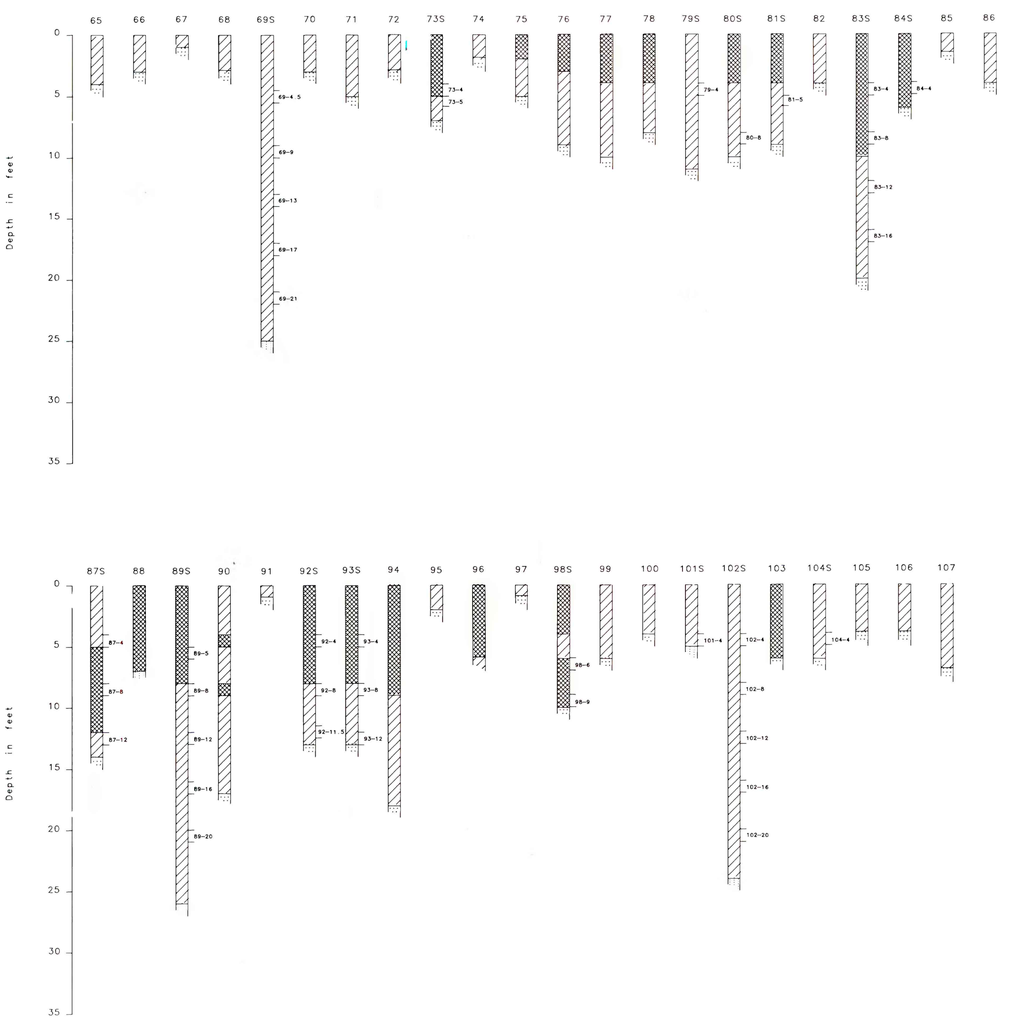
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
STATE OF NEW HAMPSHIRE
Governor's Energy Office and Department of Environmental Services
Dr. Eugene L. Boudette, State Geologist

OPEN-FILE REPORT 96-255

Figure 1.–Stratigraphy of cores taken from wetlands in the Sandown 7.5-minute quadrangle, showing depths of individual samples.



EXPLANATION

Peat, ash content generally less than 25% dry weight maximum for commercial quality peat.

Clayey peat and peaty clay.

Silt and clay with minor sand.

Sand with minor silt.

