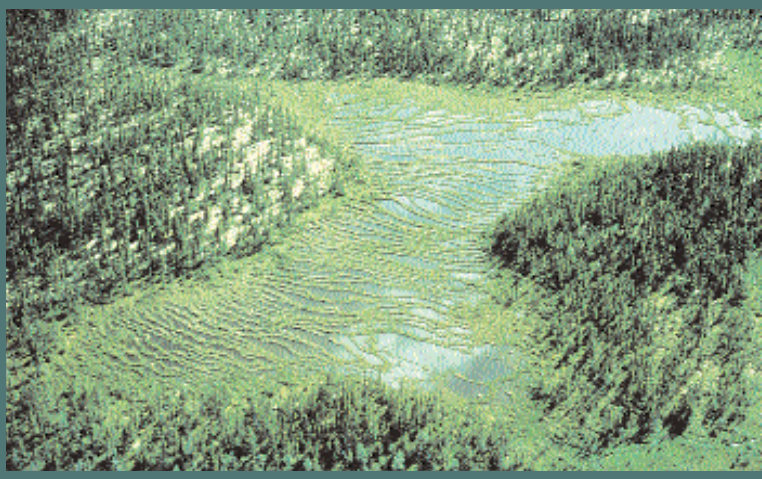
The Canadian Wetland Classification System

Second Edition

By the National Wetlands Working Group / Edited by B.G. Warner and C.D.A. Rubec



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Stephen Zoltai

1928-1997

This second edition of The Canadian Wetland Classification System is dedicated to our colleague, Stephen Zoltai for his contribution to Canadian wetlands science and his encouragement to all of the members of the National Wetlands Working Group to complete this volunteer ten-year task. It was a privilege to know and work with this remarkable man.

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Foreword

This second edition of *The Canadian Wetland Classification System* replaces a report of the same title published in 1987 by the Canadian Wildlife Service, Environment Canada as Report No. 21 in the Ecological Land Classification Series.

This revision was undertaken by the National Wetlands Working Group (NWWG), a national wetland science committee comprised of experts from government, non-government, university and private sector agencies across Canada. The NWWG has also previously published a National Atlas of Canada map folio entitled *Canada's Wetlands* in 1986 and the book *Wetlands of Canada* with Environment Canada and Polyscience Publications in 1988. Work on a Canadian wetland classification system began in 1971 by a group of wetland science experts, the Organic Terrain Subcommittee of the National Committee on Forest Lands, out of which evolved the NWWG in 1976.

The NWWG became one of the most active national subgroups under the Canada Committee on Ecological Land Classification which was established at the same time and active through the mid 1980s. The National Ecosystem Framework Project steered by the Ecological Stratification Working Group subsequently provided considerable national attention to wetland information needs. The NWWG promotes ecologically-based management, wise use and conservation of Canadian wetlands.

The NWWG acts through the support of government and non-government agencies and universities. In particular, the previous Lands Directorate and the present Wildlife Conservation Branch of the Canadian Wildlife Service, both of Environment Canada, have been major supporters of the NWWG activities for over 20 years. The activities of the NWWG and this report, however, are also the products of considerable indirect support from many agencies across Canada. This includes provision of staff time, in-house laboratory and logistical services, and organization of numerous national working meetings and field study trips for the NWWG over these two decades. Some of these agencies, notably Agriculture and Agri-Food Canada and the Canadian Forest Service of Natural Resources Canada, are listed with the current contributors. However, the support of other host organizations of NWWG members no longer active in the Group are also acknowledged.

This report is published by the Wetlands Research Centre, University of Waterloo with the assistance of the Canadian Wildlife Service of Environment Canada and the Secretariat to the North American Wetlands Conservation Council (Canada).

Preface

An art critic in a commentary of the *Group of Seven* exhibition in Toronto, published in *Saturday Night Magazine* in 1921, wrote:

"A while ago I saw in an art gallery a ... picture ... of a swamp. A repulsive, forbidding thing. One felt like taking a dose of quinine every time one looked at it. If ugliness is real beauty they have yet to prove it to a very large mass of the assembled public."

This critic, Hector Charlesworth, was referring to the now world-famous painting by Lawren Harris, entitled *Beaver Swamp, Algoma* which was recently on display at the National Gallery in Ottawa. This critic's comments reflect the mood of a bygone era. In Canada and globally we now recognize the swamp, as a picture or in nature, as a thing of beauty. The swamp in both forms has accrued in value with the passage of time.

Unlike most ecosystem types, wetlands occur throughout Canada. As such, they have become part of our universal discussions on ecosystem concepts and relationships. Wetlands in the Arctic, Prairie and Boreal ecozones of Canada engender thoughts of specific places, peculiar flora and fauna, and a definitive biological setting often cherished by our citizens. These wetlands provide threads that wind their way through all our ecosystems.

In the last decade, since the publication of the first edition of *The Canadian Wetland Classification System*, significant advances have occurred in our understanding and conservation of wetlands across Canada. The federal and all of our provincial and territorial governments have developed wetland conservation policies and/or programs; wetland conservation organizations are thriving; the country hosted the Third Meeting of the Conference of the Contracting Parties to the Ramsar Convention on Wetlands; and the North American Waterfowl Management Plan was launched, leading to securement of over one million hectares of wetland habitat. The wise use and sustainability of our wetland resources has been recognized as a key element in such efforts and as a matter of public policy.

Fundamental to these initiatives has been the establishment of a common language for the wetland resource, usable by all Canadians. *The Canadian Wetland Classification System* is now the core of this language that binds our appreciation of wetlands across a vast nation.

The partners in this report thank the National Wetlands Working Group for their efforts in revisiting, updating and republishing this important document.

Barry Warner
Clayton Rubec

Contents

Introduction

The first phase of development of a national wetland classification system in Canada was completed in 1973 as an organic terrain classification system by the National Committee on Forest Lands. Subsequently, Zoltai *et al*. (1975) proposed a four-level, hierarchical, ecologically-based wetland classification system which formed the basis of a more comprehensive Canadian wetland classification (Tarnocai 1980). Discussions on Canadian wetland classification have been published by Wells and Zoltai (1985); Glooschenko *et al*. (1993); Zoltai and Vitt (1995); and Jeglum (at press).

Jeglum *et al*. (1974) and Millar (1976) refined regional wetland classifications for Ontario and the Prairies, respectively. Other regional classification systems were developed later for British Columbia (Runka and Lewis 1981), Quebec (Couillard and Grondin 1986) and northern Ontario (Harris *et al*. 1996). Further work to develop provincial wetland classification systems has been completed in British Columbia (Kistritz and Porter 1993; Steen and Roberts 1988) and Quebec (Buteau *et al.* 1994).

The first (provisional) edition of *The Canadian Wetland Classification System,* published in 1987 as a part of the *Ecological Land Classification* Report Series by Environment Canada on behalf of the Canada Committee on Ecological Land Classification, represented a national synthesis of existing information at the time. This second edition reflects the contributors' interests in transcending the differences in the classification approaches and philosophies across Canada. This national classification system has been further refined by the National Wetlands Working Group (NWWG) on the basis of the collective expertise and research of many wetland scientists across Canada. This revision retains the general focus of the first edition. Three basic levels of classification, those being wetland class, form, and type are recognized. New information on the role of hydrology and water chemistry is added to the publication. Major refinements of the terminology and definitions for wetland forms and more recognition of subforms are included. Where the first edition recognized 71 wetland forms and no subforms, 49 wetland forms and 72 subforms are included in this revision. The contributors present generalized outlines and keys for the five wetland classes. An introduction to wetland hydrology provides background on the hydrogeomorphic setting of the various wetland classes. Wetland form and type descriptions will continue to be revised as more experience and knowledge about Canada's wetlands is gained in the future.

What is a Wetland?

A wetland is defined as: *land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment* (National Wetlands Working Group 1988). Wetlands can be subdivided into two broad categories:

Organic wetlands:

- Organic wetlands are more simply referred to as peatlands. Peatlands contain more than 40 cm of peat accumulation on which organic soils (excluding Folisols) develop. This depth limit is consistent with soil classification standards established by the Canada Soil Survey Committee (1978).

Mineral wetlands:

- Mineral wetlands are found in areas where an excess of water collects on the surface and which for geomorphic, hydrologic, biotic, edaphic (factors related to soil), or climatic reasons produce little or no organic matter or peat. Gleysolic soils or peaty phases of these soils are characteristics of these wetlands.

- Mineral wetlands are found in mineral soil areas associated with shallow water, which is generally less than 2 m deep. In some of these wetlands, vegetation is lacking and soils are poorly developed as a result of frequent and drastic fluctuations of water levels, wave action, water flow, turbidity, or a high concentration of salts or other toxic substances in the water or in the soil.

- Mineral wetlands include mineral soil areas that are modified by water control structures (e.g. dams) or that are tilled and planted but if allowed to revert to their original state, become saturated for long periods and are then associated with wet soils (e.g. Gleysols) and hydrophytic vegetation.

Wetland Classification

The Canadian Wetland Classification System contains three hierarchical levels: (1) class, (2) form, and (3) type. Five classes are recognized on the basis of the overall genetic origin of wetland ecosystems. Forms are differentiated on the basis of surface morphology, surface pattern, water type and morphology of underlying mineral soil. Types are classified according to vegetation physiognomy.

Wetland Class:

Wetlands at the class level are recognized on the basis of properties of the wetland that reflect the overall genetic origin of the wetland ecosystem and the nature of the wetland environment.

Wetland Form:

Wetland forms are subdivisions of each wetland class based on surface morphology, surface pattern, water type and morphology characteristics of underlying mineral soil. Many of the wetland forms apply to more than one wetland class. Some forms can be further subdivided into *subforms*.

Wetland Type:

Wetland types are subdivisions of the wetland forms and subforms based on physiognomic characteristics of the vegetation communities. Similar wetland types can occur in several wetland classes whereas others are unique to specific classes and forms.

The text is organized as follows. An overview of the major hydrogeomorphic factors affecting wetland development (hydrological systems) is given and summarized in a diagram. A key to assist in the differentiation of the five wetland classes — bog, fen, swamp, marsh and shallow water — is presented. Descriptions and keys for wetland forms and subforms within each of the classes follow. Descriptions of wetland types, which are applicable to all wetland classes, are also presented. References complete the text. A comparison of the terms used in the first and second editions of this and the Ramsar Convention wetland classification systems (Appendix 1); a comparison of proposed English and French wetland terms (Appendix 2); and diagrams of selected bog, fen and marsh forms are given in their respective sections. Wetland regions follow those of the *Wetland Regions of Canada* map (National Wetlands Working Group 1986) in the *National Atlas of Canada*. Soil classification terms used in this text are national standards established by the Canada Soil Survey Committee.

This wetland classification system incorporates characteristics of soil, water and vegetation. Each wetland class is described generally, while the wetland forms, subforms and types are described in more detail. The soil component of each wetland class is described at the order and great group level of soil classification. Wetland forms are associated with particular soil subgroups or soil series and the soil condition associated with wetland types are described by soil series or complexes of soil series. Similarly, hydrological and vegetation characteristics associated with wetlands are described in more detail at the wetland form and type levels of this classification system.

Several excellent CD-ROM collections of images of Canadian wetlands and peatlands have been produced (e.g. Zoltai 1997).

Constructed Wetlands

In some situations, wetlands are created by agricultural activities, hydroelectric structures and through other human activities. Over time, these sites evolve into naturally functioning wetland systems and are classified accordingly. Constructed wetlands, such as those for habitat enhancement and wastewater treatment, are often included in the mapping of Canadian wetlands. However, they essentially lie outside the focus of *The Canadian Wetland Classification System* and are not included in this publication.

Rationale for Wetland Classification

In general terms, wetlands are lands where water collects on the land surface long enough to promote soil development and support the types of plant and animal communities adapted to saturated conditions. Wetlands are small or large, expansive areas of the landscape where the water table is at or near the surface or where the land is covered by shallow water for much of the growing season. Wetlands are discrete entities and lie between unsaturated terrestrial upland and aquatic deep water in the landscape mosaic.

Wetland development is a function of climate (precipitation, temperature, wind and insolation), hydrology (internal and external drainage), chemistry (water and soils), geomorphology (landform and soil parent material), and biology (fauna and flora). Wetland development is dynamic as various types of wetlands represent transitions from one type to another. As a result, wetlands often share characteristics of more than one wetland class, form, subform or type. For example, peatlands may originate through the filling-in of lakes (a process referred to as "hydroseral succession" or "terrestrialization"), by growing over slow-flowing rivers and streams, or by spreading laterally from depressions into bordering uplands (a process referred to as "paludification"). These different developmental pathways, which have taken hundreds and thousands of years, are responsible for shaping a wide variety of peat landforms and types. Canada has over 150 million hectares of wetlands, an estimated 24% of all the World's wetlands (Government of Canada 1991, Pole Star Geomatics Inc. 1996) which exist in all of Canada's biogeoclimatic regions. These factors are responsible for Canada having a great diversity of wetland systems. Thus, there is a need to have a classification system for organizing the great array of wetlands with a common set of names that everyone can recognize.

As wetlands are products of the interaction of various environmental factors, they usually develop different characteristics that can be used to group them into classes. In this classification system, the greatest importance is attached to the various conditions that have affected wetland development, i.e. wetland morphology (elevation above surrounding terrain, surface form and pattern), source of water, chemistry of that water (nutrient levels, base saturation, pH), basin depth and shape, phytosociology and physiognomy (plant communities and their structure), and peat and sediment characteristics (physical and chemical properties). Thus, a combination of specific geomorphologic, hydrologic, chemical and biological factors are characteristic of wetland systems at a broad or general level of classification of wetland regimes (i.e. marine, estuarine, riverine, lacustrine and palustrine (Cowardin *et al*. 1979)).

At more detailed levels of classification, emphasis is placed on combinations of more specific factors associated with wetlands, such as specific soil environments, e.g. organic, gleysolic and cryosolic soils, as well as distinct, ecological processes and associated vegetation.

Because ecological relationships affect wetland development, the resulting wetland is characterized by specific properties that were, or are, sensitive to the environmental conditions under which that wetland developed or continues to develop. Each level of classification thus reflects the environment in which the wetland developed, whether these are climatic, hydrologic or chemical factors at a general level of classification, or specific forms of vegetative communities at a detailed level of classification.

The Canadian Wetland Classification System is presented in a series of descriptions and keys with classes defined on the bases of specific properties. The classification levels reflect genetic and environmental factors. Thus, a marsh is dominated by water fluctuation, minerotrophic conditions, and so on, while a fen, having a more stable water table, tends to occur in deeper basins and generally infills with organic deposits.

Use and Application of this Classification System

The Canadian Wetland Classification System is designed to be practical. The aim is to organize the knowledge of our wetlands based on the best available science in a way that can be used by specialists and non-specialists alike. The *System* is hierarchical in that classes are based upon features of the wetlands themselves rather than on interpretation of the wetlands for various uses. However, interpretation involves a second step — mapping — that is essential if the information is to be used effectively for wetland management. As the classes are based on obvious features of the wetlands, the divisions between classes or their combinations allow them to be readily identified in the field and then delineated on maps.

The *System* is designed to accommodate wetlands found within a large land area spanning many ecoclimatic zones and a wide range of uses by individuals and organizations with varied interests and objectives. The *System* is, to some extent, based upon an "expert systems" approach in which the user is expected to have a general knowledge of wetland processes and associated characteristics. It is relatively simple and straightforward once individuals are familiar with its basic principles. Furthermore, the *System* is intended to be used for any purpose at any geographical scale, from regional to local. The generalized key for the five wetland classes and classification keys for the wetland forms and subforms aim to help the user of the classification, but cross-referencing to detailed definitions and descriptions also may be required. The reader is referred to other publications of the National Wetlands Working Group (1986, 1987 and 1988) and the references given at the end of the text.

The following factors should be considered in using *The Canadian Wetland Classification System*:

1. Information about the area to be classified must be available before the *System* can be applied. Such information may include: historical data, aerial photographs, soil maps, general field reconnaissance, detailed knowledge about the site and discussions with local people. Where the level of detail provided by data is not sufficient to enable the user to apply the classification, additional data will be required.

2. Below the level of the wetland class, the *System* may still require refinement as new knowledge is gained. Experience with the description of wetland forms, subforms and types will govern future revisions of the classification. Wetland types may be broken down further to include more details of the vegetation communities.

3. One of the main purposes of this classification system is to provide a uniform framework for the characterization and description of wetlands throughout Canada. Users should pay particular attention to the definitions in the classification to ensure uniformity in application. A comparison of equivalent wetland names used in English and French is given in Appendix 2 to facilitate standardization and comparable usage in the two languages.

4. Classification forms the basis for inventories and mapping of wetlands. The *System*, when used for mapping, is scale-specific, both in terms of the minimum size of units mapped and attainable detail. For example, a number of possible mapping conventions might be applied to a wetland with a small, raised peatland about 50 m in diameter with a vegetation community that may vary in response to differences in depth of the peat and surface drainage. At a scale of 1:500, each vegetation community may be classified and mapped; at a 1:20 000 scale, it may be necessary to map the basin as one unit; and at a 1:100 000 scale, the entire wetland basin may be too small to map.

5. This is a scientific classification, which is different than evaluation systems developed for regulatory purposes. It does not focus on any site evaluation factor related to environmental, social or economic importance nor is the *System* intended to be a planning tool. Various evaluation methods have been published such as that by Bond *et al*. (1992) and the Ontario Ministry of Natural Resources (1993a and 1993b). However, it is hoped that *The Canadian Wetland Classification System* will be used for naming and describing various kinds of wetlands in these evaluation systems.

The wetland class and form have direct application to large wetland regions (National Wetlands Working Group 1986, 1988). The wetland *class* serves to sort the wetland *forms* and *subforms* into meaningful groupings for data storage, retrieval and interpretation. The wetland *form* is the basic wetland-mapping unit and should be readily recognized by users in a wide range of disciplines. The wetland *type*, the lowest level in this classification for mapping and describing wetlands, is most useful for the evaluation of wetland values and benefits, the management for wetland hydrology and wildlife habitat, and the conservation and protection of rare and endangered species. However, it is important to note that descriptions of wetland forms and types are only broad generalizations, relating to “average” site conditions that may change seasonally or over a period of years.

Factors Affecting the Development of Wetlands

Considering that the hydrological regime of a wetland is characterized by water level regime and fluctuations, water chemistry, or by a combination of the two (e.g. tidal saltwater versus freshwater), it is possible to classify wetlands accordingly. These high levels of hydrologic division can be further subdivided by incorporating the geomorphic setting of the wetland, the morphological features of the wetland landform, and the nature of the parent material in relation to the various wetland classes. For example, the degree of slope is a geomorphic condition, which applies to various minerogenous forms of marsh, fen, swamp and bog.

The following sections consider water chemistry and hydrologic factors affecting wetland development in Canada. The hydrologic system is not considered as a formal level within *The Canadian Wetland Classification System*. However, hydrological differentiation recognizes the importance of hydrology in the hierarchical differentiation of wetlands as well as contributing to wetland processes and development.

Development of a wetland is directly influenced by two main hydrological factors: the position of the water table relative to the surface and the chemistry of the surface water. These conditions are determined by the position of the wetland on the land surface in relation to water sources and the geochemistry of those waters.

The average depth of water, position of the water table relative to the wetland, water level fluctuations, nature and rate of inflows, and physical disturbance by wave action are important features of the hydrological regime of wetlands. Fluctuations may be compartmentalized into the frequency and duration of high and low levels. These may change within a few hours in the case of tidal situations, over several months or years related to spring snowmelt, high rainfall, and drought, or over decades in response to events such as frequent high floods or beaver ponding.

Water Chemistry Criteria for Wetland Classification

The chemistry of the water can follow different geochemical gradients. The terms "salty" and "brackish" are used to differentiate waters along the ocean coast according to the amount of dissolved salts, mostly sodium. The concentration of dissolved salts is controlled by distance from the open sea. Water losses through evaporation in inland areas can be high in arid and semi-arid regions; this can give rise to similar salinity gradients around saline lakes and wetlands. Some of the common water chemistry terms used in classifying wetlands are outlined in Figure 1.

Figure 1: Water Chemistry Criteria for Wetland Classification

SALINE AND BRACKISH WATER

- sea water influence
- salt spray influence
- inland saltwater

FRESHWATER

Minerotrophic:

- calcareous, marl bottoms
- rich (eutrophic)
- intermediate (mesotrophic)
- poor (minerotrophic-oligotrophic)

Ombrotrophic (ombro-oligotrophic):

- water and nutrients supplied by:
  - (i) precipitation;
  - (ii) water flowing down a gradient from a higher water divide (hydrosurface) with no mineral soil water influence.
- degree of ombrotrophy: depending on precipitation and degree of isolation.
  - (i) divergent with a downward component (uniform radial);
  - (ii) within a basin, or a flat or domed bog;
  - (iii) parallel flow (one or two sided), off a linear water divide;
  - (iv) sloping (such as bogs with unilateral orientation and slopes of blanket bogs), or convergent (where flow concentrates into water seepages, in feather and domed bogs).

A different set of terms are used to describe inland freshwater systems. "Minerogenous" water originates on the land surface or as groundwater where it comes in contact with mineral soils and bedrock. The water is rich in dissolved calcium, magnesium and sodium. "Soligenous" water is another hydrological term used to denote water that flows overland or on the surface in streams. The chemistry of soligenous water is largely dependent upon geology. "Ombrogenous" water originates exclusively from precipitation (rain or snow) and has a low concentration of dissolved minerals.

A similar set of terms can be devised by changing the suffixes. The "genous" suffix, used exclusively to identify the hydrological source of the water, can be changed to "trophic" to refer to the nutritional status of the water for plant growth. Hence, "minerotrophic" plant communities grow where the water has high dissolved mineral content and "ombrotrophic" plant communities are found in those areas where the water is low in dissolved minerals. The former are nutritionally "rich" communities and the latter are nutritionally "poor" communities. Minerotrophic communities can be subdivided into "extremely rich eutrophic"

communities and “intermediate mesotrophic” communities. “Ombrotrophic” plant communities represent an extreme condition of oligotrophy, in which the plants are growing in acidic waters that are poor to extremely poor in nutrients. Thus, it is possible to have wetland forms, subforms and types which reflect a gradient from eutrophy, mesotrophy, and oligotrophy to ombrotrophy as water flowing over the wetlands contains progressively less dissolved minerals. The hydrogeomorphic setting and hydrological processes in a wetland regulate geochemical gradients, which are then reflected in the composition of the plant communities found there.

Hydrologic Criteria for Wetland Classification

Wetland form, as recognized in this edition of *The Canadian Wetland Classification System*, is largely determined by the hydrological processes resulting from water exchanges dictated by climatic and landscape factors, controlling the nature and magnitude of water and solute fluxes. Wetland *hydrological systems* may be either “ombrogenous” or “minerogenous.” Figure 2 and Table 1 give a detailed picture of the further breakdown of these two systems into hydrological *subsystems*, *regimes* and *forms*. These terms refer to the origin of water and mineral nutrients that characterize the wetland system.

