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A WETLAND DATA BASE FOR THE WESTERN BOREAL, SUBARCTIC, AND ARCTIC REGIONS OF CANADA

S.C. Zoltai, R.M. Siltanen, and J.D. Johnson

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ABSTRACT

A data base of wetland location, classification, and peat and vegetation data, including physical and chemical peat analyses, is described and presented. Details of collection and analytical methods are given. This wetland work by the Canadian Forest Service, Natural Resources Canada, was initially intended to determine the environmental sensitivity of permafrost peatlands to anthropogenic disturbance and, later, evaluate the rate of peat accumulation and hence the rate of carbon sequestration in Canadian wetlands. However, the scope of interest in wetlands and their complexity widened over time and is reflected in the gradual evolution of the type of data collected, which has proceeded from a set of simple measurements of the peat profile to a comprehensive analysis of the physical, chemical, and vegetation characteristics of the wetlands. In all, over 425 wetland sites were investigated throughout western and northern Canada between 1970 and 1989, of which 411 sites, with 626 described, cored, and sampled wetland components, currently appear in the data base. With increasing interest in wetlands and their role in the environment, it is hoped that distributing this data base will contribute to the baseline information necessary for understanding the development of wetlands and the role they play within the ecosystems of our world.

RÉSUMÉ

DEDICATION

This work is a representation of the wetland research undertaken by Stephen C. Zoltai at the Northern Forestry Centre, Canadian Forest Service. Mr. Zoltai passed away on December 15, 1997. This report is dedicated to his memory and is a tribute to his years of scientific research.

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NOTE

The exclusion of certain manufactured products does not necessarily imply disapproval, nor does the mention of other products necessarily imply endorsement by the Canadian Forest Service.

INTRODUCTION

Wetland research was initiated by the Canadian Forestry Service in 1970. The initial objective of this research was to determine the environmental sensitivity of permafrost peatlands to anthropogenic disturbance. In time, however, the emphasis broadened to include the dynamics of both permafrost and nonfrozen wetlands by examining the conditions under which various wetlands develop. This information was intended to evaluate the rate of peat accumulation and hence the rate of carbon sequestration in Canadian wetlands. The shifting emphasis is reflected in the gradual evolution of the type of data collected, which proceeded from a set of simple measurements of the peat profile to a comprehensive analysis of the physical, chemical, and vegetation characteristics of the wetlands.

Fieldwork in the 1970s investigated permafrost peatlands in the boreal, subarctic, and arctic regions of Manitoba, Saskatchewan, and the Yukon and Northwest Territories of Canada (Table 1). In 1981, work began principally in the unfrozen wetlands of the boreal regions of Alberta, Manitoba, and Saskatchewan. Site locations are shown in Figure 1. In all, over 425 wetland sites were investigated between 1970 and 1989, of which 411 sites, with 626 described, cored, and sampled wetland components, currently appear in the data base (Tables 2 and 3).

This report presents the basic methodology used for studying these wetland environments and the information compiled to date.

METHODS

Fieldwork

Wetland Sampling

The wetlands to be studied were selected from aerial photographs on the basis of their representativeness of their kind, as well as their accessibility. The aerial photographs and maps taken to the field to locate the wetlands were marked with the study site locations. These aerial photographs and maps have been retained as reference material for re-locating the sites. The aerial photographs also serve as a visual record of study site conditions and the surrounding environment at the time the photograph was taken. Latitude and longitude were determined from maps. A study site was located as near to the center of the wetland as practical, with subsites in each wetland component, based on landform and vegetation. Each component (subsite) was described and cored separately. Field observations of the relative locations of sites and subsites, wetland class and form, coring location, and other descriptive

comments were recorded.

