immediately after collection.

The Alaska Hydrologic Survey water quality laboratory in Fairbanks, Alaska (formerly under the Division of Geological and Geophysical Surveys) performed the major ion analysis. Anatec Laboratories, Inc., in Santa Rosa, California performed the trace metal and element analyses. All samples were analyzed in accordance with the methods of the U.S. Environmental Protection Agency (1983) or American Public Health Association (1980).

RESULTS AND DISCUSSION

On-site water-quality measurements are shown in table 1. The specific conductance measurement is an indicator of ion concentration. Specific conductance ranges from 199 to 539 µS/cm @ 25°C. Wetland waters with specific conductance <800 µS/cm @ 25°C are classified as fresh (Cowardin and others, 1979). The specific conductance of seawater is approximately 50,000 µS/cm @ 25°C. The water at all sites is acidic, ranging from pH 6.3 to 6.6. Alkalinity values range from 70 to 199 mg/L, indicating the water has moderate to good acid-neutralizing capacity. Dissolved oxygen concentrations are low, except for site 2, where a relatively high dissolved oxygen concentration of 11.8 mg/L may be an indicator of surface water inflow from Little Survival Creek (fig. 1).

The results of the major ion and trace element analysis are shown in table 2. The difference between the sum of cations and anions ranges from <1 to 5.7 percent, which indicates there

Table 1. On-site water-quality measurements taken in Potter Marsh, March 23, 1984.

Site No.	Site Description	Water Temperature (°C)	pH (units)	Specific Conductance (µS/cm @25 °C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (percent saturation)	Alkalinity (mg/L as $CaCO_2$)
1	Water depth = 2.3 ft Open water; ice skim Sampling depth = 0.25 to 1.2 ft	3.0	6.3	210	5.6	42	72
2	Water depth = 3.8 ft Ice thickness: 1.7 ft Sampling depth = 2 A	3.0	6.6	208	11.8	89	70
3	Water depth = 1 ft Sampling depth = 0.4 A	0.9	6.3	199	5.0	36	73
4	Water depth = 2.4 A Ice thickness = 1.5 ft	0.0	6.5	433	6.8	47	em
5	Water depth = 2.7 ft Ice thickness = 1.3 ft Sampling depth = 2 ft	2.2	6.9	539	6.4	47	199
6	open water Sampling depth = 1 ft	0.8	6.3	291	5.0	36	106

em = erroneous measurement.

are no important errors in reported concentrations for major ions. Calcium is the predominant cation (positively charged ion), whereas bicarbonate is the predominant anion (negatively charged ion). A trilinear diagram shows the percentages of total cations and anions, in milliequivalents per liter (meq/L), for each site (fig. 3). The water type is calcium bicarbonate at sites 1, 2, 3, and 5, and calcium-sodium bicarbonate at site 6. The water at site 4 is not typed because an error was made in the alkalinity measurement.