Ombrogenous hydrological systems receive water only from direct precipitation. They are hydrologically isolated from lateral inflows or upward seepage because of their position in the landscape. Hence, their water table is elevated above the groundwater table associated with the adjacent mineral terrain. The trophic state of the vegetation reflected in the wetland form, subform and type is thus determined by the mass flux of mineral elements in precipitation, including rain, fog and snow, plus the mass flux of mineral elements due to dry deposition. Normally this implies that the wetland hydrological system is poor in nutrients, although ombrotrophic forms, subforms and types in oceanic areas may experience considerable enrichment due to elevated ionic concentrations and quantities of precipitation. Ombrogenous wetlands occur only where precipitation normally exceeds evaporation during the growing season. Bog is the only wetland class within this category.

Minerogenous hydrological systems are normally situated at positions in the landscape lower than adjacent mineral terrain, such that water and mineral elements are introduced by groundwater or littoral sources in addition to atmospheric sources. Minerotrophic wetland forms, subforms and types are thus found here and encompass a broad range of trophic levels.

These minerogenous hydrological systems depend on the strength of their linkage with the regional water system and the physical and chemical nature of the geological environment. Unlike the ombrogenous hydrological systems, the geographic range of minerogenous systems is not restricted by local climatic conditions because the additional water source is, on average, sufficient to maintain the requisite degree of saturation for wetland processes to continue. These minerogenous hydrological systems may be subdivided into *terrigenous* or *littogenous* subsystems as summarized in Figure 2 and in Table 1. Table 1 provides an ordination of Canadian hydrological subsystems, regimes, forms and subforms organized by the hydrological systems contributing to their development.

Terrigenous hydrological subsystems are mainly hydrologically-connected to local or regional groundwater systems (a *groundwater inflow regime*) or to surface water (a *surface water inflow regime*). Surface water may be diffuse (overland flow) or channelized. Terrigenous wetland subsystems include some forms of the marsh, swamp, fen and shallow water classes.

Littogenous (which also may be referred to as “shoreline”) hydrological subsystems are mainly hydrologically-connected to a tidal water body (a *tidal regime*) or riparian non-tidal water body (a *riparian regime*). Tidal regimes may be either estuarine (i.e. salt/brackish water) or lacustrine (i.e. freshwater). Riparian regimes may be either riverine or lacustrine. Some forms of the marsh, swamp, fen and shallow water wetland classes may occur in either the tidal or riparian wetland regimes.

Figure 2: Hydrological Systems and Wetland Development in Canada

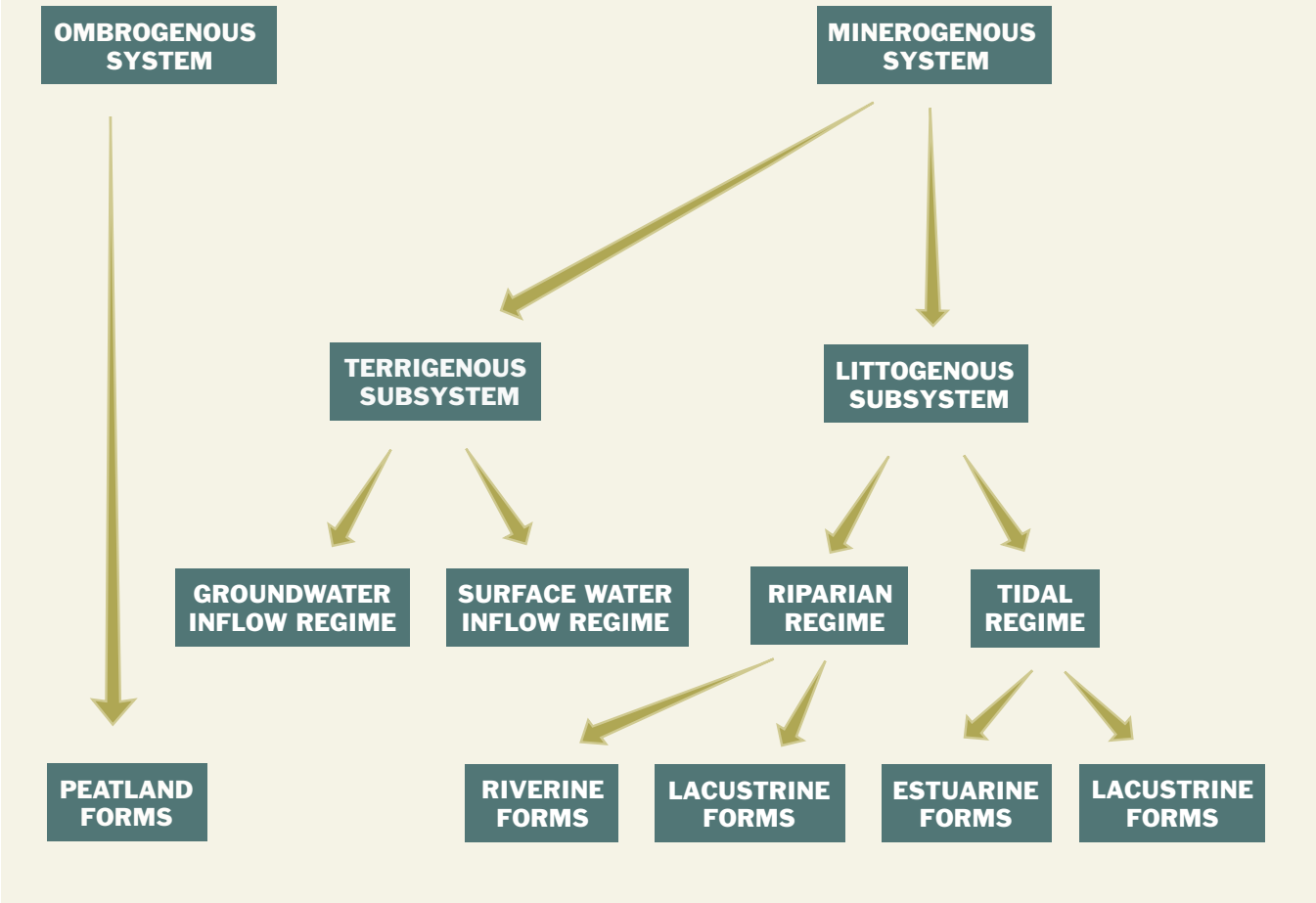


Table 1: Ordination of the Hydrological Minerogenous System

HYDROLOGICAL	HYDROLOGICAL FORMS	HYDROLOGICAL SUBFORMS
LITTOGENOUS SUBSYSTEM		
Tidal Regime	*Estuarine Forms* 1. Lagoon	• Beach • Bar
	2. Basin	• Reef • Shore
	3. Channel	• Flat • Swale
	4. Bay	
	5. Delta	• Levee Backslope • Riverine • Channel
	Lacustrine Forms 1. Riverine	• Interfluvial Basin • Swale • Shore

Table 1: Ordination of the Hydrological Minerogenous System cont'd

HYDROLOGICAL	HYDROLOGICAL FORMS	HYDROLOGICAL SUBFORMS
LITTOGENOUS SUBSYSTEM CONT'D		
Riparian Regime	*Riverine Forms* 1. Stream	• Rill • Channel • Streamshore • Island • Flowage
	2. Meltwater Channel	• Abandoned Channel • Outwash Basin • Flat • Flowage
	3. Floodplain	• Alluvial Terrace • Swale • Oxbow • Meander Scar • Levee Backslope
	4. Delta	• Shore • Interfluvial Basin • Levee Backslope • Distributory Channel • Swale
	Lacustrine Forms 1. Lakeshore	• Beach • Bar • Recession Flat • Swale • Lagoon
	2. Lake Bay	• Shoal • Bar • Island • Rock Reef
TERRIGENOUS SUBSYSTEM		
Surface Water Inflow Regime	1. Isolated a) Saline Basin b) Freshwater Basin	• Recession Flat • Swale • Slump • Blowout
	2. Linked	• Kettle • Crater • Cirque
Groundwater Inflow Regime	1. Slope	• Spring Seep • Weeping Spring • Fan
	2. Water track	• Flowage • Channel • Rill
	3. Discharge Basin a) Saline b) Freshwater c) Hummock	• Playa • Kettle • Saltspring Flat • Soaphole • Kettle • Sinkhole • Spring Pool • Slump • Cone • Dome

Wetland Classes

A classification key to the *Wetland Classes* is presented below (Table 2). The following five sections then present discussion and definition for each of the five wetland classes: bog, fen, marsh, swamp and shallow water. Classification keys and definitions of wetland forms and subforms for each class are presented.

Table 2: Classification Key to Wetland Classes

1.	Terrain affected by water table at, near or above the land surface and which is saturated for sufficient time to promote wetland or aquatic processes	2. Wetland
2.	Wetland ecosystems characterized by an accumulation of peat	3. Peatland
3.	Peatland dominated by bryophytes and graminoids	4.
4.	Peatland receiving water exclusively from precipitation and not influenced by groundwater; *Sphagnum*-dominated vegetation	Bog
4.	Peatland receiving water rich in dissolved minerals; vegetation cover composed dominantly of graminoid species and brown mosses	Fen
3.	Peatland dominated by trees, shrubs and forbs; waters are rich in dissolved minerals	Swamp
2.	Wetland ecosystems characterized by minimal or no peat accumulation, although thin layers of muck and a mix of mineral and organic muck may be present	5. Mineral Wetland
5.	Wetlands with free surface water persisting above the ground surface for variable periods or not at all. If surface water persists through the summer, water depths are sufficiently shallow to permit survival of woody or herbaceous vegetation which cover more than 25% of the surface area of the wetland	6.
6.	Periodically standing surface water and gently moving, nutrient-rich groundwater, with vegetation dominated by woody plants often more than 1 m high	Swamp
6.	Periodic or persistent standing water or slow moving surface water which is circumneutral to alkaline and generally nutrient-rich. Vegetation is dominated by graminoids, shrubs, forbs or emergent plants	Marsh
5.	Wetlands with free surface water up to 2 m deep, present for all or most of the year, with less than 25% of the surface water area occluded by standing emergent or woody plants. Submerged or floating aquatic plants usually dominate the vegetation.	Shallow Water
1.	Terrain not affected by high water table or excess surface water, or if affected, only for short periods such that hydrophytic vegetation or aquatic processes do not exist.	Upland (non-wetland)

Plate 1: Fen complex, central Labrador.
Doyle Wells, Canadian Forest Service

Plate 2: Tidal marsh near Mingan, Quebec.
Clayton Rubec, Environment Canada

Plate 3: Fens in Central Labrador.
Harry Hirvonen, Natural Resouces Canada

Plate 4: Fen complex, Kejimkujik National Park, Nova Scotia.
Clayton Rubec, Environment Canada

Plate 5: Isolated basin waters in alpine area,
Monashee Mountains, British Columbia.
Clayton Rubec, Environment Canada

Plate 6: Channel fens, James Bay Lowland
near Moosonee, Ontario.
Clayton Rubec, Environment Canada

Plate 7: Fen/open water complex, Spruce Bog Trail boardwalk, Algonquin Provincial Park, Ontario.
Clayton Rubec, Environment Canada

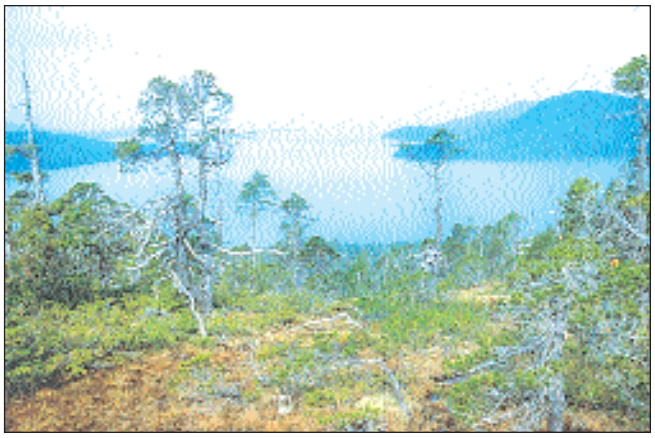


Plate 8: Lowland polygon fen near Tuktoyaktuk, Northwest Territories.
Clayton Rubec, Environment Canada

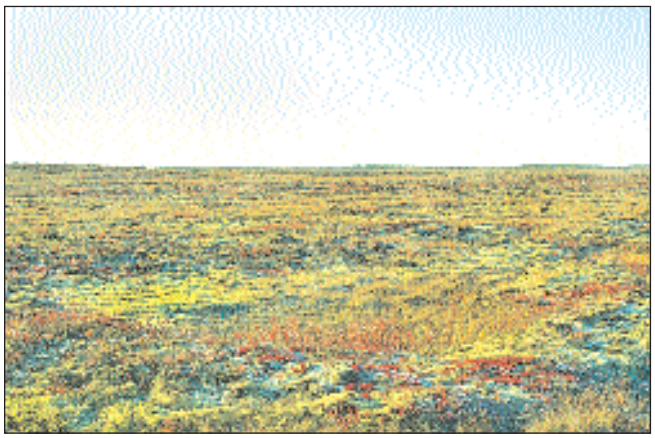


Plate 9: Domed bog near Cartwright, Labrador.
Clayton Rubec, Environment Canada

Plate 10: Shallow blanket bog, Telegraph Passage, British Columbia.
Jim Pojar, British Columbia Ministry of Forests

Plate 11: Palsa bog, Mackenzie District, Northwest Territories.
Stephen Zoltai, Canadian Forest Service

Plate 12: Bog near Inuvik, Northwest Territories.
Clayton Rubec, Environment Canada

Plate 13: Bog pools and related peatlands near Churchill, Manitoba.
Clayton Rubec, Environment Canada

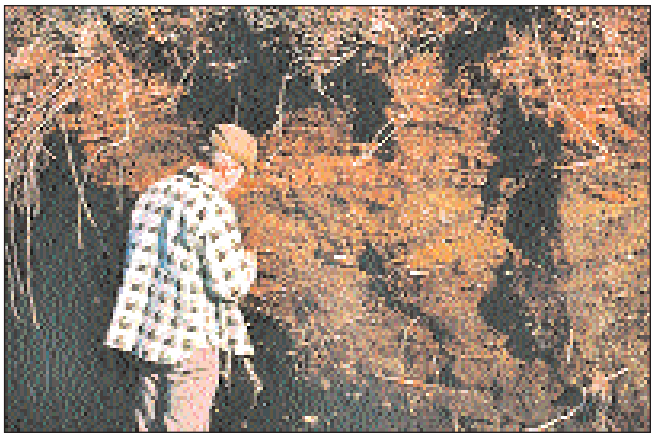


Plate 14: Eroded peatland face, edge of bog at Point Escuminac, New Brunswick.
Clayton Rubec, Environment Canada

Plate 15: Frozen peatland landscape in winter near Inuvik, Northwest Territories.
Clayton Rubec, Environment Canada

Plate 16: Tidal bay marsh, Queen Charlotte Islands, British Columbia.
Clayton Rubec, Environment Canada

Plate 17: Estuarine delta marshes, Chebogue Harbour, Nova Scotia.
Harry Hirvonen, Natural Resources Canada

Plate 18: Tidal bay marsh, Bay of Fundy, Nova Scotia.
Clayton Rubec, Environment Canada

Plate 19: Discharge basin marsh, St. Denis, Saskatchewan.
Clayton Rubec, Environment Canada

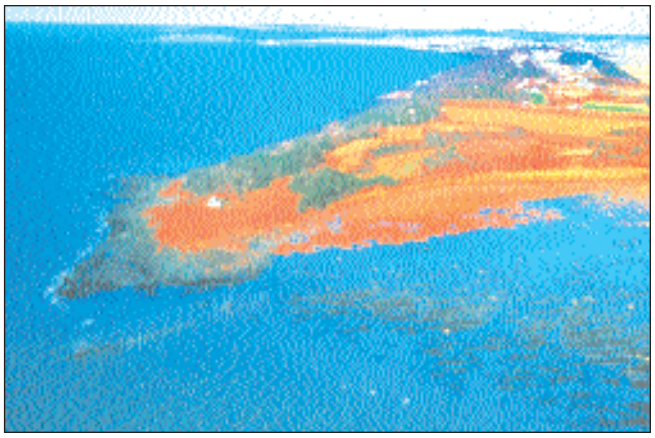


Plate 20: Tidal bay marsh, Baie de Cacouna near Rivière-de-Loup, Quebec.
Raymond Sarrazin, Environment Canada

Plate 21: Riparian marsh, Shepody Bay — Ramsar Site near Sackville, New Brunswick.
Clayton Rubec, Environment Canada

Plate 22: Pink Lady's Slipper, Purdon Bog Conservation Area near Lanark, Ontario.
Clayton Rubec, Environment Canada

Plate 23: Basin marsh, southern Saskatchewan.
Clayton Rubec, Environment Canada

Plate 24: Linked basin marsh, neat St. Denis, Saskatchewan.
Clayton Rubec, Environment Canada

Plate 25: Water track in shrub-covered fen, Heber Meadow, Kejimkujik National Park, Nova Scotia.
Clayton Rubec, Environment Canada

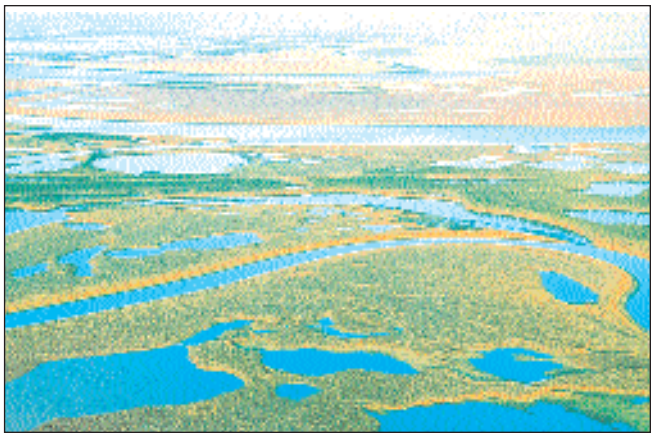


Plate 26: Delta channels and channel fens, Mackenzie River Delta, Northwest Territories.
Clayton Rubec, Environment Canada

Plate 27: Beverley Swamp, southwestern Ontario with marsh marigolds in flower and silver maple.
D. Coulson, Ontario Ministry of Natural Resources

Plate 28: Boardwalk in Waterfowl Park, Sackville, New Brunswick.
Clayton Rubec, Environment Canada

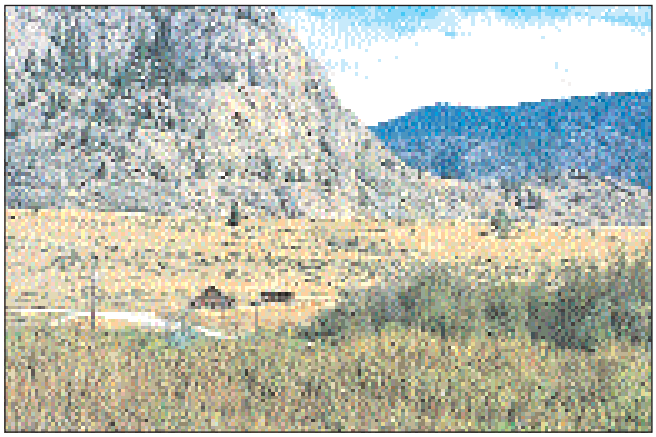


Plate 29: Basin marsh, southern Okanagan Valley, British Columbia.
Clayton Rubec, Environment Canada

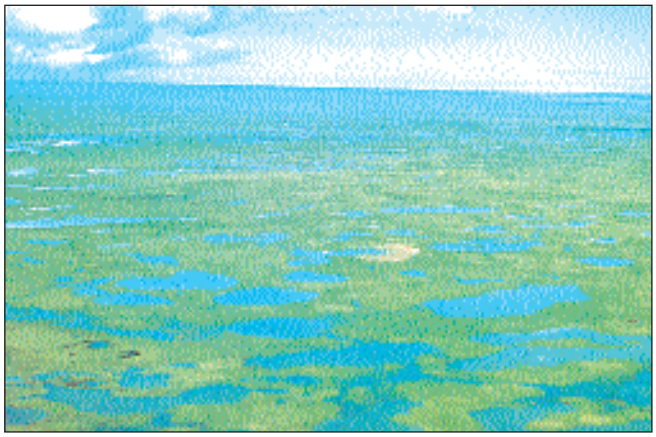


Plate 30: Fen-marsh complex, McConnell River Migratory Bird Sanctuary — Ramsar Site, Keewatin District, Northwest Territories.
Victoria Johnston, Environment Canada

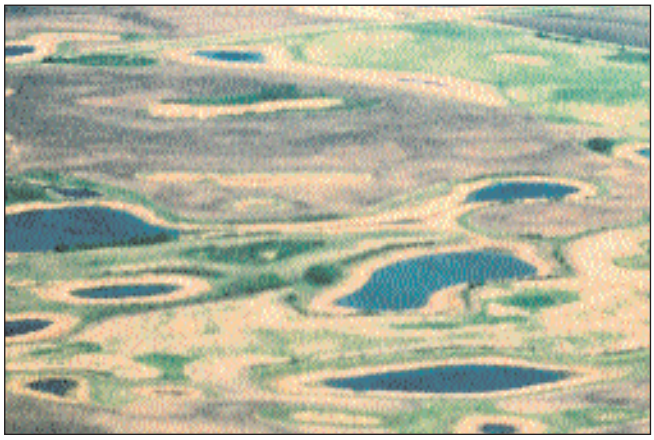


Plate 31: Basin marshes and pothole waters, Minnedosa Plain, southwest Manitoba.
Delta Waterfowl Foundation

Plate 32: Spring swamp with silver maple at South Puslinch Lake, Ontario.
Ontario Ministry of Natural Resources

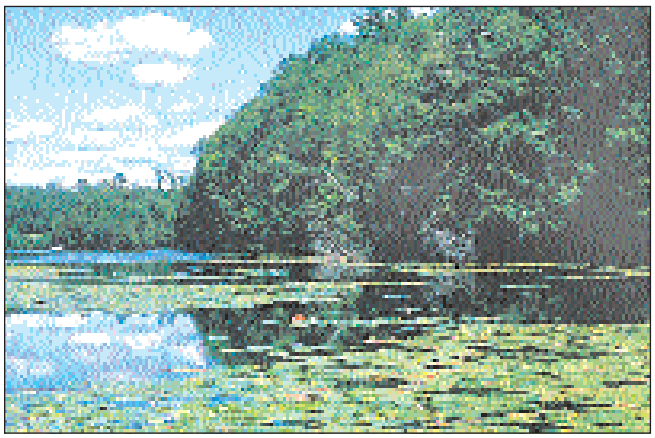


Plate 33: Lacustrine bay water with floating lily pads, Indian Lake, Chaffey's Lock, Ontario.
Clayton Rubec, Environment Canada

Plate 34: Tidal bay water mudflat at low tide, Minas Basin, Nova Scotia.
Clayton Rubec, Environment Canada

Plate 35: Marsh/basin water complex at Alaksen National Wildlife Area, Delta, British Columbia.
Clayton Rubec, Environment Canada

Plate 36: Marsh/basin water complex at Alaksen National Wildlife Area, Delta, British Columbia.
Clayton Rubec, Environment Canada

Plate 37: Beverley Swamp, southwestern Ontario.
Ontario Ministry of Natural Resources

Plate 38: Shallow water channel in the delta of Lac St-Pierre — Ramsar Site near Sorel, Quebec.
Clayton Rubec, Environment Canada

Plate 39: Floating lily plants at Indian Lake, Chaffey's Lock, Ontario.
Clayton Rubec, Environment Canada

Plate 40: Flooded swamp in Algonquin Provincial Park, eastern Ontario.
Ken Cox, North American Wetlands Conservation Council (Canada)

Plate 41: Beaver lodge in early Spring, Stoney Swamp, Nepean, Ontario.
Clayton Rubec, Environment Canada

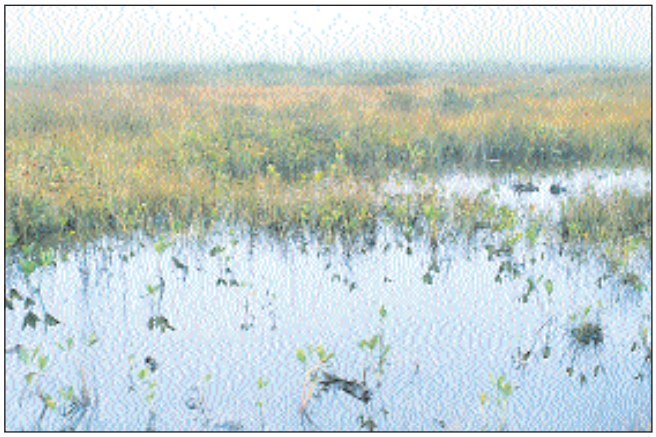


Plate 42: Tidal marsh — pool complex, near Sept-îles, Quebec.
Clayton Rubec, Environment Canada

The Mer Bleue bog near Ottawa, Ontario and one of Canada's Ramsar sites *(B.G. Warner, Wetlands Research Centre)*

Bog Wetland Class

A *bog* is a peat landform which is characterized by a variety of shapes and sizes. The bog surface, which is raised or level with the surrounding terrain, is virtually unaffected by runoff waters or groundwaters from the surrounding mineral soils. Generally the water table is at or slightly below the bog surface. As the bog surface is raised, so is the bog water table relative to the elevation of the water table at the edges of the bog. Precipitation, fog and snowmelt are the primary water sources and, thus, all bogs are ombrogenous. Given that precipitation does not contain dissolved minerals and is mildly acidic, the surface bog waters are consequently low in dissolved minerals and acidic. Bog water acidity, usually between pH 4.0 and 4.8 (Gorham and Janssens 1992), is enhanced due to the organic acids that form during decomposition of the peat and the acids present within *Sphagnum* leaves.