To begin each core, a small pit was excavated in the fibrous surface layer with a sharp knife. This fibric surface peat was sampled from the undisturbed side of the pit with a 25-mL metal cup welded to a pair of vise-grip pliers. The underlying peat was cored with an OCRS-Narraway modified McCauley [sic] peat sampler, the design of which was based on the peat sampler described by Jowsey (1966) (the correct spelling is Macaulay, presumably after the Macaulay Institute for Soil Research in Aberdeen, Scotland, where Jowsey worked). The core sampling chamber had an internal diameter of 4.0 cm and a length of 50 cm. The Macaulay peat sampler retrieved an entire 50-cm semicircular section of peat (Fig. 2). If permafrost was encountered, it was cored and sampled with a modified Hoffer probe (Zoltai 1978), which had an inside diameter of 2.2 cm and a length of about 16 cm. The usable permafrost sample retrieved by the Hoffer probe was a cylindrical plug 2–5 cm long. Both samplers had several 1-m extensions for retrieving cores from deep profiles (Fig. 3). Successive core sections were taken until the entire peat depth had been sampled, usually into the mineral soil. The Macaulay sampler extensions were marked at 50-cm intervals to determine the depth of each core section in relation to ground level.

Individual peat samples, 6 to 8 cm long, were collected at 15-cm intervals from each core section or more often if a change in the peat material was evident. Individual samples were placed in plastic bags labeled with the site number, the sample number, and the depth and were then sealed. At the same time, a small amount of sample was collected separately for macrofossil analysis. The pH of the sample was measured before bagging by placement of a strip of pH paper (Duotest, Macherey-Nagel Co., Düren, Germany) on the wet sample. Field observations of the type of peat material, the von Post scale of decomposition (Agriculture Canada Expert Committee on Soil Survey 1987), the sample pH, the sample size, and the collection depth for each sample were recorded in a field book.

Permafrost peat samples were collected individually from the Hoffer probe. The length of the individual samples was measured, and the samples were bagged. The sampling interval varied, but was generally 10 cm, as measured down the core hole. Field observations for each sample were recorded as described for unfrozen peat samples.

The depth to the water table was measured in a separate pit dug for this purpose. A small (30-mL) sample of water was collected from the pit, and another sample was taken from any surface water present near the site. The pH of the water was determined by dipping a strip of pH paper into the water at the time of collection.

Vegetation Sampling

Wetland sampling in the 1970s emphasized the peat profile and permafrost development and only cursory observations of surface vegetation were recorded. Most of these observations do not appear in the data base but are on record with the original field notes.

The peatland vegetation sampling from 1981 to 1984 in the boreal regions of Alberta, Saskatchewan, and Manitoba was designed to be compatible with the Canadian Wetland Registry (Tarnocai 1980). The size and number of vegetation plots established at each site varied depending on the wetland type and vegetation type. In patterned peatlands (fens), a restricted random technique (Daubenmire 1968) was used; this technique consisted of laying a baseline out along the center of the long axis of a string or flark (i.e., perpendicular to the direction of water flow), and placing five 1-m² quadrats randomly along the baseline. In unpatterned peatlands dominated by trees or tall shrubs, a single (or sometimes two) 5 m × 5 m plot was employed. In unpatterned peatlands dominated by graminoids or low shrubs, five 1-m² plots were established randomly along a baseline. In all instances, the intent was to describe the representative vegetation of the coring location.

Cover was estimated by the canopy method (Daubenmire 1959) by stratum (trees taller than 5 m, tall shrubs taller than 1.5 m, medium shrubs 0.5–1.5 m tall, low shrubs 0.1–0.5 m tall, ground shrubs less than 0.1 m tall, and herbs, bryophytes, and lichens). Cover estimates were made to the nearest 1% up to 10%, and to the nearest 5% above that. Species with an estimated cover of less than 1% were given a cover value of 0.5%. Cover values were averaged across the series of plots for each coring location. Voucher specimens were collected.

Floristics and Plant Identification

All collected plant material was identified to species according to the following sources: Porsild (1964), Hulten (1968), Scoggan (1979), Porsild and Cody (1980), and Moss (1983) for vascular plants; Thomson (1967, 1984), Thomson et al. (1969), Bird (1970), Brodo and Hawksworth (1977), and Hale (1979) for lichens; and Bird (1968), Lawton (1971), Koponen (1974), Vitt (1975), Vitt and Andrus (1977), and Conard and Redfearn (1979) for bryophytes. Bryophyte identifications were verified by D. Vitt at the University of Alberta, Edmonton, and lichen identifications were verified by J. Thomson at the University of Wisconsin, Madison. Voucher specimens are deposited in the herbarium of the Northern Forestry Centre, Edmonton, CAFB (Holmgren and Holmgren 1990). Nomenclature follows Scoggan (1979) and Moss (1983) for vascular plants, Ireland et al. (1987) for mosses, Stotler

and Crandall-Stotler (1977) for liverworts, and Egan (1987) for lichens.