69S core number

Sample number showing depth in feet (core number–depth in feet)

Introduction

Wetlands within the study area were visited by the authors during the spring of 1989 as part of an ongoing collaborative effort between the U.S. Geological Survey and the State of New Hampshire to study wetlands and associated peat resources within the State of New Hampshire. The intent of this study was to identify the potential for peat resources, and to provide interpretations of the areal and vertical extent of the various organic and inorganic materials present within these wetlands. Cores were taken and samples were collected in order to further the understanding of relationships between organic and inorganic components within the wetlands to adjacent surficial materials and bedrock.

The wetlands delineated on this map are areas of ground saturated long enough during each year for organic material to accumulate or for chemical changes resulting from wetness to occur in the mineral soil. The presence of these organic accumulations and chemical alteration occurrences identify the soil as hydric. In addition, the wetlands support a vegetation cover composed of swamp, marsh or bog heath plants identified as hydrophytic. These soil and vegetation criteria have been accepted by the U.S. Army Corps of Engineers (Federal Manual, 1989) as the basis for delineating wetlands. Wetlands delineated on the National Wetland Maps prepared by the U.S. Fish and Wildlife Service include the hydrologic, hydrophytic plant and hydric soil criteria, and also identify and classify water bodies and areas of ground flooded by man-made construction as wetlands. Such man-made wetlands are not included on this map.

Geologic Setting

The surficial geology within the study area and nearby regions, as described by Koteff and Moore (1994) and Gephart (1987) is made up largely of the glacial products of the late Wisconsinan Laurentide ice sheet. These include glaciomarine, glaciolacustrine, and glaciofluvial deposits consisting of poorly to well sorted and stratified clay, silt, sand, and gravel. The most widespread surficial deposit is till consisting of poorly sorted mixtures of clay, silt, sand, pebbles, cobbles, and boulders. There are few bedrock exposures within the study area.

Sampling and analytical methods

Core samples were taken at 43 different sites within the study area to determine the thickness of the various materials comprising the wetland. The authors were assisted in the field by James I. Marlowe III of the U.S. Geological Survey. A Davis sampler, a 2cm-diameter by 25cm-long core of sample from specified depths, was used. The core samples were described to construct stratigraphic profiles (figure 1), and 38 samples were taken from 15 of the cores for geochemical and quality analyses (tables 1 and 2). Instrumental neutron activation analysis (INAA) was done on whole dry samples to determine elemental composition (table 1). Moisture was determined as received, pH was determined by dispersal in water, and ash, total sulfur, and Hg were determined on dry samples (table 2).

Peat Resources

Peat is a light- to dark-brown or black residuum formed by the partial decay and disintegration of marsh, fen, swamp, or bog plants. The texture of peat may be (1) fibrous-matted material composed of mosses, ferns, grasses, rushes, reeds, sedges, and woody material from trees and shrubs, (2) finely-divided plant material so decomposed that their biological identity is lost, or (3) non-fibrous, plastic, colloidal, and macerated material deposited at the bottom of lakes or other bodies of water.

Commercial quality peat is defined by The American Society for Testing Materials (ASTM) as containing an ash content of not more than 25 percent on an air-dried basis. Peat should be at least 5 feet thick to be considered as a possible resource.

Because peat is derived from different types of vegetation and may contain different amounts and types of mineral matter, the properties and composition of peat can vary considerably in different deposits and even among different parts of the same deposit. The principal factors that determine the commercial value of peat are water-holding capacity, organic and ash contents, fiber content, sulfur content, and acidity.

The Sandown 7.5' quadrangle contains a total estimated resource potential of 1,311,700 tons of air-dried peat (table 3). This value is the summation of the estimated tonnages of air-dried peat calculated for each individual wetland containing a minimum thickness of 5 feet of commercial-grade peat. If more than one core was taken from a wetland, the peat thickness shown is the average (table 3.) Tonnages were estimated by multiplying the peat thickness of a wetland by the size of the wetland, and the resulting volume was multiplied by 200 tons of air-dried peat per acre-foot. It should be noted that these estimates are ased upon a minimal number of cores taken, and may be overstated.

Other units described on the map delineating organic materials include clayey peat and peaty clay. Clayey peat refers to a sample which generally contains more peat than inorganic material by weight on a dry basis, whereas peaty clay refers to a sample which generally contains more inorganic material than peat by weight on a dry basis. The clayey peat and peaty clay units contain significantly higher levels of ash than the peat units.