Bogs may be treed or treeless, and they are usually covered with *Sphagnum* spp. and ericaceous shrubs. The driest bogs, especially in permafrost terrain may be covered in dwarf shrubs and lichens. The soils are mainly Fibrisols, Mesisols and Organic Cryosols (permafrost soils).

Typically, bogs can be thought of as having two main soil layers: a surface layer and a deep layer. The surface layer is the living soil layer. It contains the roots and plants living on the bog surface and is aerobic. When the living plants complete their life cycle and die, they contribute peat to the surface soil layer where it subsequently undergoes decomposition. The dominant peat materials are poorly to moderately decomposed *Sphagnum* and woody peat, possibly with some sedge peat mixed throughout, especially in the deepest parts of the bog. Water flow through this surface layer is several orders of magnitude faster than in the deeper layer. The hydrological processes occurring within the surface layer, as well as the overall shape and size of the peat landform, give rise to the development of a great number of patterns of peat and pools on the bog surfaces. The lower limit of the water table in the bog is the approximate marker between the surface layer and the deeper soil layer. The deeper layer may be about 30 cm to an average of 3 to 5 m thick. There are reports of depths of up to 10 m in exceptional cases in Canada. Here the peat is water-logged and poorly oxygenated or completely devoid of oxygen. Whatever peat survives decomposition in the surface layer eventually becomes waterlogged and stored in the deeper soil layer. The peat in the deeper layer may be composed of the remains of *Sphagnum* spp. and ericaceous shrubs and cottongrass (*Eriophorum* spp.). Most peat in bogs shows stratification. Many bogs started out as fens and may even have aquatic peat in the deepest layers. Only in transition from fen to bog will there be mixed “bog” peat with *Sphagnum* and ericaceous shrubs and “fen” peat with the remains of more minerotrophic plants such as brown mosses, sedges and shrubs. Polygonal peat plateaus and palsas contain mostly fen peat and bog peat is only a thin layer on the surface.

The primary characteristics of bogs are:

(1) an accumulation of peat;
(2) surface raised or level with surrounding terrain;
(3) water table at or slightly below the surface and raised above the surrounding terrain;
(4) ombrogenous;
(5) moderately decomposed *Sphagnum* peat with woody remains of shrubs; and
(6) most frequently dominated by *Sphagnum* mosses with tree, shrub or treeless vegetation cover.

Bog Wetland Forms and Subforms

All bog wetland forms contain the features that define the bog wetland class. Differences in surface form, relief or proximity to water bodies are the main criteria that differentiate bog forms and subforms. Table 3 presents a classification key to the bog wetland forms and subforms.

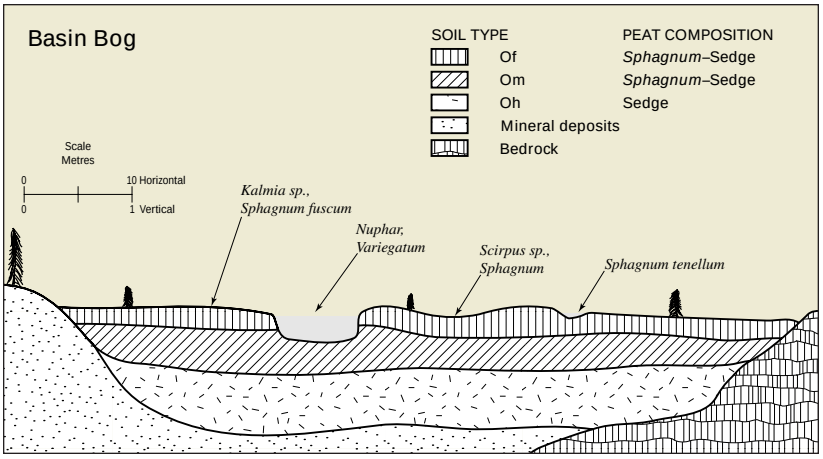
BASIN BOG

Basin bogs are situated in basins with a flat surface across the entire peatland. There are no surface feeder streams. Water is received from precipitation (rain and snowmelt) and runoff from the immediate surroundings of the basin. The thickest accumulation of peat is generally in the centre of the basin.

Characteristic features are:

(a) confinement to a basin with a relatively flat surface.

(b) surface not raised.



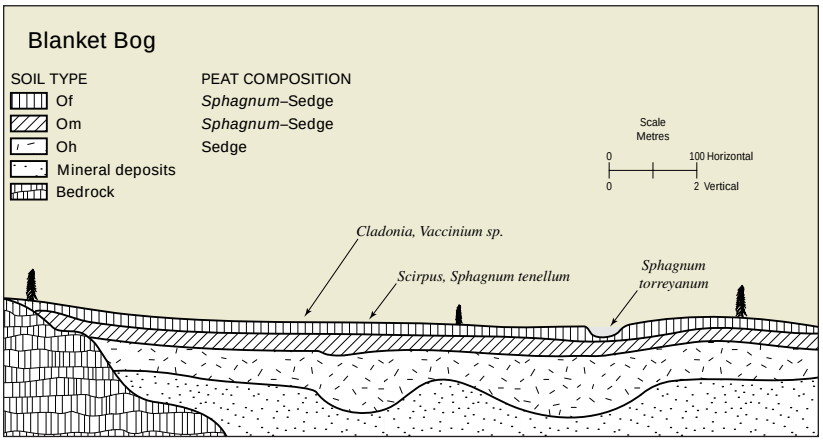
BLANKET BOG

Blanket bogs are expansive and widespread peatlands that cover gentle slopes around valleys and on hillsides. The surface is uniform and lacks pools. Peat depths seldom exceed 2 m.

Characteristic features are:

(a) widespread peat on gentle sloping terrain.

(b) no pools on surface.



COLLAPSE SCAR BOG

Collapse scar bogs are circular or oval-shaped wet depressions in perennially frozen peatland. They originated as perennially frozen peatland and subsequently the permafrost thawed which caused the surface to subside. Surface waters are poor in dissolved minerals because they are not affected by mineral-rich waters in adjacent fens.

Characteristic features are:

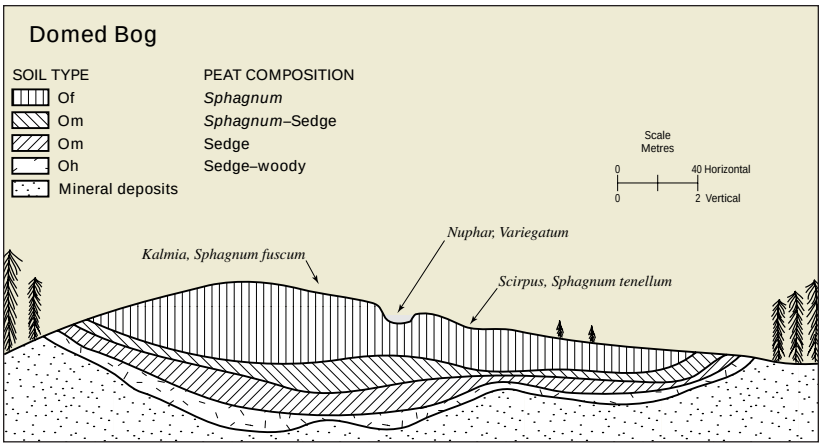
(a) small, wet depressions on perennially frozen peatland.

(b) developed entirely in peatland terrain and not in contact with mineral soils.

(c) waters poor in dissolved minerals.

DOMED BOG

Domed bogs are usually at least 500 m in diameter, with a convex surface which can be several metres higher than the edges of the wetland and surrounding terrain. Drainage radiates outwards from the centre, the highest part of the bog. Small, crescentic pools may form a concentric pattern if the highest part of the bog is in the centre, or an eccentric pattern if the highest part of the bog is off-centre. Peat depth is usually in excess of 3 m.



Characteristic features are:

(a) convex surface which can be several metres higher at the centre than at the edges.
(b) concentric or eccentric pattern of pools.

FLAT BOG

Flat bogs are not confined by a discrete basin and, therefore, occur in broad, poorly defined lowland areas. These bogs are not found on sloping terrain. The surface is more or less uniform and featureless and the depth of the peat is generally uniform across the entire peatland.

Characteristic features are:

(a) topographically unconfined in relatively flat terrain.
(b) surface is flat.
(c) relatively uniform peat depths.

LOWLAND POLYGON BOG

Lowland polygon bogs have flat or convex surfaces which are polygonal in shape (often referred to as "high-centre polygons") in permafrost regions. Individual polygons are elevated above wet trenches over ice wedges which define individual polygon bogs.

Characteristic features are:

(a) perennially frozen.
(b) polygonal in shape.
(c) surface convex or flat but higher than adjacent peatlands.

MOUND BOG

Mound bogs usually are small (up to 3 m in diameter and 0.5 to 1 m in height), discrete mounds of peat situated in or surrounded by fen. Mound bogs are sometimes referred to as "fen hummocks." Roots of bog plants are elevated above mineral-rich waters which flow below and around the bog. Several mound bogs may coalesce to form larger bog "islands."

Characteristic features are:

(a) usually quite small.
(b) convex surface.
(c) surrounded by fen.

PALSA BOG

Palsa bogs are mounds of perennially frozen peat and mineral soil, up to 5 m high, with a maximum diameter of 100 m. The surface is convex in shape and highly uneven. Collapse scar bogs may be found in association with palsa bogs. Fens commonly occur around palsa bogs.

Characteristic features are:

(a) perennially frozen.
(b) surface raised or convex.
(c) surface at least 1 m higher than its edge or surrounding fen.

PEAT MOUND BOG

Peat mound bogs are similar to mound bogs except that they occur in permafrost regions. They are small (less than 3 m in diameter) mounds of frozen peat, rising less than 1 m above adjacent, perennially frozen fen.

Characteristic features are:

(a) perennially frozen.
(b) surface raised or convex.
(c) small, usually less than 3 m in diameter and 1 m high.
(d) usually surrounded by fen.

PEAT PLATEAU BOG

Peat plateau bogs are composed of perennially frozen peat that are sharply defined. The surface sits about 1 m higher than unfrozen fen that surrounds it. The surface is relatively flat, even and often covers large areas. Peat plateau bogs appear to have developed under non-permafrost conditions which subsequently became elevated and permanently frozen. Collapse scar bogs are commonly found with peat plateau bogs. These bogs are common in areas of discontinuous permafrost.

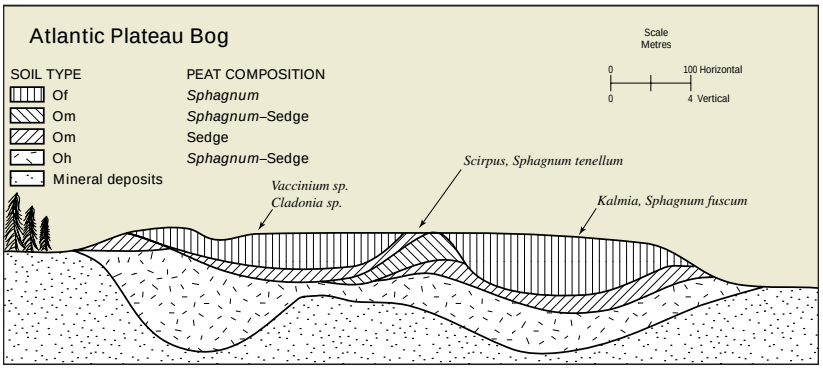
Characteristic features are:

(a) perennially frozen.
(b) sharply defined.
(c) surface is at least 1 m higher than adjacent unfrozen fen.

PLATEAU BOG

Plateau bogs are raised above the surrounding terrain. Their edges are often steeply sloping downwards to adjacent fen or mineral terrain. Two Plateau Bog subforms are recognized:

Atlantic Plateau Bog: These bogs have a flat to undulating surface raised above the surrounding terrain with the steep edges sloping downwards to surrounding mineral terrain. Pools that are often quite large with depths of 2 to 4 m are scattered on the bog surface.



Characteristic features are:

(a) raised surface above mineral terrain with steeply sloping edges.
(b) numerous small and large, deep (2 to 4 m) bog pools.
(c) commonly found in the Atlantic Wetland Regions.

Northern Plateau Bog: These bogs are raised bogs elevated 0.5 to 1 m higher than surrounding fen. The surface is more or less flat and contains numerous small shallow pools. The bog may be teardrop-shaped in northern regions with the pointed end oriented in the downslope direction.

Characteristic features are:

(a) raised above surrounding fen with steep sloping edges.
(b) often oval and teardrop-shaped.
(c) numerous small shallow pools.
(d) commonly found in the Boreal Wetland Region.

POLYGONAL PEAT PLATEAU BOG

Polygonal peat plateau bogs are perennially frozen bogs, rising about 1 m above the surrounding fen. The surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges. The permafrost and ice wedges developed in peat originally deposited in a non-permafrost environment.

Characteristic features are:

(a) perennially frozen polygon.
(b) surrounded by fen.

RIPARIAN BOG

Riparian bogs form on edges of ponds, lakeshores or banks of slow-flowing streams and rivers. Two Riparian Bog subforms are recognized:

Floating Bog: These bogs are on or adjacent to open water bodies that occur as a floating mat, underlain by water or watery peat. The surface of the bog is sufficiently elevated for the rooting zone to be free from contact with a mineral-rich water table.
Characteristic features are:

(a) flat surface.
(b) floating at the edges of ponds, lakes, streams or rivers.

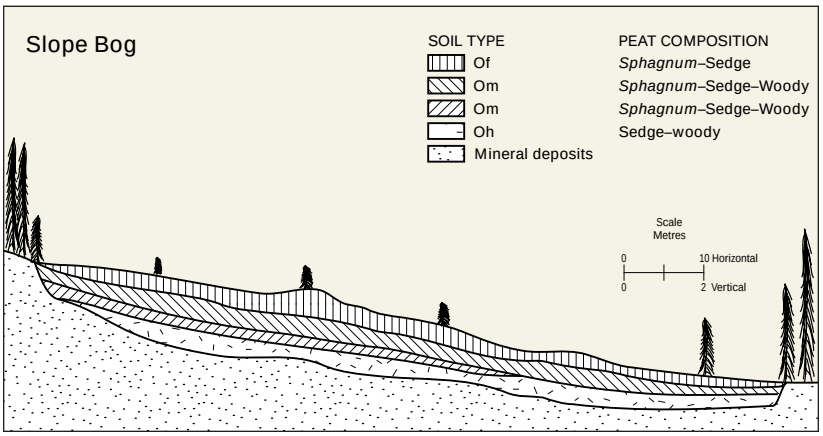
Shore Bog: These bogs occur in a similar hydrogeomorphic setting as floating bogs but differ by not floating. The surface is elevated at least 0.5 m above the water table. A shore bog may develop a floating bog onto the surface of the open water body.
Characteristic features are:

(a) flat surface.
(b) anchored at the edges of ponds, lakes, streams or rivers.

SLOPE BOG

Slope bogs occur in areas of high rainfall on sloping terrain. Waters on these bogs come from precipitation and drainage waters from adjacent peatlands which are poor in dissolved minerals. Peat depths may exceed 1 m.
Characteristic features are:

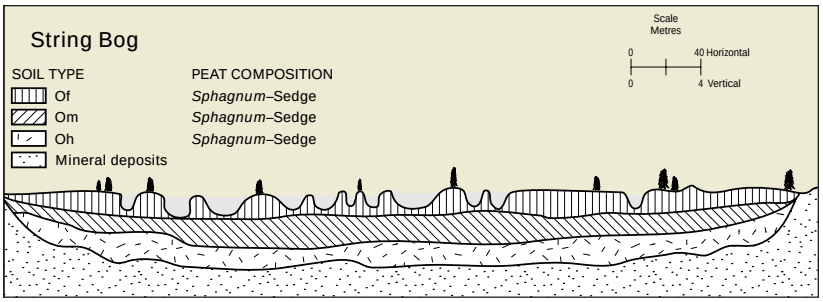
(a) surface level with surrounding terrain.
(b) in non-permafrost terrain.



STRING BOG

String bogs have a pattern of narrow (2 to 3 m wide), low (less than 1 m high) ridges of peat oriented at right angles to the direction of drainage. Wet depressions or pools occur between the ridges. The water and peat are low in dissolved minerals because the water originated in other ombrotrophic peatlands. Peat thickness exceeds 1 m.
Characteristic features are:

(a) surface of narrow peat ridges and pools oriented at right angles to water flow.



VENEER BOG

Veneer bogs occur on gentle slopes that are underlain by discontinuous permafrost. Although drainage is predominantly below the bog surface, surface flow may occur in poorly defined drainageways during peak runoff. Peat thickness is usually less than 1.5 m.
Characteristic features are:

(a) gently sloping to level terrain.
(b) the distribution of permafrost and depth of active layer varies year to year.

Table 3: Classification Key to Bog Wetland Forms and Subforms

1. Surface raised above surrounding terrain	
2. Surface convex	
3. Core frozen; abruptly domed; usually in fens	
4. Over 1 m high, diameter up to 100 m	Palsa Bog
4. Less than 1 m high, diameter up to 3 m	Peat Mound Bog
3. Not perennially frozen	
5. Convex surface small (1 to 3 m diameter); occurring in fens	Mound Bog
5. Convex surface often extensive; not occurring in fens	Domed Bog
2. Surface flat to irregular	
6. Perennially Frozen	
7. Surface with network of polygonal fissures	
8. Surface even	Polygonal Peat Plateau Bog
8. Surface with high centres in a polygonal network	Lowland Polygon Bog
7. Surface without polygonal fissures; surface about 1 m above the surrounding fen	Peat Plateau Bog
6. Not perennially frozen	Plateau Bog
9. Bogs generally teardrop-shaped	*Northern Plateau Bog*
9. Bogs not teardrop-shaped; abundance of surface water	*Atlantic Plateau Bog*
1. Surface not raised above surrounding terrain	
10. Surface relatively level	
11. With abrupt marginal peat walls	Collapse Scar Bog
11. Without marginal peat walls	
12. Adjacent to lakes and slow flowing rivers	Riparian Bog
13. Floating	*Floating Bog*
13. Not floating	*Shore Bog*
12. Not adjacent to water bodies	
14. Surface flat; topographically confined	
15. Basin deposit; depth greater in centre	Basin Bog
15. Flat deposit; depth generally uniform	Flat Bog
14. Surface flat to undulating often appreciably sloping	
16. Surface pattern of ridges and pools distinct	String Bog
16. Surface pattern of pools usually absent; extensive	Blanket Bog
10. Surface not level; appreciably sloping	
17. In non-permafrost terrain	Slope Bog
17. In permafrost terrain	Veneer Bog

Flat Bog in northwestern Ontario *(B.G. Warner, Wetlands Research Centre)*

Bog and Fen complex near Moosonee, Ontario *(C.D.A. Rubec, Environment Canada)*

Fen Wetland Class

A *fen* is a peatland with a fluctuating water table. The waters in fens are rich in dissolved minerals and, therefore, are minerotrophic. Groundwater and surface water movement is a common characteristic of fens. Surface flow may be directed through channels, pools, and other open water bodies that can form characteristic surface patterns. The dominant materials are moderately decomposed sedge and brown moss peats of variable thickness. The soils are mainly Mesisols, Humisols and Organic Cryosols.

The vegetation on fens is closely related to the depth of the water table and the chemistry of the waters present. The composition of vegetation may also reflect regional geographic variations. In general, graminoid vegetation and some bryophytes dominate wetter fens where the water table is above the surface. Shrubs are prominent in drier fens where the water table is lower. Trees appear on the driest fen sites where microtopographic features such as moss hummocks provide habitats as much as 20 cm above the water table. Sites in fens with waters extremely low in dissolved minerals are poor fens and have *Sphagnum* mosses and ericaceous shrubs. Trees, if present, are usually black spruce. Fens with slightly higher concentrations of dissolved minerals are moderately rich fens and are dominated by sedges and brown mosses (such as *Drepanocladus* sp.). The drier, rich fens have shrubs such as *Betula* spp., *Salix* spp., and *Larix laricina*. The extremely rich fens have sedge and brown mosses (e.g. *Scorpidium* sp.), as well as shrubs (*Betula* spp.) and *Larix laricina*, if the fen surface is not too wet.