Laboratory Work

Physical Analyses

The moisture content of peat samples was determined by oven drying. The fresh samples were weighed, oven dried at 80°C for 24 h, and weighed again after drying. Moisture content was calculated as percentage on a dry-weight and wet-weight basis. Moisture content was also expressed on a volume basis, according to the known volume of the samples. The bulk density of the sample was calculated, according to the weight of the dry sample of known volume.

Chemical Analyses

The oven-dry peat (about 2 g) was ground to a 0.5-mm (or smaller) size. A small portion of the ground peat sample (from 0.15 to 0.5 g depending on the type of peat material) was reduced to ash in a muffle furnace at 470°C for 16 h (Ali et al. 1988). The residual inorganic ash was weighed to obtain the ash content of the peat. The ash was dissolved in aqua regia, dried, and redissolved in HCl, and the solution was filtered. The filtrate was used to determine the elemental composition of the peat sample. The filter paper, containing the acid-insoluble ash, was burned in the muffle furnace and saved for petrographic examination.

Chemical analyses were done on the peat samples, beginning with the 1972 samples. The filtrate was prepared as outlined above and was analyzed with an atomic absorption spectrophotometer for total elemental Ca, Mg, Na, K, Cu, Fe, Mn, and Zn. In 1973, S was added to the list. Beginning with the 1981 samples, an inductively coupled plasma-atomic emission spectrophotometer (ICP-AES) was used to determine the total elemental Ca, Mg, Na, K, Al, Ti, Pb, Cu, Fe, Mn, Zn, Ni, S, and P content of the filtrates.

The conductivity of the water samples was measured in the laboratory with a Radiometer CDM 3 conductivity meter. The water samples were then prepared for analysis by filtering them and adding 1 mL of HCl as a stabilizer and preservative to 24 mL of filtered sample. The preparation was then analyzed with the ICP-AES for the same elements as the peat samples.

Data Management

Initially, printed records of the chemical analyses were retained and organized into tomes along with the recorded physical analysis data and core descriptions. To facilitate data handling and analysis, computer relational data base files were later created for the above data and the vegetation descriptions. Most of the chemical data were saved on computer disk at the time of analysis, which allowed for easy inclusion of this information in the data base. However, all of the physical analysis data and field observations were manually entered into digital form and underwent extensive data entry checks and corrections. Macrofossil data are not currently included in these data files but are available. The original tomes have been retained along with original field and laboratory records for reference.

Information is organized in three files designed for use primarily with a relational data base program. The three files separate the site description, sample analyses, and vegetation description data, as follows:

SITES.DAT, the wetland site and subsite locations along with their wetland classification coding and site-level physical description data (626 records);

SAMPLES.DAT, the core profile descriptions with physical and chemical analyses for the collected soil and water samples for each sampled subsite (8 969 records); and

VEG.DAT, the vegetation identifications and cover estimates by layer for each sampled subsite (13 675 records).

Each wetland component that was cored and sampled has a unique identifier composed of the YEAR, SITE, and SUBSITE variables, which appear in each file. The data file records can be related to each other by this unique identifier (Fig. 4). Analyses, summaries, and reports may be generated from individual files or by combining the related information from any or all of the data base files.

The files are in ASCII, comma separated value (also called comma-delimited) format, with trailing spaces removed to conserve space. This format can be imported by many data base, spreadsheet, and statistical analysis computer programs and read with any text-editing program. The sample and vegetation files are large, with thousands of records (lines of information) in each file, so the user must ensure that the particular computer program being used will read all records within the file. Preserving the decimal places when importing these data into a computer program is also an important consideration. The user should carefully confirm the preservation of decimal places in a field after the import procedure.