Discussion

The stratigraphic development of the organic and inorganic materials below the wetland surface is controlled by a variety of factors making up the overall setting of the wetland. The shape of the basin may influence the thickness of the materials in the wetland, and the type and structure of the adjacent rock materials may influence the ash and elemental content of the organic materials below the wetland surface. Ground and surface water regimes will also influence ash and elemental content.

Wetlands within the Sandown 7.5' quadrangle are within basins in which topography and geomorphology are controlled largely by glacial materials. Generally, the wetlands fill topographic lows. Peat with ash content <25% generally overlies peaty clay and clayey peat, suggesting a decrease in detrital input over time. Overall, more wetlands containing commercial quality peat and peaty materials are found in the southwest part of the study area, where glacial till is predominant.

Trace element concentrations generally increase with increasing ash content; however, there appear to be no systematic geochemical anomalies for the elements analyzed (table 1). Four samples (93-8, 98-9, 102-4, and 102-12) contain detectable gold (table 1),.

Cores from which multiple samples were taken show that ash content generally increases with depth (table 2). For all samples, the total sulfur content ranges from 0.09% to 11% (table 2).

References

American Society for Testing and Materials, 1969, D2607-69, Standard classification of peats, mosses, humus, and related products: 1916 Race St., Philadelphia, Pa., 19103, 1p.

Cowardin, L.M., 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 Report FWS/OBS-79/31, p.1-103.

Federal manual for identifying and delineating jurisdictional wetlands, 1989, Federal Interagency Committee for Wetland Delineation, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, D.C., Cooperative Technical Publication, 76pp.

Gephart, Richard, 1987, Surficial geological map of the Sandown quadrangle, New Hampshire...

Koteff, Carl, and Moore, R.B., 1994, Surficial geologic map of the Kingston quadrangle, Rockingham County, New Hampshire: U.S. Geological Survey Geologic Quadrangle Map GQ-1740. Scale 1:24,000.

Table 1.-Elemental analyses of core samples by instrumental neutron activation analysis, all values are in parts per million except where noted.