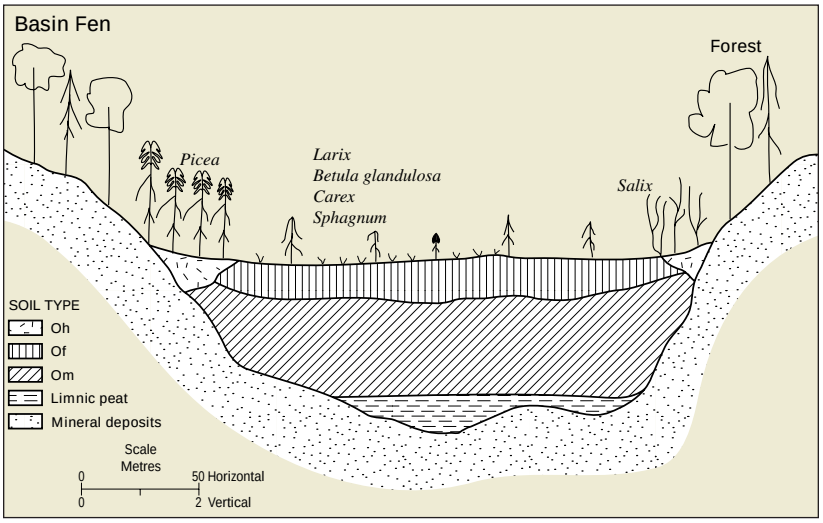
The primary characteristics of fens are:
(1) an accumulation of peat;
(2) surface is level with the water table, with water flow on the surface and through the subsurface;
(3) fluctuating water table which may be at, or a few centimeters above or below, the surface;
(4) minerogenous;
(5) decomposed sedge or brown moss peat; and
(6) graminoids and shrubs characterize the vegetation cover.

Fen Wetland Forms and Subforms

All fen wetland forms differ from one another in surface pattern, surface relief, proximity to water bodies and basin topography. Some fens may contain more than one wetland form, and as such, represent fen complexes that are described below. In other cases, fens may be more simple and are defined on the basis of the most dominant form. Table 4 presents a classification key to the fen wetland forms and subforms.

BASIN FEN

Basin fens are topographically confined to basins. The basins may be entirely isolated and closed to both surface inflow or outflow feeder streams, or they may lack only inflowing streams but will have a surface outflow. Most of the water is derived from any combination of sources from precipitation falling directly on the fen, surface runoff from the surrounding slopes and groundwater. The chemistry of the fen surface water, therefore, reflects the origin of the water entering the fen and the flow characteristics within the fen. The surface of the fen can be flat or slightly concave. The thickness of the peat is variable, most often in excess of 2 m, and consists mainly of mesic peat. Some basins originate as open water wetlands which later fill in and become grown over by fen vegetation.



Characteristic features are:
(a) a well defined basin.
(b) no surface inlets.

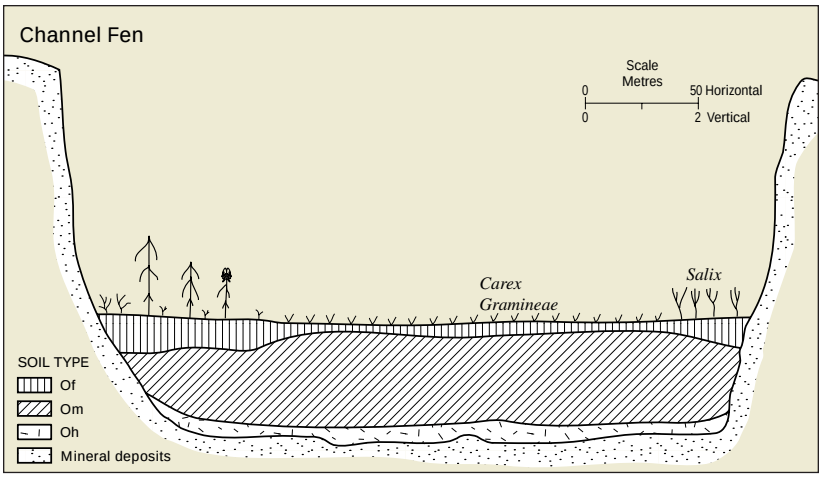
CHANNEL FEN

Channel fens occupy well-defined channels which at present do not contain an actively flowing stream. They are developed in abandoned glacial meltwater channels, glacial spillways, old river and stream channels or any other channel features which have either lost their source of water and dried up or contain a very much smaller remnant stream continuing to flow in the channel. These channels provide the opportunity for fen peat to accumulate. Small streams may persist and flow slowly across the fen. The depth of peat varies with the geomorphology and hydrological setting but may exceed 2 m. The surface of the peat is generally level or slightly concave in cross-section with some down gradient gentle slope.

Characteristic features are:

(a) well-defined, abandoned channel.

(b) small stream flowing across the fen.



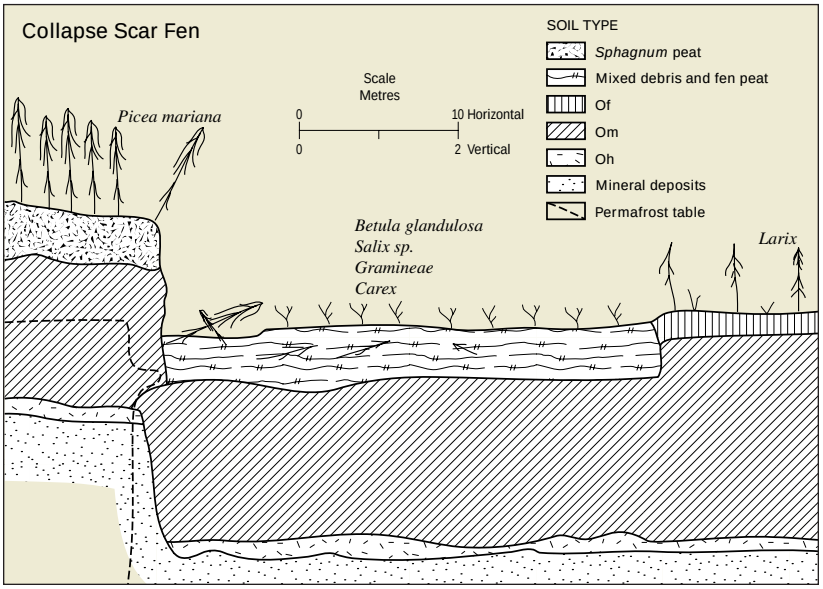
COLLAPSE SCAR FEN

Collapse scar fens are small peatlands that originated through subsidence of a part of a palsa fen. Melting of the permafrost in palsa fens causes the peatland surface to subside to the same level or slightly below the water table around the palsa. The collapse scars are often circular or oval in outline, usually at the edge of a palsa fen. Dead trees leaning in all directions and other drowned vegetation are characteristic owing to the subsidence. The peat is deep, usually in excess of 2 m, and consists of debris from the drowned vegetation and mesic peat of the fen. Collapse scar fens are wet.

Characteristic features are:

(a) a more or less circular or oval outline at the edge of or adjacent to palsa fens.

(b) dead trees often leaning in all directions with other drowned vegetation.

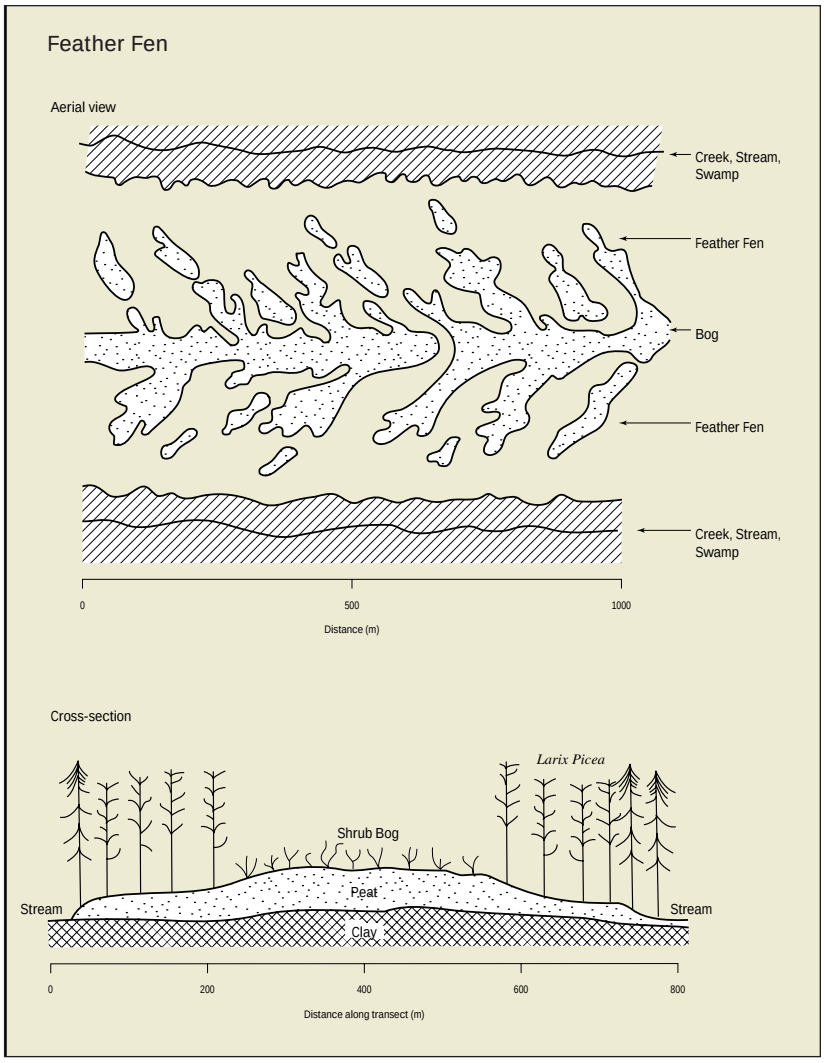


FEATHER FEN

Feather fens are situated along long, narrow, low ridges of mineral soil mixed with contiguous and/or detached bog forms which occupy the slightly elevated sites. Feather fens are formed in narrow drainageways downslope from bogs. Water in feather fens is usually directed by streams running parallel to mineral soil ridges. Peat thicknesses are usually less than 2 m.

Characteristic features are:

(a) narrow and elongated fen mixed with bog which gives feathery surface patterns when viewed from the air.



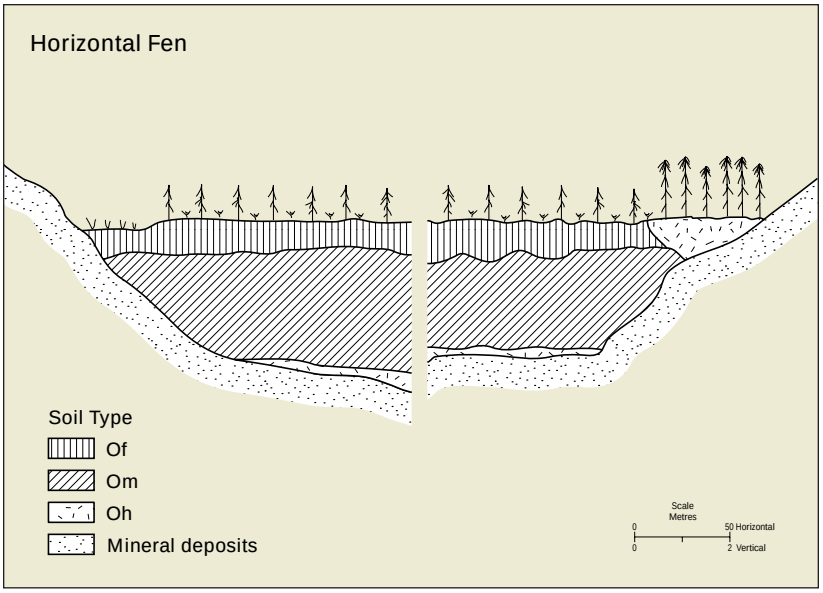
HORIZONTAL FEN

Horizontal fens occupy broad, ill-defined depressions. They occur on gentle slopes and are characterized by featureless surfaces. They are usually uniformly vegetated by graminoid, shrub or tree species. Some patterns, such as water tracks or somewhat drier treed “islands” may be present. Peat thickness varies from 2 to 3 m, depending on the topography of the underlying mineral substrate. Fibric peat is commonly found over mesic peat.

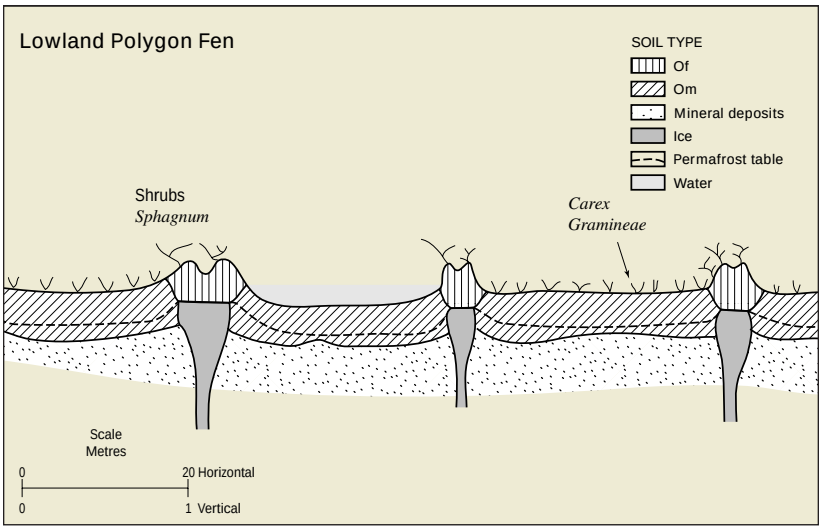
Characteristic features are:

(a) generally featureless, uniform peatland surface.

(b) subtle gradation of fen into adjacent upland.



LOWLAND POLYGON FEN



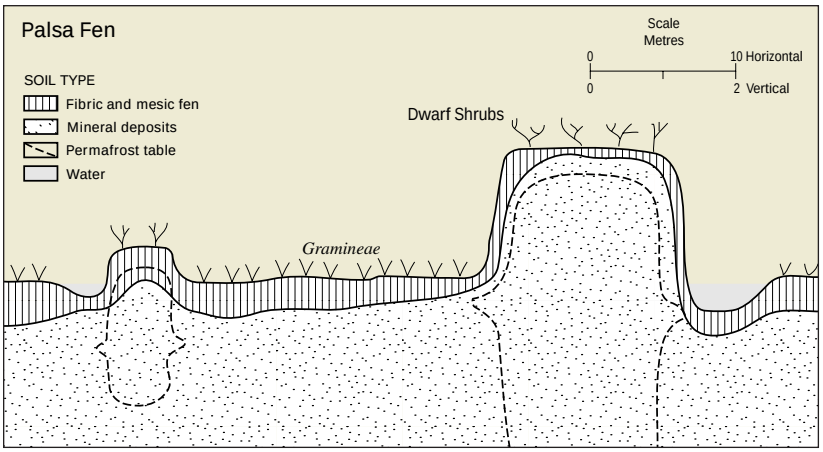
Lowland polygon fens occur in lowlands in permafrost terrain where intense winter cold causes the formation of polygonal cracks. These fens have distinct polygonal patterning produced by displacement of soil and peat. Graminoid vegetation characterizes wet low centres of the polygons. Peat-forming mosses occur along the edges of the polygons and in the trenches between polygons. Peat seldom exceeds 70 cm in the centre of the polygons.

Characteristic features are:

(a) occurrence on ice wedges in polygon pattern at the edge of peat polygons.

(b) occurrence in centres of polygons which are low and wet, with minimal peat accumulation.

PALSA FEN



Palsa fens are mounds of perennially frozen peat and mineral material, more or less circular in outline. Most palsa fens are usually much smaller, but in extreme cases may reach heights of up to 5 m above the surrounding terrain and diameters of up to 100 m. They are composed of moderately to well decomposed sedge and brown moss peat of varying thicknesses. The peat cover may be thin (less than 50 cm) and most of the palsa may be frozen mineral material and ice. The vegetation cover usually consists of sedges, mosses and shrubs. Trees are usually absent from the palsa mounds. Unfrozen and usually wet fen may surround the palsa. The term “palsa fen” is used to refer to both palsa mounds proper and their immediate vicinity, and an entire low-lying fen area with scattered palsa mounds throughout it. Collapse scar fens may occur in association with palsa fens.

Characteristic features are:

(a) perennially frozen, treeless mounds of peat (palsas) in a fen.

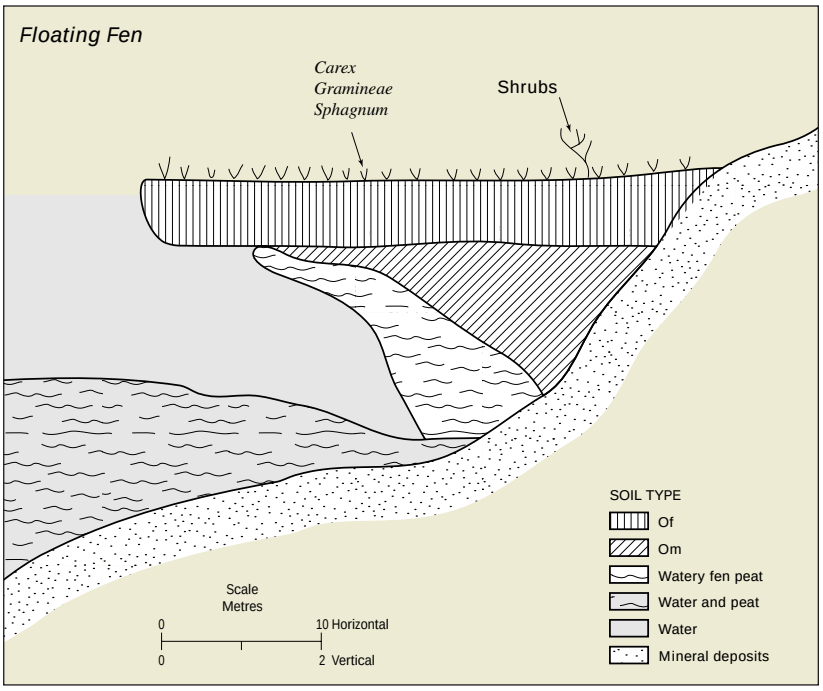
RIPARIAN FEN

Riparian fens develop adjacent to lakes, ponds and streams. The water table is influenced by the adjacent water bodies. Riparian fens may be subject to periodic flooding and display distinctive subforms based on their hydrological and peat characteristics. Three Riparian Fen subforms are recognized as follows:

Floating Fen: These fens occur adjacent to ponds or lakes and are underlain by water or a mixed water and peat. The peat surface is generally less than 0.5 m above the lake level, and the rooting zone may be in contact with the lake water. The surface peat mat is usually formed by intertwining roots of graminoids and other kinds of vegetation. The underlying peat can be debris originating either from the fen or the lake, or both. The mats often extend from the shore and float on the water surface. In some fens, living *Typha* sp. mats can break free from their substratum and float on the water to form fen communities. Buoyancy of the floating mat is thought to be aided by methane trapped in the submerged peat in the mat.

Characteristic features are:

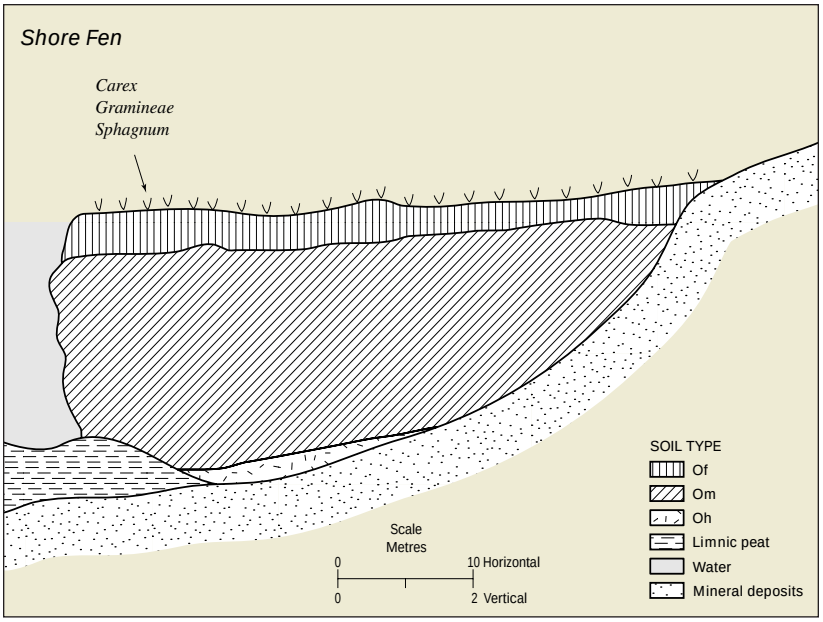
(a) fen mat adjacent to ponds or lakes.
(b) soft, buoyant mat underlain by water or mixed water and peat.



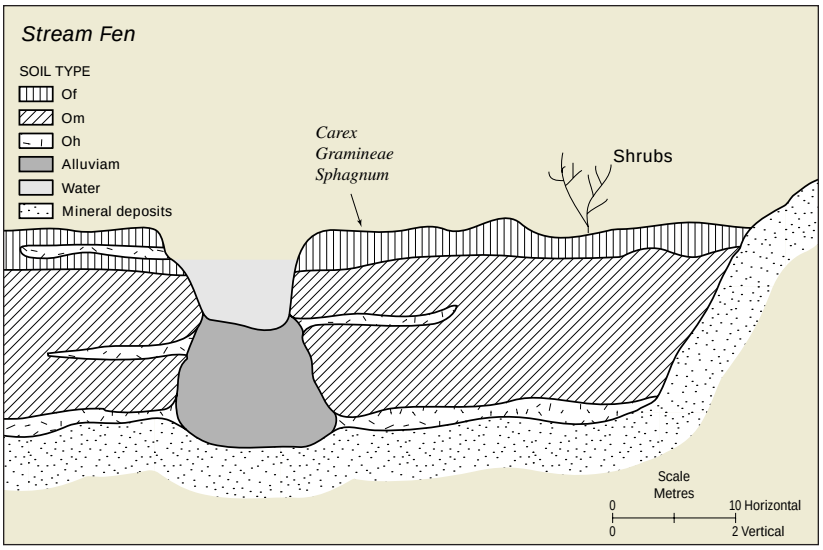
Shore Fen: These fens are situated adjacent to lakes or ponds where peat forms the shore. The surface peat does not float and is firmly anchored. In some instances, peat accumulation can impede drainage which contributes to a rise in water levels in the lake or pond and subsequent flooding of the fen around the shore. Shore fens usually contain moderately to well decomposed sedge, bryophytic or aquatic vascular plant peat. Mosses or herbaceous plants occur closest to the water and trees. Shrubs, if present, are farther away from the lake or pond edge. Peat depth usually exceeds 2 m.

Characteristic features are:

(a) situated along the shores of a lake or edge of a pond.
(b) absence of susceptibility to flooding by lake or pond waters.



Stream Fen: These fens are located in the main channel or along the banks of permanent or semi-permanent streams. The generally low gradient and slow water flow in the stream allows peat to form along the edges of the stream. Peat, consisting chiefly of moderately to well decomposed graminoid remains, forms the banks of the stream. The peat may include inorganic layers, deposited during flood stages. The peat depth is variable, and it is often in excess of 3 m. The water table of the fen is affected by the stream levels, both at normal and flood stages.