Variable names appear on the first line of each data file, in an order corresponding to the order of the

variables in each record. Variables within each record are separated by commas. Removing the trailing spaces from the variables in the ASCII files reduced the file sizes significantly but produced data tables that do not have regular spacing for the variables. This makes it difficult to interpret the variables when viewing the files with a text-editing program. However, importing the files into a spreadsheet or data base program results in proper alignment of the variables with their variable names and is therefore the recommended procedure.

A blank entry for a variable indicates that no data were either available or required for that record. It is important to differentiate such blank entries from zero entries. Certain variables may have zero as a valid number or code. Computer programs often have specific requirements for "no data" indicators, so the user must be aware of how a particular program will deal with this issue. For example, the dBASE data base program (Borland International, Inc. 1994) will accept a blank for no data, whereas the SAS statistical analysis program (SAS Institute Inc. 1990) requires a period.

The chemical analyses data are presented in unedited form, just as they are output by the ICP-AES. These data include zero values and values preceded by a less-than sign, both indicating element concentrations below the detection limit of the machine. The number of decimal places output varies by element and sample concentration. The significance of the number of figures is determined by the magnitude of the elemental concentration. The user should become familiar with the variable descriptions for the data files as presented in Appendix 1 to avoid erroneous handling of the data.

CLOSING REMARKS

More analytical data remain to be added to the data base, representing further description of the included wetland sites as well as investigations of other sites. However, the importance of the existing body of work is evidenced by the frequent interest in, and requests for, the current electronic data. For example, the data have already been used in support of federal, provincial, and academic studies ranging from studies of wetland ecological processes, and classification and mapping work to research on airborne pollution, paleoecology, fire, and climate change. A descriptive list of all the sites and subsites presently in the data base is presented in Appendix 2.

Data bases of this kind are becoming increasingly important for use as baseline information for scientific studies. The retention and accessibility of past data collection projects is increasingly important as they represent a

significant expenditure of an organization's resources and provide voluminous research data as well as a record of environmental conditions at a specific point in time. Wetlands are dynamic ecosystems and are particularly sensitive to changes in climate and other environmental conditions. With increasing interest in wetlands and their role in the environment, it is hoped that distributing this data base will contribute to the baseline information necessary for understanding the development of wetlands and the role they play within the ecosystems of our world.

The three data files are stored on the enclosed MS-DOS computer disk in a selfextracting archive file. To extract the files, copy the archive file to a directory on your computer and execute the file.

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Table 1. Summary of wetland sites and number of cores investigated by year of study

Year	Location	No. of wetland sites ^a	No. of cores ^a
1970	Central Manitoba and Saskatchewan	32	32
1971	Northern Mackenzie Valley, N.W.T.	36	68
1972	Northern Yukon and N.W.T.	38	72
1973	Mackenzie Valley, N.W.T.	24	57
1975	Somerset Island, Nunavut	1	1
1976	Northern Keewatin, Nunavut	1	1
1977	Southern Keewatin, Nunavut	2	2
1981	Alberta	60	94
1982	Northern Manitoba	65	100
1983	Southern Manitoba	59	85
1984	Saskatchewan	76	88
1989	Arctic Red River area, N.W.T.	9	9
1989	Northern Alberta	23	31
Total		426	640

^a Not all wetland sites and subsites investigated appear in the data base. Additional sites and data may be added in the future.

Table 2. Number of cores in the data base by wetland region

Wetland region ^a	No. of cores ^b
Arctic	
High Arctic	1
Low Arctic	34
Subtotal, Arctic	35
Boreal	
Continental High Boreal	181
Continental Mid-Boreal	204
Transitional Mid-Boreal	16
Low Boreal	29
Subtotal, Boreal	430
Rocky Mountain	
North Rocky Mountain	3
Subtotal, Rocky Mountain	3
Subarctic	
High Subarctic	28
Low Subarctic	130
Subtotal, Subarctic	158
Total	626

^a According to National Wetlands Working Group (1986).

^b Not all wetland sites and subsites investigated appear in the data base. Additional sites and data may be added in the future.