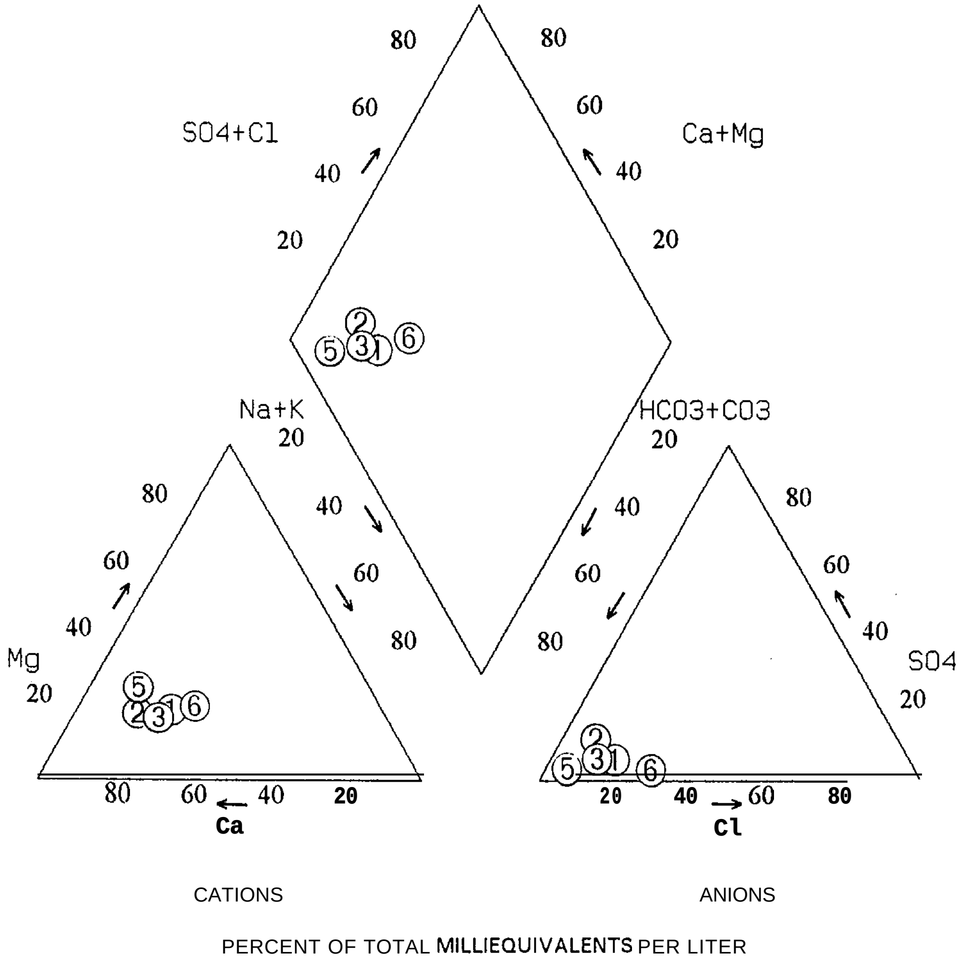
Most trace element concentrations are low and similar among sites (table 2). Total concentrations of aluminum, boron, and strontium range up to several hundred micrograms per liter (µg/L). Aluminum concentrations are similar to those measured in Rabbit and Little Rabbit Creeks (U.S. Geological Survey, 1985). Boron and strontium concentrations are moderately high. Iron concentrations range from 400 to 1600 µg/L and manganese concentrations range from 140 to 730 µg/L. Iron and manganese concentrations are inversely related to dissolved oxygen concentration; site 2 had the lowest iron and manganese levels and the highest dissolved oxygen concentration.

A comparison of trace metal concentrations at Potter Marsh with water quality criteria is shown in table 3. Alaska's water quality standard for a specific constituent is based on the most stringent criteria that protects the designated use of the water (Alaska Department of Environmental Conservation, 1996). The designated use of Potter Marsh is growth and

Table 2. Laboratory analytical results for Potter Marsh water, March 23, 1984.

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Major Ions, Dissolved (mg/L)						
Calcium	23.1	22.0	23.8	36.1	53.0	30.0
Magnesium	5.3	4.4	4.8	9.0	14.0	8.0
Sodium	10.1	6.1	8.8	18.3	11.0	20.0
Potassium	1.0	0.6	1.1	1.9	2.0	1.9
Iron	0.3	0.1	0.3	0.9	0.1	0.9
Bicarbonate, field	88	85	89	em	243	129
Chloride	8.9	6.3	8.3	28.0	8.3	30.0
Sulfate	6.5	7.8	6.6	3.5	8.6	4.5
Nitrate (as N)	0.1	0.4	0.2	nd	nd	nd
Sum of Ions						
Cations (meq/L)	2.05	1.75	2.00	nc	4.32	3.08
Anions (meq/L)	1.83	1.74	1.84	nc	4.39	3.08
Error (%)	5.7	<1	4.2	nc	<1	<1
Trace Elements, total (µg/L)						
Aluminum	73	220	180	80	69	100
Antimony	<5	<5	<5	<5	<5	<5
Arsenic	<2	<2	<2	<2	<2	<2
Barium	15	5	15	50	<5	5
Beryllium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron	200	100	80	100	200	<50
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	5	5	<5	<5	5	<5
Copper	<5	<5	<5	<5	<5	<5
Iron	500	400	700	1300	600	1600
Lead	<5	<5	20	<5	25	<5
Manganese	170	140	190	730	420	600
Mercury	<0.05	<0.05	<0.05	0.10	<0.05	<0.05
Nickel	<5	<5	<5	<5	<5	<5
Selenium	<2	<2	<2	<2	<2	<2
Silver	<1	<1	<1	<1	<1	<1
Strontium	150	150	150	260	350	200
Titanium	<20	<20	<20	<20	<20	<20
Vanadium	<10	<10	<10	<10	<10	<10
Zinc	4	4	3	68	5	2
Hardness, Calculated (mg/L as $CaCO_3$)	79	73	79	127	189	108