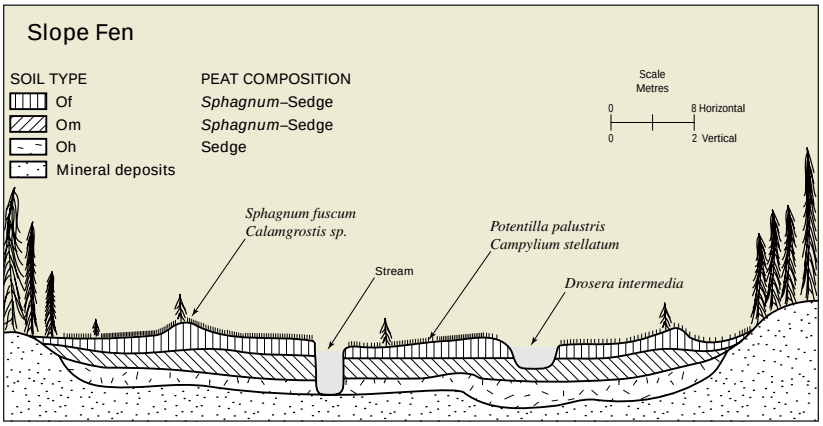
Characteristic features are:

(a) located along the main channel of a slow flowing stream.

(b) peat forming much of the banks of the stream.

SLOPE FEN

Slope fens develop on slopes in areas of high rainfall. Such slopes are also influenced by mineral-rich water from the surrounding mineral soils. The surface of the fen is sloping, commonly 5 to 30 degrees. Pools are usually absent, but wet seepage tracks may be present. The peat is usually well to moderately decomposed and may reach depths of 1 to 2 m.



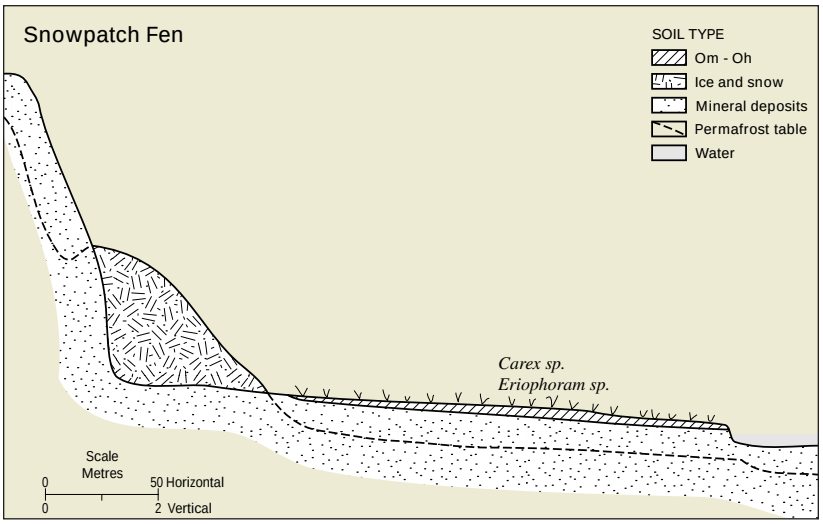
Characteristic features are:

(a) occurrence on sloping terrain.

(b) peat ridges and pools are absent.

SNOWPATCH FEN

Snowpatch fens occur on slopes below perennial or late-melting snowbanks that accumulate on the lee side of hills in the Arctic Wetland Region. The meltwater is not channelized on gentle slopes (less than three degrees) and provides a steady source of water to the fen downslope from the snowpatch. The peat is usually shallow (less than 20 cm) and is composed of well to moderately decomposed sedge or cottongrass remains. Snowpatch fens are underlain by heavily gleyed mineral soil and permafrost which exists within 50 cm of the surface.



Characteristic features are:

(a) occurrence on slopes below perennial snowpatches in the Arctic Wetland Region.

(b) thin peat is underlain by permafrost.

SPRING FEN

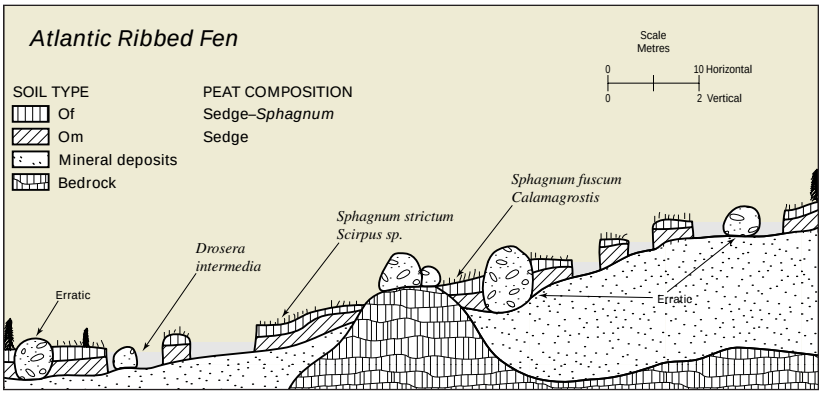
Spring fens are nourished by a continuous discharge of groundwater. The fen surface is marked by prominent drainage tracks, pools and occasionally, somewhat elevated peat "islands." The amount of dissolved minerals is highly variable, depending upon the substrate through which it has passed. In some areas, the groundwater can be highly mineral-rich with calcium, which can form a precipitate in the pools to form marl. The peat thickness often exceeds 2 m and it may be intermixed with layers of aquatic peat or marl. Characteristic features are:

(a) prominent drainage tracks originating from a water discharge area in a fen.
(b) often contains highly mineral-rich groundwater.

STRING FEN

String fens develop on sloping terrain and are characterized by narrow, peaty ridges ("strings") that enclose open water pools or depressions of open water ("flarks") or wet fen surfaces. The strings develop at right angles to the direction of surface flow. These strings act as small dams which impede water flow. This gives rise to a downslope stepped pattern from one flark and string to the next ones. The configuration and spacing of the strings appear to relate to the slope gradient: the strings are more closely spaced on steep slopes, and farther apart and more poorly defined on gentler gradients. String fens display four distinctive subforms based on peat thickness, surface configuration and drainage conditions, as follows:

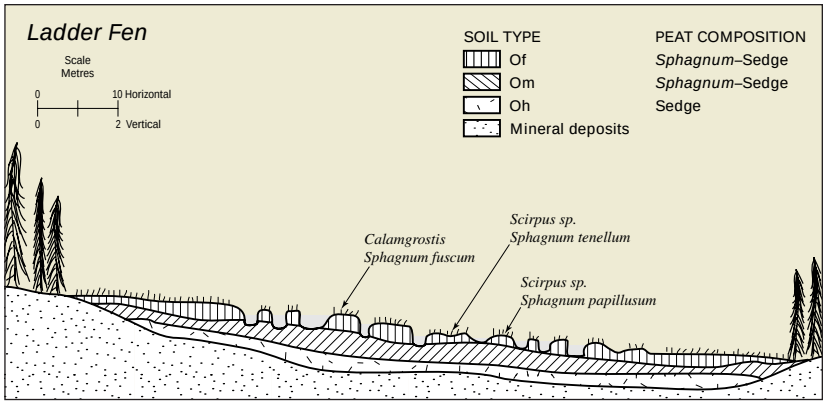
Atlantic Ribbed Fen: These fens occur on sloping terrain (5 to 30 degree slopes) in Newfoundland, Labrador and the adjacent parts of Quebec. They are characterized by narrow (usually less than 1 m wide) peat ridges that are oriented at right angles to the downslope. The ridges are steep-sided and consist of relatively thin (less than 1.5 m deep) peat that acts as an effective barrier to water flow. Shallow pools (less than 1 m deep) are enclosed between the ridges. The pools, oriented at right angles to the slope, comprise about 40 to 50% of the fen area.



Characteristic features are:

(a) occurrence in cool, humid area of Newfoundland, Labrador and adjacent Quebec.
(b) narrow, shallow peat ridges oriented at right angles to slope.
(c) shallow pools enclosed by peat ridges.

Ladder Fen: These fens occur as a narrow strip along the edges of domed bogs. They contain a series of parallel, low peat ridges which enclose narrow pools. The peat ridges are oriented at right angles to surface flow. Ladder fens act as drainageways for waters received from adjacent domed bogs and upland. The fens are developed on moderate slopes (3 to 6 degrees). The peat is usually 1 to 2 m deep and consists mainly of moderately to well decomposed *Sphagnum* spp. and sedge remains.

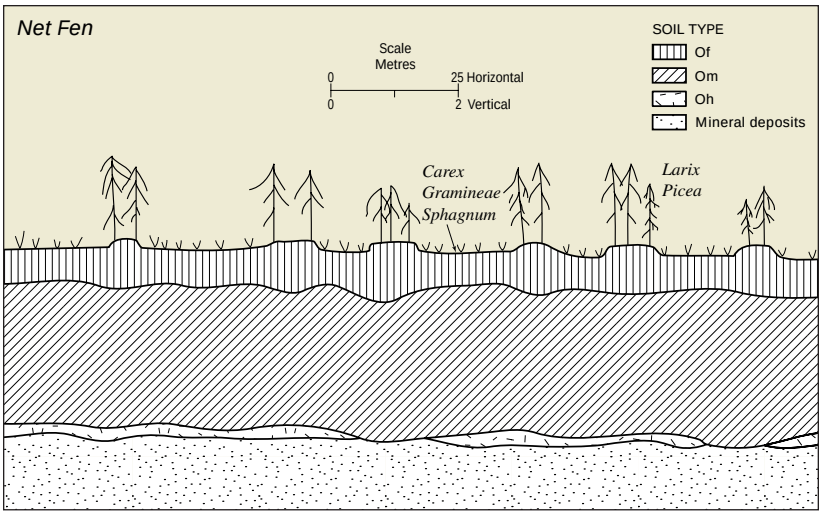


Characteristic features are:

(a) narrow (less than 20 m wide) strips of fen between domed bogs and upland.
(b) narrow peat strings and pools oriented perpendicular to the direction of surface flow.

Net Fen: These fens display a broad pattern of low, interconnected peat ridges, often resembling a polygonal pattern, although permafrost is not present. The ridges enclose wet hollows or shallow pools. The fen surface is almost flat. The peat is usually deep (less than 3 m), consisting mainly of moderately decomposed peat. Characteristic features are:

(a) Net-like, irregular pattern of low peat ridges in non-permafrost terrain.



Northern Ribbed Fen: These fens have subparallel, low peat ridges (strings) which enclose elongated wet hollows or shallow pools. The ridges and hollows are oriented perpendicular to the direction of surface flow. The thickness of peat generally exceeds 2 m, and it is composed of moderately decomposed sedge and moss remains. Trees often grow on the ridges. Characteristic features are:

(a) subparallel low peat ridges which enclose hollows oriented perpendicular to the direction of surface flow.

(b) peat usually over 2 m deep.

(c) occurrence in all parts of the Boreal Wetland Region.

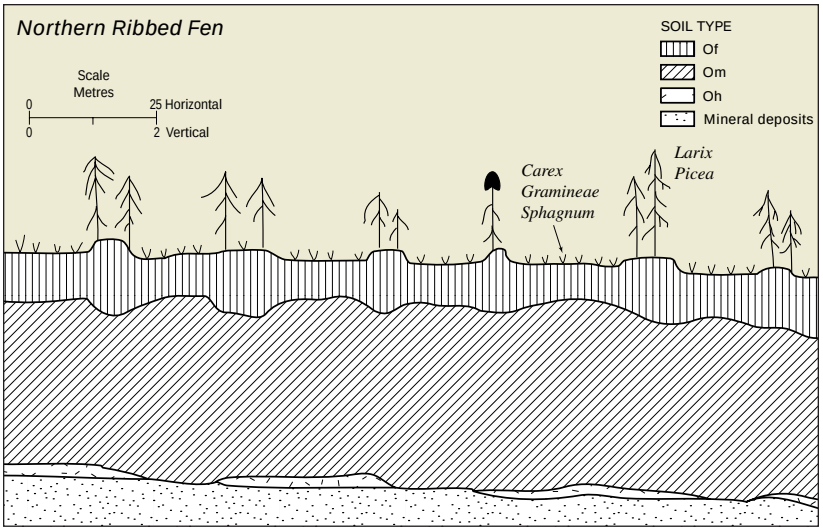


Table 4: Classification Key to Fen Wetland Forms and Subforms

1.	Surface sloping	
2.	Surface with a pattern of peat ridges and depression	String Fen
3.	Subparallel pattern of peat ridges and depressions	
4.	Occurs in valleys, often extensive	
5.	Northern regions; lowland drainage; peat usually more than 2 m thick	*Northern Ribbed Fen*
5.	Atlantic regions; mainly in upland drainage, peat usually less than 1 m thick	*Atlantic Ribbed Fen*
4.	Narrow step-like pattern; along raised bog banks	*Ladder Fen*
3.	Reticulate pattern ridges and depressions	*Net Fen*
2.	Without pronounced surface pattern	
6.	In permafrost terrain	
7.	Occurring as mounds in patterned or non-patterned fen	Palsa Fen
7.	Surface even, without mounds; associated with late-melting or perennial snowbanks	Snowpatch Fen
6.	In non-permafrost terrain	
8.	Water originating from groundwater discharge	Spring Fen
8.	Water originating as overland flow or as subsurface seepage through the peat	
9.	Surface with parallel drainageways	Feather Fen
9.	Surface smooth or with irregularly spaced tracts	Slope Fen
1.	Surface flat or depressional	
10.	In permafrost terrain, surface with network of polygonal fissures	Lowland Polygon Fen
10.	In non-permafrost terrain	Riparian Fen
11.	Located adjacent to water bodies	
12.	Peat mat floating on water or watery peat	*Floating Fen*
12.	Peat not floating	
13.	Located in main channel or along banks of continuously flowing or semi-permanent streams	*Stream Fen*
13.	Located along shores of semi-permanent or permanent lakes	*Shore Fen*
11.	Not adjacent to water bodies	
14.	Surface with circular pattern of depressed thaw hollows filled with watery peat	Collapse Scar Fen
15.	Basin part of regional drainage system	
16.	Occupying broad depressions or plains	Horizontal Fen
16.	Occupying well-defined, often incised relict channels	Channel Fen
15.	Basin not part of regional drainage system	Basin Fen

Deciduous Basin Swamp in southern Ontario with Caltha palustris *(B.G. Warner, Wetlands Research Centre)*

Swamp Wetland Class

The term *swamp* has been used in Canada to refer to forested or wooded wetlands and peatlands. The treed swamps have also been called *swamp forest* or *forested wetland*. A swamp can be defined as a treed or tall shrub (also called *thicket*) dominated wetland that is influenced by minerotrophic groundwater, either on mineral or organic soils. The essential features of the swamp class are the dominance of tall woody vegetation, generally over 30% cover, and the wood-rich peat laid down by this vegetation.

The water table is below the major portion of the ground surface, and the dominant ground surface is at the hummock ground surface, that is, 20 cm or more above the average summer groundwater level. It is the aerated (or partly aerated) zone of substrates above the water that is available for root growth of trees and/or tall shrubs. Swamps are not as wet as marshes, fens and the open bogs, but they are comparable to the treed bogs. The drier treed swamps grade into upland forest on mineral soil, and the wettest treed swamps grade into treed fen, which is wetter with less tree canopy cover. The tall shrub swamps grade into treed fen, which is wetter with less tree canopy cover. The tall shrub swamps grade into wetter marshes.

Swamps occur on mineral soils as well as on peat. The texture of underlying mineral soils is variable, ranging from clays to sands, and they frequently are Gleysols. On sands, iron-rich ortsteins or fragipans are often present, acting as impermeable layers which impede water drainage. Swamps on mineral soils tend to accumulate peat by the paludification process. When organic soils develop, they are Mesisols or Humisols that are rich in woody peat, at least in the surface layers. Swamps on peat have developed by a basin-filling process or by paludification of previously drier mineral soils. In the basin-filling process, the previous ecosystem was a marsh or fen, whereas in paludification the swamp has developed over an older, dry upland forest on mineral soil.

The nutrient regime in swamps is highly variable ranging from base-rich conditions with pH above 7.0, to base-poor conditions where pH can be in the range of 4.5 or lower. One may recognize swamp forms based on the base-rich/pH gradient, i.e. calcareous rich (eutrophic), intermediate (mesotrophic), and poor (oligotrophic). Poor minerotrophic swamps may be transitional to treed ombrotrophic bog.

There are three general physiognomic types of swamps—shrub (thicket) swamps, coniferous swamps, and hardwood (deciduous) swamps. One may also recognize a mixed swamp with conifers and deciduous trees. The understory is shaded and contains forest species that can tolerate shade. Generally, deciduous and shrub swamps occur in somewhat richer conditions, the deciduous swamp being in dry locations, and the shrub swamp in somewhat wetter locations. Coniferous swamps occur across a wider range of trophic levels from rich to poor.

The primary characteristics of swamps are:
(1) peatland and mineral wetland;
(2) water table at or below the surface;
(3) minerogenous;
(4) highly decomposed woody peat and organic material; and
(5) coniferous or deciduous trees, or tall shrub vegetation cover.

Swamp Wetland Forms and Subforms

The main criteria used to characterize the forms of swamps are landform, hydrological system and physiographic position relative to mineral soil uplands, water bodies and other classes of wetlands. Swamps are found in association with tidal systems, inland salt lakes, basins and depressions in glaciated landscapes, riparian systems (rivers, streams and flowage lakes), unconfined broad slopes, confined drainageways, and on raised, wet mineral rises and raised peat plateaus. Swamps in northern boreal areas may be associated with discontinuous or continuous permafrost, but no attempt is made to recognize these forms specifically in this classification system. A classification key to the swamp wetland forms and subforms is presented in Table 5.

DISCHARGE SWAMP

Discharge swamps are topographically flat. They are developed on sites of groundwater discharge located adjacent and above the swamp. Discharge Swamps have two subforms:

Seepage Swamp: These swamps develop around and along the outflow of groundwater seepage. There are no distinct springs on the surface.
Characteristic features are:
(a) situated in groundwater discharge zones with no obvious springs present.

Spring Swamp: These swamps are similar to seepage swamps but are developed on or along the outflow of springs. The springs may or may not supply small streams flowing through them.
Characteristic features are:
(a) situated in groundwater discharge zones with obvious springs.

FLAT SWAMP

Flat swamps develop in topographically defined basins, kettle holes or bedrock where the water is derived by surface runoff, groundwater or precipitation and occasionally by small inflowing surface streams. Flat swamps may also occupy poorly defined basins such as those in broad, shallow depressions in glacial lakebeds and outwash plains. Peat depths may be 0.5 to more than 2 m at the centre. Three Flat Swamp subforms are recognized:

Basin Swamp: These swamps are topographically defined in glacial features on ablation till plains. The edges are well-defined by the sides of the basin and the surrounding mineral soil uplands.
Characteristic features are:
(a) occurrence in well-defined basins in glacial deposits or bedrock.

Swale Swamp: These swamps occur close to lakes or open water bodies, as linear or crescentic-shaped depressions between abandoned beach ridges and in wet depressions in sand dunes.
Characteristic features are:
(a) occurrence in close proximity to lakes or large open water bodies.
(b) associated with dunes and abandoned beach ridges.
(c) linear and narrow in outline.

Unconfined Flat Swamp: These swamps are not topographically defined, often in glacial lakebeds or areas of glacial outwash. These swamps lack obvious edges and well-defined banks. They commonly occur as a broad swamp in other kinds of wetlands.
Characteristic features are:
(a) broad swamp among other kinds of wetlands with poorly defined edges.
(b) common on old glacial lakebeds and spillways.

INLAND SALT SWAMP

Inland salt swamps develop in or on the margins of inland salt (sodium, magnesium, calcium enriched) lakes, ponds or wetlands. These are often thickets that can tolerate high concentrations of salt.
Characteristic features are:
(a) located near inland, saline lakes and marshes.

MINERAL-RISE SWAMP

Mineral-rise swamps develop on raised mounds or ridges of mineral deposits or bedrock. There is evidence of the influence of underlying mineral soil. These swamps are surrounded by wet sites that maintain swamp water levels or periodic flooding. Four Mineral-rise Swamp subforms are recognized:

Beach Ridge Swamp: These swamps can be surrounded by mineral terrain, wetland or other kinds of wetland but are confined to beach ridges.
Characteristic features are: (a) occurrence on beach ridges.

Island Swamp: These swamps occur on an island, bar or point in a riparian condition.
Characteristic features are:
(a) occurrence within a riparian zone on an island, bar or point.

Levee Swamp: These swamps are similar to island swamps but occur on levees.
Characteristic features are:
(a) occurrence in a riparian zone on levees.

Mound Swamp: These swamps occur on mineral sediments or bedrock and are surrounded by peatland.
Characteristic features are:
(a) occurrence within a peatland on a bedrock or mineral sediment.

RAISED PEATLAND SWAMP

Raised peatland swamps occur as raised plateaus, similar to and often transitional to domed bogs, but there is minerotrophic groundwater influence. These are similar to mineral-rise swamps but are elevated by peat and are situated entirely in peatland terrain.
Characteristic features are:
(a) situated on raised peat plateaus rather than on mineral deposits or bedrock.

RIPARIAN SWAMP

Riparian swamps are located along rivers, streams and lakes, and are directly influenced by the water in the river, stream or lake next to them. They are subjected to dramatic water level fluctuations, seasonal flooding and influx of sediment and mineral enrichment during high water periods. Peat accumulation is usually shallow, often less than 40 cm, but depths of more than 1 m can exist. The other organic sediments often have mineral content, more than deposits in peatlands owing to frequent flooding of waters from adjacent rivers, streams and lakes. Four Riparian Swamp subforms are recognized:

Channel Swamp: These swamps occur in abandoned river or stream channels, or oxbows, often associated in meandering river valleys, braided streams, or alluvial plains. They may be seasonally flooded. Peat development is usually quite shallow.
Characteristic features are:
(a) situated in abandoned river and stream channels.
(b) not in direct contact with stream and river waters.

Floodplain Swamp: These swamps occur in the floodplain valley of rivers and streams or behind levees. These swamps are not in direct contact with the river or stream and are flooded when river and stream waters overflow their banks and cover the floodplain, often during the spring melt period. Peat depths are shallow.
Characteristic features are:
(a) situated in river and stream floodplains.
(b) not in direct contact with river and stream water.
(c) subject to flooding when river and stream waters overflow their banks.

Lacustrine Swamp: These swamps occur along the shores of permanent ponds or lakes. The high water table is maintained by the lake water level which may flood the lacustrine swamp during high water periods. Marsh or fen may occur between lacustrine swamp and the open water.
Characteristic features are:
(a) situated in close proximity to or immediately adjacent to open water bodies.
(b) subject to flooding when water table is high in the open waterbody.

Riverine Swamp: These swamps occur along the banks of rivers and permanent and intermittent streams. The water table in riverine swamps is maintained by the level of the water in the adjacent river or stream.
Characteristic features are:
(a) situated immediately adjacent to rivers and streams.
(b) subject to flooding when stream or river waters are high.

SLOPE SWAMP

Slope swamps have surfaces that slope downward with the lowest end positioned lower than the upslope side. They occupy glacial lakebeds and outwash areas, or can be associated with other kinds of wetland. They may occur in sloping drainageways, on mineral or peaty soils. Channels may be absent, but small channels with intermittent flow or small, partially buried channels may be present. Four Slope Swamp subforms are recognized:

Drainageway Swamp: These swamps occur in a confined drainageway or water track, either in mineral or peatland terrain. Water movement is as unilateral sheet flow.
Characteristic features are:
(a) sloping surface.
(b) situated in a confined drainageway or water track.