SAMPLE NUMBER	Na(%)	K(%)	Sc	Cr	Fe(%)	Co	Ni	Zn	As	Se	Br	Rb	Sr	Sb	Cs
69-4.5	0.314	0.36	2.43	6.9	0.28	2.61	<7	20.7	8.4	1.04	40.3	12.6	78	0.104	0.89
69-9	0.33	0.41	3.01	11.6	0.634	4.34	<9	34	9.2	<0.3	33.2	14.5	<120	0.091	1.26
69-13	0.259	<0.5	3.41	10.8	0.829	8.71	16	75.2	13.4	<1	41	10.1	<90	<0.06	1
69-17	0.39	<0.7	5.22	17.1	1.45	12.4	24	113	17	1.4	47	24.8	68	0.21	1.45
69-21	1.23	0.91	6.49	28.7	1.84	6.06	24	82	11.9	<2	9.6	67	131	<0.1	3.65
73-4	0.024	0.043	0.88	4.8	1.13	3.46	23	26.5	12.1	1.59	37.4	<5	76	<0.2	0.163
73-5	0.335	<0.4	3.65	20	0.568	4.21	31	40.1	4.7	1.4	47	15.8	78	0.09	0.9
79-4	0.445	0.51	2.57	13.2	0.348	3.1	<16	32.5	2.94	1	32.9	16.3	56	<0.09	1.81
80-8	0.127	0.137	2.4	10.3	0.667	5.3	14	50	9.2	1.35	49.9	8.8	72	<0.04	0.65
81-5	0.697	0.73	3.18	19.3	0.509	4.59	20	48.4	4.8	1.3	23.6	25.5	88	<0.3	1.58
83-4	0.022	<0.03	0.427	1.42	0.05	0.67	4.9	12.2	2.75	0.86	32.2	<3	71	<0.06	0.038
83-8	0.026	0.041	0.539	2.12	0.115	0.683	6.4	10.3	2.49	0.67	46	<3	42	0.047	0.081
83-12	0.279	<0.6	2.31	13.4	0.506	3.5	14.3	35	6.7	0.72	53	12.7	49	0.092	0.76
83-16	0.572	0.55	5.02	26.7	1.11	6.99	26	54	12.2	1.2	51	27.5	83	0.135	1.4
84-4	0.091	0.082	1.119	7.9	8.18	3.77	<23	29	65.9	<0.8	34.6	<10	<40	<0.1	0.66
87-4	0.302	0.34	1.91	13.4	0.422	2.47	13	21.9	7.5	0.94	41	13.4	47	<0.1	1.19
87-8	0.017	0.038	0.69	2.85	0.213	0.546	6.9	11	3.86	1.24	30.1	<3	58	0.069	0.067
87-12	1.37	0.74	5.58	39.8	1.47	7.17	34	48.1	7	<1	3.6	69.7	149	<0.1	3.13
89-5	0.24	0.25	1.98	11.9	0.222	2.1	<15	26.6	4.84	0.8	19.3	12.5	78	<0.05	1.47
89-8	0.283	0.34	2.12	13.6	0.33	3.59	<21	31.5	6.4	1.06	26.1	12.8	87	<0.2	1.32
89-12	0.153	<0.7	2.02	13.3	0.453	4.15	9.3	31.2	5.8	1.17	42	9.1	51	<0.05	1.39
89-16	0.224	<0.7	2.82	16.7	0.983	7.01	13	53.2	8.2	1.41	64	13	60	<0.1	1.23
89-20	0.406	<0.9	4.02	27	1.366	8.54	25	46	16.9	1.4	38.7	22.8	65	<0.05	1.71
92-4	0.077	0.062	1.401	5.2	0.662	2.51	10.7	14.2	20.2	1.22	38.8	2.7	46	0.136	0.391
92-8	0.091	0.12	2.12	10.5	0.899	4.62	17	11	24.3	1.08	60	<6	<30	0.25	0.5
92-11.5	0.559	<1	6.48	37.1	1.99	26.5	50	72	42.7	2.2	36.1	30.7	90	0.19	2.1
93-4	0.014	0.012	0.152	0.88	0.1	0.442	<6	3.7	0.51	0.65	21.4	<2	57	0.037	<0.02
93-8	0.122	0.172	2.18	11.3	0.483	3.59	15	19.5	17.9	1.39	49.4	7.8	46	0.121	0.54
93-12	1.07	0.88	3.45	13.2	2.17	15.54	29	37.7	38	<0.3	8.7	49.6	128	<0.07	1.28
98-6	0.066	0.154	1.14	7.37	0.047	1.73	8.7	9.5	3.37	1.23	40.5	5.4	34	0.069	0.297
98-9	0.269	<0.6	3.58	18.5	0.197	8.04	30	63.2	10.5	1.29	70	15.9	58	0.129	0.8
101-4	1.19	<1	5.6	29.7	1.15	4.88	23	37	6.3	0.96	15	45.2	151	<0.01	2.3
102-4	0.021	<0.2	0.677	3.25	0.148	2.08	<9	14.4	1.51	1.09	85	6.1	52	0.074	0.192
102-8	0.022	<0.2	1.028	4.8	0.382	3.43	<7	51.2	1.41	1.4	76	<5	43	<0.03	0.322
102-12	0.047	<0.3	1.83	10.7	1.07	8.6	21	59	2.92	2.27	89	5.7	56	0.072	0.6
102-16	0.054	0.25	2.11	11.7	1.42	9.59	24	71	3.42	1.15	87	10	<100	<0.2	1.01
102-20	0.142	0.42	3.58	22.6	2.26	20	41	81	5.9	1.4	88	17	86	<0.1	1.49
104-4	0.212	0.42	3.92	24.7	0.261	1.94	12.9	25.3	4.73	2.26	25.9	13.5	54	0.095	0.81

Table 1.-(cont.).