Table 3. Number of cores in the data base by primary wetland classification^a

Wetland classification (class and form) ^b	No. of cores ^c
Bogs	
Basin	58
Collapse scar	3
Domed	11
Flat	11
Lowland polygon (high-center)	16
Northern plateau	22
Palsa	53
Peat plateau	125
Polygonal peat plateau	34
Shore	1
Subtotal, bogs	334
Fens	
Basin	61
Collapse scar	4
Drainage	20
Floating	1
Horizontal	71
Northern ribbed	79
Shore	2
Spring	10
Lowland polygon (low-center)	18
Subtotal, fens	266
Swamps	
Basin	6
Flat	1
Peat margin	9
Stream (spring)	7
Shore	1
Subtotal, swamps	24
Marsh	
Inactive delta	1
Subtotal, marsh	1
Mineral soil	
Shallow peat ^d	1
Subtotal, mineral soil	1
Total	626

^a The primary wetland classification is coded as the PRIM_CLASS variable in the SITES.DAT data file. It is the dominant wetland classification of a given wetland site.

^b According to National Wetlands Working Group (1988).

^c Not all wetland sites and subsites investigated appear in the data base. Additional sites and data may be added in the future.

^d The term “shallow peat mineral soil” is an additional descriptive term used by the authors and is not part of the wetland classification reference noted above.

Figure Captions....

Figure 1. Map of the ecoclimatic provinces of western Canada (Ecoregions Working Group of Canada 1989) showing the location of sites described in the wetland data base.

Figure 2. The extracted peat core from a Macaulay peat sampler.

Figure 3. Pulling up a deep peat core sample using a Macaulay peat sampler with extensions.

Figure 4. A portion of the three data files that constitute the wetland data base.

APPENDIX 1

DESCRIPTIONS OF VARIABLES IN THE DATA FILES

The variables in each data file are listed here with descriptions of their characteristics, reference citations, and any caveats. The variable name appears in bold, uppercase letters (e.g., **YEAR**). Variable names also appear in their proper order on the first line of each data file, corresponding to the order of the variables in each record of the file. Number values are integers unless decimal places are specified in the variable description. Where there is no value for a variable, the field in the data file is blank, unless stated otherwise in the field description below.

Data file: SITES.DAT

YEAR: The year in which the site was surveyed (e.g., 1981).

SITE: The site number given to the site within a specific year. The site number is not unique and restarts at 1 in each new year. Site numbers can be discontinuous in the data base because some investigated sites were not suitable for inclusion in the data base.

SUBSITE: If more than one component (subsite) was surveyed at a site, each was given an A, B, C, or D suffix or A1, A2, A3 suffix, etc. accordingly. Multiple components were often sampled at a site to characterize the variability within a peatland complex (e.g., a string plot and a flark plot at a northern ribbed fen site).

NUTRIENTS: A code for the nutrient richness of the peatland (Zoltai and Johnson 1987).

- 0 not determined
- 1 very poor bog (oligotrophic)
- 2 very poor fen (oligotrophic)
- 3 poor fen (dystrophic)
- 4 moderately rich fen (mesotrophic)
- 5 extremely rich fen (macrotrophic)
- 6 moderately rich swamp (mesotrophic)

PRIM_CLASS: The primary wetland classification (class and form) of the wetland site according to the Canadian wetland classification presented in *Wetlands of Canada* (National Wetlands Working Group 1988). The class and form names conform to the reference, whereas the numerical coding system was devised by the authors for use only in the data base. Some codes listed may not appear in the data base.

0 not determined

Bog (codes 1–19)

1 basin
 2 collapse scar
 3 domed
 4 flat
 5 lowland polygon (high center)
 6 northern plateau
 7 palsa
 8 peat plateau
 9 polygonal peat plateau
 10 shore
 11 veneer

Fen (codes 20–39)

20 basin
 21 channel
 22 collapse scar
 23 drainage
 24 feather
 25 floating
 26 horizontal
 27 net
 28 northern ribbed (or string)
 29 shore
 30 spring
 31 lowland polygon (low center)

Swamp (codes 40–49)

40 basin
 41 flat
 42 peat margin
 43 stream (spring)
 44 shore

Marsh (codes 50–59)

50 delta
 51 inactive delta

Shallow water (codes 60–69): None identified.