em = erroneous measurement
nd = not detected
nc = not calculated due to error in bicarbonate alkalinity measurement



EXPLANATION

Symbol	Water Type
①	Calcium bicarbonate
②	Calcium bicarbonate
③	Calcium bicarbonate
⑤	Calcium bicarbonate
⑥	Calcium-sodium bicarbonate

Figure 3. Trilinear diagram of water analyses from five sites at Potter Marsh, March 23, 1984.

Table 3. Comparison of selected total metal concentrations measured at six Potter Marsh sites with water-quality criteria, using criteria for the protection of freshwater aquatic life and wildlife in ADEC (1991). Freshwater criteria and maximum constituent concentrations are in micrograms per liter (μg/L).

Constituent	Criteria Time Period [1]	Criteria Sample Preparation	Freshwater Criteria [2]	Maximum Concentration and site [3]
Arsenic	Instantaneous	Total	50	<2
Cadmium	4-day avg.	Dissolved	0.9 - 1.9	<0.5
Chromium	4-day avg.	Dissolved	11	5 @sites 1, 2 & 5
Copper	4-day avg.	Dissolved	9.0 - 20.4	<5
Lead	4-day avg.	Dissolved	2.1 - 7.2	20 @ site 3 25 @ site 5
Mercury	4-day avg.	Dissolved	0.012	0.10 @ site 4
Nickel	24-hr. avg.	Total-Recoverable	75 -155	<5
Zinc	24-hr. avg.	Total-Recoverable	47	68 @ site 4

[1] Time period upon which the water quality criteria is based.

[2] Criteria for cadmium, copper, lead, and nickel are dependent upon **site-specific** hardness values. See table 2 for hardness values.

Cadmium criteria are calculated with the formula: $e^{(0.7852\,[\ln(\text{hardness})] - 3.490)}$

Copper criteria are calculated with the formula: $e^{(0.8545\,[\ln(\text{hardness})] - 1.465)}$

Lead criteria are calculated with the formula: $e^{(1.273\,[\ln(\text{hardness})] - 4.705)}$

Nickel criteria are calculated with the formula: $e^{(0.76\,[\ln(\text{hardness})] + 1.06)}$

[3] Maximum concentrations shown for comparison purposes only. Measurements do not meet criteria time period and sample preparation condition.

propagation of fish, other aquatic life, and wildlife. Based on this use, the criteria for several metals considers site-specific hardness of the water, sample preparation (dissolved fraction, total fraction, or total-recoverable fraction), and time-dependent (chronic) toxicity (Alaska Department of Environmental Conservation, 1991). Time period and sample preparation associated with the data set in this report do not match water quality criteria conditions listed in table 3 (except for arsenic). Specifically, the dataset in this report (table 2) shows instantaneous readings and total fraction, whereas the criteria specify average readings and dissolved or total-recoverable fraction. Therefore, maximum trace metal concentrations measured in Potter Marsh are shown for comparison purposes only.

Calculated hardness ranges from 73 to 190 mg/L as $CaCO_3$ at the six sites (table 2). Water is classified as moderately hard to very hard (Hem, 1985). Lead concentrations greater than the lead criteria were measured at sites 3 and 5. Mercury and zinc concentrations were greater than their respective criteria at site 4. A possible explanation for elevated metal concentrations is road runoff from the New Seward Highway.