SAMPLE NUMBER	Ba	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Hf	Ta	W	Au(PPB)	Th	U
69-4.5	<130	50.4	58	<60	8.49	1.21	0.723	1.4	0.201	1.9	0.181	0.82	<5	3.96	15.2
69-9	<130	46.7	56.1	<50	8.39	1.15	0.71	1.63	0.23	1.94	0.336	0.98	<8	5.16	16.4
69-13	119	63.2	75.7	<40	10.9	1.5	0.923	2.09	0.266	1.52	0.239	3.5	<0.7	5.39	19.4
69-17	280	89.7	118.9	<70	17.3	2.33	1.45	3.29	0.417	2.5	0.389	<1	<15	8.61	23
69-21	350	65.6	93.9	<50	12.9	1.91	1.19	3.46	0.436	7.36	0.9	<1	<11	11.56	10.7
73-4	<160	18.6	19.6	<13	3.33	0.491	0.286	0.73	0.098	0.214	0.081	0.74	<4	1.07	7.7
73-5	226	40.8	56.6	<23	7.47	0.96	0.661	1.47	0.225	2.39	0.463	<3	<5	7.37	32.5
79-4	<130	25	28.9	<24	4.22	0.604	0.377	1.05	0.123	2.07	0.368	0.9	<7	4.14	6.2
80-8	<100	46.2	49.8	<40	8.33	1.07	0.71	1.43	0.19	0.89	0.147	6.2	<7	3.28	14.4
81-5	210	24.6	30.4	<30	4.15	0.701	0.399	1.09	<0.1	2.71	0.497	<0.6	<10	3.96	6.4
83-4	<60	3.61	3.06	<11	0.662	0.106	0.06	0.29	<0.04	0.129	<0.03	<0.3	<3	0.39	0.52
83-8	<70	5.12	4.01	<12	0.85	0.128	0.087	0.29	0.043	0.229	0.025	<0.3	<5	0.64	1.72
83-12	122	17.1	22.8	<14	3.22	0.471	0.313	0.96	0.124	1.45	0.232	<3	<5	2.86	4.1
83-16	225	45.6	65.8	<19	8.66	1.16	0.811	2.22	0.297	4.65	0.596	<1	<8	8.49	9.4
84-4	<90	20.9	31.3	<17	3.11	0.431	0.282	0.76	0.121	0.25	0.066	1.37	<6	1.7	3
87-4	120	14.6	21.2	<19	2.54	0.348	0.235	0.78	0.145	1.88	0.319	<1	<6	3.15	4.7
87-8	<50	2.39	3.23	<10	0.4	0.072	0.046	0.28	<0.04	0.22	0.051	<0.3	<3	1.14	2.06
87-12	360	28.9	38.6	<16	5.76	0.9	0.59	1.97	0.269	4.78	0.784	<2	<1	5.73	9.4
89-5	<90	19.4	19	<17	3.09	0.474	0.278	0.9	0.154	0.66	0.289	0.91	<5	2.02	4.4
89-8	<90	18.6	19.1	<17	3.09	0.474	0.273	0.8	0.178	1.46	0.283	0.98	<6	1.92	5
89-12	116	20.3	24.8	<12	3.18	0.5	0.296	0.85	0.099	1.05	0.224	<3	<5	2.08	5.5
89-16	180	39.7	42	<21	7.11	1	0.597	1.56	0.178	1.55	0.251	<4	<6	3.85	10.8
89-20	240	43.7	58.3	<21	8.7	1.18	0.741	1.52	0.249	2.69	0.46	<2	<13	6.41	13.7
92-4	<90	38.3	29.6	<40	7.14	0.862	0.575	1.52	<0.05	0.35	<0.1	0.66	<2	1.6	10.7
92-8	<100	38.2	39.2	<30	7.77	0.84	0.62	1.37	0.138	0.538	0.098	<0.6	<6	3.1	11.7
92-11.5	290	109	134	<70	20.6	2.31	1.7	3.41	0.409	3.23	0.537	<2	<7	9.5	23.4
93-4	70	0.93	1.05	<8	0.153	0.027	0.015	<0.1	<0.01	0.09	<0.02	<0.1	<2	0.134	0.16
93-8	<100	31.6	35.4	<25	6.31	0.732	0.519	1.33	<0.08	0.688	0.14	0.87	7.4	3.52	11.7
93-12	320	68.3	101.3	<40	13.4	1.72	1.14	2.33	0.289	2.4	0.37	<3	<8	7.67	11.1
98-6	<70	8.18	10.5	<10	1.52	0.201	0.14	0.55	<0.1	1.02	0.102	<0.2	<3	2.13	6.8
98-9	234	31.6	44.3	<22	6.5	0.84	0.599	1.49	0.184	1.64	0.347	<1	5.5	7.28	19.8
101-4	380	53.1	75.3	<28	9.07	1.36	0.862	2.66	0.332	5.82	0.88	<3	<6	8.74	11
102-4	98	7.53	6.1	<5	1.19	0.202	0.101	0.32	0.044	0.094	<0.06	1.26	3.3	0.62	3.36
102-8	101	12	11.2	<8	1.99	0.328	0.169	0.41	0.076	0.15	<0.08	0.95	<2	0.95	4.55
102-12	76	18.6	20.4	<15	3.24	0.524	0.262	0.78	0.164	0.424	0.124	<0.6	3.3	1.94	6.3
102-16	101	21.5	24.6	<14	3.95	0.601	0.328	0.97	0.193	0.46	0.139	<0.6	<3	2.44	7.9
102-20	186	35.6	48.9	<26	6.94	1.01	0.61	1.85	0.243	1.06	0.248	1	<4	4.85	12.5
104-4	136	36	51.3	<24	6.54	0.9	0.572	1.52	0.288	1.52	0.211	0.94	<0.5	5.65	8.6