Lagg Swamp: These swamps occur in the zone between upland mineral terrain and a peatland (swamp, fen or bog). The lagg swamp is a wetland distinctly enriched by runoff from the upland. Surface water movement is parallel to the upland.
Characteristic features are:
(a) sloping surface.
(b) situated between mineral terrain and peatland.
(c) mineral enriched from adjacent mineral soils.

Peat Margin Swamp: These swamps have sloping topography and are situated between peatland and upland mineral terrain. Hydrology is such that paludification allows the swamp to spread outwards into adjacent upland. They can also be a relatively less dynamic zone between upland and peatland.
Characteristic features are:
(a) sloping surface.
(b) position between peatland and mineral terrain or totally within peatland terrain.

Unconfined Slope Swamp: These swamps occur as a broad expanse of sloping wetland on glacial lakebeds and outwash areas in peatland terrain. They may also occur at the margins of extensive flat swamps.
Characteristic features are:
(a) sloping surface.
(b) broad, expansive area with poorly defined edges.

TIDAL SWAMP

Tidal swamps develop in the zone of influence of tides, at the highest reach of tides and wave influence during storms. These are often thickets that can tolerate a short period of flooding. Some forested swamps exist where there is minor influence of high tides, but not long enough to kill the trees. An example is a tidal swamp forest on the levees of rivers where they join marine waters. Two Tidal Swamp subforms are recognized:

Tidal Freshwater Swamp: These swamps occur adjacent to tidal systems. They are influenced mostly by freshwater and by brackish or saline water only during extreme high tides or storm surges. However, they are usually situated too high in the supratidal zone to be influenced by saline or brackish water.
Characteristic features are:
(a) situated near estuaries and high in supratidal zones on the sea coast.
(b) primarily freshwater and rarely brackish water.

Tidal Saltwater Swamp: These swamps occur in the intertidal and supratidal zones. The water is saline or brackish.
Characteristic features are:
(a) situated in supratidal zone on sea coast.
(b) brackish and freshwater.

Mixed Deciduous and Coniferous Swamp in central Ontario *(B.G. Warner, Wetlands Research Centre)*

Table 5: Classification Key to Swamp Wetland Forms and Subforms

1. Influenced by tidal water	Tidal Swamp
2. On or beside marine terraces, beach ridges, levees, islands, points, inundated only at highest tides and/or storm surges by saltwater; coastal and estuarine	*Tidal Saltwater Swamp*
2. Same as above, inundated only at highest tides and/or storm surges by freshwater	*Tidal Freshwater Swamp*
1. Not influenced by tidal water	
3. Margins of inland saline lakes and marshes in arid zones, influenced by high concentrations of sodium, magnesium, calcium or sulphate	Inland Salt Swamp
3. Freshwater, includes calcium-rich high pH to calcium-poor low pH waters, and permanent and seasonally flooded	
4. Topographically flat or slightly concave, water flowing into the middle of the basin, in topographically defined basins, kettle holes, swales and extensive peatlands	Flat Swamp
5. Confined depressions with distinct slopes to the side of the basin	
6. Formed on glacial deposits such as kettle holes, eskers, moraines	*Basin Swamp*
6. Orientated in linear or crescentic patterns, the hollows between beach ridges, or interdunal depressions	*Swale Swamp*
5. Unconfined basins, extensive and poorly defined depressions, occurring on flat glacial lakebeds, outwash plains	*Unconfined Flat Swamp*
4. In or along channelized systems, lakes, rivers, streams, depressions and sloping wetlands	
7. Along lakes, rivers and streams, with high water level fluctuations and periodic flooding	Riparian Swamp
8. Along lakes as zones usually landward from marsh or fen	*Lacustrine Swamp*
8. Along rivers, streams and abandoned stream or river channels	
9. Adjacent to rivers or streams	*Riverine Swamp*
9. Not immediately adjacent to flowing water, in cutoff channels, or on floodplain behind levees	
10. In a floodplain	*Floodplain Swamp*
10. In or along a cutoff river channel, including oxbows	*Channel Swamp*

Table 5: Classification Key to Swamp Wetland Forms and Subforms cont'd

7. Topographically sloping, with or without channels, or only small channels with intermittent water flow

    11. With sloping topography, in unconfined expanses, confined drainageways or water tracks — Slope Swamp

        12. Non-channelized, topographically sloping, on glacial lakebeds, outwash plains or unconfined peatlands

            13. In peatland terrain — *Unconfined Slope Swamp*

            13. Occurring in the zone between peat and mineral soil — *Peat Margin Swamp*

            13. At margins of peatlands — *Lagg Swamp*

        12. Sloping swamps in water tracks or drainageways with distinct peat banks, sometimes with small, intermittent channels flowing on them

            14. Occurring in water tracks or drainageways — *Drainageway Swamp*

            14. Occurring in wet zones between upland and peatland — *Lagg Swamp*

                15. Groundwater discharge sites — Discharge Swamp

                    16. Springs with obvious upwelling water, small streams — *Spring Swamp*

                    16. Seepage sites, no obvious upwelling water — *Seepage Swamp*

                15. Not with groundwater discharge, swamps on raised ridges or mounds, mineral or peat

17. Swamps on raised mineral mounds in fens, river islands and bars, beach ridges, and levees surrounded by wetter ecosystems, influenced by periodic flooding or high levels of mineral groundwater — Mineral-rise Swamp

    18. Mineral rises associated with riparian systems

        19. On islands or bars — *Island Swamp*

        19. On levees — *Levee Swamp*

    18. Associated with lakes or peatlands

        20. On beach ridges, surrounded by wetter land — *Beach Ridge Swamp*

        20. On mineral deposits or bedrock surrounded by wetter wetland — *Mound Swamp*

17. Swamp peat plateaus, similar to and often transitional to raised bog; influenced by mineral groundwater — Raised Peatland Swamp

Riparian Marsh on St. Lawrence River near Lachine, Quebec *(M. Melancon, Environment Canada)*

Marsh Wetland Class

A *marsh* is a wetland that has shallow water, and has levels that usually fluctuate daily, seasonally or annually due to tides, flooding, evapotranspiration, groundwater recharge, or seepage losses. Marshes may experience water level drawdowns which will result in portions drying up and exposing the sediments. Marshes receive their water from the surrounding catchment as surface runoff, stream inflow, precipitation, storm surges, groundwater discharge, longshore currents and tidal action. Marshes dependent upon surface runoff usually retain less permanent water than sites supplied by groundwater. The water table usually remains at or below the soil surface, but soil water remains within the rooting zone for most of the growing season, except in years of extreme drought.

In semi-arid regions, some basin marshes may remain dry for several consecutive years, and consequently may assume some characteristics of terrestrial ecosystems until water levels are restored by above-average precipitation and runoff. When wet, these marshes display all the characteristics and processes common to typical seasonal or semi-permanent marshes. The hydrology of marshes may vary much more dramatically seasonally from being constantly saturated or semi-permanently flooded than the other classes of wetlands. Marshes, therefore, respond to rapid fluctuations in surface water, going through cycles of drawdown and regeneration, degeneration and open water stages over the course of a few years.

A marsh is a minerotrophic and usually eutrophic wetland. Nutrients are derived from the substrate through periodic aeration. High nutrient levels give rise to the characteristic high productivity of vascular plants and high decomposition rates of the plant material at the end of the growing season. Such high rates of decomposition give rise to marshes producing significant quantities of gases such as methane and carbon dioxide. Freshwater marshes are usually circumneutral to highly alkaline owing to the presence of dissolved minerals such as calcium, potassium carbonate, or potassium bicarbonate. The water in saline marshes is high in dissolved salts because water losses through evaporation concentrate sulphates and chlorides of sodium and magnesium. In highly saline marshes, vegetation development is severely hampered because salt concentrations are so high as to become toxic to plants.

Soils and substrates encountered in marsh wetlands typically range from mineral soils such as Humic and Rego Gleysols to organic soils such as Humisols and Mesisols. Normally, marsh sediment is a mixture of unconsolidated organic and inorganic material. Clumps, hummocks, or tussocks of live and dead herbaceous vegetation may exist in standing water. Those marshes that are seasonally dry or exposed to high energy currents or tides usually accumulate little organic matter, in contrast to hydrologically more stable and permanently saturated marshes. In the latter case, such as in lakeshore or delta marshes, Humisols develop; this organic material can accumulate but seldom is more than 40 to 50 cm deep. Under persistent conditions of stable water, floating mats of vegetation form from sedges and aquatic mosses. This is characteristic of marsh stages transitional to rich fens.

Marsh vegetation predominantly comprises emergent aquatic macrophytes, chiefly graminoids such as rushes, reeds, grasses and sedges, and shrubs and other herbaceous species such as broad-leaved emergent macrophytes, floating-leaved and submergent species, and non-vascular plants such as brown mosses, liverworts, and macroscopic algae. The marsh definition embraces the terms “reed swamp” (reeds and tall grasses) and “marsh” (grass-sedge-rush community); and is equivalent to the “marsh” and “sedge meadow” communities. Vegetation is usually arranged in distinct zones of parallel or concentric patterns in response to gradients of water depths, frequency of drawdowns, water chemistry or disturbance. Three basic marsh zones are usually attributed to water duration and depth: (a) transitional open water, (b) emergent deep marsh, and (c) shallow marsh (Millar 1976). The typical sequence, which progresses from open pools with aquatic plants to emergent reeds, through sedges and reed grasses, then low rushes, sedges and herb meadows, to tall shrubs and trees at the extreme edge of the marsh, follows a decreasing moisture gradient. Saline or brackish marshes also have gradients but with fewer zones that include, barren salt flats in the centre of the marsh, rushes, and then halophytic herbs and grasses at the outer edge. Seasonal drawdowns may expose mudflats which are revegetated by pioneering herb and grass species. Plant communities of seasonal marshes are dynamic. They shift spatially with water levels, and change in composition over a short time, whereas communities of semi-permanent marshes usually are more stable, represented by stands of reeds which may persist for many years in the absence of severe drought.

Marshes occur in many geomorphological settings which include low-lying areas adjacent to rivers, lakes, the sea, and any other position on the land surface where groundwater may discharge. In northern regions, marshes are common in nutrient-rich sites associated with rivers either in the floodplains or at their mouth on alluvial fans and deltas. Along seacoasts, tidal marshes are located in estuaries or lower stream reaches, and behind baymouth bars or other sites protected from high energy waves.

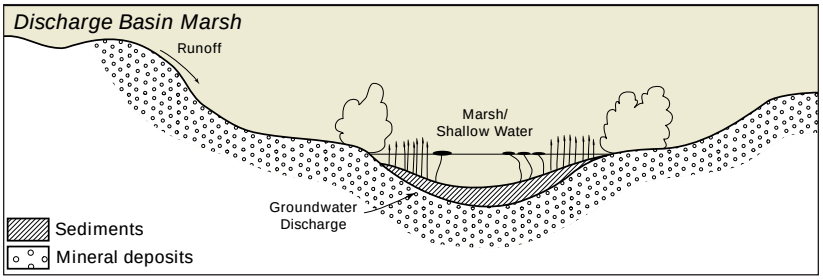
The primary characteristics of marshes are:
(1) mineral wetlands;
(2) shallow surface water which fluctuates dramatically;
(3) minerogenous;
(4) little accumulation of organic material and peat of aquatic plants; and
(5) emergent aquatic macrophytes largely rushes, reeds, grasses, and sedges and some floating aquatic macrophytes.

Marsh Wetland Forms and Subforms

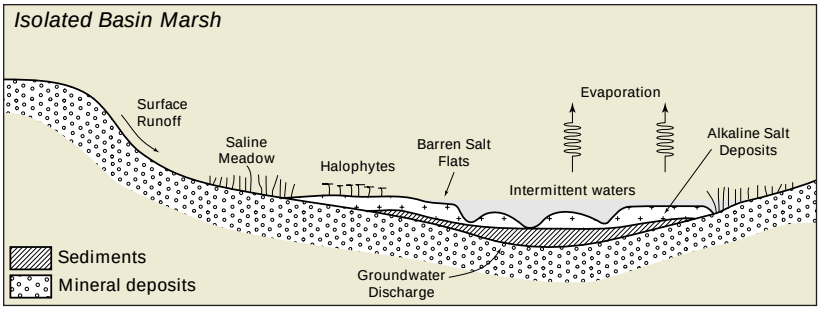
Marsh wetland forms are differentiated on the basis of the source of water and basin topography. A classification key to the marsh wetland forms and subforms is presented in Table 6.

BASIN MARSH

Basin marshes are situated in well-defined basins and depressions in inland regions outside the influence of sea waters and sea spray. They receive waters from groundwater discharge, surface runoff and stream and river inflow. Basin marsh subforms could be further subdivided into freshwater and saline subforms. Three subforms of Basin Marsh are recognized:



Discharge Basin Marsh: These marshes occupy flat areas, depressions, basins, kettles or sinkholes below the groundwater table. The basins are usually much larger and deeper than isolated basin marshes. The marsh receives most of its water as groundwater discharge that is cold and usually high in dissolved minerals. Groundwater discharge operates for much of the year, including the winter, except for some discharge basin marshes in the Continental Prairie Wetland Region. Waters can be fresh, but are often brackish and saline. In the Continental Prairie Wetland Region, discharge basin marshes may be characterized by evaporite deposits of salts and other minerals around them which preclude vegetation growth. It is possible to have freshwater or saline discharge basin marshes.
Characteristic features are:
(a) deep basins, depressions, or sinkholes that lie below the groundwater table.
(b) receives most of its water as groundwater discharge.
(c) waters may be saline or fresh, but are usually high in dissolved solids.
(d) located in topographically low areas.



Isolated Basin Marsh: These marshes occupy topographically-defined basins formed by glacial erosional and depositional processes, slumping, solution or ablation of unconsolidated deposits and bedrock. There are no surface inlets or outlets. The marsh receives water from rain, snowmelt, surface runoff, and groundwater discharge. The length of time that the marsh retains water is dependent upon water exchanges with the groundwater table, the permeability of geological substrates, and water losses by evaporation. Water may be saline with saline rings around the periphery in arid regions and fresh in non-arid regions. It is possible to have freshwater or saline isolated basin marshes.
Characteristic features are:
(a) situated in closed, topographically-defined shallow basins and depressions.
(b) lack of surface inlets and outlets.
(c) waters may be saline or fresh.

Linked Basin Marsh: These marshes occupy defined depressions that have channelized inlets and outlets operating during periods of abundant surface flow. The linked basin marsh is subject to intermittent surface and groundwater inflow, primarily from the local watershed, but may receive regional inflow from beyond the local catchment. This marsh subform usually occupies intermediate topographic positions and intermittently contains water.

Characteristic features are:

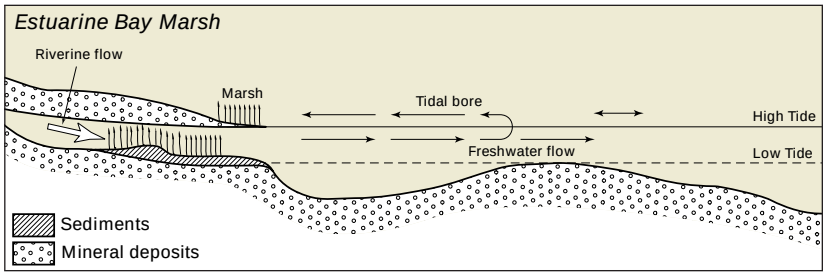
(a) situated in well-defined shallow basins and depressions that have surface inlets and outlets.

(b) the amount of water in the marsh is related to periods of abundant surface flow.

ESTUARINE MARSH

Estuarine marshes are confined to intertidal and supratidal zones of estuaries. Water levels are subjected to tidal changes but water levels do not change as greatly as in other tidal marshes. There is a major input of freshwater in these marshes which makes estuarine marsh waters brackish to fresh. Vegetation develops in zones in response to variations in slope, water depth and salinity gradient. Water is brackish or fresh. Four subforms of Estuarine Marsh are recognized:

Estuarine Bay Marsh: These marshes develop along the fringes of tidal flats, bars or tidal channels located within tidal inlets or bays which receive water from rivers and streams. Situated at or below low tide levels, the estuarine bay marsh is subjected to regular inundation by tidal saltwater and freshwater.

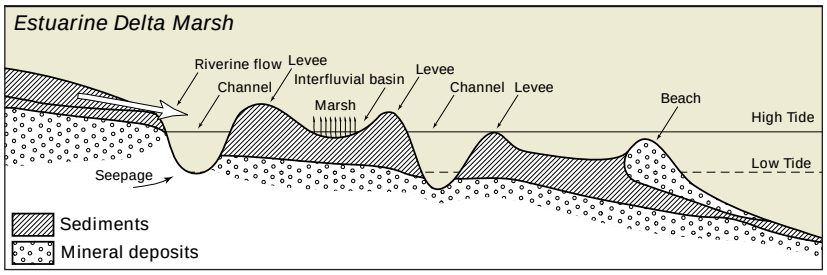


Characteristic features are:

(a) intertidal or supratidal zone of estuaries.

(b) situated in embayments or inlets of estuaries.

Estuarine Delta Marsh: These marshes develop on deltaic areas at the mouths of rivers and streams that flow into estuaries. They occur on tidal flats, levees, bars, lagoons, channels and basins which are elevated above mean low tide levels. Water levels are subjected to periodic flooding by saline and brackish water during high tides that are flushed by inflowing freshwater during low tides.



Characteristic features are:

(a) intertidal or supratidal zone of estuaries.

(b) situated on deltaic river and stream mouths.

Estuarine Lagoon Marsh: These marshes occur in embayments, lagoons and open basins in the supratidal and intertidal zone of estuaries. They are susceptible to extreme water level changes. Freshwater input is significant.

Characteristic features are:

(a) intertidal and supratidal zone of estuaries.

(b) developed in lagoons, inlets, basins that are connected to the main estuary.

Estuarine Shore Marsh: These marshes occur as linear bands along the shore of estuaries removed from the main outer coast. Freshwater input is significant.

Characteristic features are:

(a) intertidal and supratidal zone of estuaries.

(b) occur as linear features along the coast of estuaries.

HUMMOCK MARSH

Hummock marshes occur on heights of land in zones of groundwater upwelling and are perched above the groundwater table. They may be located on slopes or in depressions. Hummock marshes may form by the accretion of mineral or organic material built up by discharging mineral-rich groundwater. The surface of vegetation communities in hummock marshes is usually saturated and quaking.

Characteristic features are:

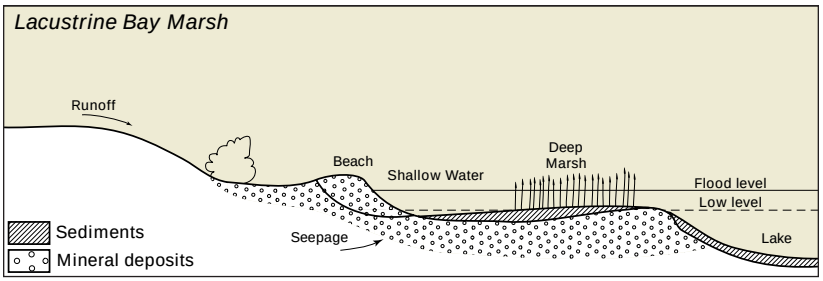
(a) shallow depressions built up by accretion of mineral and organic material.

(b) situated in groundwater discharge areas above the groundwater table.

LACUSTRINE MARSH

Lacustrine marshes occur along the shores of permanent inland, open water bodies and lakes. Water sources are a combination of input from adjacent lakes, rivers and streams flowing into the lake, surface runoff from the adjacent catchment, and groundwater discharge. Such marshes have freshwater. Three subforms of Lacustrine Marsh are recognized:

Lacustrine Bay Marsh: These marshes occupy gently sloping offshore zones, recession flats, or shoals of shallow bays of more permanent lakes, merging with deep water (more than 2 m). Lacustrine bay marshes develop in lakes subject to sediment infilling and periodic drawdowns. Water levels are not as stable in lacustrine bay marshes as they are in lacustrine shore marshes.



Characteristic features are:

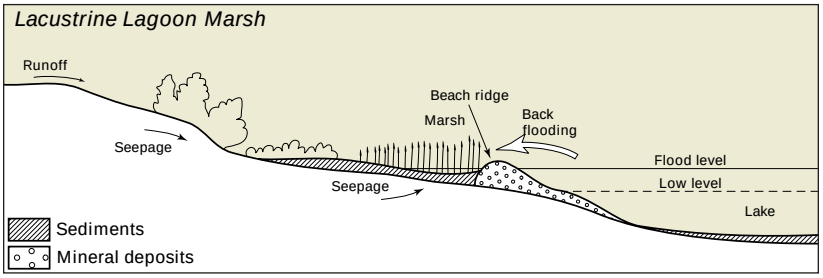
(a) situated in offshore zones and shallow bays of permanent lakes.

(b) water levels are susceptible to dramatic changes and drawdowns.

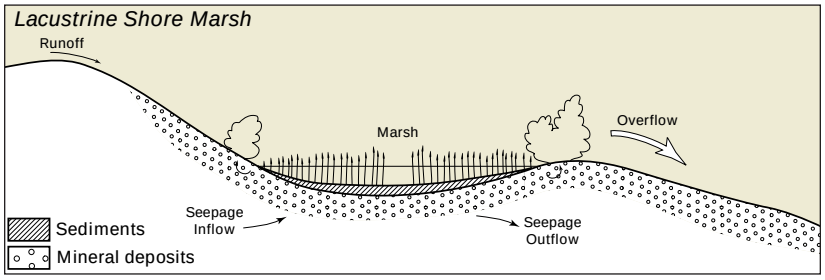
Lacustrine Lagoon Marsh: These marshes are situated in semi-closed basins behind barrier beaches or bars adjacent to lake; protected from direct wave action; subject to increases in lake level.

Characteristics features are:

(a) in basins behind barrier beaches and bars adjacent to lakes.



Lacustrine Shore Marsh: These marshes develop on recent lacustrine sediments, along the shoreline, and between high and low water positions, on permanent lakes and merging with deep water. Lacustrine shore marshes collect surface runoff and are subject to periodic flooding by wave action and rises in lake levels. They are associated with recession flats, lagoons, swales and beach ridges.



Characteristic features are:

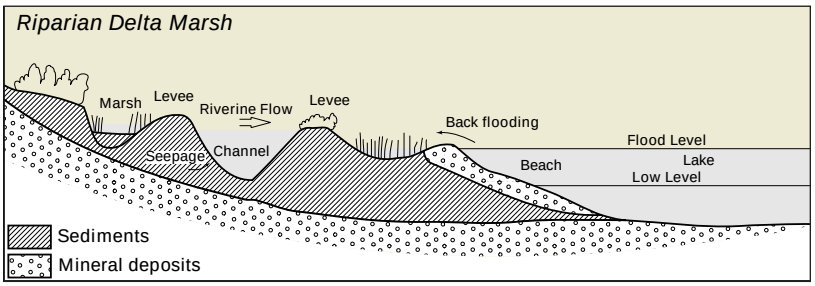
(a) situated in the nearshore zone of permanent, freshwater lakes.

(b) water levels relatively stable.

RIPARIAN MARSH

Riparian marshes occupy riparian zones of streams and rivers. They may receive waters from precipitation, groundwater discharge, and surface runoff, but are most closely linked to water quality and quantity in an adjacent stream or river. Four subforms of Riparian Marsh are recognized:

Riparian Delta Marsh: These marshes develop on active or abandoned glacial deltas which still have a stream or river running over them. The marsh is flooded by overbank flows, runoff or seiches from adjacent lakes. The marsh is associated with interfluvial basins, levee backslopes, shorelines, distributory channels or lagoons.