Mineral soil (shallow peat) (code 99)

SEC_CLASS, SEC_CLASS2, SEC_CLASS3: The secondary wetland classes and forms or other descriptors. Subsites at the same site usually have the same PRIM_CLASS code but different SEC_CLASS codes. SEC_CLASS variables can use any PRIM_CLASS class and form code or one of the following description codes:

0	not determined
70	open or treeless
71	treed (coniferous)
72	grassy
73	edge, margin, or rim
74	center
75	dammed
76	drained
77	string
78	flark
79	thicket
80	shrub
81	mound
82	treed island or island
83	treed (hardwood)

These SEC_CLASS description codes are not used for the PRIM_CLASS field.

PROV: The province or territory in which the site is located.

AB	Alberta
SK	Saskatchewan
MB	Manitoba
NWT	Northwest Territories
YT	Yukon Territory
NU	Nunavut

LATN: North latitude in decimal degrees (two decimals).

LONGW: West longitude in decimal degrees (two decimals).

ECPROV: The ecoclimatic province of the site, as defined by the Ecoregions Working Group of Canada (1989). The assignment of a site to an ecoclimatic province and region was derived by overlaying the site location (latitude and longitude) onto the ecoclimatic regions map using a geographic information system. The following codes appear in the data base:

AR	Arctic
SC	Subarctic Cordilleran
SA	Subarctic
CD	Cordilleran
BO	Boreal
GR	Grassland

ECREGION: The ecoclimatic region of the site. Codes for this variable are those defined by the Ecoregions Working Group of Canada (1989). The following codes appear in the data base:

HA	High Arctic
LBs	Subhumid Low Boreal
LA	Low Arctic
LBst	Subhumid Transitional Low Boreal
HS	High Subarctic
SCb	Boreal Southern Cordilleran
LS	Low Subarctic
SCs	Subalpine Southern Cordilleran
HBs	Subhumid High Boreal
NSCas	Complex Alpine and Subalpine Northern Subarctic Cordilleran
MBs	Subhumid Mid-Boreal
Gt	Transitional Grassland

WETREGION: The wetland region of the site, as defined by the National Wetlands Working Group (1986). The following codes appear in the data base:

AH	High Arctic
AL	Low Arctic
SH	High Subarctic
SL	Low Subarctic
BHc	Continental High Boreal
BMc	Continental Mid-Boreal
BMt	Transitional Mid-Boreal
BL	Low Boreal
MRn	North Rocky Mountain

PEATDEPTH: The depth of peat (measured in centimetres) from the peat surface (the top of the living moss) to the upper limit of the continuous mineral or marl horizon, indicating the base of the peatland development. A plus sign (+) following the PEATDEPTH value indicates that the base of the peatland was not reached by the core sampler.

PFUPPER: The upper limit of permafrost in the core profile. Measured in centimetres from the peat surface.

PFLOWER: The lower limit of permafrost in the core profile. Measured in centimetres from the peat surface. Where permafrost continued past the sampling depth, a plus sign (+) appears with the deepest measurement made.

WTDEPTH: The depth to the water table from the top of the peat surface. Measured in centimetres. Where the water table was above the peat surface, the value is negative (e.g., -10 cm). The presence of permafrost was not regarded as

representing a water table.

WETTYPE: A subjective classification by the authors based on the PRIM_CLASS and SEC_CLASS fields, vegetation notes, and observations and pictures taken in the field.

1	bog
2	open fen
3	shrubby fen
4	treed fen
5	hardwood swamp
6	conifer swamp
7	marsh
9	mineral soil

NOTES: Additional notes and comments on the site.

Data file: SAMPLES.DAT

YEAR, SITE, SUBSITE: As described for SITES.DAT.

SAMPLE: The analytical laboratory sample number of the collected peat, soil, or water sample used to describe the horizon. The sample number is not unique and restarts at 1 for each new year. To identify an individual sample the combination of YEAR+SITE+SUBSITE+SAMPLE fields must be used. Some horizons do not have a sample number, especially those from the work of the early 1970s. Some mineral horizons are entered as placeholders to indicate that mineral soil was reached at the bottom of the peat profile. Where a peat horizon was sampled more than once, a single sample was chosen to represent the characteristics of the horizon. Sample numbers are not always consecutive.

UPPER: The upper limit of the horizon. Measured in centimetres from the peat surface in organic soils and from the mineral surface in mineral soils.