CONCLUSIONS

This report presents a "snap-shot" look at the water quality in the open water areas in the southern part of Potter Marsh during late winter. Water quality parameters are generally similar among sites. Water is fresh, acidic, moderately hard to very hard, and well buffered. Dissolved oxygen concentrations are fairly low, except at site 2. Most trace elements have low concentrations. Lead, mercury, and zinc concentrations exceed water quality criteria at several sites. These metal concentrations are unverified because they are based on a single sample only. Presence of these metals may warrant metal monitoring in the spring during breakup, and summer when waterfowl are present, Turbidity and suspended sediment information in the southern part of the marsh is lacking. Sediment and chemical water quality monitoring during the spring and summer is needed to completely document water quality in the southern part of the marsh.

REFERENCES CITED

Alaska Department of Environmental Conservation, 199 1, Alaska water-quality standards workbook: Alaska Department of Environmental Conservation, Juneau, AK, 17 p., app.

_____, 1996, Alaska water quality standards, 18 AAC 70: Alaska Department of Environmental Conservation, Juneau, Title 18 Alaska Administrative Code, Chapter 70.

Alaska Department of Fish and Game, 1982, Surface hydrology of Potter Marsh: Alaska Department of Fish and Game, Anchorage, AK, 10 p.

_____, 1990, Anchorage coastal wildlife refuge draft management plan: Alaska Department of Fish and Game, Anchorage, AK, 65 p., app.

American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1980, Standard methods for the examination of water and wastes (15"' ed.): American Public Health Association, Washington, D.C., 1134 p.

Cowardin, L.W., Carter, V., Golet, F.C., and LaRoe, E.T., 1979, Classification of wetlands and deepwater habitats of the United States: U.S. Fish and Wildlife Service, FWS/OBS-79/31, Washington, D.C., 131 p.

Emanuel, R.P., and Cowing, D.J., 1982, Hydrogeology for land-use planning — The Potter Creek area, Anchorage, Alaska: U.S. Geological Survey Water Resources Investigations/Open-File Report 82-86, 4 sheets.

Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water (3rd ed.): U.S. Geological survey Water-Supply Paper 2254, 263 p.

Munter, J.A., 1987, Status of hydrogeologic work near Potter Marsh with suggestions for future work: Alaska Division of Geological & Geophysical Surveys Public-Data File Report 87-3, 7 p.

National Audubon Society, and Anchorage Audubon Society, 1983, The future of Potter Marsh: Proceedings of a National Audubon Society and Anchorage Audubon Society sponsored workshop "Toward a comprehensive management plan for Potter Marsh", Anchorage, AK, March 19, 1983.

Ott Water Engineers, 1985, Little Rabbit Creek and Potter Valley storm water drainage plan: Report prepared for Municipality of Anchorage, Department of Public Works, Anchorage, AK, August 1985, 72 p., app.

Schmoll, H.R., and Emanuel, R.P, 198 1, Generalized geologic map and hydrologic properties of Potter Creek area, Municipality of Anchorage, Alaska: U.S. Geological Survey Open-File Report 8 l-l 168, 1 sheet.

Still, P.J., and Cosby, J.M., 1989, Alaska index: streamflow, lake levels, and water-quality records to September 30, 1988: U.S. Geological Survey Open-File Report 89-269, 189 p.

U.S. Environmental Protection Agency, 1983, Methods for chemical analysis of water and wastes: U.S. Enviromnental Protection Agency, Cincinnati, OH, EPA-600/4-79-020.

U.S. Geological Survey, 1977, National handbook of recommended methods for water-data acquisition: U.S. Geological Survey Office of Water Data Coordination, Reston, VA, 2 volumes.

_____, 1985, Water resources data for Alaska, water year 1984: U.S. Geological Survey Water-Data Report AK-84- 1, 358 p.

_____, 1990, Water resources data for Alaska, water year 1989: U.S. Geological Survey Water-Data Report AK-89- 1, 232 p.