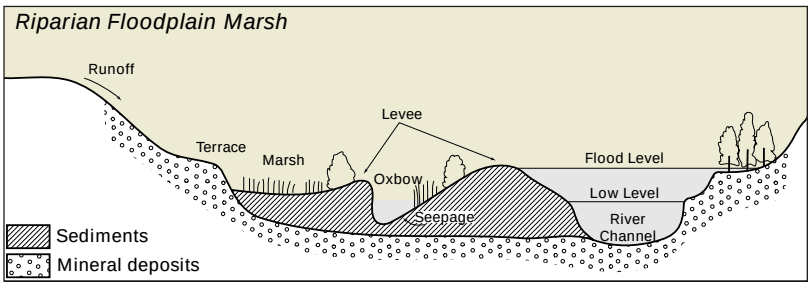


Characteristic features are:

(a) situated on deltaic plains.

(b) flooded by stream waters which overflow their banks, surface runoff or lake water.

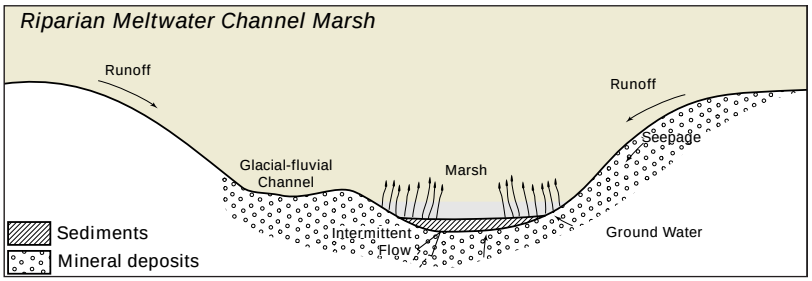
Riparian Floodplain Marsh: These marshes develop on aggraded alluvial plains and terraces bordering on but not draining into lower, perennial streams. Water is derived from surface runoff and during periodic overbank floods. Water level in the marsh is maintained by a high water table. The riparian floodplain marsh is usually associated with swales, oxbows, levees and meander scars.



Characteristic features are:

(a) situated on aggraded alluvial plains and terraces usually in swales, oxbows and meander scars.

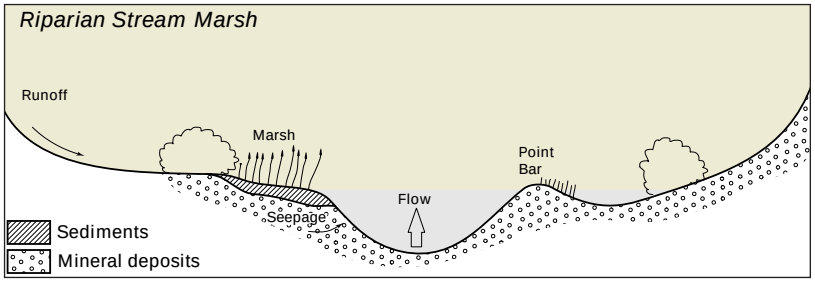
Riparian Meltwater Channel Marsh: These marshes develop in abandoned channels or in underfit stream channels situated in broad spillway valleys and postglacial alluvial and outwash plains where water flow is ephemeral or discontinuous. The primary water source in the marsh is from surface flow and groundwater inflow.



Characteristic features are:

(a) situated in broad spillway valleys, and alluvial and outwash plains.

Riparian Stream Marsh: These marshes are located on embankments, channels, islands or streambed materials on first, second or third order water courses with continuous or intermittent flow. Stream marshes are usually found on recent alluvial sediments deposited in protected areas not influenced by strong water currents. This marsh subform incorporates dammed flowages and throughflow ponds, but excludes floodplains.

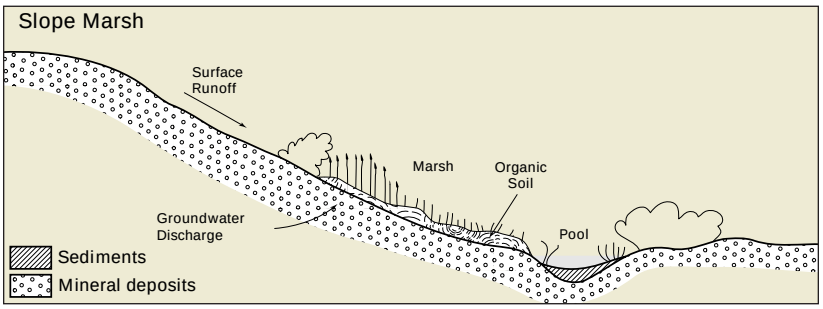


Characteristic features are:

(a) situated on embankments, channels, islands and other riparian zones of streams and rivers.

SLOPE MARSH

Slope marshes develop on lower elevation slopes where water-bearing strata and impermeable layers contact the ground surface. Slope marshes occupy wet seepage areas where groundwater discharges. The slope marsh is characterized by hummocky microrelief, soggy, saturated ground and flushes.

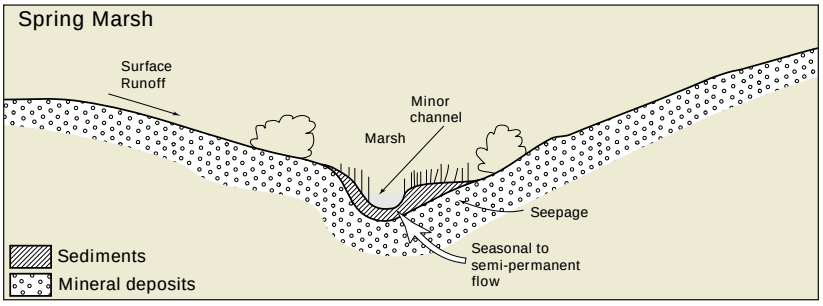


Characteristic features are:

(a) occupying seepage slopes where groundwater discharges.

SPRING MARSH

Spring marshes occupy first order water courses or rills that drain point source discharge of springs or upwelling groundwater. Drainageway tracks, pools or small eroded channels are characteristic, usually arranged in radiating or dendritic patterns.



Characteristic features are:

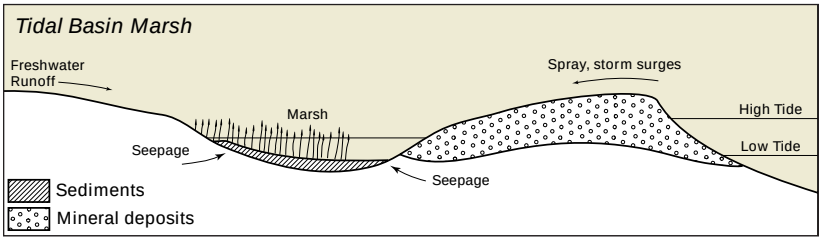
(a) situated in groundwater discharge zones.

(b) drainage patterns and pools.

TIDAL MARSH

Tidal marshes develop along beaches, bars, reefs or islands of sea coasts, protected from wave action and storm surges. Development is on coarse to fine-grained sediments in intertidal zones and some supratidal zones influenced by salt spray. Tidal marsh is flooded regularly by tidal saltwater with no major influence from freshwater. Water is saline or brackish. Vegetation communities development is in response to duration of exposure, slope gradients, distribution of tidal channels and basins, and salinity. Four Tidal Marsh subforms are recognized:

Tidal Basin Marsh: These marshes are situated within the supratidal zone in basins that do not drain during low tide. Water is brackish.



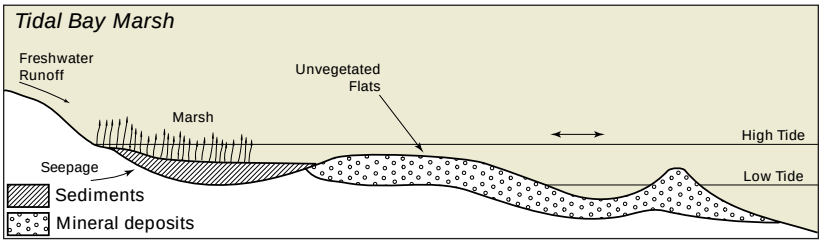
Characteristic features are:

(a) in supratidal zones on sea coast.

(b) situated in basins that do not drain during low tide.

(c) brackish water.

Tidal Bay Marsh: These marshes are situated along the open sea coast, embayments and inlets where currents from longshore drift, waves and tidal changes are not too powerful to erode the marsh. The marsh is subjected to daily tidal water level changes. Water is saline or brackish.



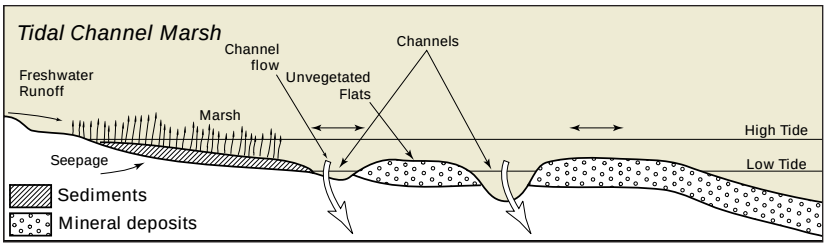
Characteristic features are:

(a) in tidal zones on the open sea coast and in embayments and inlets on the sea coast.

Tidal Channel Marsh: These marshes are situated in tidal channels in the intertidal zone that drains during low tide. Water is saline and brackish.

Characteristic features are:

(a) in tidal channels in tidal zone.



Tidal Lagoon Marsh: These marshes are situated in embayments or lagoons behind barrier beaches and bars in the supratidal zone. Saline water from the sea may enter the marsh during high tide and fresh or brackish water may enter by surface runoff or streams during low tide. Water may be saline or brackish.

Characteristic features are:

(a) in supratidal zone on sea coast.

(b) situated in embayments or lagoons behind barrier beaches and bars.

(c) water is saline during high tide and fresh or brackish during low tide.

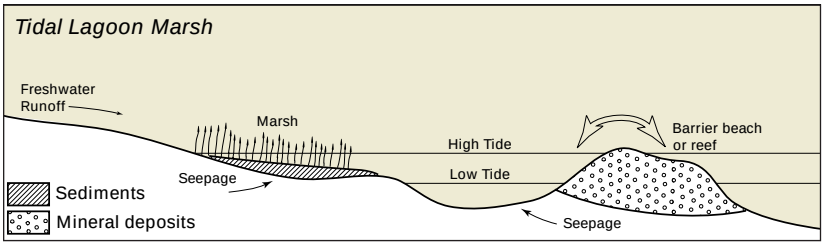


Table 6: Classification Key to Marsh Wetland Forms and Subforms

1.	Influenced by tides; subject to daily or periodic inundation by saline, brackish or freshwater of marine, estuarine or riverine currents, storm surges or salt spray	2.
2.	Confined to the intertidal and supratidal zones of ocean coasts and embayments; usually protected by headlands, beaches, strands, bars or reefs; water brackish or saline	Tidal Marsh
3.	Situated along the open ocean coast or in embayments and lagoons	
3.	Situated in tidal channels or isolated basins in supratidal zone	5.
4.	Situated along open ocean coast	*Tidal Bay Marsh*
4.	Situated in protected parts of the coast in embayments	*Tidal Lagoon Marsh*
5.	Situated in tidal channels	*Tidal Channel Marsh*
5.	Situated in basins that do not drain	*Tidal Basin Marsh*
2.	Confined to intertidal and supratidal zones of estuaries; Water is fresh to brackish, but freshwater input is minor	Estuarine Marsh
6.	Situated on estuarine tidal flats, levees, lagoons, channels and basin on estuarine delta	*Estuarine Delta Marsh*
6.	Situated in open embayments and inlets	*Estuarine Bay Marsh*
6.	Situated farther inland in estauries	7.
7.	Situated within semi-enclosed basins and lagoons: behind barrier beach bars	*Estuarine Lagoon Marsh*
7.	Situated as bands along shore zone of estuaries	*Estuarine Shore Marsh*
1.	Not influenced by tides; subject to periodic inundation and water level fluctuations; fresh, brackish or saline water	8.
8.	Situated in valleys and drainage channels with or without flowing water; water level fluctuations and flooding	Riparian Marsh
9.	Situated in river and stream channels, or adjacent to water courses; influenced by continuous or intermittently flowing water	10.
10.	Situated along streams	*Riparian Stream Marsh*
10.	Situated on alluvial plains or terraces along river and stream valleys; water is from overbank flooding and surface runoff	*Riparian Floodplain Marsh*
9.	Situated on deltas, in deltaic channels or levees, or in abandoned channels and valleys of rivers and streams	11.
11.	Situated in interfluvial basins, channels or levees on active or proglacial deltas	*Riparian Delta Marsh*

Table 6: Classification Key to Marsh Wetland Forms and Subforms cont'd

11.	Situated in abandoned proglacial meltwater channels or next to underfit streams in proglacial river or stream valleys. Waterflow is ephemeral or intermittent	*Riparian Meltwater Channel Marsh*
8.	Not confined to channels or linear drainageways	12.
12.	Situated in topographically defined depressions that retain inflowing surface runoff and groundwaters originating from surrounding catchment or upslope sources	13.
13.	Situated on the margins of permanent lakes which may have stream inlets and outlets; subject to periodic flooding and increases in water levels by wind seiches and wave action	Lacustrine Marsh
14.	Situated on the shore of lakes and other permanent open water bodies, often grading into deep water	*Lacustrine Shore Marsh*
14.	Situated in shallow bays adjacent to lakes; exposed to wave action	*Lacustrine Bay Marsh*
13.	Not in contact with open water from adjacent lake	15.
15.	Situated in semi-closed basins behind barrier beaches or bars adjacent to lake; protected from direct wave action; subject to increases in lake level	*Lacustrine Lagoon Marsh*
13.	Not situated along the shores of deep and large lakes; confined to topographically defined basins and shallow depressions that collect surface runoff and receive groundwater seepage; water fresh and saline	Basin Marsh
16.	Situated in interconnected shallow depressions that receive intermittent surface and groundwater inflow and drain via seepage, outflows or overland flows during periods of highwater	*Linked Basin Marsh*
16.	Situated in closed shallow depressions that collect surface runoff and drain via seepage outflow	*Isolated Basin Marsh*
16.	Situated in flat terrain, kettle basins or sinkholes; occurrence on the downslopes of groundwater discharge zones; usually permanent discharge of water with little change in water levels except in the semi-arid Continental Prairie Wetland Region	*Discharge Basin Marsh*
12.	Situated on slopes, in depressions or at the edge of escarpments; in basins, linear and radiating channels; occupying groundwater discharge zones	17.
17.	Situated as raised surface higher than surrounding flat topography	Hummock Marsh
17.	Situated on sloping terrain	18.
18.	Situated on slopes with a single point source of groundwater discharge, drainage channels and pools are common	Spring Marsh
18.	Situated on slopes with diffuse groundwater discharge, occurrence largely as saturated soil	Slope Marsh

Basin Water Wetland constructed by beavers, Kananaskis area, Alberta *(B.G. Warner, Wetlands Research Centre)*

Shallow Water Wetland Class

Shallow water wetlands are distinct wetlands transitional between those wetlands that are saturated or seasonally wet (i.e. bog, fen, marsh or swamp) and permanent, deep water bodies (i.e. lakes) usually with a developed profundal zone. Shallow waters are subject to aquatic processes typical of upper limnetic or infralittoral lake zones, such as nutrient and gaseous exchange, oxidation and decomposition. Ionic composition of waters varies widely. Dissolved minerals, acid-base balances, and nutrient levels are influenced by the hydrology, underlying geological materials, nutrient fluxes and plant communities. Shallow water wetlands usually contain limnic peat, mixed limnic organic-mineral material and marl in stable water regimes. Little sediment accumulation occurs in high energy shallow waters such as tidal regimes, rivers or large lakes. In semi-arid regions, shallow waters dry up intermittently, often leaving evaporite alkaline salt deposits. Except in highly saline or acid waters, these deposits provide a substrate for rooted submerged and floating macrophytes, algae and aquatic mosses.

Shallow water wetlands have standing or flowing water less than 2 m deep in mid-summer. Water levels are seasonally stable, permanently flooded, or intermittently exposed during droughts, low flows or intertidal periods. Open shallow water must occupy more than 75% of the surface area of a confined basin or saturated zone, inclusive of adjoining wetlands. Shallow water wetlands may also occupy bays and margins of profundal zones of lakes. Large depressions with permanent water may be classified separately from the surrounding wetland, if they are subject to limnic processes or have different hydrological processes such as upwelling groundwater. The shallow water wetland class excludes artificial water bodies (reservoirs, impoundments and dugouts), where water regimes are manipulated. Natural impoundments such as beaver ponds or other open water wetland systems are included where water levels are not regulated.

Shallow waters are variously called ponds, pools, shallow lakes, oxbows, sloughs, reaches or channels. Boundaries are determined by water-eroded shorelines, beaches or landward margins of mudflats, recent limnic deposits, floating mats, emergents or hydrophytic trees or shrubs. Bordering mats of rooted emergent vegetation, including inundated trees, may occupy up to 25% of the shallow water area. Shallow waters are found in all hydrogeomorphic settings, but are usually associated with lacustrine, fluvial, tidal, stream, river and permafrost systems.

Shallow Water Wetland Forms and Subforms

All shallow water wetland forms and subforms are shallow water wetlands as defined in the wetland classes, differing from one another in basin topography or proximity to various kinds of open water. Characteristic features are not separated out in this section because the descriptions of forms and subforms are themselves brief. These descriptive terms for shallow water wetlands are similar to and parallel the descriptions for marsh wetland forms. A classification key to shallow water wetland forms and subforms is presented in Table 7.

BASIN WATER

Basin water wetlands have fresh to saline water. They occur in topographic low positions, depressions and well-defined basins developed in sediment and bedrock. Waters are derived from precipitation, surface runoff, surface streams and rivers, ice melt and groundwater discharge. Basin water wetlands may be found in permafrost and non-permafrost terrain. Six subforms of Basin Water wetlands are recognized:

Discharge Basin Water: These wetlands occupy flat or concave basins situated in topographic low areas where they mainly receive groundwater inflow but there is no outflow. Evaporation may be high, in which case, some of these wetlands are strongly saline. Shorelines may be poorly defined or recessional. Freshwater situations are more permanent than those with saline waters.

Isolated Basin Water: These wetlands occupy closed, shallow depressions or water catchments enclosed by low ridges on low relief landscapes. They are found in the high or intermediate topographic positions of the landscape.

Linked Basin Water: These wetlands differ from isolated basin water wetlands by having open basins with inflowing and outflowing streams.

Polygon Basin Water: These wetlands are pools located within peatland depressions in low-centred polygon fens.

Thermokarst Basin Water: These wetlands are confined to permafrost terrain pitted with numerous water bodies due to thawing of permafrost, forming subsidence depressions with unstable shorelines.

Tundra Basin Water: These wetlands occupy shallow depressions or catchment areas on tundra, underlain by mineral soil or thin peat in permafrost terrain. Water collects in them from surface run-off, stream inflows or seasonal thawing of permafrost.

ESTUARINE WATER

Estuarine water wetlands occur within the shallow subtidal, intertidal and supratidal zones of estuaries along the sea coast. Waters may be brackish or fresh. Six subforms of Estuarine Water wetland are recognized, based on different geomorphic settings:

Estuarine Basin Water: These wetlands are similar to tidal basin water wetlands but occupy basins in the supratidal zone of estuaries.

Estuarine Bay Water: These wetlands are similar to tidal bay water wetlands but are situated in estuaries.

Estuarine Channel Water: These wetlands are similar to tidal channel water wetlands but occupy channels within the intertidal and supratidal zone of estuaries.

Estuarine Delta Water: These wetlands are associated with deltas and alluvial plains in estuaries.

Estuarine Lagoon Water: These wetlands are similar to tidal lagoon water wetlands but are situated in estuaries where the water is brackish or fresh.

Estuarine Shore Water: These wetlands are similar to tidal shore water wetlands but are situated in estuaries.

LACUSTRINE WATER

Lacustrine water wetlands are confined to the high and low shore zone and littoral zone of freshwater lakes. Water is fresh and derived from precipitation, surface runoff, rivers and streams, and groundwater discharge. Water levels may fluctuate dramatically. Three subforms of Lacustrine Water wetland are recognized:

Lacustrine Bay Water: These wetlands are similar to tidal bay water wetlands but are situated on freshwater lakes.

Lacustrine Lagoon Water: These wetlands are similar to tidal lagoon water wetlands but are situated on freshwater lakes.

Lacustrine Shore Water: These wetlands occur in the zone of wave action in beach or strand areas. This includes the high shore, low shore and littoral zones.

RIPARIAN WATER

Riparian water wetlands are situated in riparian zones of freshwater rivers and streams. The source of water and the water level in these riparian water wetlands are largely controlled by water in the adjacent river or stream. Four Riparian Water wetland subforms are recognized:

Riparian Delta Water: These wetlands occur on alluvial plains and areas where alluvium is deposited where a river or stream enters a lake. An active delta is well drained with interconnecting channels, lakes and ponds. The process of sediment deposition is ongoing. Associated wetlands are flooded frequently. In some instances, former lake shorelines have receded or disappeared over geologic time leaving isolated deltas. Flooding of associated wetlands is infrequent, due to river flooding or wind tides (seiches).

Riparian Floodplain Water: These wetlands occupy abandoned channels, oxbows or river meanders on river floodplains. Isolated by levees and point bars, but flooded only occasionally by high river flows, these wetlands usually receive water from run-off or groundwater sources, and are subject to infilling with silt and organic matter.

Riparian Meltwater Channel Water: These wetlands occupy glaciofluvial meltwater channels and spillways and “U” shaped valleys where active sediment deposition seldom occurs. Water flow is intermittent or blocked.

Riparian Stream Water: These wetlands occur when active water flow is usually confined to well-defined channels with eroded banks, and a gradient in water flow. Water flow is usually persistent and continuous. Some sediment deposition on stream reaches.

TIDAL WATER

Tidal water wetlands occur in the subtidal, intertidal and supratidal zone of the sea coast. Tidal water wetlands are saline or brackish. Normal mean tide water levels are less than 2 m deep. Five subforms of Tidal Water wetland are recognized, based primarily on different geomorphic settings:

Tidal Basin Water: These wetlands occur in basins in the intertidal and supratidal zones. They do not drain during low tide and are susceptible to flooding during the highest high tides, storms and rainfalls.

Tidal Bay Water: These wetlands occur in fjords and inlets at a considerable distance inland from the coast. They may be enclosed by headlands or narrow arms and inlets.

Tidal Channel Water: These wetlands occur in channels usually within the intertidal zone.

Tidal Lagoon Water: These wetlands occur in depressions behind an offshore bar, beach ridge or shore dune that act as a barrier or dam. Water circulation is restricted but subject to fluctuations in salinity on sea coasts.

Tidal Shore Water: These wetlands occur in the open coastal zone and are less protected from wave and long-shore drift than coastal bay water wetlands.