THICK: The thickness of the horizon represented by the analyzed sample. Measured in centimetres.

U_F: The state of the horizon when sampled (frozen [F] or unfrozen [U]).

POSN: The position of the sample in the profile:

- 1 acrotelm: the zone of biomass accumulation and rapid aerobic decomposition
- 2 catotelm: the zone of biomass sequestration and slow anaerobic decomposition
- 3 basal: the organic–mineral interface at the base of the peat profile

BD: The bulk density of the collected sample in grams per cubic centimetre (three decimal places).

T_ASH: The total ash remaining after dry ashing (Ali et al. 1988) of the sample, expressed as percentage of dry weight (one decimal place).

VP: The field estimate of the degree of decomposition of the horizon, based on the von Post scale of decomposition.

(Agriculture Canada Expert Committee on Soil Survey 1987).

Fibric

- 1 undecomposed
- 2 almost undecomposed
- 3 very weakly decomposed
- 4 weakly decomposed

Mesic

- 5 moderately decomposed
- 6 strongly decomposed

Humic

- 7 strongly decomposed
- 8 very strongly decomposed
- 9 almost completely decomposed
- 10 completely decomposed

MATERIAL: A code describing the material in the horizon:

- 0 mineral soil
- 1 sphagnum peat
- 2 sphagnum peat with wood
- 3 sylvic peat
- 4 moss peat ($\geq 60\%$ brown mosses)
- 5 sedge–moss peat
- 6 sedge–moss peat with wood
- 7 humus
- 8 lacustrine peat
- 9 marl
- 10 wood
- 11 profile water or ice
- 12 organic–mineral mix
- 81 surface water sample

82 water table sample

CONTAMINAT: Assessment of whether the horizon appears chemically contaminated from an outside source (e.g., road dust or smelter). This assessment is based on the site's proximity to a possible source and on anomalies in the elemental analyses, usually in the site's surface horizons.

F false
T true

PH: The pH of the sample (one decimal place).

W_COND: The electrical conductivity of the sample in milliSiemens (for water samples only) (three decimal places).

M_VOL: The moisture content as a percentage of sample volume (one decimal place).

M_DRYW: The moisture content as a percentage of sample oven-dry weight (no decimal place).

M_WETW: The moisture content as a percentage of sample wet (or fresh) weight (one decimal place).

CA, MG, NA, K, AL, TI, PB, CU, FE, MN, ZN, NI, S, P: Total element analysis (in milligrams per kilogram) of dry ashing extract (Ali et al. 1988) by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) (Kalra and Maynard 1991). These values are taken directly from the ICP-AES. Zero values and values preceded by a less-than symbol indicate concentrations below the detection limit of the machine. Concentration values vary by orders of magnitude from site to site, and hence the number of decimal places output varies as well. Care should be taken to preserve the maximum number of decimal places when importing these variables (from 0 to 4 decimal places).

Data file: VEG.DAT

YEAR, SITE, SUBSITE: As described for SITES.DAT.

LAYER: The physiognomic layer code:

1 tree >5 m
2 tall shrub >1.5 m
3 medium shrub 0.5–1.5 m
4 low shrub 0.1–0.5 m

- 5 herb, graminoid, and ground shrub <0.1 m
- 6 bryophyte
- 7 lichen

COVER: The total percent area coverage within a layer by the species within the plot. Shrub or tree species may occur in more than one layer in the plot depending on the height of individual plants. However, an individual plant is assigned to only one layer on the basis of the physiognomy and, if a shrub or tree species, the height of the individual's present form. Cover estimates were made to the nearest 1% up to 10% and to the nearest 5% above that. Species with an estimated cover of less than 1% were given a cover value of 0.5%.

ACRON: A unique seven-letter acronym for the plant name comprising the first four letters of the genus name and the first three letters of the species name. Where possible, the acronyms conform to the *Alberta Plants and Fungi—Master Species List and Species Group Checklists* (Alberta Energy/Forestry, Lands and Wildlife 1992).

GEN_SPEC: The Latin genus and species names of the plant.

APPENDIX 2
DESCRIPTIVE LIST OF WETLAND SITES IN THE DATA BASE