Table 2.-Ash, pH, sulfur, Hg, and moisture content of core samples
Values are in weight percent except where noted.

SAMPLE NUMBER	ash%	pH	total sulfur%	Hg-ppm (as received%)	moisture
69-4.5	34.8	4.3	0.96	0.02	88.5
69-9	42.2	4.8	0.77	0.03	89.1
69-13	59.7	4.1	0.52	<0.005	85.4
69-17	59.5	4	0.74	<0.005	85.7
69-21	86.7	4.1	0.12	<0.005	84.3
73-4	3.3	4.7	2.3	0.05	78.4
73-5	26.2	4.7	0.84	<0.005	81.1
79-4	45.6	5.1	0.43	0.05	82.6
80-8	30.4	5.5	1.4	0.05	89.4
81-5	49.9	5.3	0.46	0.03	82.7
83-4	3.6	4.9	0.26	0.03	90.6
83-8	9.6	5.3	0.48	<0.005	93.3
83-12	50.7	5.2	0.43	<0.005	87.6
83-16	62.2	4	0.6	<0.005	84.1
84-4	19.4	2.1	11	0.04	88.9
87-4	34.2	5.4	0.74	0.02	89.4
87-8	3.8	4.6	0.36	0.04	89.3
87-12	94.7	3.4	0.27	<0.005	52.5
89-5	22.8	5.7	0.69	0.02	88
89-8	34.2	5.7	0.48	0.04	90
89-12	58.2	5	0.35	<0.005	87.6
89-16	49.6	4.4	0.66	0.01	88
89-20	69	3.9	0.5	0.01	83.4
92-4	11.2	5.2	1.3	0.05	91.2
92-8	31.1	3.9	0.09	0.04	91.7
92-11.5	66.9	3.4	1.5	<0.005	81.7
93-4	3.4	5	0.09	<0.005	90.2
93-8	28.9	4.5	1	0.02	91
93-12	80.9	2.7	4.6	<0.005	74.9
98-6	4.2	3.9	0.82	<0.005	91
98-9	27.5	4.2	1.1	<0.005	90.5
101-4	76.3	5.6	0.32	<0.005	73.5
102-4	31.1	5	0.62	<0.005	91.5
102-8	39.2	4.9	0.71	0.02	90.7
102-12	41.1	4.4	1	<0.005	91.4
102-16	43.4	4	1.1	<0.005	90.6
102-20	40.8	3.1	1.8	<0.005	90
104-4	28.2	3.9	0.88	<0.005	86.9

Table 3.--Estimated Peat Resources

Resources are estimated on the basis of a minimum thickness of 5 feet and assuming a one-acre foot yield of 200 tons air-dried peat.

Wetland as designated by core number(s)	Acres	Peat thickness in core (ft.)	Air-dried weight (short tons)
73	85	5	85,000
83	324	10	648,000
84	95	6	114,000
87	19	7	26,600
88	27	7	37,800
89	23	8	36,800
92	26	8	41,600
93,94	107	8.5	181,900
96	59	6	70,800
98	29	8	46,400
103	19	6	22,800
		Total	1,311,700

WETLAND AND PEAT RESOURCE MAP OF THE SANDOWN 7.5-MINUTE QUADRANGLE, NEW HAMPSHIRE

By

John C. Jackson and Cornelia C. Cameron

1996