Lacustrine Shore Water Wetland, Quill Lakes, Saskatchewan ***(C.D.A. Rubec, Environment Canada)***

Table 7: Classification Key to Shallow Water Forms and Subforms

1. Influenced by tides, water is marine, estuarine and riverine; water levels fluctuate, mainly daily, with periodic inundation due to exceptionally high tides or storms; water is saline or fresh	2.
2. Occurring in shallow subtidal, intertidal or supratidal zones of sea coasts or embayments; water is saline or brackish	Tidal Water
3. Situated within the subtidal zone	4.
4. Situated in open inlets and embayments	*Tidal Bay Water*
4. Situated on the open sea coast	*Tidal Shore Water*
3. Situated within the intertidal and supratidal zone	5.
5. Situated in tidal channel or channel complexes within the intertidal zone that drain during low tide	*Tidal Channel Water*
5. Situated in basins or embayments that do not drain during low tide	6.
6. Situated in semi-enclosed basins or embayments behind barrier beach bars in supratidal zone; may be flooded by high tides, storm surges or runoff	*Tidal Lagoon Water*
6. Situated in closed basins in the intertidal and supratidal zone; do not drain during low tide; may be flooded by high tides, storm surges, surface runoff and precipitation	*Tidal Basin Water*
2. Situated in shallow subtidal, intertidal and supratidal zones of estuaries, water is fresh or brackish	Estuarine Water
7. Situated within the subtidal zone	8.
8. Situated on estuarine deltas	*Estuarine Delta Water*
8. Situated in embayments and inlets	*Estuarine Bay Water*
7. Situated within the intertidal and supratidal zone	9.
9. Situated along streams and rivers	*Estuarine Shore Water*
9. Situated in tidal channels or channel complexes that drain during low tide in the intertidal zone	*Estuarine Channel Water*
9. Situated in basins or embayments behind bay mouth bars in the intertidal or supratidal zones	10.
10. Situated in closed basins or flats in intertidal and supratidal zones; not draining during low tide; may be flooded during high tide, storm surges or runoff	*Estuarine Basin Water*
10. Situated in semi-enclosed basins or embayments behind barrier beach bars in supratidal zone; may be flooded during high tide, storm surges or by stream and river inflows	*Estuarine Lagoon Water*

Table 7: Classification Key to Shallow Water Forms and Subforms cont'd

1. Not influenced by tides; water is from channelized flow, runoff, precipitation and groundwater; water levels fluctuate seasonally or at irregular intervals; water is usually fresh	11.
11. Situated on deltas and along rivers and streams	Riparian Water
12. Water continuously flowing; situated along streams	*Riparian Stream Water*
12. Water not continuously flowing	13.
13. Intermittent or discontinuous flow; situated in abandoned glacial spillways	*Riparian Meltwater Channel Water*
13. Intermittent flow; water usually restricted to overbank flow; high water table; situated in impoundments behind ridges, levees on alluvial plains	15.
14. Situated on river floodplains	*Riparian Floodplain Water*
14. Situated on stream deltas	*Riparian Delta Water*
11. Situated along the margins and shores of lakes and other permanent open water bodies	15.
15. Situated in shallow offshore areas of permanent lakes	Lacustrine Water
16. Situated on open lakeshore and offshore zones	*Lacustrine Shore Water*
16. Situated in quiet embayments and protected areas next to open lakes	17.
17. Situated in quiet embayments of lakes	*Lacustrine Bay Water*
17. Situated in semi-enclosed basins, usually behind barrier beach bars	*Lacustrine Lagoon Water*
15. Situated in topographically defined basins, water is fresh or saline	Basin Water
18. Basin situated in non-permafrost terrain	19.
19. Situated in catchments in topographic low positions; water is from surface runoff precipitation and groundwater discharge; with no outflow	*Discharge Basin Water*
19. Situated in well-defined basins with inlets and with or without outlets	20.
20. Situated in well-defined basins with inflowing and outflowing streams	*Linked Basin Water*
20. Situated in isolated, well-defined basins with or without inflowing stream but no outflowing stream	*Isolated Basin Water*
18. Basins situated in permafrost terrain, water is fresh	
21. Situated in polygonal pools in peat depressions; often situated on low-centred polygon fens	*Polygon Basin Water*
21. Situated in shallow depressions, often in mineral terrain	22.
22. Shallow depressions underlain by mineral soils or thin peat; stable, steep sides	*Tundra Basin Water*
22. Shallow depressions due to thawing of permafrost; unstable, collapsing peat shores	*Thermokarst Basin Water*

Wetland Types

The terms used to describe wetland types are based on the general physiognomy of the vegetation cover, rather than on species. The physiognomic terms, when used in conjunction with wetland forms, constitute the wetland types.

AQUATIC

This wetland type is dominated by aquatic macrophytes. Specific aquatic wetland types are:

- *Floating Aquatic* — dominated by aquatic macrophytes with leaves floating on the surface of the water.
- *Submerged Aquatic* — dominated by aquatic macrophytes completely submerged below the surface of the water.

FORB

This wetland type is dominated by forb species which are all non-graminoid herbaceous plants.

GRAMINOID

This wetland type is dominated by undifferentiated grass-like plants. Specific graminoid wetland types are:

- *Grass* — dominated by communities of low, tall or mixed grass species (e.g. *Zizania* spp.)
- *Low Rush* — dominated by communities of *Juncus* spp. and *Triglochin* spp.
- *Reed* — dominated by communities of reed species (e.g. *Phragmites* spp.)
- *Sedge* — dominated by communities of sedge (*Carex* spp. and *Eriophorum* spp.)
- *Tall Rush* — dominated by communities of *Scirpus* spp. and *Typha* spp.

LICHEN

This wetland type is dominated by lichen species (mostly *Cladina* or *Cladonia* spp.).

MOSS

This wetland type is dominated by moss species. The most common mosses are *Sphagnum* spp., feather-mosses (*Pleurozium* spp., *Hylocomnium* spp. and *Ptilium* spp.) and brown mosses (*Drepanocladus* spp., *Scorpidium* spp. and *Tomenthypnum* spp.).

NON-VEGETATED

These are non-vegetated with less than 5% of the surface area covered with vegetation.

SHRUB

This wetland type is dominated by shrub species. Specific shrub wetland types are:

- *Low Shrub* — includes both low shrubs (0.1 to 0.5 m) and dwarf shrubs (less than 0.1 m).
- *Mixed Shrub* — includes tall shrubs (more than 1.5 m), medium shrubs (0.5 to 1.5 m), and low shrubs (0.1 to 0.5 m).
- *Tall Shrub* — includes both tall shrubs (more than 1.5 m) and medium shrubs (0.5 to 1.5 m). Stunted trees may also be included.

TREED

This wetland type is dominated by tree species. Specific treed wetland types are:

- *Coniferous Treed* — dominated by needleleaf species in the tree layer (more than 5 m tall). The most common species are *Picea mariana* and *Larix laricina* which grow on organic soils and represent a characteristic type in the Boreal Wetland Region. *Thuja occidentalis* is the most common species found in the nutrient-rich, more southern wetlands in eastern Canada. *Pinus contorta*, *Thuja plicata*, and *Chamaecyparis nootkatensis* occur on the Pacific coast.
- *Hardwood Treed* — dominated by broadleaf species in the tree layer (more than 5 m tall). The most common species are *Acer* spp., *Fraxinus nigra*, *Ulmus americana*, *Betula* spp., and *Populus balsamifera*. Wetlands of this type generally occur on mineral soils or on highly decomposed organic soils.
- *Mixed Treed* — dominated by both needleleaf and broadleaf species in the tree layer (more than 5 m tall) with combinations of species characteristic of both coniferous and hardwood treed swamps.

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Fen complex in central Kejimkujik National Park, Nova Scotia *(C.D.A. Rubec, Environment Canada)*

Appendix 1: Comparison of Wetland Form Names used in the Provisional (1987) and Second (1997) Editions of The Canadian Wetland Classification System and the Ramsar Convention

CWCS PROVISIONAL EDITION (1987) WETLAND FORM	CWCS CODE	RAMSAR CONVENTION WETLAND TYPE	CWCS SECOND EDITION (1997) WETLAND FORM
BOGS			
Atlantic Plateau Bog	B1	U - Peatland, Open Bog	Plateau Bog, *Subform*: •Atlantic Plateau Bog
Basin Bog	B2	Xp - Forested Peatland	Basin Bog
Blanket Bog	B3	U - Open Bog	Blanket Bog
Collapse Scar Bog	B4	Vt - Tundra Wetland	Collapse Scar Bog
Domed Bog	B5	U - Peatland, Open Bog	Domed Bog
Flat Bog	B6	Xp - Forested Peatland	Flat Bog
Floating Bog	B7	U - Peatland, Open Bog	Riparian Bog, *Subform*: •Floating Bog
Lowland Polygon Bog	B8	Vt - Tundra Wetland	Lowland Polygon Bog
Mound Bog	B9	Vt - Tundra Wetland	Mound Bog
Northern Plateau Bog	B10	Vt - Tundra Wetland	Plateau Bog, *Subform*: •Northern Plateau Bog
Palsa Bog	B11	Vt - Tundra Wetland	Palsa Bog
Peat Mound Bog	B12	Vt - Tundra Wetland	Peat Mound Bog
Peat Plateau Bog	B13	Vt - Tundra Wetland	Peat Plateau Bog
Polygonal Peat Plateau Bog	B14	U - Peatland, Open Bog	Polygonal Peat Plateau Bog
Shore Bog	B15	U - Peatland, Open Bog	Riparian Bog, *Subform*: •Shore Bog
Slope Bog	B16	Xp - Forested Peatland	Slope Bog
String Bog	B17	Vt - Tundra Wetland	String Bog
Veneer Bog	B18	U - Peatland, Open Bog	Veneer Bog
FENS			
Atlantic Ribbed Fen	F1	U - Peatland, Open Fen	String Fen, *Subform*: •Atlantic Ribbed Fen
Basin Fen	F2	U - Peatland, Open Fen	Basin Fen
Channel Fen	F3	U - Peatland, Open Fen	Channel Fen
Collapse Scar Fen	F4	Vt - Tundra Wetland	Collapse Scar Fen
Feather Fen	F5	Xf - Freshwater Swamp Forest	Feather Fen
Floating Fen	F6	U - Peatland, Open Fen	Riparian Fen, *Subform*: •Floating Fen
Horizontal Fen	F7	U - Peatland, Open Fen	Horizontal Fen
Ladder Fen	F8	U - Peatland, Open Fen	String Fen, *Subform*: •Ladder Fen
Lowland Polygon Fen	F9	Vt - Tundra Wetland	Lowland Polygon Fen
Net Fen	F10	U - Peatland, Open Fen	String Fen, *Subform*: •Net Fen
Northern Ribbed Fen	F11	Vt - Tundra Wetland	String Fen, *Subform*: •Northern Ribbed Fen
Palsa Fen	F12	Vt - Tundra Wetland	Palsa Fen
Shore Fen	F13	U - Peatland, Open Fen	Riparian Fen, *Subform*: •Shore Fen
Slope Fen	F14	U - Peatland, Open Fen	Slope Fen
Snowpatch Fen	F15	Vt - Tundra Wetland, Water from Snowmelt	Snowpatch Fen
Spring Fen	F16	U - Peatland, Open Fen	Spring Fen
Stream Fen	F17	U - Peatland, Open Fen	Riparian Fen, *Subform*: •Stream Fen

CWCS PROVISIONAL EDITION (1987) WETLAND FORM	CWCS CODE	RAMSAR CONVENTION WETLAND TYPE	CWCS SECOND EDITION (1997) WETLAND FORM
MARSHES			
Active Delta Marsh	M1	L - Permanent Inland Delta H - Intertidal Marsh	Estuarine Marsh, *Subform*: • *Estuarine Delta Marsh* Riparian Marsh, *Subform*: • *Riparian Delta Marsh*
Channel Marsh	M2	M - Permanent River or Stream	Riparian Marsh, *Subform*: • *Riparian Meltwater*
Coastal High Marsh	M3	H - Intertidal Marsh	Tidal Marsh, *Subform*: • *Tidal Basin Marsh*
Coastal Low Marsh	M4	H - Intertidal Marsh	Tidal Marsh, *Subforms*: • *Tidal Bay Marsh* • *Tidal Lagoon Marsh*
Estuarine High Marsh	M5	F - Estuarine Water; J - Intertidal Marsh	Estuarine Marsh, *Subform*: • *Estuarine Lagoon Marsh*
Estuarine Low Marsh	M6	F - Estuarine Water; H - Intertidal Marsh	Estuarine Marsh, *Subform*: • Estuarine Bay Marsh
Floodplain Marsh	M7	Xf - Riverine Floodplain, Seasonally Flooded Grassland	Riparian Marsh, *Subform*: • Riparian Floodplain Marsh
Inactive Delta Marsh	M8	L - Permanent Inland Delta	Riparian Marsh, *Subform*: • Riparian Delta Marsh
Kettle Marsh	M9	Ss - Seasonal Pond, Seasonally Flooded Meadows	Basin Marsh, *Subform*: •Isolated Basin Marsh
Seepage Track Marsh	M10	Ss - Seasonal Freshwater Pond or Marsh	Spring Marsh OR Slope Marsh
Shallow Basin Marsh	M11	Ss - Seasonal Freshwater Pond or Marsh	Basin Marsh, *Subform*: •Linked Basin Marsh
Shore Marsh	M12	Tp - Permanent Pond, Marsh or Swamp	Lacustrine Marsh, *Subforms*: • Lacustrine Bay Marsh • Lacustrine Lagoon Marsh • Lacustrine Shore Marsh
Stream Marsh	M13	W - Freshwater Shrub Marsh	Riparian Marsh, *Subform*: • Riparian Stream Marsh
Terminal Basin Marsh	M14	Ss - Seasonal Freshwater Pond or Marsh	Basin Marsh, *Subform*: • Discharge Basin Marsh
Tidal Freshwater Marsh	M15	Sp - Permanent or Seasonal Brackish or Saline Lake, Flat or Marsh	Estuarine Marsh, *Subform*: • Estuarine Shore Marsh
—	M16	Y - Freshwater Spring	Hummock Marsh
SWAMPS			
Basin Swamp	S1	Xp - Forested Peatland,	Flat Swamp, *Subform*: • Basin Swamp
Flat Swamp	S2	W - Freshwater Shrub Swamp	Flat Swamp, *Subform*: • Unconfined Flat Swamp
—	S2a	W - Freshwater Shrub Swamp	Flat Swamp, *Subform*: •Swale Swamp
Floodplain Swamp	S3	Xf - Freshwater Swamp Forest, Seasonally Flooded Forest	Riparian Swamp, *Subform*: • Floodplain Swamp
—	S3a	Xf - Freshwater Swamp Forest	Riparian Swamp, *Subform*: • Channel Swamp
Peat Margin Swamp	S4	W - Freshwater Shrub Swamp	Slope Swamp, *Subforms*: • Lagg Swamp • Peat Margin Swamp
—	S4a	W - Freshwater Shrub Swamp	Slope Swamp, *Subform*: • Drainageway Swamp
—	S4b	W - Freshwater Shrub Swamp	Slope Swamp, *Subform:* • Unconfined Slope Swamp

CWCS PROVISIONAL EDITION (1987) WETLAND FORM	CWCS CODE	RAMSAR CONVENTION WETLAND TYPE	CWCS SECOND EDITION (1997) WETLAND FORM
SWAMPS CONT'D			
Shore Swamp	S5	W - Freshwater Shrub Swamp	Riparian Swamp, *Subform*: • Lacustrine Swamp
Spring Swamp	S6	W - Freshwater Shrub Swamp	Discharge Swamp, *Subform*: • Spring Swamp
—	S6a	W - Freshwater Shrub Swamp	Discharge Swamp, *Subform*: • Seepage Swamp
Stream Swamp	S7	M - Permanent River or Stream Xf - Riverine Floodplain	Riparian Swamp, *Subform*: • Riverine Swamp
—	S8	Sp - Intermittent Saline Pond	Inland Salt Swamp
—	S9	W - Freshwater Shrub Swamp	Mineral-rise Swamp, *Subforms*: • Beach Ridge Swamp • Island Swamp • Levee Swamp • Mound Swamp
—	S10	I - Intertidal Forest	Tidal Swamp, *Subforms*: • Tidal Freshwater Swamp • Tidal Saltwater Swamp
—	S11	Xp - Forested Peatland	Raised Peatland Swamp
SHALLOW WATER FORMS			
Channel Water	W1	M - Permanent River or Stream	Riparian Water, *Subform*: • Riparian Meltwater Channel Water
Delta Water	W2	L - Permanent Inland Delta	Riparian Water, *Subform*: • Riparian Delta Water Estuarine Water, *Subform*: • Estuarine Delta Water
Estuarine Water	W3	F - Estuarine Water G - Intertidal Mud, Sand or Salt Flat	Estuarine Water, *Subforms*: • Estuarine Basin Water • Estuarine Bay Water • Estuarine Channel Water • Estuarine Lagoon Water • Estuarine Shore Water
Kettle Water	W4	Ts - Seasonal Freshwater Pond	Basin Water, *Subform*: • Discharge Basin Water
—	W4a	Ts - Seasonal Freshwater Pond	Basin Water, *Subform*: • Linked Basin Water
Non-tidal Water	W5	O - Permanent Freshwater Lake (>8ha)	Lacustrine Water, *Subforms*: • Lacustrine Bay Water • Lacustrine Lagoon Water
Oxbow Water	W6	O - Permanent Freshwater Lake (>8ha)	Riparian Water, *Subform*: • Riparian Floodplain Water
Shallow Basin Water	W7	Tp - Permanent Freshwater Pond (<8 ha); Ts - Seasonal Freshwater Pond or Marsh including Sloughs and Potholes	Basin Water, *Subform*: • Discharge Basin Water
Shore Water	W8	O - Permanent Freshwater Lake (>8 ha)	Lacustrine Water, *Subform*: • Lacustrine Shore Water
Stream Water	W9	M - Permanent River or Stream; Ts - Seasonal River or Stream	Riparian Water, *Subform*: • Riparian Stream Water
Terminal Basin Water	W10	Ts - Seasonal Freshwater Pond or Marsh	Basin Water, *Subform*: • Isolated Basin Water
Thermokarst Water	W11	Vt - Tundra Wetland	Basin Water, *Subform*: • Thermokarst Basin Water

CWCS PROVISIONAL EDITION (1987) WETLAND FORM	CWCS CODE	RAMSAR CONVENTION WETLAND TYPE	CWCS SECOND EDITION (1997) WETLAND FORM
SHALLOW WATER FORMS CONT'D			
Tidal Water	W12	A - Shallow (<2 m) Water; G - Intertidal Mud, Sand and Salt Flat	Tidal Water, *Subforms*: • Tidal Basin Water • Tidal Bay Water • Tidal Channel Water • Tidal Lagoon Water • Tidal Shore Water
Tundra Pool Water	W13	Vt - Tundra Wetland	Basin Water, *Subform*: • Tundra Basin Water
OTHER			
Open Lakeshore or Nearshore Ocean Water	—	O or A- Freshwater Lake or Marine Water (>2-6 m)	Non-wetland, Open Water
Sand	—	E - Maritime Sandy, Shingle or Pebble Beach	—
Deep Ocean Water (>6 m)	—	A - Marine Water	—
Artificial Wetlands	—	6 - Reservoirs and Impoundments	—
Rock	—	D - Rocky marine shore	—

Appendix 2: Proposed English and French Terms used in the Second Edition of The Canadian Wetland Classification System

ENGLISH	FRENCH
WETLAND CLASS	**CLASSE DE TERRE HUMIDE**
bog	bog
fen	fen
marsh	marais
swamp	marécage
shallow water	eau peu profonde
WETLAND FORM	**FORME DE TERRE HUMIDE**
Atlantic plateau	de plateau de l'Atlantique
Atlantic ribbed	côtelé de l'Atlantique
beach ridge	de crête de plage
basin	de bassin
basin water	eau de bassin
blanket	en couverture
bog margin	marge de bog
channel	de chenal
collapse scar	effondré
discharge	écoulement
discharge basin	bassin de l'écoulement
discharge basin water	eau de bassin de l'écoulement
domed	bombé
drainageway	canalisé
estuarine	estuarien
estuarine basin water	eau estuarien de bassin
estuarine bay water	eau estuarien de baie
estuarine channel water	eau estuarien de chenal
estuarine delta water	eau estuarine de delta
estuarine lagoon water	eau estuarine de lagune
estuarine shore water	eau estuarien de rivage
feather	penné
flat	plat
floating	flottant
floodplain	de plaine d'inondation
horizontal	horizontal
hummock	butte
inland salt	salé de l'interieur
island	d'île
isolated basin	de bassin isolé
isolated basin water	eau de bassin isolé
kettle	de kettle
lacustrine	lacustrien
lacustrine water	eau lacustrien
lacustrine bay water	eau lacustrien de baie
lacustrine lagoon water	eau lacustrien de lagune
lacustrine shore water	eau lacustrien de rivage
ladder	en échelle
lagg	lagg
lagoon	de lagune
levee	levée
linked basin	de bassin relisé
linked basin water	eau de bassin relisé
lowland polygon	polygonal des basses terres
mineral-rise	butte minérale
mound	de butte
net	réticulé
northern plateau	de plateau du Nord
northern ribbed	côtelé du Nord
palsa	à palse
peat margin	à marge tourbeuse

ENGLISH	FRENCH
WETLAND FORM	**FORME DE TERRE HUMIDE**
peat mound	de butte tourbeuse
peat plateau	de plateau tourbeux
plateau	de plateau
polygonal basin water	eau de bassin à polygons
polygonal peat plateau	de plateau polygonal tourbeux
raised peatland	de tourbière élevée
riparian	riparien
riparian delta water	eau riparien de delta
riparian floodplain water	eau riparien de plain d'inondation
riparian meltwater channel water	eau riparien de chenal de fonte
riparian stream water	eau riparien de ruisseau
riparian water	eau riparien
riverine	riverain
seepage	drainage oblique
shore	de rivage
slope	incliné
snowpatch	de combe à neige
spring	de source
stream	de ruisseau
string	structuré
swale	dépression
thermokarst basin water	eau de bassin thermokarstique
tidal	marée
tidal basin	de bassin à marée
tidal basin water	eau de bassin à marée
tidal bay	de baie à marée
tidal bay water	eau de baie à marée
tidal channel	de chenal intertidal
tidal channel water	eau de chenal intertidal
tidal freshwater	eau douce à marée
tidal lagoon	de lagune intertidal
tidal lagoon water	eau de lagune intertidale
tidal saltwater	eau salée à marée
tidal shore water	eau de rivage intertidale
tidal water	eau de marée
tundra basin water	eau de bassin de toundra
unconfined flat	plat sans marges
unconfined slope	incliné sans marges
veneer	en plaqué
WETLAND TYPE	**TYPE DE TERRE HUMIDE**
aquatic	aquatique
coniferous treed	boisé conifèrier
floating	flottante
forb	à latifoliés
graminoid	graminoide
grass	à graminés
hardwood treed	boisé feuille
lichen	à lichens
low rush	à petits joncs
low shrub	arbustif bas
mixed shrub	arbustif mixte
mixed treed	boisé mixte
moss	à mousses
non-vegetated	dénudé
reed	à roseaux
sedge	à *Carex*
shrub	arbustif
submerged	submergé
tall rush	à grands joncs
tall shrub	arbustif haut
treed	boisé